An empirical investigation of the visual rightness theory of picture perception

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Abstract

This research subjected the visual rightness theory of picture perception to experimental scrutiny. It investigated the ability of adults untrained in the visual arts to discriminate between reproductions of original abstract and representational paintings by renowned artists from two experimentally manipulated less well-organized versions of each art stimulus. Perturbed stimuli contained either minor or major disruptions in the originals' principal structural networks. It was found that participants were significantly more successful in discriminating between originals and their highly altered, but not slightly altered, perturbation than expected by chance. Accuracy of detection was found to be a function of style of painting and a viewer's way of thinking about a work as determined from their verbal reactions to it. Specifically, hit rates for originals were highest for abstract works when participants focused on their compositional style and form and highest for representational works when their content and realism were the focus of attention. Findings support the view that visually right (i.e., "good") compositions have efficient structural organizations that are visually salient to viewers who lack formal training in the visual arts.
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1. Introduction

A widely held view among writers on Western art is that the meaning of a painting reveals itself only if a viewer sees it as an arrangement of components organized in a

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comprehensive structure (see, e.g., Arnheim, 1974, 1988). According to this view, if a composition is to have maximum impact on a viewer, its induced organizational structure must be, in Carpenter and Graham's (1971) words, "visually right" (i.e., "good"). They assert that a good composition is one in which there is a "certain order of relationships and equilibrium between the parts that is both expressive and visually right. There is a kind of inevitability which suggests that out of unlimited possibilities the artist has found the one correct way of expressing his vision" (p. 25). The notion of visual rightness is implicitly present in many treatises on art and visual perception. As one example, Arnheim (1974) has written that "for any special relationship between objects there is a 'correct' distance, established by the eye intuitively. Artists are sensitive to this requirement when they arrange the pictorial objects in a painting or the elements of a piece of sculpture" (p. 12).

If, as suggested above, a visually right composition has a very efficient structural organization, then it is reasonable to expect that its organization should be salient to viewers of the work. Support for this assertion is provided by research conducted by Locher, Gray, and Nodine (1996). They observed that design and museum professionals and individuals untrained in the visual arts were in good agreement as to the structural framework underlying the balance organization of abstract and representational paintings. For all participants, disruption of the balanced organization of the art stimuli led to reliable shifts in the location of the perceived balance centers of the originals compared with their experimentally manipulated less-balanced perturbations. Using the same set of stimuli, Locher, Stappers, and Overbeeke (1999) found that untrained participants and those with training in design theory were in agreement as to the location of major structural elements within balanced compositions; the location chosen conformed to the original's compositional structure but not necessarily to its actual location in the original. Locher et al. (1999) assert that these findings cast doubt on a strict interpretation of the visual rightness theory. Rather, they suggest that there are several locations within the spatial system of a visually right composition at which pictorial features could occur without disturbing the structural network and unitary effect of a composition created by a skilled artist. According to Locher et al., it is the spatial system or structural skeleton of a composition which is visually right, not necessarily the specific location of all elements within that system.

Locher et al.'s (1996, 1999) findings described above demonstrate that the ability to detect the induced structural skeleton of a painting resulting from a visually right design does not require expert knowledge of design principles. On the other hand, research suggests that the ability to *discriminate* between several articulation possibilities of visually right compositions may require formal training. Gordon and Gardner (1974) observed that college students untrained in the visual arts were able to discriminate reproductions of abstract paintings from an experimentally modified version of each. Accuracy of detection of the originals was 62%. McManus, Cheema, and Stoker (1993) found that subjects were slightly but significantly better than expected by chance at distinguishing computer facsimiles of original Mondrian paintings from perturbed versions of each; the hit rate was 55%. More recently, Locher et al. (1999) reported that design professionals were reliably more successful than in-

dividuals untrained in the visual arts at distinguishing between reproductions of original abstract and representational paintings by recognized artists from experimentally reconstructed less well-organized versions of each art stimulus (hit rates were 64% and 55%, respectively).

While untrained individuals' hit rates for originals reflect accuracy significantly higher than chance performance in these studies, the values are not greatly above the expected chance level of 50%. Failure to provide stronger support for the visual rightness theory may, however, be due to several limitations of the studies described. One limitation involves the nature of the altered images used as stimuli in these studies. For example, Locher et al. (1999) suggest that a possible reason why untrained individuals in their study were not more highly proficient at discriminating originals from perturbed versions may be that the alterations made to the originals produced only minor disruptions in their principal structural networks. That is, the location of the repositioned element(s) in each altered version still conformed to its principal organizational network and the interrelations among elements within the perturbations continued to present a structured totality, albeit a somewhat less clearly defined one perceptually. This assertion is supported by Locher et al.'s finding that only design professionals evaluated the perturbed pictures as significantly less balanced than the originals.

No previous study has used more than one perturbation to test the visual rightness theory. The present research examined viewers' ability to discriminate between original compositions and perturbations of them that are subtle and others in which alterations to the structural organization are visually more salient. Stimuli consisted of reproductions of original artworks by eight renowned artists (and therefore presumably visually right) and a perturbed version of each created by Locher et al. (1996). They repositioned one or two pictorial features in each composition to a new location in the picture that still conformed to the principal structural network created by its artist. A second set of altered versions was created for the present research by repositioning one or more pictorial elements in each composition to a region in the perturbation that produced a more visually salient disruption of the composition's original structure. It was anticipated that participants would be significantly more successful at discriminating between the original compositions and their more perturbed versions than to perturbations in which the original structure is only slightly modified.

A second limitation of previous investigations of the visual rightness theory is that no attempt has been made thus far to determine whether the way one thinks about an artwork influences his or her ability to accurately discriminate an original composition from structurally altered versions of it. Art is capable of layers of stimulation and interpretation. In thinking about a painting, one may consider its physical and structural properties, its subject matter, or its emotional expressiveness. A question addressed by the present study is whether different ways of thinking about a painting by those unsophisticated in the visual arts make more or less salient the supposed elegant structural organization of a visually right composition. Intuitively, it seems reasonable to expect that if the viewer of a painting focuses his or her attention on its structural organization, then his or her ability to discriminate an original

artwork from a structurally less well-organized version of it would be greater than if he or she focused primarily on the work's emotional content. It follows from this that the stylistic quality of a painting may be expected to differentially influence the unsophisticated viewer's experience with a work. Representational art invites one to focus attention on its pictorial content and emotional aspects whereas a viewer is forced, in a sense, to attend to the physical and structural features of abstract works which, by definition, lack realistic qualities. Thus, the compositional elements of abstract works may enhance one's sensitivity to good design in such works as contrasted with representational ones, and correspondingly, increase the likelihood that an original abstract composition would be discriminated from perturbed versions of it to a greater extent than would be the case for representational works.

The present research tested this hypothesis. Participants were asked to identify original compositions from two less well-organized perturbed versions of each. Additionally, they provided a list of characteristics and properties of the picture that contributed to their selection of it as the original. These responses were used to classify participants' reactions to the pictures according to those characteristics of each of the five stages of Parsons' (1987) cognitive developmental account of aesthetic experience. According to this model, individuals pass through a common sequence of five stages with respect to their understanding of what paintings are about. Where an individual is situated in this sequence reflects the kinds of art he or she has experienced and how he or she has been encouraged to think about them.

The types of reactions to art characteristic of each stage of Parsons' (1987) model are as follows. Stage 1 reactions are primarily characterized by freewheeling associative responses to subject matter; pictorial contents are stimuli to pleasant experience and often reflect favoritism (e.g., Red is my favorite color. I like the dog. It looks interesting, the way she is looking up. It makes me think of being at the beach and how good it would be to be there right now.). The dominant reactions at Stage 2 are to a painting's realism and beauty. At this stage, the basic purpose of painting is believed to be representing something (e.g., It looks just like the real thing. It is really just scribbling; my little brother could do that. It is very ugly). Expressiveness of the contents of a composition, that is, the experiences they produce, reflects Stage 3 reactions (e.g., The picture really grabs me. You can see the artist felt sorry for her. It gives me the feeling of gloom and depression. I like the people's expressions.). At Stage 4, individuals respond to the style and form of compositions; they place emphasis on the way the medium itself is handled by the artist (e.g., It is very balanced. The colors are so varied yet the overall effect is white. The sand seems simplified to the point that it does not tell you it is background. The whole picture is cut by the red line.). Finally, at Stage 5 an observer is autonomous in his/her reaction to art. The viewer's own experience with art is the basis for his or her reaction to an artwork (e.g., I do not like it; it is not my taste. I like the primitive rugged feeling and childlike quality that the artist gets with the textural looseness; he does not define all forms).

The present study also addressed a limitation of previous attempts to investigate the influence of expertise in the visual arts on viewers' ability to discriminate original compositions from perturbed versions of them. Participants in these studies (i.e., Gordon & Gardner, 1974; Locher et al., 1999; McManus et al., 1993) were classified

as naïve if they reported no formal training in the visual arts. However, such individuals likely differ with respect to their developmental level of aesthetic experience, and it may be that accuracy of detection of originals requires a certain level of aesthetic sophistication and not necessarily formal training in the visual arts. Specifically, it may be that the structural organization of a visually right original is more noticeable to someone who typically judges paintings in terms of their style or form than to someone who typically reacts to the beauty, realism or expressiveness of its content. This leads to the prediction that the ability to correctly discriminate an original from perturbed versions of it would be directly related to a viewer's level of aesthetic experience as indicated by his or her pattern of reactions (classified according to Parsons' model, 1987) to the set of art stimuli studied. This hypothesis was tested in the present study.

In sum, the present research subjected the visual rightness theory to further empirical scrutiny by studying the individual and combined influence on detection accuracy of original abstract and representational compositions of (1) the extent to which perturbed versions differ in structural organization from originals, (2) the nature of an unsophisticated viewer's reaction to a picture, and (3) his or her developmental level of aesthetic experience.

2. Method

2.1. Participants

Participants were 100 undergraduate students majoring in psychology at the author's institution. Only those volunteers who reported no formal education or studio training in the visual arts were accepted as subjects. The 41 male and 59 female participants ranged in age from 19 to 30 ($M = 24.5$).

2.2. Stimuli

The art stimuli used in this experiment consisted of reproductions of four abstract and four representational paintings by renowned artists selected from a stimulus set assembled by Locher et al. (1996). Locher et al. chose these artworks for their distinctive compositional balance and because their structural geometry permitted the types of experimental manipulations of compositional structure described below. The artist and title of each painting used in the present study are listed in Table 1. Two experimentally manipulated less well-organized versions of each artwork were included in the stimulus set. Outline renditions of the original and two altered versions of each painting are shown in Fig. 1, and detailed explanations of the nature of the alterations made to each original are contained in Appendix A. One set of perturbed compositions was created by Locher et al. who, following the recommendations of an art historian and a graphic artist designer, altered with a computer graphics program the location of one or two pictorial elements deemed to be an integral part of the balance structure of each composition. Manipulations were not

Table 1
Titles and artists of the art stimuli, percent of each version selected as the original, and corresponding chi-square values for each picture

Title	Artist	Version			χ^2	χ^2
		Original	Perturbed 1	Perturbed 2		
Abstract works						
1 Path 1	Liberman	45	34	21	8.7	1.53
2 The Golden Wall	Hofmann	49	32	19	13.8*	3.56
3 MZ 308, Gray	Schwitters	51	31	18	16.8*	4.87
4 White Sea	Avery	57	25	18	26.2*	12.48*
Representational works						
5 Still Life with Mortar and Pestle	Matthiasdottir	47	36	17	14.0*	1.45
6 Still Life, Red Peppers on White Table	Vallotton	43	44	13	18.8*	0.01
7 The Washerwomen	Serusier	42	36	22	6.4	0.46
8 The Daughters of Edward Darley Boit	Sargent	45	41	15	15.4*	0.19

Note: Results of the chi-square tests (df = 2) performed separately on the frequencies for the three versions of each picture are shown in the first column of chi-square values. The second column of chi-square values (df = 1) are the results of tests performed separately on the original and perturbed version 1 frequencies for each picture.
* $p < 0.006$.

readily noticeable when the altered and original versions were viewed in sequence. After an element was repositioned in a perturbed picture, the vacated area was carefully filled in to match the surrounding composition (see Locher et al. for a detailed description of the procedures used to generate their structurally altered versions). Henceforth, these works are referred to as perturbed version 1 stimuli.

A second set of perturbed compositions (perturbed version 2 stimuli) was generated for the present study by repositioning one or more elements in each original to a region in the composition that created a more visually salient disruption of the composition's primary structural organization. Changes in the organizational structures were suggested by a group of individuals trained in the visual arts. With the representational works, care was taken not to violate the rules of projective geometry that constrained their structural organization.

Reproductions of the originals and their altered counterparts were generated from the same graphics program so that the color and texture of the three versions were consistent. All images were printed on $8\frac{1}{2} \times 11$ in. (21.6 × 27.9 cm) paper and measured approximately 8 in. (20.32 cm) on a side (slight variations in the size of the picture images reflected differences in the actual sizes of the originals).

2.3. Procedure

The three versions of each picture were placed on a table one next to the other with a distance of 6 in. (21.24 cm) between each. The eight tables required to display
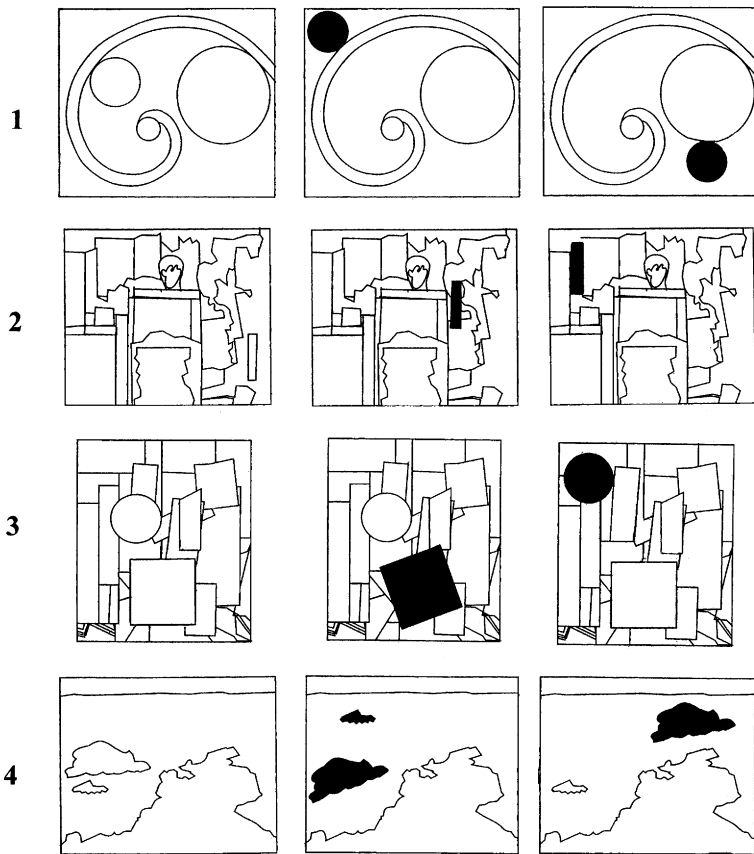
Fig. 1. Outline renditions of the pictures used as stimuli. The number of each picture corresponds to the number assigned to it in Table 1. The original, perturbed version 1 stimuli, and perturbed version 2 stimuli are shown in the left, middle, and right columns, respectively. The elements repositioned in each perturbed version are shown in black. To illustrate that the entire landscape above the river in Serusier's perturbed version 2 composition (shown in the right column of row 7) was reflected about the central vertical axis of the work, striated lines have been drawn through this region in the picture.

the full set of stimuli were spread out in a large well-lighted room in which the experiment took place. Groups of between four and eight participants completed the experiment at the same time. Participants examined the three versions of a given picture and decided which one was a copy of the original composition. They indicated their choice in a space provided on a response form and then checked whether they had (1) never, (2) possibly, (3) probably, or (4) definitely seen the picture before. Following this, participants wrote reasons for their decision. They were instructed to list as many characteristics or properties of the picture as possible that contributed to their selection of it as the original, and any reactions they had to it.

Each group of participants evaluated the eight sets of pictures in a different random order and the three versions of each picture were arranged in different positions
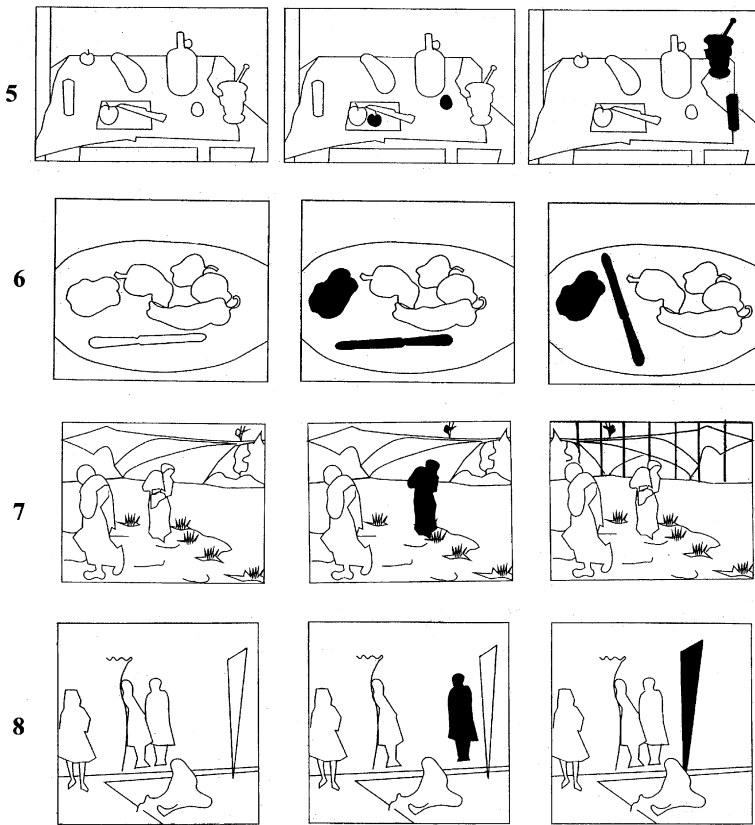
Fig. 1 (*continued*)

that were counterbalanced across the groups of participants. The experimental session lasted approximately 30 min.

2.4. Categorization of the types of responses to the pictures

Participants' written reactions to each picture were categorized as reflecting one of five types of aesthetic responses according to Parsons' (1987) model described earlier. It was found that only 1% of participants' reactions to the full set of stimuli were type 1 and another 1% were type 5. Therefore, data for these two reaction types were not included in this report. An example of one type 2, 3, and 4 reaction for each picture is presented in Appendix B. Participants' reactions were classified in the following way: If all of the comments for a given picture reflected the same type of response, then reaction to that picture was said to be of that type of response. For example, the following participant's comments for Vallotton's *Still Life, Red Peppers on White Table* reflect only level 2 reactions. "It just seems like the way I would position things on my own table if I were given the same items. The arrangement seems

true to life. For example, the glass should not be too close to the edge of the table or it might fall off.'' Only level 4 comments are contained in this participant's reaction to Liberman's *Path 1*. ''Picture A is more compact, everything is together. The other pictures seem off balance, as if they are not put together correctly. The red ball seems misplaced, it does not look good there.'' When a participant's comments included two or more types of reactions, the participant's response to the picture was categorized as being of the highest level observed. For example, the following comments to Matthiasdottir's *Still Life with Mortar and Pestle* contain level 2 and 4 reactions and would therefore be categorized as a level 4 reaction. ''It looks like a real picture. Everything is in its place. The other two pictures are not as symmetrical.''

Two research assistants separately categorized the types of reactions for the eight pictures for all participants. When a discrepancy in assigned levels occurred for a given picture, the two raters discussed the discrepancy and a single level was agreed upon.

3. Results

3.1. Accuracy of detection of the original compositions

Participants indicated that there was little or no likelihood ($M = 1.37$, SD $= 0.27$; $1 =$ never, $2 =$ possibly, $3 =$ probably, and $4 =$ definitely seen an artwork) that they had encountered any of the art stimuli before the experimental session. This finding makes it unlikely that participants' identification of the original compositions was related to their familiarity with them. In fact, informal examination of the data set revealed that in the few cases when participants affirmed that they had either probably or definitely seen a composition before, they were no more likely to identify the work as an original than were participants who reported never having seen the work.

The percentage for each version of each picture selected as the original is shown in Table 1. To determine whether differences between these values are significant, two chi-square analyses were performed on the frequency data for each picture. The first analysis assessed the significance of differences in frequencies among the three versions of a given picture and the second compared frequencies for the original and perturbed version 1 stimuli. Results of the two sets of analyses are reported in Table 1. The significance level was set at 0.006 for each of the two sets of eight tests according to Bonferroni's inequality principle to make the maximum probability of a type 1 error no larger than 0.05 across analyses. As shown in Table 1, the frequencies with which the three versions of a given picture were selected as the original differed significantly for six of the eight pictures. In each of the six cases, as well as for the remaining two pictures that did not achieve significance, the same pattern of results obtained. Specifically, hit rates for the original compositions, shown in Table 1, were greater than expected by chance. The average hit rate for the four abstract works was somewhat higher than the average for the four representational works (50.5% versus 44.3%; chance $= 33.3\%$).

Additionally, participants were much less likely to select perturbed version 2 stimuli as the original than either perturbed version 1 stimuli or the original itself. Note in Table 1 that the eight perturbed version 2 stimuli were selected as originals at rates considerably less than those expected by chance. Clearly, when major disruptions were introduced into the principal structural networks of the originals, relatively few participants judged the resulting perturbed pictures to be the originals. On the other hand, participants were much less sensitive to the minor structural alterations created in perturbed version 1 stimuli. This is indicated by the findings that these stimuli were selected as originals much more frequently than were perturbed version 2 stimuli. Additionally, although perturbed version 1 stimuli were selected as originals less often than their corresponding originals, results of the chi-square analyses (see Table 1) revealed that the differences were not significant for seven of the eight compositions. Only Avery's *White Sea* was selected as the original significantly more frequently than either perturbed version 1 or 2. Participants had a particularly difficult time discriminating between the original and perturbed version 1 stimuli of the works by Vallotton and Sargent as indicated by the finding that the two versions of each composition were selected as originals approximately equal numbers of times.

3.2. Types of reactions to the art stimuli

The percentages of participants' type 1, 2, 3, 4 and 5 reactions to the full set of stimuli were 1%, 44%, 13%, 43% and 1%, respectively. As previously mentioned, due to the very small numbers of type 1 and 5 reactions, data for these two reaction types were not included in any analyses reported below. Table 2 presents the percent-

Table 2
Percent of type 2, 3, and 4 reactions and corresponding chi-square values for each picture and percent of type 2 and 4 reactions and chi-square values for original versions correctly identified

Picture	Type of reaction			χ^2	Type of reaction to original		χ^2
	2	3	4		2	4	
Abstract works							
1	30	7	63	48.0*	49	51	0.1
2	28	7	65	44.0*	24	76	27.0*
3	17	15	68	54.7*	28	72	19.4*
4	48	2	50	44.7*	33	67	11.6*
Representational works							
5	73	24	3	78.2*	74	26	23.1*
6	71	10	19	65.6*	65	35	9.0*
7	60	5	35	45.9*	90	10	64.0*
8	25	32	43	6.4	57	43	1.9

Note: df = 2 and 1 for chi-square values in columns 1 and 2, respectively; picture numbers correspond to those assigned to the artworks in Table 1; types of reaction: 2 = beauty and realism, 3 = expressiveness, 4 = style and form; percentages are based on totals for type 2, 3, and 4 reactions only.
* $p < 0.006$.

ages of type 2, 3 and 4 reactions to each artwork and the result of the chi-square analysis performed separately on the frequencies for each picture. To adjust for the fact that eight analyses were performed, only chi-square values that achieved significance at or beyond 0.006 were considered indicators of reliable differences in the type of reaction to the original for each picture.

As shown in Table 2, participants used significantly more type 2 and 4 reactions than type 3 to think about all pictures, with the exception of Sargent's work *The Daughters of Edward Darley Boit* (see artwork #8 in Table 2) as discussed below. Across the full stimulus set the numbers of type 2 and 4 reactions were approximately the same (44% and 43%, respectively). However, when the distribution of these two types of reactions is examined separately for each of the eight stimuli, it is clear that the way participants thought about a picture was influenced by its stylistic type. As seen in Table 2, participants reacted much more frequently with type 4 than type 2 responses to the abstract works by Liberman (*Path 1*), Hofmann (*The Golden Wall*) and Schwitters (*MZ 308*, *Gray*) (see artworks #1, 2, and 3, respectively, in Table 2). Recall that type 4 reactions are those that focus on the form and style of a composition. The opposite result occurred for the representational works by Matthiasdottir (*Still Life with Mortar and Pestle*), Vallotton (*Still Life, Red Peppers on White Table*) and Serusier (*The Washerwomen*) (see artworks #5, 6, and 7, respectively, in Table 2). Reactions to their compositions were type 2 in nature which focus on the realism and beauty of a composition. Thus, it appears that participants based their decisions concerning which version was the original on the realistic qualities of representational works whereas, given that abstract works by definition lack representational content, participants tended to focus on the structural arrangement of abstract works when trying to decide which version was the original.

Exceptions to these general trends were observed for one abstract and one representational work. In the case of the reproduction of Avery's abstract titled *White Sea* (artwork #4 in Table 2), participants used 48% type 2 and 50% type 4 reactions. This approximately even distribution of the two kinds of reactions reflects the fact that Avery's composition contains some features that, albeit abstract in style, were described by some participants as "islands in the sea." The realistic work by Sargent, titled (*The Daughters of Edward Darley Boit*), drew approximately the same number of type 2, 3, and 4 reactions (see artwork #8 in Table 2). This is the only picture in the stimulus set to receive a substantial number of type 3 reactions, that is, reactions to the quality of expressiveness that this composition produced in the viewers. Participants who reacted in this way to Sargent's compositions remarked, for example, that "The girls standing together represents friendship." and "The original is the one in which the girls are closer together, within whispering distance."

3.3. Detection accuracy as a function of reaction type and picture style

Table 2 presents the percentage of type 2 and 4 reactions to originals that were correctly identified (type 3 reaction data were excluded from these analyses because so few such reactions were observed). Differences between the occurrence of type 2

and 4 reactions for each picture shown in Table 2 were evaluated for significance by a chi-square test and the results reported in the table. Only chi-square values significant at or above alpha 0.006 are indicated as reliable. Results revealed that accurate detection of an original was associated more frequently with one type of reaction to it than another for six of the eight art stimuli. As shown in Table 2, when original abstract works were correctly identified, participants displayed significantly more type 4 than type 2 reactions for three of the four abstract compositions, namely, for Hofmann's *The Golden Wall*, Schwitters' *MZ 308*, *Gray*, and Avery's *White Sea* (see artworks #2, 3, and 4, respectively, in Table 2). On the other hand, type 2 reactions were significantly more common than type 4 when representational works by Matthiasdottir (*Still Life with Mortar and Pestle*), Vallotton (*Still Life, Red Peppers on White Table*), and Serusier (*The Washerwomen*) (see artworks #5, 6, and 7, respectively, in Table 2) were correctly identified. Thus, accuracy of discrimination between an original and perturbed versions of it appears to depend on a match between the stylistic characteristic of a work and a viewer's way of thinking about it.

3.4. Accuracy of detection as a function of aesthetic experience level

Was accuracy of detection related to a participant's level of aesthetic experience as manifested by his or her reactions to the present set of stimuli? To answer this question, an "aesthetic experience level score" was computed for each participant by summing up his or her eight reaction types for the full set of stimuli. For example, if a participant responded to five pictures with type 4 reactions and to the remaining three pictures with type 2 reactions, his or her experience level score would be 26 ($5 \times 4 = 20$ plus $3 \times 2 = 6$). Thus, a high experience level score indicates that an individual's reactions to the set of stimuli were based predominately on their form and style. Someone with a low score was prone to note the pictures' realism and beauty. The observed range of scores was 17–29 ($M = 23.7$, SD $= 1.9$). (It should be emphasized that a participant's aesthetic experience level computed in this way is not taken to reflect his or her stage of aesthetic development according to Parsons' (1987) model. It merely reflects a participant's overall reaction style to the set of stimuli examined in this study.)

To determine if accuracy of detection of original compositions was related to participants' aesthetic experience level, a separate Pearson product moment correlation coefficient was computed between the aesthetic experience level scores and the number of correct detections of representational and abstract originals achieved by each participant. A small but significant inverse relationship, $r(98) = -0.22$, $p < 0.05$, was obtained for the representational works, however, no significant relationship between the variables was found for the abstract works, $r(98) = 0.11$, ns. Thus, the ability to discriminate an original representational composition from its perturbed versions seems to have been facilitated by a consistent strategy of focusing attention on the realism and beauty of the artworks. On the other hand, being prone to focus attention on the style and form of the works did not enhance detection of original abstract compositions.

4. Discussion

The visual rightness theory holds that the structural skeleton or network created by a skilled artist is the correct or best organization of its pictorial features (see, e.g., Carpenter & Graham, 1971). Such an organization should be, according to this view, highly salient to an observer regardless of his or her level of sophistication in the visual arts. If the theory is correct, it follows that when alterations are introduced into the spatial system of the original, viewers should be able to discriminate the resulting perturbed version from the original. Furthermore, the ability to discriminate an original from perturbed versions of it should be directly related to the extent to which the alterations introduced into the perturbations disrupt the supposed visually right structural network of the original. Results of the present study support these assertions. Specifically, it was found that for the set of eight artworks, participants selected originals at a level above that expected by chance (47% versus 33.3%, respectively). Furthermore, they were highly sensitive to major disruptions made to the structural networks of the originals as indicated by the fact that they selected perturbed version 2 pictures as originals only 18% of the time.

Findings indicate that participants were, however, unable to discriminate original compositions from perturbations of them in which only minor changes had been introduced into the principal structural networks. For the full set of stimuli, perturbed version 1 stimuli were selected as originals 35% of the time, a value comparable to chance performance and not significantly different than the hit rates for the originals. As mentioned earlier, Locher et al. (1999) have pointed out that findings such as these cast doubt on a strict interpretation of the visual rightness theory. They argue that it is the spatial system or structural skeleton of a ''good'' composition which is visually right, not necessarily the specific location of all elements within that system. That is, there are several locations within the spatial system of a visually right composition at which pictorial features could occur without disturbing the structural network and unitary effect of a composition created by a skilled artist. Results suggest that the perturbed version 1 stimuli used in this study reflect such articulation possibilities.

The overall hit rates for originals of abstract and representational works in the present study were 16% and 11%, respectively, above those expected by chance. They are also somewhat higher than hit rates reported in previous studies, especially for abstract works. Specifically, Locher et al. (1999) and McManus and Kitson (1995) report hit rates that were 9% and 6% above chance levels, respectively, for the original versions of their representational art stimuli and Locher et al., Gordon and Gardner (1974), and McManus et al. (1993) report rates for abstract works that were 2%, 12% and 4%, respectively, above chance levels. Taken together, previous findings suggest that individuals untrained in the visual arts are able to discriminate original works from altered versions of them at levels only slightly above chance performance. Failure of previous studies to provide stronger support for the visual rightness theory, as contrasted with the higher hit rates obtained in the present research, may be due to task differences between investigations. Participants in previous studies were simply asked to identify the original versions of artworks whereas

participants in this investigation were also required to record their reactions to the stimuli. It is possible that this procedure encouraged participants to attend more carefully to the structural skeletons of the stimuli than did participants in previous studies, and this increased their sensitivity to the spatial system or organization of pictorial features within a visually right composition.

Results obtained by the present study provide clear evidence that accuracy of detection of visually right compositions was differentially influenced by the interaction of the style and unique characteristics of the artworks and the way participants thought about them. Paralleling the general trend for participants to respond to all versions of the abstract art with significantly more type 4 than type 2 reactions, it was found that when the originals by Hofmann, Schwitters and Avery were correctly identified, significantly more reactions to these stimuli were type 4 (76%, 72%, and 67%, respectively). Similarly, just as participants used more type 2 than type 4 reactions for all versions of the representational stimuli, correct detections of original representational works occurred much more frequently when participants' reactions to them were of type 2. For the works by Matthiasdottir and Serusier, these values are 74% and 90%. These findings provide clear evidence that proficiency in being able to discriminate original works from perturbed versions of them was a function of the interaction of the compositions' stylistic properties and specific content, and the way a viewer thought about and reacted to a given picture.

The importance of a viewer's way of thinking about a painting on his or her sensitivity to a good design observed in the present research is consistent with observations made by Locher et al. (1999) for a subset of the art stimuli used in the present study. They found that when design professionals and individuals untrained in the visual arts were asked to replace a major structural element removed from each of six originals at the location where it appears in the original, the locations chosen by both groups conformed to the compositional structure of the original. Thus, when untrained individuals performed a task that required them to carefully attend to the structural organization of both abstract and representational compositions, they were very proficient at identifying the structural skeleton utilized by the artist.

In sum, when participants in this study were asked to discriminate between visually right original compositions and structurally perturbed versions of them, they were very proficient at the task when alterations made to the originals produced major disruptions in their structural networks. When modifications were introduced such that they created relatively little disruption of the unitary effect of a composition, the ability to identify the original required a match between the stylistic properties of a given work and the way the viewer reacted to it. Under these conditions, the hit rates observed in the present study provide stronger support for the visual rightness theory than previously reported in the literature and they identify a factor that must be incorporated into future empirical attempts to validate the visual rightness theory of picture perception. The present findings also suggest that an investigation of any aspect of picture perception would profit from observations of the ways individuals think about art. To date, this has been a neglected variable in most studies of the nature of the aesthetic experience associated with visual stimuli such as paintings.

Appendix A. Modifications made to perturbed versions of the original compositions

Described below are the structural modifications made to each original composition to create its perturbed version 1 (PV1) and perturbed version 2 (PV2) stimuli. These modifications are seen in Fig. 1.

In the original painting of *Path 1* by Lieberman, the locations of the large red, medium yellow and small blue circular areas within the thick, black curved line create an integrated and balanced compositional whole. As seen in Fig. 1, the structural weight of the original composition appears to be uniformly distributed about the center of the pictorial field. Repositioning the yellow circle "outside" of the black line in PV1 of this composition disrupts the continuous spatial arrangement of the colored circles within the curved line. Additionally, this modification shifts the perceived center of balance of the composition toward the upper left corner and away from the middle of the composition where it is located in the original. In PV2, the yellow circle is found in the lower right quadrant of the picture field and it is now readily apparent that the structural weight created by the compositional elements is heaviest in this region.

The structural balance of Hofmann's abstract *The Golden Wall* is achieved by a relatively even distribution of surfaces colored red, yellow and blue on either side of the composition's vertical midline. In PV1 created from this original, a blue rectangular area was repositioned from the lower right picture field, as seen in Fig. 1, to a position on the horizontal midline. This gives the composition a slightly top-heavy appearance. PV2 was created by placing the blue rectangle next to a larger blue surface in the upper left picture field, with the result that the composition's structural weight appears to be highly concentrated in this region.

Schwitters' abstract *MZ 308, Gray* is composed primarily of rectangular areas of different colors that are aligned with the composition's vertical midline. We modified the original composition's structure somewhat in PV1 by rotating the large yellow square in the lower half of the picture field. This disrupted the vertical organization of the balance structure and increases the perceived structural weight of the bottom half of the composition. A perceptually more salient disruption of this composition's balance structure was created in PV2 by repositioning the white circle to the upper left picture field where it is surrounded by portions of dark blue and brown rectangles. This change produces an increase in the perceived structural weight contained in the upper left picture field as compared to the weight in the other three quadrants.

Participants described the structural components of Avery's *White Sea* as two islands in the sea seen to the left of the jagged coastline in the foreground. A dark sky is depicted above the horizon; it extends across the top of the pictorial field. These features are dark green and black and are in sharp contrast to the light yellow–green color of the sea. The structural weight of the pictorial elements is evenly distributed about the original composition's vertical midline. This balance was disrupted in PV1 by moving the small island into its upper left picture field which now contains more structural weight than in its upper right field. Repositioning the large island to the upper right picture field of PV2 results in a readily apparent imbalance of structural weight to the right and left of the composition's vertical midline.

The elements on the table of Matthiasdottir's *Still Life with Mortar and Pestle* are distributed uniformly across the table's surface and they are aligned in two rows. This configuration creates a very balanced structural organization in the original work. A less-balanced structural organization was created in PV1 by repositioning the red tomato from the upper left corner of the table to the cutting board below, and by moving the green lime closer to the jug. These changes not only disrupt alignment of the compositional elements, but also increase the perceived structural weight on the right as contrasted to the left side of the composition. The red water tumbler has been moved to the right side of the table in PV2 and the mortar and pestle have been repositioned higher in the pictorial field. As a result of these changes, there is a readily apparent imbalance in structural weight in PV2 about the vertical midline. In fact, the upper right picture field appears to contain greater structural weight than in the other three quadrants.

The orientation alignment of the red peppers and knife in Vallotton's *Still Life, Red Peppers on White Table* conforms to the oval appearance of the table on which they rest. Additionally, the distribution of structural weight is relatively balanced about the composition's vertical midline. Alignment of the elements has been disrupted in PV1 by tilting the pepper at the left side of the table in a more up-right position and by rotating the knife 180° which places its dark wood handle in the right picture field. This combination of modifications increases the perceived structural weight in the right as contrasted to the left picture fields. The position of the knife in PV2 clearly disrupts the global structural organization of that composition and increases the structural weight above the horizontal midline as compared to the lower region.

An important factor that contributes to the balance of Serusier's composition *The Washerwomen* is his use of color. Specifically, the dark blue expanse of the river on the right side of the composition is balanced by the very dark blue dress worn by the woman in the left picture field. A rust-colored landscape is depicted in the upper left region of the picture. It is balanced by a large green tree and by green fields in the upper right region of the composition. All other areas of the composition are shades of yellow. The second woman, who is also wearing a dark blue dress, stands at the midline of the original composition. Moving this woman slightly to the right of the midline, as was done in PV1, increases somewhat the concentration of darker colors, and correspondingly the perceived weight, on the right side of the altered composition. Additionally, repositioning the small tree at the top right of the composition closer to the midline appears to tie together the structural elements in the upper right picture field. Together these two modifications contribute to an increase of the perceived structural weight of this region in the PV1 versus the original pictures. In PV2, the entire landscape above the river was reflected about the central vertical axis of the composition. This placed the rust-colored area directly above the blue river in the right picture field resulting in a much greater concentration of dark colors in the right picture field.

Finally, in *The Daughters of Edward Darley Boit*, painted by Sargent, one sees a child seated on the floor in the foreground of a well-lighted room and another child standing to the left in the same room. Two other girls are standing next to each other

just inside a very dark room extending to the top and right edges of the composition. The edge of a large red screen is depicted in the renditions of the composition as a long thin triangular shape at the extreme right of the room. The screen extends behind a large vase to the wall at the left (not shown). It is this red area that serves as the balancing element for the standing girls in the left picture field. Repositioning one of the girls close to the red area in the left field, as was done in PV1, disrupts this balance by increasing somewhat the perceived structural weight in the right versus the left picture fields. A much more salient disruption of the balance structure was achieved in PV2 by moving the red edge of the screen closer to the girls, thereby increasing the perceived structural weight in the left picture field.

Appendix B. An example of a type 2, 3, and 4 reaction for each composition

Picture	Reaction type and one participant comment
1	2. The yellow circle is moved in all three pictures but B is more pleasing to my eye.
	3. I got a stronger sense of tension in B.
	4. I did not think it was B or C because the circle is out of the ''loop'' and this does not look right. The circle belongs inside the loop.
2	2. The picture reminds me of a bedroom bureau and mirror.
	3. The colors look more alive in B.
	4. In A everything was not one-sided, there is something on each side to draw your attention, although there are not equal amounts on each side.
3	2. C was more pleasing because the circle in the upper corner reminds me of the sun.
	3. I like picture B because its more like me, relaxed.
	4. In picture A everything seems to be in the right place and straight up and down.
4	2. They look like islands, which is why I choose A because that is the way I would picture the scene.
	3. It looks very cold, very unfriendly.
	4. The picture fills the whole canvas; everything is aligned and congruent.
5	2. Everything in picture A looks in the right place when you are cooking. It reminds me of my grandmother's kitchen.
	3. I find the arrangement of items in picture B to be much more interesting, more thought-provoking about the picture's meaning.
	4. I picked C because it looks more put together and balanced. The tomatoes are next to each other and there are no empty spots on the table.

Appendix B (*continued*)

Picture	Reaction type and one participant comment
6	2. The knife just seems in the right place as it would be after I cut something. 3. I find B to be the most visually interesting. 4. There is a nice flow of the peppers and the knife in picture B. They look to be in the correct positions on the table.
7	2. It looks like a typical washing day for these women; they are going about their daily business. 3. Picture A looks like somewhere I would like to be. You can feel the vibes in the environment. 4. Based on the direction of the two women walking and the placement of the red field and blue river, I think that B is the better composition.
8	2. This reminds me of a childhood scene. 3. The girls are closer to each other in A. This makes for a more friendly atmosphere. 4. The red line looked to be where it was supposed to be, and the girls standing away from each other made the picture more symmetrical.

Note: Picture numbers correspond to those assigned to the artworks in Table 1.

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