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# Images Influencing Images: How Pictorial Context Affects the Emotional Interpretation of Art Photographs

Claire Reymond[1], Jan B. Vornhagen[2], Matthew Pelowski[3, 4], Klaus Opwis[1], and Elisa D. Mekler
[1] Department of Psychology, Center for General Psychology and Methodology, University of Basel
[2] Department of Computer Science, Aalto University
[3] Faculty of Psychology, University of Vienna
[4] Vienna Cognitive Science Hub, University of Vienna

Images are never seen in isolation. Instead, they are perceived within a spatial and temporal tapestry of neighboring images. What impact do other images have on our emotional response toward a particular image? Answers to this basic question have vital implications for a range of fields—especially for visual communication and for curating art, where resources are invested in arranging images within a visual context. Previous studies have provided mixed results, suggesting that juxtaposed images may lead to contrast or assimilation processes increasing and decreasing our liking of an image. But how specific image features in neighboring images (image's ambiguity or formal similarities between images) modulate our affective interpretation of an image has almost never been explored. In Study 1, we compared the emotion perceived in art photographs ("target" images) when displayed on their own versus when displayed in juxtaposition with negatively or positively valenced nonart ("context") images. Additionally, we analyzed the influence of the artwork's perceived ambiguity. In Study 2, we examined the effect of the perceiver's expertise and the formal similarity between the images on the rated valence of the target image. Our results show that the emotion perceived in the artwork contrasted away from or assimilated toward the valence perceived in the context image depending on which evaluative dimension was activated. Moreover, the influence of negative contextual material on the target image's valence was more pronounced. We conclude by saying that the evaluative dimension is part of the pictorial context that influences the affective interpretation of an image.

*Keywords:* ambiguity, context, emotion perceived in art photographs, formal similarity, juxtaposition

> Whatever the artist may do, however, he cannot avoid showing his surface in the midst of other surfaces of an environment. A picture can only be seen in a context of other non-pictorial surfaces. James J. Gibson in The Ecological Approach to the Visual Perception of Pictures. (Gibson, 1978, p. 229)

Images can emotionally move us, intellectually challenge us, or sometimes even change our view of the world. But images are never perceived in isolation. They are rather always experienced embedded in a context. Contextual information such as the physical space in which a work is encountered (e.g., Gartus et al., 2015), the information provided next to the artwork (e.g., Cupchik et al., 1994; Szubielska & Sztorc, 2019), or the judgments of others (e.g., Lauring et al., 2016) influences the aesthetic experience of an image (for an overview on contextual influences on art perception, see Pelowski & Specker, 2020). Specifically, and expanding on the quote by Gibson, wherever we look at images—whether on the street, on a screen, or in a book—they are always accompanied by myriad other visual artifacts: the context in which images are encountered consists of other images. This is especially true for art, where images are most often seen in a gallery or museum and encountered within a specific progression of other images.

The value, and perhaps one of the purposes, of art is to touch us emotionally (Pelowski et al., 2020). At the same time, how images influence the perceived emotional interpretation of neighboring images is a complex phenomenon, involving a multitude of aspects (e.g., influences can be based on formal features of the image like format, color, and style or content-related factors like the image statement and emotional expression). This poses a unique challenge for professionals that deal with the presentation of (art) images. Curators and gallery owners spend time and effort arranging images next to each other for exhibitions and online

Claire Reymond https://orcid.org/0000-0002-8988-7263
Jan B. Vornhagen https://orcid.org/0000-0002-8516-7840
Matthew Pelowski https://orcid.org/0000-0001-5563-3727
Klaus Opwis https://orcid.org/0000-0003-0509-8070
Elisa D. Mekler https://orcid.org/0000-0003-0076-6703
Elisa D. Mekler is now at the Department of Digital Design, IT University of Copenhagen.

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Correspondence concerning this article should be addressed to Claire Reymond, who is now at Institute Digital Communication Environments, FHNW University of Applied Sciences and Arts Northwestern Switzerland, Freilager-Platz 1, 4002 Basel, Switzerland. Email: claire.reymond@fhnw.ch

museum tours (e.g., Flacke, 2016), and designers put a lot of thought into how to present images on double-page spreads in catalogues, books, and newspapers (e.g., Samara, 2007). At the same time, professionals who study and work intensively with the presentation of images are (implicitly) aware of interaction effects between images, and they compose image series to intensify, contradict, or change their evaluation and message (Ganz & Thürlemann, 2010; Hofmann, 1985; Reymond, 2013). The knowledge gained from our study thus supports curators in their aim to shape encounters with art in exhibition contexts, and it may enable designers to use the interplay of images in visual design more consciously to afford an intended effect. This will in turn impact the emotions experienced as part of our interaction with (art) images. However, there is a lack of empirical studies examining the effect of pictorial context and the modulating effect of specific image features on the emotion perceived in an image. Even more, existing studies have led to contradictory results, which indicates a need for more controlled and targeted research on images' impacts on other images and the resulting affective interpretations. This is the aim of the present article.

## Pictorial Context and Its Impact on Perceived Emotions

In this article, *pictorial context* refers to the spatial and temporal environment of a stimulus consisting of images shown next to each other or in a sequence (Cohn, 2013, 2015). Contextual information—often presented as images—has been shown to influence the perception of emotions in faces (Barrett et al., 2011): for example, an expression of disgust paired with a muscled body was more likely to be interpreted as a proud face, which shows that the emotions perceived in images of faces were interpreted according to the context in which they were encountered (Aviezer et al., 2008). At the same time, a photograph of a fearful face was evaluated as more fearful surrounded by an image depicting a threatening situation than in a happy or neutral situation (Righart & de Gelder, 2008). In film, the influential power of sequential images is known as the Kuleshov effect (Kuleshov, 1974; Mobbs et al., 2006): the affective interpretation of identical moving images of a face was changed by the sequence viewed before it containing highly emotional material. Recent studies have replicated the Kuleshov effect by demonstrating that the perceived valence and arousal of moving images showing neutral faces depended on previously viewed scenes (Calbi et al., 2017), and faces seen in a negative or positive context elicited higher valence and arousal reactions than faces in neutral contexts (Mobbs et al., 2006). In a study on the perception of a work of art, the facial expressions of two depicted figures were judged on the basis of the context in which they were seen: manipulating the position of a fearful figure affected the perceived emotional interpretation of another figure in the same image (Marian & Shimamura, 2012).

Similarly, images accompanying textual news reports in mass media have been shown to systematically influence the (emotional) understanding of the written message (Price et al., 1997). Images can serve as frames for interpreting neighboring text, since they use various rhetorical means—metaphors, illustrations, symbols—that graphically capture the essence of an event (Rodriguez & Dimitrova, 2011, p. 51). The emotional valence of a picture placed next to a text has been shown to influence the subsequent cognitive processing of information such "that reactions to featured photographs shift the primarily text-based perceptions and evaluation of issues in the direction suggested by the photographs" (Gibson & Zillmann, 2000, p. 355).

## Perceptual Processes Underlying the Impact of the Pictorial Context

The influence of the pictorial context on the perception of an image can be explained as a categorization of neutral faces according to the emotions attributed to the context (Calbi et al., 2017) or as a visual frame used to interpret the meaning of text (Rodriguez & Dimitrova, 2011). Specifically, two processes have been proposed:

First, images that are seen after very favorably rated images are perceived as less favorable. In that case, the perceived image (target image) forms a *contrast* to the image that is seen in the context (context image). Paintings from Goya's tapestry period were liked more when they were seen after works from his dark period (Dolese et al., 2005); beauty ratings for a set of moderately beautiful photographs of buildings were higher after viewing a set of less beautiful pictures (Tousignant & Bodner, 2014); and abstract paintings were rated more beautiful when paired with less beautiful paintings (Tousignant & Bodner, 2018).

This effect of stimuli contrasting *away* from contextual stimuli was described by Fechner's principle of aesthetic contrast (Fechner, 1898, cited in Allesch, 2018). Fechner's principle describes a hedonic contrast. It distinguishes between positive hedonic contrasts, when a stimulus is rated better after seeing a contextual stimulus, and negative hedonic contrasts, when a stimulus is evaluated as worse after perceiving a contextual stimulus (Dolese et al., 2005). Parducci's (1965) range-frequency model provided an explanation for Fechner's principle of aesthetic contrast and aligns it with some general psychological heuristics such as the anchoring effect (for an overview, see Furnham & Boo, 2011). Parducci (1965) proposed that a stimulus will be rated on a fictitious rating scale relative to other recently rated stimuli and that both the range (distance between the most positive and most negative stimuli) and the distribution of recently rated stimuli have an influence on how a stimulus is rated. That is, an extremely positive or negative context stimulus will push the target's rating down or up and so provoke contrast effects. Also, if the other stimuli are evenly distributed (vs. not evenly distributed), a neutral stimulus will be placed closer (vs. more far away) to the middle of the rating scale.

Second, an image may assimilate *toward* an image seen before or next to it. Images that were preceded by highly negative IAPS (International Affective Picture System; Lang et al., 1997) context images assimilated toward the negative context images (Mullennix et al., 2018). When rating the pleasantness of an artwork, contrast effects occurred when the artwork was presented next to contextual stimuli that were formally similar to the target but clearly aesthetically inferior to it. Assimilation effects were registered when the contextual stimulus was aesthetically similar to the target stimulus (Arielli, 2012). Assimilation effects were also found based on participants' tendency to repeat the previous response (Chang et al., 2017; Kondo et al., 2012). Pegors et al. (2015) showed an assimilation effect to previous evaluations, but at the same time the stimulus qualities that participants had viewed in the preceding trial had a contrasting effect on the judgment of the current stimulus.

Several models have been proposed to describe the effects of assimilation and contrast (Förster et al., 2008; Schwarz & Bless, 1991). One of them is Mussweiler's (2003) selective accessibility model. Mussweiler's model is based on a three-stage process: the selection of a context stimulus to which the target stimulus will be compared, the comparison between the two, and the evaluation of the comparison. Applied to images, this suggests that perceived similarity between a target image and context image facilitates assimilation, that is, the target image is rated as *more similar* to the context image. Conversely, perceived dissimilarity between two images facilitates contrasting evaluations, in which the target image is perceived as *more different* from the context image.

Some studies have shown that negative stimuli have a more pronounced effect on subsequent ratings of stimuli than positive ones. In a study by Calbi et al. (2017), presenting happy or fearful faces before neutral faces had a clear effect on the assessment of the neutral faces, but only in the fear condition. Similarly, Mullennix et al. (2018) only found an assimilation effect when target images were shown next to negative image material and not when they were paired with positive images. This effect may be explained with the motivated attention theory (Bradley et al., 2003; Lang et al., 2013; Schupp et al., 2004). Cues indicative of danger and fear evoke response facilitation compared with neutral stimuli and motivate a defensive attitude, which become manifest in avoidance and heightened vigilance (Bradley et al., 2012). The comparably stronger impact of negative image material is consistent with the negativity bias, which explains this effect as a function of evolutionary adaptation (Baumeister et al., 2001; Vaish et al., 2008).

Curators and designers have an interest in presenting artworks in a way that supports, challenges, or contradicts the images' inherent meanings and in evoking genuine emotional reactions to them. By using formal analogies or contrasting contents, they shape interactions between images, creating possibilities of influence between images that stand side by side. But this knowledge largely remains tacit, based on curators' and designers' many years of experience and practical work with images. A better understanding of which processes underlying the effects of pictorial context are activated under which circumstances may therefore help inform curatorial decisions and facilitate teaching novice image practitioners.

## The Present Studies

We investigated two distinct factors that might account for how pictorial context shapes viewers' emotional attributions in images. In Study 1, we examined the role of ambiguity on perceived emotion in juxtaposed images. In Study 2, we investigated formal similarity between images as a potential moderator for how pictorial context impacts viewers' evaluation of art photographs. We did this by measuring the emotion perceived in a target image when participants were confronted with an emotionally negative or emotionally positive context image compared with when the target image was viewed on its own.

## Study 1: The Effect of Ambiguity on Valence Ratings in Juxtaposed Presentation

Ambiguity refers to when multiple meanings are attributed to an object and the meaning varies depending on the information, context, and interaction between an observer and an object (Gaver et al., 2003). In images, cognitive ambiguity is a visual experience that elicits multiple interpretations (Jakesch et al., 2013). Because works of art exhibit semantic instability (Jakesch & Leder, 2009; Muth et al., 2015), they are predisposed to be affected by contextual influences. According to Herr et al. (1983), contextual information can be activated as a prime. If the prime is moderately extreme, "it is the ambiguity of the target that determines whether assimilation or contrast effects emerge" (p. 334).

The aim of Study 1 was therefore to investigate the extent to which image ambiguity moderates the influence of the pictorial context—in the form of negatively versus positively valenced context images shown in juxtaposition—on the emotional attribution of a target image.

### Method

#### Participants

Study 1 included 106 participants recruited via Prolific (prolific.co; mean age = 26.3, $SD$ = 7.3, 38 female, 66 male, two nonbinary). This sample size was informed by a simulation study using the BEST package (Bayesian Estimation Supersedes the $T$ test; v0.5.4 Kruschke & Meredith, 2021). We used the default priors to estimate a required sample needed for excluding artworks with unreliable ambiguity ratings (i.e., ambiguity ratings with an $SD > 1$ on a 7-point Likert-type scale). For Study 1, this resulted in a recommended sample size of $n \geq 54$ per group.

All participants had normal or corrected-to-normal vision as well as normal color vision. Participants received monetary compensation (about US$2) for enrolling in the study. Both studies were approved by the ethics committee of the University of Applied Sciences and Arts Northwestern Switzerland.

#### Stimuli

Photographs depicting landscapes and scenes were used as stimuli for both studies. The focus of our study was to examine the affective interpretation of images seen with negatively or positively valenced context images. However, we did not include context images that were likely to elicit strong emotions (e.g., mutilated bodies or dangerous animals), because we wanted to investigate a more realistic situation of images that could be presented side by side (for studies using highly emotional stimuli, see Mullennix et al., 2018). We therefore excluded images showing humans and animals.

The stimuli in Study 1 consisted of 20 target images and 20 context images. The target images were horizontal format high-quality (150 dpi) digital color photographs of fine art by contemporary Western artists (see "Art Photographs" for a full list of the artworks, artists, and links to the retrieved photographs in the repository: https://osf.io/ptfqe/). The images were downloaded from the artist's own website, from museum's websites, or from auction houses. As such, the images were expected to represent the most faithful reproductions of the original photograph's contrast and color (Reymond et al., 2020). Context images were selected from the OASIS Image Set (Open Affective Standardized Image Set; Kurdi et al., 2017) and consisted of horizontal format (nonart) color photographs. We used context images that were prerated as either having a negative (mean valence = 1–2.5/7) or a positive (mean valence = 5.5–7/7) valence.

Participants were not informed about the provenance of either set of photographs (i.e., they were not informed whether the images were categorized as art or not). We did this for two reasons: first, to obtain more pronounced valence ratings, as it is known that images classified as nonart receive more extreme valence ratings (Gerger et al., 2014; Leder et al., 2014; Pelowski, Gerger, et al., 2017). Second, and more importantly, we did not label them as art so as to avoid establishing two categories of stimuli, art images and nonart images, which could introduce potential confounding factors (Dolese et al., 2005; Zellner et al., 2003, 2009).

The target images were displayed next to context images, as it has been shown that the effect is more pronounced if the images are shown juxtaposed rather than sequentially (Khaw & Freedberg, 2018; Tousignant & Bodner, 2018). Ten target images were shown paired with 10 negatively valenced context images (OASIS, Kurdi et al., 2017), and another 10 fine-art photographs were paired with 10 positively valenced context images.

### Procedure

The experiments were designed using Unipark software (Unipark, 2017). After providing informed consent, participants were informed that they would view images and be asked to rate them.

Study 1 consisted of three blocks presented in the same order for all participants (For an overview on the study design of Study 1 see Figure 1). Block 1 contained two subblocks (Block 1a & Block 1b). In Block 1a participants were asked to rate the images according to their ambiguity and in Block 1b regarding their valence. The subblock order was counterbalanced across participants. In both subblocks, participants were presented each of the 20 target images alone. All images were shown centered on a white background for an indefinite amount of time, and participants could take as long as they wished to look at and rate the image (Arielli, 2012; Dolese et al., 2005; Mullennix et al., 2018). After answering the question presented underneath the image, participants clicked "Continue" at the bottom of the page to see the next image.

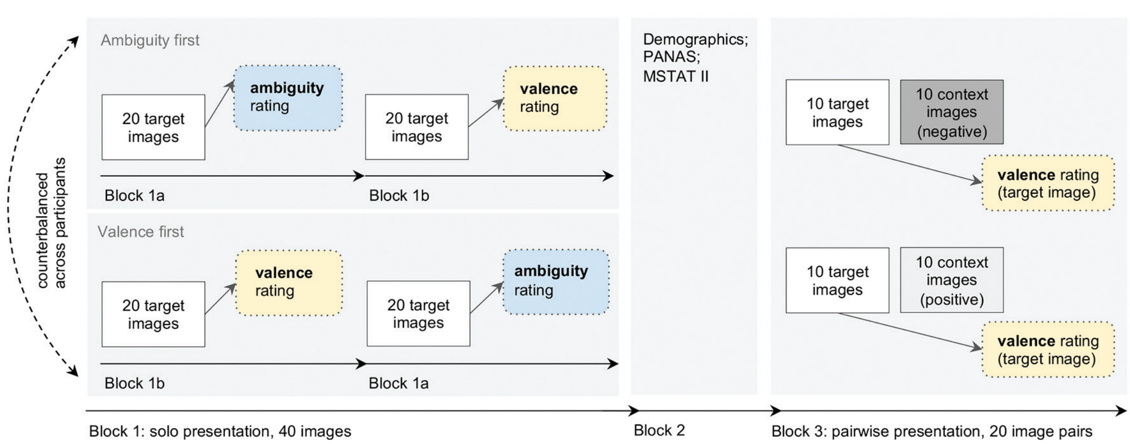
In Block 2, participants were asked to provide demographic information (age, gender) and to indicate whether they were professionally involved in assessing or creating images (i.e., as designers, curators, photographers, etc.). We asked participants to state their current affect (PANAS; Thompson, 2007) as well as their tolerance to ambiguity (MSTAT-II; McLain, 2009). Block 2 was also defined to distract participants from their ratings in Block 1.

Block 3 began with the instruction that now two images (a target image and a context image) would be presented side by side and that one of the two images (the target image) should be evaluated in terms of perceived emotion. Following this, participants saw 10 target images paired with 10 OASIS images (Kurdi et al., 2017) with negative valence and another 10 target images paired with OASIS images with positive valence. Participants could view the target and context images for as long as they wanted. All the image pairs were shown one after another in a randomized order. To make sure that participants rated the valence of the target image and not the context image, a black bar (4 px) was placed under the target image. Whether the target or the context image was placed on the left or on the right was fully randomized. Finally, participants were asked to indicate if they had recognized any of the photographs (to control for effects of familiarity) and to state whether they had answered the questions conscientiously. On average, it took participants about 15 minutes to complete the study.

### Measures

We collected measurements on five different scales during three phases of our first study. In Blocks 1 and 3, ratings were made using a slider displayed beneath the image(s). In Block 1a participants were asked to indicate how ambiguous (0 = *not at all*, 100 = *very much*) they perceived the displayed image to be. Ambiguity was described as "to what extent an image allows for multiple interpretations and meanings" (Jakesch et al., 2013; Muth et al., 2015). In Block 1b, participants were asked to state the emotion they perceived in the photograph (0 = *very negative*, 100 = *very positive*), regardless of the emotion it aroused in them (Gabrielsson, 2001; Kallinen & Ravaja, 2006). In our studies, the evaluations of perceived emotions are referred to as valence ratings.

**Figure 1**
*Design of Study 1*




*Note*. All participants were shown the three blocks of the study in the same order and all participants were presented with all the images of the study. Note that the images are replaced by placeholders because of copyright restrictions. PANAS = Positive and Negative Affect Schedule; MSTAT II = Multiple Stimulus Types Ambiguity Tolerance scale–II. See the online article for the color version of this figure.

In Block 2, we used the PANAS short version (Positive and Negative Affect Schedule; Thompson, 2007) to assess positive and negative affect, since the perception of art is influenced by the perceiver's affective state (Konečni & Sargent-Pollock, 1977; Leder et al., 2004). Eight items ("ambiguous stimuli in general," "insoluble/illogical/irreducible/internally inconsistent stimuli") of the MSTAT-II questionnaire (McLain, 2009) were used to measure participants' tolerance toward ambiguous stimuli.

During the last phase of the study (Block 3), participants rated the emotion they perceived in a target image next to a context image, regardless of the emotion it aroused in them on a scale from 0 (*very negative*) to 100 (*very positive*). For all the ratings on images, participants were asked to note their first impression to assess their initial response to the image.

## Results and Discussion

The complete analyses and data are available at: https://osf.io/ptfqe/. For the analysis, we used R 4.1 (R Core Team, 2021) and additional packages for data handling (Comtois, 2021; Pedersen, 2020; Wickham et al., 2019) and Bayesian analysis (Bååth, 2015; Kruschke & Meredith, 2021). We opted for a Bayesian approach due to the absence of clear confirmatory hypotheses. We opted for computing highest density intervals (HDIs) to estimate the most probable effect sizes for the effects of interest. Compared with a frequentist approach, which usually computes the probability of the data given the null hypothesis, $P(D|H)$, the Bayesian approach computes the probability of the hypothesis given the observed data and prior beliefs, $P(H|D)$ (Dienes, 2008). We therefore used Bayesian inferences to estimate the probability of certain effect sizes given our data. In our studies, we interpret an effect as existing when the HDI excludes zero. If zero is included but is in the periphery of the HDI (i.e., when the most likely values clearly point into one direction), we will report this as a directional trend. We will remain undecided if the most likely values are distributed around zero.

### Descriptive Statistics

The descriptive analysis of the short version of the PANAS (Positive and Negative Assessment Scale; Thompson, 2007) showed that participants scored generally low on negative affect ($M$ = 1.57, $SD$ = .93) and medium on neutral and positive affect ($M$ = 3.28, $SD$ = 1.13). Similarly, participants indicated a moderate tolerance for ambiguous stimuli in general (MSTAT-II G, $M$ = 3.95, $SD$ = .7; MSTAT-II I, $M$ = 3.36, $SD$ = 1.25). None of the participants indicated they knew any of the presented stimuli; two participants indicated that they were unsure if they knew a stimulus, but they did not correctly guess what the stimuli were.

### Main Analysis

To explore our first question—how the ambiguity of the target image moderates the effect of the context image—we compared the ambiguity ratings with the valence ratings. We also examined whether the order in which the images were rated (i.e., ambiguity first versus valence first) affected participants' ratings. No meaningful correlation was found between the ambiguity of the target image and the changes in valence from the presentation of single images to pairwise presentation (positive condition, $r$ = .037; negative condition, $r$ = .041).

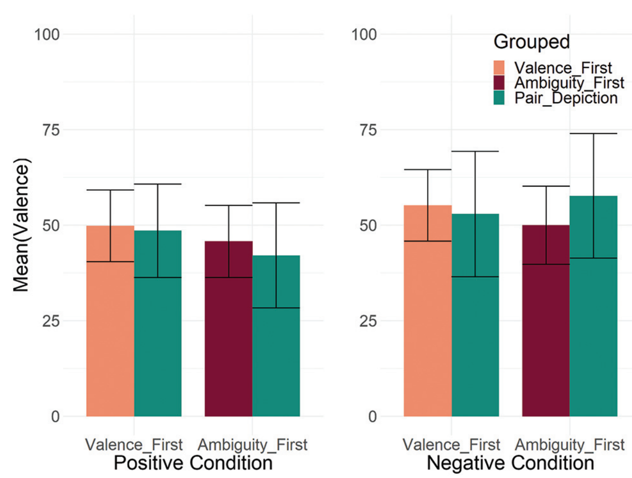
However, as shown in Figure 2, the order in which participants rated ambiguity and valence resulted in the artworks being rated differently in the paired condition. When ambiguity was rated first, participants changed their valence ratings more strongly from the single presentation to the pairwise presentation. Furthermore, when the images were judged first for their ambiguity and then for their valence, the effect of juxtaposition produced contrast effects for both the positive and the negative conditions. When the valence of the images was judged first, a slight tendency to an assimilation effect was observed in the negative condition and a contrast was seen in the positive condition. The overall effect was more pronounced when the target images were seen next to negative image material than next to positively valenced images (see Figure 2).

To answer our second question—Does the presence of a juxtaposed context image influence the emotion perceived in a target picture?—we compared the valence ratings in the single-image condition to the paired condition. First, we applied Bayesian analysis to estimate the size of the difference between the rating of a target stimulus seen on its own and the rating when it was seen with a context picture (see Figure 3). We used a flat prior and computed 95% HDIs to estimate the extent to which the valence ratings of the target images changed when they were presented with a context image. The estimated effect size of the difference was computed by subtracting the rating of the single image from the paired rating, so a negative effect size indicates a more positive rating in the single condition, and positive effect size indicates a more positive rating in the paired condition.

Looking at the HDIs for the effect sizes shows that compared with when displayed individually, the target images were rated more negatively when paired with a positively valenced context image (mode = −.24, $HDI_{low}$ = −.47, $HDI_{high}$ = −.01; Figure 3A)

**Figure 2**

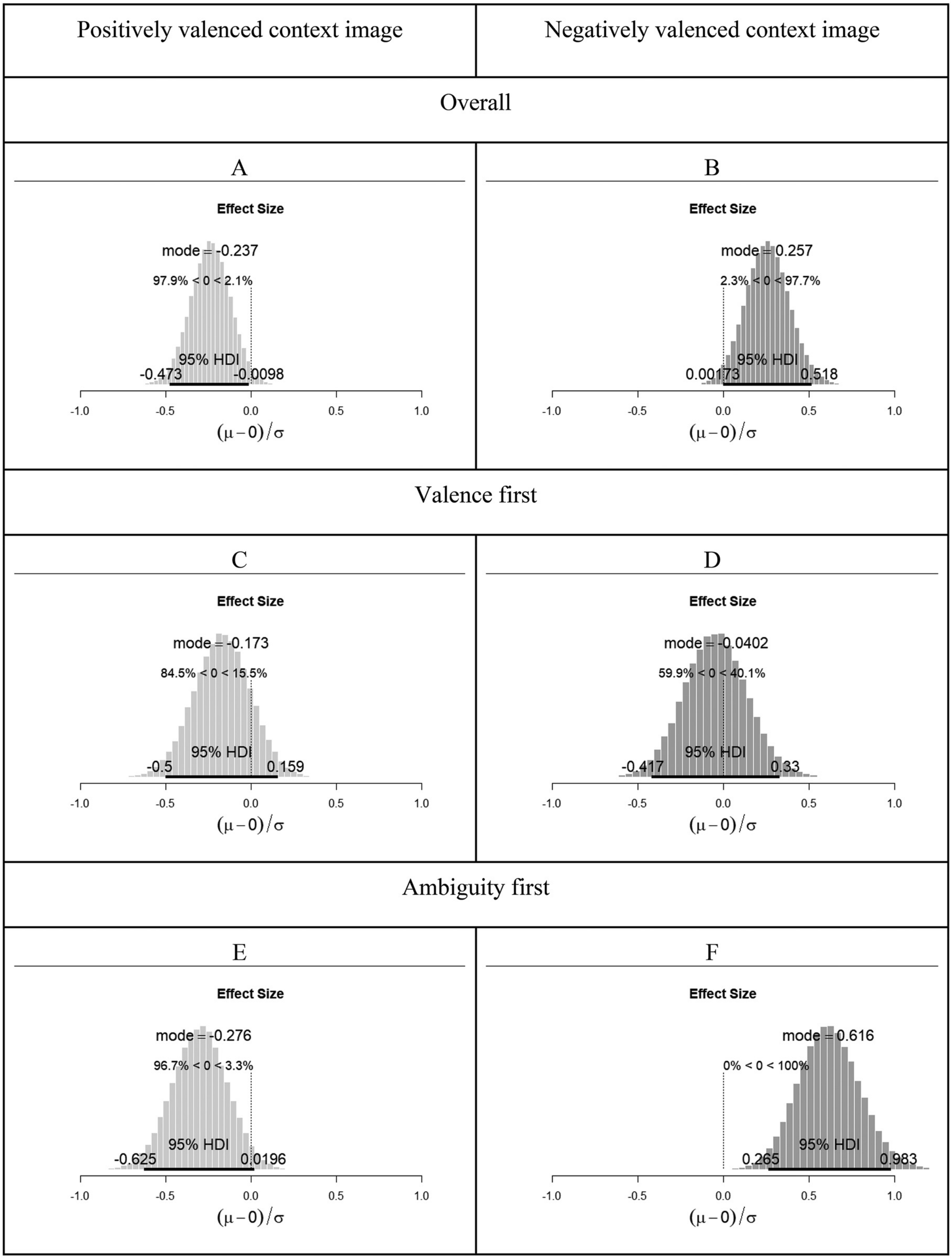
*Mean Ratings and Standard Deviation for Valence Over All Stimuli When Presented Alone in the Valence First Condition (Light Orange/Light Gray) and the Ambiguity First Condition (Dark Red/Dark Gray) and When Presented Paired With a Context Picture (Green/Gray)*




*Note.* See the online article for the color version of this figure.

**Figure 3**

*Shown Are the 95% HDIs for the Estimated Effect Sizes of the Differences Between the Ratings of the Paired and the Single Presentations of the Images*




*Note*. The effect sizes are categorized by the valence of the context image and if valence was rated first (Valence first) or second (Ambiguity first) during the first block. A negative effect size indicates a more positive rating in the single condition. HDI = highest density intervals.

and more positively when presented with a negatively valenced context image (mode = .26; $HDI_{low}$ = .002, $HDI_{high}$ = .52; Figure 3B). When taking the rating order (ambiguity first versus valence first) into account, the estimations of the effect sizes change for valence first: there was a negative mode to the effect size but no clear trend toward negative effect size (mode = −.04, $HDI_{low}$ = −.42, $HDI_{high}$ = .33; Figure 3D) when the target images were presented with negatively valenced context images. When the context image was positively valenced, the ratings of the target images showed a slight trend toward less positive values in the paired condition compared with the single-image condition (mode = −.17, $HDI_{low}$ = −.5, $HDI_{high}$ = .16; Figure 3C). In the ambiguity first condition, the target images tended toward more negative values when paired with a positively valenced context image (mode = −.3, $HDI_{low}$ = −.63, $HDI_{high}$ = .02; Figure 3E). The target images were rated more positive when paired with a negatively valenced context image (mode = .6, $HDI_{low}$ = .27, $HDI_{high}$ = .99; Figure 3F).

In Study 1, we examined image ambiguity as a moderating aspect in the juxtaposition effect. In Study 2, we investigate the effect of formal similarity on perceived valence in the paired condition.

## Study 2: Effect of Formal Similarity on Valence Ratings in Paired Images

What underlies contrast and assimilation effects is the premise of similarity in the rated stimuli. In past studies, similarity has been considered in terms of category membership (Dolese et al., 2005; Mussweiler & Bodenhausen, 2002; Rota & Zellner, 2007) or how extreme the standard is (Herr et al., 1983). But contrast effects have also been observed irrespective of whether the context images were assigned to a same, a similar, or a different category (Tousignant & Bodner, 2014, 2018). These results suggest that similarity may be an elastic concept in the evaluation of images.

Categorical similarity evaluates the correspondence of conceptual factors, which are based on knowledge or expertise and processed top-down (Leder et al., 2004; Pelowski, Markey, et al., 2017). In contrast, formal similarity describes the similarity of basic image features, which are assessed in a bottom-up manner at the beginning of the image evaluation process (Pelowski, Markey, et al., 2017). Formal similarity encompasses diverse image features, such as color, orientation, size, and motion, and can be perceived in time or space (Arnheim, 1957). According to Mussweiler (2003), comparisons between context and target stimuli are based on a rapid search for salient similarities. It is therefore to be expected that bottom-up processed image features such as color and shape influence the comparison process on a basic level.

Crucially, image expertise affects the perceived similarity between stimuli and therefore influences context effects. "Because experts use as their basic-level categories what are the subordinate levels for novices" (Rota & Zellner, 2007, p 179), they recognize similarities that novices do not see. In a study assessing the attractivity of flowers, this resulted in a hedonic contrast for laypeople but not for experts (Rota & Zellner, 2007). More specifically, unlike laypeople, design experts are expected to recognize formal similarities, since they are trained to judge images not only in terms of their content but also in terms of their formal properties and similarities (Arielli, 2012; Hofmann, 1985).

In our second study, we analyzed the role of formal similarity between target and context images as a moderating factor for the emotion perceived in target images that are presented juxtaposed to a context image. We assumed that formal similarity between the target and context image would enhance the influence of the context image on the target image. This effect was expected to be strongest between a target image and a formally similar context image with negative emotional valence. We compared ratings by laypeople and design experts.

### Method

#### Participants

We used the expected valence means of the target pictures as priors to estimate how many people were needed to reliably detect a deviation of 1 from the single image ratings on a 7-point Likert scale. This resulted in a recommended sample of $n \geq 54$ per group. Consequently, 122 participants were recruited via Prolific (prolific.co). The mean age was 33.7 ($SD$ = 10.39), and there were 90 women and 32 men. In addition, we recruited 56 design experts (design students and lecturers from the FHNW Academy of Art and Design; mean age = 28.95, $SD$ = 9.78, 36 female, 19 male, one nonbinary). This resulted in a final sample size of $N$ = 178, of which 56 people identified as experts. In total, 46 persons of the design students and lecturers indicated to work professionally with art images. Additionally, 10 participants from the Prolific sample indicated professional experience with images and were therefore assigned to the expert group. The experts from each sample did not identifiably differ in their valence ratings in either of the four conditions and were consequently treated as a singular expert group (see Study2_Analysis in the repository). All participants had normal or corrected-to-normal vision as well as normal color vision. Participants recruited via Prolific received monetary compensation (about US$2) for completing the study.

Of the Prolific sample, one participant indicated that they had seen one of the stimuli before, but they did not identify it correctly. Of the design experts, 14 (25%) indicated that they recognized artworks, and nine of them correctly recognized a few of the works. As eight persons in the total sample of Study 2 recognized the artwork by Jeff Wall (After *Invisible Man* by Ralph Ellison, the Prologue, 1999–2000), we examined the effect of this stimulus in our analyses. However, we found that the recognition of this image had no effect on the valence ratings in our study. For this reason, we retained this image in our set (see the complete analysis in the OSF repository [https://osf.io/ptfqe/], Study 2, Figure 7.1 & 7.2).

#### Stimuli

The same fine art photographs and context images as in Study 1 were shown in pairs. To obtain formal similarity between the target and context images, the selection process of the images was conducted in two phases: first, context images with required valence values were selected from the "scenes" category of the OASIS (Kurdi et al., 2017) dataset. In a second phase, art photographs were chosen that resembled the selected context images in motif, color, and form. The selection process was done by the first author in collaboration with a lecturer in design at the FHNW Academy of Art and Design and in accordance with the other authors. The formal similarity between the images was preassessed by five individuals not involved in the study.

Four experimental pairing conditions were defined. In the negative formal similarity condition (A), a fine art photograph (target image) was shown with a negatively valenced OASIS image (context image) that was formally similar (see Figure 4). In the negative no formal similarity condition (B), a fine art photograph was shown with a negatively valenced context image that was not formally similar (see Figure 5). In the positive formal similarity condition (C), an art photograph was presented with a positively valenced context image that was formally similar. In the positive no formal similarity condition (D), one art photograph was presented with a positively valenced context image that was not formally similar. Each of the 20 fine art photographs was assigned either to the positive-valence condition or the negative-valence condition (10 positive and 10 negative). Within these conditions, the same target image was paired once with a formally similar context image and once with a formally dissimilar context image (see Figure 4 and 5). Thus, 20 target images (all fine art photographs) and 40 context images (all OASIS images) were used (see "Image Pairs" in the repository for a detailed overview). All the target pictures had been rated regarding their valence and ambiguity in Study 1.

### Procedure

Study 2 consisted of three blocks presented in the same order for all participants (see Figure 6 for the study design of Study 2).

In Block 1, participants were presented with each of the 20 target images paired in four different conditions (A = negative formally similar condition, B = negative not formally similar condition, C = positive formally similar condition, D = positive not formally similar condition). At the end of Block 1, two image pairs were shown again to test the reliability of the ratings. After the first block was completed, participants were asked in Block 2 to provide demographic information (age, gender) and to rate their current affect (PANAS; Thompson, 2007). Participants were also asked to indicate whether they had recognized any of the images they saw in the study and whether they were professionally involved in assessing or creating images.

In Block 3, participants were presented with 20 pairs of a target and a context image displayed side by side. To test the reliability of the ratings and similarly to Block 1, two image pairs were shown again at the end of Block 3. To make sure that participants rated the valence of the target image and not the context image, a black bar (4 px) was placed under the target image. Whether the target or the context image was placed on the right or on the left was fully randomized. All the images shown in this study were presented in a randomized order.

To conclude the experiment, participants were then asked to indicate whether they had recognized any of the fine-art photographs (to control for effects of familiarity) and to state whether they had answered the questions conscientiously.

### Measures

We collected measurements on three different scales during the three phases of Study 2. In Block 1, participants were asked to indicate how formally similar (0 = *not at all*, 100 = *very much*) the two images were on a sliding scale displayed beneath the images. Formal similarity was described as how much the two photographs looked formally similar and that this included "qualities of composition such as color, shape, form and line" (Cupchik et al., 1992, p. 42).

During Block 2, participants rated their current affective state using the 10 items from the PANAS (Thompson, 2007). In Block 3, participants were asked to rate the emotion they perceived in the target photograph, regardless of the emotion it aroused in them on a sliding scale from 0 (*very negative*) to 100 (*very positive*). When rating formal similarity and perceived emotion, participants were instructed to note their first impression of the image.

## Results and Discussion

As in Study 1, the complete analyses and data can be found at: https://osf.io/ptfqe/. For analysis, we used R 4.1 (R Core Team, 2021) and additional packages for data handling (Comtois, 2021; Pedersen, 2020; Torchiano, 2020; Wickham et al., 2019) and Bayesian analysis (Bååth, 2015; Kruschke & Meredith, 2021). We used the same decision rules for Study 2 as we applied for Study 1.

### Descriptive Statistics

Test–retest reliability, as measured by the repeated images in Block 1 and Block 3, showed that all the image ratings had good

**Figure 4**

*Example of Pairing Condition A in Study 2*

*Note*. The images on the right of figure are from the OASIS image set which is open access and cited in their paper (https://pubmed.ncbi.nlm.nih.gov/26907748/). Target image on the left: Thomas Keller, Ohne Titel, from the series Häuser—Where Distance Lives, 2004–2010 (www.thkeller.com). Reprinted with permission. See the online article for the color version of this figure.

**Figure 5**
*Example of Pairing Condition B in Study 2*

*Note.* The images on the right of figure are from the OASIS image set which is open access and cited in their paper (https://pubmed.ncbi.nlm.nih.gov/26907748/). Target image on the left: Thomas Keller, Ohne Titel, from the series Häuser—Where Distance Lives, 2004–2010 (www.thkeller.com). Reprinted with permission. See the online article for the color version of this figure.

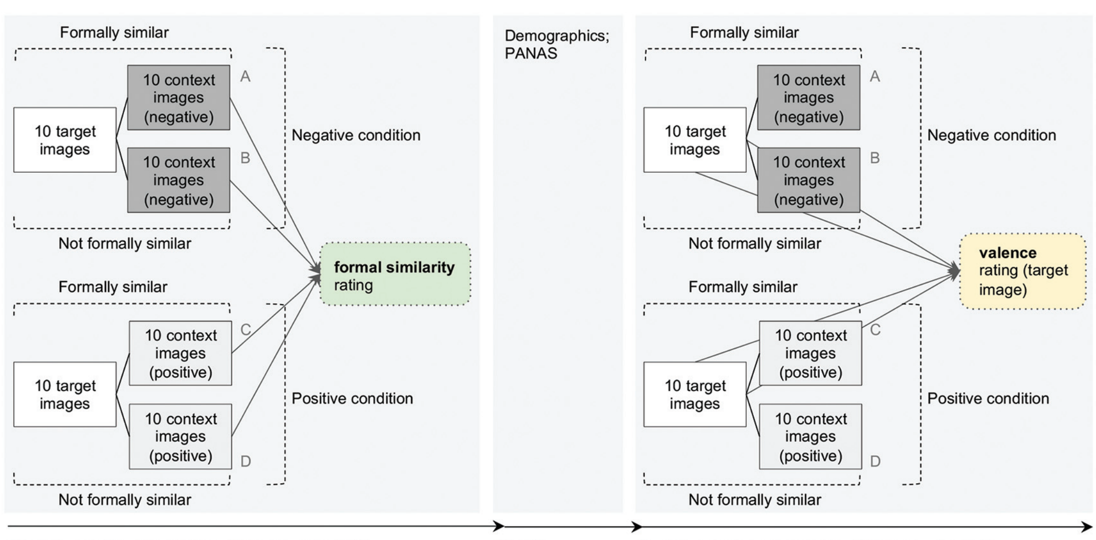
reliability (total, $r = .76$, $n = 244$). Hence, all the data were retained for analysis. Results from the short version of the PANAS (Thompson, 2007) indicated that the participants—comparable to Study 1—scored generally low on negative affect ($M = 1.58$, $SD = .92$) and medium on neutral or positive affect ($M = 3.35$, $SD = 1.1$).

### *Main Analysis*

To answer our research question for Study 2—Does formal similarity moderate the juxtaposition effect?—we first examined the subjective formal similarity ratings. We compared the similarity ratings of the design experts ($n = 56$) and laypeople ($n = 122$). The design experts rated formal similarity comparably to the laypeople with the effect size between the average similarity ratings in the formally similar (Cohen's d = .11) and not formally similar ($d = -.15$) being negligible (cf. Torchiano, 2020). Thus, we aggregated the two groups as one in the following analysis. As depicted in Figure 7, the formally similar pairs—although perceived as clearly more similar than the pairs that were not formally similar—were rated to be moderately similar, scoring between 40 and 60 on formal similarity.

We then compared the valence measurements for the single-presentation condition from Study 1 with the valence measures in the juxtaposed condition in Study 2 for each of the four conditions ($n = 10$): A = negative formally similar condition, B = negative not formally similar condition, C = positive formally similar condition, D = positive not formally similar condition. Since the effect size of the difference was computed by subtracting the valence scores in Study 1 from the valence scores in Study 2, a

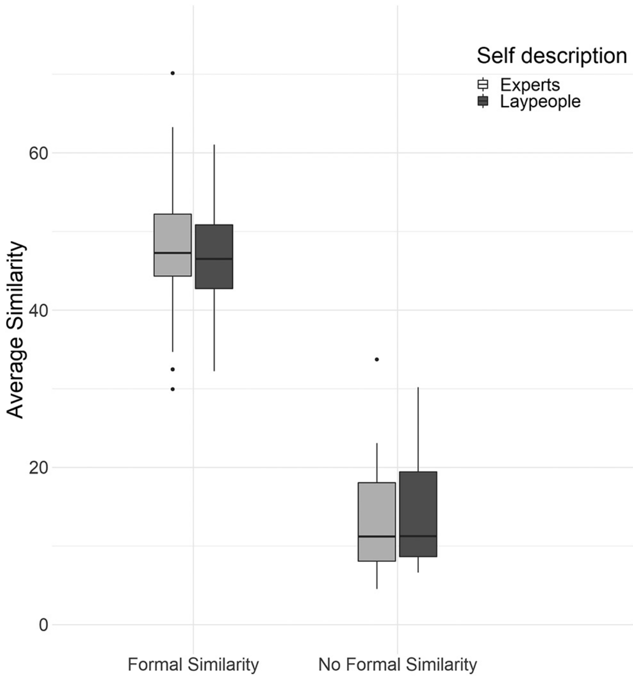
**Figure 6**
*Design of Study 2*




*Note.* All participants were shown the three blocks of the study in the same order and all participants were presented with all the images of the study. Note that the images are replaced by placeholders due to copyright restrictions. PANAS = Positive and Negative Affect Schedule. See the online article for the color version of this figure.

**Figure 7**

*Average Rating of the Formal Similarity of the Fine Art Photographs and Their Assigned Pair, Separated Into Formal Similarity and No Formal Similarity*




negative effect size indicates that the artworks were rated more positive when presented on their own than in the juxtaposed condition (see Figure 8). A clear effect can be observed in three of the four conditions with only Figure 8C (positive, formally similar) showing an effect not excluding zero. However, the HDI trends in the same direction as the HDI in Figure 8D (positive, not formally similar). Similarly to Study 1, the effect was more pronounced when the target image was paired with a negative context image (formally similar condition: mode = −1.57, $HDI_{low}$ = −2.69, $HDI_{high}$ = −.59; Figure 8A; not formally similar condition: mode = −1.84, $HDI_{low}$ = −3.06, $HDI_{high}$ = −.71; Figure 8B) than when the artwork was paired with a positively valenced context image (formally similar condition: mode = −.56, $HDI_{low}$ = −1.28, $HDI_{high}$ = .15; Figure 8C; not formally similar condition: mode = −.82, $HDI_{low}$ = −1.63, $HDI_{high}$ = −.07; Figure 8D). All the effect size's modes correspond to a large effect according to Cohen (1992). As can be seen in Figure 8, formal similarity between the target and context image did not have a substantial effect. On the contrary, the effect was slightly more pronounced in the conditions where there was not any evident formal similarity between the images (the differences between the individual artworks can be found in the repository; Study2_Analysis).

Next, we compared the design experts ($n$ = 56) and laypeople ($n$ = 122) regarding their valence ratings. Comparably to the similarity ratings, experts and laypeople rated perceived emotions similarly: positive, $M$ = 45.1, $SD$ = 23.9 versus $M$ = 44.6, $SD$ = 24.3; negative, $M$ = 42.8, $SD$ = 23.7 versus $M$ = 43.2, $SD$ = 23.3. Moreover, the differences in the affect scores (PANAS; Thompson, 2007) between the experts (positive affect, $M$ = 3.01, $SD$ = 1.14; negative affect, $M$ = 1.62, $SD$ = .95) and laypeople (positive affect, $M$ = 3.51, $SD$ = 1.03; negative affect, $M$ = 1.56, $SD$ = .91) was negligible. Because the valence ratings and the affect scores were comparable between experts and laypeople, we did not pursue analysis of expertise effects further (for a more detailed description of the two groups, please refer to the OSF repository [https://osf.io/ptfqe/].

Finally, we explored whether the juxtaposition effect could be tied to the arousal score of the context image. We used a Pearson correlation to investigate the connection between the valence scores in the paired condition with the prerated arousal scores of the OASIS (Kurdi et al., 2017) pictures (see the repository). However, owing to only having 10 pairs per condition, the estimations of potential correlations were rather wide, which hindered determining whether such effects were present. Whereas art photographs paired with negatively valenced context pictures slightly skewed toward negative correlations (median $r$ = −.15, $HDI_{low}$ = −.57, $HDI_{high}$ = .30), art photographs paired with positively valenced context pictures skewed toward positive correlations (median $r$ = .25, $HDI_{low}$ = −.18, $HDI_{high}$ = .64).

## General Discussion

The perhaps essential value of art is to touch us emotionally (Pelowski et al., 2020). When we encounter art, however, we rarely perceive art images in isolation. This in turn has an influence on the affective interpretation we attribute to a single piece of art. We conducted a study that reflected a common situation for encountering art: art photographs are often embedded in a pictorial context. Our focus was to manipulate the valence of neighboring images (using prerated negatively or positively valenced context images) and the formal similarity (formally similar or not formally similar) between the target and context images so as to examine the effect of these image features on the emotional attribution of the art image. We also considered the ambiguity of the artworks and the expertise of the viewers.

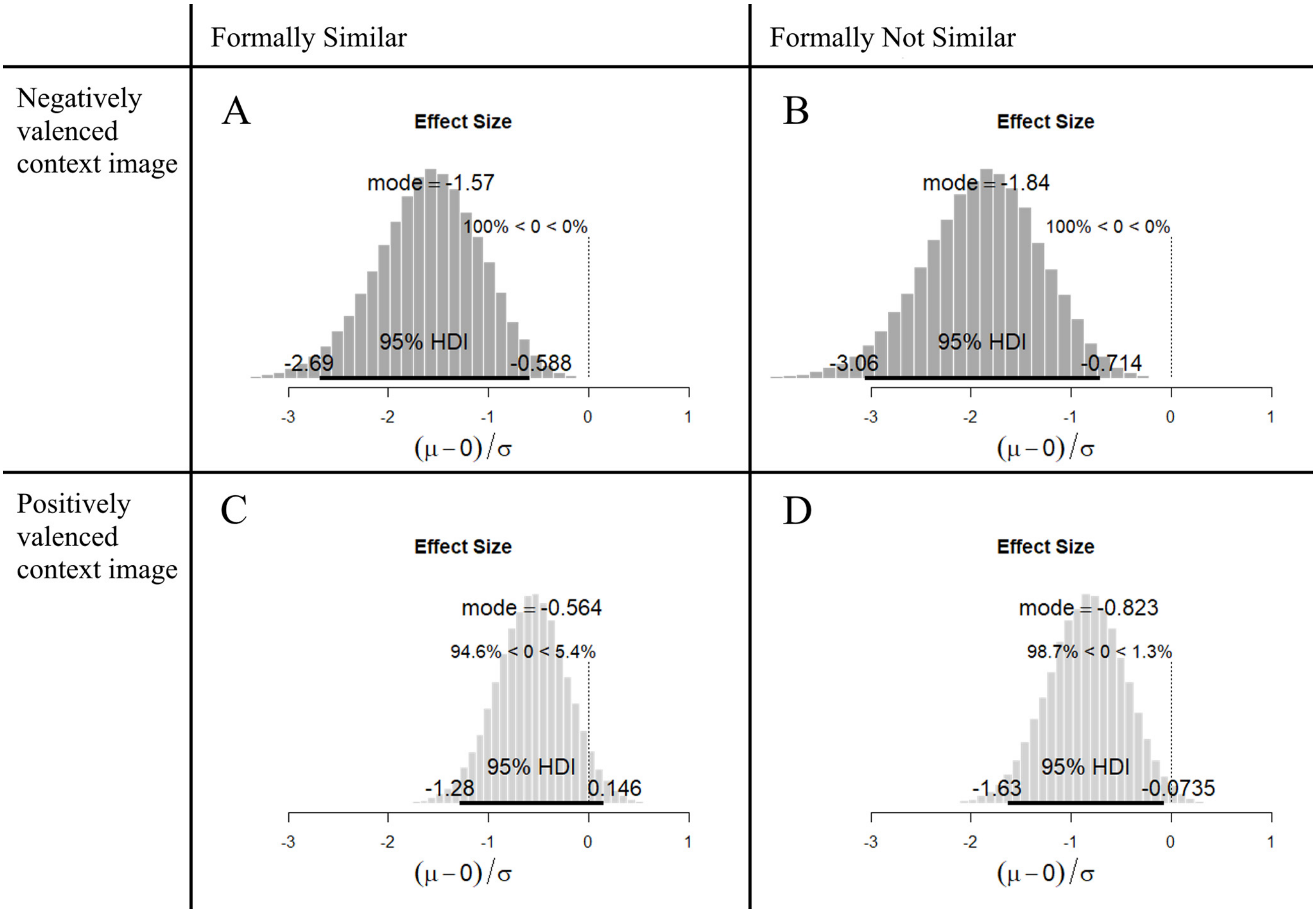
### Juxtaposition Effects on the Affective Interpretation of Art Photographs

In our studies, we clearly showed that neighboring images influence the affective interpretation of art photographs. These results reflect earlier findings that emotionally loaded image material affects the interpretation of faces (e.g., Barrett et al., 2011; Righart & de Gelder, 2008) and text (e.g., Price et al., 1997; Rodriguez & Dimitrova, 2011). But more importantly, our results extend the findings of previous studies that showed an influence of neighboring images on the liking and aesthetic evaluation of images (e.g., Arielli, 2012; Mullennix et al., 2018; Tousignant & Bodner, 2014).

We demonstrated—in line with previous studies (e.g., Calbi et al., 2017)—that negative pictures exert a stronger influence on neighboring images than positive ones do. Although our results exhibited less pronounced effects compared with studies that used unambiguously negative images (Mullennix et al., 2018), our results show that the perception of images and their emotional attribution can be influenced by other images—even if they depict merely subtly negative material. The reason why negative pictures tend to have a stronger impact on neighboring images has been

**Figure 8**

*The 95% Highest Density Intervals (HDIs) for the Differences Between the Paired Ratings in Study 2 and the Single Valence Ratings From Study 1 of the Same Stimulus*




*Note.* Categorized according to the valence and the formal similarity of the context image. A negative effect size indicates a more positive rating in the single condition. HDI = highest density intervals.

explained as a general negativity bias (Baumeister et al., 2001; Rozin & Royzman, 2001). However, in contrast to Calbi et al. (2017) and Mullennix et al. (2018), we also found a negative trend when target images were presented alongside context images with positive valence. This allows us to explain the generally stronger influence of negative contextual material on the target image in terms of negativity bias, but the positive condition in our studies shows that we are actually dealing with a contrast effect and not just a general negativity bias. If this effect was merely attributable to a negativity bias, the ratings of the images in the positive conditions would have remained the same when the target image was presented alone and when it was presented in juxtaposition with the context image. In our studies, however, we found that target images were rated more negative when viewed juxtaposed with positive images than when viewed alone.

Past studies have mainly opted for a between subject design, using prerated stimuli (Arielli, 2012; Dolese et al., 2005; Mullennix et al., 2018; Tousignant & Bodner, 2014, 2018). In our studies we applied a mixed subject design: In our first study we used a within subject design to evaluate the differences from the single and the paired presentation and a between subject design to evaluate the ambiguity versus valence first conditions. In Study 2 we applied a between subject design to evaluate the impact of the formally similar and formally less similar context images. Here single ratings were provided by participants in Study 1 and compared with the valence ratings by participants in Study 2. Interestingly, we did observe larger effect sizes in the second—between subject design—study. This might be due to the participants in Study 1 exhibiting an anchoring effect (Furnham & Boo, 2011) after having rated the same images on valence a short time before which in turn may have contributed to differences in effect sizes for the two studies.

## Contrast and Assimilation Prompted by Rating Dimension

Our results revealed contrast and assimilation effects. In our first study, we found an overall contrast effect: images shown with a negatively valenced context image were perceived to be more positive than if they were seen alone, whereas images shown with a positive context image were rated more negative than when rated alone. When separating the ratings into valence first and ambiguity first conditions, we believe that there might be a slight tendency for an assimilation effect in the negative condition and a contrast effect in the positive condition when the valence was rated first. This pattern was also found in our second study, where it revealed more pronounced effects.

The selective accessibility model (Mussweiler, 2003) predicts assimilation when the comparison of the two stimuli reveals that the target and context stimulus are similar and contrast when they are perceived as dissimilar. As we can see in our analysis, the effects in the ambiguity first and valence first conditions of our first study point in slightly different directions. In the framework of the accessibility model (Mussweiler, 2003), we interpret these results in that sense, that in the valence first, positive condition, the target images might have been perceived as dissimilar to the context images (thus causing a trend for a contrast effect). But in the valence first, negative condition, a not clearly discernible effect (although pointing toward an assimilation effect) suggests that it was unclear whether the target images were evaluated as similar or dissimilar to the context images. In turn, the target images in the ambiguity first condition must have been rated as clearly dissimilar to the context images, resulting in contrast effects in both conditions. In general, however, it remains in the realm of the hypothetical which features of the target image were compared with the context image and consequently prompted assimilation and contrast. Mussweiler (2003) points out that the process of comparison is not always conscious. Comparisons between context and target images may occur spontaneously or even subliminally, and those comparative features may be "identified, retrieved, or constructed on the spot" (p. 480). Similarly, Higgins and Chaires (1980) proposed that if the recently activated dimension "is applicable to the stimulus (i.e., there is a sufficient match between the features of the construct and the features of the stimulus), then it will be used to encode or characterize the stimulus" (Higgins & Chaires, 1980, p. 351). We therefore argue that the different effects in our first study were possibly attributable to the order of the rating dimensions and the target knowledge that was thereby activated. In that sense, the rating dimension can be seen, in addition to the neighboring image, as part of the pictorial context in which the target images were assessed, so it too influences the emotional evaluation of the images.

In our studies, we showed the target and context image next to each other in a simultaneous presentation. According to Wedell et al. (1987), the simultaneous evaluation of two stimuli makes it difficult for the perceiver to distinguish the subjective experiences evoked by each stimulus. The evaluation of the target image should therefore shift toward the evaluation of the context stimulus seen in juxtaposition compared with when the target is evaluated after the context stimulus. This would result in an assimilation effect. Our data from the negative, valence first condition in Study 1 as well as the negative conditions in Study 2 are in accordance with Wedell et al. (1987). However, in the other conditions, we did not find any assimilation, even though the two images were presented simultaneously. We argue that simultaneous presentation may facilitate an assimilation effect, but this does not lead per se to an approximation of the stimuli.

## Limitations and Future Work

In the following, we review the main limitations of our study and discuss possibilities for future work. In our studies, we showed that contrast and assimilation effects were influenced by the order of the evaluative dimensions, but we could not say with certainty which target knowledge was activated. Future studies should investigate the role of evaluation dimensions and their influence on the emotional interpretation of art. In our experiment, rating ambiguity in general had an effect on the valence ratings in our first study. But the intensity of perceived ambiguity in the target images themselves did not show a clear correlation with the valence ratings in the single and the paired conditions. This could be attributable to the fact that target images used in our experiment were rated as moderately ambiguous. In future work, using images that exhibit more pronounced ambiguity could reveal an answer to the question of whether images depicting a rather vague meaning are more susceptible to contextual influences (Herr et al., 1983; Muth et al., 2015). We also investigated whether formal similarity (Arnheim, 1957) would enhance the influence of the context image on the target image, but we did not find any evidence for this. On the contrary, the effect was more pronounced in the condition with no formal similarity. This result raises the question of whether the content of images has a greater influence on neighboring images than their formal aspects. However, because the images used in our studies were not found to be extremely similar, further studies could consider including computer vision tools to select formally similar images. This could provide a set of images whose formal similarity is more pronounced and would moreover ensure more reproducible measurements of formal analogies.

We also investigated viewer-centered aspects. Because trained designers are accustomed to evaluating the formal aspects of images, we expected the influence of formal similarity to be more pronounced in experts' ratings than in laypeople's ratings (Rota & Zellner, 2007). Although our data showed that there was no difference between experts and laypeople in terms of formal similarity and in subsequent valence ratings, these results need to be examined in more detail using comparable group sizes. This lack of clear results may also be attributable to the fact that the images were not rated to be as formally similar as we expected them to be. Another aspect that should be mentioned is the fact that participants in Study 1 may have suspected what the intention of the study was as they were asked to rate the same images on several occasions. Future studies may use a study design that more consistently conceals the intent of the study. We also expect that measuring the current affective state of the viewers not only in the middle of the experiment but also at the beginning and end of the experiment could have shed more light on the question why we found a more pronounced negative effect in the rating of the juxtaposed images in our studies (Konečni & Sargent-Pollock, 1977; Leder et al., 2004). Although participants indicated no substantial negative affect, it is possible that it could have been negative before participating in the experiment or even changed during the course of the study due to the evaluation of the images. Future studies should therefore assess participants' affect also at the beginning as well as the end of the study, especially if the rating dimensions concern perceived emotions.

## Conclusion

What insights do these results offer to visual designers and curators? In summary, our results empirically support experts' tacit knowledge in placing images. The image context influences the emotional interpretation of an image. This confirms the importance of the work of curators and designers in visual communication in arranging images, because context influences the affective interpretation we attribute to images. A curator can render the affective interpretation of an image more negative by placing it next to a similar image with a negative connotation. A designer makes an image look more positive by displaying it in the context to a negative image that shows no similarities to it. Essentially, our results confirm that it is highly desirable to show artworks again and again in different contexts to enable new experiences that allow us to rediscover different, contradictory facets of an image. Interestingly, our results also show that other, nonpictorial factors influence our evaluations of images, which is consistent with a growing body of work demonstrating the variety of contextual influences on art perception (Pelowski & Specker, 2020). If a cognitive context in which an art image is viewed is made salient, it will have an influence on the evaluation of the image. In that sense, curators and designers can effectively use not only neighboring images as an influencing context but also the thematic orientation of an exhibition or the title of a catalogue to make (art) images appear in a new, undiscovered light.

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