Acta Psychologica 135 (2010) 191–200

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy

Priming semantic concepts affects the dynamics of aesthetic appreciation

Stella J. Faerber [a,b], Helmut Leder [b], Gernot Gerger [b], Claus-Christian Carbon [a,b,*]

[a] Department of General Psychology and Methodology, University of Bamberg, Bamberg, Germany
[b] Faculty of Psychology, University of Vienna, Vienna, Austria

ARTICLE INFO

Article history:
Received 15 December 2009
Received in revised form 12 June 2010
Accepted 14 June 2010
Available online 7 July 2010

PsycINFO classification:
2229 (Consumer Opinion & Attitude Testing)
2300 (Human Experimental Psychology)
2323 (Visual Perception)
3920 (Consumer Attitudes & Behaviour)

Keywords:
Priming
Semantic network
Semantic concept
Aesthetic appreciation
Visual preference
Design evaluation
Consumer psychology
Semantic association

ABSTRACT

Aesthetic appreciation (AA) plays an important role for purchase decisions, for the appreciation of art and even for the selection of potential mates. It is known that AA is highly reliable in single assessments, but over longer periods of time dynamic changes of AA may occur. We measured AA as a construct derived from the literature through attractiveness, arousal, interestingness, valence, boredom and innovativeness. By means of the semantic network theory we investigated how the priming of AA-relevant semantic concepts impacts the dynamics of AA of unfamiliar product designs (car interiors) that are known to be susceptible to triggering such effects. When participants were primed for innovativeness, strong dynamics were observed, especially when the priming involved additional AA-relevant dimensions. This underlines the relevance of priming of specific semantic networks not only for the cognitive processing of visual material in terms of selective perception or specific representation, but also for the affective–cognitive processing in terms of the dynamics of aesthetic processing.

1. Introduction

Have you ever looked at your family photo album thinking, "Oh dear, was I really wearing that back then?" We seem to forget our past preferences, even if sometimes this may be a good thing considering that we could get bewildered looks from others if we wore the same clothes today. Thumbing further through the album, we might also see some objects that we still fancy and would still consider wearing. Obviously, our aesthetic appreciation (AA), and perhaps even our taste, is not static, it changes over time (Carbon, 2010; Cox & Cox, 2002; Moulson & Sproles, 2000; Sproles, 1981).

Most importantly, these changes occur in a rather complex pattern, wherein for one object there may be an increase in appreciation, for another a decrease, and for yet another no changes may occur at all. As most research in the realm of empirical aesthetics focuses on stable properties or relations between key variables of aesthetic experience, we might be misled to believe that aesthetic phenomena operate in a rather static way. This might be an explanation for the divergence that, on the one hand, we experience strong dynamics in AA in our everyday lives, most prominently when the latest fashion trends are often initially rejected, but are later appreciated after a period of familiarization, while, on the other hand, research continuously reports AA of high reliability e.g., for facial attractiveness with internal consistencies of $\alpha \geq 0.9$ and inter-rater reliability of $\alpha \geq 0.9$ (Carbon, Grüter, Grüter, Weber, & Lueschow, 2010), and re-test reliability within short intervals of $r \geq 0.72$ (Knight & Keith, 2005). A meta analysis (Langlois et al., 2000) revealed inter-rater reliabilities of $r = 0.90$ for adults, $r = 0.85$ for children, $r = 0.88$ for cross-ethnic and $r = 0.94$ for cross-cultural agreement when evaluating the attractiveness of others.

Although the static or initial view on AA is indeed important for many domains, for instance, the attractiveness of a face at first glance or the first impression of a consumer product, it is essential to understand the dynamics behind it to be able to predict future preferences. Considering that humans base important decisions, such as what product to buy, or even: which partner to choose, on AA, cognitive psychology is interested in understanding the underlying cognitive processes triggering such dynamics.

1.1. Measuring aesthetic appreciation (AA)

Research on AA has focused on obtaining insight into associated variables such as attractiveness, beauty, liking, emotional affection,

* Corresponding author. University of Bamberg, Department of General Psychology and Methodology, Markusplatz 3, 96047 Bamberg, Germany. Tel.: +49 951 863 1860; fax: +49 951 601 511.
E-mail address: ccc@experimental-psychology.com (C.-C. Carbon).

0001-6918/$ – see front matter
doi:10.1016/j.actpsy.2010.06.006

interestingness, good–bad, pleasant–unpleasant, boredom and many more (e.g., Carbon & Leder, 2005; Cox & Cox, 2002; Hekkert, Snelders, & van Wieringen, 2003; Leder, Carbon, & Ripsas, 2006). Also the 'affective response' has been measured according to a sample of variables partly in line with the aforementioned ones including liking, arousal, interesting–boring, good–bad, and pleasantness (e.g., Bornstein, Kale, & Cornell, 1990; Redondo, Fraga, Padron, & Pineiro, 2008; Zajonc, Crandall, Kail, & Swap, 1974). What is particularly interesting for the present study is that some researchers did not focus on one key variable only to assess the attitude towards certain stimuli, but instead measured a combination of variables (see for an overview Table 1).

For instance, Zajonc et al. (1974) pointed out that since the publication of the seminal finding of the mere exposure effect (Zajonc, 1968) the "enhancement of attractiveness" (p. 667) has been observed

Table 1
Overview of variables of the construct aesthetic appreciation (AA) as used in related literature implementing more than one scale. This list is not exhaustive, it can only be considered as an excerpt from the literature on measuring the attitude towards objects (RE = repeated exposures: in these studies participants saw the stimulus material more than once before submitting their ratings).

Variable	Actual scale	Operationalisation for	RE	Source
Attractiveness (as well as beauty, and liking)				
	Attractiveness	AA	Yes	Carbon and Leder (2005)
	Attractiveness	AA	Yes	Carbon, Michael, and Leder (2008)
	Unattractive – attractiveness	Aesthetic preferences	Yes	Cox and Cox (2002)
	Attractiveness	AA	No	Leder and Carbon (2005)
	Ugly – beautiful	Aesthetic preference	No	Hekkert, Snelders, and van Wieringen (2003)
	Like – dislike	Attitude	Yes	Bornstein and D'Agostino (1992)
	Like – dislike	Affective response	Yes	Bornstein, Kale, and Cornell (1990)
	Liking	AA	No	Carbon (2010)
	Likable – not likable	Aesthetic preferences	Yes	Cox and Cox (2002)
	Dislike – like	Attitude	Yes	Fang, Singh, and Ahluwalia (2007)
	Liking	AA	No	Leder, Carbon, and Ripsas (2006)
	Like – dislike	Affective response	Yes	Zajonc, Crandall, Kail, and Swap (1974)
Arousal				
	Emotional affection	AA	No	Leder, Carbon, and Ripsas (2006)
	Arousal	Affective response	No	Gomez and Danuser (2004)
	Arousal	Affective response	No	Redondo, Fraga, Padron, and Pineiro (2008)
	Arousal – nonarousal	Affective response	No	Russell and Mehrabian (1977)
Interestingness				
	Interesting – uninteresting	Hedonic value of novelty	Yes	Berlyne (1970)
	Interesting – boring	Affective response	Yes	Bornstein, Kale, and Cornell (1990)
	Interestingness	AA	No	Leder, Carbon, and Ripsas (2006)
	Boring – interesting	Affective response	Yes	Obermiller (1985)
	Interesting – boring	Affective response	Yes	Zajonc, Crandall, Kail, and Swap (1974)
Valence (as well as pleasantness)				
	Bad – good	Aesthetic preferences	Yes	Cox and Cox (2002)
	Good – bad	Affective response	Yes	Brentar, Neuendorf, and Armstrong (1994)
	Bad – good	Attitude	Yes	Fang, Singh, and Ahluwalia (2007)
	Bad – good	Affective response	Yes	Obermiller (1985)
	Good – bad	Affective response	Yes	Zajonc, Crandall, Kail, and Swap (1974)
	Beneficial – harmful	Affective response to novelty	Yes	Zajonc, Crandall, Kail, and Swap (1974)
	Pleasing – displeasing	Hedonic value of novelty	Yes	Berlyne (1970)
	Pleasing – displeasing	Affective response	Yes	Brentar, Neuendorf, and Armstrong (1994)
	Pleasant – unpleasant	Aesthetic preferences	Yes	Cox and Cox (2002)
	Unpleasant – pleasant	Attitude	Yes	Fang, Singh, and Ahluwalia (2007)
	Pleasantness	Affective response	No	Gomez and Danuser (2004)
	Unpleasant – pleasant	Affective response	Yes	Obermiller (1985)
	Pleasantness	Affective response	No	Redondo, Fraga, Padron, and Pineiro (2008)
	Pleasure – displeasure	Affective response	No	Russell and Mehrabian (1977)
Boredom				
	Interesting – boring	Affective response	Yes	Bornstein, Kale, and Cornell (1990)
	Boredom	AA	Yes	Carbon, Michael, and Leder (2008)
	Boring – interesting	Affective response	Yes	Obermiller (1985)
	Interesting – boring	Affective response	Yes	Zajonc, Crandall, Kail, and Swap (1974)
Innovativeness (as well as novelty, originality, and old/new)				
	Imitative – innovative	Subjective novelty	Yes	Brentar, Neuendorf, and Armstrong (1994)
	Innovativeness	Innovativeness	No	Carbon (2010)
	Innovativeness	Innovativeness	Yes	Carbon and Leder (2005)
	Innovativeness	Innovativeness	Yes	Carbon, Michael, and Leder (2008)
	Innovativeness	Innovativeness	No	Leder and Carbon (2005)
	Familiar – novel	Novelty	No	Cox and Cox (2002): Pretest
	Original – unoriginal	Novelty	No	Cox and Cox (2002): Pretest
	Not original – original	Novelty	No	Hekkert, Snelders, and van Wieringen (2003)
	Unusual – common	Novelty	No	Cox and Cox (2002)
	Old – new	Subjective novelty	Yes	Brentar, Neuendorf, and Armstrong (1994)
	Old – new	Recognition	Yes	Bornstein, and D'Agostino (1992)
	New – old	Novelty	No	Cox and Cox (2002): Pretest
	Old – new	Recognition	Yes	Obermiller (1985)

not just by measuring good–bad scales but was also measured using scales such as interesting–boring, beneficial–harmful, good–bad, and like–dislike. Besides the key variable 'attractiveness' research on the enhancement of attractiveness has focused on the variable boredom, since it is seen as a limiting factor for the mere exposure effect (Bornstein et al., 1990). Interestingness, a rather cognitive variable, was identified as an important factor for AA, too. For instance, Zajonc et al. (1974) argued that inanimate stimuli in particular are liked, because they are interesting and Day (1967) showed a complex interplay between interestingness and complexity, both related to preferences for visual objects. Although interestingness and boredom are strongly (inversely) related, interestingness is an activating and engaging characteristic, whereas boredom is not the absence or a low degree of interestingness, but rather a limiting factor for appreciation (Berlyne, 1970). Apparently, boredom is found on a different scale of time perspective. Regarding the dynamics of AA both variables are very promising since interestingness primarily shows short-termed effects while boredom might have a more lasting influence. The variables 'arousal' and 'valence', on the other hand, are important for assessing the affective response (e.g., Russell & Mehrabian, 1977) and were found to be related to preferences, too (e.g., Berlyne, 1970). Furthermore, a number of authors included scales such as innovativeness, novelty, and originality as important variables for AA (e.g., Brentar, Neuendorf, & Armstrong, 1994; Carbon, Michael, & Leder, 2008; Cox & Cox, 2002), since novelty and subjective familiarity are joint predictors for AA (Hekkert et al., 2003).

To summarise, research on AA reflects a multitude of dimensions which add to the whole construct of AA. Consequently, we assessed AA through the following six key variables derived from the literature: attractiveness, arousal, interestingness, valence, boredom and innovativeness (see for details Table 1). This way we were able to obtain a more comprehensive pattern of the AA than in previous studies simply investigating attractiveness (e.g., Carbon & Leder, 2005), which can only be seen as one, though important, aspect of the complex concept of AA (Leder, Belke, Oeberst, & Augustin, 2004). While we refer to these six variables as the (whole) construct of AA within the context of the present paper, we do note that these six concepts can only be seen as a part of the whole semantic network of AA. Therefore, they cannot be assumed to cover every aspect of aesthetic perception.

1.2. Dynamics of aesthetic appreciation (AA)

As mentioned above, aesthetic research mainly focuses on static phenomena. One way to overcome this limitation was Robert Zajonc's "mere exposure" paradigm, where participants were repeatedly exposed to certain stimuli (Zajonc, 1968). Zajonc and colleagues showed that mere exposure to a stimulus enhances the attitude towards it (Zajonc, 1968), especially when stimuli are presented subliminally (Kunst-Wilson & Zajonc, 1980). In a meta analysis Bornstein (1989) revealed that indeed mere exposure works most efficiently when viewers are not aware of having seen the stimuli. Experiments on mere exposure were particularly fruitful in investigating the connection between cognitive and affective evaluations, but rather limited with respect to higher aesthetic processes involving elaboration, understanding or mastering of a given material. For instance, elaborative processes of artworks through specific entitling (Leder et al., 2006) or effects of ambiguity, and the overcoming of such ambiguity, in portraits such as Leonardo's Mona Lisa (Bohrn, Carbon, & Hutzler, 2010) or long-termed cycles of taste (Carbon, 2010), cannot be adequately explained by the mere exposure approach.

Carbon and Leder (2005) developed a paradigm for elaborating material in a controlled way. By forcing participants to evaluate the given material on a variety of variables participants incidentally elaborated the stimuli in a deep way. Using this *Repeated Evaluation Technique* (RET) they identified the design property "innovativeness" as a key variable for triggering dynamics in appreciation for object evaluation (see Table 1) and defined innovativeness as "originality by virtue of introducing new ideas" (p. 587). As innovative products include highly novel object properties, or at least an uncommon combination of known properties (Leder & Carbon, 2005), they often break common visual habits. This characteristic is probably the reason why people are often overwhelmed by highly innovative product designs or pieces of art. Without any further familiarization with such material, this often leads to rejection or avoidance of such objects. Moulson and Sproles (2000, p. 47) explicitly speak of a consumer's "inherent conservatism" toward new styles. Most importantly, the appreciation process does not necessarily stop at this stage. Dealing with innovative products is accompanied by modifications of the processing systems for these product representations and leads to the integration of these new experiences into the perceptual system. At the same time, as the object representations are modified, associative areas of the neural network of perception will register these configurations and will in turn be modified (Versace, Labeye, Badard, & Rose, 2009). Since networks of visual object perception and emotional neuronal networks are closely linked (Pessoa, 2008), this might lead to the aforementioned multidimensional dynamics of AA for innovations in everyday life.

The RET typically consists of three test phases, an initial test phase (T1) where participants are asked to rate the attractiveness of/ liking of/ preference for the material, the repeated evaluation phase (RET phase) where participants have to evaluate the material on a variety of dimensions (e.g., comfortable or stylish) and a final test phase (T2) where the ratings of T1 are repeated. Due to the active elaboration, RET stands in contrast to Zajonc's (1968) mere exposure approach, where participants are exposed to the material in a rather passive way. Bornstein (1989, Table 1) already noted that mere exposure was rather ineffective when highly complex patterns such as paintings, drawings or matrices were used as stimulus material. One explanation for this is based on the finding that more complex material requires active processing which should be linked to deeper processing according to the "levels of processing" theory (see Craik, 2002; Craik & Lockhart, 1972). In everyday life we indeed experience novel material, for instance, new consumer products or unfamiliar works of art, by testing, using, considering or discussing it—a behaviour which the active elaboration approach of RET aims to simulate in a controlled way. Indeed, by using RET we could demonstrate typical dynamics of AA (Leder & Carbon, 2005) known to take place in real contexts: highly innovative material is often initially rejected and later appreciated, while low innovative, highly familiar material is perceived as boring over time, with the result of being finally rejected. These basic patterns were supported by Carbon and colleagues who investigated eye movements (Carbon, Hutzler, & Minge, 2006) and pupillometry (dilatation of the pupil) (Carbon et al., 2006) and observed changes in electrodermal activity (Carbon et al., 2008) while inspecting the material.

1.3. The impact of semantic concept activation

Until now, the question which remains unanswered is what underlying mechanisms trigger such dynamics of AA. According to the spreading-activation theory of semantic networks one could argue that the specific initial phase (T1) of a typical RET experiment, assessing attractiveness and innovativeness—itself—had an impact on the following repeated elaborations of the stimuli and thus on the dynamics of AA (cf. Collins & Loftus, 1975). In this respect the activation or priming of these nodes or concepts (attractiveness and innovation) would have prepared further elaborations, since activation of a node spreads out along the path of the (semantic) network. During further processing of the target material the networks of the concepts attractiveness and innovativeness might still have been activated and the later processing of the stimuli could therefore have been influenced by these activations. Aside from this automatic spreading of activations, Chwilla, Hagoort, and Brown (1998) described additional mechanisms concerning semantic priming, among them expectations that participants generate. For instance, participants might form expectations after the ratings of attractiveness and innovativeness for the associated topics and therefore further elaborations of the stimulus material will be primed to these two concepts.

According to this rationale, the initial evaluations of the stimulus material on attractiveness and innovativeness led to priming activations of these concepts which had a determining influence on the subsequent final ratings. As attractiveness is a key variable of AA, we were interested in the impact of the primed semantic concept of attractiveness. The priming of this concept could further lead participants' thoughts, expectations and attention to AA itself. This would keep emotional as well as cognitive networks active during the RET phase and could particularly trigger dynamics of AA. As mentioned above, we know that innovativeness is an influential variable concerning AA and is closely linked to novelty, familiarity and typicality, which was identified as a predictive variable for AA (see also Hekkert et al., 2003). Activating the network of processing innovativeness could lead to awareness of innovative/novel features within the used stimuli and facilitate the integration of novel features into the processing system of these objects. Furthermore, we hypothesised that a combination of concepts such as that of the construct AA (attractiveness, arousal, interestingness, valence, boredom, and innovativeness) could have an even greater impact on the further aesthetic processing than the activation of just one singular concept. Therefore, we assumed that the semantic network of AA integrates different concepts such as attractiveness, arousal, interestingness, valence, boredom, and innovativeness and that priming parts of this network could impact the dynamics of AA. Within this framework we varied the quality and the quantity of the primed parts of the semantic network of AA. Note: Here, we only aim to determine whether there is a difference between qualities, without specifying these qualities in the semantic network of AA. To our knowledge no other study has investigated the impact of priming semantic concepts on the dynamics of AA in a systematic way.

1.4. The present study

In the present study we focused on the influence of primed semantic concepts on the development of dynamics of AA. We hypothesised that depending on the specific primed concepts different degrees of dynamics of AA arise. To ensure the possibility of such dynamics to emerge, we used carefully manipulated material differing in the degree of innovativeness, a variable known to evoke such dynamics (Carbon & Leder, 2005). We used car interiors as stimulus material for two reasons: (1) they are highly complex visual stimuli which can be plausibly varied on the dimension of "innovativeness", (2) they can be plausibly manipulated on a variety of further design properties in a systematic way: while we were mainly interested in manipulating the stimuli on the dimension innovativeness, we controlled the degree of properties known to influence AA such as complexity (Berlyne, 1970) or curvature (Bar & Neta, 2006; Carbon, 2010). Previous studies (Carbon & Talker, 2006) with the currently used stimulus material indeed revealed clear dynamics as in former experiments using the Repeated Evaluation Technique (RET), namely, an increase in attractiveness for highly innovative car interiors, but a decrease in attractiveness for low innovative car interiors over time.

Our experiments were structured in two phases: (1) the pre-processing phase (priming of the semantic concept and RET phase) and (2) the (final) test phase (rating of the construct AA). Fig. 1 gives an overview of the experimental designs of the whole series of the performed experiments. Altogether, we carried out six experiments varying the priming of semantic concepts before the stimulus material was elaborated with the RET to assess the impact of these activations on the development of the dynamics of AA, which we collected in the final test phase.

To systematically investigate the possible impact of a primed semantic concept we started the experimental series with a procedure where no semantic concept was implemented (Experiment 1). In the second experiment we used the semantic concept "attractiveness", in the third experiment the semantic concept "innovativeness" and in the fourth experiment the above mentioned most complex construct of AA including all six concepts related to AA. Since due to the ratings of six concepts in the fourth experiment the whole pre-processing phase in this experiment inherently provided more opportunities for elaborating the material, a fifth experiment was carried out as a control experiment to investigate whether effects regarding the findings of Experiment 4 were due to a mere longer processing stage of the stimulus material or due to specific priming of semantic concepts. In Experiment 5 again no specific semantic concepts were enforced, although more scales in the RET phase were used to equate the length of the pre-processing phase with Experiment 4. Furthermore, to assess the contribution of the RET to

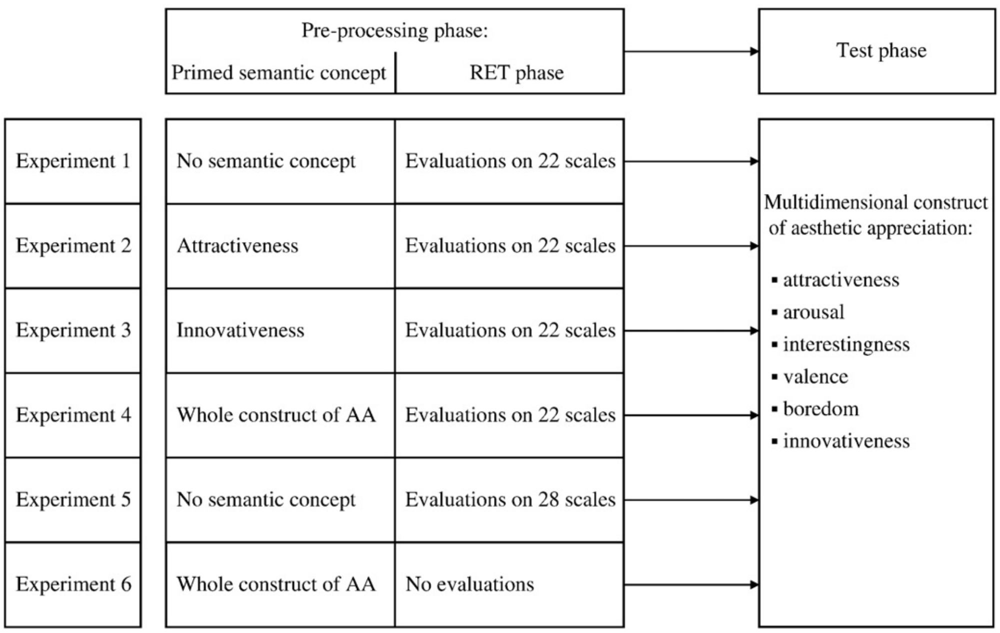

Fig. 1. Experimental designs of the series of six experiments. All experiments consisted of a pre-processing phase and a test phase. The pre-processing phase comprised the specific priming of a varying semantic concept (except for Experiments 1 and 5 where this activation did not occur) and the elaboration of the stimulus material by employing the Repeated Evaluation Technique (RET; exept for Experiment 6 where the RET was not used) (Carbon & Leder, 2005). The semantic concept activation occurred through asking the participants to rate the stimulus material on the specific attribute, for example, in Experiment 2 participants rated the stimuli on attractiveness. The test phase included the ratings of the construct aesthetic appreciation (AA; containing the variables *attractiveness*, *arousal*, *interestingness*, *valence*, *boredom* and *innovativeness*).

Table 2
Description of participants per experiment: total number of participants, number of females, number of males, as well as mean (*M*) and standard deviation (*SD*) of age. For sample information of the base rates see Experiment 6 (as the same sample was used for the base rates and Exp. 6).

	Participants			Age	
	Total	Female	Male	*M*	*SD*
Exp.1	24	21	3	22.8	3.9
Exp.2	24	19	5	22.3	3.3
Exp.3	24	21	3	21.8	4.2
Exp.4	24	19	5	22.4	4.7
Exp.5	24	22	2	20.9	2.1
Exp.6	24	20	4	22.1	2.4
Total	144	122	22	22.1	3.5

the results of priming the whole construct of AA in Experiment 4, we implemented a further control experiment (Experiment 6). Here, we used the same design as in Experiment 4 (priming the whole construct of AA), but omitted the entire RET phase, so that the priming was followed immediately by the test phase.

In the context of this paper, we operationalise AA as the attitude towards an object, which is characterised by an integrative nature of AA-relevant affective and cognitive components. As described in detail above, we measure this construct through six variables: attractiveness, arousal, interestingness, valence, boredom, and innovativeness. The dynamics of AA are operationalised by interactions between time and innovativeness as proposed by Carbon and Leder (2005).

2. Method of Experiments 1–6

2.1. Participants

A total of 144 undergraduate students participated for course credit. This sample consisted of 122 women and 22 men with a mean age of 22.1 years ($SD = 3.5$) (for detailed information on the individual experiments see Table 2). All of them had normal or corrected-to-normal vision assured by the standard Snellen Eye test. None of the participants took part in more than one of the reported experiments.

2.2. Apparatus and stimuli

The stimulus material consisted of 18 photo-realistic images of artificial car interiors (see Fig. 2 for exemplary stimuli) with a size of 800×513 pixels presented on a 17-inch Apple eMac CRT monitor with a resolution of 1024×768 pixels. The stimuli, generated with Adobe Photoshop 7.0, varied on two levels of innovativeness (low, high) and were carefully controlled for further design properties known to affect AA, complexity and curvature. For both levels of innovativeness we systematically varied fully crossed complexity and curvature on 3×3 levels (low, medium, high) (for a detailed description of these dimensions see Carbon & Leder, 2005; Leder & Carbon, 2005). Several previous studies were used to ensure equal degrees of complexity and curvature for both levels of innovativeness using 7-point Likert scales (Carbon & Talker, 2006).

2.3. Procedure

The experiments consisted of two phases: the pre-processing phase and the test phase. While the test phase was exactly the same in all experiments, the pre-processing phase varied across the experiments (see Fig. 1 for a graphic overview of the experimental designs).

2.3.1. Pre-processing phase

The pre-processing phase consisted of two parts: the priming of the semantic concept and the RET phase. We implemented the priming of the specific concept(s) by asking the participants to rate the stimuli in terms of the respective specific concept(s) (e.g., attractiveness) on a 7-point Likert scale (1 = "least significant", 7 = "most significant"). The 18

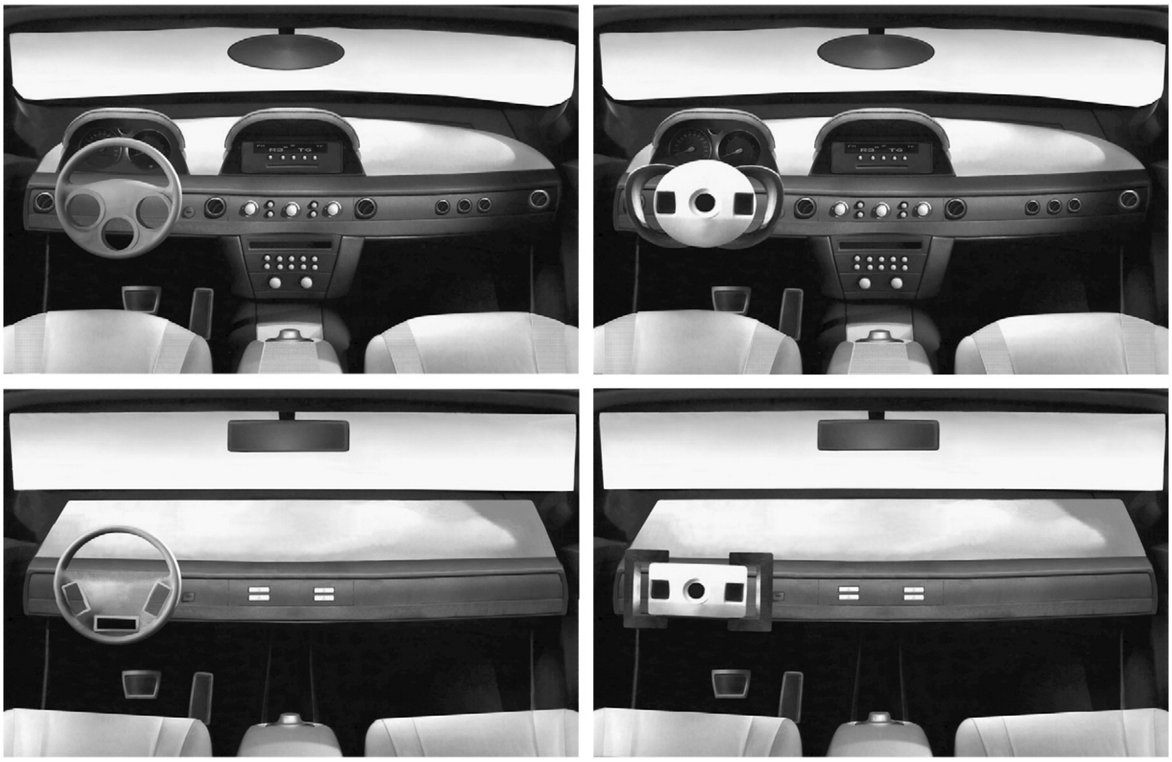

Fig. 2. Examples of the stimulus material, given here by typical low (left) versus highly innovative (right) designs where the levels of curvature and complexity were both fixed to a high degree (above) and a low degree (below), respectively. The stimulus material varied systematically regarding innovativeness, curvature and complexity by alternating elements of the car interiors such as steering wheel, mirrors, dashboard, switches, fresh air nozzles, middle console and seats.

stimuli were presented one after the other on the screen in randomised order for 2.6 s and rated one after the other by pushing buttons 1–7.

In the RET phase participants rated the stimuli on different scales. These scales met two requirements: (1) they asked for low emotionality and low arousal,[1] thus assessing rather cognitive attributes; (2) none of them were identical with one of the variables included in the construct of AA used here (attractiveness, arousal, interestingness, valence, boredom and innovativeness). We used attributes which rely on shape and form features of the designs and should therefore facilitate the integration of specific design features into the perceptual system through activating the object-selective cortex (Op de Beeck, Torfs, & Wagemans, 2008). The attributes we used were: rectangular (*rechteckig*), oblong (*länglich*), oval (*oval*), continuous (*ebenmäßig*), factual (*sachlich*), uniform (*gleichförmig*), homogenous (*homogen*), anonymous (*anonym*), sober (*nüchtern*), schematic (*schematisch*), angled (*winklig*), minimalist (*schlicht*), concrete (*konkret*), solid (*solide*), regular (*regelmäßig*), formal (*förmlich*), rounded (*abgerundet*), compact (*kompakt*), neat (*ordentlich*), conventional (*konventionell*), classic (*klassisch*) and restrained (*dezent*). The six additional attributes of Experiment 5 were: straight (*geradlinig*), simple (*einfach*), systematic (*systematisch*), purposeful (*zweckmäßig*), precise (*präzise*), and well-arranged (*übersichtlich*). The order of the scales was randomised for each participant. For each scale, all 18 stimuli were presented one after the other for 2.6 s in a randomised order and thereby rated on a 7-point Likert scale (1 = "least significant", 7 = "most significant").

In Experiment 1 the pre-processing phase consisted of only the RET phase and no priming was implemented. In Experiment 2 the concept attractiveness was primed. Thus, the pre-processing phase consisted of 23 scales including attractiveness which was presented as the first scale followed by the 22 randomised scales used in Experiment 1. Experiment 3 was identical with Experiment 2, but the concept innovativeness served as a prime. In Experiment 4 we implemented a more extensive semantic concept including the whole construct of AA. Thus, participants first rated the stimuli according to the scales attractiveness, arousal, interestingness, valence, boredom and innovativeness in a fixed order (semantic concept(s) activation) followed by the randomised order of the 22 RET scales. Also, to reduce anchor effects, in this experiment as well as in Experiments 5 and 6 the participants previewed the stimuli (without rating) by simultaneously viewing one half of the items on the screen for 6 s followed by the other half of the items for another 6 s. The positions of the stimuli for the preview phase were pseudo-randomised and held constant for all participants. After that the pre-processing phase and the test phase followed. No concept was primed in Experiment 5, however we implemented a prolonged RET phase with 28 scales (see above). Finally, in Experiment 6, as in Experiment 4, the whole construct of AA served as a prime but we did not apply the RET to rule out the explanation that dynamic effects in Experiment 4 were solely based on the extensively primed concept of AA.

2.3.2. Test phase

The test phase followed immediately after the pre-processing phase. Participants rated all stimuli one after the other in randomised order for each variable of the AA variables presented in the following order: *attractiveness* (*attraktiv*), *arousal* (*anregend*), *interestingness* (*interessant*), *valence* (*positiv*), *boredom* (*langweilig*) and *innovativeness* (*innovativ*). All variables were assessed on 7-point Likert scales (1 = "least significant", 7 = "most significant"). The presentation duration was again fixed at 2.6 s. The next stimulus appeared automatically after the participant had submitted his/her rating. Participants were instructed to respond to the respective question as spontaneously as possible. Trials for each rating block were fully randomised. All experiments were presented by PsyScope 1.25 PPC (Cohen, Macwhinney, Flatt, & Provost, 1993). All participants were tested individually.

2.4. Base rates

In Experiments 1–6 we tested the construct aesthetic appreciation (AA) after the pre-processing phase. To investigate whether dynamics in AA occurred we compared each experiment with base rates of the stimulus material. We collected base rates from the priming phase of Experiment 6. Accordingly, the sample was the same as in Experiment 6. The stimulus material and apparatus were the same as in all experiments. The procedure for collecting the ratings of the AA variables was the same as in the test phase of the experiments. Also, to reduce anchor effects, the participants previewed the stimuli as described above. The participants were tested individually. Results of the descriptive analysis are presented in Fig. 3.

2.5. Test of dynamics of aesthetic appreciation

In order to test the hypotheses describing effects of the different semantic concept primes, we concentrated on changes in the ratings for both levels of innovativeness. To investigate whether dynamics in AA occurred we compared the ratings of each experiment with the base rates. We first averaged data over complexity and curvature levels resulting in means of the two levels of innovativeness per variable and per subject. We then conducted a mixed-design analysis of variance (ANOVA) with innovation (low, and highly) as within-subject factor, time (T1: from the base rates; T2: from the final test phase of a given experiment) as between-subject factor, and the ratings as dependent variable. Such an ANOVA was calculated for each experiment and for each variable separately. The subjects needed for collecting the base rates and the ones who participated in Experiment 6 were the same. Nonetheless, we also conducted a mixed-design ANOVA with time as between-subject factor instead of a within-subject factor for Experiment 6 to ensure comparability of statistics across all experiments.

2.6. Boredom scale

The scale of the variable *boredom* was reversed for all analyses and illustrations in all figures, since this was the only scale that was negatively correlated with appreciation.

3. Results and discussion of Experiments 1–6

3.1. Reliability of the construct aesthetic appreciation (AA)

We tested the implemented construct of AA for its reliability using data of the base rates. Inter-rater reliability was assessed separately for each variable using calculations of Cronbach's alpha. Reliability was very high for all variables (*attractiveness*: $\alpha = 0.956$; *arousal*: $\alpha = 0.956$; *interestingness*: $\alpha = 0.944$; *valence*: $\alpha = 0.952$; *boredom*: $\alpha = 0.956$; *innovativeness*: $\alpha = 0.954$) indicating high internal consistency.

3.2. Results and discussion

In the following we will first conduct descriptive analyses of the test phases for every single experiment, which are presented in Fig. 3.

[1] In the RET phase of the original paper, where the RET concept was introduced (Carbon & Leder, 2005), participants elaborated the target material on multiple scales including attributes such as futuristic ("futuristisch") and conservative ("konservativ"). The ratings of the stimuli regarding these attributes might themselves activate networks closely related to innovativeness that we introduced in Experiment 3 as a semantic concept. To rule out such confounding activations in the RET phase and to increase the control over the impacts of the specific semantic concepts, we selected attributes for the RET phase from a pre-study with scales referring to adjectives of neutral valence, low arousal (strength of emotion) and low subjectivity (the degree to which ratings would differ between subjects: highly subjective, e.g., "fascinating"; low subjective, e.g., "rectangular"). The selected scales consisted of rather "cognitive" attributes mostly concerning aspects such as form and shape of the designs. We are indebted to Dave Perrett for providing this idea in a discussion at the ECVP 2005 in La Coruña.

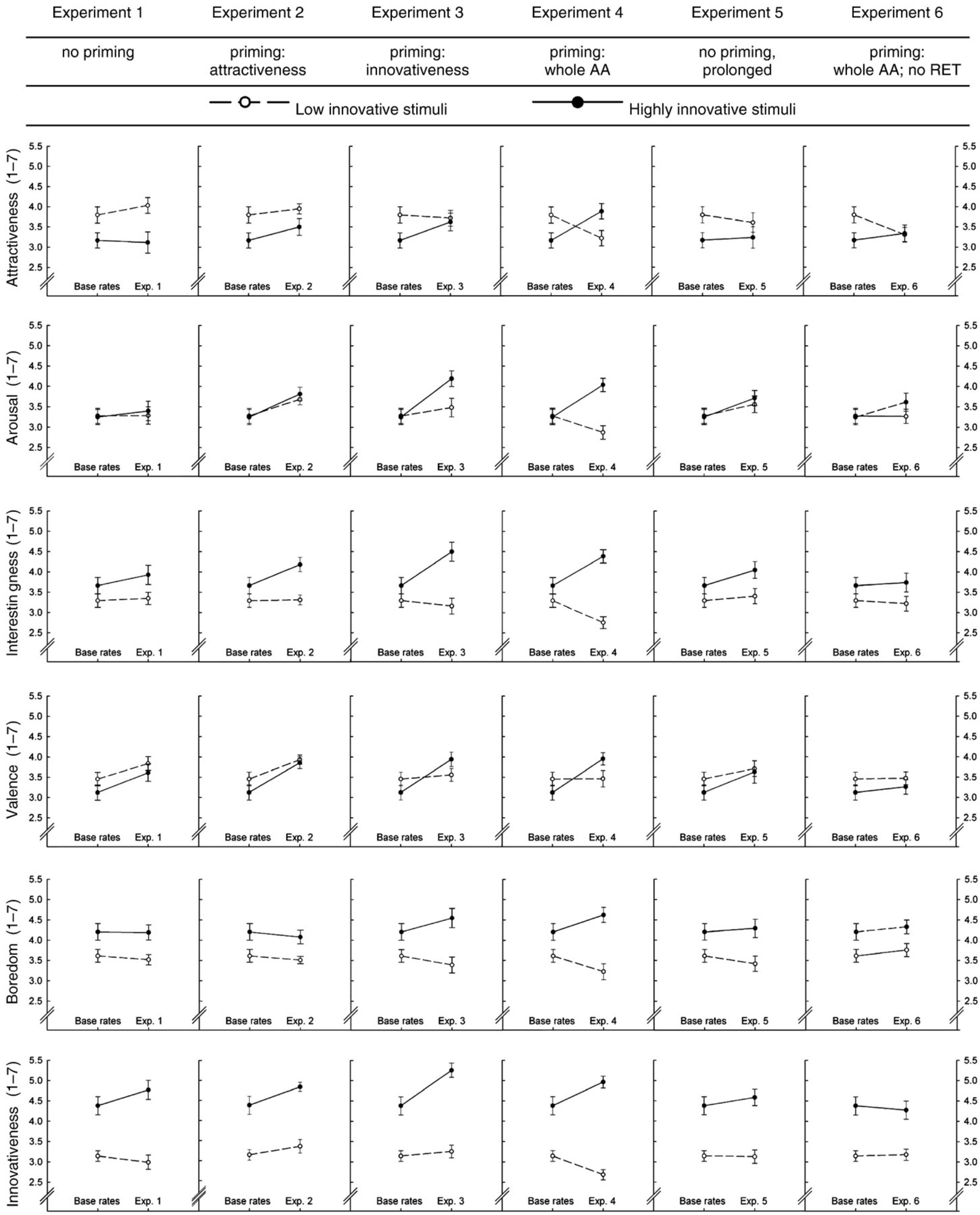

Fig. 3. Comparisons of Experiment 1 (first column from left), 2 (second column from left), 3 (third column from left), 4 (fourth column from left), 5 (fifth column from left) and 6 (sixth column from left) with the base rates: The different AA variables (*attractiveness*, *arousal*, *interestingness*, *valence*, *boredom* and *innovativeness*) are displayed per rows. For each variable and each comparison with the base rates the interaction between time and innovativeness is indicated by mean and standard error of the mean. *) for reasons of better readability, the scale boredom was inverted to be concordant with the other scales.

Table 3
Test of dynamics of aesthetic appreciation: Comparative analyses of base rates and experiments 1–6 for all variables (VAR): attractiveness (ATT), arousal (ARO), interestingness (INT), valence (VAL), boredom (BOR) and innovativeness (INN). Effects (EFF) for Innovativeness (I) as well as the interactions between innovativeness and time (T1 = base rate; T2 = regarding experiment ; I×T) are indicated. Significant interactions between I and T are in bold. Degrees of freedom for all *F*-tests are 1/46. For a more detailed description, see Section 2.5. *Test of dynamics of aesthetic appreciation*.

VAR	EFF	Base vs. Exp.1 (no priming)				Base vs. Exp.2 (priming: attractiveness)				Base vs. Exp.3 (priming: innovativeness)				Base vs. Exp.4 (priming: whole AA)				Base vs. Exp.5 (control exp. for Exp. 4)				Base vs. Exp.6 (control exp. for Exp. 4)			
		df	*F*	η_p^2	*p*	*df*	*F*	η_p^2	*p*	*df*	*F*	η_p^2	*p*	*df*	*F*	η_p^2	*p*	*df*	*F*	η_p^2	*p*	*df*	*F*	η_p^2	*p*
ATT	I	1	15.1	0.25	0.001	1	11.2	0.20	0.002	1	4.4	0.09	0.041	1	<1	0.01	0.919	1	5.7	0.11	0.022	1	3.7	0.07	0.061
	I×T	1	<1	0.01	0.474	1	<1	0.01	0.578	1	2.5	0.05	0.125	**1**	**12.8**	**0.22**	**0.001**	1	<1	0.01	0.541	**1**	**4.5**	**0.09**	**0.039**
ARO	I	1	<1	0.01	0.801	1	<1	0.01	0.749	1	3.3	0.07	0.074	1	11.4	0.20	0.002	1	<1	0.01	0.747	1	<1	0.02	0.352
	I×T	1	<1	0.01	0.674	1	<1	0.01	0.621	1	3.9	0.08	0.054	**1**	**12.5**	**0.21**	**0.001**	1	<1	0.01	0.642	1	1.2	0.03	0.275
INT	I	1	8.4	0.16	0.006	1	15.9	0.26	0.001	1	21.3	0.32	0.001	1	40.0	0.47	0.001	1	8.2	0.15	0.006	1	6.6	0.13	0.014
	I×T	1	<1	0.01	0.527	1	2.6	0.05	0.115	**1**	**6.8**	**0.13**	**0.012**	**1**	**15.9**	**0.26**	**0.001**	1	<1	0.01	0.444	1	<1	0.01	0.672
VAL	I	1	2.4	0.05	0.125	1	1.8	0.04	0.189	1	<1	0.01	0.888	1	<1	0.01	0.617	1	<1	0.02	0.381	1	3.2	0.07	0.081
	I×T	1	<1	0.01	0.768	1	<1	0.02	0.401	1	4.0	0.08	0.052	**1**	**6.9**	**0.13**	**0.011**	1	<1	0.01	0.588	1	<1	0.01	0.696
BOR	I	1	16.9	0.27	0.001	1	13.6	0.23	0.001	1	19.7	0.30	0.001	1	33.6	0.42	0.001	1	11.3	0.20	0.002	1	15.4	0.25	0.001
	I×T	1	<1	0.01	0.799	1	<1	0.01	0.942	1	2.1	0.04	0.159	**1**	**5.5**	**0.11**	**0.023**	1	<1	0.01	0.521	1	<1	0.01	0.951
INN	I	1	76.9	0.63	0.001	1	89.2	0.66	0.001	1	94.1	0.67	0.001	1	142.8	0.76	0.001	1	92.2	0.67	0.001	1	48.6	0.51	0.001
	I×T	1	2.5	0.05	0.122	1	<1	0.02	0.398	**1**	**5.3**	**0.10**	**0.026**	**1**	**12.6**	**0.22**	**0.001**	1	<1	0.01	0.432	1	<1	0.01	0.680

After that we will compare every experiment with the base rates (see method section of Experiment 1, *Test of dynamics of aesthetic appreciation*) to test the occurrences of dynamics of AA. All effects of and interactions with innovativeness are reported in Table 3 (Experiments 1–6). The interaction between time and innovativeness indicates whether changes over time for low and/or highly innovative stimuli, thus dynamics of AA, occurred. Therefore, to increase the readability and to focus on the hypotheses concerning the dynamics of AA, we will only discuss in the following any interactive effects of time and innovativeness for every dependent AA variable. We will not report further possible main effects of the between-subject factor time, since they are not part of our specific research question in this study and no specific hypotheses are stated concerning these effects. The detailed statistics of all the following analyses are presented in Table 3.

The analyses between the base rates and Experiment 1 revealed no significant interaction for time and innovativeness for *attractiveness*, *arousal*, *interestingness*, *valence*, *boredom* and *innovativeness*. We could not detect any difference in aesthetic appreciation after a pre-processing phase consisting of only the RET phase in comparison with the base rates (Fig. 3 (first column from left). When Experiment 2 was compared with the base rates again no interaction was significant for any AA variables. Thus, priming the semantic concept attractiveness had no significant effect on the development of dynamics in AA either (Fig. 3, second column from left). In Experiment 3 we found significant interactions for time and innovativeness for the variables *interestingness* and *innovativeness* as well as trends for *arousal* and *valence*. No other interaction was significant. So, the priming of the concept innovativeness in the pre-processing phase resulted in dynamics in two of the six AA variables (Fig. 3, third column from the left). After priming the whole construct of AA dynamics (Experiment 4) we found dynamics in all AA variables (Fig. 3, fourth column from the left). Conversely, we found no dynamics of AA after a prolonged RET phase when no concept was primed (Experiment 5; Fig. 3, fifth column from the left). Priming the whole construct of AA (Experiment 6), however, without including an RET phase produced dynamic changes for low and highly innovative material in *attractiveness* (Fig. 3, sixth column from the left).

In sum, we observed no dynamics in Experiments 1, 2, and 5, but we found dynamics in *attractiveness* in Experiment 6 and dynamics in *interestingness* and *innovativeness* as well as trends for *arousal* and *valence* in Experiment 3. Most importantly, we obtained significant dynamics of the whole AA construct in Experiment 4. This indicates that no dynamics of AA were observed when no concept was primed—even with the prolonged RET phase in Experiment 5. Regarding the quality of the primed concept we received different results: while we found *no* dynamics, indicated by non-existing interactions for time and innovativeness, when attractiveness was primed as the only concept, we *did* observe dynamics for interestingness and innovativeness after priming the concept innovativeness. This indicates that the quality of the primed concepts was important to trigger dynamics of AA. The most extensive dynamics of AA occurred after increasing the quantity of the primed semantic network when the whole construct of AA variables was primed and the RET procedure was implemented. As a result, significant interactions between time and innovativeness were obtained for all variables of AA and, thus, Experiment 4 demonstrated the strongest dynamics in AA. It should be noted that this effect was not due to the longer pre-processing phase, since we did not find any dynamics in Experiment 5 which was created as a control experiment with the same length of the pre-processing phase as in Experiment 4. Neither was it the impact of priming the AA concept(s) alone, because we received less dynamics in Experiment 6 (only in *attractiveness)* with a pre-processing phase consisting only of priming the whole construct of AA, without an RET phase. Therefore, results showed an effect of priming as well as an effect of the RET on the dynamics of AA.

4. General discussion

We investigated the impact of priming semantic concepts related to aesthetic appreciation (AA) in combination with elaborations of the stimulus material (via RET) on the dynamics of AA. We measured AA as a multidimensional construct derived from the literature through *attractiveness*, *arousal*, *interestingness*, *valence*, *boredom* and *innovativeness* (see Table 1) and demonstrated high internal consistency of the multidimensional construct of AA using base rates collected from 24 subjects (initial testing). Possibilities of developing dynamics of AA were realised by using car interior stimuli that varied in the dimension “innovativeness”, which is a key dimension identified for triggering dynamics of appreciation. Thereby, an interaction between time and innovativeness indicated whether dynamics of AA occurred. Our hypothesis that priming of semantic concepts related to AA impacts further processing, thereby triggering the dynamics of AA, was strongly confirmed, since dynamics only occurred when priming of semantic concepts related to AA was implemented. Clear dynamics occurred after having primed the concept innovativeness (Experiment 3) and even stronger dynamics were revealed after having primed the whole construct of AA (Experiment 4). Also we observed weak dynamics, only for attractiveness (Experiment 6) when the whole construct of AA was primed but no RET was conducted. Most importantly, we could show differential impacts of the quality and the quantity of the primed semantic concepts. Concerning the quality, when only one single concept related to AA was primed (Exp. 2: attractiveness; Exp. 3: innovativeness) only the concept innovativeness triggered dynamics of AA. Testing the quantity we observed the strongest dynamics in Experiment 4 with the most extensive semantic concept(s) primed including the multidimensional construct of AA.

Concerning the priming of semantic concepts one could argue that it is very important that parts of the semantic networks which are involved in the aesthetic processing are activated during processing to trigger strong dynamics of AA. This conclusion was indeed supported by the comparison between Experiments 4 and 5. With exactly the same number of scales assessed within the pre-processing phase strong dynamics only developed when the complex semantic concept of AA in Experiment 4 was activated. Elaboration of the stimulus material exclusively on the basis of rather cognitive design features such as those concerning form and shape might prevent deeper aesthetic processing. In contrast, after priming semantic concepts strongly (and specifically) related to AA, participants probably had associations and expectations in the direction of the activated semantic networks during further processing, which facilitated dynamics of AA.

We found that the primed semantic concept of innovativeness had a greater impact on the development of the dynamics than that of attractiveness and thus, that the quality of the network is essential. Although both concepts seemed to be promising semantic concepts for triggering further aesthetic processing, innovativeness might be more important for producing dynamics of AA, especially with the stimuli employed. The activation of this semantic concept fosters the awareness of this characteristic in the stimulus material and also promotes the integration of that specific dimension including novel, innovative, and unusual features in the designs. This could lead to an update of object representations which may influence the aesthetic appreciation of the stimulus material. The most successful semantic concept in triggering dynamics of AA combined several concepts related to AA, among others, the concepts attractiveness and innovativeness (Experiment 4). This might indicate that the quantity, thus the extension, of the implemented semantic network had a specific impact, revealed by broader and stronger dynamics than either in Experiment 2 or 3. It could alternatively be interpreted as a qualitative change, too. Only the specific combination of these scales related to AA could generate such pronounced dynamics as observed in Experiment 4. Moreover, these effects were not due to differences in the mere length of the pre-processing phase, nor can they be solely attributed to priming since we found less strong dynamics in Experiment 6. According to Collins and Loftus (1975), this indicates that the spreading activations of the construct AA had further influence on the processing, elaboration and, not to forget, the *appreciation* of the stimuli. This in turn indicates possible expectancies of the participants in the direction of the processing of specific aesthetic dimensions when evaluating the stimuli during the Repeated Evaluation Technique (RET; Carbon & Leder, 2005) phase. As the semantic networks for elaborating the stimulus material regarding cognitive design features such as form and shape, assessed in the RET phase, are connected to those of the processing of AA, a reactivation of the AA-related processing network during the RET phase is also possible. In this sense a possible explanation is that associated networks such as that for emotional processing registered modifications of the processing system (e.g., object representations) during the RET phase (Versace et al., 2009) and thus, that the networks for processing AA (which probably includes parts of the emotional processing network) were modified indirectly. These associated networks required, at least partly, a pre-activation, since we observed clearly reduced, in fact statistically insignificant, dynamics in Experiments 1 and 5, where such priming was not employed.

In sum, our results reflect the plasticity of perception and appreciation. In line with Versace et al.'s (2009) concept of a multimodal, dynamic, functional and situational concept of memory, our appreciation apparatus seems to be constantly modified and adapted to newly processed stimuli, and thus new experiences. Most importantly, we showed that priming AA-related concepts influenced the AA over time. In line with many studies reported in the priming literature, we showed further evidence that priming affected the re-assessment of given stimuli or, in our case, the aesthetic processing (Experiment 6). But even more interestingly, we found that priming specific concepts had an impact on further processing of the stimuli, thus the following elaborations of the material via RET, which lasted about half an hour, and therefore directly influenced the development of AA over time (Experiments 3 and 4). This could lead to the interpretation that priming affected the reorganization or adaptation of the perceptual system.

However, further research is necessary to define the semantic network of AA in more detail. Also, it would facilitate the interpretation of priming effects if distances between concepts of the semantic network of AA were known. For example, up to now it is unclear why priming innovativeness led to dynamics in the variables innovativeness and interestingness as well as trends in arousal and valence. Varying distances between the concepts used in our study could account for differences in the development of the dynamics. Furthermore, a more detailed knowledge of the semantic network of AA could explain why we found changes due to the priming of innovativeness but not attractiveness.

We did not observe dynamics of AA in Experiments 1 and 5, in which the pre-processing phase *only* consisted of the RET phase, contrary to previous studies also using the RET (Carbon & Leder, 2005). There are two major differences between both approaches: (1) in Carbon and Leder's study participants were asked to rate the stimulus material regarding attractiveness and innovativeness before the RET, which could be interpreted as a priming on two specific semantic networks. (2) In the present series of experiments we purposely used attributes in the RET phase, which were related to rather superficial and shallow aspects of the designs (for more detail on scale qualities see also footnote 1); the original study of Carbon and Leder (2005), however, used a combination of elaborative, cognitive and emotional scales within the RET phase. The authors introduced the RET to simulate everyday life experiences with objects such as consumer products or works of art, which are able to evoke aesthetic experiences. The usage of a variety of scales in the initial study had the disadvantage of losing control of which semantic concepts are specifically primed and which dimensions of cognitive processing are particularly triggered. In the present study, we explicitly used scales related to AA only in a priming phase and excluded all aesthetically relevant scales from the RET phase to be able to minimise confounding factors of priming of aesthetically relevant processing. However, even with the scales used in the present study we found an impact of the RET procedure since we observed clearly reduced dynamics in Experiment 6 (no RET phase) compared to Experiment 4 (with RET phase).

Another critical point for our study concerns the generalization of our findings to other object classes. We used car interiors in this study since we can control a series of aesthetically relevant factors rather easily. It is questionable whether strong dynamics in AA can also be observed with natural material such as faces or nature scenes. Here, more biologically driven programs for assessing the aesthetic value might be at work. It would also be interesting to look at the duration of the dynamics which we obtained in the current study. We know from the face literature that adaptation effects can be quite sustained lasting up to days and weeks (Carbon & Ditye, in press), but we also have indications from artificial objects such as car exteriors that dynamics of aesthetic appreciation do occur over periods of several years and decades (Carbon, 2010). Systematic research seems promising to reveal not only the ingredients for dynamics in AA but also their limits and scopes.

It is obvious that the revealed dynamics of AA modulated by the specific usage of priming of semantic networks are not only relevant for cognitive basic research, but offer insight for applied research, too. In the field of market research as well as for the consumer product industry our results highlight the importance of developing tests for the appreciation of new products, which involve deep processing of the material. Simple consumer tests with only one presentation of the products which do not give consumers the chance to really understand these products and integrate them into their visual habits seem inadequate. A more dynamic view regarding this key problem of consumer research plus a clear strategy which encourages consumers to engage with the products seems mandatory. One possibility to assess such changes experimentally is to use the Repeated Evaluation Technique (RET) in combination with systematic priming of semantic networks beforehand. This enables intense elaboration of the target material and could lead to deeper insights into what kind of novel features frustrate or overwhelm consumers. As pointed out by Fournier, Dobscha, and Mick (1998) this could help to predict which design innovations will eventually be appreciated, and which products will ultimately be bought.

In our present research we demonstrated the importance of the activation of semantic networks linked to AA for further aesthetic processing of stimuli. We observed differential influences on these dynamics due to the quality and the quantity of the primed semantic networks. It is now important to get further insights into additional variables modulating aesthetic appreciation. The variables in question should focus more on the processing of the stimuli versus the mere properties of the stimuli themselves. Of particular interest of future aesthetic research will be the dynamics underlying these variables to solve questions we never cease to wonder about: what will we like in the future?

Acknowledgments

This research was supported by a grant to HL and CCC from the FWF "Fonds zur Förderung der wissenschaftlichen Forschung" (National Austrian Scientific Fund; P18910). We thank Christine Talker for developing the stimuli and Michael Forster, Bianca Reinisch and Ellina Fink for conducting parts of the experiments as well as Andrea Lyman and Géza Harsányi for proofreading. Last but not the least, we wish to thank Tom Beckers, Johan Wagemans and two anonymous reviewers for providing valuable comments and constructive criticism for an earlier version of this manuscript.

References

Bar, M., & Neta, M. (2006). Humans prefer curved visual objects. *Psychological Science*, *17*(8), 645—648.
Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception & Psychophysics*, *8*(5A), 279—286.
Bohrn, I., Carbon, C. C., & Hutzler, F. (2010). Mona Lisa's smile: Perception or deception? *Psychological Science*, *21*(3), 378—380.
Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin*, *106*(2), 265—289.
Bornstein, R. F., & D'Agostino, P. R. (1992). Stimulus-recognition and the mere exposure effect. *Journal of Personality and Social Psychology*, *63*(4), 545—552.
Bornstein, R. F., Kale, A. R., & Cornell, K. R. (1990). Boredom as a limiting condition on the mere exposure effect. *Journal of Personality and Social Psychology*, *58*(5), 791—800.
Brentar, J. E., Neuendorf, K. A., & Armstrong, B. (1994). Exposure effects and affective responses to music. *Communication Monographs*, *61*(2), 161—181.
Carbon, C. C. (2010). The cycle of preference: Long-term dynamics of aesthetic appreciation. *Acta Psychologica*, *134*(2), 233—244.
Carbon, C. C., & Ditye, T. (in press). Sustained effects of adaptation on the perception of familiar faces. *Journal of Experimental Psychology: Human Perception & Performance*.
Carbon, C. C., Grüter, T., Grüter, M., Weber, J. E., & Lueschow, A. (2010). Dissociation of facial attractiveness and distinctiveness processing in congenital prosopagnosia. *Visual Cognition*, *18*(5), 641—654.
Carbon, C. C., Hutzler, F., & Minge, M. (2006). Innovativeness in design investigated by eye movements and pupillometry. *Psychology Science*, *48*(2), 173—186.
Carbon, C. C., & Leder, H. (2005). The repeated evaluation technique (RET). A method to capture dynamic effects of innovativeness and attractiveness. *Applied Cognitive Psychology*, *19*(5), 587—601.
Carbon, C. C., Michael, L., & Leder, H. (2008). Design evaluation by combination of repeated evaluation technique and measurement of electrodermal activity. *Research in Engineering Design*, *19*, 143—149.
Carbon, C. C., & Talker, C. (2006). Evaluating design perception of 36 car interiors. Unpublished research report. Faculty of Psychology, University of Vienna.
Chwilla, D. J., Hagoort, P., & Brown, C. M. (1998). The mechanism underlying backward priming in a lexical decision task: Spreading activation versus semantic matching. *The Quarterly Journal of Experimental Psychology. A: Human Experimental Psychology*, *51*(3), 531—560.
Cohen, J., Macwhinney, B., Flatt, M., & Provost, J. (1993). Psyscope: An interactive graphic system for designing and controlling experiments in the psychology laboratory using Macintosh computers. *Behavior Research Methods, Instruments, & Computers*, *25*(2), 257—271.
Collins, A. M., & Loftus, E. F. (1975). Spreading activation theory of semantic processing. *Psychological Review*, *82*(6), 407—428.
Cox, D., & Cox, A. D. (2002). Beyond first impressions: The effects of repeated exposure on consumer liking of visually complex and simple product designs. *Journal of the Academy of Marketing Science*, *30*(2), 119—130.
Craik, F. I. M. (2002). Levels of processing: Past, present ... and future? *Memory*, *10*(5–6), 305—318.
Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: Framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671—684.
Day, H. Y. (1967). Evaluations of subjective complexity, pleasingness and interestingness for a series of random polygons varying in complexity. *Perception & Psychophysics*, *2*(7), 281—286.
Fang, X., Singh, S., & Ahluwalia, R. (2007). An examination of different explanations for the mere exposure effect. *Journal of Consumer Research*, *34*(1), 97—103.
Fournier, S., Dobscha, S., & Mick, D. G. (1998). Preventing the premature death of relationship marketing. *Harvard Business Review*, *76*(1), 42—47.
Gomez, P., & Danuser, B. (2004). Affective and physiological responses to environmental noises and music. *International Journal of Psychophysiology*, *53*(2), 91—103.
Hekkert, P., Snelders, D., & van Wieringen, P. C. W. (2003). 'Most advanced, yet acceptable': Typicality and novelty as joint predictors of aesthetic preference in industrial design. *British Journal of Psychology*, *94*, 111—124.
Knight, H., & Keith, O. (2005). Ranking facial attractiveness. *European Journal of Orthodontics*, *27*(4), 340—348.
Kunst-Wilson, W. R., & Zajonc, R. B. (1980). Affective discrimination of stimuli that cannot be recognized. *Science*, *207*(4430), 557—558.
Langlois, J. H., Kalakanis, L., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological Bulletin*, *126*(3), 390—423.
Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology*, *95*, 489—508.
Leder, H., & Carbon, C. C. (2005). Dimensions in appreciation of car interior design. *Applied Cognitive Psychology*, *19*(5), 603—618.
Leder, H., Carbon, C. C., & Ripsas, A. L. (2006). Entitling art: Influence of title information on understanding and appreciation of paintings. *Acta Psychologica*, *121*(2), 176—198.
Moulson, T., & Sproles, G. (2000). Styling strategy. *Business Horizons*, *43*(5), 45—52.
Obermiller, C. (1985). Varieties of mere exposure: the effects of processing style and repetition on affective response. *Journal of Consumer Research*, *12*(1), 17—30.
Op de Beeck, H. P., Torfs, K., & Wagemans, J. (2008). Perceived shape similarity among unfamiliar objects and the organization of the human object vision pathway. *The Journal of Neuroscience*, *28*(40), 10111—10123.
Pessoa, L. (2008). On the relationship between emotion and cognition. *Nature Reviews. Neuroscience*, *9*(2), 148—158.
Redondo, J., Fraga, I., Padron, I., & Pineiro, A. (2008). Affective ratings of sound stimuli. *Behavior Research Methods*, *40*(3), 784—790.
Russell, J. A., & Mehrabian, A. (1977). Evidence for a 3-factor theory of emotions. *Journal of Research in Personality*, *11*(3), 273—294.
Sproles, G. B. (1981). Analyzing fashion life-cycles: Principles and perspectives. *Journal of Marketing*, *45*(4), 116—124.
Versace, R., Labeye, E., Badard, G., & Rose, M. (2009). The contents of long-term memory and the emergence of knowledge. *European Journal of Cognitive Psychology*, *21*(4), 522—560.
Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, *9*(2), 1—27.
Zajonc, R. B., Crandall, R., Kail, R. V., & Swap, W. (1974). Effect of extreme exposure frequencies on different affective ratings of stimuli. *Perceptual and Motor Skills*, *38*(2), 667—678.