The interplay of objective and subjective factors in empirical aesthetics

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Abstract The field of empirical aesthetics sets out to understand and predict our aesthetic preferences (Palmer et al., 2013). Its history dates back to the birth of visual psychophysics and the work of Gustav Fechner (1876), while multiple models of aesthetic experience have been proposed in the intervening years (Chatterjee & Vartanian, 2014; Leder et al., 2004; Pelowski et al., 2017). This chapter briefly sets out the history of empirical aesthetics, and the state of the research field at present. I outline recent work on inter-observer agreement in aesthetic preference, before presenting empirical work that argues the importance of first objective (characteristics of stimuli) and then subjective (characteristics of context) factors in shaping aesthetic preference. Considering the role of properties of the stimulus, I will review literature on the relationship between aesthetic preference and symmetry, shape, compositional structure, colour and complexity as well as considering the potential role of statistical properties of images. I will then review putative subjective predictors of aesthetic preference including the role of context, framing and the influence of information about the artist and the artistic process. Both subjective and objective approaches will be evaluated from an individual differences perspective, focusing on the mediating role of familiarity, expertise, culture, cognitive ability and personality. Finally, I will attempt to draw these approaches together with reference to aesthetic sensitivity: an individual observer's propensity to have an aesthetic response to a particular objective image characteristic, and will explore some putative factors that may modulate and explain individual differences in aesthetic sensitivity.

Introduction

The field of empirical aesthetics sets out to understand and predict human aesthetic preferences (Palmer et al., 2013). The origins of modern-day empirical aesthetics reside in the early psychophysical experiments of Gustav Fechner (1876) in his seminal work 'Vorschule der Aesthetik'. Fechner's aesthetics 'from below' positioned objective stimulus properties at the heart of the empirical aesthetic project,

providing the foundation for later efforts to establish lawful relationships between stimulus properties and aesthetic preferences (Birkhoff, 1933; Eysenck, 1940) with reference to psychobiological mechanisms of arousal (Berlyne, 1974). Such efforts focused on the predictive value of low-level stimulus properties, such as colour, symmetry, proportion, contrast, contour, and later on collative properties such as order, complexity and ambiguity (Berlyne, 1974). Such an approach remains common in empirical aesthetics. However, more recent research in the field has placed focus on sensory and cognitive processing dynamics, modelling how observers respond to salient properties of the stimulus (Flavell et al., 2020; Reber et al., 2004), but also incorporating the sensory and cognitive history of the observer (Cutting, 2003; Zajonc, 1968). The latter approach highlights the critical role subjective aspects such as context and exposure play in shaping our aesthetic experiences. Objective and subjective perspectives have been brought together in comprehensive aesthetic models in recent years, bringing both psychological and neuroscientific understanding to the numerous objective and subjective mechanisms identified by researchers in the field (Chatterjee & Vartanian, 2014; Leder et al., 2004; Leder & Nadal, 2014; Pelowski et al., 2017; Tinio, 2013). Finally, contemporary accounts focus on the additional role of curiosity and expectation violation in responses to artworks (Muth et al., 2015; Van de Cruys & Wagemans, 2011).

This chapter will seek to address two key questions in the field of empirical aesthetics. The first is to what extent aesthetic preferences are shared or unique. If preferences are found to be completely idiosyncratic this would strongly suggest that attempts to establish lawful relations between stimulus properties and aesthetic preferences are bound to fail. However, if preferences are found to be shared to some degree, this does not necessarily entail that the shared variance among observers is determined by objective stimulus properties, rather than common subjective experiences (Vessel, 2010; Vessel et al., 2018). Therefore, the second question is to what extent objective (characteristics of stimuli) and subjective (characteristics of context) properties are responsible for shaping aesthetic preferences. Having addressed these two critical questions, I will attempt to integrate an individual difference approach with stimulus-based approaches by exploring recent research on aesthetic sensitivity. It is worth noting here that the focus of this chapter is on behavioural empirical studies of preferences for visual stimuli. Much insight can be drawn from neuroscientific perspectives on visual aesthetics (Chatterjee & Vartanian, 2014) and from empirical work in other stimulus domains such as music (Brattico & Pearce, 2013), but such perspectives lie beyond the scope of this chapter.

Are aesthetic preferences shared or unique?

Aesthetic preferences are idiosyncratic (Vessel, 2010; Vessel et al., 2018), but the extent of this idiosyncrasy appears to be strongly dependent on the stimulus category at the focus of research. Vessel and Rubin (2010; 2018) investigated the

proportions of 'shared' and 'private' taste adult observers displayed across different stimulus categories. Participants were required to make pairwise preference judgments on pictures of real-world scenes and abstract images, and across-observer agreement was computed via pairwise correlations between preference judgments of every pair of participants (Vessel, 2010). Participants showed a high degree of cross-observer agreement for pictures of real-world scenes (46%), while cross-observer agreement for abstract images was significantly lower (20%). In addition, within-observer reliability (correlations in participants' preference estimates between the first and second half of the testing session) was high for both sets of images suggesting that variability in cross-observer agreement could not be attributed to measurement error. In a follow-up study Vessel and Rubin (2018) measured preferences for a much larger stimulus set including: faces, natural landscapes, interior and exterior architecture, and visual art. Cross-observer agreement was highest for an ethnically diverse sample of faces (66%), and a sample of natural landscapes (29%), lower for architecture (12%), and lower still for visual art (8%). The reasons for variance in cross-observer agreement across these domains could be due to properties of the stimulus; for example averageness, facial symmetry and sexual dimorphism have been shown to be consistent predictors of facial attractiveness (Fink & Penton-Voak, 2002). On the other hand, such variance could be due to shared or unique environmental mechanisms such as mere exposure, which posits that observers develop a preference for stimuli that they have had greater amounts of exposure to (Zajonc, 1968). The following section will explore putative objective predictors of aesthetic preference in more detail.

Objective predictors of aesthetic preference

Symmetry

Symmetry has been described as an 'aesthetic primitive' due to the special status conferred to it by the visual system (Makin et al., 2018). Increased regularity in patterns appears to elicit more fluent visual processing, evidenced by increased accuracy and reduced reaction times in behavioural data (Makin et al., 2016) and by a greater amplitude of the sustained posterior negativity (SPN) in occipital electrodes in event-related potential (ERP) studies (Makin et al., 2016). Correspondingly, increased regularity strongly predicts observers' implicit (Makin et al., 2012) and explicit preferences for random dot patterns (Höfel & Jacobsen, 2003; Jacobsen & Höfel, 2002), an effect that has been replicated in cross-cultural samples (Makin et al., 2018). Preference for symmetry can be conceptualised as a broader preference for perceptual goodness, or Prägnanz in the Gestalt psychological tradition (Palmer

& Griscom, 2013). In the context of Makin et al. (2016; 2018) perceptual goodness was mathematically quantified using the Holographic Weight of Evidence Model (Van der Helm & Leeuwenberg, 1996), which is defined as the relationship between the evidence for regularity and the total amount of information in a pattern. These mathematical approaches to stimulus properties overlap with computational approaches to aesthetics which are further elaborated in the section on Global Image Properties below. Beyond the simple dot patterns used in the aforementioned studies (Höfel & Jacobsen, 2003; Jacobsen & Höfel, 2002; Makin et al., 2012, 2016, 2018), symmetry is also a predictor of preference for more complex and ecologically-valid stimuli such as faces, flowers and landscapes (Bertamini et al., 2019; Hůla & Flegr, 2016; Perrett et al., 1999). Two distinct mechanisms may underlie preference for symmetry. The first is perceptual fluency (Reber et al., 2004); more symmetrical stimuli are easier to process by the visual system as evidenced by neuroscientific and behavioural data, and ease of processing gives rise to feelings of pleasure and reward (Makin et al. 2018). On the other hand preference for symmetry may result from sexual selective mechanisms via an association between symmetry and physical fitness, a view that is supported by the fact that symmetry preference is strongest for faces compared with other non-biologically relevant stimuli (Little, 2014).

Shape and composition

Rudolf Arnheim (1965) argues compellingly for the significance of perceptual goodness in his seminal work 'Art and Visual Perception', demonstrating its relevance for higher-order shape and compositional properties of visual stimuli. There has been much speculation concerning whether the golden ratio (or golden section, denoted by the symbol ϕ) is a signifier of perceptual goodness in works of art and design, and the presence of the golden ratio was one of the first objective stimulus properties to be investigated in empirical aesthetics (Fechner, 1876). However, there is little evidence to support the existence of a preference for the golden ratio. Rather, in-depth studies on this topic have revealed preferences converging on prototypical geometric shapes (McManus, 1980; McManus & Weatherby, 1997) and on compact triangular shapes (Friedenberg, 2012). In terms of shape contour, a robust preference for curvature relative to angularity has been found for abstract geometric shapes, real-life objects and environments (Bar & Neta, 2006; Palumbo et al., 2015, 2020; Vartanian et al., 2013), a preference which has found to be reliable in cross-cultural research (Gómez-Puerto et al., 2016). The origin of a preference for curvature remains a debate in the literature. Some authors suggest it derives from optimal stimulation of the visual system via Gestalt principles such as good continuation (Bertamini et al., 2016), while other researchers argue that a preference for curvature derives from an evolutionary adaptive avoidance of sharp stimuli (Bar & Neta, 2006),

Extending out from preference for proportion and contour of singular forms, Arnheim (1965) referred to the tension inherent in the configuration of forms, even in a stimulus as simple as a circle within a frame (Figure 1). Arnheim posited that observers prefer specific compositional arrangements that ensure balance and preserve meaning. This was explored empirically in a series of studies in which participants rated the goodness of dots placed in different locations in relation to a surrounding frame (Wickens et al., 2008). The authors discovered a preference for dots located in the centre and along the medial axes of a rectangular frame, lending support for Arnheim's conjecture. This 'centre-bias' has since been replicated in studies on photographic composition (Abeln et al., 2016) and drives eye movements during free viewing of visual images (Judd et al., 2011; Tseng et al., 2009).

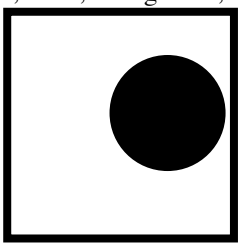

Fig. 1. Arnheim's (1965) example of the tensions inherent in a form within a frame; the disk may be perceived as being 'drawn toward the contour to the right' (p.12) and if the distance between the disk and frame is altered, the effect may be weakened or there may be a contrary repulsion effect.

However, the positioning of objects within a frame also interacts with an object's identity, such that objects facing or moving left-to-right are more preferred in the left-hand side of the frame, and vice-versa, a phenomenon termed the inward bias (Wickens et al., 2008). In a similar manner, vertical positioning of objects in a frame interacts with the affordance spaces of those objects, such that a bowl is most preferred in a lower position in a frame, and a light fitting is preferred in a higher position in a frame (Sammartino & Palmer, 2012a). Such interactions make it increasingly difficult to make straightforward predictions concerning which arrangement of forms within a frame will be judged to be the most aesthetically pleasing.

Colour

Palmer & Schloss (2010) demonstrated that there are robust relationships between colour attributes hue, lightness and saturation and preferences for those attributes. Western observers show relative preferences for hues at the blue end of the spectrum and for relatively more saturated colours. Ou et al. (2004, 2018) theorised that colour preferences are based on semantic associations with particular hues, whilst Hurlbert & Ling (2007) demonstrated that cone-opponent colour processing predicted colour preference curves. However, colour preferences show intriguing

hue-lightness interactions, such that observers show a marked dislike for dark yellows and oranges, which are not explained successfully in the aforementioned theories. This pattern of colour preference is accounted for by Ecological Valence Theory (EVT; Palmer & Schloss, 2010) which posits that colour preferences are determined by the emotional valence of objects associated with those colours. Thus, dark yellows and oranges are arguably disliked due to their associations with biological waste, and blues are preferred due to their association with clear skies and water. This theory was empirically supported by amalgamating data from participants on their: object-colour associations, object valence, and object-colour match ratings, creating a weighted affective valence estimate (WAVE). WAVEs predicted participants colour preference data remarkably well (Palmer & Schloss, 2010) and colour preferences could be altered by experimental exposure to objects with negative or positive valence (Strauss et al., 2013). Subsequent studies revealed that colour preferences could also be linked to associations with abstract concepts, such as an observer's university and political affiliation (Schloss et al., 2011; Schloss & Palmer, 2014).

Order, complexity and Global Image Properties

In his influential book 'Studies in the new experimental aesthetics: Steps towards an objective psychology of aesthetic appreciation' Daniel Berlyne (1974) posited that stimuli of intermediate complexity generate an optimal level of arousal, and should therefore be most preferred by observers. However, this conjecture has found limited support, with empirical findings obscured by different conceptualisations and manipulations of complexity (Nadal et al., 2010). Recent research has highlighted the complementary role of order or unity in Berlyne's Psychobiological Theory, demonstrating that an optimal balance or combination of order and complexity predicts ratings of soothingness and fascination for images of organised objects (Van Geert & Wagemans, 2019). The interplay of order and complexity was first highlighted by Birkhoff (1933) who developed a mathematical formula for aesthetic preference via a balance of order and complexity (Van Geert & Wagemans, 2020), foreshadowing computational approaches to aesthetics (Brachmann & Redies, 2017).

Image statistical approaches in aesthetics aim to determine Global Image Properties (GIP) of a stimulus that can be automatically computed and related to image preference (Letsch & Hayn-Leichsenring, 2020). Image statistical analysis can produce a number of different measures including: fractality, self-similarity, complexity, and anisotropy (variation in gradient orientations in an image). Statistical analysis of artworks has revealed that they are similar to natural scenes (Graham et al., 2009; Graham & Redies, 2010; Redies et al., 2012) and that different styles and periods of art can be attributed to their underlying image statistics (Hayn-Leichsenring et al., 2017; Mather, 2018). Furthermore, image statistics correlate with verbal

descriptions of artworks, suggesting that they capture meaningful aspects of visual stimuli (Letsch & Hayn-Leichsenring, 2020; Lyssenko et al., 2016). Image statistical measures have also been used to study aesthetic responses to artworks, with observers preferring less self-similar (statistical features of the whole image are comparable with smaller parts of the image) paintings of representational still-lifes and landscapes, and less complex portraits (Hayn-Leichsenring et al., 2017). However, research has revealed that image statistics are not robustly predictive of preference for abstract artworks (Letsch & Hayn-Leichsenring, 2020; Mallon et al., 2014). Finally, a reliable preference for fractal images in a specific fractal domain (1.3-1.5) has been found in both artworks and non-artistic images (Graham et al., 2010; Graham & Redies, 2010; Spehar et al., 2003, 2015). Computational approaches constitute a highly objective approach to the study of stimulus-driven aesthetic preference, but as a result can present difficulties in interpretation of experimental findings. This is especially true for images with higher ecological validity which vary not only on these lower-level visual features, but also on mid-level features associated with element grouping and higher-order properties such as semantic associations with both abstract and representational content, and which are not currently captured by these computational methods.

Do aesthetic primitives exist?

It is easy to mistake the presence of robust relationships between stimulus properties and aesthetic preference as evidence for universal, evolutionarily hard-wired preferences. However, even the most reliable preferences for particular stimulus properties can be the result of shared enculturation or exposure. For example, Huang et al. (2018) found that both adults and 4 year-old children spontaneously attend to symmetrical patterns, but that preference for symmetrical patterns was evident in adults but not in children, calling into question the argument that processing fluency underpins preference for symmetry. Rather, Huang et al. (2018) posit that mere exposure (Zajonc, 1968) may account for a preference for symmetry in adulthood. Furthermore, while the story of empirical aesthetics centres around group-level responses to manipulation of objective stimulus properties, authors consistently highlight a high level of reliable variance in observers' aesthetic responses to even very simple stimuli.

Drawing on some of the stimulus properties discussed above, Jacobsen and Höfel (2002) found evidence of substantial individual differences in preference for symmetry, while Bertamini et al. (2019) found that individual differences for symmetry for one stimulus class did not predict preference for symmetry in another stimulus class, suggesting that a unitary preference for symmetry across stimulus categories does not exist. Preference for complexity in artworks is determined to some extent by individual differences in visual working memory capacity (Sherman et al., 2015) and the soothingness of order is predicted by sub-clinical traits associated with

organising tendencies in obsessive compulsive disorder (Van Geert & Wagemans, 2019). Cross-cultural research has revealed differences in preferences for spatial composition, finding that preference for an object's location in a frame is mediated by the observer's culture's prevailing reading direction (Chokron & De Agostini, 2000; Ishii et al., 2011; Pérez González, 2012). Furthermore, Schloss and Palmer (2017) found that Chinese participants' WAVEs were predicted better by symbolic associations (red=revolution) and US participants' WAVEs by object associations (red=apple), while Taylor et al. (2013) found that WAVEs did not predict colour preference in the Himba tribe of Namibia. Finally, McManus et al. (2010) discovered large and stable individual differences in preferences for proportioned rectangles, with very simple patterns being ascribed individualised meanings (McManus & Wu, 2013). This finding lends support to the notion of the 'Gestalt nightmare', in which even the weakest stimuli elicit complex semantic associations in the viewer, which presents huge challenges for identifying group-level preferences (Makin, 2016). Indeed, semantic associations of stimuli often far outweigh the influence of any lower-level stimulus features on aesthetic preference, as demonstrated in Martindale's (1990) critical explorations of Daniel Berlyne's (1974) Psychobiological Theory. The prominent role of individualised semantic associations casts doubt on the possibility of establishing lawful relations between stimulus properties and aesthetic preferences.

Subjective determinants of aesthetic preference

Having considered stimulus-based properties that influence aesthetic preference, we can now turn to subjective properties. Subjective factors tend be broadly attributed to observer-level (personality, expertise, exposure) and context-level (framing, knowledge about the artist and process) variables. The following section will focus on the latter, and take an individual differences approach to these variables at the conclusion of the section to ascertain the extent to which such contextual factors have predictable effects on aesthetic preference across observers.

Effect of context

Context has a large impact on aesthetic preference, particularly for visual works of art. Sammartino and Palmer (2012b) showed that the seemingly robust centre and inward biases for spatial composition could be manipulated by the addition of titles that changed the metaphorical meaning of an image. Complementarily, labelling an artwork with a metaphorically congruent title leads to increased meaning (Cupchik et al., 1994; Leder et al., 2006) and aesthetic appreciation (Leder et al., 2006; Millis, 2001; Russell & Milne, 1997) and providing titles that accentuate particular aspects

of the image (e.g. presence of depicted movement) leads to increased sensory awareness of those attributes (Mastandrea & Umiltà, 2016). The presence of an artistic frame around a stimulus can also have an impact on the quality and intensity of aesthetic judgements. Displaying objects in unexpected contexts (e.g. a post-box on a tennis court) induces an aesthetic stance; observers are more likely to respond at the poles of an aesthetic Likert scale for objects in abnormal contexts, and more neutral aesthetic responses toward objects in semantically congruent contexts (Kirk, 2008). Informing observers that a set of photographs of mouldy food come from an art exhibition in contrast to a health and safety booklet has no impact on reports of disgust but does modulate positive valence toward the photographs (Wagner et al. 2014). Furthermore, perceived beauty and positive affective responses are more tightly linked in artistic contexts (Wagner et al., 2014).

Effect of artist and process

Knowledge about the creative process and the artist herself can also modulate aesthetic responses to artworks. Informing participants that an artwork was made by a professional artist rather than the experimenter leads to increased aesthetic ratings for the same stimuli (Kirk et al., 2009), while labelling an artwork as created by a *famous* artists boosts its aesthetic appraisal further (Mastandrea & Crano, 2019). Contrariwise, attribution of part of the creative process to a computer algorithm leads observers to downgrade their liking of an artwork (Chamberlain et al., 2018) and artworks with an association with criminal activity such as graffiti tags also elicit diminished aesthetic appraisal relative to visually similar artforms such as calligraphy (Chamberlain et al., in press). These effects likely operate through observers' assumptions about the creative process. The effort heuristic (Kruger et al., 2004) posits that perceived effort is used as proxy for quality in the absence of disambiguating information. In a series of studies, Kruger et al. (2004) showed that participants valued artworks and designed objects more if they were informed that they took longer to create. This effect was most pronounced in situations in which the quality of the object was difficult to determine purely on the basis of sensory information (Kruger et al. 2004). However, the effort heuristic itself is malleable. If observers are required to read a piece of text highlighting the role of talent (in contrast to effort) prior to evaluating objects, experimental effects are reversed and participants rate more quickly created artworks as more valuable (Cho & Schwarz, 2008). Finally, the authenticity of an artwork plays a large role in its aesthetic reception. An artwork's history is important because, being a non-functional item in the practical sense, it is prone to biases around contagion, the notion that it is the end point of a performance, and intuitions about its originality and scarcity (Newman & Bloom, 2012). In support, Newman and Bloom (2012) found that informing observers that an object was a duplication of an existing object led to devaluation of the duplicate, but only in the context of artworks (paintings) not artifacts (cars).

Supporting the notion that contagion is also an important factor in the valuation of art, the contact level between creator and object had a much larger impact on perceived value of artworks than artifacts (Newman & Bloom, 2012).

Stability of contextual influences

Whilst categorised as subjective determinants of aesthetic preference, some of the contextual effects described above, such as the effort heuristic or essentialist beliefs associated with duplication, could conceivably account for some of the shared variance in aesthetic attitudes if sufficiently stable within a given cultural setting (Vessel, 2010; Vessel et al., 2018), whilst others are by their nature transient. Effects of authorship on aesthetic preference do not seem to diminish if the responses of expert artists are compared with non-experts (Chamberlain et al. 2018), suggesting that these biases concerning artistic process are not superseded by artistic knowledge. However, individual differences in expertise do determine the magnitude of framing effects where the framing relies on adequate recognition of prestige (Verpooten, 2018; Verpooten & Dewitte, 2017).

Finally, many studies have shown that the personal context of the observer in terms of their demographics and personality affects the kind of artistic stimuli they seek in the first instance. Both expertise and the Big Five personality factor of 'openness to experience' (McCrae, 2007) have been shown to be predictive of preference for abstract and modern art (Batt et al., 2010; Chamorro-Premuzic et al., 2009; Kruger et al., 2004; McManus & Furnham, 2006; van Paasschen et al., 2015). Openness to experience represents a tendency towards intellectual curiosity, aesthetic sensitivity, liberal values, and emotional differentiation (McCrae, 2007) and also predicts preference for the visual arts more generally (Feist & Brady, 2004) and the prevalence of aesthetic 'chills' (Silvia & Nusbaum, 2011). Need for cognitive closure, an aversion toward semantic and sensory ambiguity which can be modulated in a state or trait-like manner, also predicts dislike for abstract art (Ostrofsky & Shobe, 2015) and for ambiguous movie endings (Wiersema et al., 2012). Expertise has a marked influence over how observers inspect and categorise artworks (Augustin & Leder, 2006; Vogt & Magnussen, 2007; Zangemeister et al., 1995) and an observer's willingness to engage with abstract and ambiguous art (Silvia, 2013; van Paasschen et al., 2015). Thus, it can be seen that stable and fluctuating observer-centred and context-centred variables modulate aesthetic preferences in a complex and interacting manner. The next section will attempt to summarise the effects of both objective and subjective predictors of aesthetic preference and introduce an approach that takes into account the action of objective features at the group-level and individual differences at the subject level.

Considering the interplay between objective and subjective approaches

The previous sections have summarised evidence for both objective and subjective between-groups effects on aesthetic preference. Objective features such as symmetry, proportion, contour, colour and composition show reliable associations with aesthetic preference, particularly for simple stimuli that accentuate the target stimulus property. Similarly, contextual information and inferences about effort and authenticity demonstrate reliable effects on perceived value of visual stimuli. However, a consistent caveat to these group-level effects is the existence of substantial and reliable differences which do not merely represent variance due to error but can instead be attributed to person-level variables. The aetiology of these individual differences can be attributed to multiple sources. Behavioural genetic research implies that variation in genes account for a limited proportion (approximately 30%) of the variance in perceived facial attractiveness (Germine et al., 2015), and a similar proportion of the variance in the intensity of aesthetic appraisal of abstract objects and scenes (Bignardi et al., 2020). The remaining variation likely lies within unique environmental factors, due to individual differences in exposure and enculturation. Individual differences in expertise and personality likely play a strong role in modulating the role of objective predictors, an issue that has been addressed with the revival of the concept of aesthetic sensitivity.

Aesthetic sensitivity

A useful way of conceptualising individual differences in empirical aesthetics is through the notion of aesthetic sensitivity. This concept originates in the work of Hans Eysenck, who posited the existence of an individual difference in the ability to detect objective beauty in a stimulus, similar to the notion of a general intelligence factor, *g* (Eysenck, 1940). It will have become clear that establishing an objective notion of beauty as a property of the stimulus was bound to fail. However, recently researchers have revived the label if not the underlying meaning of Eysenck's aesthetic sensitivity (Corradi et al., 2019, 2020). Under its revised conception, aesthetic sensitivity is the extent to which a particular objective feature (symmetry, contour, complexity) influences an observer's aesthetic valuation. Empirical support for the existence of aesthetic sensitivity was derived from a study which re-examined stimuli from a seminal study on curvature preference (Bar & Neta, 2006) and found both group-level preference for curvature as well as large individual differences, across two different stimulus categories (real objects and abstract designs; Corradi et al. 2019). A follow-up study using a larger range of stimuli again found evidence for high variability in preference for curvature, symmetry, complexity and balance in visual stimuli (Corradi et al. 2020). Furthermore, sensitivity across

different stimulus properties was not correlated, although sensitivity was stable over time, echoing existing individual difference research (Bertamini et al., 2019; McManus et al., 2010).

Research exploring the underlying determinants of aesthetic sensitivity is still in its infancy. Individual differences in aesthetic sensitivity for contour and symmetry was found to be weakly predicted by expertise, but not by personality factors such as openness to experience (Corradi et al. 2020). In a similar study, Cotter et al. (2017) found individual differences in preference for curvature could be explained by personality and expertise. It is possible that visual sensitivity, that is the extent to which individuals can visually detect differences in symmetry, contour, balance, may be predictive of aesthetic sensitivity. Research on fractal patterns suggests that observers' preferences for levels of fractality and their visual sensitivity to those particular patterns are tightly linked (Spehar et al., 2015). It would be valuable to investigate whether an observer's ability to detect the curvature of contours, the presence of symmetry and the objective complexity of an image, predicted their aesthetic sensitivity for the same stimulus feature. Whilst the focus of research on aesthetic sensitivity is predominantly focused upon stimulus-based features which influence aesthetic preference, it is reasonable to believe that aesthetic sensitivity could be extended to the realm of subjective factors as well. Some observers may be more or less sensitive to the effect of context, or of factors associated with the artist or artistic process. This is indicated by a study finding that prestige effects (stating that an artwork was located at the Museum of Modern Art in New York rather than a local art gallery) only impact the aesthetic preferences of expert artist observers (Verpooten, 2018; Verpooten & Dewitte, 2017). It is also possible that aesthetic sensitivity functions in a domain-specific manner. Objective and subjective features of natural and man-made objects may influence aesthetic preferences of observers in different ways. It is possible that biologically- relevant stimuli induce sensitivity at the level of stimulus properties, while artworks elicit sensitivity at the level of subjective factors (Vessel & Rubin, 2010; 2018). This domain-specificity may further interact with other individual differences measures (such as expertise) whereby sensitivity to objective and subjective features is determined by the level of artistic knowledge an individual has. The notion of aesthetic sensitivity is a useful tool with which to move beyond group-level principles in empirical aesthetics, and to categorise and predict the individual differences that permeate the data collected in this domain.

Conclusion

This chapter has provided an overview of empirical psychological perspectives to aesthetic preferences. It can be seen that contemporary approaches to the investigation of aesthetic preferences are still heavily influenced by early work in the field (Fechner 1876; Berlyne, 1971) which strove to identify lawful relationships

between objective stimulus properties and aesthetic responses. This approach has to a large extent failed, partly due to the combinatorial influence of objective factors (Makin, 2016) and the myriad subjective influences that often supersede the effects of stimulus properties on aesthetic preference. However, we have seen that there are robust and replicable group-level effects of stimulus features like symmetry and curvature which appear to be culturally invariant (Gomez-Puerto et al. 2018; Makin et al. 2018), suggesting that it is not necessary to abandon all efforts to identify objective determinants of aesthetic preferences. Contextual factors have recently received more attention as researchers pursue more complete models of the aesthetic process. It is clear that information about the artist and the artistic process has a large impact on the strength of aesthetic judgments to artistic stimuli (Chamberlain et al. 2018; Mastandrea & Cruno, 2019; Kirk et al. 2009; Kruger et al. 2004; Newman & Bloom, 2012). Merely framing a sensory experience as being one of viewing an artwork, impacts on the kind of emotional and evaluative response the observer has to the artwork (Wagner et al. 2014; Kirk et al. 2008).

Group-level objective and subjective effects aside, permeating much of this research is the observation that people significantly and reliably differ in their aesthetic responses to stimulus features. The question of why people differ in their aesthetic judgments has been present since the inception of empirical aesthetics, but has gained much more prominence in recent years (Vessel & Rubin, 2010; Vessel & Rubin, 2018; Cotter et al. 2017; McManus et al. 2010). Putative mechanisms for individual differences in aesthetic span both genetic and environmental influences. These sources of variance encapsulate differences in exposure via expertise (both practical and intellectual knowledge of the artistic domain) and culture, and trait-level differences due to cognitive ability and personality. While there is a promising line of research exploring the aetiology of individual differences for stimulus features, there is very little research exploring the effect of individual differences in response to contextual manipulations, which is likely to be a fruitful line of research in the future. Furthermore, findings concerning individual differences can be better understood in relation to the notion of aesthetic sensitivity, which posits that individuals' aesthetic responses are driven to a greater or lesser extent by different features of the stimulus and context. By combining what we know about the relatively stable subjective and objective features of an aesthetic experience alongside the sources of variance surrounding them, it seems possible to develop a more complete understanding of the seemingly unpredictable nature of individual aesthetic preferences.

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