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When reality backfires: Product evaluation context and the effectiveness of augmented reality in e-commerce

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Abstract

Augmented reality (AR) enables consumers to project product holograms into their surrounding real-world context in real time using their mobile devices. Although AR may improve online consumers' product evaluation, AR-deploying retailers give up control over the context in which their products are evaluated. As a result, AR retailers' products might end up being evaluated in unfavorable contexts, such as disorganized rooms. Negative spillover effects from such unfavorable AR contexts onto the perceptions of evaluated products may lead consumers to refrain from purchasing the products. In two online experiments and a controlled field study with a total of 1000 participants, we find that unfavorable AR contexts negatively affect consumers' product-related purchase intention. This relationship is serially mediated by processing disfluency and deteriorating product quality perceptions of consumers. The negative contextual effects are mitigated if the product under evaluation is of unique design and thus more conceptually fluent or if the AR context becomes less perceptually salient and thus the product more perceptually fluent. We discuss diminished reality and facilitated product comparisons via AR as potential countermeasures for AR retailers and provide suggestions for future research.

KEYWORDS

augmented reality, field study, perceptual salience, processing fluency, product design uniqueness, product evaluation context, product quality

1 | INTRODUCTION

Augmented reality (AR) is an innovative technology to inspect products online via mobile devices. It can facilitate online product evaluation due to its ability to embed product holograms into consumers' surrounding real-world usage context in real time (Azuma et al., 2001; Heller et al., 2019a). AR thereby blends the virtual world of online shopping with the possibility of more interactively inspecting physical products by projecting them into a real-world environment (Gatter et al., 2022; Hilken et al., 2018). However, this novel advantage for consumers also bears a potential risk for AR-deploying retailers ("AR retailers"): When offering AR for product inspection, retailers give up control over the context in which their products are evaluated.

In offline retail stores, retailers traditionally present their products in favorable contexts. For example, furniture products are depicted within stylized showrooms, fashion items are neatly displayed on tidy shelves, and fitting rooms are equipped with favorable lighting. As retailers would certainly avoid having their products presented in unfavorable contexts, regularly tidying up showrooms or shelf displays is well within the scope of retailers' control.

When evaluating products via AR, however, consumers' real-world contexts ("AR context") can oftentimes deviate from such favorable settings. In contrast to traditional retail settings, retailers cannot easily control or modify the context in which consumers evaluate AR-enabled products ("AR products"), as the AR context is, in most cases, consumers' own homes (Snap Inc. & Deloitte Digital, 2021).

Table 1 gives an overview of the different product evaluation contexts and their controllability by retailers for AR and non-AR retail settings (see, e.g., Flavián et al., 2019 for further reading).[1] In particular, while traditional online retailing, traditional offline retailing, AR offline retailing (i.e., using AR-enabled devices in retail stores), and virtual reality retailing offer retailers the controllability of both product and context, retailers can only control the product but not the context in AR online retailing.

Thus, AR retailers' products may end up being evaluated by consumers in unfavorable contexts. Accounting for spillover effects from the evaluation context onto consumers' perceptions of products is of particular importance, as consumers tend to evaluate products based on the inferences they make from various contextual stimuli (e.g., Baker et al., 1994; Schnurr et al., 2017). Consumers may hence perceive the products evaluated in unfavorable contexts as less desirable and thus refrain from purchasing them (Baker et al., 1992). Therefore, unfavorable product presentation via AR poses a potential threat to retailers, hitherto largely ignored by research (von der Au et al., 2023).

Prior AR research was mainly concerned with AR's distinctive properties compared to traditional product evaluation technologies, such as product pictures and three-dimensional (3D) product models. In general, AR was found to lead to more favorable consumer reactions compared with noncontextual product pictures (e.g., Barta et al., 2023b; Tan et al., 2022; Yim & Park, 2019; Yim et al., 2017) as well as contextual product pictures and rotatable 3D product models (Heller et al., 2019b; Hilken et al., 2017). This superiority of AR-based product evaluation can be explained by AR's unique affordance of enabling consumers to interactively move and rotate and, at the same time, vividly evaluate the inspected product in its context (Hilken et al., 2017; Yim et al., 2017). Evaluating products in their context via AR was found to be especially useful for contextual products, that is, products that require their usage context to be properly evaluated, such as furniture (Heller et al., 2019a).

A second stream of AR research is concerned with AR-based product information in retail stores instead of AR-based product presentation in an e-commerce setting. In this stream of AR research, it is not the product that is virtually projected into the user's

[1]Although AR can also be used in offline retail stores and with different devices such as smart glasses (Orús et al., 2021), we focus on AR in online retailing when consumers use their mobile devices (i.e., smartphones or tablets) at home. We do not further consider related applications like virtual reality, as they are independent of users' real-world surroundings (de Ruyter et al., 2020).

TABLE 1 Comparison of AR and non-AR retail settings.

		AR online retailing	Online retailing	AR offline retailing	Offline retailing	VR retailing
Common device types		Mobile (smartphone, tablet), AR headsets (smart glasses), PC (desktop, laptop) with webcam[a]	Mobile (smartphone, tablet), PC (desktop, laptop)	Mobile (smartphone, tablet), AR headsets (smart glasses)	-	Head-mounted displays (standalone VR goggles or mobile phone inserted into VR headset)
Product presentation		*Virtual*	*Virtual*	*Virtual*	*Real*	*Virtual*
Product evaluation context		*Real-world* environment (e.g., at home)	2D *virtual* environment (website)	*Real-world* environment (in store)	*Real-world* environment (in store)	3D *virtual* environment (simulated world)
Product-context interactivity		Interaction with *virtual* product and *real-world* environment	Interaction with *virtual* product and *virtual* environment	Interaction with *virtual* product and *real-world* environment	Interaction with *real* product and *real-world* environment	Interaction with *virtual* product and *virtual* environment
Controllability of product evaluation setting by retailer	Product	Controllable ✓	Controllable ✓	Controllable ✓	Controllable ✓	Controllable ✓
	Context	*Not* controllable ✗	Controllable ✓	Controllable ✓	Controllable ✓	Controllable ✓

Abbreviations: 2D, two-dimensional; 3D, three-dimensional; AR, augmented reality; PC, personal computer; VR, virtual reality.

[a]Note that PCs with webcams are only suitable for AR applications where a focal product is projected onto the user rather than into the surrounding environment, for example, for virtually trying-on glasses or make-up.

surrounding real-world environment but rather the supplementary information regarding physical products (e.g., Hoffmann et al., 2022). A third stream of AR research addresses the specific characteristics of AR smart glasses and their effects on consumer reactions (e.g., Carrozzi et al., 2019; Heller et al., 2019b; Rauschnabel, 2018).

What prior AR research has in common is that the potential effects stemming from characteristics of the AR context have thus far been ignored (von der Au et al., 2023). Our research differs from existing AR research in that we manipulate the characteristics of the AR context to account for both layers of AR product evaluation: the inspected product as well as its evaluation context. Table 2 gives an overview of related AR research.

The goal of our study is to understand the effects of an AR product's evaluation context on consumers' product perceptions and their resulting purchase behavior for the product evaluated in this context. We theorize the relationship between the AR product's evaluation context and product-related inferences consumers make based on contextual stimuli, and how these inferences translate into consumers' purchasing behavior. To this end, we draw on the overarching concept of processing fluency by Reber et al. (2004) to explain how contextual stimuli affect product-related outcomes. We conducted two online experiments in which we manipulated the AR context regarding its visual complexity (e.g., disorganized room) and investigated how this affects consumers' processing fluency, their resulting product quality perception and, ultimately, their purchase intention for the focal AR product. We subsequently tested our findings in a controlled field study. Our results demonstrate that a visually complex AR context has significant negative consequences for AR retailers: Consumers cannot fluently process AR products evaluated in such contexts and, thus, perceive them as qualitatively inferior, resulting in a lower purchase intention. We identify product design uniqueness as product- and contextual perceptual salience as context-related boundary conditions, such that the negative contextual effects are mitigated if the AR product under evaluation is of unique design or if the AR context becomes perceptually less salient.

We contribute to consumer psychology research in several ways. As we analyze context-related spillover effects on consumers' processing fluency and subsequent product perceptions when they evaluate products in their *actual* usage context (e.g., in a room at home), we extend previous work that has examined context-related fluency effects when consumers evaluate products in stylized contexts in retail stores (e.g., Orth & Crouch, 2014; Orth & Wirtz, 2014) or online shops (e.g., Im et al., 2010). In our case, the product evaluation context evades control by retailers—an unprecedented situation, enabled by novel product evaluation technologies such as AR. Thus, we synthesize two disjoint research streams: research on contextual effects and research on AR effectiveness.

While the vast majority of previous AR research has either manipulated the product evaluation technology or AR-specific characteristics but at the same time ignored contextual effects (von der Au et al., 2023), we keep the product evaluation technology (AR) as well as AR-specific characteristics constant. In fact, we manipulate the AR product's evaluation context (Study 1 and 2) and the product under evaluation (Study 1 and 3). Examining how consumers' reactions to AR are affected by the actual reality, which bears potential risks for retailers, allows us to gain a more holistic understanding of AR's effectiveness in e-commerce.

2 | CONCEPTUAL BACKGROUND AND HYPOTHESES

2.1 | Main mechanism: Processing fluency

In the following, we theorize the relationship between the AR product's evaluation context and product-related inferences consumers make based on contextual stimuli, and how these inferences translate into consumers' purchasing behavior. To this end, we draw on the overarching concept of processing fluency by Reber et al. (2004).

Processing fluency is defined as the subjective ease with which a visual stimulus can be processed by an individual (Reber et al., 1998) and serves as an information cue to derive meaning from the stimulus (Schwarz, 2004). Fluent processing can lead to favorable consumer evaluations of the given stimulus (e.g., Labroo et al., 2008; Landwehr et al., 2011; Orth & Crouch, 2014), as it may signal the positivity of the stimulus (Winkielman et al., 2006).

Prior research has identified visual complexity as an influential contextual stimulus for consumers' processing of information and subsequent product evaluation (e.g., Orth & Crouch, 2014; Orth & Wirtz, 2014). Visual complexity describes the amount of information a stimulus contains (Garner, 1974; Mayer & Landwehr, 2018). Although several conceptualizations of visual complexity exist (e.g., clutter, quantity of objects, symmetry, color variety), it can also be driven by the disorganization of a scene (Oliva et al., 2004; Orth & Wirtz, 2014).

Visual complexity is also part of the Preference Framework by Kaplan and Kaplan (1989) and therefore appears particularly appropriate to investigate as contextual stimulus in our setting. The framework identifies design patterns of environmental stimuli that facilitate users' information processing. Users' preference for an environment is hence predicted based on their need to understand and explore it. Combined with two levels of immediacy (immediate and inferred), the four resulting dimensions of the framework are coherence (immediate understanding; i.e., the ease of structuring the space), visual complexity (immediate exploration), legibility (inferred understanding; i.e., the ease of wayfinding in and understanding the space), and mystery (inferred exploration; i.e., the desire to explore the space as it may promise more to be seen; Rosen & Purinton, 2004; Stamps, 2004). The framework has proven capacity to improve understanding of consumer behavior in offline (e.g., R. Kaplan et al., 1998), online (e.g., Lavie & Tractinsky, 2004; Rosen & Purinton, 2004), and virtual environments (e.g., Lee & Chen, 2014; Orth et al., 2019).

In contrast to visually simple stimuli, visually complex stimuli demand more cognitive resources and thus hinder fluent processing

TABLE 2 Overview of related AR research.

Study	Manipulation of AR context	Method	Product category	Conceptual base	Main findings
Carrozzi et al. (2019)	No ✗	Lab experiments	Toys	Situated cognition theory	Ability to customize AR product increases perceived ownership. AR allows consumers to socially differentiate and at the same time assimilate with others.
Heller et al. (2019a)	No ✗	Lab experiment (Study 1), online experiments (Study 2–4), field study (Study 5)	Food (Study 1–4), furniture (Study 3, 4), toys (Study 5)	Mental imagery theory, style of processing theory	Evaluating products in context via AR increases mental imagery generation, leading to higher processing fluency, decision comfort and word-of-mouth intentions.
Heller et al. (2019b)	No ✗	Lab experiments	Furniture	Active inference theory	Gesture control reduces mental intangibility of AR-delivered products, leading to increased decision comfort and willingness to pay.
Hilken et al. (2017)	No ✗	Lab experiments	Fashion (Study 1, 3, 4), cosmetics (Study 2)	Situated cognition theory, style of processing theory	AR product evaluation increases spatial presence, leading to higher decision comfort, word-of-mouth- and purchase intentions for AR products.
Tan et al. (2022)	No ✗	Quasi-experiment	Cosmetics	Product uncertainty	Generally positive but small sales effects of AR usage. Effect more pronounced for niche/long-tail and expensive products, and for consumers new to product categories and online channel.
Yim et al. (2017)	No ✗	Online experiments	Fashion, jewelry	Interactivity theory, vividness theory	AR product evaluation increases immersion, leading to higher enjoyment, perceived usefulness, and purchase intentions for AR products.
Yim and Park (2019)	No ✗	Online experiment	Fashion	Body image	Individuals with unfavorable body image value AR product evaluation more, as AR allows for avoiding exposure to others in offline purchase situations, while at the same time enabling improved product trial.
This study	Yes ✓	Online experiments (Study 1, 2), field study (Study 3)	Furniture	Perceptual and conceptual processing fluency	Visually complex AR contexts reduce processing fluency, product quality perceptions and purchase intentions. Effect is attenuated for AR products with unique design and for perceptually less salient AR contexts.

Abbreviation: AR, augmented reality.

(Mayer & Landwehr, 2018; Reber et al., 2004). Based on the Preference Framework, we expect the relationship between contextual stimuli and processing fluency to apply to the AR context as well, as AR can be regarded as channel interface merging the offline environment with virtual products (Spreer & Kallweit, 2014). Consistent with prior research on offline, online, and virtual environments, we thus hypothesize the following for the AR context (i.e., an offline environment with virtual products, see Table 1):

H1a A more visually complex AR context reduces consumers' processing fluency.

As consumers' processing experience can shape their evaluative judgments about products (Whittlesea et al., 1990), the visual characteristics of a product's evaluation context and their subjective processing experience may hence be used as quality cues and can thus substantially affect consumers' perception of product quality. Disfluency (i.e., the difficulty to process information; Walter et al., 2020) arising from a more visually complex product evaluation context may be associated with lower stimulus quality (Reber et al., 1998) and hence—as speculated by Orth and Crouch (2014)—may induce consumers to infer lower quality of the evaluated target stimulus (i.e., the product).

Perceived product quality has been found to be a decisive determinant in consumers' product evaluation, and its role in consumers' purchase decisions is well established: Lower quality perceptions lead consumers to evaluate products less favorably and, hence, to refrain from purchasing the product (e.g., Dodds et al., 1991; Wells et al., 2011).

Following this theoretical reasoning, we investigate processing fluency and its effect on product quality perceptions as an underlying mechanism linking context-related drivers and product-related outcomes. We expect processing fluency and perceived product quality to serially mediate the relationship between the AR evaluation context's visual complexity and consumers' purchase intention for a product evaluated in this context, such that lower processing fluency entails lower quality perceptions and thus lower purchase intentions for products evaluated in more visually complex AR contexts. Thus, we hypothesize:

H1b Lower processing fluency reduces consumers' product quality perception and, ultimately, their purchase intention for products evaluated in a more visually complex AR context (serial mediation).

2.2 | Product-related and contextual moderators

When evaluating a product in the AR context, not only the evaluation context but also the properties of the product are likely influencing consumers' processing fluency and subsequent reactions.

A product's design is a crucial antecedent of consumers' reactions toward that product (Bloch, 1995). Specifically, the uniqueness of a product's design has been identified as a product-related determinant of processing fluency. Product design uniqueness is defined as the degree of commonalities a product's design shares with the product category's design characteristics (Stanton et al., 2016). Uniquely designed products can thus be considered atypical in the sense that they share fewer design characteristics with (proto)typical (i.e., representative) products of the same category (Franke & Schreier, 2008). Due to their atypical design, unique products generally demand more cognitive resources for processing and are thus processed less fluently compared with typical products (Landwehr et al., 2011; Winkielman et al., 2006).

However, if unique products are evaluated in a more visually complex context, the conceptual associations regarding the unique product may mitigate the negative effects of a more complex context. As visually more complex environments were found to encourage creative, novel, and unconventional choices (Biliciler et al., 2021; Vohs et al., 2013), processing fluency may be improved due to the ease with which the unique product in the more complex context comes to mind readily ("conceptual fluency"; Lee & Labroo, 2004). Thus, if evaluated in a more visually complex context, the higher conceptual fluency of a unique (vs. typical) product partly compensates its lower perceptual fluency (i.e., the ease with which the stimulus can be perceived; Lee & Labroo, 2004). Both these types of fluency can compensate each other (Reber et al., 2004) and constitute processing fluency altogether (Schwarz, 2004).

As a result, the negative effect of a more complex AR context on processing fluency and its consequences would be less pronounced when consumers evaluate a unique product in contrast to a typical product. We hypothesize:

H2 Product design uniqueness moderates the negative effects of a more visually complex AR context on consumers' processing fluency, such that the negative effects on processing fluency and downstream variables (perceived product quality and purchase intention) will decrease as product design uniqueness increases (moderated serial mediation).

We further argue that the negative effects of a more complex AR product evaluation context will not uniformly occur for different characteristics of the context. In addition to the aforementioned product-related moderator, we thus investigate the perceptual salience of the AR context as a context-related boundary condition.

The salience of situational stimuli was found to influence viewers' perceptions and judgments in an automatic, subconscious way (McArthur & Post, 1977; Nisbett & Ross, 1980; S. Taylor et al., 1979). Certain elements of a stimulus may become perceptually less salient if they are visually less prominent to the viewer than other elements of the stimulus (Borgida & Howard-Pitney, 1983; Hall et al., 2016; Mairena et al., 2022).

On the one hand, a perceptually less salient evaluation context means that conceptual fluency of the product might be lower (as its usage context is less visible). On the other hand, perceptual fluency may be higher, as the product can be perceived more easily if the context is visually less prominent. In other words, if the perceptual

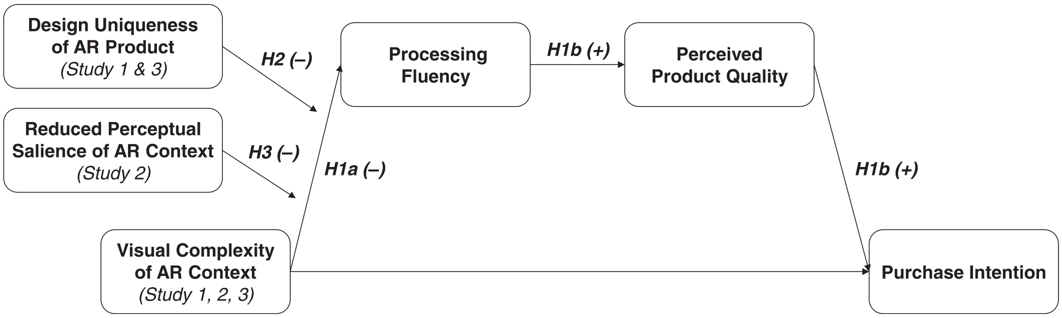

FIGURE 1 Conceptual model.

salience of a more complex context is reduced, perceptual fluency of the product may be increased and overcompensate the reduction of its conceptual fluency. Processing fluency will, thus, be maintained, and subsequent negative effects will be attenuated.

Thus, we hypothesize a moderating effect of the perceptual salience of the AR context in the relationship between the context and consumers' processing fluency:

H3 The perceptual salience of the AR context moderates the negative effects of a more visually complex context on consumers' processing fluency, such that the negative effects on processing fluency and downstream variables (perceived product quality and purchase intention) will be attenuated if the perceptual salience of the AR context is reduced (moderated serial mediation).

Figure 1 summarizes our research model and corresponding hypotheses.

3 | METHODOLOGY

We test our hypotheses in two online experiments and a controlled field study. In the online experiments, we manipulated the visual complexity of the context (simple/complex) and our respective hypothesized moderators. For our context manipulations, we used picture-based stimuli of a real usage context.

The advantage of using picture-based stimuli compared with, for example, making participants use real AR in their own homes, is that they allow us to retain full experimental control over the context in which participants evaluate the product stimulus. Thus, we avoid having the same complication that AR retailers face, namely, a lack of control over the product's evaluation context. Our final product-context stimulus pictures, nevertheless, reflect what consumers would see on their devices' display when using AR to evaluate products in a real-world usage context.

The contextual stimulus material hence depicts a corner within a room of a typical European apartment. For the visually simple conditions, the room interior was arranged in an organized manner. For the visually complex conditions, the room interior was arranged in a disorganized manner.

We created a variety of potential context stimuli and pretested them via the survey platform Prolific to determine the most effective manipulations of visual complexity of the context. A total of 106 UK-based participants (M_{age} = 38.07, 65.1% female) rated a randomized series of the range of context stimuli we created, answering how organized the rooms displayed in the images felt to them (single-item scale adapted from Ross et al., 2021).[2] We selected the two images with the most extreme ratings for (dis)organization as our final stimuli for the context manipulation. These stimuli differ significantly in terms of perceived visual complexity ($M_{complex}$ = 6.04, $SD_{complex}$ = 1.71 vs. M_{simple} = 2.45, SD_{simple} = 2.02, $t(105)$ = 12.40, p < 0.001). See Figure 2 for the resulting stimuli for our context manipulation.

In the field study, we made participants use a real AR application and thereby gave up control over users' product evaluation context. We experimentally manipulated our hypothesized product-related moderator (unique/typical design) and had participants rate their AR context.

In both experimental studies, the scenario was as follows: Participants were asked to imagine they were looking for a new chair for their room and that they eventually found a white chair in a furniture retailer's online shop. Conditional on the experimental group to which they were randomly assigned, participants were then displayed the white chair within the manipulated context. In the field study, participants read the same scenario and were asked to project the chair into their real-world environment to evaluate it using AR. They were randomly assigned to either group receiving the unique or the typical chair. Figure 3 gives an overview of how our three studies are interrelated with each other.

4 | STUDY 1: DESIGN UNIQUENESS OF AR PRODUCT

4.1 | Experimental design and procedure

In this study, we test H1a and H1b regarding the hypothesized serial mediation of the effect of the AR context's visual complexity on consumers' purchase intention via processing fluency and perceived

[2]We used seven-point response scales throughout all of our studies. Scale items used in Study 1, 2, and 3 can be found in Appendix A of the Supporting Information.

FIGURE 2 Resulting stimuli for low (left) and high visual complexity (right) of the context.

	Manipulation of ***Visual Complexity of AR Context***	
	Yes: Online Experiments	***No: AR Field Study***
Manipulation of ***Design Uniqueness of AR Product***	**Study 1**	**Study 3**
Manipulation of ***Perceptual Salience of AR Context***	**Study 2**	Future Research

FIGURE 3 Overview of studies.

product quality. In addition, we test H2 regarding our hypothesized product-related moderator, product design uniqueness, on the path between the context's complexity and consumers' processing fluency. To this end, we conducted a randomized 2 × 2 full factorial, between-subjects design (see Figure 4 for our experimental design and stimuli). We manipulated context complexity (complex/simple) as well as the chair's design uniqueness (unique/typical). We used the pretested context stimuli and inserted two distinct chair models differing in their design uniqueness.

We conducted a pretest of several chair models via Prolific to determine a pair of chairs which significantly differ in design uniqueness, yet which at the same time do not differ in potential key decision variables. 99 UK-based participants (M_{age} = 43.69, 48.5% female) rated a randomized series of distinct chair models displayed against a white background. The resulting chairs were rated significantly different in terms of design uniqueness (M_{unique} = 5.83, SD_{unique} = 1.20 vs. $M_{typical}$ = 4.36, $SD_{typical}$ = 1.42, $t(95)$ = 5.52, $p < 0.001$). Between the two chairs, there were no significant differences in key decision variables such as purchase intention, perceived product quality, product liking, and product familiarity.[3] Further, the rather moderate preferences for either chair suggest that it is unlikely that strong perceptions of the chairs themselves would dilute potential effects from the context onto the chairs in the following experiment (Graf & Landwehr, 2017).

In addition, we verified that the chairs were actually perceived as products that need their context to be properly evaluated. Participants indicated that they would highly benefit from seeing the chairs in a room for evaluation (M_{unique} = 4.67, SD_{unique} = 1.55 and $M_{typical}$ = 4.86, $SD_{typical}$ = 1.32, $t(95) = -0.65$, p = 0.517).

From these results, we conclude that it can be reasonable to assume a potential occurrence of spillover effects from the context onto the chairs and that both chairs have an equal upfront likelihood that such effects may occur in the following experiment.

In the main experiment, after being shown the respective stimulus image, respondents were asked about their intention to purchase the chair. To keep the product's price out of the equation, we asked participants to assume that the price of the chair meets their expectations. We then elicited our mediators, that is, perceived quality of the chair and perceived processing fluency of the stimulus. We also conducted manipulation checks regarding the perceived visual complexity of the room in which the chair was displayed and the product's design uniqueness.

We concluded the survey by asking for participants' familiarity with the chair, their perceived realism of the stimulus image and individual-related control variables such as participants' need for structure, need for uniqueness, product design acumen, need for touch, familiarity with online and furniture shopping, as well as demographic questions. We included reasonable attention checks and captured survey-related meta-data (e.g., participants' screen resolution, starting time, and time spent). Respondents who had already participated in the pretests were ineligible to participate in Study 1.

4.2 | Results and discussion

4.2.1 | Sample description and manipulation check

We recruited 400 UK-based participants via Prolific (M_{age} = 41.11, 49.8% female), resulting in at least 99 participants per experimental condition. The results from independent samples t tests indicate that

[3]Purchase intention: M_{unique} = 2.58, SD_{unique} = 1.94 versus $M_{typical}$ = 2.96, $SD_{typical}$ = 1.59, $t(90.74) = -1.04$, p = 0.301; perceived product quality: M_{unique} = 3.92, SD_{unique} = 1.25 versus $M_{typical}$ = 4.02, $SD_{typical}$ = 1.21, $t(95) = -0.42$, p = 0.679; product liking: M_{unique} = 3.13, SD_{unique} = 2.00 versus $M_{typical}$ = 3.46, $SD_{typical}$ = 1.57, $t(89.05) = -0.91$, p = 0.367; product familiarity: M_{unique} = 3.24, SD_{unique} = 1.52 versus $M_{typical}$ = 3.73, $SD_{typical}$ = 1.50, $t(95) = -1.63$, p = 0.107.

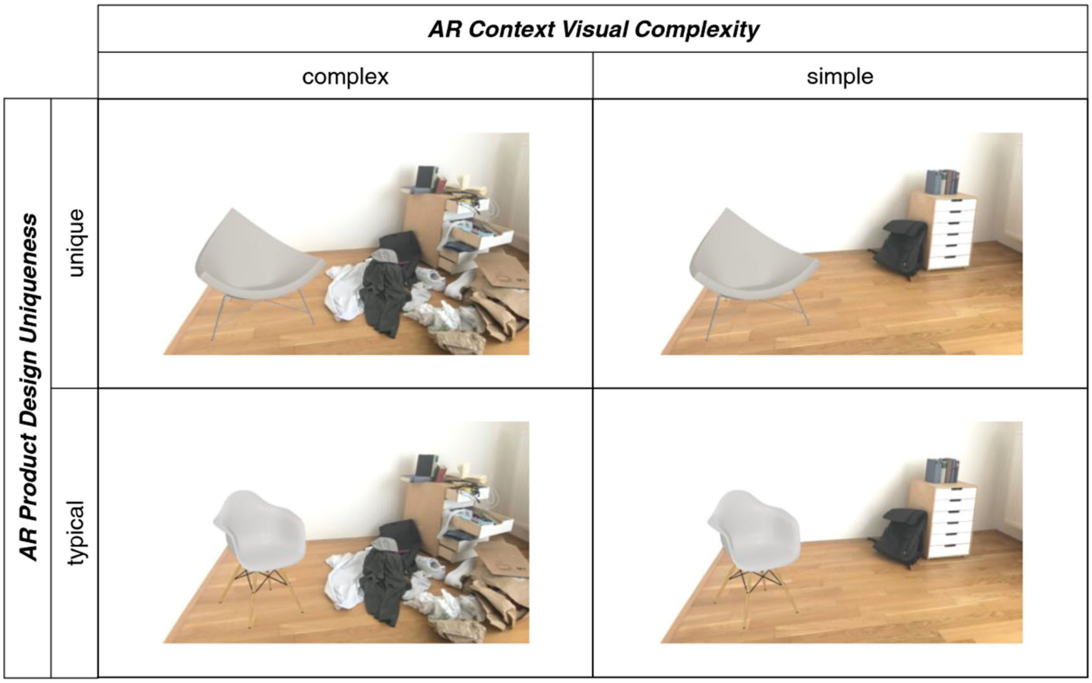

FIGURE 4 Experimental design and stimuli of Study 1.

our manipulation of the context's visual complexity worked as intended ($M_{complex}$ = 6.86, $SD_{complex}$ = 0.48 vs. M_{simple} = 2.57, SD_{simple} = 1.69, $t(230.47) = 34.61$, $p < 0.001$). The same holds for our manipulation of product uniqueness (M_{unique} = 5.68, SD_{unique} = 0.98 vs. $M_{typical}$ = 3.96, $SD_{typical}$ = 1.63, $t(329.24) = 12.81$, $p < 0.001$).[4]

4.2.2 | (Moderated) serial mediation analyses

To examine the mechanism proposed in H1a and H1b, we conduct a moderated serial mediation analysis testing the mediating roles of processing fluency and product quality perceptions in respondents' purchase decisions for the chair evaluated in AR contexts differing in visual complexity. To this end, we follow the bootstrapping approach by Hayes (2022) for conditional indirect effects (PROCESS model 83 with 5,000 bootstrap samples and robust SEs).

As hypothesized in H1a, we find a significantly negative effect of the context's visual complexity on participants' processing fluency ($b = -1.430$, SE = 0.252, $p < 0.001$). H1b is supported as well, as we find a significantly negative serial mediation effect of the context's visual complexity on participants' purchase intention via processing fluency and perceived product quality (indirect effect = −0.061, SE = 0.030, 95% CI = [−0.127, −0.011]). Thus, context complexity reduces processing fluency, which in turn reduces perceived product quality and, ultimately, purchase intention.

To investigate product design uniqueness as a hypothesized product-related boundary condition (H2), we include it as moderator variable in the relationship between the AR context's complexity and processing fluency in a moderated serial mediation model. Supporting H2, the negative effect of context complexity in the underlying process is attenuated for unique products (conditional indirect effect = −0.028, SE = 0.016, 95% CI = [−0.065, −0.003]; index of moderated serial mediation = 0.033, SE = 0.023, 95% CI = [0.001, 0.087]). The results, including control variables, are visualized in Figure 5.[5]

In sum, our findings indicate that processing fluency and perceived product quality serially mediate the effect of the AR context's complexity on purchase intention for a product evaluated in this context. Thus, the context of product evaluation influences consumers' fluency of information processing, their product perceptions and, ultimately, their purchase decisions. Consumers perceive products as being of lower quality if the product is evaluated in a more complex context, as their processing fluency is hampered by the context's visual complexity.

Uniquely designed products suffer less from a visually complex AR context compared to products of typical design. As theorized, we attribute this finding to the increase in conceptual fluency when unique products are evaluated in a more complex context, which partly compensates the complexity-driven reduction in perceptual fluency.

[4]Data of Study 1–3 is available for replication at https://osf.io/dk58n. See Appendix B of the Supporting Information for summary statistics of other main variables by conditions of Study 1–3.

[5]See Appendix C of the Supporting Information for regression results of moderated serial mediation analyses of Study 1–3.

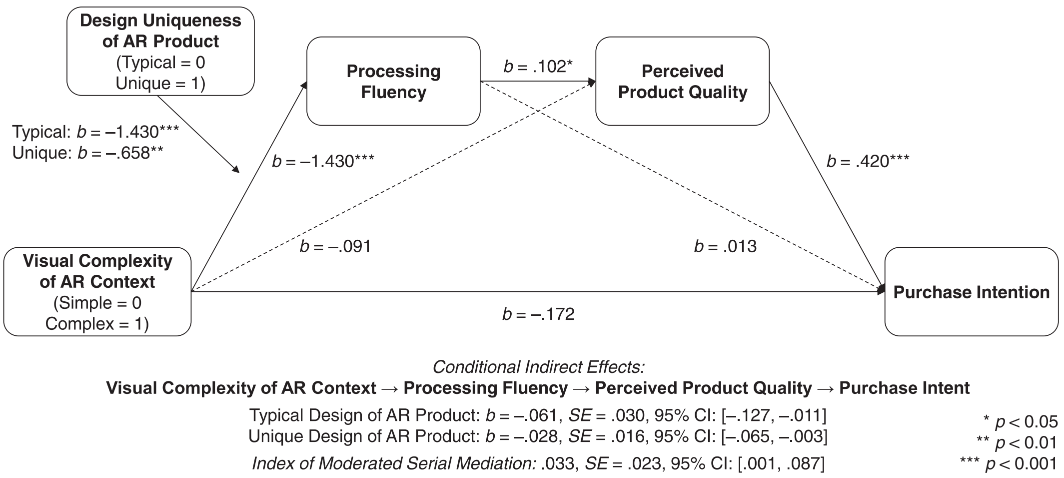

FIGURE 5 Moderated serial mediation results of Study 1.

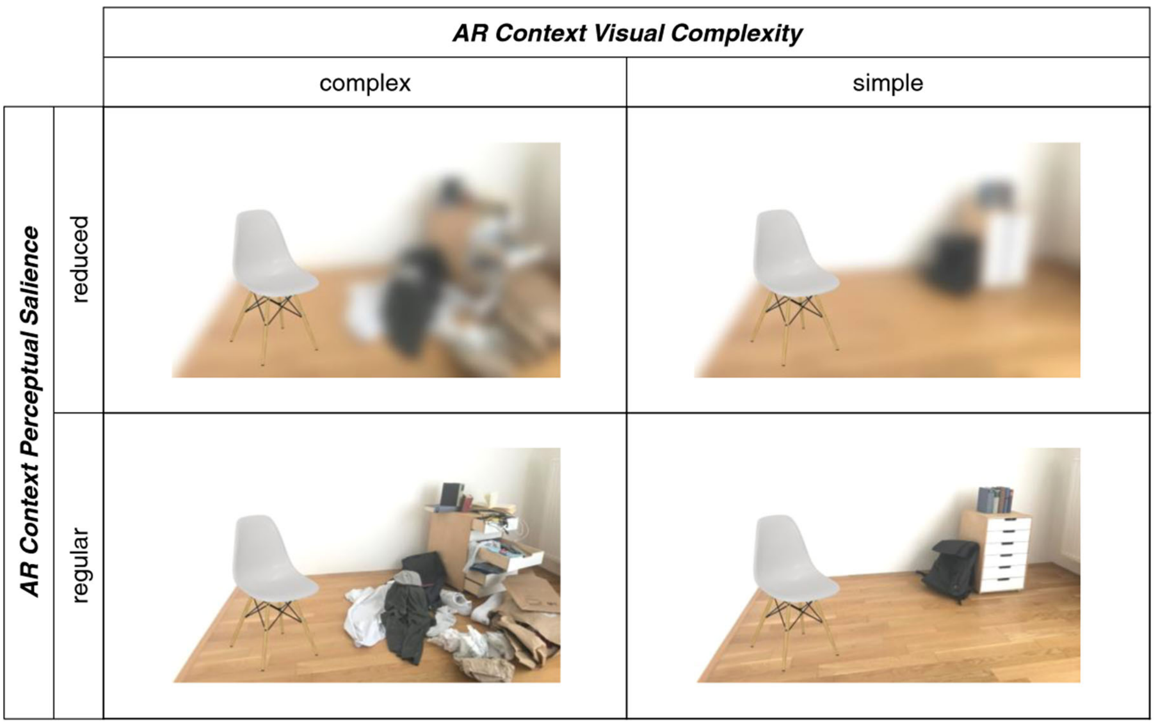

FIGURE 6 Experimental design and stimuli of Study 2.

5 | STUDY 2: PERCEPTUAL SALIENCE OF AR CONTEXT

5.1 | Experimental design and procedure

To replicate the test of H1a/H1b and to test H3 of our proposed model, we conducted another online experiment in which we manipulated the visual complexity of the AR context and our hypothesized context-related moderator, the context's perceptual salience (reduced/regular), resulting in a 2 × 2 full factorial, between-subjects design (see Figure 6 for our experimental design and stimuli).

We pretested another white chair for neutrality in terms of several main decision variables, independent of context. To this end, we recruited 106 UK-based participants (M_{age} = 38.07, 65.1% female) via Prolific. They were displayed the focal chair against a white background and rated their purchase intention, product liking, and product familiarity. The chair was not rated too extreme in either direction.[6] The rather moderate mean preferences suggest that also for this model of the chair, it is unlikely that strong perceptions of the

[6] Purchase intention: M = 3.52, SD = 1.79; product liking: M = 4.12, SD = 1.52; product familiarity: M = 4.39, SD = 1.46.

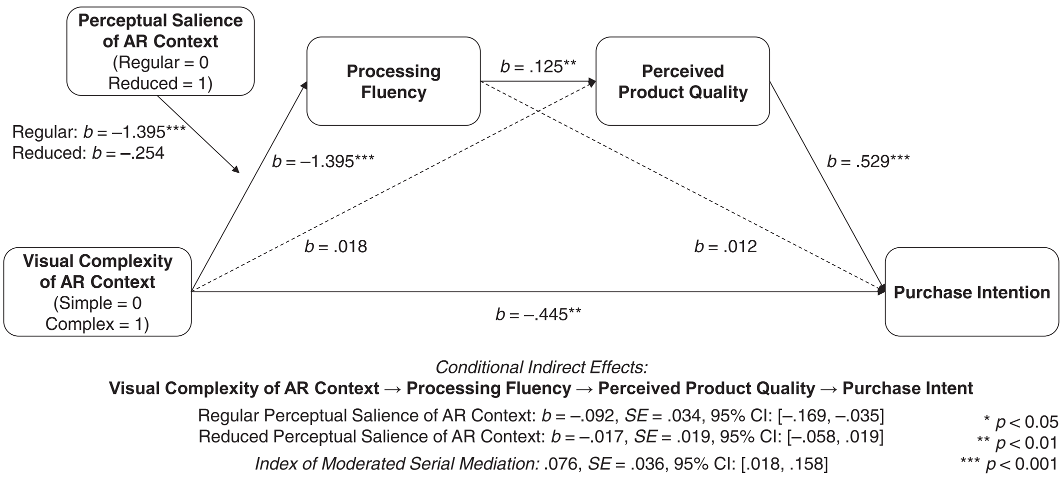

FIGURE 7 Moderated serial mediation results of Study 2.

chair itself would dilute potential effects from the context onto the chair in the following experiment (Graf & Landwehr, 2017).

We also verified that the chair was actually perceived as a product that needs its context to be properly evaluated. Participants indicated that they would highly benefit from seeing the chair in a room for evaluation ($M = 5.28$, $SD = 1.52$). From these results, we again conclude that it can be reasonable to assume a potential occurrence of spillover effects from the context onto the chair.

For our manipulation of the context's perceptual salience, we created blurred copies of the two context stimuli resulting from the initial pretest described in Section 3. We decided to operationalize the reduction of the context's perceptual salience by blurring, as it is a common way to decrease the visual prominence of parts within a scene (Hall et al., 2016; Mairena et al., 2022).

In Study 2, the scenario and the survey flow were identical to those in Study 1. Respondents who had already participated in Study 1 or in the pretests were ineligible to participate in Study 2.

5.2 | Results and discussion

5.2.1 | Sample description and manipulation check

We recruited 401 UK-based participants via Prolific ($M_{age} = 40.97$, 50.4% female), resulting in at least 100 participants per experimental condition. Again, our manipulation of the context's visual complexity worked as intended ($M_{complex} = 6.39$, $SD_{complex} = 1.05$ vs. $M_{simple} = 2.80$, $SD_{simple} = 1.61$, $t(342.12) = 26.43$, $p < 0.001$).

5.2.2 | (Moderated) serial mediation analyses

We replicate the significantly negative effect of the AR context's visual complexity on participants' processing fluency ($b = −1.395$, $SE = 0.256$, $p < 0.001$), as hypothesized in H1a. We also replicate the significantly negative indirect effect of context complexity on purchase intention via processing fluency and perceived product quality (indirect effect = −0.092, SE = 0.024, 95% CI = [−0.169, −0.035]; PROCESS model 83 with 5000 bootstrap samples and robust SEs; Hayes, 2022), as hypothesized in H1b.

To test the moderating effect of the AR context's perceptual salience in the relationship between context complexity and processing fluency as proposed in H3, we include the context's perceptual salience as a moderator variable on the path between context complexity and our first serial mediator, processing fluency. In support of H3, we find that the negative effect of context complexity is only present if the context is perceptually salient. If its perceptual salience is reduced, however, the negative effect of context complexity on processing fluency and subsequent variables in the underlying process is nonsignificant (conditional indirect effect = −0.017, SE = 0.019, 95% CI = [−0.058, 0.019]; index of moderated serial mediation = 0.076, SE = 0.036, 95% CI = [0.018, 0.158]). The results, including control variables, are visualized in Figure 7.

In sum, these results indicate that reduced perceptual salience of the AR context attenuates the negative effects of its visual complexity. We attribute this finding to the reduction of the visual prominence of the context, such that perceptual fluency and hence processing fluency are maintained.

6 | STUDY 3: FIELD STUDY

6.1 | Experimental design and procedure

To replicate the test of H1a, H1b, and H2 in a real-world setting, we conducted a field study in which we manipulated our product-related moderator, product design uniqueness, between subjects. In this study, participants used a browser-based mobile AR application on their smartphones to evaluate the respective chair in their real-world surroundings. To this end, we created 3D models of the same chairs

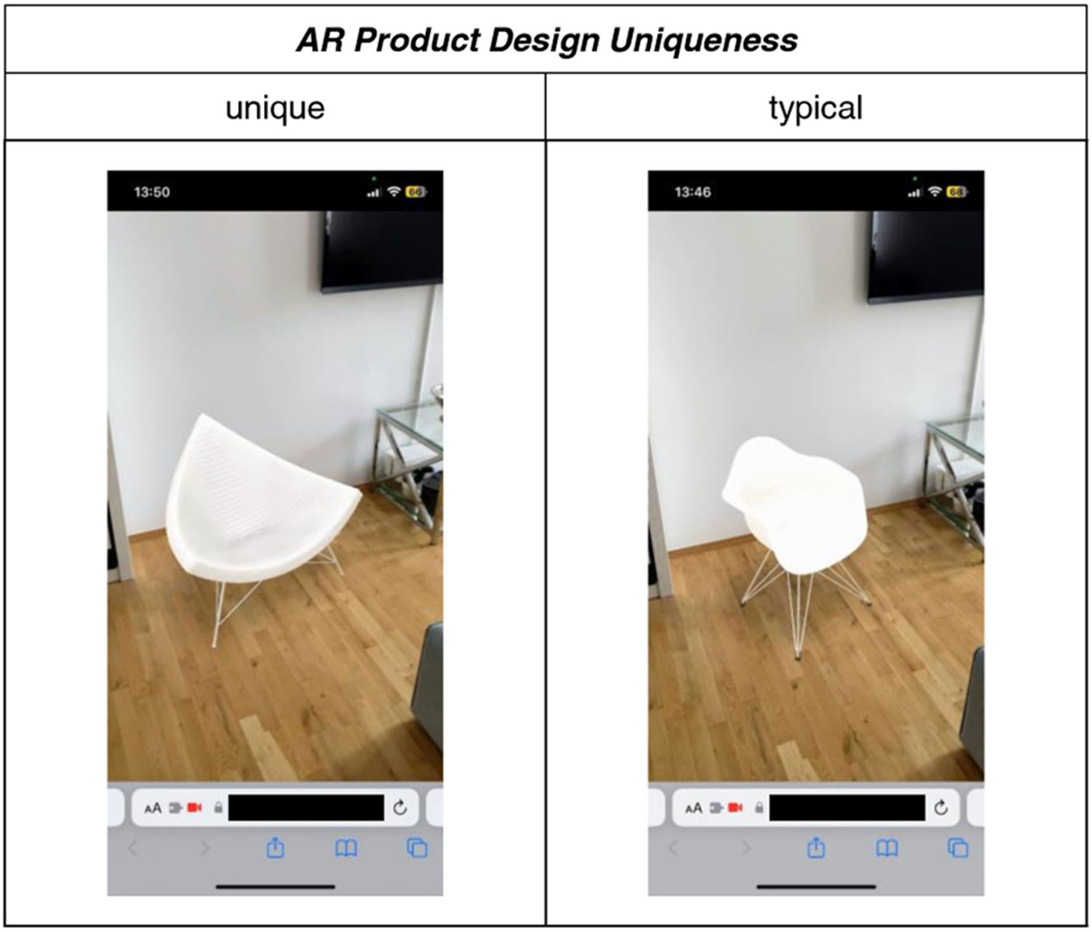

FIGURE 8 Experimental design and stimuli of Study 3.

we used in Study 1. We embedded the custom-built AR application[7] into our survey, such that participants did not have to leave the survey page to evaluate the AR product. Another advantage of the AR solution we chose is that it loads fast and detects real-world surfaces instantly, such that participants could evaluate the AR product without further ado. Moreover, it enabled participants to interact with the chair easily (i.e., move and rotate it). See Figure 8 for our experimental design, depicting screenshots of the AR product stimuli in an exemplary real-world evaluation context. The scenario and survey flow were identical to those of the previous studies. Respondents who had already participated in previous studies were ineligible to participate in Study 3.

As participants were evaluating a 3D space rather than two-dimensional (2D) pictures in this study, we additionally asked for the four informational variables of the Preference Framework (i.e., mystery, visual complexity, legibility, and coherence; Kaplan & Kaplan, 1989). We concluded the survey by additionally asking for participants' product involvement, their familiarity with AR, and their mood.

6.2 | Results and discussion

6.2.1 | Sample description and manipulation check

We recruited 199 UK-based participants via Prolific (M_{age} = 37.09, 49.2% female), resulting in at least 98 participants per experimental condition. Again, our manipulation of product uniqueness worked as intended (M_{unique} = 4.61, SD_{unique} = 1.49 vs. $M_{typical}$ = 3.33, $SD_{typical}$ = 1.63, $t(197) = 5.79$, $p < 0.001$).[8]

6.2.2 | (Moderated) serial mediation analyses

Testing our moderated serial mediation model with the informational variables of the Preference Framework, we find that only those related to exploration of the context (i.e., visual complexity and mystery) have a significant effect on processing fluency and

[7]We relied on the customizable, browser-based AR solution “8thWall” provided by Niantic (https://www.8thwall.com/).

[8]We also captured the time participants spent using the AR application (in seconds) to verify that they paid attention: M = 130.88, SD = 88.20. From this rather high mean value, we conclude that participants spent an adequate amount of time using the AR application.

subsequent variables.[9] AR contexts high in visual complexity and at the same time low in mystery lead to disfluency ($b = -0.539$, SE = 0.205, $p = 0.009$) and have a negative indirect effect on purchase intention via processing fluency and perceived product quality (indirect effect = −0.050, SE = 0.027, 95% CI = [−0.107, −0.002]; PROCESS model 83 with 5000 bootstrap samples and robust SEs; Hayes, 2022), consistent with H1a and H1b, respectively.

We also replicate the attenuating moderated serial mediation effect of product design uniqueness (H2). In contrast to typical products, negative effects of the AR context in the underlying process are nonsignificant for unique products (conditional indirect effect = −0.028, SE = 0.033, 95% CI = [−0.097, 0.034]; index of moderated serial mediation = 0.022, SE = 0.038, 95% CI = [−0.054, 0.100]).

In sum, our findings indicate that also in an AR field setting, processing fluency and perceived product quality serially mediate context-related effects on product-related purchase intention. If the AR context is visually complex and at the same time does not invite to explore the space (i.e., low mystery), consumers experience disfluency, perceive products as qualitatively inferior and thus have a lower intention to purchase the evaluated product. Mystery is the 3D counterpart of visual complexity (Kaplan, 1988) and both variables are associated with the highest sensory depth of all four variables of the Preference Framework (Evans & McCoy, 1998). Thus, it comes as no surprise that visual complexity and mystery are influential predictors of consumers' information processing in the AR context.

Uniquely designed products suffer less from negative effects of the AR evaluation context compared to products of typical design, although we find this difference to be less pronounced when products are evaluated in a 3D AR space rather than in a 2D picture plane.

7 | GENERAL DISCUSSION

7.1 | Theoretical contribution

Our study contributes to consumer psychology research in several ways. We analyzed context-related spillover effects on consumers' perceptions when evaluating products in their actual usage context (e.g., evaluating a piece of furniture in a room at home). In such a situation, the product evaluation context evades control by retailers—an unprecedented situation enabled by novel product evaluation technologies such as AR. Generally, we examined how AR is affected by the actual reality, which bears potential risks for retailers hitherto overlooked by AR research (von der Au et al., 2023). By manipulating the AR context (Study 1 and 2) and a design-related aspect of the product (Study 1 and 3), while keeping the product type constant, we contribute to a more holistic understanding of AR's effectiveness in e-commerce.

We theorized and empirically tested the relationship between the evaluation context of the AR environment and product-related inferences consumers make based on these environmental stimuli. By applying the Preference Framework (Kaplan & Kaplan, 1989) to a 3D product evaluation space in our AR field study, we are the first to follow the call by Orth and Wirtz (2014) to examine how the other variables of the framework influence processing fluency alongside visual complexity.

We identify a context-related (i.e., perceptual salience) as well as a product-related boundary condition (i.e., design uniqueness) in the relationship between an AR context's visual complexity and consumers' processing fluency. We extend prior research on the interplay between visual complexity and processing fluency, as we investigated two distinct types of processing fluency: perceptual fluency and conceptual fluency. We replicate the general negative effect of the context's visual complexity on consumers' perceptual fluency. Yet, we find that by merely reducing the perceptual salience of the context, this negative effect of visual complexity on perceptual fluency is entirely offset. In addition, we demonstrate a product-context configuration in which visual complexity can actually have a less disadvantageous effect on processing fluency than one would expect when accounting for the well-researched perceptual fluency only—namely via the conceptual fluency of processing uniquely designed products in more visually complex contexts.

Moreover, we repeatedly demonstrate a novel link between processing fluency and product quality perceptions. While previous work thoroughly examined effects of processing fluency on *affective* consumer reactions, such as pleasure and product aesthetics (e.g., Graf & Landwehr, 2017; Orth & Crouch, 2014; Orth & Wirtz, 2014; Reber et al., 2004), we show that—as speculated by Orth and Crouch (2014)—processing fluency can also be decisive for *cognitive* consumer reactions, such as perceptions of product quality. We thus extend the body of research on fluency effects on nonaesthetic product judgments (for an overview, see Reber et al., 2004).

7.2 | Managerial implications

Our results have several implications for AR retailers. If their AR products are evaluated in an unfavorable context, detrimental effects on consumers' evaluation of these products and, finally, on their purchase decisions can occur. As AR retailers cannot directly control the AR context, however, they are well advised to implement measures to conceal the context's visual complexity or increase the perceived uniqueness of the product.

Diminishing the reality that is visible on the display of consumers' devices can maintain perceptual fluency and thus avoid unfavorable product quality inferences and lower purchasing intention. For example, retailers could employ artificial intelligence to automatically recognize and digitally remove complexity-enhancing elements from reality to visually simplify the AR context consumers see on their

[9]We formed an index for the exploration dimension of the Preference Framework, consisting of the respective scales for visual complexity and mystery (reverse coded, such that higher scores indicate lower preference). For consistency and brevity reasons, we refer to this index as visual complexity.

devices' screen.[10] Alternatively, reducing the visual salience of complexity-enhancing elements (e.g., by blurring the AR context) or virtually adding mystery-enhancing elements (which invite to explore) can also counteract negative contextual effects.

The problem of visually complex AR contexts is less severe (however still present) for atypical products, as their unique design is conceptually more congruent with complex contexts. Thus, AR retailers should be mindful of contextual effects especially in the case of nonunique products, as they may presumably account for a larger fraction of products evaluated by consumers due to their more mainstream-appealing, typical product design. In addition to improving consumers' perceptual fluency by visually simplifying the AR context, AR retailers could also enhance the conceptual fluency of typical products evaluated in visually complex AR contexts by making the products appear more unique. Directly within the AR experience, AR retailers could, for instance, offer product customization options (e.g., color swap) or showcase certain feature details which, to a certain extent, differentiate a rather typical product from other products of its category. Similarly, AR retailers could facilitate direct product comparisons by integrating multiple holograms of similar products within the AR experience at once, thus highlighting differentiating product attributes to make each product appear somewhat unique compared to the others.

7.3 | Limitations and future research

We have to acknowledge limitations that provide avenues for future research. First, our experiments used a stimulus product that was pretested to rely on its usage context to be properly evaluated. Thus, future research can replicate our methodology with other products and test our observed effects for contextual products against the domain of noncontextual products, as consumers may rely less on contextual stimuli when evaluating such products.

Second, there may be differences in individuals' information processing capabilities contingent on their field dependence, that is, their ability to visually detach single elements from the context in which they are embedded (Goodenough et al., 1987).

Third, we measure purchase intentions rather than actual decisions made by participants. While measuring actual choices undoubtedly contributes to a rich understanding of consumer behavior, self-reported purchase intentions were shown to approximate sales (e.g., Ajzen, 1991; Morwitz et al., 2007; Taylor et al., 1975), and it is not uncommon to measure behavioral intentions in AR studies (e.g., Hilken et al., 2017; Orús et al., 2021). Nevertheless, future research could compare our results to actual consumer decisions. In addition, future research could also study other interesting outcome variables as proposed in the S-O-R based conceptual framework of consumer experience, experiential values, and consumer behavior of AR in retail settings by Chen et al. (2022)—for example, those related to decision-making or to the approach and avoidance of the technology (e.g., Barta et al., 2023a; Heller et al., 2019b; Jessen et al., 2020).

Fourth, we considered mobile AR usage via smartphones in our study. As there may be different effects for different device types (e.g., Barta et al., 2021; Orús et al., 2021), testing our findings for other AR devices, such as tablets, PCs or smart glasses (see e.g., Flavián et al., 2019), could hence be another worthwhile endeavor for future research.

[10]Digitally removing real objects from AR view in real time is no longer science fiction. Via so-called “inpainting” technique, real objects can be digitally overlaid by patterns of their surrounding background environment and, thus, are rendered out of the visible scene (sometimes also referred to as “Diminished Reality”). See for instance Siltanen (2015) and Mori et al. (2017) for more detailed descriptions and application examples.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in OSF at https://osf.io/dk58n.

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SUPPORTING INFORMATION

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