Innovation is appreciated when we feel safe: On the situational dependence of the appreciation of innovation

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Relevance to Design Practice: The article reveals the adaptive function of aesthetically-based design evaluations. For design practice it emphasises the relevance in which situational context design products are evaluated, particularly if the products show innovative properties that simultaneously bear some unfamiliar, potentially dangerous, yet new and fascinating qualities.

Keywords: Design Evaluation; Empirical Aesthetics; Innovation; Preference; Situated Cognition; Context Dependence; Liking

Abstract

Appreciation of innovative goods requires the fulfilment of several pre-conditions, e.g. before we can admire an innovative design we must have elaborated it. In the present study, we focused on situational context as one factor affecting appreciation of innovations. In order to demonstrate that evaluation of innovation is sensitive to situational demands, we studied the selective activation of fascinating facets versus threatening or even dangerous aspects of innovation on the appreciation of consumer products. We varied the specific direction of elaboration towards potentially fascinating or dangerous aspects of car designs that differed in their degree of innovativeness. Participants showed specific appreciation for highly innovative designs only if they had elaborated the material on the basis of scales associated with the more fascinating aspects of their stimuli. A repetition after a week revealed that participants recalibrate to the appreciative norms with which they started, but that they showed the same dissociate pattern of results after having elaborated the material again. The findings underline the adaptive function of aesthetically-based evaluations strongly depending on the situational context in which they are evaluated.

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Introduction

Aesthetically based evaluation of the environment seems to be a key functionality of the human brain (Faerber & Carbon, 2012). The latest research shows the clear adaptive quality of aesthetic appreciation (Carbon, 2011, 2012). Major factors of this adaptivity were identified by elaboration effects (De Bont & Schoormans, 1995), Zeitgeist-dependent norms (Carbon, 2010), or levels of expertise (Vogt & Magnussen, 2007) — in short: the assessment of aesthetic quality is clearly context-dependent (see Carbon & Jakesch, in press; Leder, Belke, Oeberst, & Augustin, 2004). This view is contrary to the classic Fechnerian idea that object-inherent features determine whether something is beautiful or aesthetically pleasing, but is compatible with the situated cognition approach originating from social psychology. For instance, Schwarz (2007) claims that "to serve action in a given context, any adaptive system of evaluation should be informed by past experience, but highly sensitive to the specifics of the present" (pp. 639). Whereas deeper knowledge of such adaptive behaviour in situational contexts has already been compiled for a variety of aspects in social contexts, comparable effects have to date rarely been investigated with respect to aesthetic evaluations, or even design objects (Blijlevens, Gemser, & Mugge, 2012).

In order to study the effects of situational context on the aesthetic assessment of objects, Carbon and Leder (2005) employed a technique developed in the context of applied aesthetics called "Repeated Evaluation Technique" (RET). The core of this technique is to initiate implicit elaboration of the inner qualities of consumer products by asking people to evaluate these products in a variety of product-relevant dimensions (e.g., prestige, pleasantness, innovativeness). The target-oriented usage of specific combinations of dimensions within the RET enables the activation of discrete situational contexts or "semantic concepts" (Faerber, Leder, Gerger, & Carbon, 2010).

In the present study, we investigated the impact of situational contexts on the appreciation of innovativeness in car interiors. Innovativeness is well known to be a key variable for predicting the success of a specific car design (Leder & Carbon, 2005). Here, we chose this variable because it has been shown that the appreciation of innovativeness strongly depends on associative factors, e.g. as triggered by elaboration (Carbon & Leder, 2005). To generate specific (associative) contexts for the participants, we confronted them with evaluative dimensions that either stressed the potentially positive aspects of innovativeness using fascinating, novelty-based attributes (condition *Fascination*) or emphasised potentially negative aspects of innovativeness by employing threatening properties of innovation, namely unfamiliar objects (condition *Danger*). Moreover, we conducted the experimental procedure twice —the second testing after a one-week break.

This temporal variation is a new way to show another important aspect of dynamic changes in appreciation and allows for the testing of whether (and which) situational context enables sustainable changes in aesthetic appreciation. As dependent measures, we not only focused on attractiveness or liking, but followed a multidimensional approach of assessing aesthetic appreciation (see for a deeper discussion on the multidimensional measurement of aesthetic appreciation in Faerber, et al., 2010). For assessing aesthetic appreciation we used the following variables: 1) attractiveness, 2) innovativeness, 3) interestingness, 4) owning interest unlimited, and 5) owning interest limited (see method section for details).

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Experiment

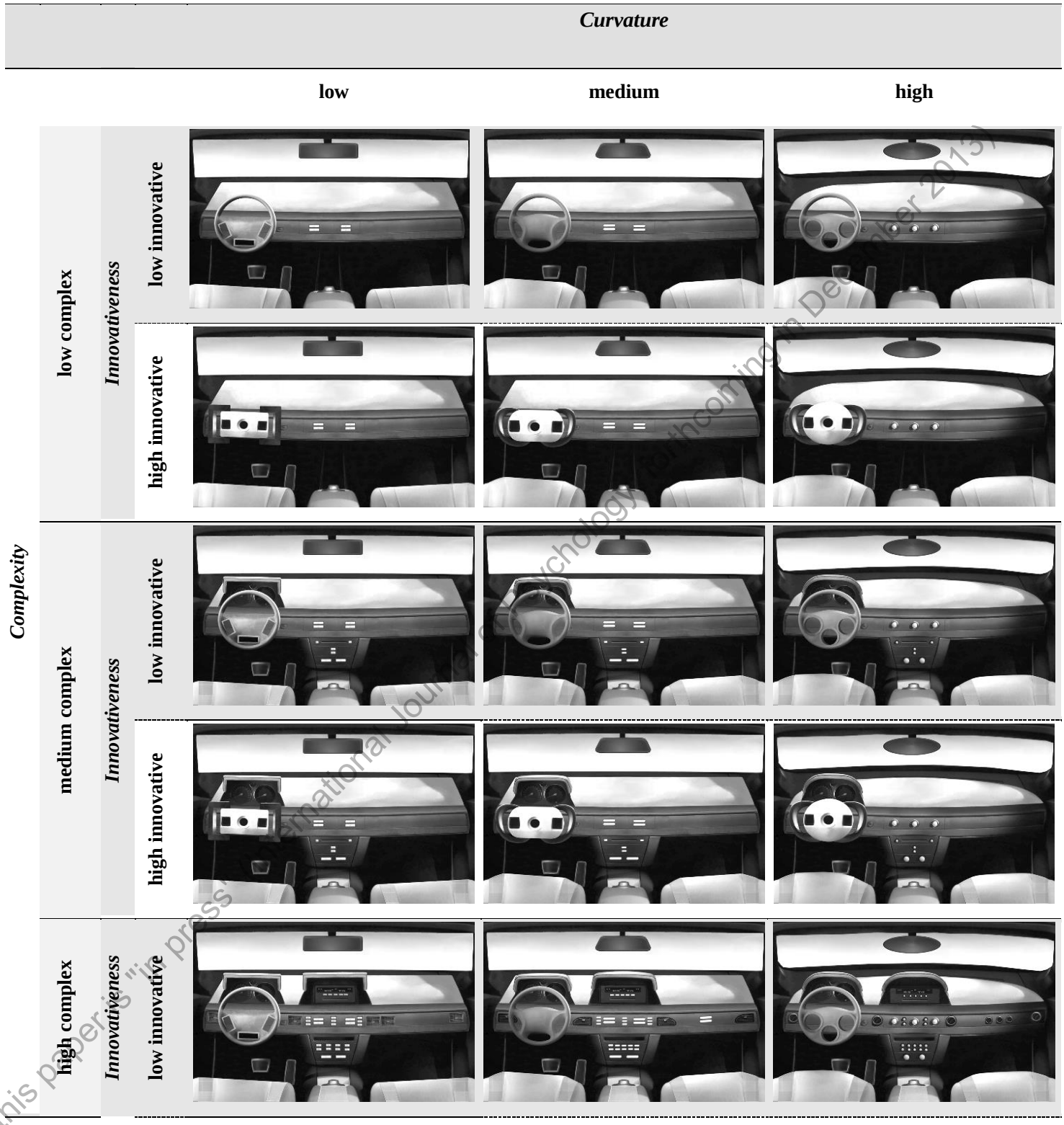
Experiment Design

Participants

Fifty-one undergraduate students of the University of Vienna participated for course credit. Twenty-four people (17 women and 7 men; mean age = 21.6 years) were assigned the *Fascination* condition and 27 (19 women and 8 men; mean age = 22.0 years) the *Danger* condition. All participants had normal or corrected-to-normal visual acuity and normal colour vision, as was assured by a standard Snellen Eye chart test and a short version of the Ishihara colour test. None of the participants had any specific expertise concerning the car industry or car (interior) design, as was assured by participants' self-reports.

Apparatus and Stimuli

The stimulus set comprised 18 images of artificial car-interiors having a size of 800 × 513 pixels (see Figure 1 for the stimulus set), and were presented on a 17-inch Apple eMac CRT monitor with a resolution of 1024 × 768 pixels. The stimuli had been generated using Adobe Photoshop 7.0. In order to create a stimulus set marked by sufficient heterogeneity of innovativeness, we arranged for a systematic variation of the images so that the focus variable *Innovativeness* (9 low, 9 high) was fully crossed with regard to *Complexity* (6 low, 6 medium, 6 high) and *Curvature* (6 low, 6 medium, 6 high), two dimensions highly important in design and preference (see Bar & Neta, 2006; Imamoglu, 2000; Leder & Carbon, 2005).The validity of the resulting crossing-levels was tested by several pre-studies (see Gerger, Leder, Faerber, & Carbon, 2011). Importantly, in contrast to the line-drawing versions used in Leder and Carbon (2005), the stimuli used in the present study consisted of grayscale, photo-realistic versions of car interiors (see Figure 1).



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***Figure 1*. Stimuli used in the experiment. The stimuli varied in *curvature* (columns), *complexity* (major rows), and *innovativeness* (minor rows).**

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Procedure

The experiment consisted of two sessions that were separated by a week-long break. Each session consisted of three parts: first a test phase (T1 or T3 for session 1 or 2, respectively), a context activation phase realised via RET and a re-test phase mirroring the first test phase (T2 or T4 for session 1 or 2, respectively). Thus, the whole experiment followed the following procedure of phases: session 1: T1→RET→T2→ break (one week) → session 2: T3→RET→T4. In each of the four test phases (T1-T4), participants rated the complete stimulus set block-wise according to the following pre-defined order of variables: 1) *attractiveness*, 2) *perceived innovativeness*, 3) *interestingness*, 4) *owning interest unlimited*, and 5) *owning interest limited*. *Attractiveness* and *perceived innovativeness* were asked for in the first two blocks of each test phase as they were our focal dependent variables. In order to include alternative measures of positive attitude towards the stimulus, we also measured *interestingness* (see Cupchik & Gebotys, 1990) of the design and two versions of *owning interest*. When asked about the desire to own something, people might differ in the extent to which they consider the possible price of the stimulus to be relevant. To account for this we addressed the factor price using two versions. *Owning interest unlimited* addresses the desire to own the interior-design where price is not an issue, whereas *owning interest limited* addresses the desire to own the interior-design where the price also had to be considered. Using different scales to measure attitudes towards the stimulus allowed us to uncover differential effects of the different aspects of the attitude. All ratings in the present study were given by use of seven-point Likert scales (1 = *least significant*, 7 = *most significant*). Within each variable block, stimuli were presented in randomised order; the ratings were self-paced by the participants. In the context activation/RET phase, participants evaluated the stimuli on 11 different dimensions (the order was randomised for each participant). Again, participants had to evaluate the stimuli one by one on seven-point Likert scales (1 = *least significant*, 7 = *most significant*). For the two experimental conditions manipulating the situational context, we chose a specific combination of dimensions emphasising the positive (fascinating, novel and stimulating) aspects of the designs (condition *Fascination*); or emphasizing negative aspects by referring to possible dangers or risks

(condition *Danger*), respectively[1]. This means participants in the *Fascination* condition rated the stimuli in the RET phase on 11 positive dimensions, whereas participants in the *Danger* condition rated the stimuli in the RET phase on 11 negative dimensions (for the scales see Footnote 1). All other aspects including the selection of stimuli were kept constant across the groups.

Participants were instructed to use the full range of the scale, and to give their ratings as spontaneously as possible. Trials were presented using PsyScope 1.25 PPC (Cohen, MacWhinney, Flatt, & Provost, 1993). All participants were tested individually. To test for stability or sustainability of the revealed effects we asked participants to come to the lab twice within about seven days but did not provide further information on the purpose of the second session. The resulting delay of one week between T2 and T3 is appropriate to exclude artefacts based on mere memory effects (which are already highly improbable as participants had to evaluate too many stimuli on too many variables to be able to refer to previous evaluations) and to isolate typical representational effects (see Carbon & Ditye, 2011, 2012). Both test sessions lasted about 40 minutes each.

Results

Our major aim was to investigate situational context effects on the appreciation of innovativeness. Accordingly, we primarily tested whether situational context (*Fascination* or *Danger* condition) had a different impact on the attractiveness ratings given in the test phases.

Analyses of Variable Attractiveness

Attractiveness ratings were sampled over participants for highly and less innovative stimuli respectively (variable *Innovativeness*), with the four different test phases as levels of the within-participants factor *Phase*, and the two evaluation conditions (stressing fascination vs. danger as levels of the between-participants factor *Situational context*). The descriptive inspection of data (see Table 1 and Figure 2) had already indicated an interaction between level of innovativeness and phase, but only for the *Fascination* condition.

Table 1. Mean values (plus *SD* in parentheses) of all dependent variables split by *Phase* (Test-time 1 = T1 and T2 in session 1; T3 and T4 in session 2) and *Innovativeness* (low-innov vs. high-innov) for condition *Danger* (top) and *Fascination* (bottom).

Situational context: *Danger*						
		attractiveness	*perceived innovativeness*	*interestingness*	*owning interest unlimited*	*owning interest limited*
T1	high-innov	2.73 (1.5)	4.24 (1.7)	4.11 (1.8)	3.22 (1.7)	2.93 (1.7)
	low-innov	3.21 (1.5)	3.03 (1.6)	3.13 (1.8)	3.31 (1.8)	3.69 (1.8)
T2	high-innov	3.06 (1.6)	4.39 (1.7)	4.03 (1.6)	3.28 (1.8)	2.61 (1.5)
	low-innov	3.75 (1.8)	3.26 (1.8)	3.31 (1.9)	3.26 (1.8)	3.92 (1.8)

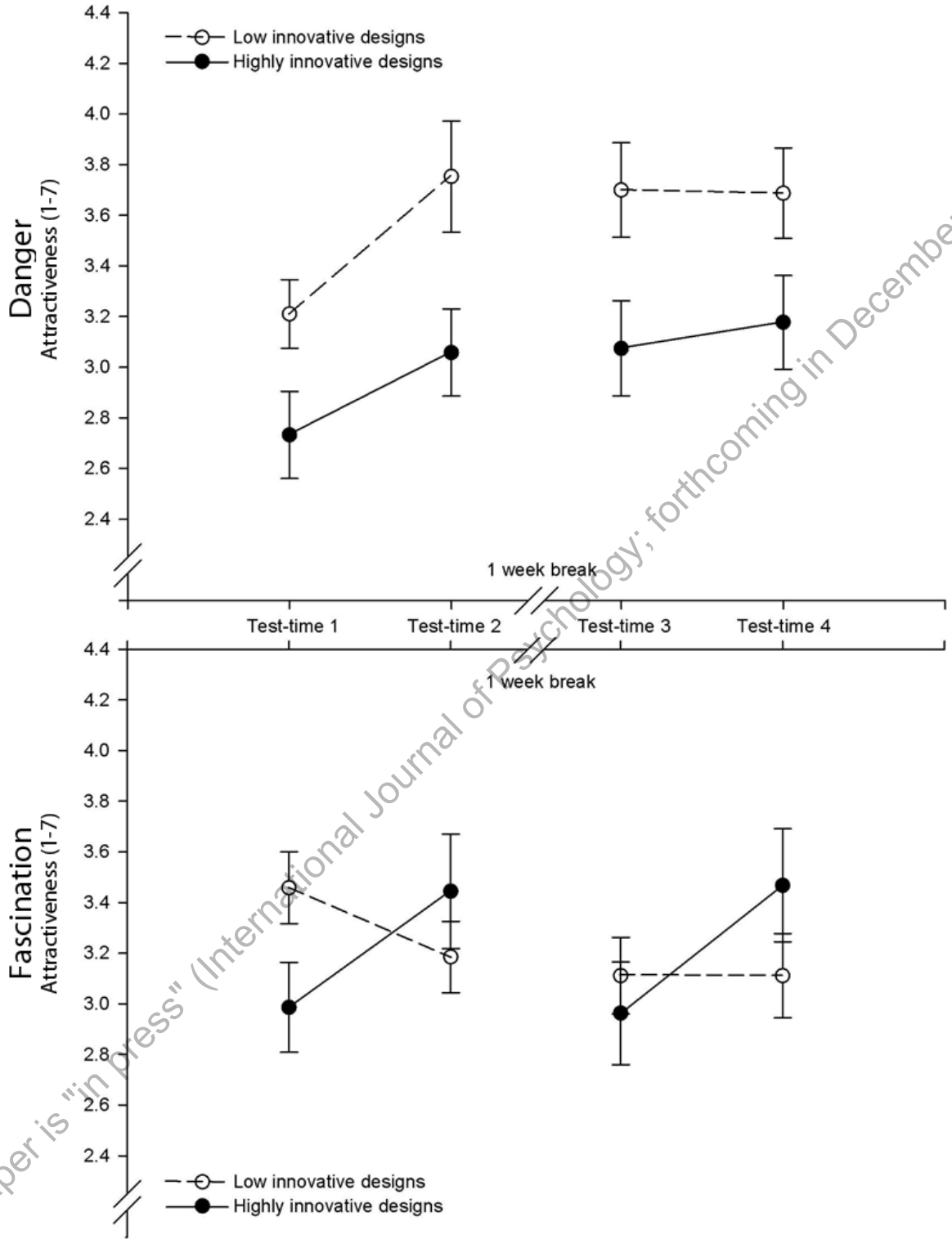
[1] Scales in condition *Fascination* were: exciting, arousing, thrilling, stimulating, surprising, groundbreaking, progressive, novel, fascinating, ingenious, and terrific. Scales in condition *Danger* were: dangerous, breakdown probable, error-prone, unsafe, risky, user unfriendly, difficult to get used to, exhausting, unclear, inconvenient, and inexpedient.

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T3	high-innov	3.07 (1.7)	4.33 (1.7)	4.13 (1.8)	3.24 (1.9)	2.89 (1.8)
	low-innov	3.70 (1.7)	3.16 (1.7)	3.21 (1.9)	3.43 (2.0)	3.75 (2.0)
T4	high-innov	3.18 (1.7)	4.42 (1.6)	3.99 (1.8)	3.37 (1.9)	2.81 (1.6)
	low-innov	3.69 (1.9)	3.14 (1.7)	3.34 (1.9)	3.53 (1.9)	3.94 (2.0)
Situational context: *Fascination*						
		attractiveness	*perceived innovativeness*	*interestingness*	*owning interest unlimited*	*owning interest limited*
T1	high-innov	2.99 (1.5)	4.19 (1.6)	4.07 (1.9)	2.96 (1.9)	2.78 (1.7)
	low-innov	3.46 (1.4)	3.05 (1.5)	3.03 (1.8)	3.08 (1.9)	3.76 (2.0)
T2	high-innov	3.44 (1.8)	4.33 (1.6)	4.01 (1.7)	3.26 (1.9)	2.70 (1.8)
	low-innov	3.19 (1.6)	2.88 (1.4)	2.88 (1.6)	3.04 (1.8)	3.69 (2.1)
T3	high-innov	2.96 (1.6)	4.09 (1.8)	3.92 (1.7)	3.25 (2.0)	2.89 (1.8)
	low-innov	3.11 (1.6)	2.93 (1.7)	2.81 (1.6)	3.12 (1.9)	3.75 (2.0)
T4	high-innov	3.47 (1.7)	4.42 (1.6)	4.16 (1.7)	3.48 (1.9)	2.93 (1.7)
	low-innov	3.11 (1.8)	3.07 (1.6)	2.99 (1.7)	3.26 (1.8)	3.80 (2.0)

A three-way mixed-design analysis of variance (ANOVA) was conducted with *Innovativeness*, *Phase* and *Situational context* as independent variables and ratings of attractiveness as dependent variable. Results revealed a weak effect of *Phase*, $F(3, 147) = 3.90$, $p = .0103$, $\eta_p^2 = .074$, and two interactive effects: a two-way interaction between *Phase* and *Situational context*, $F(3, 147) = 3.70$, $p = .0133$, $\eta_p^2 = .070$, and a three-way interaction between *Phase*, *Innovativeness*, and *Situational context*, $F(3, 147) = 3.49$, $p = .0173$, $\eta_p^2 = .067$. No other effects were significant.

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Figure 2. Attractiveness ratings split by *Phase* (Test-time 1 = T1 and T2 in session 1; T3 and T4 in session 2) and *Innovativeness* (low vs. high) for condition *Danger* (top) and *Fascination* (bottom). Error bars indicate ± 1 standard error of the mean (SEM).

In order to further explore the three-way interaction effect of *Phase, Innovativeness* and *Situational context* we analysed the data separately for session 1 (T1 vs. T2) and session 2 (T3 and T4). For each session, we conducted a three-way mixed-design ANOVA for attractiveness with *Phase* (T1 vs. T2 or T3 vs. T4, respectively) and *Innovativeness* as within-participants factors, and *Situational context* as between-participants factor. We did indeed obtain a significant three-way interaction between *Phase, Innovativeness* and *Situational context* for session 1 (T1 vs. T2), $F(1, 49) = 5.33$, $p = .0252$, $\eta_p^2 = .098$, but not for session 2 (T3 vs. T4), $F(1, 49) = 2.41$, $p = .1268$, *n.s*. As shown in Figure 2, low innovative designs were preferred across both situational contexts initially (T1), but appreciation was lost in the Fascination condition. Concurrently, highly innovative designs which were disliked at T1 only gained appreciation in the Fascination, but not the Danger, condition. Overall, within the context of the Danger condition, the difference in appreciation between low innovative designs versus highly innovative designs generally did not change: Across all test times, low innovative designs were largely preferred over highly innovative designs in the danger context condition. Besides, in the Danger context condition we found a general increase in liking of all material from T1 to T2; for later test times we found stable levels of appreciation.

When we analysed the sustainability of the effects of dissociate appreciation of innovativeness, by testing T1 against T3 in a mixed-design ANOVA, analogously structured as before for testing T1 vs. T2, we did not find any interactive effects. This indicates that participants had already recalibrated their appreciation after 1 week, thus again showing negative tendencies when further confronted with innovative material. However, an additional mixed-design ANOVA testing T1 against T4 revealed very similar interactive effects as for T1 vs. T2: the interaction between *Phase* and *Innovativeness*, $F(1, 49) = 4.29$, $p = .0437$, $\eta_p^2 = .080$, as well as between *Phase*, *Innovativeness* and *Situational context*, $F(1, 49) = 5.02$, $p = .0295$, $\eta_p^2 = .093$, were significant.

Analyses of Variable Perceived Innovativeness

Concerning perceived innovativeness, a three-way 2 × 4 × 2 mixed-design analysis of variance (ANOVA) with *Innovativeness*, *Phase* (T1, T2, T3, T4) and *Situational context* as independent variables and ratings of perceived innovativeness as dependent variable, revealed a large significant effect of *Innovativeness*, $F(1, 49) = 47.02$, $p < .0001$, $\eta_p^2 = .490$, but no other effects. As defined by the pre-experimental categorisation, innovative designs were indeed perceived as being significantly more innovative in all conditions, and this did not change over time.

Analyses of Further Variables

Concordant analyses on the basis of three-way 2 × 4 × 2 mixed-design analyses of variance (ANOVA) showed the following effects on the further dependent variables: The analysis of interestingness data also showed *Innovativeness* having a significant effect, $F(1, 49) = 31.06$, $p < .0001$, $\eta_p^2 = .39$, with highly innovative materials rated as being more interesting. There were no other significant effects. Analysis of the owning interest unlimited data revealed a significant effect of *Phase*, $F(3, 147) = 4.12$, $p = .0078$, $\eta_p^2 = .077$, indicating a slight increase over time for the variable. Analysis of the owning

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interest limited data showed a large significant effect of *Innovativeness*, $F(1, 49) = 30.74$, $p < .0001$, $\eta_p^2 = .386$, with higher values for less innovative than for highly innovative designs. No other effects were significant.

To sum up, appreciation for highly innovative material started low for both experimental conditions and stayed low in the *Danger* context. In contrast, and in accordance with previous studies (e.g., in eyetracking behaviour Carbon, Hutzler, & Minge, 2006; e.g., on attractiveness Carbon & Leder, 2005; e.g., in pupillometry Carbon, Michael, & Leder, 2008), the *Fascination* context educed positive aspects of highly innovative design, leading to increased appreciation; however, this had to be re-activated by further elaboration after one week. From this it is possible to document a clear dissociation of the dynamics of appreciation over time, depending on the situational context (*Fascination vs. Danger*).

Discussion and Inferences

In the present paper, we investigated the impact of situational contexts on the appreciation of design innovation. Using car interior designs of varying levels of innovation, we compared two kinds of situational contexts, stressing either the fascinating (positive) or the dangerous (negative) aspects of innovation in car design.

We observed strong dynamics of appreciation over time triggered by elaboration in the *Fascination* condition, with cross-over interactions between *Phase* and *Innovativeness*. This is compatible with previous findings from applied aesthetics stating that innovativeness is often rejected at first glance but appreciated after having elaborated the innovative material and potentially understood the inherent design concept (Carbon & Leder, 2005; Gerger, et al., 2011). The inherent risk of innovative products becoming either a top or a flop is avoided by copycats — products which benefit from copying the outer appearance of successful earlier products.

In contrast, the disliking of innovative aspects of car design continued over time despite elaboration in the *Danger* condition. There was only a mild increase in the liking of *all* materials independent of its innovativeness level, compatible with a mere-exposure effect (Zajonc, 1968): The more often we encounter the same object the more we will like it (see also Kunst-Wilson & Zajonc, 1980; Zajonc, 2001)—an effect we can also explain by modern theories of "perceptual fluency" (e.g., Reber, Winkielman, & Schwarz, 1998), "cognitive fluency" (e.g., Belke, Leder, Strobach, & Carbon, 2010) or "conceptual fluency" (e.g., Lee & Labroo, 2004). One reason for the absence of a further gain in appreciation from T3 onwards could be a saturation effect. Saturation is a well-documented phenomenon in the context of mere exposure, taking place from approx. 10 repetitions on (Bornstein, 1989). Although participants could clearly differentiate between less and highly innovative materials in the *Danger* condition from the beginning on, they did not change their specific appreciation of less innovative material which was persistently preferred to highly innovative designs. One reason for this persistence could be the activation of a specific mind-set (Faerber, et al., 2010) that does not allow participants to re-evaluate and elaborate the material. In this respect, the behaviour of the participants in the *Danger* condition resembles that of highly rigid persons (Carbon & Schoormans, 2012). The activated mind-set seems to have inhibited an integration of the

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material into the participants' visual habits, as the innovative attributes are interpreted as potential dangers whose consequences are not hazarded. In other words, in the *Danger* condition participants became *de facto* more conservative in their ratings.

Evaluation was quite different in the *Fascination* condition. Although participants started quite similarly by preferring less innovative material, they obviously found inherent characteristics of the innovative car interiors appealing after they had elaborated the material within the RET phase. The dissociation between the *Danger* and *Fascination* conditions provides clear support for a situation-sensitive and adaptive aesthetic sense. This finding is consistent with situated cognition approaches, wherein behaviour is contextualised within the actual situation in which it occurs (e.g., Smith & Semin, 2004, 2007).

Regarding the sustainability of situational context factors on aesthetic appreciation the data show that even after one week (T3), the impact was still very strong in the *Danger* condition. This is in accordance with the assumption that danger- and fear-related processes might have a special role in memory consolidation (LaBar & Cabeza, 2006). In contrast, although participants in the *Fascination* condition showed highly dynamic patterns of appreciation with disliking innovative material in the beginning but fully appreciated it after elaboration, this gain of appreciation was lost within one week during the break between the test sessions. This might indicate that the effects of specific activation of fascination for innovation are not long lasting but need permanent refreshment—a factor that should be taken into account for applied contexts.

In sum, varying the quality of a situational context through the use of different evaluation dimensions had strong effects on attractiveness evaluations over time. Being directed towards the potentially dangerous or fascinating aspects of objects might result in the selective consideration of various features of those objects.

Situational influences are presumably more distinct for more ambiguous objects, and therefore particularly salient for innovative objects, which could be seen as positive and fascinating, or negative, uncertain, and dangerous. This also has practical implications for the introduction of innovative products: a strong emphasis on the fascinating factors of a product might be an important and necessary ingredient for its success.

Implications for Product Design and Marketing

The present study revealed how the aesthetic appreciation of innovation, which is often seen as a driving force in product design, is sensitive to situational contexts. When the situational context activated concepts related to the potential dangers of an innovation (condition *Danger*), participants were prevented from further elaborating this innovation in a positive way. However, when the situational context stressed fascination, challenge, and novelty (condition *Fascination*), there was a cross-over interaction between *Phase* and *Innovativeness* for attractiveness ratings. Actually, the attractiveness of innovative material increased as a result of elaboration.

The findings for the appreciation of innovative material in the *Fascination* condition

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can especially explain why in highly appealing contexts of, e.g., motor car shows we can appreciate highly innovative, unconventional, uncommon and distinctive pieces of design. In such contexts, the visitors' mind-set is more likely to be primed to experience fascinating and challenging elements. In this mind-set, the results clearly suggest we are open to new experiences and can contemplate new, innovative, and challenging material. Otherwise, if such contexts were to include negative or even dangerous associations, one would most likely not visit such shows voluntarily. Alternatively, we could qualify the results straightforwardly in the following sense: Participants in the danger context seem to stay in a "rejection of innovation modus"[2], which implies that notions of danger, insecurity or other negative connotations might be very detrimental for appreciating innovative products. Of course the nature of the context triggering such effects is an interesting topic for future basic but also applied research. Another issue could be to test participants differing in their need for safety and different product classes which differ in their association with safety aspects.

The present study shows that aesthetic appreciation is by nature dynamic and context-dependent, and thus highly adaptive to the ever-changing world we encounter day-by-day. For design and marketing purposes it is therefore highly desirable to create stimulating and fascinating contexts, rather than danger avoiding contexts, when presenting highly innovative products in order to attract consumers in the most efficient way.

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[2] thanks for this insight provided by a reviewer

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