# The dynamics of surprise and curiosity

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# CHAPTER 5

## Interest in complex novelty

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# Interest in Complex Novelty

In the future, people may control devices with their brainwaves, influence the weather with cloud making machines, and clean their house using robotic cleaning flies. This is just a snapshot of the numerous new products and technologies that are currently being developed[11] and that may find their way into people's daily lives. Innovation may provide people with many new and useful things and people most likely first hear about it via news coverage or through websites that focus specifically on technological innovation. Journalists, bloggers, or developers communicate about what is new and the widespread attention for, for instance, products introduced at the yearly Consumer Electronics Show (CES; see cesweb.org) suggests that the assumption is that many people are interested in new and innovative things.

Interestingly, though, many new products fail (the estimated failure rate ranges from 40% in Castellion and Markham, 2012, to 75% in Schneider and Hall, 2011; see also Cierpicki, Wright, and Sharp, 2000)[12]. So, even though new products and technologies may be exciting, useful, and often enthusiastically communicated about, success is sometimes hindered. The question is how to introduce novel products to increase

[11] For brainwaves tattoo see: ideaconnection.com/new-inventions/temporary-tattoos-could-make-telekinesis-possible-06794.html; for cloud making machine see: ideaconnection.com/new-inventions/cloud-making-machine-could-help-offset-climate-change-06674.html; for robotic cleaning flies see: electroluxdesignlab.com/en/submission/mab/links

[12] Failure rates differ somewhat between industries (e.g., in 2004 there were more failures in consumer goods/services [45%] than health care [36%], cf. Castellion & Markham, 2012). See also Best Practices study by the Product Development & Management Association's (PDMA).

the chance that people will become interested in it. One issue that may play a role is that novelty can be challenging because it may come with unfamiliarity and a difficulty understanding it (e.g., Mukherjee & Hoyer, 2000; Rindova & Petkova, 2007; see also Oreg, 2003; Oreg & Goldenberg, 2015). This does not concern "simple" novelty like new flavors or modernized package design, but is rather an issue of complex novelty like technological change. Complex novelty is the combination of atypicality/unfamiliarity (novelty) and difficulty of understanding this at first sight (complexity: see also Berlyne, 1960, 1971; Silvia, 2005). People might resist complex novelty because they experience uncertainty regarding its purpose and meaning (see also Antioco & Kleijnen, 2010; Carbon & Schoormans, 2012; Castaño, Sujan, Kacker, & Sujan, 2008; Kleijnen, Lee, & Wetzels, 2009; Hoeffler, 2003; Oreg & Goldenberg, 2015). So, to become interested in complex novelty, it is key that people have a sense that they can cope with it. This has concrete implications for how complex novelty should be introduced to people.

**Complex Novelty**

Complex novelty can be exciting in terms of promising possibilities, but people might also feel that they do not exactly grasp what it is or what it is for (see also Berlyne, 1971; Hoeffler, 2003; Mukherjee & Hoyer, 2000). For example, robotic cleaning flies may offer the prospect of saving a lot of time cleaning, but at the same time it is not really clear how these little robots find dirt or what it means that they fly around in one's house. This lack of understanding might confront people with an information-gap, which can make them

curious and motivated to find out more about it (e.g., Loewenstein, 1994; Noordewier & Van Dijk, 2015; Silvia & Kashdan, 2009). At the same time, it can challenge people's preference to understand their environment and their need for certainty, predictability, and structure (e.g., Abelson et al., 1968; Gawronski & Strack, 2012; Kay, Whitson, Gaucher, & Galinsky, 2009; Noordewier & Breugelmans, 2013; Proulx, Inzlicht, & Harmon-Jones, 2012). Not understanding complex novelty may actually lower interest rather than promote interest, as people may find it difficult to deal with.

Research on the appraisal structure of interest also points to the importance of feeling able to deal with complex novelty. In particular, it has been argued that feeling interested is driven by a combination of a novelty-complexity appraisal and a coping potential appraisal (Silvia 2005; see also Kashdan & Silvia, 2009; Silvia, 2008). The novelty-complexity appraisal refers to the evaluation of an event as new, unexpected, complex, hard to process, surprising, mysterious, or obscure. The coping potential appraisal is the estimation of having the skills, knowledge, and resources to deal with an event (cf. Silvia, 2005). Complex novelty obviously meets the first appraisal, but the question is whether people experience sufficient levels of coping potential to experience interest, as the complexity component may actually interfere with this. So, the more complex and novel a product is, the less likely it becomes that people experience coping potential. This is also in line with Berlyne's notion (e.g., Berlyne, 1960, 1971) that people want to avoid things that become too novel because they are too arousing (see also Noseworthy, Di Muro, & Murray, 2014) and findings that show

that "most advanced, yet acceptable" (MAYA) works best in industrial design (cf. Blijlevens, Carbon, Mugge, & Schoormans, 2012; Hekkert, Snelders, & Van Wieringen, 2003).

**Coping with Complex Novelty**

Importantly, this logic also provides clear directions on how to increase interest in complex novelty. By increasing people's coping potential with complex novelty, interest in it should increase as well. Supporting this, interest in art appears to be positively related to understanding the meaning of the artwork (e.g., provided via titles of abstract art or extra information about a poem; Millis, 2001; Silvia, 2005), given that people have sufficient time to process the meaning of the information (Leder, Carbon, & Ripsas, 2006). Also, research has shown that interest in an unclear task was highest when people experience moderate levels of self-efficacy, whereas low and high self-efficacy resulted in lower interest because the task was respectively too difficult or too easy (Silvia, 2003). In addition, in a theoretical analysis of technological change and product design, Rindova and Petkova (2007) argued that people might be better able to cope with novel technologies when they are presented in a familiar product design, because the familiarity makes it easier to comprehend.[13] Finally, Carbon and Leder (2005) showed that innovative product design becomes more attractive when people are repeatedly exposed to it (see also Carbon &

[13] A nice illustration of this logic is Horsey Horseless (cf. Rindova & Petkova, 2007), a car that was presumably invented in 1899 with a head of a horse (i.e., more familiar as means for transportation) attached to the front to make people feel more at ease with the strange new vehicle. For an image, see content.time.com/time/specials/2007/article/0,28804,1658545_1657686,00.html and to read about the idea to make the horse head hollow to be able to put fuel in it.

Leder, 2007), presumably because the extra elaboration increases their understanding of the product. Taken together, these insights suggest that when introducing complex novelty, interest might be increased by making it easier to understand rather than only highlighting the innovative elements.

Yet, in addition to increasing *actual* coping potential (i.e., product-specific understanding), it is also plausible that a more general subjective feeling of coping potential increases interest in complex novelty. In this view, people are predicted to become more interested in complex novelty when they *perceive* they can deal with complex novelty, such that they can tolerate or even enjoy the unfamiliarity and difficult to understand component of complex novelty. Perceived coping potential thus refers to general psychological state in which people evaluate complex novelty, which is independent of features of the complex novelty itself.

Indirect evidence indeed points to such a relation between perceived coping potential and people's preference for predictability and familiarity. For instance, when people experience high as opposed to low personal control, they are more likely to accept disorder and randomness (e.g., Rutjens, Van Harreveld, Van der Pligt, Kreemers, & Noordewier, 2013; see also Kay et al., 2009) and thus possibly also novelty. In addition, people who feel certain are more likely to go for novel products whereas people who feel uncertain are more likely to prefer familiarity (Oishi et al., 2012; see also Van Horen & Pieters, 2013). Finally, people who focus on fascination or growth appreciate novelty more than people who focus on danger or maintaining or

attaining security (Carbon, Faerber, Gerger, Forster, & Leder, 2013; promotion vs. prevention focus, Gillebaart, Förster, & Rotteveel, 2012).

Although rather diverse and not always focusing on *complex* novelty, these findings suggest that contextual factors related to coping potential predict preferences for novel or disorderly targets. Translating this to interest in complex novelty, this suggests that when people are in a state of high coping potential, they feel they can deal with the unfamiliarity and difficulty component of complex novelty, whereas when they are in a state of low coping potential, this same unfamiliarity and difficulty component can be experienced as challenging or even stressful (e.g., Oishi et al., 2012). As such, people are predicted to be more interested in complex novelty when they feel they have high vs. low coping potential. When introducing complex novelty, it is therefore important to do this in settings where people feel they can cope.

Importantly, this may provide innovators with alternative means to increase interest in complex novelty. Rather than concentrating only on increasing product-specific understanding (actual coping potential) they may benefit from increasing the idea that people can cope (perceived coping potential). Moreover, this logic suggests that coping potential can affect interest without changing novelty-complexity evaluations. This may be of importance to innovators, who might worry that increasing coping potential lowers the perceived innovativeness of their products. In addition, this implies that the two appraisals underlying interest (novelty-complexity and coping potential; Silvia, 2005) can independently produce interest.

In sum, it seems that people need to have a sense that they can understand complex novelty to become interested in it. This can either be through *actual* coping potential (i.e., product-specific understanding) or through *perceived* coping potential (i.e., feeling able to deal with difficulty understanding). We predict that people who experience relatively high actual or perceived coping potential are more interested in complex novelty than people who experience relatively low actual or perceived coping potential. To test this hypothesis, we measure interest in complex new products (Experiments 5.1 and 5.2) and recent inventions (Experiment 5.3), after increasing actual coping potential by communicating similarity with familiar products (Experiments 5.1 and 5.2) or after increasing perceived coping potential in an autobiographical recall task (Experiment 5.3). In all studies, we included novelty and complexity measures, to test the (in)dependence of the novelty-complexity and coping potential appraisals.

**Pretest**

To select complex novel stimuli for Experiments 5.1 and 5.2, we conducted a pretest. We selected 12 complex novel products based on an internet search. An Amazon's Mechanical Turk (MTurk) sample ($N$ = 30; US participants only and at least 96% of previous studies completed [i.e., hit rate]; age/gender information unavailable) viewed pictures of the products in random order, including the product name: robot vacuum cleaner, Mercator personal manager bracelet, Sci-Fi LED watch, iTaste 134 E-Cigarette, Orbit dry ice washing machine, flexible 6-inch organic light emitting diode (the picture made it clear that this

was a phone), vibrating ring alarm, bio polymer refrigerator, MAB computerized cleaning flies, smart stop smoking wearable device, flexible wrist computer, headbones conduction headphones.

**Table 5.1:** Mean (and SD) interest, coping potential, novelty, and complexity of the four products selected for the main study (Pretest).

| | dry ice washing machine | bio polymer refrigerator | MAB robotic cleaning flies | personal manager bracelet |
|---|---|---|---|---|
| interest | 6.35 (0.84) | 6.62 (0.78) | 6.05 (1.12) | 5.93 (1.09) |
| coping potential | 3.51 (1.60) | 4.18 (1.71) | 2.77 (1.36) | 4.37 (1.59) |
| novelty | 6.25 (0.97) | 6.35 (0.77) | 6.07 (1.04) | 5.55 (0.95) |
| complexity | 5.90 (1.28) | 6.15 (1.07) | 6.02 (1.07) | 5.33 (1.20) |

Note. Other products in the pretest were not selected because they were rated as relatively familiar (means equal or smaller than 4; vacuum cleaner, e-cigarette), relatively simple (means equal or smaller than 4; e-cigarette), relatively high coping potential (means equal or higher than 4.5; LED watch, e-cigarette, phone, ring, flexible arm computer, headphones), or relatively low interest (means lower than 5.5; vacuum cleaner, e-cigarette, stop smoking device).

Each product was evaluated in terms of *interest* (interesting, boring [reverse coded]; overall $\alpha$ = .88[14]), *novelty* (novel, familiar [reverse coded]; overall $\alpha$ = .90), *complexity* (complex, simple [reverse coded]; overall $\alpha$ = .92) and *coping potential* ("I feel able to understand the product", "I have a sense of what this product can be used for", "I am unsure how to try this product" [reverse coded], reliably adapted from Silvia, 2005; overall $\alpha$ = .93). The four products chosen for the main study were rated as interesting, but not extremely so (to avoid ceiling

[14] All alphas reported in this pretest and subsequent studies are Cronbach's alphas on all relevant items.

effects), relatively low in terms of coping potential and high on novelty and complexity (see Table 5.1). The products were: Orbit dry ice washing machine, Bio polymer refrigerator, MAB computerized cleaning flies, Mercator personal manager bracelet.[15] In the next two studies, we tested whether increasing the actual coping potential of these products would also increase interest in it.

### Experiment 5.1: Similarity to a Familiar Product

In Experiment 5.1, we tested whether communicating similarity of a complex novel product to a comparable familiar product would increase interest in it. Previous research showed that communicating analogies of a new product to something known increases product comprehension (Feiereisen, Wong, & Broderick, 2008; Gregan-Paxton, Hibbard, Brunel, & Azar, 2002). Based on this, we predicted that communicating similarity of a complex novel product with a comparable familiar product would increase actual coping potential and interest in the product.

In addition, for exploratory purposes we included a measure of individual differences in innovativeness and curiosity (Curiosity and

[15] For a picture and more information about the products, see:

- Orbit dry ice washing machine: see http://www.wired.co.uk/news/archive/2012-02/17/dry-ice-washing-machine
- MAB computerized cleaning flies: see http://electroluxdesignlab.com/en/submission/mab/
- Bio polymer refrigerator: see http://inhabitat.com/zero-energy-bio-refrigerator-cools-your-food-with-future-gel/
- Mercator personal manager bracelet: see http://www.designbuzz.com/mercator-personal-manager-besoms-a-fashion-accessory-for-the-trendy/

Exploration Inventory [CEI-II]; Kashdan et al., 2009). The Curiosity and Exploration Inventory measures the extent to which people are motivated to look for new knowledge and experiences and embrace the uncertainty and unpredictability of everyday situations. The Innovativeness scale (Goldsmith & Hofacker, 1991) measures the extent to which people are early vs. late adopters of novel products (Rogers, 2003). We predicted that high curious people and people who are often the first in knowing or owning novel products might be less affected by communicating similarity than low curious people or people who are late in knowing or owning novel product. These people are more likely to be interested in the products independent of our manipulation because the complexity is not necessarily challenging (and maybe even exciting, see Kashdan et al., 2009) and interest in novelty is part of being an innovative person (see Goldsmith & Hofacker, 1991).

**Method**

A total of 100 participants were recruited on MTurk (US participants only, hit rate 96%, age/gender information unavailable). First, they filled out the Curiosity and Exploration Inventory (CEI-II, Kashdan et al., 2009; e.g., "I am at my best when doing something that is complex or challenging", $\alpha$ = .91), followed by the Innovativeness scale (Goldsmith & Hofacker, 1991; e.g., "In general, I am among the first in my circle of friend to buy new products or technologies", where we specified each item such that it referred to novel products or technologies; $\alpha$ = .83). Then, they were randomly assigned to one of the two conditions: the similarity vs. control condition.

Participants viewed pictures from the four complex new products selected in the pretest and evaluated each product before viewing the next one. In the *control condition*, they saw the pictures with the product title: Orbit dry ice washing machine, Bio polymer refrigerator, MAB computerized cleaning flies, Mercator personal manager bracelet. In the *similarity condition*, they saw the pictures with the product title as well as similarity information: The Orbit dry ice washing machine works just like a regular washing machine, but without water and soap. / The Bio polymer refrigerator works just like a regular refrigerator, but with a special gel to keep your products cool. / The MAB computerized cleaning flies works like a regular vacuum cleaner, but with multiple small cleaning objects that move independently and automatically find dirt. / The Mercator personal manager bracelet works like your personal assistant, which you can wear as a bracelet.

Participants evaluated the products sequentially and in the same order. Below the product information, participants could complete the dependent measures. First, we measured interest in the product by asking to what extent they agreed with the following four statements about the product (reliably adapted from Silvia, 2005; $\alpha = .89$): "I think this product is interesting", "I think this product is boring" (reverse coded), "This product makes me feel curious", "I would like to try this product". Then, we measured coping potential ($\alpha = .83$), novelty ($\alpha = .71$), and complexity ($\alpha = .80$) using the same items as in the pretest. All questions could be answered on scales ranging from 1 = *not at all*, to 4

= *moderately*, to 7 = *extremely*. After evaluating all four products the study ended and participants were thanked and debriefed.

**Results**

In this and subsequent studies, we did not conduct null hypothesis significance tests but instead, we calculated effect sizes to measure the magnitude of effects (Trafimow & Marks, 2015; see also Lakens, 2013). Specifically, we report Glass's Δ when we compare means relative to a control condition (with the *SD* of the control condition; Experiments 5.1 and 5.2) and Cohen's *d* (with pooled *SD*) when we compare experimental groups without a control condition (Experiment 5.3). In addition, when referring to main effects or interactions, we also report eta squared ($\eta^2$) or standardized Betas (βs) where relevant.

**Table 5.2:** Mean (and SD/SE) interest, coping potential, novelty, and complexity as a function of condition (similarity vs. control; Experiment 5.1).

| | **similarity** | **control** | **Glass's Δ** |
|---|---|---|---|
| interest | 5.80 (0.90/0.13) | 5.43 (0.97/0.14) | 0.38 |
| coping potential | 4.59 (1.08/0.15) | 4.14 (1.02/0.15) | 0.44 |
| novelty | 5.48 (0.93/0.13) | 5.30 (0.87/0.12) | 0.21 |
| complexity | 4.94 (1.20/0.17) | 4.87 (0.88/0.13) | 0.07 |

Results showed that (see Table 5.2) participants in the similarity condition reported more interest in the products ($M$ = 5.80, $SD$ = 0.90) than participants in the control condition ($M$ = 5.43, $SD$ = 0.97; Glass's Δ = 0.38). In addition, participants in the similarity condition reported more coping potential with the product ($M$ = 4.59, $SD$ = 1.08) than participants in the control condition ($M$ = 4.14, $SD$ = 1.02;

Glass's $\Delta$ = 0.44). Finally, participants in the similarity vs. control condition rated the products fairly similar in terms of novelty ($M$ = 5.48 $SD$ = 0.93 vs. $M$ = 5.30, $SD$ = 0.87; Glass's $\Delta$ = 0.21) and complexity ($M$ = 4.94, $SD$ = 1.20 vs. $M$ = 4.87, $SD$ = 0.88; Glass's $\Delta$ = 0.07).

Next, we checked the effects of individual differences in curiosity and innovativeness, using standardized means for the curiosity (CEI)[16] and innovativeness scale.

**Curiosity.** The effect size of the interaction between similarity/control condition and curiosity on complexity was $\eta^2$ = .03, and on coping potential $\eta^2$ = .03 (other interaction effect sizes, $\eta^2$ = .01). In addition, the effect size of the main effect of curiosity on interest was $\eta^2$ = .09, and on coping potential $\eta^2$ = .05 (other curiosity main effect sizes, $\eta^2$ = .00). The effect size of the main effect of similarity/control condition on interest was $\eta^2$ = .04, and on coping potential $\eta^2$ = .04 (other similarity/control effect sizes, $\eta^2$ = .00).

To interpret the curiosity x similarity/control condition interactions, we ran a regression with similarity/control condition, low/high curiosity (standard deviation below/above the mean, following Aiken & West, 1991; for all estimated means and $\beta$s, see Table 5.3), and the interactions on coping potential and complexity. For complexity, there was a similarity/control condition x low/high curiosity interaction with $\beta$ = .32 (other effects: $\beta$s between -.17 and .21). For coping potential, there was a similarity/control condition x

[16] For ease of presentation, we report results with the whole CEI-scale rather than with the embracing and stretching subscales. Results using the subscales are comparable.

low/high curiosity interaction with β = -.30, and a low/high curiosity main effect with β = .40. High curious people reported almost equal levels of coping potential in the similarity and control condition ($M_{similarity}$ = 4.64 vs. $M_{control}$ = 4.58, β = .03), whereas low curious people reported higher coping potential in the similarity condition than the control condition ($M_{similarity}$ = 4.55 vs. $M_{control}$ = 3.72; β = .39). So, for high curious people the similarity did not change their coping potential, whereas for low curious people it increased.

**Table 5.3.** Estimated interest, coping potential, novelty, and complexity as a function of low vs. high curiosity in the similarity vs. control condition (Experiment 5.1).

| | low curiosity | | | high curiosity | | |
|---|---|---|---|---|---|---|
| | similarity | control | β | similarity | control | β |
| interest | 5.46 | 5.19 | .14 | 6.13 | 5.67 | .24 |
| coping potential | 4.55 | 3.72 | .39 | 4.64 | 4.58 | .03 |
| novelty | 5.40 | 5.42 | -.01 | 5.56 | 5.17 | .22 |
| complexity | 4.73 | 5.05 | -.16 | 5.15 | 4.69 | .22 |

Note: βs in the table represent the comparison of the control vs. similarity condition in the regression. βs for the main effects for low/high curiosity: interest = .25 / coping potential = .40 / novelty = -.14 / complexity = -.17. βs for the similarity/control condition x low/high curiosity interaction: interest = .09 / coping potential = .30 / novelty = .19 / complexity = .32.

**Innovativeness.** The effect size of the main effect of innovativeness on interest was $\eta^2$ = .04. In addition, the effect size of the main effect of similarity/control condition on interest was $\eta^2$ = .03, and on coping potential $\eta^2$ = .04. The effect sizes of the interactions between similarity/control condition and innovativeness were negligible, $\eta^2$ = .00, and so were other effect sizes, $\eta^2$ <= .01. The

effect of similarity on interest was thus independent of individual differences in innovativeness.

In line with our predictions we found that communicating similarity of a complex novel product to a comparable familiar product increased interest in it. Communicating similarity also increased coping potential with the complex novel product and based on the appraisal structure of interest (Silvia, 2005), we assume that the increased interest is explained by this increased coping potential. Importantly, communicating similarity did not affect ratings of novelty or complexity of the products. Therefore, the increased coping potential cannot be explained by the product seeming more familiar or simple. This finding also suggests that the two appraisals underlying interest (novelty-complexity and coping potential) can be influenced separately and jointly but independently predict interest.

It should be noted, however, that besides communicating similarity (e.g., "works like a regular vacuum cleaner"), we also gave participants some extra information about how the complex novel products work (e.g., "works with multiple small cleaning objects that move independently and automatically find dirt"). Consequently, we cannot be certain that it is the similarity, the information, or a combination of both that drives our effect. In the next study, we therefore manipulated similarity and information separately.

### Experiment 5.2: Similarity or Information

In Experiment 5.2, we presented participants with the same complex novel products as in Experiment 5.1. Next to a control

condition that only gave the product title, we either communicated similarity, gave information about how it works, or both. Because all this would increase people's understanding of the product, we predicted that relative to the control condition, communicating similarity, information, and similarity + information would all increase actual coping potential and interest in the complex novel product.

We improved our manipulation in three ways. First, to more clearly communicate similarity in the similarity condition and to distinguish it from the information on how the products work, we now explicitly state "similar to" (rather than "works just like" in Experiment 5.1). In addition, we improved the information on the Orbit dry ice washing machine, such that it now explained what is new about it, like the information about the other products (i.e., "works with dry ice to clean clothes", rather than "works without water and soap", which could be interpreted as an advantage and focuses less on the innovative part). Finally, in this study, products were now presented in random order rather than in the same order.

**Method**

Similar to Experiment 5.1, participants ($N$ = 200; 80 females, 120 males; $M_{age}$ = 32.93 years, $SD_{age}$ = 10.24; all American; education distribution was 0.5% none, 18.5% high school/GED, 35% some college, 39% bachelor's degree, 5.5% master's degree, 1.5% doctoral degree/PhD) were randomly assigned to conditions and viewed pictures of the products with a product title. In the *control condition*, this was all they saw and read. In the *similarity condition*, participants read: Orbit dry ice washing machine: similar to a regular washing machine. /

Bio polymer refrigerator: similar to a regular refrigerator. / MAB computerized cleaning flies: similar to a regular vacuum cleaner. / Mercator personal manager bracelet: similar to a personal assistant. In the *information condition*, participants read: Orbit dry ice washing machine: works with dry ice to clean your clothes. / Bio polymer refrigerator: works with a special gel to keep your products cool. / MAB computerized cleaning flies: works with multiple small cleaning objects that move independently and automatically find dirt. / Mercator personal manager bracelet: works with software in a bracelet to keep you organized. In the *similarity + information condition,* participants read both the similarity and information (i.e., combination of sentences described above). Interest ($\alpha$ = .90), coping potential ($\alpha$ = .80), novelty ($\alpha$ = .69), and complexity ($\alpha$ = .75) were measured in the same way as in Experiment 5.1.

Next, we asked some background questions. To be able to check for potential mood differences, we asked, "How do you feel right now?" on a scale 1 = *negative* to 7 = *positive*. Then, as previous experience with the products could affect coping potential independent of our manipulations, we asked, "Please indicate below whether you have seen the products you evaluated before you participated in this study?" (yes/no) for each product separately (2.5% saw the Orbit dry ice washing machine before, 7.5% the Bio polymer refrigerator, 2% the MAB computerized cleaning flies, and 5% the Mercator personal manager bracelet; excluding these participants did not affect the pattern of results so they were included in the analyses). Finally, participants reported their gender, age, nationality (American, other; open question),

educational level (none, high school/GED, some college, bachelor's degree, master's degree, doctoral degree/PhD, not sure) and whether they had participated before in a similar study, in which we asked participants to evaluate the same four products (i.e., Experiment 5.1; yes/no—two participant indicated to have participated before, which did not affect the pattern of results so they were included in the analyses). After completing the background questions, participants were thanked and fully debriefed.

**Results**

Inspection of the mean novelty of the separate products showed that the bracelet was overall evaluated as less novel ($M$ = 4.48) than the other products (means ranged between 5.82 and 5.83). Also, the bracelet was evaluated as less complex ($M$ = 4.34) than the other products (means ranged between 5.18 and 5.65). In the time between the data collection of Experiments 5.1 and 5.2, several smart watches have been introduced to the market and it seems reasonable to assume that the bracelet became less novel and less complex to participants. Therefore, the bracelet is not a suitable product to test our reasoning and we excluded the ratings of this product from the main analyses. Including the bracelet in the analyses resulted in a similar, but weaker pattern of results.

Results showed that (see Table 5.4) compared to participants in the control condition ($M$ = 5.26, $SD$ = 1.12), participants reported more interest in the products in the similarity condition ($M$ = 5.74, $SD$ = 0.91; Glass's $\Delta$ = 0.43), and somewhat more in the information condition ($M$ = 5.59, $SD$ = 1.23; Glass's $\Delta$ = 0.29), and the similarity +

information condition ($M$ = 5.59, $SD$ = 1.22; Glass's Δ = 0.29). In addition, compared to participants in the control condition ($M$ = 3.57, $SD$ = 1.12), participants reported to have more coping potential in the similarity condition ($M$ = 4.12, $SD$ = 0.96; Glass's Δ = 0.49), the information condition ($M$ = 4.31, $SD$ = 1.20; Glass's Δ = 0.66), and the similarity + information condition ($M$ = 4.15, $SD$ = 0.83; Glass's Δ = 0.52).

**Table 5.4:** Mean (and SD/SE) interest, coping potential, novelty, and complexity as a function of condition (similarity vs. information vs. similarity + information vs. control; Experiment 5.2).

| | similarity | information | similarity + information | control condition |
|---|---|---|---|---|
| interest | 5.74 (0.91/0.13) Δ = 0.43 | 5.59 (1.23/0.17) Δ = 0.29 | 5.59 (1.22/0.17) Δ = 0.29 | 5.26 (1.12/0.16) |
| coping potential | 4.12 (0.96/0.14) Δ = 0.49 | 4.31 (1.20/0.17) Δ = 0.66 | 4.15 (0.83/0.12) Δ = 0.52 | 3.57 (1.12/0.16) |
| novelty | 6.08 (0.86/0.12) Δ = 0.71 | 5.98 (0.97/0.14) Δ = 0.58 | 5.68 (1.14/0.16) Δ = 0.19 | 5.53 (0.78/0.11) |
| complexity | 5.49 (0.98/0.14) Δ = 0.26 | 5.38 (1.09/0.15) Δ = 0.16 | 5.46 (1.02/0.14) Δ = 0.23 | 5.22 (1.03/0.15) |

Note: Δ = Glass's delta relative to control condition.

Interestingly, and different from Experiment 5.1, compared to participants in the control condition ($M$ = 5.53, $SD$ = 0.78), participants rated the products as more novel in the similarity condition ($M$ = 6.08, $SD$ = 0.86; Glass's $\Delta$ = 0.71) and the information condition ($M$ = 5.98, $SD$ = 0.97; Glass's $\Delta$ = 0.58). Novelty ratings in the similarity + information condition ($M$ = 5.68, $SD$ = 1.14; Glass's $\Delta$ = 0.19) were fairly similar to those in the control condition. Finally, compared to participants in the control condition ($M$ = 5.22, $SD$ = 1.03), participants rated the products as somewhat more complex in the similarity condition ($M$ = 5.49, $SD$ = 0.98, Glass's $\Delta$ = 0.26) and the similarity + information condition ($M$ = 5.46, $SD$ = 1.02, Glass's $\Delta$ = 0.23), while complexity ratings were fairly similar in the information condition ($M$ = 5.38, $SD$ = 1.09, Glass's $\Delta$ = 0.16).

Finally, compared to the control condition ($M$ = 5.59, $SD$ = 1.22), participants' mood was fairy similar in the similarity condition ($M$ = 5.52, $SD$ = 1.20, Glass's $\Delta$ = -0.06), the information condition ($M$ = 5.63, $SD$ = 1.18, Glass's $\Delta$ = 0.03), and the information + similarity condition ($M$ = 5.78, $SD$ = 1.33, Glass's $\Delta$ = 0.16).

**Discussion**

Taken together, the findings of Experiments 5.1 and 5.2 show that people are more interested in complex novelty when similarity to a comparable familiar option is communicated and/or information is given on how the product works. We assume that interest increased because the similarity and/or information increased actual coping potential (i.e., product-specific understanding; see also Silvia, 2005). It

should be noted, however, that our manipulations could have increased perceived coping potential as well. The fact that people understand complex novelty might make them feel competent, which could also induce a readiness for complex novelty in general. Moreover, the connection to something familiar in the similarity condition could, besides product-specific understanding, also provide people with a more general safe feeling that could serve as a base for interest in complex novelty (see also Carbon et al., 2013; Gillebaart et al., 2012; Oishi et al., 2012). We will come back to this in the General Discussion.

Next, it is interesting that the strongest effects were obtained by communicating similarity. This finding is important for product developers who want to introduce their complex new product. Rather than only focusing on the innovative components of their product, they need to address the feeling that people can cope with the innovation. That this works best by explaining how the product is similar to an already known option is probably not the first thing that comes to mind when wanting to introduce a complex novel product.

In fact, when we asked an MTurk sample to imagine that they were product developers and predict what would be effective communication, they did not make choices that matched these findings. Specifically, participants ($N$ = 50; 22 females, 28 males; $M_{age}$ = 32.76 years, $SD_{age}$ = 9.25; all American; Education distribution was 24% high school/GED, 32% some college, 38% bachelor's degree, 4% master's degree, 2% Doctoral degree/PhD; 4 participants participated in one of the previous studies, which did not affect the pattern of results so they were included in the analyses) were asked to evaluate the stimulus

materials used in Experiment 5.2, to predict the most effective way to create interest in the product. We stated:

> Imagine you are a product developer. After an extensive development process, you created a new technological product. You are very excited about the innovativeness of the product and you can't wait to communicate to the world about it. Together with your marketing team, your aim is to create "a buzz" about your product: get attention, make people talk about your product and get them interested to find out more about it. There are of course many other new products that are being introduced. What would be an effective communication method to stand out and to be evaluated as innovative and interesting?

Then, they saw the picture of the products and saw all four text options (product title only, similarity to a familiar product, information about how it works, similarity and information together; see Experiment 5.2). They evaluated each of these four options on "People would be curious to find out more about it", "The product would attract attention", "People would be interested in the product" and "The product would be evaluated as innovative", on 7-point scales (1 = *not at all* to 7 = *extremely*). Then, they were asked to rank order the options from 1 = *most effective* to 4 = *least effective*.

We aggregated the items for the product title only ($\alpha$ = .96), similarity ($\alpha$ = .95), information ($\alpha$ = .93), and similarity + information ($\alpha$ = .96) and compared the means. Results showed that relative to only

the product title ($M$ = 4.08, $SD$ = 1.42), the similarity text was expected to be less effective ($M$ = 3.62, $SD$ = 1.27, Glass's $\Delta$ = = -0.32), whereas the information text ($M$ = 5.47, $SD$ = 0.83, Glass's $\Delta$ = 0.98) as well as the similarity + information text ($M$ = 5.36, $SD$ = 0.93, Glass's $\Delta$ = 0.90) was expected to be more effective. In line with this, in the rank ordering, only 5.5% chose the similarity text as most effective, whereas 14.5% chose the product title only, 45% the information, and 25.25% the similarity and information. So, while our results showed that communicating similarity is the most effective strategy to increase interest in complex novelty, participants in this study actually think this is the least effective option.

The next study tests whether solely inducing perceived coping potential (i.e., a state in which people can tolerate complex novelty) also increases interest in complex novelty.

### Experiment 5.3: Recall Coping Potential

In Experiment 5.3, we asked people to recall a situation in which they experienced high vs. low coping potential before they evaluated different recent inventions. Based on previous autobiographical recall procedures (e.g., De Hooge, Nelissen, Breugelmans, & Zeelenberg, 2011; Noordewier & Breugelmans, 2013) we reasoned that when people recall such an event, this would temporarily affect feelings of coping potential. Specifically, the recall was assumed to make memories accessible (e.g., Higgins, Rholes, & Jones 1977) through the spreading of activation of related constructs via an associative network (e.g.,

Berger & Fitzsimons, 2008; Collins & Loftus 1975; Neely, 1977). This temporarily actives feelings and associations related to high vs. low coping potential. Prior to evaluating the inventions, this manipulation aimed to induce a general psychological state in which people are less or more able to tolerate the unfamiliar and difficulty component of complex novelty (see also Smith & Semin, 2007). It thus constitutes a contextual manipulation of coping potential rather than a product-specific manipulation. We predicted that people who were in a state of high coping potential would be more interested in complex novel inventions than people who were in a state of low coping potential.

**Method**

We recruited a total of 103 participants (44 females, 59 males; $M_{age}$ = 36.93 years, $SD_{age}$ = 11.37) on MTurk. Settings were the same as in Experiments 5.1 and 5.2 (96% hit rate, US only). Nationality was distributed as: 101 Americans, 1 Italian, and 1 Asian. Educational level was distributed as: 11 high school/GED, 33 some college, 41 bachelor's degree, 12 master's degree, and 6 doctoral degree/PhD. Participants were randomly assigned to conditions and were asked to recall an event in which they had high vs. low coping potential. After general instructions, we explained what we meant with high [low] coping potential:

> Coping potential is the extent to which one is able to deal with an event. In some situations, people have low coping potential and in other situations, people have high coping potential. In this study, we are interested in high [low] coping potential situations. Having high

> [low] coping potential means that you have [lack] the skills, knowledge, or resources to deal with an event. So, even if [when] things are complicated, unfamiliar, or unclear, someone with high [low] coping potential is able to [cannot] deal with it. Please take a moment to think about high [low] coping potential and what this means to you.

Then, we asked participants:

> Please describe an event in your life that was complex or unfamiliar you had high [low] coping potential; you had [lacked] the skills, knowledge, or resources to deal with it; so, you could [could not] understand the situation and you were able/unable to deal with it.

Note that both in the low and the high coping potential condition, participants were asked to recall a complex or unfamiliar event. We did this to avoid that the content of the recall would be different in terms of complexity. We asked participants in the high [low] coping potential condition to recall the situation by responding to the questions: "What was complex or unfamiliar about the event?", "How did you realize that you understood [did not understand] the event?", "How did you realize that you could deal [were unable to deal] with the event?", "Which skills, knowledge, or resources did you have that enabled you [were you lacking that prevented you] to deal with the event?" Stories were diverse. Participants, for example, recalled events related to work challenges, moving house, death, illness, addiction, money issues, or

accidents. Some reported examples of coping are staying calm, relying on social support, using experience (high coping potential) vs. feeling overwhelmed, not knowing what to do, and lacking experience (low coping potential).

To get a better understanding of the content of the stories and similarities or differences between conditions, two independent coders who were blind to condition, rated the material. They rated, "To what extent is the situation complex?" ($r$ = .61; $N$ = 97[17]), "To what extent could the person deal with the situation?" ($r$ = .86; $N$ = 92), "To what extent could the person influence the situation (i.e., control)?" ($r$ = .60; $N$ = 94) on 1 = *not at all* to 7 = *extremely*. Finally, they rated "What was the valence of the situation?" on 1 = *negative* to 7 = *positive* ($r$ = .64; $N$ = 94) and the type of situation (e.g., work, illness, death, relations).

After aggregating the ratings of both coders, we compared the means between high vs. low coping potential conditions. This showed that the high coping potential stories reflected a higher ability to deal with the situation ($M$ = 5.48, $SD$ = 0.88) than the low coping potential stories ($M$ = 2.16, $SD$ = 0.91; $d$ = 3.71). In addition, the high coping potential stories reflected more controllability ($M$ = 4.06, $SD$ = 1.76) than the low coping potential stories ($M$ = 2.91, $SD$ = 1.37, $d$ = 0.73). Also, the high coping potential stories were somewhat more positive ($M$ = 2.81, $SD$ = 1.04) than the low coping potential stories ($M$ = 2.26, $SD$ = 0.81, $d$ = 0.59) and somewhat less complex ($M$ = 5.45, $SD$ = 0.92) than low coping potential stories ($M$ = 5.66 $SD$ = 0.85, $d$ = -0.24).

[17] Note that there are sometimes missing data, as dimensions were only coded when information was available to accurately code it.

Finally, the distribution of the type of situations was: 26.5% work, 12.7% death, 9.8% illness, 7.8% relations, 5.9% money, 4.9% computer or technical issues, 4.9% accidents or mechanical failure, 3.9% education, 2.9% moving house, 15.7% other (e.g., addiction, low self-esteem), 4.9% missing (e.g., no clear information).

High as compared to low coping potential stories thus reflected higher ability to deal with the situation and higher controllability, which confirms that people indeed recalled situations in which they had relatively high vs. low coping potential. The differences in valence and particularly complexity were unanticipated, but compared to the other findings relatively weak.

After the recall task, we asked people to report their level of coping potential ("How would you rate your current coping potential?" from 1 = *low coping potential* to 7 = *high coping potential*). Then, the study continued to the evaluation of three recent inventions. Participants read, in random order, approximately 100-word descriptions of three inventions: 1) A temporary electronic tattoo, able to read brain wave activity, that could allow people to control machines with their mind; 2) Nano sensors for health monitoring, implants that can monitor molecules and health of cells; and 3) A cloud machine, a weather modification device that can influence the climate. For each invention, we measured interest (i.e., "This invention is interesting, this invention is boring" [reverse coded], "This invention makes me feel curious", "I would be interested in more information about this invention", $\alpha = 88$; reliably adapted from Silvia, 2005) and coping potential (i.e., "This inventions is hard to understand" [reverse coded], "I have a sense of

what the invention can be used for", $\alpha$ = .68; sufficiently reliably adapted from Silvia, 2005). All items could be answered on 7-point scales from 1 = *not at all* to 7 = *extremely*.

Finally, participants were asked various background questions. First, to be able to check for potential mood differences, we asked, "How do you feel right now?" on a scale 1 = *negative* to 7 = *positive*. Then, to be able to check whether recalling a high vs. low coping potential event was equally difficult, we stated, "We asked you to describe a recent event in your life that was complex, unfamiliar, or ambiguous with a certain level of coping potential. How difficult was it to come up with this event?". The scale ranged from 1 = *not at all* to 7 = *extremely*.

Then, as previous knowledge about the inventions could affect coping potential independent of our manipulation, we asked, "Please indicate to what extent you knew about the existence of the inventions before you participated in this study?" for each invention separately (i.e., "Did you know about...") from 1 = *not at all* to 7 = *in great detail*. For the tattoo ($M$ = 1.18, $SD$ = 0.68), the cloud machine ($M$ = 1.83, $SD$ = 1.45) and the nano sensors ($M$ = 1.64, $SD$ = 1.30) ratings were very low, which shows that the inventions were indeed novel to participants.

Finally, we asked participants to report their gender, age, nationality (American, other; open question), educational level (none; high school/GED; some college; bachelor's degree; master's degree; doctoral degree/PhD; not sure) and whether they had participated before in a study on coping potential and inventions (i.e., we ran a pilot a couple of month before this study; yes/no—nobody indicated to have

participated before). After completing the background questions, participants were thanked and fully debriefed.

**Results and Discussion**

A comparison of the general coping potential measure in the high vs. low coping potential recall condition (see Table 5.5), showed that, as predicted, participants who recalled a high coping potential situation reported higher levels of coping potential $M$ = 5.78, $SD$ = 0.85) than people who recalled a low coping potential situation ($M$ = 4.69, $SD$ = 1.67; $d$ = 0.82). In addition, participants in the high coping potential condition were more interested in the invention ($M$ = 5.91, $SD$ = 0.77) than participants in the low coping potential condition ($M$ = 5.40, $SD$ = 0.90; $d$ = 0.61). Finally, participants in the high coping potential condition reported somewhat more coping potential with the invention ($M$ = 5.15, $SD$ = 0.86) than in the low coping potential condition ($M$ = 4.85, $SD$ = 1.07; $d$ = 0.31).

Next, we checked whether controlling for differences in knowing about the invention and participants' mood changed the pattern of results. First, an ANCOVA with high vs. low coping potential condition on interest and coping potential with knowing about the inventions as covariate (mean of the three measures) showed that knowing before had an effect on coping potential with the inventions, $\eta^2$ = .06, and only weakly on interest, $\eta^2$ = .02. With knowing before in the analyses, the effect of high vs. low coping potential on interest remained, $\eta^2$ = .07, and the effect on coping potential was weak, $\eta^2$ = .01.

**Table 5.5:** Mean (and SD/SE) coping potential (general and with the invention) and interest as a function of recall condition (high vs. low coping potential; Experiment 5.3).

| | high coping potential | low coping potential | Cohen's *d* |
|---|---|---|---|
| general coping potential | 5.78 (0.85/0.12) | 4.69 (1.67/0.23) | 0.82 |
| interest in invention | 5.91 (0.77/0.11) | 5.40 (0.90/0.12) | 0.77 |
| coping potential with invention | 5.15 (0.86/0.12) | 4.85 (1.07/0.15) | 0.31 |

Next, while coping potential condition affected mood somewhat, $\eta^2 = .03$, there was still an effect of high vs. low coping potential on interest when mood was added as a covariate to the analyses, $\eta^2 = .06$, and the effect on coping potential was weak, $\eta^2 = .02$, as before. Interestingly, besides coping potential condition, mood also had an effect on interest, $\eta^2 = .07$ (other effects, $\eta^2 = .00$).

In sum, in line with our predictions we found that people who experienced more coping potential were more interested in complex novelty. While effects on specific coping potential with the invention were weaker, it seems likely that the interest was higher in the high vs. low coping potential condition because people felt more able to deal with the unfamiliar and complex component of novelty.

## General Discussion

Complex novelty like new technologies can be exciting in terms of promising possibilities. At the same time, people might feel that they do

not exactly grasp what the product or invention is or what it can be used for (see also Berlyne, 1971; Hoeffler, 2003; Mukherjee & Hoyer, 2000). This lack of understanding might hinder the success of complex novel products and inventions. That is, feeling interested is driven by a combination of a novelty-complexity appraisal and a coping potential appraisal (i.e., having the skills, knowledge, and resources to deal with an event; Silvia, 2005). Yet, the more complex and novel a product is, the more it interferes with people's preference to understand their environment (e.g., Aronson et al., 1968; Berlyne, 1971; Gawronski & Strack, 2012; Kay et al., 2009; Noordewier & Breugelmans, 2013; Proulx et al., 2012) and the less likely it becomes that people experience coping potential.

In agreement with this, we showed that people with relatively high coping potential are more interested in complex novelty than people with relatively low coping potential. We show this in two different ways. First, by increasing product-specific understanding of the product through communication similarity and/or providing information on how the product works, we increased *actual* coping potential (Experiments 5.1 and 5.2). Second, using an autobiographical recall procedure, we induced feelings and association related to high vs. low coping potential to affect *perceived* coping potential (Experiment 5.3).

As said, by increasing actual coping potential, we may have increased perceived coping potential as well, by making people, for instance, feel competent dealing with complex novelty in general or providing them with a familiar base to become interested in other complex novel things (see also Carbon et al., 2013; Gillebaart et al.,

2012; Oishi et al., 2012). The manipulations of Experiments 5.1 and 5.2 may actually result in a mixture of actual and perceived coping potential. Future research could disentangle this by, for instance, investigating whether actual coping potential with one series of complex novel products can produce interest in another set of complex novel products. In addition, it could be investigated whether similarity or familiarity that does not directly affect product-specific understanding can increase coping potential and interest (e.g., product design that reminds people of something familiar, see also Carbon & Leder, 2005; Rindova & Petkova, 2007).

Low coping potential might be one of the reasons why many complex novel products fail (Castellion & Markham, 2012; Cierpicki et al., 2000; Schneider & Hall, 2011) as the uncertainty about its meaning or purpose might result in resistance rather than acceptance (see also Antioco & Kleijnen, 2010; Castaño et al., 2008; Hoeffler, 2003; Kleijnen et al., 2009; Oreg & Goldenberg, 2015). The finding that increasing coping potential increases interest in complex novelty fits a more general perspective on knowing states (cf. Keltner & Shiota, 2003; Silvia, 2008), that suggests that people first need to master a situation before they can appreciate it (e.g., Noordewier & Breugelmans, 2013; Noordewier, Topolinski, & Van Dijk, 2015). According to this perspective people will only approach an unknown, unpredictable, or unstructured situation when they feel they are able to cope with it.

In addition, our findings have implications for how to introduce complex novelty. Complex new products and technologies are more likely to become successful when they are introduced in settings where

people have high coping potential. People are more likely to be interested in complex novelty when they are, for instance, in control or certain as compared to lacking control or feeling uncertain (Oishi et al., 2012; Rutjens et al., 2013; Van Horen & Pieters, 2013). It is also conceivable that there are situations of extreme levels of coping potential that might result in actively approaching complex novelty. For instance, when people experience boredom (Bench & Lench, 2013) or extreme levels of structure (Rutjens, Van Harreveld, & Cunningham, 2015), the unfamiliar or puzzling nature of complex novelty might be pleasant mind activation.

In addition, rather than only highlighting the innovative elements of complex new products or technologies—which is a likely and maybe even the default strategy when wanting to introduce a new product (see also the study in the discussion of Experiment 5.2)—acceptance of complex novelty might be increased by making it easier to understand. This could be accomplished by communicating similarity to a familiar product, as done in Experiments 5.1 and 5.2, but probably also via familiarity in product design (Rindova & Petkova, 2007). At the same time, it should be noted that interest does not necessarily always translate to acceptance. While interest in complex novelty is a necessary pre-condition of the adoption of complex novelty, the relation between interest and acceptance is undeniably more complex than that. Practical issues (e.g., people cannot afford it or do not need it) might lower the interest-acceptance relationship and also after people find out more about the complex novel product, they could conclude not to like it (see also Muth et al., 2015 for a connection between interest, insight,

and liking). Yet, while not everybody necessarily may want to *own* complex novel products like a dry ice washing machine or computerized cleaning flies, for the development of these products, interest could contribute to support, (crowd) funding, and ultimately, success.

Finally, while product developers might worry that increasing actual or perceived coping potential might make their product seem more like other products, and thus more ordinary, this is not what we found. Our manipulations increased coping potential in Experiments 5.1, 5.2, and 5.3, but evaluations of novelty and complexity of the products and inventions remained unaffected (Experiments 5.1 and 5.3) or increased (Experiment 5.2). This suggests that the novelty-complexity and coping potential appraisals work independently (Silvia, 2005) and that it is indeed the ability to deal with complex novelty that predicts interest rather than decreased levels of novelty or complexity. Taken together, our findings suggest that people first need to feel able to cope, before they can become interested in cleaning their house using robotic cleaning flies, creating rainfall on a hot summer day with a weather modification device, or turning on their television with a brainwave tattoo.