Trends in
Cognitive Sciences

Spotlight

How do we see style?

Aenne A. Brielmann[1,*]

In a recent series of experiments, Boger and Firestone ask: How do we perceive style?'. Their findings suggest that style perception relies on basic perceptual processes involved in differentiating image content from its context. Their research highlights that we need to understand both content and style processing to fully understand perception.

When I point at Figure 1 and ask, 'What do you see?', you will probably tell me, 'Dogs'. You tell me about the content of the images. However, if I ask you about the differences between panels A, B, and C, you will need to tell me about how the images depict dogs. You tell me about their style.

Much like we do when we tell others what we see, research on perception has so far mostly ignored style and instead focussed on content. A recent series of studies by Boger and Firestone [1] has now shed light on the potential mechanisms underlying style perception.

Boger and Firestone base their studies on a simple but powerful hypothesis: style perception is a form of parsing the content of an image from its context. We know a lot about how visual perception deals with various forms of context, such as typefaces, lighting conditions, or the presence of other (dis)similar objects. Therefore, these authors set out to test whether the style of an image would affect human behaviour in the same way as previously investigated forms of context.

Before delving into experimental results, it is important to define what we mean by 'style'. It is an intuitive concept, especially in the context of the arts, and has been studied in that context (see [2] for an overview). More broadly speaking, style refers to those aspects of the appearance or depiction of an object that can vary without changing its identity.

Boger and Firestone base their research on such a broad conceptualisation of style, applicable beyond the arts. In terms of operationalising and manipulating style in their experiments, the authors take a simple approach. They use a style transfer network [3] for most studies, an algorithm that changes the appearance of an input image without changing its main object or its recognisability, and images of utensils from different cutlery sets in other studies.

A first series of studies reimagined experiments that originally studied the impact of fonts on reading speed and accuracy. These so-called 'font tuning' experiments have shown that people read more fluently when text is presented in single rather than mixed typefaces [4]. In Boger and Firestone's experiments, participants saw sets of three to nine images and reported the number of images that showed a given scene type (e.g., mountains). Analogous to font tuning experiments, participants were less accurate and slower in their reports when image styles varied compared with displays with homogenous styles.

The second set of studies tested whether people 'discount' style when looking at images. The hypothesis here is that people tend to see past the style of an object in the same way that they 'see through' the change of the apparent colour of an object when different coloured lights are shone on it. This hypothesis implies that changes in style should be less noticeable to people compared with changes in content given otherwise equal image properties. Indeed, when participants were asked to judge whether two briefly, consecutively shown images were the same or different, they were better at detecting changes in image content compared with style.

The final set of behavioural studies investigated whether style can have an impact on people's memory. The authors asked whether style can bias what we remember having seen. It is well known that content can bias memories; after seeing a series of mostly animal images, you are more likely to think you saw an elephant, even if you did not, compared with falsely remembering having seen a book. Again, the results of the current studies paralleled previous findings; participants were more likely to falsely remember having seen a utensil in the style of previously seen utensils (i.e., one belonging to the same cutlery set). Thus, people appear to not only parse style from content and discount it, but also to extrapolate what objects in a series of the same style should look like.

Finally, Boger and Firestone entertain two additional questions: do deep neural networks (DNNs) trained to identify image content also implicitly learn to encode style information and does this encoding track human style judgments? Their data showed that style-similarity judgements by humans for scenes in different painterly styles closely align with how similar the encodings of these images by a DNN are to each other. These findings add to a growing line of research showing that object recognition DNN encodings contain information that tracks complex human judgements, even those as subjective as aesthetic preferences (e.g., [5]).

Like any set of experiments, Boger and Firestone's are not without their limitations. Perhaps most importantly, these studies do not, and were not designed to, provide a comprehensive understanding of what 'style' is. They leave open questions about the boundaries of the term, such as: are typefaces a form of style? Is a spork a stylised fork (or spoon)

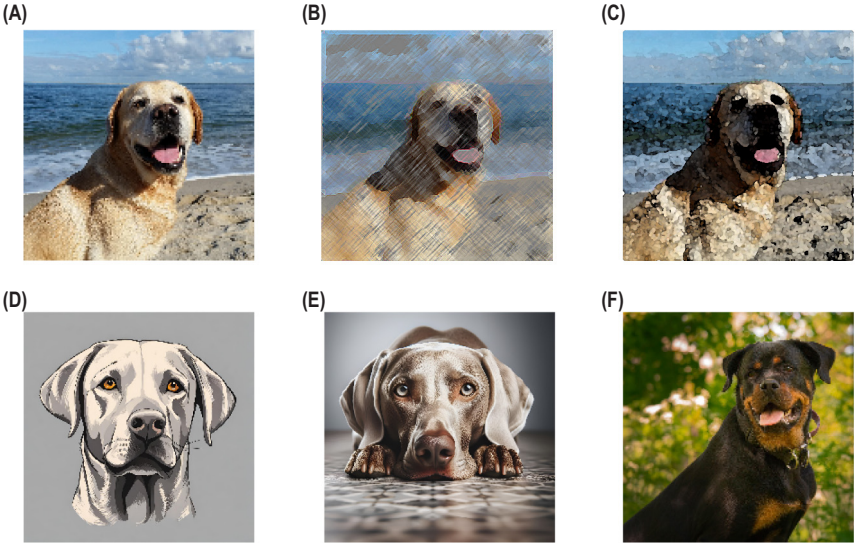

Figure 1. Images illustrating different potential meanings of style. Images of dogs are used as example here. (A) Original photograph obtained searching for 'dog, labrador retriever'. (B,C) Same photograph, stylised using artistic filters in Adobe Illustrator. (D,E) Images resulting from the same search term as (A) but created using different media: (D) human-created digital medium, (E) artificial intelligence (AI)-generated image. (F) Photograph of a different dog breed (rottweiler).

or is it its own object? At which level of abstraction does style end and a new object category begin (see Figure 1D,E)?

Despite this fundamental open question and the usual limitations [1536 stimuli in six styles for the majority of studies, controlled for low-level features in some of these, use of Western, Educated, Industrialised, Rich, and Democratic (WEIRD) populations, etc.], a highly visible and psychophysics-based investigation of style perception is indicative of a recent shift in how human vision is studied. There is an increasing awareness that people perceive their environment based not only on its content and affordances, but also on its aesthetic properties, that is, on how things look and people's affective response to that. The field of empirical (neuro-)aesthetics [6], which studies the latter, is often misunderstood as solely focussing on the arts.

Boger and Firestone's experiments are also convincing proof that we can study (visual) object properties as intangible as style with well-established, psychophysiological methods. In that sense, this work resembles and carries forward the ideas of Gustav Fechner, who wrote the foundational book on not only psychophysics, but also on the empirical study of aesthetics [7].

In sum, these recent findings show that style is more than just an optional add-on for visual objects: it is part of visual processing and has consequences for how we perceive and respond to what we see. They encourage future research to explore further how the way in which content is depicted influences human perception and, in turn, decision-making.

Declaration of interests

None declared by author.

[1]Liverpool Hope University, Liverpool, UK

*Correspondence:
brielma@hope.ac.uk (A.A. Brielmann).

https://doi.org/10.1016/j.tics.2025.09.020

References

1. Boger, T. and Firestone, C. (2025) The psychophysics of style. *Nat. Hum. Behav.* Published online August 5, 2025. https://doi.org/10.1038/s41562-025-02249-8
2. Zhao, Y. *et al.* (2023) Zooming in on style: exploring style perception using details of paintings. *J. Vis.* 23, 2
3. Ghiasi, G. *et al.* (2017) Exploring the structure of a real-time, arbitrary neural artistic stylization network. *arXiv* Published online May 18, 2017. http://dx.doi.org/10.48550/arXiv.1705.06830
4. Walker, P. (2008) Font tuning: a review and new experimental evidence. *Vis. Cogn.* 16, 1022–1058
5. Brielmann, A.A. *et al.* (2024) Modelling individual aesthetic judgements over time. *Philos. Trans. R. Soc. B* 379, 20220414
6. Pearce, M.T. *et al.* (2016) Neuroaesthetics: the cognitive neuroscience of aesthetic experience. *Perspect. Psychol. Sci.* 11, 265–279
7. Fechner, G.T. (1876) *Vorschule der Aesthetik*, Breitkopf & Härtel