

Running head: Appeal of challenge in perception of art

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The appeal of challenge in the perception of art:
How ambiguity, solvability of ambiguity and the opportunity for insight affect appreciation

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Abstract

We asked whether and how people appreciate ambiguous artworks and examined the possible mechanisms underlying the appeal of perceptual challenge in art. Although experimental research has shown people's particular appreciation for highly familiar and prototypical objects that are fluently processed, there is increasing evidence that in the arts, people often prefer ambiguous materials, which are processed less fluently. Here, we empirically show that modern and contemporary ambiguous artworks evoking perceptual challenge are indeed appreciated. By applying a multilevel modelling approach together with multidimensional measurement of aesthetic appreciation, we revealed that the higher the subjectively perceived degree of ambiguity within an artwork, the more participants liked it, and the more interesting and affecting it was for them. These dimensions of aesthetic appreciation were also positively related to the subjectively reported strength of insights during elaboration of the artworks. The estimated solvability of the experienced ambiguity, in contrast, was not relevant for liking and even negatively linked to interest and affect. Consequently, we propose a critical view of the frequently reported idea that processing (modern) art simply equals a kind of problem-solving task. We suggest the dynamic gain of insights during the elaboration of an ambiguous artwork, rather than the state of having solved a problem, to be a mechanism possibly relevant to the appeal of challenge in the perception of ambiguous art.

Keywords: Ambiguity, Modern art, Problem solving, Insight, Aesthetic Aha

Introduction

The appeal of ambiguity

Psychological aesthetics research has repeatedly shown that we like visual stimuli that are easy to process; for instance, participants in different studies preferred typical objects in comparison to their less typical alternatives (e.g., Halberstadt, 2006) and rated familiar faces as being more attractive than less familiar ones (e.g., Langlois, 1994). The corresponding results are often explained by referring to the so-called “fluency hypothesis” (Reber, Schwarz, & Winkielman, 2004; Reber, Winkielman, & Schwarz, 1998)—although the explanation that fluency always increases preference has been challenged only recently (Albrecht & Carbon, 2014). The success of many ambiguous or indeterminate pieces of modern art—think of Picasso’s famous portraits or the concealing and fragmentation of objects in Cubist artworks—seems to run counter to the fluency hypothesis as well: despite challenging our perceptual and cognitive habits rather than being easily processed, these items are particularly appreciated—in terms of aesthetic as well as monetary value. For a thorough investigation of the aesthetic impact of ambiguous art, it is therefore necessary to explore mechanisms aside from the fluency of processing. One of these might be the possibility of deciphering recognizable patterns, which was described as a relevant factor for the success of—especially Picasso’s—Cubist artworks in regard to the art market (Muth, Pepperell, & Carbon, 2013).

(How) do we appreciate ambiguity in art?

Do we indeed appreciate ambiguous art? Evidence from psychological aesthetics makes us question the overall appeal of challenging art objects. However, there is evidence in favor of the appreciation of perceptual challenge being induced by ambiguity and other *collative*

variables like novelty, complexity, uncertainty and conflict (affording collation among elements of an object or among actual and expected information, respectively; Berlyne, 1971) which includes various dimensions of appreciation and perceptual challenge.

Jakesch and Leder (2009) provided a first indication that moderate instead of low degrees of ambiguity might be preferred in the domain of art perception. A positive connotation of non-fluent material was revealed *inter alia* for ambiguous surrealist artworks. Though these artworks were rated as being harder to process, they were still preferred to their non-ambiguous counterparts (Jakesch, Leder, & Forster, 2013). Concordant evidence for the appreciation of other, non-fluently processed material was found for design objects with low degrees of typicality (Blijlevens, Carbon, Mugge, & Schoormans, 2012) as well as for highly innovative and novel design objects (Carbon & Schoormans, 2012; Hekkert, Snelders, & van Wieringen, 2003). Furthermore, Wittmann, Bunzeck, Dolan, and Düzel (2007) showed that the anticipation of novelty alone can already activate the reward system.

While these findings relate to liking and reward, the appeal of ambiguous artworks might be assignable to other facets of aesthetic appreciation (as well), e.g., to the *powerfulness of affect* which is assumed to cover a wider range of emotional reactions toward artworks even if they are not *beautiful* (Pepperell, 2011). *Powerfulness of affect* was indeed found to increase with the difficulty of object detection with regard to indeterminate paintings (Ishai, Fairhall, & Pepperell, 2007). Furthermore, ambiguity, novelty, complexity, uncertainty and conflict were repeatedly reported as being positively linked to interest—mostly in a linear fashion (for judged complexity see Berlyne, Ogilvie, & Parham, 1968; for high effort and interest see Ellsworth & Smith, 1988; for ambiguity see Jakesch et al., 2013). A positive relationship between ambiguity and interest was found even when the ambiguous material

was judged as less beautiful by the beholders (Boselie, 1983; in this case, non-artistic simple line drawings were used which elicit disjunctive ambiguity by offering two incompatible figures). Turner and Silvia (2006) found that high interest does not necessarily need high pleasantness—actually the disturbingness of a painting predicted interest in a positive way while it was negatively related to pleasantness. Although interest is linked to positive emotions (Ellsworth & Smith, 1988), it is separable from enjoyment or happiness in several regards: as described above, perceptual challenge is often positively linked to interest but negatively to enjoyment, and effects of interest and enjoyment are further divergent (e.g., interestingness is a better predictor of viewing time than enjoyment, Berlyne, 1971; for an overview on these differences see Silvia, 2006). It seems essential for variables associated with affect and interest, respectively, that the stimulus or artwork offers some difficulty or at least “a certain amount of disorientation” to the perceiver (Berlyne, 1971, p. 215). These factors might come along with uncertainty and perceptual challenge thought to be evoked by many ambiguous pieces of art (Jakesch & Leder, 2009; Van de Cruys & Wagemans, 2011) not only during the historical era of modernity (Gamboni, 2002).

In sum, it is reasonable to assume that ambiguity in (modern) art affects these two important further dimensions of aesthetic appreciation, i.e., affect and interest, to a larger extent than liking. Therefore, we use a multidimensional concept of aesthetic appreciation in the following (see Faerber, Leder, Gerger, & Carbon, 2010).

Why might we appreciate ambiguity in art?

Ambiguity refers to multiple meanings attributed to an object and varies with information, context and interaction between an observer and an object (Gaver, Beaver, & Benford, 2003). It is thus more a subjective than an objective variable. Consequently, in order to understand

why ambiguity in art is or can be appreciated, it is important to follow an experimental approach that not only focuses on specific features of the aesthetic object, but considers the dynamic interplay between observer and artwork itself. In reference to appraisal approaches, Silvia (Silvia, 2005b, p. 353) claims that “it is misleading to assert a general law of stimulus intensity and emotional response that is independent of the subjective meaning of the stimulus“. This opposes ideas relating the intensity and the arousal-potential of a stimulus to liking (e.g., Berlyne, 1971). Approaches that further integrate a dynamic perspective claim, for instance, that processes such as (1) running through loops of hypothesis testing during aesthetic processing (Carbon & Jakesch, 2013; Leder, Belke, Oeberst, & Augustin, 2004) and the understanding of art (Leder, Carbon, & Ripsas, 2006), (2) the elaboration of aesthetic qualities (Carbon & Leder, 2005) or (3) ‘struggling’ with an ambiguous artwork itself bring pleasure (Ramachandran & Hirstein, 1999) and influence the aesthetic value we ascribe to it. Accordingly, Hekkert and Leder (2008) assume that we like patterns that “allow us to see relationships or create order” (p. 262). In the case of ambiguous artworks, there might be multiple opportunities for such struggling and pattern recognition in the course of elaboration. In line with the dynamic perspective, Zeki (2004) claims that “it is not ambiguity itself ... that is aesthetically pleasing ... It is rather the capacity of multiple experiences” (p. 192). A recent study on repeated evaluations of two-tone images (Muth & Carbon, 2013) reported an increase in liking for an image when participants detected a hidden Gestalt. Multiple opportunities for detection might be able to induce multiple of these so termed “Aesthetic Ahas”, which should, in line with Zeki’s proposal, induce even higher appreciation.

The “Aesthetic Aha effect” (Muth & Carbon, 2013), or the impact of perceptual insight, respectively, is also in accord with the suggestion of Van de Cruys and Wagemans

(2011) that an increase in certainty (e.g., by the detection of a face) after the encounter of a perceptually difficult situation (e.g., an indeterminate pattern) might be rewarding. Berlyne (1971) similarly speculated that for interest we might need both: “disorientation” (p. 215) as well as a promise of success after a period of processing. This idea was originally linked to his suggestion of rewarded reduction of arousal (Berlyne, 1960, later he discarded this view, as subsequent studies pointed to links between high arousal and reward; see an overview by Silvia, 2006). While this might be the case for some artworks, we may ask whether such a kind of dissolution of uncertainty is necessary for assessing the valence of ambiguous art in general. In a study on Cubist art (Muth et al., 2013), detectability (i.e., the ease with which objects can be detected within the artwork) was indeed strongly correlated with liking. Importantly, Cubist artworks typically ‘hide’ objects, often instruments or bodies, but in contrast to two-tone images they always remain indeterminate to a certain degree so that visual searching will continue even after cues have been detected (Gombrich, 1960). Therefore we assume that we do not necessarily have to completely ‘solve’ a given ambiguity before we can appreciate the respective stimulus. It might be sufficient to get a piece of information or an initial clue to have at least a partial perceptual or cognitive insight concerning the artwork. In the case of art, it might even be important to avoid complete resolution of a given ambiguity so that it is “not banal, conventional or academic, and ... not gimmicky or fanciful or kitsch” as Hyman (2010) describes less pleasing ambiguities.

The question of reward by ambiguity resolution potentially also relates to the role of appraisal in art perception: an artwork might be challenging *in the eyes and the mind* of an observer and elicit non-fluency of processing. At the same time, the observer might create subjective meaning during the elaboration of the artwork. Rather than solutions to the posed “problem” of ambiguity, these self-produced insights might be perceived or anticipated as an

ability to cope with the challenge posed by the artwork and thus evoke the observer's interest. In terms of appraisal theory, interest might be elicited by a combination of two appraisals: one concerning the challenging character of an object and the other one concerning one's own ability to cope with this challenge by understanding (see Silvia, 2005b).

Taken together, we can identify two major lines of argumentation concerning potential mechanisms influencing the appreciation of ambiguous art: (a) We can assume that the processing of ambiguous artworks is a kind of problem solving and that appreciation is determined by the progress (and result) of ambiguity reduction. (b) Alternatively, we can take a more dynamic stance and assume that insights during processing are rewarded irrespective of a progress in regard to ambiguity reduction and/or its full resolution.

Who might particularly appreciate ambiguity in art?

When examining effects of ambiguity it is important to note that there might be neither *the* ambiguous object nor a specific object with a certain level of ambiguity. In contrast, the intensity of ambiguity might be strongly dependent on the recipient's personality and experience. How ambiguity is perceived and appreciated might thus depend on the perceiver to a high degree: "Esthetic appreciation of art, then, may be a route by which the individual obtains mastery over the challenges of novelty, complexity, and ambiguity, and faces emotion and responds to its challenge too ... But exposing a person to art which can offer challenging experience does not in itself guarantee that he will have such experience. He may shut himself off from seeing the complexities, he may disregard all features not familiar and realistic" (Child, 1971, p. 9). This description refers to the personality variable *ambiguity tolerance* which might be especially relevant in the perception and appreciation of ambiguity (in art). It differentiates among people in regard to their tendency to reduce ambiguous

cognitive patterns to certainty (Frenkel-Brunswik, 1949), their tendency to perceive contradictions, inconsistencies and ambiguous information and to be positively affected by it (Reis, 1996). To ambiguity-intolerant people, ambiguous situations or stimuli might be actually threatening (Budner, 1962). Frenkel-Brunswik (1949) linked the concept of ambiguity intolerance to various behavioral features; e.g., perceptual reversals, rigidity in categorization and also seeking for certainty; Reis (1996) later classified different domains of ambiguity tolerance: ambiguity tolerance for seemingly unsolvable problems, for social conflicts, in regard to the image of the parents, for role stereotypes and for new experiences. In sum, there is a variety of instruments measuring ambiguity tolerance while a clear operational definition is still missing (Furnham & Marks, 2013). The impact of ambiguity tolerance with regard to aesthetic perception and judgment is revealed by a few studies that relate higher ambiguity tolerance to preference for surreal paintings (only if they contain few elements, Furnham & Avison, 1997) and for surreal film clips (Swami, Stieger, Pietschnig, & Voracek, 2010). Child and Chapman (1973) examined age-dependent links among aesthetic sensitivity and ambiguity tolerance and de Bont, Schoormans, and Wessel (1992) showed that persons with high ambiguity tolerance are more likely to accept unconventional designs than persons with low ambiguity tolerance.

2. Research questions and hypotheses

The present study asks how and why people appreciate perceptually challenging, ambiguous artworks. We aimed to shed further light on the appreciation of artworks that are ambiguous and therefore cannot be processed fluently. The theoretical ideas and empirical findings described in the introduction suggest that appreciation of non-fluent material might consist in its positive effects on dimensions aside from the typically measured *liking*, such as *interest*

and *affect*. We thus used a three-dimensional concept of aesthetic appreciation and expected *ambiguity* to primarily affect the aesthetic appreciation dimensions *interest* and *affect* (see also Faerber et al., 2010). As artworks can potentially have a different effect on perception than on cognition (Carbon & Jakesch, 2013; Leder et al., 2004), we further differentiated between *perceptual affect* and *cognitive affect* in the present study.

As described above, two different processes can be considered as potentially underlying the appeal of ambiguity in art: the reward by insights triggered during the processing of ambiguous material and the reward by solvability of ambiguity. Accordingly, we compared the effects of *strength of insights* and *solvability of ambiguity* on aesthetic appreciation. “Insights”, in the terms used here, might refer to perceptual insights (e.g., an emergent Gestalt), cognitive insights (e.g., stylistic aspects or symbolic interpretations) or reflexive insights (e.g., into one’s own perceptual mechanisms) during the perception of ambiguous art (see Table 1 for examples extracted from free descriptions of insights by participants looking at ambiguous visual artworks in the course of the study). We supposed that the factor *strength of insights* might be more crucial for the aesthetic appreciation of ambiguous artworks than the estimated *solvability of ambiguity* (e.g., how easy it is to resolve via elaboration the “riddle” posed by the ambiguous artwork). In order to account for differences in personality between participants, we assessed *ambiguity tolerance* via the IMA questionnaire (Inventory for measuring tolerance of ambiguity, Reis, 1996).

[Please insert Table 1]

3. Methods

3.1 Participants

Thirty-nine participants took part in the experiment on a voluntary basis (21 female and 18 male; age $M = 25.0$ years, range = 18-41 years, $SD = 5.9$). One additional dataset was excluded from the analysis due to monotonous response behavior to avoid higher error variance of the experimental result, an effect recently reported in regard to participants' inattention (Maniaci & Rogge, 2014). A *Snellen* Eye chart test and a sub set of the *Ishihara* color cards assured that all of them had normal or corrected-to-normal visual acuity and normal color vision. The participants were naïve to the purpose of the study and did not have any training in art or art history besides regular school education.

3.2 Apparatus and stimuli

Photographs of 17 ambiguous artworks of the 20th and 21st century were shown on an LG W2220P screen with a 22-inch screen size at a resolution of 1680×1050 pixels. Of each stimulus, an additional paper-mounted version was created using a color-print of the respective artwork. A list of the artworks can be found in Table 2. To assess participants' level of *ambiguity tolerance*, we utilized the "Inventar zur Messung der Ambiguitätstoleranz" (Inventory for measuring tolerance of ambiguity, IMA) by Reis (1996) comprising 40 items which reflect four subscales describing different domains of ambiguity: *ambiguity tolerance* for seemingly unsolvable problems, for social conflicts, in regard to the image of the parents, for role stereotypes and for new experiences (internal consistencies of scales are between Cronbach's $\alpha=.74$ and $\alpha=.86$; entire scale: $\alpha=.87$).

[Please insert Table 2]

3.3 Procedure

The experiment consisted of two phases (see Figure 1) with a fixed order of blocks. The first phase comprised five rating blocks in each of which all stimuli were shown in randomized order. During the rating blocks, the participants sat at an approximate distance of 55 cm in front of the screen and rated the stimuli with regard to the variables 1) *liking*, 2) *interest*, 3) *powerfulness of affect* (“how strong does the artwork affect you?”), 4) *perceptual affect* (“how strong does the artwork affect your perception?”) and 5) *cognitive affect* (“how strong does the artwork affect your thoughts?”), respectively, using a 7-point Likert-scale (from 1 = *not at all* to 7 = *very much*). Blocks 4 and 5 were introduced to discern relevant elements of the variable *powerfulness of affect*.

In the second phase of the experiment the participants saw the whole set of stimuli again, this time in a fixed, non-randomized order. Participants 1) rated each picture concerning its degree of *ambiguity*, 2) described the ambiguities they perceived in the picture in a free-typed report on a second computer (viewing an additional paper-mounted version of the according picture, no time constraints), 3) rated the level of *solvability of ambiguity*, 4) described their insights in a free-typed report on a second computer (viewing an additional paper-mounted version of the according picture, no time constraints) and 5) rated the *strength of their insights*. The rating scales followed the same scheme as before (i.e., Likert scales from 1 = *not at all* to 7 = *very much*). Description phases were introduced to guarantee that the collected ratings for the *solvability of ambiguity* and the *strength of their insights* were based on deep elaboration of the material. Pictures were shown in a non-randomized order to avoid participant distraction due to the re-ordering of the paper-mounted versions by the experimenter.

[Please insert Figure 1]

3.4 Results and discussion

Following Silvia's (2007) proposal to consider the use of multilevel modeling for research in psychological aesthetics, we analyzed the data accordingly. This kind of analysis allows for testing within-person effects that are particularly interesting in a field in which standards of evaluation are hardly achievable (thus scaling of aesthetic appreciation potentially differs to a high degree between subjects). The experimental design also called for multilevel models because we were interested in how personality factors such as *tolerance of ambiguity* modulate the aesthetic appreciation of a) *ambiguity*, b) *solvability of ambiguity* and c) *strength of insights* during the processing of the artworks. We thus conducted five identically-structured multilevel models, one for each of the five dependent variables (each person-mean centered): 1) *liking*, 2) *interest*, 3) *powerfulness of affect*, 4) *perceptual affect* and 5) *cognitive affect*.

Each multilevel model contained the following predictor structure as fixed coefficients: A) ambiguity aspects of the artworks (*ambiguity*, *solvability of ambiguity*, and *strength of insights*), each variable centered on the stimulus mean (called, *ambiguity-deviation*, etc. hereafter), B) interactions of A-factors with personality factors (*tolerance of ambiguity*: “problem solving” [IMA-PR] and “open for experiences” [IMA-OE]), each factor centered on the grand mean, C) ambiguity aspects of the artworks: again *ambiguity*, *solvability of ambiguity* and *strength of insights*, but this time each variable AS as stimulus mean (called, *ambiguity-stimulus*, etc. hereafter). Additionally, we fed the models with random coefficients regarding ambiguity aspects of the artworks (*ambiguity*, *solvability of ambiguity* and *strength of insights*), each variable centered on the stimulus mean. The models also contained the 17 stimuli as repeated effects yielding a total number of 34 parameters. To increase the

readability of the data analysis, we have presented all significant effects in an overall table comprising all five multilevel models (see Table 3).

[insert Table 3 about here]

For all models - meaning for all dependent variables - we revealed significant positive effects of *ambiguity* (ambiguity-deviation): the higher participants assessed the *ambiguity* of a stimulus, the more they appreciated it in terms of *liking*, *interest*, *affect*, *perceptual affect* and *cognitive affect*. The same was the case for *strength of insights*. Importantly, these main effects were only modulated by personality factors for *liking* and *cognitive affect*: when IMA-PR was higher, *ambiguity* was more appreciated in terms of *liking* and *cognitive affect*—these modulations as well as the main effect of *ambiguity* on both variables are also illustrated in Figure 2 (for *liking*) and Figure 3 (for *cognitive affect*). We can detect that the majority of persons (each regression line refers to one single participant) showed a positive relationship between *ambiguity* and the corresponding dependent variable, but people who showed low IMA-PR scores more often tended to break this general trend—although this effect is of course far from being clear-cut. IMA-PR additionally showed an interactive effect with *solvability of ambiguity*: people who assessed the *solvability of ambiguity* in a picture as being higher were more cognitively affected the higher they scored on the IMA-PR scale. Furthermore, we detected several effects on the mean ratings of stimulus properties, such as positive effects of *ambiguity* on *perceptual affect* and *cognitive affect*, negative effects of *solvability of ambiguity* on *interest* and *affect*, a positive effect of *solvability of ambiguity* on *perceptual affect* and positive effects of *strength of insights* on all variables but only a trend with regards to *perceptual affect*.

At least two major conclusions can be drawn from the whole bunch of analyses: first, the complexity of the data pattern demonstrates how important it is to use a multidimensional approach to do justice to the multiple facets of ambiguity—most importantly, we have to differentiate between aspects of *ambiguity*, *solvability of ambiguity* and *strength of insights*. We could not find any evidence that the *solvability of ambiguity* is an important factor for appreciating ambiguity. There is a direct relationship of *solvability* to *interest* as well as *affect* but—contrary to simple ideas of art perception as a kind of problem solving—it is a negative one. Second, although exerting only a modest influence, specific and art-relevant personality factors such as *tolerance of ambiguity* seem to be promising candidates to explain person-specific effects in regard to the appreciation of artworks, especially to those artworks that do not offer one determinate meaning.

4. General discussion

We asked how and why beholders appreciate ambiguity in art. In contrast to previous reports we found no evidence for a preference for low (Reber et al., 2004) or moderate (Jakesch & Leder, 2009) levels of ambiguity but a clear positive relation of high levels of ambiguity with *liking*, *interest* and *powerfulness of (perceptual and cognitive) affect*. We revealed the largest effect for *interest*—which indicates that this dimension is especially crucial concerning the aesthetic appreciation of ambiguity in modern art.

The appraisal approach to aesthetic emotions as proposed, for example, by Silvia (2005a) essentially defines aesthetic emotions as based on cognitive evaluations (that are expected to be, most often but not necessarily, unconscious and automatic). This means: How the recipient will react to an artwork cannot simply be reduced to objectively measurable properties, but depends on the perceiver's subjective perception and experience of the

respective aesthetic object. The appraisal approach further states that different aesthetic emotions are each based on specific appraisal structures which are understood in terms of specific combinations of multiple appraisal components. Common appraisal components suggested by appraisal theorists are, for instance, novelty, intrinsic pleasantness, certainty/predictability, goal significance, agency, coping potential and compatibility with social or personal standards (Ellsworth & Scherer, 2003). For the aesthetic emotion “interest”, Silvia (2005a) suggests two main appraisal components: (1) the appraisal of novelty (related properties are: being “new, sudden, unfamiliar, ambiguous, complex, obscure, uncertain, mysterious, contradictory, unexpected, or otherwise not understood”, p. 122), and (2) the appraisal of one’s own potential to cope with that object (“people’s appraisal of whether they can understand the ambiguous event”, p. 122). In the present study, we investigated different kinds of coping with ambiguity: the subjectively estimated *strength of insights* and the subjective *solvability of ambiguity*. *Strength of insights* during the elaboration of an artwork was found to be a significant indicator for aesthetic appreciation. This linkage of insights to (aesthetic) emotions is in accord with ideas that stress interactionist features of art processing rather than the search for effects of objective features of an aesthetic object. The relevance of personality factors like *ambiguity tolerance* furthermore underlines this point.

Uncertainty reduction might be rewarding (Dörner & Vehrs, 1975; Van de Cruys & Wagemans, 2011); however, a complete resolution of ambiguity is not necessary for the appreciation of an artwork (see, for instance, Leder et al., 2004). In our study, subjective *solvability of ambiguity* indeed was not significantly linked to *liking* and was even negatively linked to *interest* and *affect*. Taken together, these two findings could mean that insights are linked to appreciation even (or even more so) if the ‘problem’ posed by the present ambiguity

stays unsolved during processing. This is a conceptual challenge, if we understand both variables as being related to problem solving. Examples of participants' insight descriptions (see Table 1), however, might help to discern them on a theoretical basis: for instance, one participant described her insight into René Magritte's (1928) *Les Jours Gigantèsques* (see Figure 1) simply as: "the insight is, that I cannot fully solve the picture". Others described insights on the level of the content of the piece (e.g., identifying the scene as a rape), sudden Gestalt perception (when detecting a second person in the picture), insights into one's own perceptual mechanisms (e.g., "I recognize something although it is not really there") or into one's own affective reactions (e.g., "maybe I am so disgusted because ..."). Reflective statements like that first cited above particularly exemplify that insights during the processing of an artwork can be triggered by the ambiguity of the artwork without resolving it. This point might be a usable extension to Leder et al.'s (2004) model of aesthetic appreciation and aesthetic judgments, in which evaluation is linked to cognitive mastering by a loop "in relation to their success in either revealing a satisfying understanding, successful cognitive mastering or expected changes in the level of ambiguity" (p. 499). We also suggest that insights—which do not necessarily resolve or promise to resolve the ambiguity of an artwork—might positively influence aesthetic evaluation. At the same time, ambiguity and the expectation of its resolution might be a motivation for (prolonged) involvement in art perception in the first place. This is in accord with our finding that *ambiguity* is linked to *interest* which has repeatedly been reported to motivate exploration and engagement (Izard & Ackermann, 2000; for an overview on the motivational effects of interest see Silvia, 2006). The variance in people's descriptions of a single stimulus furthermore reveals that an object is not ambiguous, interesting or affecting per se but only as a consequence of people's active elaboration of it.

Beyond this, it is plausible that if interest needs “disorientation” (Berlyne, 1971, p. 215), ambiguity should not be too easily decipherable in order to be - or stay - interesting.

Furthermore these findings might explain how artworks can be appealing without offering a determinate solution or interpretation, respectively (c.f., Muth et al., 2013 for Cubist artworks).

It is important to note that the concept of insight used by our participants is not entirely in accordance with a classical definition of insight (German “Einsicht”) as the sudden, smooth and fluent solution to a problem (see e.g., Bowden, Jung-Beeman, Fleck, & Kounios, 2005). Taking our participants’ descriptions into account, insight might also be construed as the sudden understanding of something after all (“Oh yes, I see that...”) whereas this “something” does not (fully) dissolve a problem that was directly posed by the ambiguity of the artwork. Another case of non-classical insights is given by Cubist artworks that force the perceiver to restart their search for identifiable objects again and again by offering contradictory cues (Gombrich, 1960): Although the perceiver will never reach a definite solution, there are insightful moments marked by a relative stability of meaning. As these examples show, aesthetics research is potentially confronted with different kinds of insights in the context of art perception. This must also be taken into account when dealing with the question of whether insights in art perception are produced by analytic thinking or rather by a process involving insight-specific mechanisms (e.g., recomposing) or by a combination of both (see e.g., Bowden et al., 2005; see also Weisberg, who offers an integrative approach to this topic). On the one hand we can state that not every artwork poses a classical insight problem: although they often challenge the perceiver, artworks do not always offer unexpected sudden solutions. On the other hand artworks are not riddles to be solved via analytic steps (as exemplified by Cubist artworks). In contrast: the differentiation between

solvability of ambiguity and *strength of insight* as described above reveals that people might well also experience insight (in the broad sense) even if it does not refer to a previously perceived problem, and that an insight does not necessarily have to lead to the solution of any such problem at all in order to be appreciated.

Our results further support the notion that, in order to advance towards the specific insights to be gained from ambiguous and challenging artworks, the dynamics of stability and instability of meaning during elaboration must be taken into account. Such a dynamic perspective also allows for recognition of the multiplicity of insights that one and the same artwork can offer: during elaboration the perceiver gets into various shades of the piece, each of which might present another sub-problem or challenge offering the opportunity for another insight. Such sub-problems concern, for instance, the “style” of an artwork (eventually leading to an insight via a categorization of the features), or the *sujet* (eventually leading to insightful associations, for instance on the social role of women in the 18th century), or even the “insolvability” of indeterminacy itself (eventually evoking a gain of insight on own perceptual mechanisms). Importantly, these sub-problems are connected within the artwork, this way a certain style might influence the associations we have concerning the *sujet* and ambiguities among them form new sub-problems (evident for instance in artworks from the post-expressionist art stream of *New Objectivity*, in German: “Neue Sachlichkeit”).

5. Conclusion

In the present study, we investigated the effect of *ambiguity* on a rather broad, multidimensional concept of aesthetic appreciation which we measured using the variables *liking*, *interest*, *powerfulness of affect*, *perceptual affect* and *cognitive affect*. Taking these diverse key dimensions of appreciation of ambiguous art into consideration, a fine-grained

picture of aesthetic processing emerged that allows us to further specify the involved mechanisms. We asked whether the *solvability of ambiguity* was really crucial for these aesthetic appreciation of ambiguous modern artworks, as is supposed by ideas that consider the processing of modern art as a kind of problem-solving. Our results did not confirm the according claims but suggest, in contrast, that the subjective *strength of insights* to be gained from an artwork is the most important factor here. Consequently, we advocate that the *process* of elaborating ambiguous artworks and gaining insights, rather than the *state of having solved* “a problem” posed by these artworks, is essential for explaining the aesthetic appreciation they receive. It is also important to note that further variables beyond *liking* seem to be highly relevant especially for modern artworks — above all *interest*. The role of *ambiguity tolerance* is yet to be clarified but our preliminary findings highlight the potential relevance of this personality variable in regard to the relationship between *liking* and *ambiguity*.

To sum up, the various and diverse streams of modern art might prevent us from getting easy clues about how such works appeal to us, but if we integrate further variables associated with aesthetic appreciation, e.g., *interest* and *powerfulness of affect*, as well as personality factors like *ambiguity tolerance* we might obtain deeper insights into how pieces of ambiguous art prompt such strong aesthetic experiences as they do.

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Tables

Table 1

*Examples of how participants described their insights during the elaboration of the artworks
(obvious spelling mistakes have been corrected for better readability).*

Artwork	Translated description	Original description (in original wording)
Bellmer, H. (1966). <i>Transfert des Sens.</i>	some of the depicted women look directly at the observer → that contributes to agitation	die dargestellten Frauen blicken den Betrachter tw. direkt an → das trägt zur Unruhe bei
Bellmer, H. (1966). <i>Transfert des Sens.</i>	thrilling to reflect on why bodies are intertwined so unclearly, which body belongs to whom? Do all love all?	spannend zu überlegen, warum Körper so unklar verschlungen sind, welcher Körper gehört wem? Lieben alle alle?
Bellmer, H. (1960). <i>Untitled.</i>	the longer the observation the clearer the forms get, hachures support the spacial impression of the object	je länger die Betrachtung, desto deutlicher werden Formen, Schraffuren unterstützen räumlichen Objekteindruck
Boden, B. (1966). <i>Kleiner Mann im Ohr.</i>	Sometimes most subtle indication suffices to convey a message By the ring, strong look, legs Rest is circumstantial	Manchmal reichen subtilste Andeutungen um Botschaft zu übermitteln Durch Ring, starker Blick, Beine Rest nebensächlich
Collien, P. (1964). <i>Daphne.</i>	presumably by the same artist like picture 3; vegetable and human are not as exclusive as thought	vermutlich von selben KünstlerIn wie Bild 3; Pflanzliches und Menschliches nicht so trennscharf wie gedacht
Cragg, T. (2000). <i>Can-Can.</i>	Assumption what it could be; parts of a technical device	Annahme, was es darstellen könnte; Teile aus einem technischen Gerät
Cragg, T. (2000). <i>Can-Can.</i>	I like the work, it dissolves the black and white thinking a bit: something can be very massive, heavy and solid and at the same time plastic in such a way that the work makes a light and delicate impression. I see furthermore two music instruments (most probably two French horns) which strengthen the positive association with this work.	Mir gefällt das Werk, es löst das schwarz weiß denken ein wenig auf: etwas kann sehr massiv, schwer und fest und trotzdem in so einer Art verformbar sein, dass das Werk einen leichten und filigranen Eindruck macht. Ich sehe außerdem zwei Musikinstrumente (am ehesten zwei Waldhörner), die die positive Assoziation mit diesem Werk noch verstärken.
Gober, R. (1990). <i>Untitled.</i>	This is where the curse word "you bag" comes from	Daher kommt das Schimpfwort „Du Sack“.
Maar, D. (1930). <i>Doppelporträt mit Huteffekt.</i>	Sometimes when one sits in a train and looks out of the window, one sees oneself in the pane and one's neighbor and the faces mix exactly like this	Manchmal wenn man im Zug sitzt und aus dem Fenster schaut sieht man in der Scheibe sich und seinen Sitznachbar und die Gesichter mischen sich dann genauso.
Maar, D. (1930). <i>Doppelporträt mit Huteffekt.</i>	(...) this is the fascinating thing here. The brokenness is not solvable and the central motive, terrific.	(...) Dass ist das Faszinierende hier. Diese Zerbrochenheit ist nicht auflösbar und zentrales Motiv, grandios.
Maar, D. (1930). <i>Doppelporträt mit Huteffekt.</i>	Clever composition can (with little means) also induce an effect.	Geschickte Anordnung kann (mit wenigen Mitteln sonst) auch Effekt bringen.
Maar, D. (1930). <i>Doppelporträt mit Huteffekt.</i>	I interpret the painting like this, that a person can have many faces, so can be very multifaceted. Here one part is proud and intent on doing something (the profile with the nose), the other part is longing and melancholic.	Ich interpretiere das Gemälde so, dass eine Person mehrerer Gesichter haben kann, also sehr facettenreich sein kann. Hier ist ein Teil stolz und festentschlossen (das Profil mit der Nase), der andere Teil sehnsüchtig und wehmütig.
Magritte, R.(1928). <i>Les Jours Gigantesques.</i>	It seems to me that the woman is threatened by the man; he touches her although she does not want that. Her hair seems strangely heavy and also her face is not very feminine, but rather hard and rough and frightened. The first impression of a dancing, happy woman faded entirely+.	Mir scheint, dass die Frau von dem Mann bedroht wird; er fasst sie an obwohl sie das nicht möchte. Ihr Haar wirkt seltsam schwer und auch ihr Gesicht ist nicht sehr weiblich, sondern eher hart und grob und angsterfüllt. Der erste Eindruck von der tanzenden, fröhlichen Frau ist vollständig verschwunden.

Miller, L. (1937). <i>Raumportrait Ägypten.</i>	hm... impression: sadness and melancholy, a little bit; at the same time also freedom... (This image is somehow specifically interesting; it has something intangible in its effect...)	hm... Eindruck: Tristesse und Wehmut, ein wenig; zugleich aber auch Freiheit... (Dieses Bild ist irgendwie besonders interessant; es hat etwas Ungreifbares in seiner Wirkung...)
Miller, L. (1937). <i>Raumportrait Ägypten.</i>	Mirror or image? (upper side of the picture) torn cloth= new freedom or disappointment as there lies only desert behind?	Spiegel oder Bild? (oben im Bild) zerrissenes Tuch= neue Freiheit oder Enttäuschung weil dahinter nur Einöde liegt?
Oppenheim, M. (1936). <i>Frühstück in Pelz.</i>	The furred cup might hint at the barbaric methods with which we partially obtain our food. In everyday life, and what would be less mundane than drinking a cup of tea, we are repeatedly pointed to that, the cup of fur (like "tearing the fur over the ears") [in German meaning something like "to take someone for a ride"] imposes on us how cruel and inhuman or -animalistic, respectively, some food production is (...)	Die fellerne Tasse könnte auf die barbarischen Methoden hinweisen mit denen wir z.T. unsere Lebensmittel gewinnen. Im Alltag, und was könnte weniger alltäglich sein als eine Tasse Tee zu trinken, werden wir immer wieder darauf hingewiesen, die Tasse aus Fell (wie "das Fell über die Ohren ziehen") drängt einem gerade auf wie grausam und tier-/ bzw. menschenverachtend manche Lebensmittelerstellung ist (...)
Oppenheim, M. (1938). <i>Steinfrau.</i>	from the warm colors the picture seems peaceful, the woman is almost like a Rubens-woman	durch die warmen Farben wirkt das Bild friedlich, die Frau fast wie eine Rubens-Frau
Teige, K. (1951). <i>Collage 374.</i>	Insight is hard to say; thoughts alternate constantly between the different aspects of the image. And I wonder; why does the picture seem a little bit spooky	Einsicht schwer zu sagen; Gedanken wechseln dauernd zwischen den verschiedenen Bildaspekten hin und her. Und frage mich; warum das Bild etwas gespenstisch wirkt
Teige, K. (1951). <i>Collage 374.</i>	grotesque motives besides the image (female body, breast) demarcate themselves strongly from the landscape in terms of color and technique.	groteske bildfremde Motive (Frauenkörper, Brust) grenzen sich zur Landschaft farblich wie technisch stark ab
Teige, K. (1951). <i>Collage 374.</i>	Reference moon/ female cycle? Moon in pre-Columbian cultures of central America always female (goddess of the moon); also in the Romance languages "the" moon is female...	Bezug Mond/ weiblicher Zyklus? Mond z.B. in präkolumbianischen Kulturen Mittelamerikas immer weiblich (Mondgöttin); auch in den romanischen Sprachen ist "der" Mond weiblich...
Thiele, P. (1984). <i>Der große Bruder.</i>	We "tinker" (mentally) a lot together, what artists again know and use. And: somehow one is happy about the "hidden" image (otherwise this work here would maybe be boring...)	Wir „basteln“ (gedanklich) viel zusammen, was Künstler wiederum wissen und sich zu Nutze machen. Und: irgendwie freut man sich doch über das „versteckte“ Bild (sonst wäre das Werk hier vielleicht langweilig...)
Thiele, P. (1984). <i>Der große Bruder.</i>	it is fun to look at the many small details, I wonder whether the life of the old man is shown in the little pictures	macht Spaß, die vielen kleinen Details anzusehen, ich frage mich, ob wohl das Leben des alten Mannes in den kleinen Bildern gezeigt ist

Table 2

The study used photographs of the following artworks:

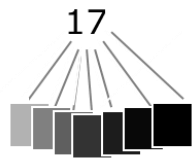
Artist	Year of creation	Title
Bellmer, H.	1960	Untitled
Bellmer, H.	1966	Transfert des Sens
Boden, B.	1966	Kleiner Mann im Ohr
Breitling, G.	1966	Maleditia Calumnia
Collien, P.	1964	Daphne
Coste, C.	2007	Corps viscéral V
Cragg, T.	2000	Can-Can
Gober, R.	1990	Untitled
Lin, W.	2004	Landscape
Maar, D.	1930	Doppelporträt mit Huteffekt
Magritte, R.	1928	Les Jours Gigantesques
Miller, L.	1937	Raumportrait Ägypten
Oppenheim, M.	1936	Frühstück in Pelz
Oppenheim, M.	1938	Steinfrau
Táborský, H.	1933	Self portrait 2
Teige, K.	1951	Collage 374
Thiele, P.	1984	Der große Bruder

Table 3

Results of the five multilevel models. Only significant parameters are reported.

Model/parameter	estimation	SE	df	t	p-value
Model #1 Liking					
<i>ambiguity-deviation</i>	.147	.039	37.3	3.76	.001
<i>insights-deviation</i>	.148	.040	40.6	3.76	.001
<i>IMA-PR * ambiguity-deviation</i>	.021	.008	25.0	2.73	.012
<i>insights-stimulus</i>	.477	.168	209.4	2.84	.005
Model #2 Interest					
<i>ambiguity-deviation</i>	.231	.040	27.9	5.85	<.0001
<i>insights-deviation</i>	.146	.048	36.1	3.01	.005
<i>solvability-stimulus</i>	-.405	.126	237.4	-3.20	.002
<i>insights-stimulus</i>	1.087	.175	256.0	6.19	<.0001
Model #3 Affect					
<i>ambiguity-deviation</i>	.166	.044	33.0	3.78	.001
<i>insights-deviation</i>	.231	.044	39.8	5.29	<.0001
<i>solvability-stimulus</i>	-.413	.123	238.3	-3.35	.001
<i>insights-stimulus</i>	1.228	.178	246.0	6.89	<.0001
Model #4 Perceptual-Affect					
<i>ambiguity-deviation</i>	.136	.052	39.6	2.61	.013
<i>insights-deviation</i>	.179	.038	31.6	4.70	<.0001
<i>ambiguity-stimulus</i>	.444	.114	200.0	3.90	<.0001
<i>solvability –stimulus</i>	.253	.110	213.3	2.31	.022
Model #5 Cognitive-Affect					
<i>ambiguity-deviation</i>	.220	.043	29.6	5.01	<.0001
<i>insights-deviation</i>	.121	.050	41.6	2.40	.021
<i>IMA-PR * ambiguity-deviation</i>	.024	.008	18.4	2.90	.009
<i>IMA-PR * solvability-deviation</i>	.016	.006	495.2	2.58	.010
<i>ambiguity-stimulus</i>	.305	.127	202.6	2.38	.018
<i>insights-stimulus</i>	.467	.173	200.9	2.70	.006

Phase 1



Liking

Interest

Affect


Perceptual affect


Cognitive affect

Phase 2



 *Ambiguity*

 *Ambiguity*

 *Solvability*

 *Insights*


 *Strength of insights*

Figure 1. Procedure of the study. Example for stimulus material: René Magritte (1928). *Les Jours Gigantesques*; © VG Bild-Kunst, Bonn 2014.

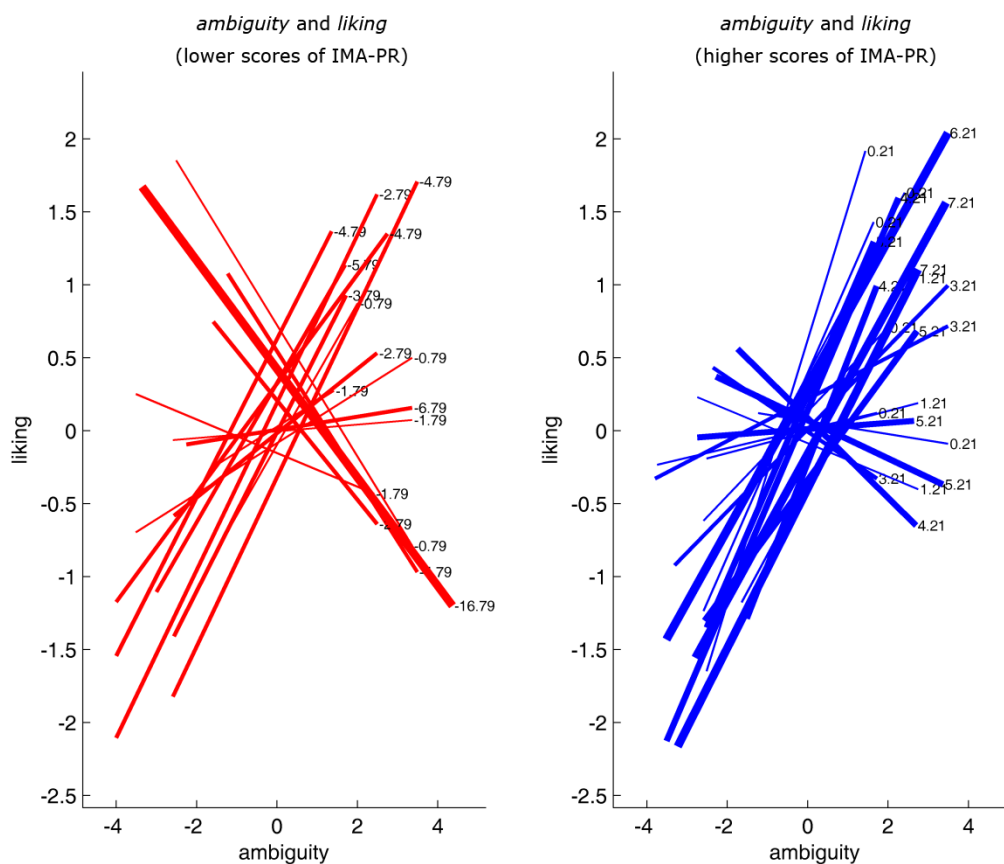


Figure 2. Relationship between *ambiguity* (i.e. *ambiguity-deviation*) and *liking* (person-mean centered) for persons with low vs. high scores in the IMA-PR (deviation from grand mean), expressed as within-person analyses. The thicker the line the stronger the degree of deviation of IMA-PR from the grand mean (exact IMA-PR scores as deviations from the grand mean are given for each regression at the right end of the regarding line).

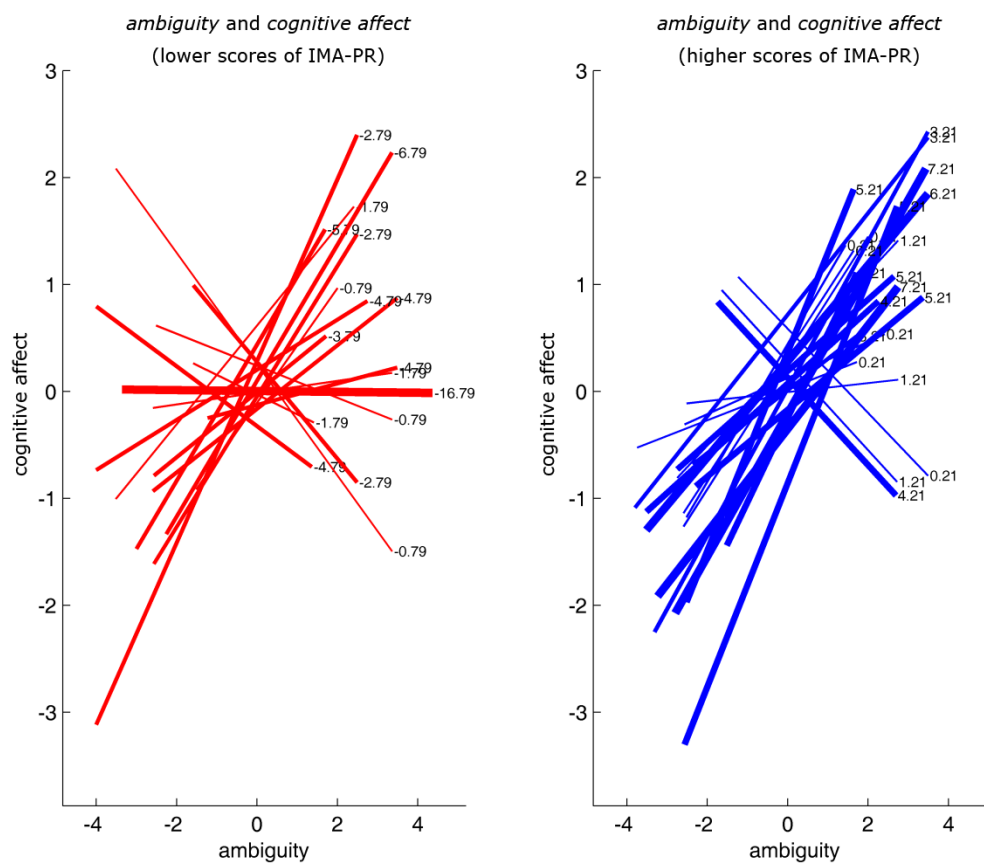


Figure 3. Relationship between *ambiguity* (i.e. *ambiguity-deviation*) and *cognitive affect* (person-mean centered) for persons with low vs. high scores in the IMA-PR (deviation from grand mean), expressed as within-person analyses. The thicker the line the stronger the degree of deviation of IMA-PR from the grand mean (exact IMA-PR scores as deviations from the grand mean are given for each regression at the right end of the regarding line).