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Rigidity rather than age as a limiting factor to appreciate innovative design

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Abstract

In this paper, we study to what degree older consumers differ from middle-aged consumers with respect to the appreciation of new product designs. We asked respondents from both age groups to evaluate innovative designs that were shown repeatedly, replicating a regular market situation by using the *Repeated Evaluation Technique* (RET). The results show that rigidity, but not age influences the speed of appreciation towards new product designs under these circumstances. Our findings indicate that it is a misconception that older consumers are slower in adopting new product innovations per se.

Older consumers and new products

New products are introduced in the market continuously. The majority of people need time to get used to new products, to appreciate new product design, to understand new product features, and to overcome technology-related risks before they appreciate and subsequently think about buying these new products (Bagozzi & Lee, 1999; Cox & Cox, 2002; Leder & Carbon, 2005). Consumers adopt new products (Carbon, 2010), but the speed in doing so differs strongly between individuals. Rogers (1964) differentiates consumers based on the speed of their new product adoption. Consumers who belong to the first 2.5 percent of a population with regard to accepting new products are referred to as *innovators*. *Early adopters* are the 13.5 percent of consumers who are next in line in adopting new products. Most consumers belong to the so called *early* and *late majority*. This large group consists of consumers who, after being exposed to the new product already being used by the *innovators* and *adopters*, adopt the new product relatively late in time. The 16 percent of

consumers who accept new products very late in time are called *laggards*. Especially, in the case of consumers that belong to the *late majority* or *laggards* much time is needed before they adopt new products (Cox & Cox, 2002; Leder & Carbon, 2005).

According to Rogers the adoption of a new product is a learning process. Consumers need to get to know the benefits of a new product before they are going to adopt it. They get new product information out of the market and from other consumers. The speed by which consumers are exposed to new product information differs between consumers. *Adopters*, for example, are known to have an active social network that can provide them with up-to-date information about new products. In contrast, *late majority* and *laggards* are exposed to new product information later in time.

A high level of exposure to new product information influences the appreciation for new products positively and as a result speeds up the new product adoption process. Next, the adoption of new products differs between consumers and is influenced by a number of psychological factors. *Innovators*, for example, are reported to differ from other consumers in psychological factors like cognitive style (Foxall & Bhate, 1993). Consumers with a higher tolerance of ambiguity showed a higher appreciation of new product designs (de Bont, Schoormans, & Wessel, 1992). Demographic factors like age are also reported to influence the speed of adoption. *Innovators,* for instance, are often relatively young (Foxall, Goldsmith, & Brown, 1998), and young consumers are shown to change markets (Spero & Stone, 2004).

Because of the fact that younger people are relatively fast in new product adoption, companies are highly interested in younger consumers (Story & French, 2004). On the contrary, many companies consider older consumers (as) an uninteresting target group due to their low speed of new product adoption. In this study, we focus on the older consumers for a number of reasons. First, the elderly population will see substantial growth in Western countries in the next decades. Secondly, the spending power of the elderly is high and increasing (Gunter, 1998) due to acquired wealth (Horovitz, 2010) and reduced expenses on

child-rearing and paying off mortgages (French & Fox, 1985). Thirdly, many new products that come to the market can provide high value benefits to older consumers. Products that adjust to posture like adjustable car chairs are for example especially profitable for older consumers.

Although it is widely believed that older consumers have more difficulty with the adoption of new products (see e.g., Loudon & Della Bitta, 1993), the literature on the relation between older consumers and the adoption of innovations is inconclusive. On the one hand, the literature indicates that older consumers have a stronger resistance to innovations and show a lower adoption speed. Gilly and Zeithaml (1985), for example, investigated the adoption of consumer-related technologies like self-scanning systems in grocery stores by the elderly. In this study, they show that lower percentages of the elderly were in the trial and adoption stages for most of the innovations. Furthermore, the literature on innovation indirectly indicates that the older consumer is more resistant to change and as such less open to innovations. In the group of *innovators* young educated male professionals with a relatively high discretionary spending power are over-represented (Fox, 1994). In other words, *innovators* are relatively young consumers. However, for the acceptance of new products in the greater market, the so called *adopters*, are much more important. This group consists of consumers who accept new products after they have been embraced by the *innovators*. The *adopters* highly influence the majority of consumers in new product acceptance. In studies comparing *adopters* and *non-adopters* of home-computers, it was found that *adopters* are in most cases not young consumers (Dickerson & Gentry, 1983). In a number of more recent studies on the adoption of new technology, it was found that older consumers are likely to adopt new technology as quickly as younger consumers. One reported difference is that older consumers focus more on benefits than costs: they accept new technology more quickly when they see the benefits of the new product (Melenhorst, Rogers, & Bouwhuis, 2006).

As indicated before, new product adoption is also influenced by psychological factors. Psychological literature indicates that the performance of the elderly is comparable to that of younger people in many domains, except when they are hindered by severe mental or physical restrictions (Park & Gutchess, 2006; Park et al., 2002; Yoon et al., 2005). In a number of studies psychological factors that assess consumers' reactions to new information, like ambiguity intolerance and rigidity, are related to the acceptation of new products. In this paper we focus on rigidity. Rigidity refers to an obstacle to problem solving which arises from over-dependence on prior experience, which makes it difficult for a person with experience in a specific problem domain to recognize novel solution strategies. Indeed, the behavior of rigid people tends to be stable over time (Viek, 1997) and may change less in response to situational demands (Schultz & Searleman, 2002). The idea that older people are more rigid and less inclined to change than other age groups is not underscored by research. For instance, in a longitudinal study with 3,442 participants, Schaie and Willis (1991) found stable levels of rigidity for persons aged between 18 and 60 years. Increased levels of rigidity were detected only after the age of 60. Additionally, research of Panek, Stoner and Beystehner (1983) indicates that young adults are even more rigid then old adults.

So, the role of age in the adoption of new products in general and innovative design in particular is inconclusive. On the one hand, it can be argued that older consumers have a greater resistance to innovations; on the other hand, it can be argued that they will not differ in this respect from other age segments. This last idea corresponds with the remark of Loudon and Della Bitta (1993) that it is a misconception that older consumers are psychologically rigid and hardly inclined to change their consumption habits.

Based on the above, it can be argued that although older consumers are able to adjust to new products, they are, in many cases, still found to be slower new product adopters. One of the reasons behind this might be the fact that older consumers though having the ability to adjust to the new product information do not adjust to this information or at a slower pace

because they miss a lot of information on new products that reaches other consumers. This idea also corresponds with results in the study of Gilly and Zeithaml (1985) who report that older consumers who are slower in adopting new products differ in the way they use new product information that is available.

In this paper we contribute to the literature by investigating whether older consumers are indeed slower in appreciating new products even after they are confronted heavily with new product information. To this end, we used the *Repeated Evaluation Technique* (RET, Carbon & Leder, 2005), in which participants are repeatedly constrained to familiarize themselves with innovative material in order to enable the valid testing of their appreciation of this material. We use the appreciation of new product design as a proxy for new product adoption. This approach is supported by research of Talke, Salomo, Wieringa and Lutz (2009) who show that appreciation of innovative product design is highly correlated with new product adoption.

It is important to note that it is quite common for typical consumers to reject innovative material at first sight, but RET lets participants elaborate the given material so that it may be integrated into their visual habits. After an RET session, most people do not only like the innovative material that they rejected previously, they also start to dislike the familiar and low innovative material they preferred before. Such elaboration effects are in accordance with everyday life experience; people have to get used to new and innovative products before they can really appreciate them. In terms of Rogers: many consumers need to see other consumers using a new product before they appreciate it and its benefits. In several studies, we could prove that RET (Faerber & Carbon, 2010; Gerger, Leder, Faerber, & Carbon, in press) is a valid instrument for testing the appreciation of innovative products (e.g., within an eyetracking study see Carbon, Hutzler, & Minge, 2006; within an EDA/SCR study see Carbon, Michael, & Leder, 2008): Participants in these studies showed the indeed often proposed inherent conservatism, high rejection rates of innovative products first. When the

participants are asked on a variety of dimensions, such as form aspects of the products, people are forced to elaborate the material—they integrate the new visual stimuli into their visual habits. This helps to understand the material and, finally, to appreciate some of the products which would have been rejected if no such connection to the common visual habits exist.

We compare the appreciation of innovative product design of persons sampled out of a group of older consumers with those sampled out of a group of middle-aged consumers. Next, we take into account the effect of the level of psychological rigidity/flexibility on appreciation for highly innovative designs.

Based on the literature we formulate the following hypotheses:

Hypothesis 1: After repeated exposure to an innovative product design, older consumers will have a lower appreciation for this product than middle-aged consumers.

Hypothesis 2: After repeated exposure to an innovative product design, participants with higher levels of rigidity will have a lower appreciation for this product than participants with lower levels of rigidity.

Experiment: Appreciation of innovative design in relation to age and rigidity

Method

Participants.

Participants (*N*=61, all males) were selected from a consumer household panel. Two participants had to be excluded: one due to missing age details, the other due to missing data. Only males were selected to rule out an effect of gender on rigidity as is reported by Vollhardt (1990).

The test sample consisted of two subsamples: elderly people ("*old*") defined by an age of ≥ 56 years (*N*=30, *M*=65.1 ys, range 56-75 ys) and less old people defined by an age of ≤

55 years ("*middle-aged*") (*N*=29, *M*=48.3 ys, range 35-55 ys). We decided to split the group in one group younger or equal and one group older then 55 years based on median split.

It was decided to compare the group of old consumers to a group of middle-aged consumers and not to take in a group of younger consumers to avoid interaction effects of rigidity and age that can occur due to the fact that younger consumers are in some studies found to be less rigid than older ones (Panek et al., 1983).

All participants had normal or corrected to normal vision, were tested individually and received a small financial compensation for participation.

Apparatus and stimuli.

As stimulus material we used 18 car interiors presented as line drawings with grey-scale shadings. These car interiors varied in terms of perceived innovativeness while other design factors such as complexity and curvature were matched between both levels (low and high) of innovativeness. Ratings of the perceived innovativeness could be found elsewhere (e.g., Carbon & Leder, 2005; Carbon et al., 2008). Figure 1 shows designs representing low or high innovativeness.

[insert Figure 1 about here]

The stimuli were presented in a size of 800 x 600 pixels on a 12-inch TFT monitor with a screen resolution of 1024 x 768 pixels.

Procedure.

In this study, participants first had to accomplish the experimental study on design appreciation, followed by a rigidity test based on the Wisconsin Card Sorting Test (WCST).

Experiment on design appreciation. For the experiment on design appreciation, participants were seated approximately 60 cm in front of the computer monitor. The experiment started with test phase T0, in which the designs were presented sequentially and

the participants were asked to indicate their base-rate liking of each one. No time restrictions were imposed on the participants. They answered each question by pressing a key from 1 to 7, relating to a 7-point-Likert scale (from ‘1’: “not liked at all”, up to ‘7’: “liked very much”). The next trial would then begin automatically. The order of trials in this and all other phases was randomly selected by the experimental control program PsyScope (Cohen, MacWhinney, Flatt, & Provost, 1993). After a short break of about three minutes, the similarly constructed test phase T1 started. T1 was used (a) to measure the reliability of evaluations (given in T0), and (b) to control appreciation dynamics for mere exposure or delay effects. An extended rating phase followed. This phase, which consisted of 23 rating blocks[1], is called the RET (*Repeated Evaluation Technique*) phase (cf. Carbon & Leder, 2005). After all RET ratings had been given, there was a short break during which the participants were instructed to answer two final ratings with as much careful consideration as possible, followed by test phase T2 where participants were again asked for their liking of the stimuli. Figure 2 illustrates the whole sequence of the experimental procedure, which lasted 40 minutes on average.

[insert Figure 2 about here]

Rigidity test. Participants’ rigidity was tested by an adapted WCST (Grant & Berg, 1948) developed by Shane T. Mueller within the PEBL (The Psychology Experiment Building Language) project, which is dedicated to providing freely available experimental standard procedures. The WCST is a neuropsychological test of “set-shifting” which indicates the ability to show flexibility in the face of changing schedules of reinforcement. The test

[1] innovatief“ (innovative), „afstotend“ (deterrent), „uitnodigend“ (inviting), „smaakvol“ (tasteful), „"met klasse"„ (classy), „klinisch“ (clinical), „praktisch“ (practical), „comfortabel“ (comfortable), „"van hoge standaard"„ (of high quality), „onduidelijk“ (unclear), „futuristisch“ (futuristic), „modern“ (modern), „luxueus“ (luxurious), „elegant“ (elegant), „solide“ (solid), „geinig“ (hip), „conservatief“ (conservative), „extravagant“ (extravagant), „slordig“ (unsophisticated), „kitsch“ (kitschy), „speels“ (playful), „"over nagedacht"„ (carefully designed), „handig“ (convenient).

starts by showing four cards with different numbers of symbols in different colors (e.g., four blue stars). The participant is then given a fifth card and asked which of the four cards the fifth card matches best, without instructing him/her which dimension (symbol, number or color) the match should be based on. Feedback is given on the correctness of the match and the next trial starts. After a while, the dimension that is used, is changed; e.g. instead of matching the cards on number they are now matched on color. The participants must now adjust to the new dimension in order to make the proper matches. Participants differ in the numbers of trails they need to match the right dimensions; high numbers of incorrect trials indicate that participants do not adjust to new dimensions after a dimension change. Participants had to complete 128 trials, which took 10 minutes on average.

Results and Discussion

Liking data from the test phases were aggregated for low and high innovative designs per person. 2 x 2 subsamples of participants were compiled on the basis of age group (*middle-aged* vs. *old*; mean split) and rigidity (low vs. high; mean split). Rigidity assignment was operationalized by dichotomizing perseveration errors, i.e. the number of errors due to the failure to adjust to the new dimension.

First, we analyzed how much appreciation changed over the three different test phases for low- and high-rigidity persons via correlation analyses. Second, we analyzed effects of time and elaboration on appreciation for innovative designs via Analyses of Variance (ANOVA). Third, we tested the relation between rigidity and age by employing correlation analyses.

Analysis of appreciation data via correlation analyses. First, correlations of appreciation data between different test phases were tested for both rigidity groups (Table 1). Throughout, very high (positive) correlations were obtained for ratings between all test phases

for the high-rigidity group, indicating highly stable appreciation patterns independent of time effects and specific treatment via RET. This is in full accordance with the "rigidity" label that had been assigned to the participants in this group. Neither elaboration nor repetition changed their appreciation of specific designs between T0, T1 and T2. The non-rigid group clearly showed a different pattern. Although T0-T1 correlations were significant(ly positive), correlations between T2 and T1 or T0 dropped and reached a non-significant level. These results were cross-checked by calculating the correlations across groups. We obtained very high inter-group correlations between T0 and T1 and also between T2 of the high-rigidity group and T0 or T1 of the low-rigidity group. This underlines that highly rigid persons seem to be relatively impervious to efforts to change their appreciation of innovative designs.

[insert Table 1 about here]

Analysis of appreciation data via ANOVA. Our main analysis investigated appreciation data for T0 vs. T1 and for T1 vs. T2 via two separate Analyses of Variance (ANOVA). Mean ratings for the liking evaluations of each participant were submitted to a mixed design ANOVA with *Phase* (T0 vs. T1 and T1 vs. T2, respectively) and *Innovativeness* (low vs. high) as within-subjects factors and *Rigidity* (low vs. high) and *Age* (young vs. old) as between-subjects factors.

The T0-T1 ANOVA revealed only one significant effect, the main effect of *Innovativeness*, (M_{low}=3.27, M_{high}=2.93), $F(1, 53) = 15.3$, $p \leq .01$, which is in full accord with the idea that the absence of specific elaboration of innovative material leads to two effects following Carbon and Leder (2005): (a) innovative material will be disliked, (b) appreciation does not change over time when neither specific elaboration nor intense familiarization takes place.

The T1-T2 ANOVA revealed a different pattern. The main effect of *Phase* was identified as significant: (M_{T1}=3.11, M_{T2}=2.60), $F(1, 52) = 11.5$, $p \leq .01$, qualified by a two-way interaction between *Phase* and *Innovativeness,* $F(1, 52) = 13.9$, $p \leq .01$, which replicates findings on elaboration via the *Repeated Evaluation Technique*: highly innovative material that is relatively disliked at the beginning rises in appreciation while low innovative designs that are initially preferred drop in appreciation. Most importantly, the revealed effects were further qualified by a three-way interaction between *Phase*, *Innovativeness* and *Rigidity,* $F(1, 52) = 3.9$, $p \leq .05$. As illustrated by Figure 3, only low-rigidity participants showed the typical disordinal interaction between *Phase* and *Innovativeness.* To further test this statistically, we conducted two additional ANOVAs that only included the two within-subjects factors *Phase* and *Innovativeness*, one for the low-rigidity group and the other for the high-rigidity group. As already speculated by graphical inspection, we obtained significant main effects of *Phase* for both groups, F's > 5.3, p's $\leq .05$, but only an interaction of *Phase* and *Innovativeness* for the low-rigidity group, $F(1, 27) = 18.0$, $p \leq .01$. Thus, only low-rigidity participants showed that they were capable of including newly seen material into their visual habits and could successfully adjust to these new experiences. In other words, the low-rigidity persons behaved quite flexibly, changing their minds after elaborating the material. Note that the age of participants did *not* explain any appreciation effects, as shown by non-significant interactive effects with age and its non-significant main effect.

[insert Figure 3 about here]

Analysis of the relation between age and rigidity.

As pointed out above in the section on ANOVA results, we found no age-dependent effects in the current test scenario, neither as a main effect nor an interactive one. As this finding is very important for the research question of how likely the elderly are to accept

innovative products, we investigated the relationship between the factors *Age* and *Rigidity* in more detail. First, a *t*-test for independent groups showed that age did not differ between both rigidity groups ($M_{\text{low rigidity}}$=54.5 ys, $M_{\text{high rigidity}}$=58.6 ys, $t(55)=1.6$, $p=.11$, *n.s.*). Second, a Spearman rank correlation between age and rigidity did not show a significant relation, $R=.207$, $p=.14$, *n.s.* To sum up, there was no significant link between age and rigidity, and the age profiles of the rigidity groups did not differ.

Discussion and managerial implications

Before consumers are willing to adopt a new product they need to appreciate it. In the market place, appreciation for a new product is enhanced by providing consumers with new product information. Exposure to new product information familiarizes consumers to the new product. Extensive exposure to new product information enhances product appreciation. In this paper, we discuss whether older and rigid consumers are slower in adopting new products after being exposed extensively to new product information. We used the *RepeatedEvaluation Technique* (RET, Carbon & Leder, 2005), which simulates extensive exposure to new product information. As a consequence, RET familiarizes consumers to a new product in a short time period. The typical pattern resulting from the RET is that consumers faced with new products change their natural initial negative view of the product into a positive one.

This study confirmed the results found in other RET studies: a repeatedly constrained presentation of new product designs led to familiarity and, as a result, to appreciation for our innovative designs, which enabled the valid testing of the market acceptance of innovative material. Further, the results of our study show that no age effect is found on the appreciation of highly innovative product design after participants elaborated the material via RET: older consumers appreciate our highly innovative designs as fast as middle-aged consumers do. Next, our results show that rigidity has a clear effect; more rigid consumers have a lower

appreciation for highly innovative designs. Most importantly, an interaction effect of age and rigidity on design appreciation is not found.

Our results are important from a new product development point of view. First, our data show, as expected, that rigid consumers do not easily accept new information, like new product designs. Because rigid consumers have more difficulty to adjust psychologically to new stimuli, rigid consumers have difficulty with appreciating new product designs. It can reasonably be expected that consumers who score high on rigidity belong to the *late majority* or *laggard*s on the innovation adoption curve of Rogers and, as such, are of a lesser market significance for companies developing products that feature really new functionalities or styling. Next, our results show that rigidity is not strongly related to age. Older consumers are not evidently more rigid then middle-aged ones. This means that consumer rigidity is not a reason to avoid developing new products for older consumers. More important, the results of our study also show that older respondents had the same appreciation for the new designs as the middle-aged respondents after the designs were presented using the RET. This means that older consumers have the same probability of adjusting to new products as other consumers, at least in case when they are exposed to new product information.

This result contradicts the research in which it is stated that older consumers are more reluctant to accept new technology, even if they may profit from it (Im, Bayus, & Mason, 2003). However, our results do match the literature on age effects in which it is indicated that the majority of older people, excluding those who have severe mental or physical problems, do have the ability to cope with new product information and are willing to adopt new products, especially when the product benefits are clear and relevant to them (Melenhorst et al., 2006).

Companies must launch new products in order to thrive. The market acceptance of new products is strongly influenced by the psychological acceptance of innovations. This research clearly indicates that older consumers do not have more problems

than other consumers with the psychological acceptance of highly innovative product designs when they have the opportunity to familiarize themselves with the new product. So, it is possible to convince older consumers to adopt new products. However dedicated ways, like special product trials (see Lunsford & Burnett, 1993), are needed to bring new product information to the attention of older consumers. Under such conditions, targeting older consumers may become a profitable new product strategy.

Figures

Figure 1. Examples of the designs used in the study. Low innovative designs are presented on the left, high innovative designs on the right.

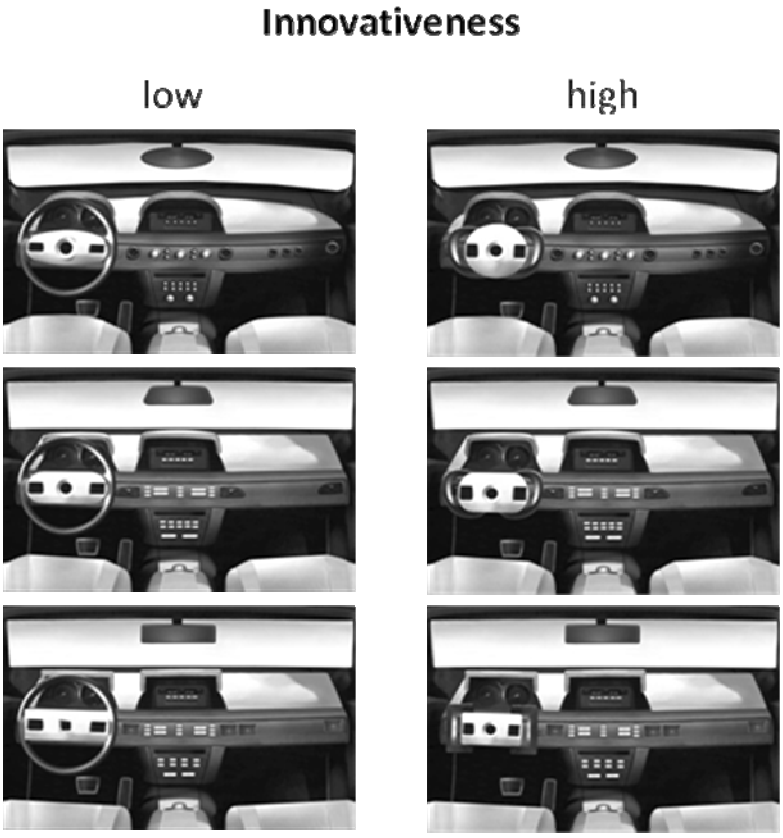


Figure 2. Time course of the experiment. In T0, T1 and T2 the liking of the designs was asked for. In the RET phase, designs were repeatedly evaluated for further variables, starting with attribute 1 (Attrib1), attribute 2 (…2) till the k-th attribute (…k). In the given experimental setup k was set to 23.

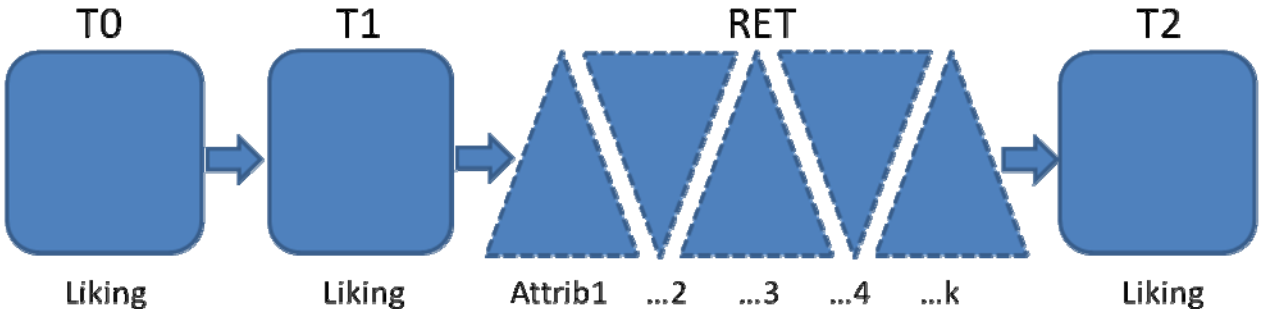
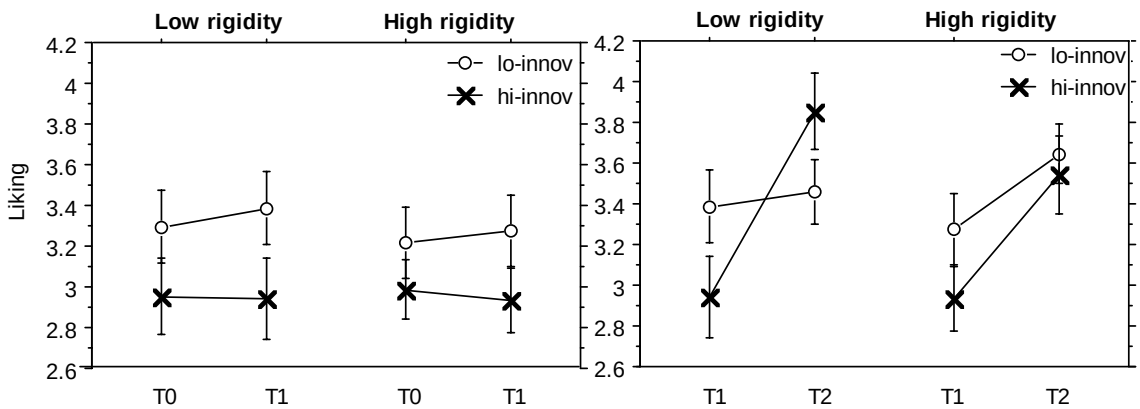


Figure 3. Liking data for the low and high rigidity group. On the left side, a double chart is shown for the T0 vs T1 comparison; on the right side the same is shown for the T1 vs T2 comparison.



Tables

Table 1. Correlation of ratings between test phases for both rigidity groups and correlations across rigidity groups are provided. Grey-shaded fields show correlations within one rigidity group. Bold figures indicate significant correlations based on a strict alpha-corrected *p*-value of *p*=.01/15=.00067.

		Low rigidity			High rigidity		
		T0	T1	T2	T0	T1	T2
Low Rigidity							
	T0	**1**	**.934**	.521	**.964**	**.911**	**.892**
	T1	**.934**	**1**	.491	**.939**	**.948**	**.894**
	T2	.521	.491	**1**	.467	.341	.674
High Rigidity							
	T0	**.964**	**.939**	.467	**1**	**.966**	**.917**
	T1	**.911**	**.948**	.341	**.966**	**1**	**.878**
	T2	**.892**	**.894**	.674	**.917**	**.878**	**1**

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