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Original Communication

Rigidity Rather Than Age as a Limiting Factor in the Appreciation of Innovative Design

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Abstract. In this paper, we study the degree to which older consumers differ from middle-aged consumers with respect to their 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, under these circumstances, rigidity but not age influences the speed of appreciation of new product designs. Our findings indicate that it is a general misconception that older consumers are slower to adopt new product innovations per se.

Keywords: innovation, consumer product experience, buying, age, rigidity, design

Older Consumers and New Products

New products are introduced into the market continuously. Most people need some 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 can 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 at which they do so differs greatly between individuals. Rogers (1964) differentiated consumers based on the speed at which they adopt new products. He referred to consumers who belong to the first 2.5% of a population with regard to accepting new products as *innovators* and to the 13.5% who are next in line to adopt new products as *early adopters*. 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% of consumers who accept new products very late are called *laggards*. Consumers who belong to the *late majority* or *laggards* need a great deal of time before they adopt new products (Cox & Cox, 2002; Leder & Carbon, 2005).

According to Rogers (1964), adopting a new product is a learning process. Consumers need to become acquainted with the benefits of a new product before adopting it. They acquire new product information from the marketplace and other consumers. The speed at which consumers are exposed to new product information differs. Adopters, for example, are known to have an active social network that provides them with the latest information about new products. The late majority and laggards, in contrast, are not exposed to new product information until much later.

A high level of exposure to new product information has a positive influence on people's appreciation for new products and thus speeds up the process by which they adopt them. Consumers also differ with respect to the speed at which they adopt new products, and these differences are based on psychological factors. Innovators, for example, reportedly differ from other consumers in cognitive style (Foxall & Bhate, 1993): Consumers with a higher tolerance of ambiguity have been found to show a higher appreciation of new product designs (de Bont, Schoormans, & Wessel, 1992). Demographic factors like age have also been reported to influence the speed of adoption. Innovators, for instance, are often relatively young (Foxall, Goldsmith, & Brown, 1998), and young consumers have been shown to change markets (Spero & Stone, 2004).

Because younger people adopt new products relatively quickly, companies are highly interested in attracting younger consumers (Story & French, 2004). In contrast, many companies consider older consumers uninteresting as a target group because of their slow adoption of new

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products. In this study, we chose to focus on older consumers for a number of reasons. First, the older population will see substantial growth in Western countries in the next few decades. Second, the spending power of the elderly is high and increasing (Gunter, 1998) due to acquired wealth (Horovitz, 2010) and reduced expenses for child-rearing and mortgage (French & Fox, 1985). Third, many new products that come to the market can provide high-value benefits to older consumers. Products like adjustable car seats are, for example, especially beneficial to older consumers.

Although it is widely believed that older consumers have more difficulty adopting new products (see, e.g., Loudon & Della Bitta, 1993), the literature on the relationship between older consumers and the adoption of innovations is inconclusive. On the one hand, the literature indicates that older consumers show more resistance to innovations and adopt them more slowly. Gilly and Zeithaml (1985), for example, investigated the adoption of consumer-related technologies like self-scanning systems in grocery stores by the elderly. They showed that lower percentages of the elderly were in the trial and adoption stages for most of the innovations. Furthermore, the literature on innovations indirectly indicates that older consumers are more resistant to change and as such less open to innovations. Young, educated, male professionals with relatively high discretionary spending power are overrepresented in the group of innovators (Fox, 1994). However, for the acceptance of new products in the greater market, the so-called adopters are much more important, 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 nonadopters of home computers, for example, it was found that adopters are usually not just young consumers (Dickerson & Gentry, 1983). In a number of more recent studies on the adoption of new technology, older consumers were 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 above, new product adoption is also influenced by psychological factors. The psychological literature indicates that the performance of older people 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 consumer reactions to new information, like ambiguity intolerance and rigidity, are related to the acceptance of new products. In this paper, we focus on rigidity, which refers to an obstacle to problem solving arising from an overdependence on prior experience making 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 age 60. Additionally, the research of Panek, Stoner, and Beystehner (1983) indicated that young adults are even more rigid than older 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, one could argue that older consumers have a greater resistance to innovation; on the other hand, one could argue that they do not differ from other age groups in this regard. This last idea corresponds to the remark by Loudon and Della Bitta (1993), namely, that it is a misconception that older consumers are psychologically rigid and hardly inclined to change their consumption habits.

Based on the above, one could argue that, although older consumers would be able to adjust to new products, in many cases they are still slower to adopt new products. One reason behind this might be that older consumers, although they have the ability to adjust to new product information, miss much of the information on new products that reaches other consumers. This idea also corresponds with the results of the study of Gilly and Zeithaml (1985), who report that older consumers who adopt new products more slowly differ in how they use the available new product information.

In this paper, we investigate whether older consumers are indeed slower in appreciating new products even after they are heavily confronted 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 their appreciation thereof to be validly tested. We used the appreciation of new product design as a proxy for new product adoption. This approach is supported by research by Talke, Salomo, Wieringa, and Lutz (2009), who show that appreciation of innovative product design is highly correlated with new product adoption.

It is quite common for typical consumers to initially reject innovative material, but RET allows participants to elaborate the given material so that it can be integrated into their visual habits. After an RET session, most people not only like the innovative material they had initially rejected, they also start to dislike the familiar and low-innovative material that they had originally preferred. 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. According to Rogers (1964), many consumers need to see other consumers using a new product before they appreciate it and its benefits. In several studies, we were able to prove that the RET (Faerber & Carbon, 2010; Gerger, Leder, Faerber, &

Carbon, 2011) is a valid instrument for testing the appreciation of innovative products (e.g., in an eye-tracking study, see Carbon, Hutzler, & Minge, 2006; in an electrodermal activity/skin potential response study, see Carbon, Michael, & Leder, 2008). Participants in these studies showed the indeed often proposed inherent conservatism, high rejection rates of innovative products first. But when they are asked about a variety of dimensions, such as form aspects of the products, they are forced to elaborate the material – and end up integrating the new visual stimuli into their visual habits. This helps us to understand the material and, finally, to appreciate some of the products that would have been rejected if no such connection to common visual habits existed.

We compared the appreciation of innovative product design of people sampled from a group of older consumers with those sampled from a group of middle-aged consumers. Then we took into account the effect of the level of psychological rigidity/flexibility on appreciation for highly innovative designs.

Based on the literature, we formulated 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 the effect of gender on rigidity as reported by Vollhardt (1990).

The test sample consisted of two subsamples: *older individuals* aged 56 years and older (N = 30, M_{age} = 65.1 years, age range: 56–75 years) and *middle-aged individuals* aged 55 years or younger (N = 29, M_{age} = 48.3 years, age range: 35–55 years). We split the group into two groups, one younger than or equal to and one older than 55 years, based on median split.

We compared the group of older consumers to the group of middle-aged consumers but not to a group of younger consumers to avoid interaction effects of rigidity and age; some studies have found younger consumers to be less rigid than older consumers (Panek et al., 1983). All participants had normal or corrected-to-normal vision, were tested individually, and received modest financial compensation for participation.

Apparatus and Stimuli

As stimulus material, we used 18 car interiors presented as line drawings with gray-scale shadings. These cars interiors varied in terms of perceived innovation. Other design factors, such as complexity and curvature, were kept as similar as possible. This was confirmed by a pretest. Ratings of perceived innovation had been collected previously (e.g., Carbon & Leder, 2005; Carbon et al., 2008). Figure 1 shows designs representing low or high levels of innovation.

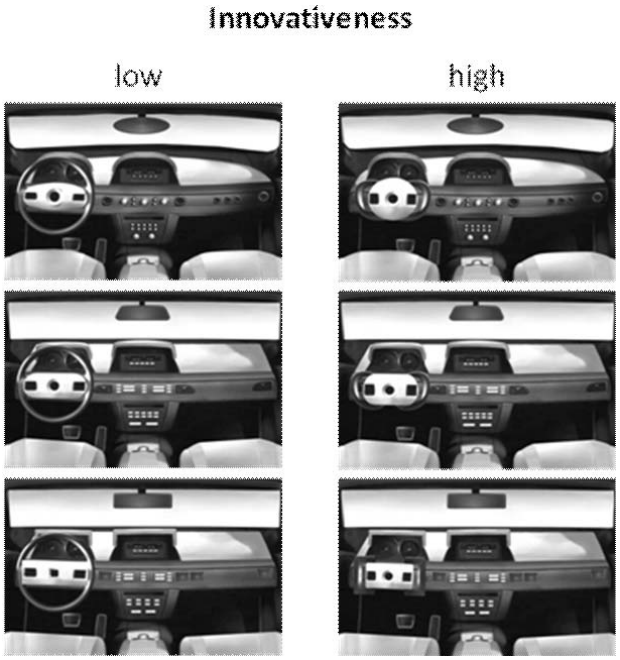

Figure 1. Examples of the designs used in the study. Designs with a low level of innovativeness are presented on the left, highly innovative designs on the right.

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

Procedure

After participating in the experimental study on design appreciation, participants took a rigidity test based on the Wisconsin Card Sorting Test (WCST).

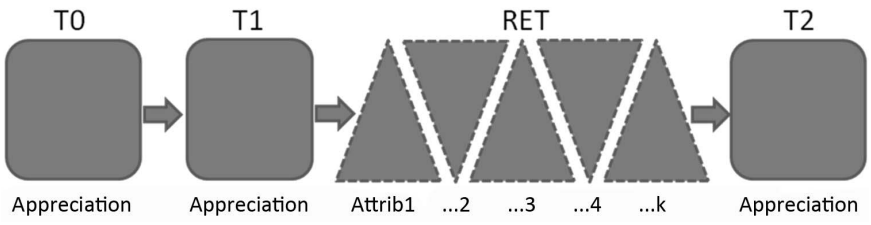

Figure 2. Time course of the experiment. In T0, T1, and T2, participants were to indicate their appreciation for the designs. In the RET phase, designs were repeatedly evaluated with respect to further variables, starting with attribute 1 (Attrib1), attribute 2 (. . . 2), until the *k*th attribute (. . . *k*). In the given experimental setup, *k* was set to 23.

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. The participants were asked to indicate how much they liked each design (base level) on a 7-point Likert scale (from 1 = *did not like at all*, up to 7 = *liked very much*) by pressing the corresponding computer key (1–7). No time restrictions were imposed on the participants. After the test phase, the next trial began 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 3 min, the similarly constructed test phase T1 started. T1 was used to (1) measure the reliability of evaluations (given in T0) and (2) control appreciation dynamics for mere exposure or delay effects. This was followed by an extended rating phase[1] called the RET phase (see Carbon & Leder, 2005). In this phase each stimulus was rated on 23 items, translated in Dutch.

After all RET ratings had been given, there was a short break during which the participants were instructed to give two final ratings with as much careful consideration as possible, followed by test phase T2 in which participants were again asked how much they liked the stimuli. Figure 2 illustrates the entire experimental procedure, which lasted 40 min on average.

Rigidity Test

Participants' rigidity was tested by an adapted WCST (Grant & Berg, 1948) developed by Shane T. Mueller within the framework of the PEBL (The Psychology Experiment Building Language) project, dedicated to providing freely available experimental standard procedures. The WCST is a neuropsychological test of "set shifting," which indicates a person's ability to show flexibility in the face of changing schedules of reinforcement. The test 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 best matches, 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 relevant dimension is changed; for example, instead of matching the cards according to number, they are matched according to color. The participants need to adjust to the new dimension in order to make the proper matches. Participants differ in the numbers of trials they need to match the cards according to the right dimensions; high numbers of incorrect trials indicate that participants do not adjust easily to new dimensions after a dimension change.

Participants completed 128 trials, which took 10 min on average.

Results and Discussion

Appreciation data from the test phases were aggregated for low and high innovative designs per person. 2 × 2 subsamples of participants were compiled on the basis of Age group (middle-aged vs. older; mean split) and Rigidity (low vs. high; mean split). Rigidity was operationalized by number of perseveration errors, that is, the number of errors made due to the failure to adjust to the new dimension.

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

1 "innovatief" (innovative), "afstotend" (deterrent), "uitnodigend" (inviting), "smaakvol" (tasteful), "met klasse" (classy), "klinisch" (clinical), "praktisch" (practical), "comfortable" (comfortable), "van hoge standard" (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).

Table 1
Correlation between T0, T1 and T2 for the two rigidity groups

	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**

Notes. Correlations between ratings of test phases for both rigidity groups and across rigidity groups. Gray-shaded fields show correlations within a rigidity group. **Bold** figures indicate significant correlations based on a strict α-corrected *p*-value of $p = .01/15 = .00067$.

Analysis of Appreciation Data via Correlation Analyses

First, correlations of appreciation data from different test phases were tested for both rigidity groups (Table 1). Very high (positive) correlations were obtained between ratings from all test phases for the high-rigidity group, indicating highly stable appreciation patterns independent of time and specific treatment via RET. This is in full accordance with the "rigidity" label assigned to the participants in this group. Neither elaboration nor repetition changed their appreciation for specific designs between T0, T1, and T2. The nonrigid 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 nonsignificant level. These results were crosschecked by calculating the correlations across groups. We obtained very high intergroup correlations between T0 and T1 and also between T2 of the high-rigidity group and T0 or T1 of the low-rigidity group. This shows that highly rigid people seem to be relatively impervious to efforts to change their appreciation of innovative designs.

Analysis of Appreciation Data via ANOVA

Our main analysis investigated the appreciation data from T0 vs. T1 and from T1 vs. T2 via two separate ANOVAs. Mean ratings for the appreciation evaluations of each participant were submitted to a mixed design ANOVA with Phase (T0 vs. T1 and T1 vs. T2, respectively) and Innovation (low vs. high) as within-subject factors and Rigidity (low vs. high) and Age (middle-aged vs. older) as between-subjects factors.

The T0-T1 ANOVA revealed only one significant effect, the main effect of Innovation ($M_{low} = 3.27$, $M_{high} = 2.93$), $F(1, 53) = 15.3$, $p \leq .01$, which is in full accord with the idea that the absence of specific elaboration of the innovative material leads to two effects (see Carbon & 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 Innovation, $F(1, 52) = 13.9$, $p \leq .01$, which replicated findings on elaboration via the RET: Highly innovative material that is disliked at the beginning rises in appreciation while less innovative designs, which are initially preferred, drop in appreciation. Most importantly, the revealed effects were further qualified by a three-way interaction between Phase, Innovation, 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 Innovation. To test this further, we conducted two additional ANOVAs, which only included the two within-subjects factors Phase and Innovation, one for the low- and one for the high-rigidity group. As already speculated after graph inspection, we obtained significant main effects of Phase for both groups, Fs > 5.3, p's ≤ .05, but only an interaction of Phase and Innovation for the low-rigidity group, $F(1, 27) = 18.0$, $p \leq .01$. Thus, only the low-rigidity participants showed that they were capable of including newly seen material in their visual habits and were able to successfully adjust to these new experiences. In other words, the low-rigidity participants behaved quite flexibly, changing their minds after elaborating the material. Note that the participants' age did *not* explain any appreciation effects, as shown by nonsignificant interactions with age and the nonsignificant main effect of age.

Analysis of the Relationship 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 as an interaction. As this finding is very important for the research question concerning how likely older individuals 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 rigidity groups did not differ with respect to age ($M_{low\ rigidity} = 54.5$ years, $M_{high\ rigidity} = 58.6$ years, $t(55) = 1.6$, $p = .11$, *ns*). Second, a Spearman rank correlation between age and rigidity did not show a significant relationship, $r = .207$, $p = .14$, *ns*. Thus, there was no significant link between age and rigidity, and the age profiles of the rigidity groups did not differ.

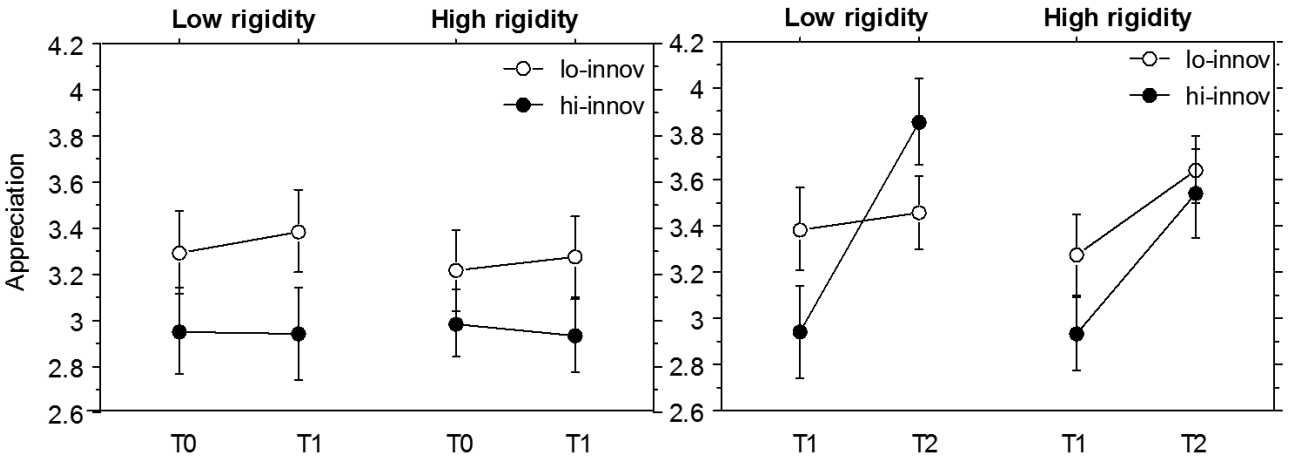

Figure 3. Appreciation data for the low- and high-rigidity groups. On the left, a double chart is shown for the T0 versus T1 comparison; on the right, the same is shown for the T1 versus T2 comparison.

Discussion and Managerial Implications

Before consumers are willing to adopt a new product they need to appreciate it. In the marketplace, appreciation for a new product is enhanced by providing consumers with new product information. Exposure to new product information familiarizes consumers with the new product. Extensive exposure to new product information enhances product appreciation. In this paper, we discussed whether older and more rigid consumers are slower to adopt new products after being exposed extensively to new product information. We used the RET (Carbon & Leder, 2005), which simulates extensive exposure to new product information. As a consequence, the RET familiarizes consumers with a new product in a short amount of time. 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 showed that there was no age effect for the appreciation of highly innovative product design after participants elaborated the material as required by the RET: Older consumers appreciated the highly innovative designs as fast as middle-aged consumers did. In addition, our results showed that rigidity had a clear effect: More rigid consumers showed less appreciation for highly innovative designs. Most importantly, we did not find an interaction effect of age and rigidity on design appreciation.

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. As rigid consumers have more difficulty adjusting psychologically to new stimuli, they have difficulty appreciating new product designs. It is reasonable to expect that consumers who score high on rigidity belong to the *late majority* or the *laggards* described by Rogers' (1964) innovation adoption curve and, as such, are of a lesser market significance for companies developing products that feature exceptionally new functions or styling. Also, our results showed that rigidity is not strongly related to age. Evidently, older consumers are not more rigid than middle-aged consumers. This means that rigidity is not a reason to avoid developing new products for older consumers. It is even more important to note that the results of our study showed that older respondents showed 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 when they are exposed to new product information.

This contradicts the research that found that older consumers are more reluctant to accept new technology, even if they may profit from it (Im, Bayus, & Mason, 2003). However, our results match the literature on age effects, which indicates that the majority of older people, excluding those who have severe mental or physical problems, 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 need to 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 psychologically accepting 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 spe-

cial product trials (see Lunsford & Burnett, 1993), are needed to bring new product information to the attention of older consumers. Under these conditions, targeting older consumers may become a profitable new product strategy.

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