Order, Complexity, and Aesthetic Preferences for Neatly Organized Compositions

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Abstract

Why do people like images of neatly organized compositions, collected on blogs like Things Organized Neatly©? We explored which factors might contribute to aesthetic preferences for these images of a set of objects, or parts of objects, organized in a neatly or tidy way, focusing on both stimulus and person properties related to order, complexity, and the balance between order and complexity.

In a large-scale online study, 421 participants chose which of two simultaneously presented images they preferred (100 pairs) and completed some personality questionnaires. The images within each pair were selected to be very similar except for how ordered and/or complex they were on certain perceptual dimensions. In a second part of the study, 84 of these participants also rated how ordered, complex, soothing, and fascinating they found the 184 images.

Images high in order and high in complexity were perceived as more fascinating, whereas images high in order but low in complexity were perceived as more soothing. Aesthetic preferences increased with increasing differences in soothingness and fascination between the two images. Subjective order and subjective complexity were both related to aesthetic appreciation, and independently so, suggesting that the balance between order and complexity involves no interaction. Participants differed in how often they preferred the more ordered, complex, soothing, and fascinating image in a pair, which could partly be attributed to age and personality. In general, stimulus and person interact in determining aesthetic appreciation, but deeper theoretical understanding of these interactions requires further investigation with more parametrically varied stimuli.

Keywords: aesthetics, order, complexity, individual differences

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For many centuries, philosophers and scientists as well as lay people have asked themselves why they aesthetically prefer some images over others. Previous research in the field of psycho-aesthetics has identified several factors that might contribute to our aesthetic preferences in general – objective and subjective image properties – as well as in interaction with properties related to the individual exhibiting the preference (Palmer, Schloss, & Sammartino, 2013).

Order (i.e., aspects related to the structure and organization of information in a stimulus), complexity (i.e., aspects related to the quantity and variety of information in a stimulus), and the balance between order and complexity have often been proposed as determinants or indicators of aesthetic appreciation (Van Geert & Wagemans, 2019).

Previous research on order, complexity, and aesthetic appreciation used very diverse stimulus sets and measures of order and complexity (both objective and subjective, different image calculations and ratings) as well as aesthetic appreciation (different tasks and ratings; Marin & Leder, 2013; Nadal, Munar, Marty, & Cela-Conde, 2010; Van Geert & Wagemans, 2019). Order and complexity were often investigated separately rather than in combination (Van Geert & Wagemans, 2019). In addition, various individual differences were investigated in various ways but most of these studies did not investigate which individual difference factors relate to these differences in appreciation (Van Geert & Wagemans, 2019; one exception is Lyssenko, Redies, & Hayn-Leichsenring, 2016). For example, individuals can differ in how they perceive order and complexity, but also in how their perceptions of order and complexity relate to their aesthetic appreciation (Van Geert & Wagemans, 2019). The various ways of studying individual differences include clustering or grouping of participants (e.g., Güçlütürk, Jacobs, & van Lier, 2016) and continuous correlation with diverse person properties (e.g., Lyssenko et al., 2016). Although plenty of studies investigated the relation

between complexity and aesthetic appreciation, the relation of order and the balance between order and complexity with aesthetic appreciation remains understudied (Van Geert & Wagemans, 2019). The current study provides an extensive case study, including several individual difference measures, several objective and subjective measures of order and complexity as well as several measures of aesthetic appreciation for one specific type of stimuli: images of neatly organized compositions. Also, it goes beyond an exclusive focus on complexity by investigating the relations between order, complexity, and aesthetic appreciation more broadly.

Images of neatly organized compositions are images of a set of objects, or parts of objects, organized in a neatly or tidy way. These images are immensely popular: More than 500,000 people are following the Tumblr-blog of Things Organized Neatly© (http://thingsorganizedneatly.tumblr.com/) curated by Austin Radcliffe (Radcliffe, 2016). This raises the question as to why this type of images is so popular and attracts the interest of so many people. We hypothesized factors related to the balance between order and complexity to play an important role in the aesthetic appreciation for images of neatly organized compositions. Therefore, we used this type of images to investigate the relation between aesthetic appreciation and stimulus and individual difference factors related to (the balance between) order and complexity. In addition, these images take an intermediate position between art stimuli with many diverse semantic contents and the simplified artificial stimulus sets which are often used. To provide insight in not only general factors related to appreciation but also individual differences, we collected data from a large-scale and diverse sample of participants (i.e., in age, gender, and level of education) in an online study.

Neatly Organized Compositions

A neatly organized composition is a set of objects, or parts of objects, organized in an orderly (i.e., tidy, neat) way (see Figure 1 for examples). Other terms that are related to this

topic are organization porn (i.e., stylized images of everyday objects arranged in a neat, visually pleasing way; Alleyne, 2015), knolling (i.e., arranging objects in parallel or in right angles as a way to organize them, a term first used by Andrew Kromelow in 1987 and popularized by Tom Sachs in 2009; Hay, 2015; Sachs, 2011), and flat lay photography (i.e., objects spread out on a flat surface and photographed from above; Innis, 2016). Although the blog of Things Organized Neatly© (http://thingsorganizedneatly.tumblr.com/) is a popular reference, images of neatly organized compositions circulate on various online sharing platforms like Reddit, Pinterest and Tumblr as well as on social media like Instagram (Alleyne, 2015). Ursus Wehrli, a Swiss artist, is also working with neatly organized compositions, both of daily-life objects and pieces of art (cf. books like "Tidying Up Art" and "The Art of Clean Up"; Wehrli, 2002, 2011). Wehrli even created an app to let people tidy up art themselves (Kein & Aber, 2012). Furthermore, his TED talk about tidying up art given in 2006 but put online in 2008 has more than 1,250,000 views (Green, 2013; Wehrli, 2006).

In lay interpretations, the appreciation of neatly organized images is often linked to obsessive-compulsive tendencies (e.g., Bielski, 2010; The Webbys, 2015). Furthermore, lay interpretations emphasize that some people watch the neatly organized images to calm down or to relax (e.g., Alleyne, 2015; Ellison, 2015), as these images bring "a sense of order to the chaos of everyday life" (Ellison, 2015).

Order, Complexity, and Aesthetic Appreciation

Both order and complexity have a long history as important factors influencing aesthetic appreciation (Van Geert & Wagemans, 2019). We will define objective complexity as aspects related to the quantity and variety of information in the stimulus, and objective order as aspects related to the structure and organization of the information in the stimulus (Van Geert & Wagemans, 2019).

Berlyne hypothesized stimuli with intermediate complexity levels to be aesthetically preferred above stimuli with low or high complexity (Nadal, 2007). Although many studies do find this inverted U-shaped relationship between complexity and aesthetic appreciation (e.g., Imamoglu, 2000; Munsinger & Kessen, 1964), others find either a positive linear (e.g., Friedenberg & Liby, 2016; Osborne & Farley, 1970) or a non-inverted U-shaped relationship (e.g., Phillips, Norman, & Beers, 2010). Nadal et al. (2010) proposed that the contradictory findings result from differences in how complexity was conceptualized, manipulated, and/or measured in these studies, as well as from the ignorance towards the multidimensionality of complexity. Van Geert and Wagemans (2019) suggested that one additional reason for the mixed findings could be that order was not investigated or controlled for in these studies, influencing the aesthetic appreciation of the stimuli independently from or in interaction with complexity.

Indeed, also aspects related to order have been found to influence aesthetic appreciation. In studies comparing aesthetic appreciation for symmetric and non-symmetric stimuli, symmetric patterns are often preferred (e.g., Cárdenas & Harris, 2006; Jacobsen et al., 2006; Weichselbaum et al., 2018). Also more complex types of perceptual balance are found to be an important predictor for aesthetic appreciation (e.g., Hübner & Fillinger, 2016; Wilson & Chatterjee, 2005). To our knowledge, the contribution of other aspects of order to aesthetic appreciation, like the presence of strong grouping cues (Wagemans et al., 2012), has not been investigated systematically.

Many theories and ideas concerning aesthetic appreciation, by both philosophers and empiricists (e.g., Descartes, Baumgarten, Fechner, Berlyne), include the importance of a right balance between order on the one hand and complexity on the other hand (Berlyne, 1960; Gilbert & Kuhn, 1953/1972). Berlyne (1960) hypothesized that moderate arousal potential would lead to the highest level of aesthetic appreciation, and that the principle of unity in

diversity would relate to this inverted U-shaped function: Whereas diversity relates to complexity, novelty, and ambiguity, and in that way leads to increasing arousal, unity would moderate or temper arousal. Furthermore, he expected individual differences in the optimal point of balance between order and complexity (Berlyne, 1960). Arnheim (1954/2004) stated that a balance between order and complexity is necessary to avoid boredom on the hand and confusion on the other hand. Complexity without order is expected to evoke confusion, whereas order without complexity is expected to evoke boredom. Gombrich (1984/1992) later added that delight lies somewhere between boredom and confusion.

Birkhoff (1933) was the first to propose an exact measure of aesthetic preference based on order and complexity: He stated that aesthetic preference should relate positively with order and negatively with complexity (M = O/C; Boselie & Leeuwenberg, 1985; Palmer et al., 2013). Eysenck (1941) proposed an alternative measure to predict human's preference for simple polygons, in which both order and complexity contributed positively to aesthetic preference (M = O x C; Boselie & Leeuwenberg, 1985; Nadal, 2007). He believed that the final formula would be more complex than his simple proposal, however (Eysenck, 1942).

Some previous empirical studies supported that both aspects of order and complexity play a role in determining aesthetic appreciation. Eisenman and Rappaport (1967) presented participants with a photograph showing 9 random shapes and 3 symmetrical shapes that were used in earlier studies by Vanderplas and Garvin (1959) and Birkhoff (1933), respectively. Participants indicated which three shapes they preferred most and which three they preferred least, and rated each shape on three differential scales (i.e., "beautiful-ugly", "fast-slow", and "strong-weak"). Symmetry was evaluated positively by all participants in the sample, even by participants with a high preference for complexity. This study would suggest the effects of symmetry (i.e., a form of order) and complexity to be independent. Eisenman and Gellens (1968) performed a study in which they simultaneously varied symmetry and complexity (i.e.,

the number of vertices of the figures). Participants showed a strong preference for complex symmetric figures over the other three possible combinations (i.e., simple symmetric, simple asymmetric, and complex asymmetric figures). Complexity was thus only preferred when symmetry was also present, which would indicate a dependency or interaction between order and complexity. Jacobsen and Höfel (2002) asked participants to judge the beauty of graphic patterns. On the group level, symmetry correlated highest with the beauty judgments, and complexity second highest. On an individual level however, diverse relationships were found between beauty on the one hand and symmetry and complexity on the other hand. Bies, Blanc-Goldhammer, Boydston, Taylor, and Sereno (2016) investigated the aesthetic appreciation of exact fractal patterns and, similar to Jacobsen and Höfel (2002), found positive relations of both symmetry and complexity with aesthetic appreciation in general, as well as individual differences in these relations.

These studies provide evidence in favor of both order and complexity playing a role in influencing aesthetic appreciation but they also have some limitations: (a) in these studies, only symmetry is investigated as an aspect of order; (b) often a very restricted type of stimuli is used with limited ecological validity; and (c) it is not clear whether order and complexity interact in how they influence aesthetic appreciation and if so, in what manner; and (d) although individual differences are sometimes reported (e.g., Bies et al., 2016, Jacobsen & Höfel, 2002), the studies did not investigate whether these differences can be related consistently to other individual difference factors (e.g., personality). Our study on neatly organized compositions aimed to overcome these limitations, by using a more ecologically valid (albeit less controlled) set of stimuli varying in a broader set of order and complexity aspects, and investigating how differences between subjective ratings for these stimuli related to different types of aesthetic appreciation (i.e., aesthetic preferences, soothingness ratings, and fascination ratings). Furthermore, this study investigated how both stimulus and person

properties linked to order and complexity relate to aesthetic appreciation for images of neatly organized compositions. Specifically, personal need for structure and obsessive-compulsive tendencies are quite likely to bear a special relationship to the preference for images of neatly organized compositions (see further discussion below).

The Present Study

Our study aimed to explore the variability in aesthetic appreciation of neatly organized compositions and which stimulus properties, person properties, and interactions between stimulus and person are associated with this variability. By extension, the study can also contribute to knowledge about human aesthetics and factors influencing human aesthetics in general. The focus was on both stimulus and person properties hypothesized to relate to (the balance between) order and complexity. A plethora of earlier research has indicated that pronounced individual differences in aesthetic preference can exist (e.g., Güçlütürk et al., 2016; Jacobsen, 2004; Vessel & Rubin, 2010). This is also the case for real-world images when the semantic meaning of the images is de-emphasized (Vessel & Rubin, 2010). In the case of images of neatly organized compositions, the organization brought into these images could de-emphasize the semantic meaning of the presented objects. Therefore, we hypothesized that both stimulus and person properties as well as their interaction would be important factors underlying the aesthetic appreciation for images of neatly organized compositions.

To be able to take individual differences in aesthetic appreciation into account and investigate factors associated with these differences, we aimed for a rather large and very diverse sample of participants (i.e., in age, gender, and level of education). To reach this aim, we conducted the study online. Furthermore, both a Dutch and an English version of the study were administered to be able to investigate whether or not the results for the Dutch-speaking

sample (mainly participants living in Flanders, the northern part of Belgium) could be generalized to a more culturally diverse sample of English-speaking participants[1].

Firstly, we investigated the variability in aesthetic *preferences* for neatly organized compositions and the sources of this variability. Participants' aesthetic preferences were measured using a spatial two-alternative forced-choice (2AFC) method. This means that participants indicated which one of two simultaneously presented images they preferred. The images within each pair were chosen to be very similar except for how ordered and/or complex they were on certain perceptual dimensions like color, texture, configuration, number of objects, type of objects, and perspective. The disadvantage of the relative nature of the choice data collected did not outweigh the advantages of minimal memory load and easy response method, which is important for an online study. Also in the literature, this paradigm is described as optimal in most respects (Palmer et al., 2013).

As we expected the principle of balancing order and complexity to be important in determining aesthetic preferences for neatly organized compositions, we selected stimulus and individual difference dimensions hypothesized to relate to (the balance between) order and complexity (Van Geert & Wagemans, 2019). These stimulus and person properties could then be related to the preferences for specific (types of) images. Because this was the first psychological study involving images of neatly organized compositions, the aim was to study a rather wide range of possibly relevant stimulus and individual difference dimensions in a rather exploratory fashion.

To better understand the variability in aesthetic preferences, we looked at the relations of aesthetic preference with subjective order and complexity ratings as well as with objective indicators of complexity and individual differences in these relations. Additionally, we also

[1] In a follow-up study, a shortened Chinese version of this study will be conducted to further investigate any cross-cultural similarities or differences in the aesthetic preferences for images of neatly organized compositions.

investigated how aesthetic preferences related to two other measures indicating positive aesthetic value, more specifically how soothing and fascinating each image was perceived to be, and whether there were individual differences in the relations of these soothingness and fascination ratings with aesthetic preferences.

Secondly, we investigated which stimulus and person properties related to *subjective order and complexity* ratings. By checking the relations with different stimulus properties, we could study which objective measures were most closely related to subjective measures of order and complexity. By checking individual differences in perceived order and complexity, we could study whether differences in preference were possibly a consequence of individual differences in perceived order or complexity of the images.

Thirdly, we also investigated which stimulus and person properties related to subjective judgments of *soothingness and fascination* of images of neatly organized compositions, as these different types of positive aesthetic value could interrelate with different levels of balance between order and complexity.

All the more specific research questions and hypotheses are reported in the Supplementary Material.

Exploring differences between stimuli. Although we agree with Berlyne (1960) that it is important to investigate both form and content (i.e., perceptual and conceptual) dimensions contributing to aesthetic appreciation, the main focus of this study was on perceptual stimulus dimensions possibly related to the balance between order and complexity. We focused on perceptual stimulus aspects as we thought that these would be relatively less influenced by individual differences that are very peculiar to specific stimuli. Further research could then focus on conceptual or semantic stimulus aspects involved in the aesthetic appreciation of neatly organized compositions.

Objective indicators of complexity that were computed were PHOG self-similarity, HOG complexity, HOG anisotropy, Fourier slope, and fractal dimension (Braun, Amirshahi, Denzler, & Redies, 2013; Redies, Hasenstein, & Denzler, 2007). Subjective order and complexity were measured in a second (optional) part of the study using rating scales from 1 (*not at all ordered/complex*) to 7 (*extremely ordered/complex*). In this part of the study, we also asked participants to indicate how soothing and fascinating they experienced each image in order to examine the function images of neatly organized compositions could have for people in everyday life, and to explore which type of positive evaluation is most related to aesthetic preferences for neatly organized compositions. Do people appreciate an image more if it is soothing than when it is fascinating? Or do people also differ in their preferences for more soothing (i.e., probably more related to high order) or more fascinating (i.e., probably more related to high complexity) images? In lay interpretations, watching images of neatly organized compositions is often related to its soothing function. However, not everyone watches these images in their free time and individuals could differ in the reactions these pictures evoke.

Exploring differences between participants. Based on the lay views on the appreciation of neatly organized images and on an extensive review of the literature on individual differences in aesthetic preferences (Van Geert & Wagemans, 2019), we selected a number of individual difference dimensions related to (the balance between) order and complexity that, in interaction with the properties of the stimuli, could play a role in the aesthetic preference for certain neatly organized images. Each of these individual difference dimensions will be discussed below. The selected questionnaires measure each of these dimensions in an accurate but concise way, to be able to measure different traits without asking too much time for participants to complete. We focused on individual differences related to personality, as we had clear hypotheses regarding the impact of these differences on

aesthetic appreciation and because they seemed most relevant in a non-clinical sample of adult participants.

Big Five personality traits. We included a measure of the Big Five personality traits because they are the most commonly investigated individual difference traits in current aesthetics research (Chamorro-Premuzic, Furnham, & Reimers, 2007). Earlier studies found relations of Openness to Experience with preference for art in general and with preferences for complexity (e.g., Chamorro-Premuzic, Burke, Hsu, & Swami, 2010). Also the other Big Five traits were sometimes found to be related to preferences for complexity (e.g., Conscientiousness in Chamorro-Premuzic et al., 2010; Neuroticism in Lyssenko et al., 2016). Furthermore, investigating possible associations between very general personality dimensions and aesthetic preferences seemed a good start for this first study on images of neatly organized compositions. We selected the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) because it is freely available, widely used in online assessment (e.g., Srivastava, John, Gosling, & Potter, 2003), and recommended for use in cross-cultural settings (Schmitt, Allik, McCrae, & Benet-Martinez, 2007) and when a short Big Five instrument is needed (Denissen, Geenen, van Aken, Gosling, & Potter, 2008).

Cognitive structuring. The Personal Need for Structure scale (PNS; Thompson et al., 1989, 1992) was selected because of the previously found associations with a tendency to organize information in less complex ways (Neuberg & Newsom, 1993). It seemed more closely related to preferences for order than the broader concept measured by the Need For Closure Scale (Webster & Kruglanski, 1994). That is, the need for cognitive closure can be fulfilled in other ways besides increasing structure in the encountered information, for instance, by avoiding or limiting the amount of information that is encountered (Neuberg & Newsom, 1993).

Obsessive-compulsive tendencies. By including a measure related to obsessive-compulsive tendencies, and more specifically related to obsessive-compulsive arranging behavior towards increasing symmetry and order, we aimed to investigate empirically the assumed associations of lay people between the appreciation of neatly organized compositions and obsessive-compulsive ordering behavior. The Symmetry, Ordering, and Arranging Questionnaire (SOAQ; Radomsky & Rachman, 2004) was selected as this questionnaire is focused on the ordering and arranging symptoms related to obsessive-compulsive disorder (OCD). Furthermore, the authors of the questionnaire argued that compulsive ordering and a drive for symmetry in OCD could be seen as extreme instances of a common preference for order and symmetry (Radomsky & Rachman, 2004).

Method

Participants

Anyone between 16 and 100 years old and able to understand Dutch or English instructions could participate. There were no restrictions regarding nationality or mother tongue. Participants were recruited via personal contacts of the researchers, social media, and offline advertisements in public places and university buildings. Participation was completely voluntarily: No monetary reward was offered for participation.

The first part of the study was completed by 421 participants between 16 and 77 years (274 women, 147 men, M_{age} = 39.8 years, SD_{age} = 15.8 years)[2]. Of these 421 participants, 365 completed the Dutch and 56 the English version of the study. No data were excluded for analyses. Of the 421 participants in the first part, 84 participants between 20 and 75 years also completed the second (optional) part of the study (56 women, 28 men, M_{age} = 43.4 years,

[2] In total, the first part of the study was started 486 times. Sixty-five participations in the first part were not completed.

SD_{age} = 16.7 years)[3]. Only 8 participants in the second part completed the English version, whereas 76 completed the Dutch version. Further details on the demographic characteristics of the sample are shown in Supplementary Tables S1 and S2. The study received ethical approval from the Social and Societal Ethics Committee of the authors' institution (G-2016 04 547).

Materials

Images. Hundred image pairs involving 184 different images were selected (16 images were included twice). First, we collected images of neatly organized compositions from online sources (blogs, websites, etc.), constituting an extensive database including more than 1,000 images. Secondly, we removed images containing aspects of order and complexity on a more conceptual level. Thirdly, from the remaining images, we tried to pair images that were very similar except for how ordered and/or complex they were on certain perceptual dimensions like color, texture, configuration, number of objects, type of objects, and perspective; for more information on the stimulus pair selection and the order/complexity dimensions included, see the Supplementary Information). As this study tried to find a balance between ecological validity and experimental control, only existing images were used, but they were sometimes slightly adapted to better fit the purpose of the study (i.e., to make the images within a pair more comparable). These adaptations included using only a subsection of the existing image, extrapolating it by copying a row, or trimming the borders of the image. Image size was maximized while keeping the original aspect ratio of the image, a maximal width of 580 pixels and a maximal height of 600 pixels, starting from the largest version of the image that we had available. As we do not have permission to share some of the images, it is not possible to include all image pairs used in the Supplementary Information.

[3] In total, the second part of the study was started 123 times. Thirty-nine participations in the second part were not completed.

An overview of the images and image pairs that we are allowed to show can be found on osf.io/fxekp/. We did not pilot whether the images in each pair actually differed in how ordered or complex participants perceived them to be. The average order and complexity ratings for the images that were collected in the second part of the study, however, can give an indication of differences between the images in perceived order and complexity[4].

Big Five Inventory. The Big Five Inventory (BFI; John et al., 1991) is a short self-report instrument (44 items) to measure the Big Five dimensions of personality (i.e., Extraversion, Neuroticism, Conscientiousness, Agreeableness, and Openness to Experience; McCrae & John, 1992) when no further differentiation between individual facets is needed (John, Naumann, & Soto, 2008). This measure uses short phrases instead of single adjectives as it was found that such items are answered more consistently when they are accompanied by definitions or elaborations (Goldberg & Kilkowski, 1985). Each BFI scale includes between eight and ten items and participants have to indicate their agreement with each statement using a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In U.S. and Canadian samples, the English version of the BFI scales showed substantial convergent and divergent validity with other Big Five measures as well as with peer ratings. Reliability of the scales ranged from .75 to .90 (John et al., 2008). Also the Dutch version of the BFI (created and validated by Denissen et al., 2008) showed good psychometric properties. It was found to be equivalent in factor structure to the English original and the relative independence and internal consistency of the scales were preserved. As in Denissen et al. (2008), a principal components analysis with varimax rotation of the 44 BFI items was conducted on the data of participants to the Dutch version of the current study (N = 365). The analysis yielded similar results to those of Denissen et al. (2008). The five factor solution explained 44% of the variance, with absolute primary loadings ranging from .35 to .77, with an average primary

[4] The image that was assumed to be less ordered/more complex (i.e., id1) was indeed perceived as more complex in 78 of the 100 image pairs, and as less ordered in 62 of the 100 image pairs.

loading of .59. However, some absolute cross-loadings went up to .49, with an average of .20. The results of this principal component analysis as well as that on the English questionnaire data collected in this study, and an additional confirmatory factor analysis for both language versions are included in the analysis file on osf.io/j3a8h/.

Personal Need for Structure scale. The Personal Need for Structure scale (PNS; Thompson et al., 2001) is a self-report measure of 12 items created to measure several aspects of the desire for simple structure. It is commonly calculated using a single factor that captures participants' overall tendency to prefer simple structure (Thompson et al., 2001), but other authors suggest a two-factor interpretation in which item 5 ("I enjoy being spontaneous.") is excluded and in which the scale captures both the Desire for Structure (DFS) and the Response to Lack of Structure (RLS; Cavazos, Judice-Campbell, & Ditzfeld, 2012; Neuberg & Newsom, 1993). Although those two subscales are found to correlate quite highly (r = .54–.75; Neuberg & Newsom, 1993), it might be worth to look at the subscale scores as well, as differential relations were found between the subscales and dimensions of the Big Five (Neuberg & Newsom, 1993). Participants were asked to respond using a 6-point rating scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*).

Several versions of the PNS scale with slightly different item wordings and item orders circulate. The version that was used in this study is the version presented by Thompson et al. (1989), because the Dutch translation that was used (Het Nieuwe TeamWerken, 2015) was based on this version of the scale. The English version was found to have sufficient reliability and convergent and discriminant validity (Neuberg & Newsom, 1993; Thompson et al., 2001). No validation information was available about the Dutch translation of the PNS scale. Two principal components analyses with varimax rotation of the 12 PNS items were conducted on the data of participants to the Dutch version of the current study (N = 365), one exploring a one-factor solution and one exploring a two-factor solution. The one-factor

solution explained 38% of the variance, with loadings ranging from .40 to .77. As one item (i.e., “I enjoy being spontaneous”) showed a somewhat lower loading (i.e., .40) on the common factor than the other items (i.e., ranging from .52 to .77), and this item was sometimes dropped from the scale in earlier studies (e.g., Neuberg & Newsom, 1993), we decided to remove this item from the scale in this study as well. The two-factor solution, which explained 49% of the variance, did not resemble the two factors of Neuberg and Newsom (1993). Therefore, in the analyses using the PNS, the one-factor solution including 11 items was used. The results of these principal component and additional confirmatory factor analyses for both Dutch and English questionnaire data collected in this study are included in the analysis file on osf.io/j3a8h/.

Symmetry, Ordering, and Arranging Questionnaire. The Symmetry, Ordering, and Arranging Questionnaire (SOAQ; Radomsky & Rachman, 2004) is a self-report measure developed to assess beliefs and behavior associated with compulsive ordering and arranging, features of obsessive-compulsive disorder (OCD). Participants are asked to rate how strongly they agree with each statement on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*). The authors suggest that compulsive ordering and a drive for symmetry are extreme manifestations of the common preference for order and symmetry (Radomsky & Rachman, 2004). Based on a sample of undergraduate students, the English SOAQ has a very good inter-item and test-retest reliability as well as very good convergent and divergent validity (Radomsky & Rachman, 2004). As the SOAQ was translated to Dutch for the purpose of this study, no validation information for the Dutch version was available. A principal components analysis with varimax rotation of the 20 SOAQ items was conducted on the data of participants to the Dutch version (N = 365) to test the one-factor solution. The one-factor solution explained 57% of the variance, with loadings ranging from .60 to .84. The results of

this principal component analysis for both Dutch and English questionnaire data collected in this study are included in the analysis file on osf.io/j3a8h/.

Image questionnaire. Participants were asked some additional questions regarding their earlier experiences with the type of images involved in this study, and their liking of the presented images. More specifically, participants were asked to rate the pleasantness of looking at the images (i.e., "How pleasant did you find the images to look at in general?") on a scale ranging from 1 (*not at all pleasant*) to 7 (*very pleasant*). Moreover, participants were asked to indicate their previous experience with this type of images (i.e., "Did you see similar images before?") on a scale ranging from 0 (*never*) to 4 (*very often*). If they indicated to have seen similar images before, they were also asked to indicate whether they had already consciously sought for similar images (i.e., "If so, did you already consciously search for similar images?") on the same scale ranging from 0 (*never*) to 4 (*very often*). When participants indicated that they had already sought for similar images, they were asked to describe why they had done so (i.e., "If so, why?").

Procedure

Data were collected online from May 2016 until January 2017. When participants visited the webpage of the questionnaire, they were provided with a short description of the study and were asked for their informed consent. If participants agreed to participate, they were asked to log in with an e-mail address, to complete some basic demographic information (i.e., gender, age, mother tongue, and highest education level), and the Big Five Inventory (BFI, 44 items).

Then, a 2AFC image task was conducted, in which participants had to indicate which of two simultaneously shown images they preferred. Participants were presented with 100 image pairs and were asked each time to click on the image they preferred. The image pairs were presented in a semi-random order, preventing that pairs including images that were used

in more than one pair were shown immediately after each other. Additionally, the position (i.e., left or right) of the images hypothesized to be the more complex was counterbalanced between participants: For approximately half of the participants, the image hypothesized to be more complex ("id1" from now on) was always the right image presented on the screen, whereas for the other half this image was the left one[5]. When participants had indicated their preference for one of the images, the test automatically continued to the next pair.

Afterwards, participants completed the Personal Need for Structure scale (PNS, 12 items) and the Symmetry, Ordering, and Arranging Questionnaire (SOAQ, 20 items), as well as the short questionnaire about their aesthetic appreciation of the type of images that were shown and their previous experience with them. After completing the questionnaires, participants were given a short debriefing text and they could indicate if they wanted to be informed about the results of the study and if they wanted to participate in an additional task at a later moment. The mean completion time for the first part of the study was 23 minutes and 57 seconds. The median completion time was 16 minutes and 42 seconds.

If participants indicated that they were willing to participate in an additional task at a later moment, an automatically generated e-mail was sent to invite them for participation. As this optional task was expected to take quite a long time and to be quite exhausting, participants were asked in this e-mail to take enough time for participation and to try not to lose concentration if they decided to participate. When participants visited the webpage of this additional task, they were asked for an additional informed consent, logged in with the same e-mail address they had provided in the first part of the study, and were shown six example images (not part of the test images; three of them are shown in Figure 1) to remind them of the type of images they would see. The latter was done to remind participants of the variety of

[5] Averaged over all image pairs, which image within each pair was positioned left or right had no influence on the proportion of preference for that image, based on a two-sample test for equality of proportions, χ^2 (1) = 2.85, p = .09.

the images in the set, and to diminish context and order effects on the ratings (Palmer et al., 2013). Then, the same images as those in the 2AFC image task were presented (184 images) in a randomized order. This time, participants were asked to rate each image separately on four characteristics (i.e. ordered, complex, soothing, and fascinating) using a 7-point scale ranging from 1 (*not at all*) to 7 (*extremely*). The order of the four characteristics was randomized across participants but stayed constant for each individual participant. The mean completion time for the second part of the study was 1 hour, 20 minutes, and 3 seconds. The median completion time was 57 minutes and 52 seconds. It has to be noted that some participants took long breaks, which influenced completion times. After rating all 184 images, a short debriefing text was presented and participants were thanked for their participation. Additionally, participants could indicate if they wanted to be informed about the results of the study and if they were willing to participate in further research concerning the topic.

Image Calculations

For each of the 184 images used in the study, five statistical image properties were calculated: self-similarity, complexity, anisotropy, Fourier slope, and fractal dimension[6]. The objective measures of self-similarity, complexity, and anisotropy were calculated using the Pyramid of Histograms of Orientation Gradients (PHOG) method (Bosch, Tisserman, & Munoz, 2007). A high value for *PHOG self-similarity* indicates that the parts of the image are very similar to the image as a whole (Lyssenko et al., 2016)**.** An image has high *HOG-based complexity* when there are large changes in luminance or color in the image, whereas an image has low HOG-based complexity when there are only small changes in luminance or color in the image. A high value for *HOG anisotropy* indicates that the magnitude of the changes in luminance or color is higher for some orientations than for other orientations in the image, whereas a low value indicates that the magnitude of the changes in luminance or color

[6] We want to thank Prof. Christoph Redies for calculating these measures for us.

is similar across orientations. *Fourier slope* can be interpreted as the relative prominence of low spatial frequencies (representing coarse detail) compared to high spatial frequencies (representing fine detail) in an image. Although a negative slope generally indicates that the low spatial frequency content is more prominent than the high spatial frequency content, the high spatial frequencies are relatively more prominent in images with a less negative Fourier slope (i.e., higher than -2) than in images with a more negative Fourier slope (i.e., lower than -2; Redies, Brachmann, & Hayn-Leichsenring, 2014). *Fractal dimension* indicates how visually complex a pattern is by comparing how the structure in the pattern changes at different magnifications or spatial scales (Taylor, Spehar, Van Donkelaar, & Hagerhall, 2011). The higher the fractal dimension, the more complex the image (Redies et al., 2014). Fractals are forms that have the same structure or patterns when zooming in or out of the image (Hagerhall, Purcell, & Taylor, 2004). For more details on how these objective measures were calculated, one can consult the Supplementary Information.

Data Analysis

For the ratings of order, complexity, soothingness, and fascination, average scores per image (N = 184) and per participant (N = 84) were calculated. For the average ratings per image, first the standardized score for each image was calculated per participant per rating scale, to eliminate biases in the use of the rating scale. Then, the average rating per image per rating scale (across participants) was calculated. To calculate the average ratings per participant, the ratings were not first standardized per participant, as we were also interested in better understanding different uses of the scale (e.g., higher scores on average could indicate that a person experiences the images overall as more ordered, complex, soothing, or fascinating).

To explore the variability in aesthetic preferences for neatly organized compositions, we calculated the proportion of participants that preferred a specific image in each of the

image pairs. We also calculated the proportion of image pairs in which each participant preferred the more ordered, complex, soothing, or fascinating image in the pairs.

To explore which stimulus aspects are associated with aesthetic preference, we calculated Pearson product-moment correlations between the different image pair measures and proportions of preference for a specific image in the pairs.

To explore individual differences in preference for order, complexity, soothingness, or fascination, Pearson correlation coefficients between the different preferences and the measured person properties were calculated. Multiple linear regression analyses were conducted to investigate whether the predictive effect of each person property stayed when controlled for the other predictors. For testing the effects of gender and education, we used Welch two sample t-test and a one-way analysis of variance, respectively.

To explore the variability in order and complexity ratings between images, we computed Pearson correlation coefficients between the average order and complexity ratings per image and the other image measures available. Multiple linear regression analyses were conducted to investigate whether the predictive effect of each stimulus property stayed when controlled for the other predictors. The same procedure was followed for exploring variability in soothingness and fascination ratings between images.

To explore the variability in order and complexity ratings between participants, we computed Pearson correlation coefficients between the average order and complexity ratings per individual participant and the other individual difference measures available. The same procedure was followed for exploring variability in soothingness and fascination ratings between participants.

All data processing and analyses were conducted using the statistical program R (Version 3.3.3; R Core Team, 2017) and the following R packages: tidyverse (Wickham, 2017), lavaan (Rosseel, 2012), psych (Revelle, 2017), cowplot (Wilke, 2017), knitr (Xie,

2018), corrplot (Wei & Simko, 2016), Hmisc (Harrel Jr, 2017), SemiPar (Wand, 2014), qgraph (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012), and asbio (Aho, 2017). The data, analysis code, and other open materials for this study are available on osf.io/ksa7r/.

Results

After describing the overall pleasantness of the images and the participants' previous experience with them, we first report the variability in aesthetic preferences for neatly organized compositions, which stimulus properties are associated with aesthetic preferences in general, and which person properties interact with these stimulus properties to predict individual differences in aesthetic appreciation. Secondly, we investigate the variability in judgments of order and complexity, and stimulus and person properties predicting average and individual participant's judgments of order and complexity. Thirdly, the variability in ratings of soothingness and fascination is explored, as well as stimulus and person properties predicting these ratings of soothingness and fascination. Finally, we investigate individual differences in the correlation between order and complexity on the one hand and soothingness and fascination on the other hand, as well as which person properties relate to these individual differences in correlation.

Overall Pleasantness and Experience

Overall, most participants perceived the images as pleasant to look at (i.e., 78.2% of participants indicate somewhat pleasant, pleasant, or very pleasant; which decreases to 59.4% when dropping "somewhat pleasant") and did not regularly see similar images before (i.e., 88.3% of participants). Of the participants who had seen similar images before, almost no participants indicated to search for this type of images regularly (i.e., 2.4% of 79.6%, which is approximately 1.9% of all participants; see Supplementary Figures S6 and S7).

Aesthetic Preferences

Amount of variability between image pairs and participants. As expected, image pairs differed in the amount of individual variation in preference that was present: Proportions of preference for image id1 varied between 0.24 and 0.80 (M = .5021, SD = .1301; see Supplementary Figure S8). As all preference proportions differed from 0 or 1, participants differed in which image within the pair they preferred. However, in 61 of the 100 image pairs tested, one of the images was preferred significantly more often than would be expected by chance (proportions between 0.24 and 0.42 and between 0.59 and 0.80), based on exact binomial tests, $p < .001$ (two-tailed). Thus, some general preferences exist for certain images within the pairs for a considerable part of the pairs. Preferences for image id1 also varied between participants, with preference proportions ranging from 0 to .89 (M = .5021, SD = .1280; see Supplementary Figure S9).

Relations between aesthetic preferences per image pair and image pair measures. The proportion of preference for image id1 in each pair correlated positively with the difference score in fascination and soothingness between the images in the pairs, $r(98) = .60$, $p < .0001$ and $r(98) = .57$, $p < .0001$, respectively. The bigger the difference in soothingness or fascination between the image in a pair, the more participants preferred the more soothing or fascinating image in the pair (see Supplementary Figure S10). The correlation between the preference proportion for image id1 also correlated positively with the difference in order ratings between the images, $r(98) = .35$, $p = .0004$. The bigger the difference in order rating between the images in a pair, the more participants preferred the more ordered image in the pair (see Supplementary Figure S11). No other correlations between the preference proportion for the more preferred image and the image pair measures were significant at the $\alpha = .001$–level (small α because of multiple testing). All correlations of the different image pair measures with the proportion of preference for the image preferred on average are reported in Supplementary Figure S12.

Relations between preferences for order and complexity per individual participant and person properties. A participant's preference for the more ordered image in the pairs correlated positively with the participant's Personal Need for Structure (Pearson product-moment correlation coefficient, $r(419) = .27$, $p < .0001$ and with the participant's SOAQ score, $r(419) = .26$, $p < .0001$. The higher a participant's scores on the PNS and the SOAQ, the more often the participant chose the more ordered image in the image pairs. Additionally, scoring high on Openness to Experience was related somewhat negatively with a preference for the more ordered image in the pairs, $r(419) = –.13$, $p = .0067$. Age also correlated somewhat negatively with a preference for the more ordered image in the pairs, $r(419) = –.14$, $p = .0040$. The correlations between a preference for order and the other Big Five personality traits (i.e., Conscientiousness, Extraversion, Agreeableness, and Neuroticism) were non-significant at the $\alpha = .01$–level).

A preference for the more complex image in the pairs correlated negatively with an participant's PNS, $r(419) = –.20$, $p < .0001$, and with the participant's SOAQ score, $r(419) = –.29$, $p < .0001$. The higher a participant's scores on the PNS and the SOAQ, the less often the participant chose the more complex image in the pairs. Additionally, a preference for the more complex image in the pairs was related positively with Openness to Experience, $r(419) = .22$, $p < .0001$, and negatively with Conscientiousness, $r(419) = –.14$, $p = .0041$. The correlations between a preference for complexity and the other Big Five personality traits (i.e., Extraversion, Agreeableness, and Neuroticism) were non-significant at the $\alpha = .01$–level. Age correlated negatively with a preference for complexity, $r(419) = –.22$, $p < .0001$[7]. Higher-educated and female participants more often preferred the more complex image in the pairs than lower-educated and male participants (see Supplementary Information).

[7] The effects of SOAQ, Openness to Experience, and age on the preference for complex images stayed significant when controlling for Openness and age, SOAQ and age and SOAQ and Openness, respectively (using multiple linear regression analyses on the standardized individual difference dimensions; more details in the Supplementary Information).

An overview of all correlations can be found in Figure 2. In this correlation table, also the relations between the individual difference variables are shown. As expected, individual participants' scores on the PNS correlated positively with the individual participants' SOAQ scores, $r(419) = .44$, $p < .0001$, and negatively with Openness to Experience, $r(419) = –.31$, $p < .0001$. However, the correlation between SOAQ scores and Openness to Experience was only marginally significant, $r(419) = –.12$, $p = .0136$. Conscientiousness showed a slight positive correlation with both PNS, $r(419) = .20$, $p < .0001$, and SOAQ scores, $r(419) = .22$, $p < .0001$. Extraversion, $r(419) = –.17$, $p = .0003$, and Neuroticism, $r(419) = .25$, $p < .0001$, only showed correlations with PNS scores, not with SOAQ scores, $r(419) = .08$, $p = .1152$ and $r(419) = .03$, $p = .5733$ for Extraversion and Neuroticism, respectively.

Relations between preferences for soothingness and fascination per individual participant and person properties. A preference for the more soothing image in the pairs correlated positively with a participant's PNS, $r(419) = .29$, $p < .0001$, and with the participant's SOAQ score, $r(419) = .25$, $p < .0001$. The higher a participant's scores on the PNS and the SOAQ, the more often the participant chose the more soothing image in the pairs. Additionally, a preference for the more soothing image in the pairs was related negatively with Openness to Experience, $r(419) = –.24$, $p < .0001$[8]. The correlations between a preference for soothing images and the other Big Five personality traits (i.e., Conscientiousness, Extraversion, Agreeableness, and Neuroticism) as well as age were non-significant at the $\alpha = .01$–level.

A preference for the more fascinating image in the pairs correlated negatively with the participant's SOAQ score, $r(419) = –.20$, $p < .0001$. The higher a participant's scores on the SOAQ, the less often the participant chose the more fascinating image in the pairs.

[8] The effects of PNS, SOAQ, and Openness to Experience on the preference for soothing images stayed significant when controlling for SOAQ and Openness, PNS and Openness, and PNS and SOAQ, respectively (using multiple linear regression analyses on the standardized individual difference dimensions; more details in the Supplementary Information).

Additionally, a preference for the more fascinating image in the pairs was related negatively with age, $r(419) = -.26$, $p < .0001$[9]. The correlations of a preference for fascinating images with the PNS score and with the Big Five personality traits (i.e., Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) were non-significant at the $\alpha = .01$–level.

Order, Complexity, Soothingness, and Fascination Ratings

Amount of variability between images. There was considerable variability in the mean ratings for order, complexity, soothingness, and fascination between images (see Figure 3 and Table S5). Additionally, participants differed in the ratings they gave for each image, and the amount of individual variation also differed between images (see Table S5). Based on these results, we can conclude that there is variation between images in how ordered, complex, soothing, or fascinating they are perceived to be on average, but also in how much individual variation there is for each image's rating score.

Amount of variability between participants. There was considerable variability in the mean ratings for order, complexity, soothingness, and fascination between individual participants (see Table 1). Additionally, participants differed in the ratings they gave for each image, and the amount of variation across images also differed between participants (see Table 2).

Relations between ratings and other image measures. The correlations between the image measures are reported in Figure 4.

Average order and complexity ratings per image. The average order rating per image (standardized per person and averaged across participants of the second part of the study) did not correlate significantly with the average complexity rating per image, $r(182) = -.07$, $p =$

[9] The effects of SOAQ and age on the preference for fascinating images stayed significant when controlling for age and SOAQ, respectively (using multiple linear regression analyses on the standardized individual difference dimensions; more details in the Supplementary Information).

.3395. However, the average standardized order rating did correlate positively with Fourier slope, $r(182) = .26$, $p = .0003$, and negatively with anisotropy, $r(182) = –.24$, $p = .0011$. No other statistical image properties correlated significantly with the standardized order ratings per image at the $\alpha = .01$–level. Furthermore, the average order rating per image was highly correlated with the average ratings of how soothing, $r(182) = .59$, $p < .0001$, and how fascinating, $r(182) = .54$, $p < .0001$, the image was perceived to be.

The average complexity rating per image (standardized per person and averaged across participants of the second part of the study) did correlate significantly (ps < .01) with all statistical image properties in the expected directions (see Figure 4). Average complexity ratings correlated especially high with HOG complexity, $r(182) = .62$, $p < .0001$, and fractal dimension, $r(182) = .63$, $p < .0001$. Scatter plots for these correlations are shown in Supplementary Figure S13. Furthermore, the average complexity rating per image was correlated negatively with the average ratings of how soothing, $r(182) = –.25$, $p = .0008$, and positively with how fascinating, $r(182) = .52$, $p < .0001$, the image was perceived to be.

Average soothingness and fascination ratings per image. The average rating of how soothing an image was perceived to be correlated positively with the average fascination rating per image, $r(182) = .61$, $p < .0001$. Additionally, the average soothingness rating correlated negatively with anisotropy, $r(182) = –.29$, $p < .0001$, and somewhat negatively with HOG complexity, $r(182) = –.19$, $p = .0090$ (see Supplementary Figure S14). As reported before, the soothingness rating per image correlated positively with the order rating per image, $r(182) = .59$, $p < .0001$, and negatively with the complexity rating per image, $r(182) = –.25$, $p = .0008$ (see Figure 5). Correlations between soothingness ratings and other image measures were non-significant at the $\alpha = .01$–level.

The average rating of how fascinating an image was perceived to be correlated positively with both order, $r(182) = .54$, $p < .0001$, and complexity ratings, $r(182) = .52$, $p <$

.0001, as reported before (see Figure 6). Additionally, the average fascination rating showed similar correlations to the objective image measures as the average complexity rating: positive correlations with self-similarity, $r(182) = .22$, $p = .0029$, HOG complexity, $r(182) = .34$, $p < .0001$, Fourier slope, $r(182) = .44$, $p < .0001$, and fractal dimension, $r(182) = .47$, $p < .0001$, and a negative correlation with anisotropy, $r(182) = –.47$, $p < .0001$ (scatter plots for HOG complexity and anisotropy in Figure S15). However, the correlation between anisotropy and fascination was more strongly negative than the correlation between anisotropy and average perceived complexity (significant difference at the $\alpha = .01$–level).

Relations between ratings per individual participant and person properties.

Average order and complexity rating per participant. Average individual order ratings correlated positively with average complexity, $r(82) = .29$, $p = .0074$, average soothingness, $r(82) = .39$, $p = .0002$, and average fascination ratings, $r(82) = .34$, $p = .0016$. Average individual complexity ratings also correlated positively with average soothingness, $r(82) = .28$, $p = .0102$, and average fascination ratings, $r(82) = .52$, $p < .0001$. In other words, participants who gave high average ratings on one scale, also gave high average ratings on the other scales. There were no significant correlations between the order and complexity ratings per participant and other participant measures at the $\alpha = .01$–level. All correlations are reported in Supplementary Figure S16. Order ratings of female participants were slightly higher than those of male participants (see Supplementary Information).

Average soothingness and fascination rating per participant. Except for the correlation between the average soothingness rating per participant and the participant's SOAQ score, $r(82) = .28$, $p = .0097$, no other correlations between the average ratings and other participant measures were significant at the $\alpha = .01$–level.

Predicting average soothingness and fascination ratings based on measures of order and complexity.

Predicting soothingness ratings per image. We conducted multiple linear regression analyses to examine the joined impact of standardized average order and complexity ratings on the standardized average soothingness and fascination ratings. The standardized average rating of how soothing participants perceived an image to be could be predicted by how ordered and how complex the image was perceived to be: the two predictors explained 38.62% of the variance, *Adj.* $R^2 = .3862$, $F(2,181) = 58.58$, $p < .0001$. Both the standardized average order rating and the standardized average complexity rating of the image predicted its soothingness. The higher the standardized average order rating, the higher the standardized soothingness rating for that image ($\beta = .55$, $p < .0001$, *partial* $R^2 = .3539$). The lower the standardized average complexity rating, the higher the standardized soothingness rating for that image ($\beta = -.17$, $p = .0005$, *partial* $R^2 = .0643$; see Figure 7). The model including an interaction between order and complexity did show similar significant main effects, but no significant interaction between the standardized order and complexity ratings.

Predicting fascination ratings per image. We conducted a second multiple linear regression to test if the standardized average order and complexity ratings predicted the standardized average fascination ratings per image. The two predictors explained 59.66% of the variance in fascination ratings, *Adj.* $R^2 = .5966$, $F(2,181) = 136.30$, $p < .0001$. Both the standardized average order rating ($\beta = .45$, $p < .0001$, *partial* $R^2 = .4535$) and the average complexity rating ($\beta = .39$, $p < .0001$, *partial* $R^2 = .4392$) of the image predicted the fascination ratings. The higher the standardized average order rating and the higher the standardized average complexity rating for the image, the higher the standardized fascination rating was for that image (see Figure 8). The model including an interaction between order

and complexity did show similar significant main effects, but the interaction was only marginally significant (β = .13, p = .06).

Exploratory analyses of individual differences in relation of soothingness or fascination with order and complexity.

Individual correlations of soothingness or fascination with order and complexity. To further explore individual differences in which factors relate to aesthetic appreciation, we plotted the correlations of soothingness with order and complexity (see Figure S17) and of fascination with order and complexity (see Figure S18) for each individual separately (N = 84). There seems to be more variation in the correlation between soothingness and complexity than in the correlation between soothingness and order (see Figure S17). Most participants show a positive correlation between fascination and order and between fascination and complexity, but a few show a negative correlation between fascination and order or a negative correlation between fascination and complexity (see Figure S18).

For each participant, the correlations of order with soothingness and with fascination, $r(82) = .69$, $p < .0001$, as well as the correlations of complexity with soothingness and with fascination, $r(82) = .68$, $p < .0001$, were very similar. Thus, there seems to be some consistency in the relation of order with different aesthetic appreciation measures for each individual separately: The higher the correlation for an individual between order or complexity and soothingness, the higher that person's correlation between order or complexity and fascination. The relation between preference for the more ordered image in the pair also correlated positively with the correlations between order and soothingness, $r(82) = .36$, $p = .0007$, and between order and fascination, $r(82) = .24$, $p = .0265$, though less highly than the relation of order with soothingness and fascination. The same trend was visible for the relation between preference for the more complex image in the pair and the correlation

between complexity and soothingness, $r(82) = .28$, $p = .0104$, but not for this preference and the correlation between complexity and fascination, $r(82) = .09$, $p = .42$.

Relation of individual participants' correlations with person properties. An overview of all these correlations can be found in Figure 9. Individual participants' PNS and SOAQ scores showed a slightly positive correlation with the correlation between order and soothingness: The higher a participant's scores on the PNS or SOAQ, the more positive that participant's correlation between order and soothingness, $r(82) = .27$, $p = .0128$, and $r(82) = .30$, $p = .0059$, respectively. Furthermore, Openness to Experience and the correlation between fascination and complexity correlated negatively, $r(82) = –.26$, $p = .0166$: The more open, the weaker or more negative the correlation between complexity and fascination.

The relation between age and the correlation between order and fascination was somewhat negative, $r(82) = –.24$, $p = .0278$, as was the relation between age and the correlation between complexity and soothingness, $r(82) = –.23$, $p = .0326$: The older, the weaker the relation between order and fascination, and the weaker the relation between complexity and soothingness. In addition, age also related to the correlation between order and complexity, $r(82) = –.37$, $p = .0006$, and between soothingness and fascination, $r(82) = –.26$, $p = .0192$): The older the participant, the more negative the relation between order and complexity ratings and between soothingness and fascination ratings.

All the correlations reported in this section should be interpreted with the necessary caution, however, because of the relatively small sample size in combination with the exploratory nature of this investigation.

Discussion and Conclusion

Summary of the Main Findings

Neatly organized images are aesthetically pleasant. In general, images of neatly organized compositions were perceived as pleasant to look at. Most of our participants did not

have extensive prior experiences with this type of images, indicating that the sample was not biased towards a subpopulation of fans of neatly organized images. We can conclude that overall, neatly organized compositions are experienced as aesthetically pleasing, even by people who do not look for this type of images regularly in daily life. This is in line with our assumption that the popularity of neatly organized images is based partly on the positive aesthetic appreciation of this type of images amongst the general population.

Both stimulus and person contribute to variability in aesthetic preferences. The amount of variability in aesthetic preferences, both between image pairs and between participants, indicated that it is worthwhile to focus on both stimulus and person properties in predicting aesthetic preference. This principle has been known in the literature on empirical aesthetics for a long time but here we substantiate this claim by a set of novel, sometimes unexpected findings. Concerning *stimulus properties*, there was some relation between order (as rated) and aesthetic preferences for neatly organized compositions. In addition, we found aesthetic preferences per image pair to relate positively to soothingness and fascination (as rated): The bigger the difference in soothingness or fascination between the images in a pair, the larger the proportion of participants preferring the more soothing or fascinating image.

Concerning *person properties*, we found indications that individual differences in aesthetic preferences for *order* related to scores on personality measures (i.e., Openness to Experience, Personal Need for Structure or PNS, Symmetry, Ordering, and Arranging Questionnaire or SOAQ). The higher a person scored on the Personal Need for Structure (PNS) scale and the Symmetry, Ordering, and Arranging Questionnaire (SOAQ), the more often that person chose the more ordered image in the pairs. The higher a person scored on Openness to Experience, the less often that person preferred the more ordered image in the pairs. The lower a person scored on the SOAQ or the PNS and the higher on Openness to Experience, the more often that person preferred the more *complex* image in the pairs. Age

showed a negative relation to a preference for complexity: The older the person, the less often that person chose the more complex image in the pairs. The results on Openness to Experience are in line with previous research showing a positive relation of openness with preferences for complexity (e.g., Chamorro-Premuzic, Burke, Hsu, & Swami, 2010).

Often choosing the more *soothing* image in the pairs related positively with an individual participant's score on the SOAQ and PNS. High openness related to less often choosing the more soothing image in the pairs. Proportions of preference for the more soothing image in the pairs thus correlated with the same person properties as did proportions of preference for the more ordered image in the pairs, although the correlations with preferences for soothingness were somewhat less strong. Possibly the correlations found with preferences for soothingness are a consequence of the correlations of the person properties with preferences for order, especially since the correlation between the two types of preferences was so high, $r(419) = .57$, $p < .0001$. Often choosing the more *fascinating* image in the pairs related negatively with an individual participant's score on the SOAQ and age. The pattern of correlations between proportions of preference for fascination and the person properties resembled that of proportions of preference for complexity. Possibly the correlations found with preferences for fascination are a consequence of the correlations of the person properties with preferences for complexity. These two types of preference correlated highly positive, $r(419) = .68$, $p < .0001$. In line with this idea, an earlier study reported a positive correlation between subjective complexity and interest (Lyssenko et al., 2016).

Both stimulus and person contribute to variability in order and complexity ratings. The amount of variability in order and complexity ratings, both between images and between participants, indicated that it is worthwhile to focus on both stimulus and person properties relating to perceptions of order and complexity. Concerning the *stimulus*

properties, perceived complexity related highly positive with some objective indicators of complexity (i.e., HOG-based complexity, fractal dimension, and to a certain extent Fourier slope). This finding strengthens the usefulness of this type of statistical image properties as indicators of subjective complexity in the search for factors relating to aesthetic appreciation, and is in line with earlier research reporting similar positive relations with other stimulus types (e.g., Lyssenko et al., 2016, Spehar, Walker, & Taylor, 2016).

Despite considerable variability in the average order and complexity ratings per participant, the *person properties* measured in this study did not associate with individual differences in mean order and complexity ratings. Differences in the overall perceived level of order and complexity could thus not explain the relation between person properties and overall aesthetic preferences for order and complexity. Interactions between stimulus and person in the perceptions of order and complexity are probably more interesting to explore than the main effect of a person's characteristics across all images. We believe this is an important finding of generic value in the literature of empirical aesthetics.

Both stimulus and person contribute to variability in soothingness and fascination ratings. As for order and complexity, considerable variation was found in the average soothingness and fascination ratings, both per image and per participant. It is thus worthwhile to explore both stimulus and person properties relating to perceptions of soothingness and fascination. *Soothingness* ratings per image related positively with order but slightly negative with complexity. In predicting the average soothingness score for an image, order was by far the most important predictor, but complexity still significantly increased the model fit. Together, order and complexity ratings explained almost 39% of the variability in the average soothingness ratings per image. *Fascination* showed independent positive associations with both order and complexity. In predicting the average fascination ratings per image, both order and complexity were significant predictors, together explaining almost 60%

of the variability in the average fascination ratings per image. The positive relation of fascination with both order and complexity is in line with an earlier study evidencing positive relations of structure and complexity with interest ratings for abstract paintings (Lyssenko et al., 2016).

Although considerable variability existed in the average soothingness and fascination ratings per participant, the person properties measured in this study did not strongly associate with individual differences in mean soothingness and fascination ratings. Only participants' SOAQ scores showed a slight positive correlation with mean soothingness ratings per participant across all images. Interactions between stimulus and person in the perceptions of soothingness and fascination are probably more interesting to explore than the main effect of a person's characteristics across all images. This confirms our earlier argument about the general importance of stimulus x person interactions in aesthetics.

Consistency in how order and complexity relate to aesthetic appreciation on the individual participant level. The relations of order and complexity with soothingness and fascination, and to some degree aesthetic preference, correlated positively, indicating consistency in how order and complexity relate to different types of aesthetic appreciation. Furthermore, some exploratory results indicated that individual differences in personality and age may be related to how order and complexity relate to different types of aesthetic appreciation for a specific individual.

Theoretical Reflections

Based on the new results obtained in this study, we propose different possible pathways towards aesthetic appreciation, influenced by both stimulus and person characteristics, and especially the interaction between them (see Figure 10). This should be taken as a tentative proposal based on a correlational study using a very specific type of images with arrangements of objects and object parts varying simultaneously along multiple

dimensions. This proposal awaits further confirmation from experimental studies with more parametrically varied stimuli.

When investigating images of neatly organized compositions, aesthetic preferences relate positively with both the perceived soothingness and fascination of the images. However, soothingness and fascination relate differently to the perceived order and complexity of the image. Whereas the soothingness of an image can be predicted by high order and low complexity, how fascinating an image is perceived to be is associated with high order and high complexity. This set of interrelations is unique to the present study. Individuals differ in the extent to which their aesthetic preferences are associated with perceived order and complexity, and (consequently) also in the extent to which their aesthetic preferences are associated with soothingness and fascination[10]. Symmetry, ordering, and arranging tendencies, a personal need for structure, and low openness are indicators of a preference for the more ordered images in the pairs, whereas low symmetry, ordering, and arranging tendencies, low personal need for structure, high openness, and young age related to a preference for the more complex images in the pairs. Although not unexpected, this pattern of results is also a new finding.

Some objective indicators of complexity (i.e., HOG-based complexity, fractal dimension, and to a certain extent Fourier slope) related strongly positively with subjective complexity. Some objective indicators of complexity showed a slightly positive relation with subjective order, but these relations should be interpreted rather cautiously.

[10] Preferences for soothingness correlated with the same person properties as did preferences for order, although somewhat less strongly so. Also the overall pattern of correlations of the person properties was similar for preferences for fascination and preferences for complexity. Possibly the correlations found with preferences for soothingness and fascination are a consequence of the correlations of the person properties with preferences for order and complexity. The observation that also the correlations of soothingness and order ratings per image with the statistical image properties were similar, as well as those of fascination and complexity ratings per image with the statistical image properties, strengthens that idea. In the same vein, Lyssenko et al. (2016) found interest ratings to show similar associations with self-similarity, HOG complexity, and anisotropy as complexity ratings, but the associations were less strong for interest than for complexity.

In future research, it would be interesting to further investigate (a) which person characteristics relate to individual differences in the relations of soothingness and fascination with order and complexity; and (b) which other objective stimulus characteristics relate to subjective order and complexity.

Different routes to aesthetic appreciation. Although soothingness and fascination differ in their relations with order and complexity, both soothingness and fascination seemed to relate positively with aesthetic preferences. These novel findings can be regarded as further empirical support of the Pleasure-Interest Model of aesthetic appreciation proposed by Graf and Landwehr (2015, 2017), in which aesthetic appreciation can be mediated by both pleasure and interest. In order to do so, we assume pleasure-based liking to relate to preferences for soothingness and interest-based liking to preferences for fascination. In future analyses and studies, it would be interesting to investigate individual differences in the relative importance of soothingness and fascination in predicting aesthetic preferences, and relatedly also differences in processing styles (i.e., automatic or controlled), as suggested in the model of Graf and Landwehr (2015, 2017).

Combination of order and complexity rather than balance between them. Like in the literature (Arnheim, 1966; see also Van Geert & Wagemans, 2019), the relation between order and complexity seemed to be both complementary and antagonistic. On the one hand, order and complexity *complement* each other in predicting how fascinating an image is perceived to be. On the other hand, order and complexity are *partial opposites* in their relation to soothingness. The balance between order and complexity seems to be a *combination* of the independent relations of order and complexity with different types of aesthetic appreciation, rather than an *interaction* between order and complexity. In relation to the early proposals of Birkhoff (1933; M = O / C) and Eysenck (1941; M = O * C), this research proposes that soothingness can be predicted by order minus complexity (M = O – C), and fascination by

order plus complexity (M = O + C; see Figure 11). Although these conclusions resonate to some earlier claims and findings, the empirical basis we offer in this study on neatly organized compositions is richer and stronger than ever before. Our findings for fascination also relate to the findings of Post et al. (2016), who stated that it is the maximization of both unity (i.e., order) and variety (i.e., complexity) that yields the greatest aesthetic appreciation. In relation to this earlier work, future studies should focus on individual differences in the relation between order and complexity, and in the relation of order and complexity with different types of aesthetic appreciation.

Limitations

Specific type of stimuli. Different types of positive aesthetic appreciation correlated positively with each other. This can possibly be explained by their common positive association with order. Overall, order had a strong relation with the different types of aesthetic appreciation assessed (i.e., preferences, soothingness, fascination). This finding could be heavily influenced by the selected stimulus type, i.e., images of neatly organized compositions, and should therefore be interpreted with the necessary caution. More generally, as we expected aspects related to order and complexity to be especially important in the appreciation for images of neatly organized compositions, relations of appreciation with aspects of order and complexity could be more pronounced in neatly organized compositions than in other stimulus types.

Low experimental control. By selecting existing images of neatly organized compositions for this study but only matching images that were assumed to be comparable, we attempted to balance ecological validity and experimental control. Future studies should try to supplement our findings with more ecologically valid and more controlled investigations, to increase relevance of the findings for daily life on the one hand and to

increase knowledge about the causal relationships between the measured concepts on the other hand.

Exploratory nature of the project. Although we formulated research questions and hypotheses at the start of the research (cf. "Research questions and hypotheses" in the Supplementary Material), not all of them were very clearly specified in advance (e.g., the type of balance between order and complexity) and the main aim of this study was to explore possible relationships between the measured concepts. There is need for additional investigations to try to confirm the relationships found on the basis of our data.

Other factors predicting aesthetic appreciation. Although the focus of this study was on stimulus and person properties related to (the balance between) order and complexity, many other factors might play a role in aesthetic appreciation. For example, the colors in the image could be important, or whether the image represents natural or non-natural objects. Also, the mood or goal state of the participants was not measured in this study, although this could also influence aesthetic appreciation (see also motivational orientation in Deng & Poole, 2012, and the Pleasure-Interest Model of Aesthetic Liking by Graf & Landwehr, 2015, 2017). Conceptual aspects could also be relevant in some types of neatly organized compositions. Further analyses on the collected data as well as new studies could explore these factors and many more.

We found indications for many individual differences in aesthetic appreciation (i.e., preferences, soothingness, and fascination). For some of the preferences, we made a few suggestions about possible driving factors, but much more remains to be investigated.

Conclusion

In conclusion, aesthetic appreciation for images of neatly organized compositions is closely related to both the amount of order and complexity perceived in the images. Images are perceived as more fascinating when they are more ordered and more complex. Soothing

images are highly ordered but low in complexity. Individuals differ in their preferences for more ordered, complex, soothing, and fascinating images, and these differences can partly be related to differences in personality. In general, both stimulus and person interact in determining aesthetic appreciation. Further investigations should focus on both empirically investigating and theoretically explaining these interactions.

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Tables

Table 1

Variability in Ratings Between Participants

Mean ratings per participant				
Measure	Min	Max	Mean	SD
Order	2.26	6.74	4.55	0.77
Complexity	1.46	6.97	3.50	0.91
Soothingness	1.04	5.29	3.35	0.83
Fascination	1.04	5.36	3.55	0.87
Standard deviation of ratings per participant				
Measure	Min	Max	Mean	SD
Order	0.43	2.48	1.37	0.42
Complexity	0.27	2.24	1.48	0.37
Soothingness	0.26	2.39	1.45	0.41
Fascination	0.27	2.45	1.47	0.39

Figures

Figure 1. Examples of neatly organized compositions.

(A) Chromatic Sampler (Yellow Detail; 2009). Unaltered marine plastic found on the coast of the UK. From “Chromatic Sampler,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/779-2/). Copyright by Steve McPherson ©2018. Reprinted with permission. (B) Image from “The Burning House,” by Sam Ingles (https://theburninghouse.com/page/32). Copyright by Sam Ingles samingles.com ©2018. Adapted with permission. (C) Image by Liz Jones from Betty Jo Designs (http://linoforest.blogspot.com/). Copyright by Liz Jones from Betty Jo Designs ©2018. Adapted with permission.

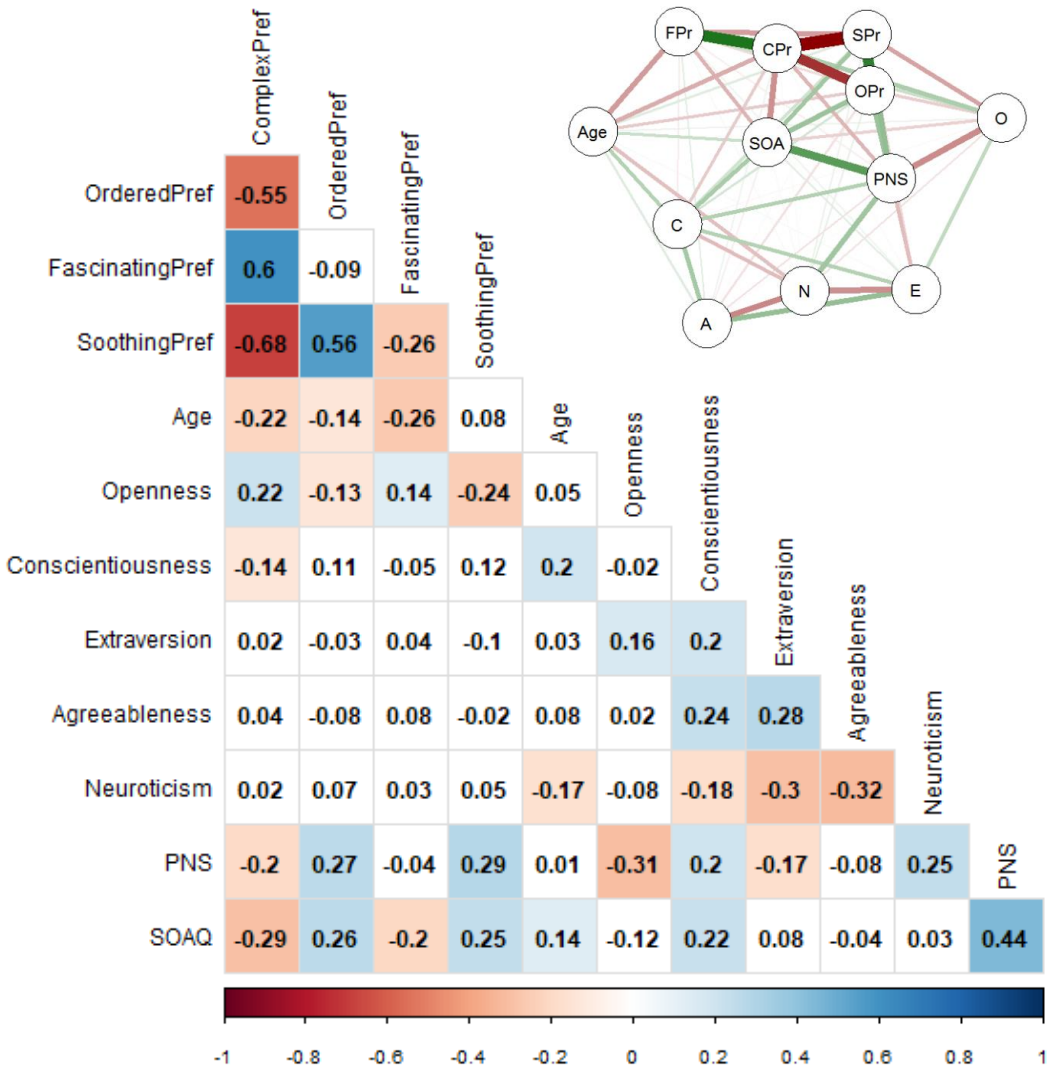

Figure 2. Correlations between the different participant measures (*N* = 421). Correlation plot generated with the R package corrplot (Wei & Simko, 2016), network visualization of the correlations generated with the R package qgraph (Epskamp et al., 2012).

Note. OPr = OrderedPref = preference for ordered images, CPr = ComplexPref = preference for complex images, SPr = SoothingPref = preference for soothing images, FPr = FascinatingPref = preference for fascinating images, O = Openness to Experience, C = Conscientiousness, E = Extraversion, A = Agreeableness, N = Neuroticism, PNS = Personal Need for Structure, SOAQ = Symmetry, Ordering, and Arranging Questionnaire. Correlations with $p < .01$ are shown on a colored background.

Figure 3. The 25% least complex (top) and the 25% most complex (bottom) images that are also in the 25% least ordered (left) versus the 25% most ordered (right) images of the dataset.

From left to right per quadrant:

UPPER LEFT

(a) Image from “Keys,” by Capistrano Lock & Safe (http://www.capolock.com/310keys.asp). Copyright by Capistrano Lock & Safe ©2018. Adapted.

(b) Vintage paint brushes. From “Day 81,” by Lisa Congdon (http://collectionaday2010.blogspot.com/2010/03/day-81.html). Copyright by Lisa Congdon ©2010. Reprinted with permission.

(c) Image from “Keys,” by Capistrano Lock & Safe (http://www.capolock.com/310keys.asp). Copyright by Capistrano Lock & Safe ©2018. Adapted.

(d) Vintage brushes. From “Day 2,” by Lisa Congdon (http://collectionaday2010.bl

ogspot.com/2010/01/day-2.html). Copyright by Lisa Congdon ©2010. Reprinted with permission.

(e) Image from “Top 5 Pretzels,” by Craig Chapman (http://realfoodrealkitchens.com/news/2013/4/26/top-5-pretzels-in-the-real-food-real-kitchens-office-snacks). Copyright by Craig Chapman ©2013.

(f) Vintage notebooks. Image by Hilda Grahnat (https://www.flickr.com/photos/hildagrahnat/4349083613/in/album-72157623240186157/). Copyright by Hilda Grahnat ©2010. Adapted.

(g) Rainbow donuts. Image by Julie Seabrook Ream (https://www.instagram.com/p/BU1oR5VgkZq/?taken-by=hey_jules_studio). Copyright by Julie Seabrook Ream ©2017. Adapted.

(h) Pocket knives. Image from “Pocket knives,” by Richard Wanderman (https://www.flickr.com/photos/richardspics/4560831706/in/photostream/). Copyright by Richard Wanderman ©2010.

(i) Vintage erasers. From “Day 1,” by Lisa Congdon (http://collectionaday2010.blogspot.com/2010/01/day-2.html). Copyright by Lisa Congdon ©2010. Adapted with permission.

(j) Image from “Things Organized Neatly,” by Wary Meyers (https://thingsorganizedneatly.tumblr.com/post/13167231366). Copyright by Wary Meyers ©2011.

(k) Image from “Interior design at housing fairs,” by Kristiina Kurronen (https://susannavento.fi/project/interior-design-for-deko-house/). Copyright by Kristiina Kurronen ©2019.

(l) Image from “Peter Borrett’s Corkscrew Story,” by Peter Borrett (https://www.corkscrewappraisals.com/blog/corkscrew_story_eighteen). Copyright by Peter Borrett ©2014. Reprinted with permission.

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(a) Pretzel image by unkown photographer. No working link available.

(b) 12 years graffiti writing. From “Beneath A Steel Sky,” by Ozkar Gorgias (https://beneathasteelsky.com/post/1507694938/12-years-graffiti-writing). Copyright by Ozkar Gorgias ©2011.

(c) Image from “Lately…,” by Caroline South (http://www.scrapsofus.com/2014/06/lately.html). Copyright by Caroline South ©2014. Adapted.

(d) Image from “Wright Kitchen,” by Brittany Wright (https://www.wrightkitchen.com/work/). Copyright by Brittany Wright ©2018.

(e) Image from “for ARTS SAKE,” by artssake (https://artssake.tumblr.com/post/11922272517). Copyright by artssake ©2011. Adapted.

(f) Image from “Submission photo by violets,” by VIOLETS (https://thingsorganizedneatly.tumblr.com/post/85556240908/submission-photo-by-violets). Copyright by VIOLETS ©2014. Adapted.

(g) Remix of Josef Albers Homage to [Charles Strite as] a square, also known as GITTERBROT (detail; 2013). Project by Sean Cottengim and David Corns (https://thingsorganizedneatly.tumblr.com/post/50433083110/sean-woodrow-david-corns). Copyright by Sean Cottengim and David Corns ©2013. Adapted with permission.

(h) Flowers Set IV. From “Flowers Set IV,” by pastelliyon (https://pastelliyon.tumblr.com/post/21808633841). Copyright by pastelliyon ©2018.

(i) Some Pills. Image by unknown photographer (https://thingsorganizedneatly.tumblr.com/post/6692137258/submission-some-pills).

(j) Image by Nick Maggio (https://thingsorganizedneatly.tumblr.com/post/945754080). Copyright by Nick Maggio ©2018.

(k) Image from “Arrangements,” by Emily Blincoe (http://www.emilyblincoe.com/arrangements/833r9cw0zeo1ld5auln29wlvjju26z). Copyright by Emily Blincoe ©2018.

LOWER LEFT

(a) Image from “Arrangements,” by Emily Blincoe (http://www.emilyblincoe.com/arrangements/efjziwoiin79j0d96wbfyoqf0cde9n). Copyright by Emily Blincoe ©2018.

(b-c) Images by Liz Jones from Betty Jo Designs (http://linoforest.blogspot.com/). Copyright by Liz Jones from Betty Jo Designs ©2018. Adapted with permission.

(d) Combination Piece (Orange No2) (2009). Unaltered marine plastic found on the coast of the UK. From “Combination Piece (Orange No2),” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/combination-piece-orange-no2/). Copyright by Steve McPherson ©2018. Adapted with permission.

(e) Image by Liz Jones from Betty Jo Designs (http://linoforest.blogspot.com/). Copyright by Liz Jones from Betty Jo Designs ©2018. Adapted with permission.

(f) The Data Center Mural Project (2016). Image by Jenny Odell (https://thingsorganizedneatly.tumblr.com/post/24075213048/jenny-odell). Copyright by Jenny Odell ©2018.

(g) Image by Liz Jones from Betty Jo Designs (http://linoforest.blogspot.com/). Copyright by Liz Jones from Betty Jo Designs ©2018. Adapted with permission.

(h) Dark (Combination Piece - Blue, Square, No1) (2012). Unaltered marine plastic found on the coast of the UK. From “Dark,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/dark/). Copyright by Steve McPherson ©2018. Adapted with permission.

(i) Combination Piece (Red No1) (2009). Unaltered marine plastic found on the coast of the UK. From “Marine Plastic,” by Steve McPherson (https://www.stevemcpherson.co.uk/steve-mcpherson-marine-plastic/). Copyright by Steve McPherson ©2018. Adapted with permission.

(j) Image by Ania Wawrzkowicz & Aliki Kirmitsi (https://thingsorganizedneatly.tumblr.com/post/22903252699/photography-ania-wawrzkowicz). Copyright by Ania Wawrzkowicz & Aliki Kirmitsi ©2012.

(k) Ghosts of Consumption/Archaeology of Culture (for Piet M.) (2012). Image from “Ghosts of consumption (for Piet M.),”, by Pam Longobardi (https://driftersproject.net/blog/2012/07/06/drifters-project-works/14-ghosts_of_consumption/). Copyright by Pam Longobardi ©2012. Adapted.

(l) Camera Collection (2012). Image from Jim Golden and Kristin Lane (https://jimgolden.tumblr.com/post/35853915763/new-work-camera-collection-i-collaborated-with). Copyright by Jim Golden and Kristin Lane ©2012.

(m) Visibility (Combination Piece – Orange, Square, No1) (2012-2013). Unaltered marine plastic found on the coast of the UK. From “Visibility,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/713-2/). Copyright by Steve McPherson ©2018. Adapted with permission.

(n) Dark (Combination Piece - Blue, Square, No1) (2012). Unaltered marine plastic found on the coast of the UK. From “Dark,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/dark/). Copyright by Steve McPherson ©2018. Adapted with permission.

(o) Larboard (Combination Piece – Red, Square, No1) (2012). Unaltered marine plastic found on the coast of the UK. From “Larboard,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/larboard/). Copyright by Steve McPherson ©2018. Adapted with permission.

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(a) Bottlecap collection. Image by Julie Seabrook Ream (https://www.instagram.com/p/BSOmcAjAEYR/?taken-by=hey_jules_studio). Copyright by Julie Seabrook Ream ©2017. Adapted.

(b) Copper Beech Leaf Circle (2009). Image by Richard Shilling (https://www.flickr.com/photos/escher1/3951356098/in/album-72157613787390157/). Copyright by Richard Shilling https://www.richardshilling.co.uk/ ©2009. Reprinted with permission.

(c) Danmala. Image from Kathy Klein (https://thingsorganizedneatly.tumblr.com/post/25238344437/danmala-kathy-klein). Copyright by Kathy Klein ©2012.

(d) Eucalyptus leaves. From “Creative nature,” by Caroline South (http://www.scrapsofus.com/2016/01/creative-nature.html). Copyright by Caroline South ©2016.

(e) Image by Julie Seabrook Ream (https://www.instagram.com/p/BR3b_LUg4i9/?taken-by=hey_jules_studio). Copyright by Julie Seabrook Ream ©2017.

(f) Let’s draw…! Image from José Lourenço (https://jose-lourenco.tumblr.com/post/166288060596/lets-draw). Copyright by José Lourenço ©2018. Reprinted with permission.

(g) Let’s build…! Image from José Lourenço (https://jose-lourenco.tumblr.com/post/118122910236/lets-build). Copyright by José Lourenço ©2018. Reprinted with permission.

(h) Image from Herschel Supply Co. (https://www.pinterest.com/pin/61994932347806866/). Copyright by Herschel Supply Co. ©2018.

(i) System Accumulation (2011). Unaltered marine plastic found on the coast of the UK. From “System Accumulation,” by Steve McPherson (https://www.stevemcpherson.co.uk/artwork/system-accumulation/). Copyright by Steve McPherson ©2018. Adapted with permission.

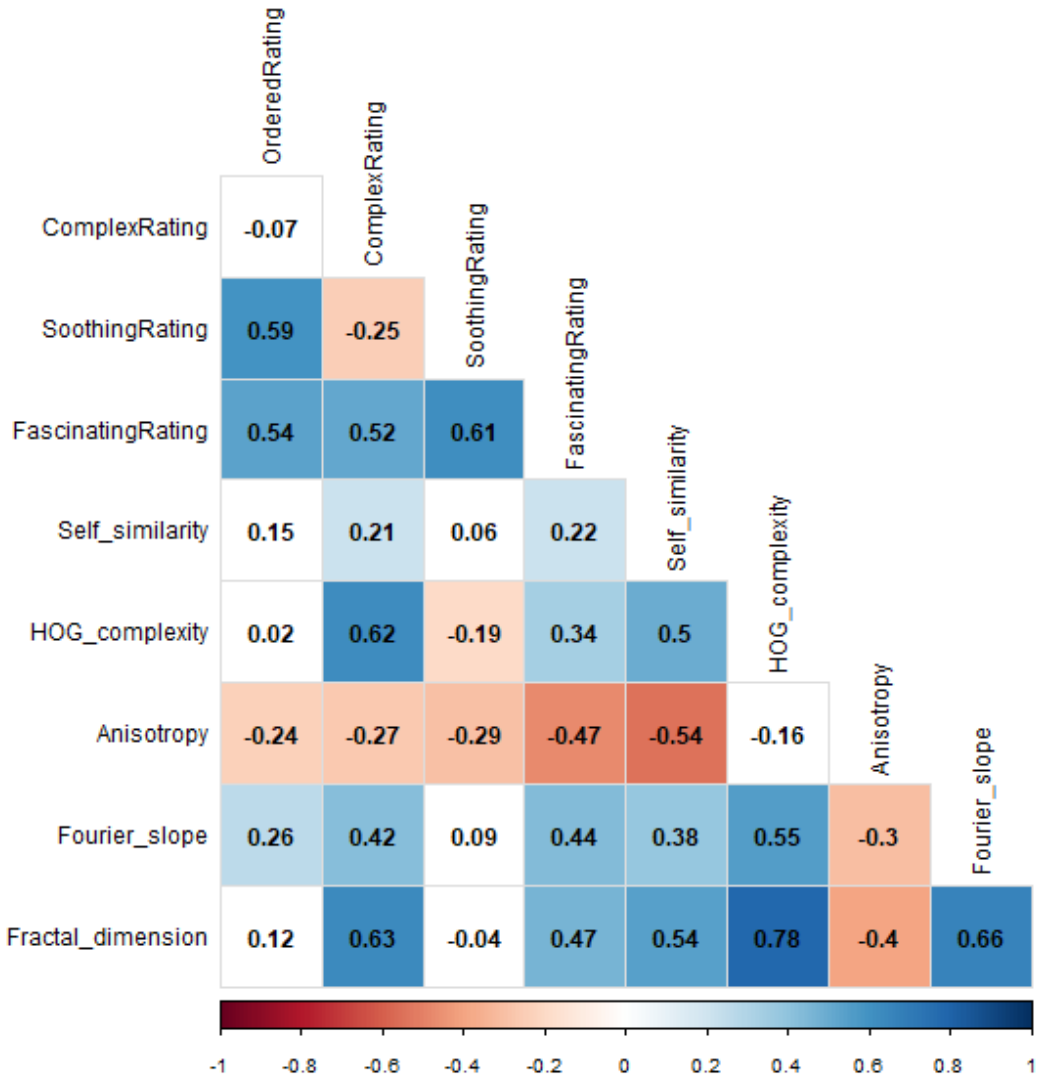

Figure 4. Correlations between average rating scores per image and other image measures (*N* = 184).

Note. Correlations with $p < .01$ are shown on a colored background.

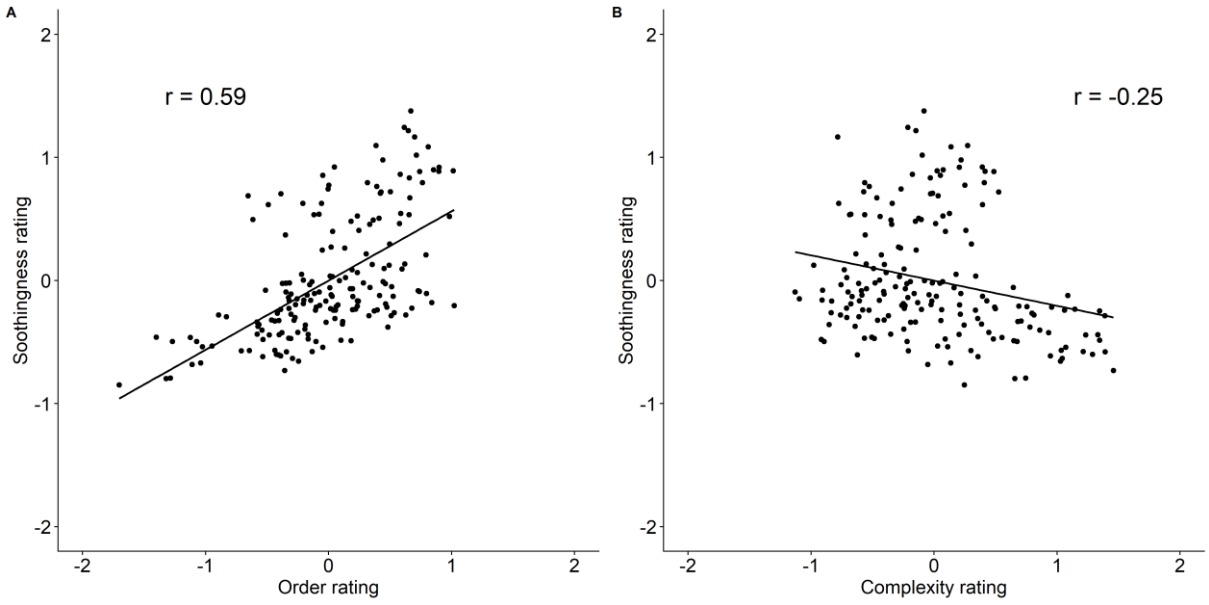

Figure 5. Scatter plots of the soothingness ratings for each image plotted against the order (a) and complexity ratings (b) for each image (N = 184).

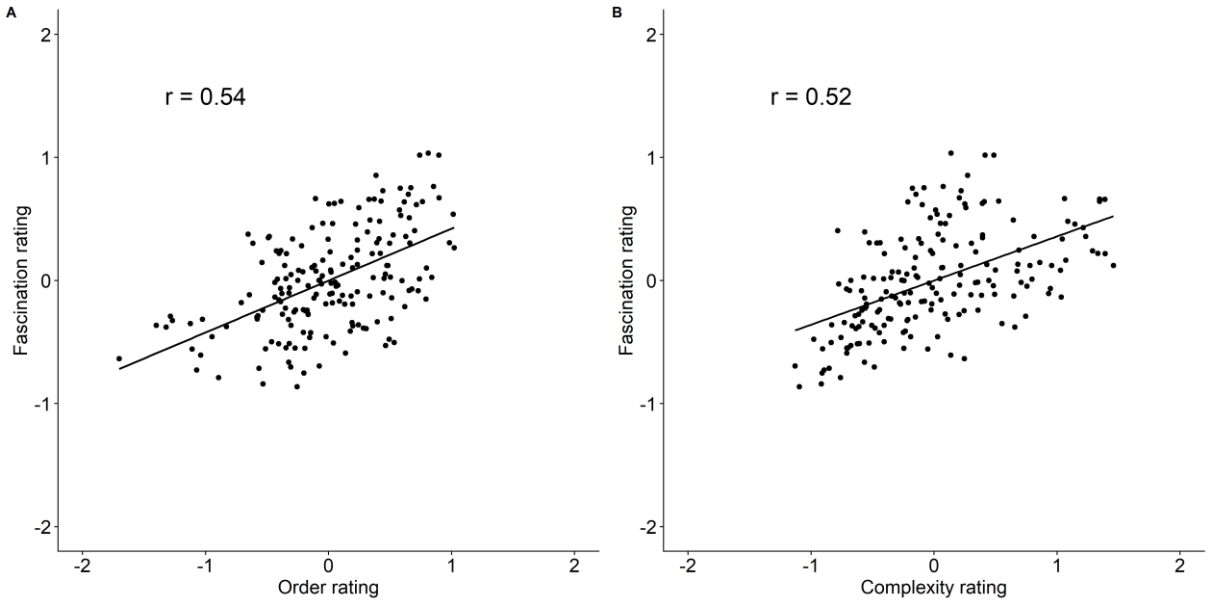

Figure 6. Scatter plots of the fascination ratings for each image plotted against the order (a) and complexity ratings (b) for each image (N = 184).

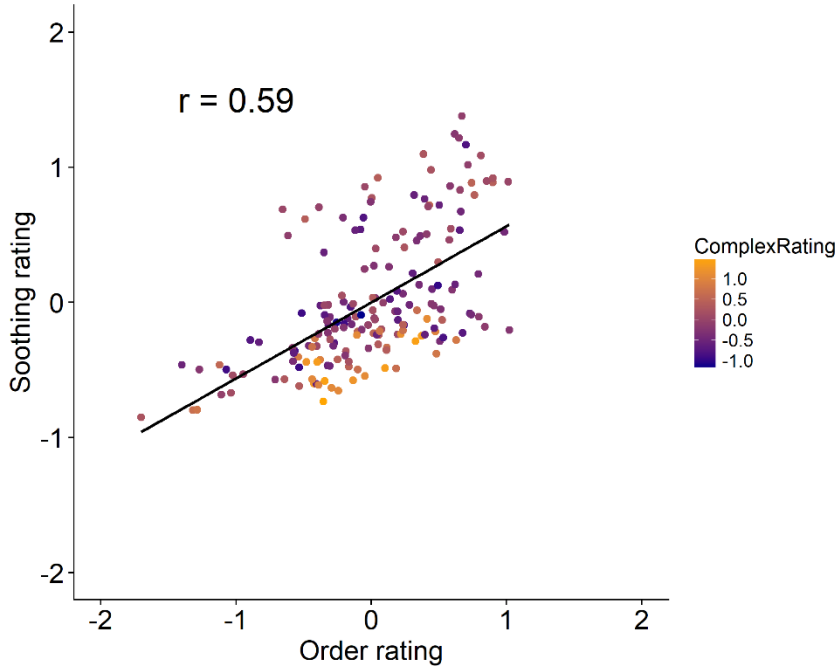

Figure 7. Scatter plot of the soothing ratings for each image plotted against the order ratings for each image, with a color code indicating complexity ratings (N = 184).

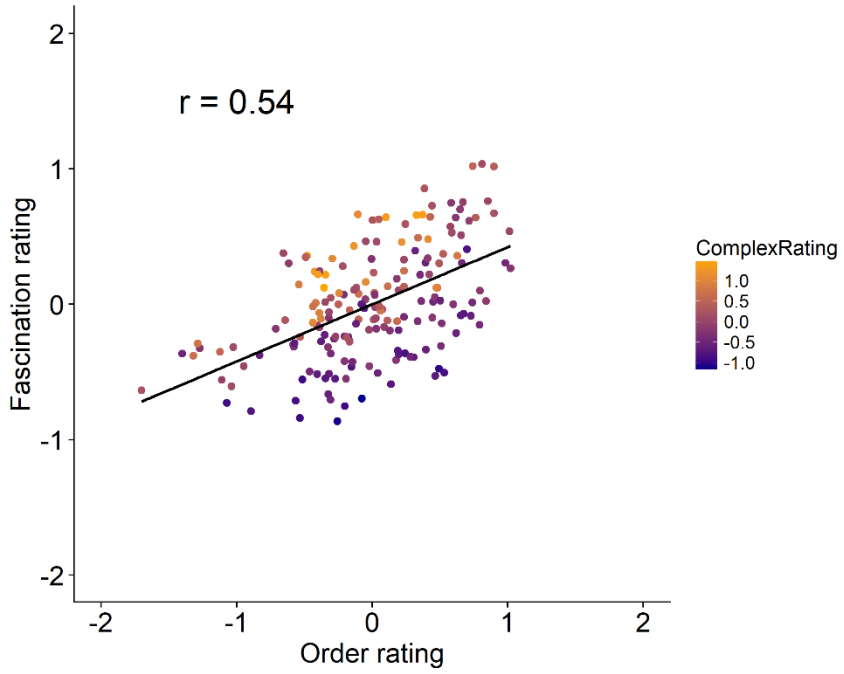

Figure 8. Scatter plot of the fascination ratings for each image plotted against the order ratings for each image, with a color code indicating complexity ratings (*N* = 184).

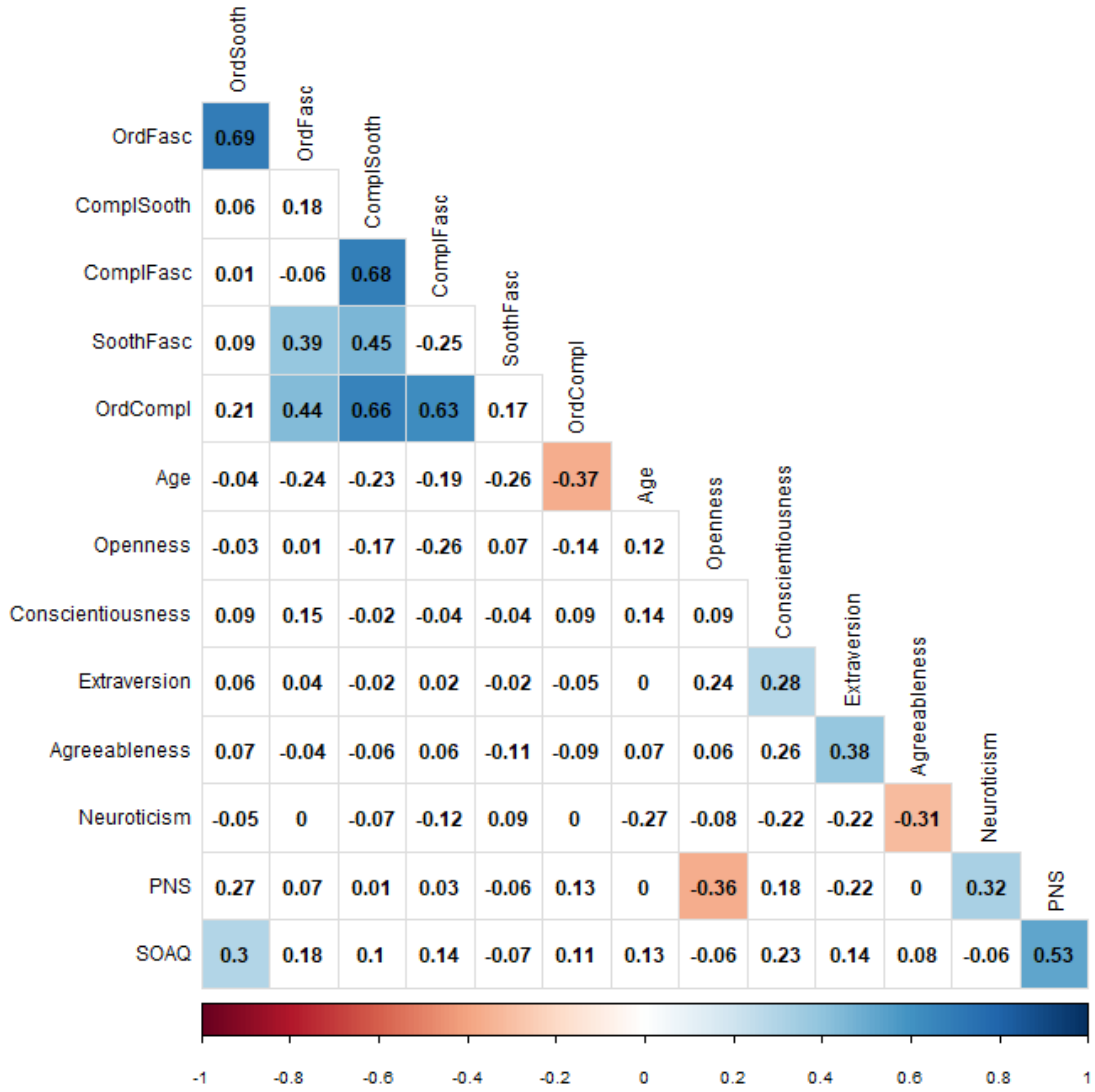

Figure 9. Correlations between the relations between order, complexity, soothingness, and fascination and person properties (N = 84).

Note. OrdSooth = correlation between order and soothingness ratings per individual participant, OrdFasc = correlation between order and fascination ratings per individual participant, ComplSooth = correlation between complexity and soothingness ratings per individual participant, ComplFasc = correlation between complexity and fascination ratings per individual participant, SoothFasc = correlation between soothingness and fascination ratings per individual participant, OrdCompl = correlation between order and complexity ratings per individual participant, PNS = Personal Need for Structure, SOAQ = Symmetry,

Ordering, and Arranging Questionnaire. Correlations with $p < .01$ are shown on a colored background.

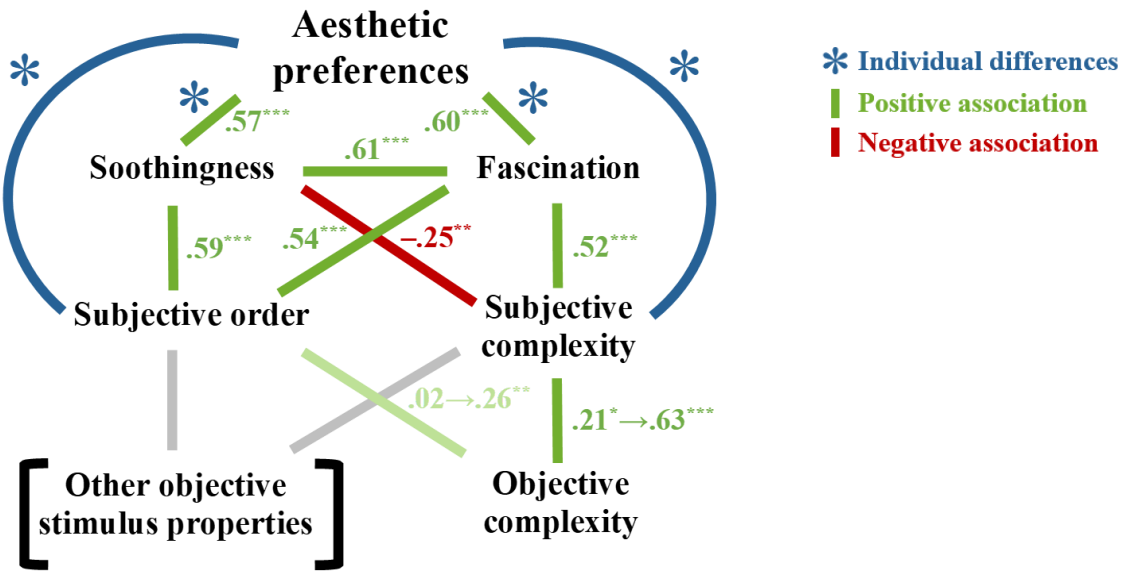

Figure 10. Schematic representation of the study's main findings.

Note. Numbers indicate Pearson product-moment correlations; *p < .01, **p < .001, ***p < .0001. For the correlations with the objective complexity measures, the range of correlations is indicated, going from the correlation with the objective measure for which the correlation was smallest in absolute number to the correlation with the objective measure for which the correlation was largest in absolute number. Retrieved from https://doi.org/10.6084/m9.figshare.8038775.

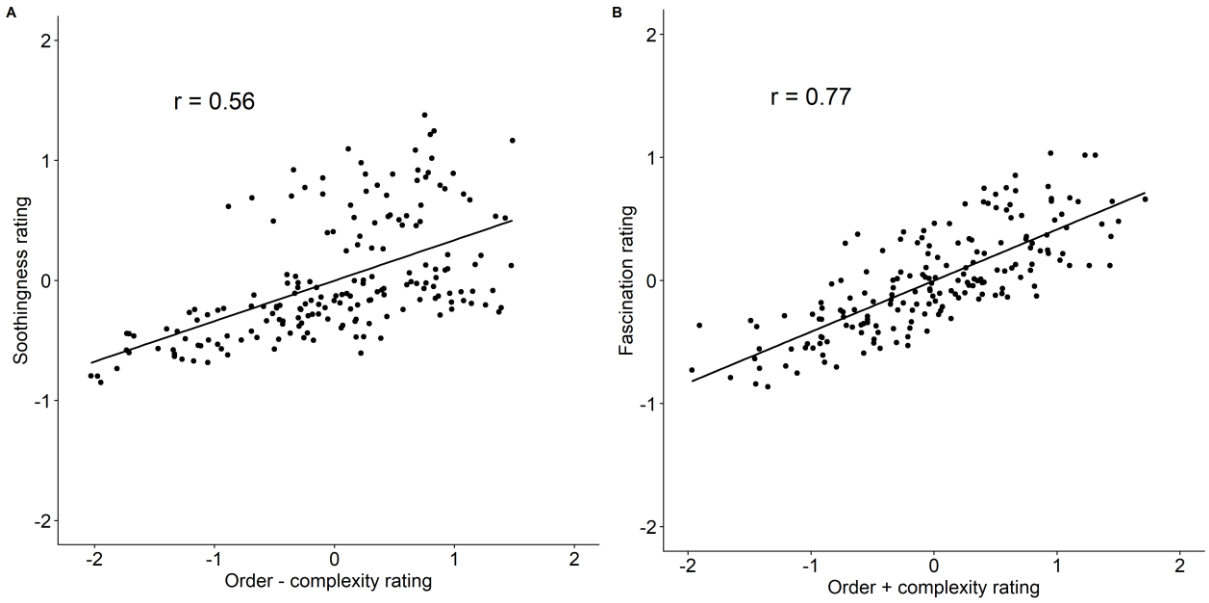

Figure 11. Scatter plot of the fascination ratings for each image plotted against the combined order and complexity ratings for each image (*N* = 184).