Neuroaesthetics and Consumer Culture: Unveiling the Roots of Aesthetic Preferences

Sara Parvaresh Rizi[1], Roshni Lulla[2]
[1]William Lyon Mackenzie Collegiate Institute, Toronto, Ontario, CAN
[2]Brain and Creativity Institute, University of Southern California, Los Angeles, California, USA

Abstract

The brain contains multiple systems that work together to visually process sensory information in our daily lives. Though, when it comes down to emotions linked to said visual sensory information, how would one define what is beautiful? And, delving deeper, how would one apply this knowledge to create more aesthetically pleasing art or convince consumers to potentially buy their products from looks alone? This paper examines the interactions between aesthetic principles, neural mechanisms, and consumer choices. It reveals the influence of evolutionary principles on human aesthetic choices, which are driven by large-scale neural networks. Within the realm of consumer decision-making, aesthetics in product design, wield substantial influence over the perception of products' aesthetics. Moreover, the brain's reward system emerges as a critical determinant of how consumers assess the context of aesthetic items, including their packaging. The paper also underscores the prevalence of aesthetics over functionality in consumer choices. Finally, it highlights the rich potential for future research in the field of neuroaesthetics, with an emphasis on understanding the impact of cultural contexts and emerging technologies on evolving consumer preferences.

Introduction

The application of human creativity that aims to enhance, transcend, or even distort reality in human perception is referred to as art. The creation of art entails a complex interplay of the principles that govern art—something called ‘aesthetics’. Aesthetics is defined as a set of principles associated with the appreciation of beauty, especially in art. Thus, art can evoke a spectrum of different aesthetic experiences, which can occur during the perception or production of art, which evokes intense feelings (often pleasure) depending on the viewer, the context, and the object.

Common constructs of what creates aesthetics in art are the properties of harmony, symmetry, contrast, prototypicality, and unity (Patrick, 2015). Harmony is the degree to which the resources of a composition form a unified pattern. A painting that displays many tones of green would be considered harmonious. If this painting were to include a striking stroke of red, then it would use contrast, which is the juxtaposition of elements of art that make something distinguishable when placed beside another. Additionally, if the artwork was done on a square canvas rather than a trapezoidal one, it would be considered more prototypical, as prototypicality is a measure of how representative an object is of a category. Lastly, the property of symmetry is shown through the balanced and proportionate similarity of elements, which face each other around an axis. For example, a square or circular object would be considered symmetrical, while

a scalene triangle would not be. These principles work together to create an aesthetic art piece, that of which has ultimately become ‘aesthetic’ because of the heuristics that the artist has consciously or subconsciously used to stimulate the visual areas of the brain (Hirstein & Ramachandran, 1999). These methods artists utilize play with the constructs of aesthetics, and are governed by principles that humans all perceive as beautiful.

Since the rise of advertisement from the invention of the TV in the 1950s, consumers, people purchasing goods for personal use, have been central to upholding the capitalist society that has encompassed society since. Something central that every brand needed to market their products with, at this point, was something that would grasp their target audience’s attention more than their competitors would. It may not have been the functionality or price that would catch the public eye, but rather a subtle symphony of aesthetic design that drew people in. Perhaps advertisers would attempt to increase the contrast between the colours, the elegant minimalism of its packaging, or the dynamism of its design to catch your eye.

Consumers are approximately 20% more likely to reach for the objectively higher, than lower aesthetic products (Shi et al., 2021). The field of neuroaesthetics examines the effectiveness of marketing strategies by integrating neuropsychology and art. There are various types of marketing approaches that range in complexity, from high to low design packaging, that aim to influence our purchasing choices. Key features like dynamism, dimensionality, contrast, and minimalism can act on various neurobiological principles and can take advantage of psychological tendencies. For one, the consumer preference for dynamic (i.e. circular) imagery can be attributed to the human brain's innate inclination towards motion. Additionally, the appeal to consumers in single dimensionality (i.e. sketched images occupy the single dimension of ‘line’) lies in the focus it offers, as it facilitates the brain to focus solely on extracting the specific features from that dimension. Preference for small, minimalist packaging design – which plays greatly on a single dimension of colour or shape – is grounded in the perception of quality, as it is perceived to produce less waste. Lastly, the preference for contrast is a result of evolution, as it aided early humans in detecting predators that stood out against their surroundings (van Dongen & Zijlmans, 2017). These preferences showcase the intricate interplay between our brain's neural mechanisms and our aesthetic sensibilities, influencing consumer choices and perceptions in everyday life.

The review will investigate the psychological aspects of marketing that underlie humanity’s appreciation of beauty, and unravel the mysteries of how our minds are enchanted by the aesthetics of our surroundings, especially when it concerns consumers. This review explores the evolutionary and biological bases behind aesthetic preferences in the consumer market within the context of the interdisciplinary field of neuroaesthetics. By deciphering the neural underpinnings of the aesthetic factors that captivate the consumer eye, the connection between the brain’s mechanisms and aesthetic perception will become more apparent, and will showcase how everyday consumer choices are made.

1.1 - The evolutionary basis

The evolutionary basis of the mind plays a significant role in dictating how modern aesthetic choices are made. Evolutionary theorists have three main principles to describe human perception of aesthetics. Firstly, beauty is a factor for health and vigor in mate selection (Chatterjee, 2011). Mates that had lopsided, asymmetrical faces were usually suffering from sickness or ailment, which decreased the healthy offspring they produced. Second, beautiful objects are those that are complex and yet are processed efficiently (Chatterjee, 2011). For instance, nature is extremely complex, yet, the interesting shapes and colours within nature pique the interest of the human mind. Lastly, creating or appreciating art is an important ritualistic function that enhances social cohesion (Chatterjee, 2011). However, modern-day appreciation of human faces does not solely rely on complexity. In facial feature studies, week-old babies look longer at attractive faces if those attractive faces are more symmetrical, regardless of complexity. Additionally, in an fMRI study, in which participants made an aesthetic appraisal of abstract geometrical shape with disrupted symmetry, symmetry was more influential in affecting aesthetic judgment than stimulus complexity (Cinzia & Vittorio, 2009). Assuming that symmetrical faces are conventionally more attractive, then a multifaceted approach that incorporates varying elements of aesthetics, primarily symmetry, is fundamental for evaluating the effects of facial beauty on the human perception.

Evolutionary biases play a major role in the decision-making of modern-day humans. For example, the human preference for glossiness of a product reflects deeply ingrained preferences for water as a critical resource (Patrick, 2015). This would explain why many marketable objects that include text on paper (e.g. magazines, brochures) would be printed on glossier paper. Similarly, whether currency notes are crisp or wrinkled can influence spending decisions (Patrick, 2015). The aesthetic principle of symmetry is also deeply rooted in an evolutionary heuristic, as organisms favoured mates with more symmetrical bodies. Parasitic infestations that decrease fitness/fertility can also stunt the growth and development of affected animals, making them less symmetrical; thus, individuals select against asymmetrical potential mates to maximize reproductive efficiency (Hirstein & Ramachandran, 1999). Furthermore, contrast was appreciated by humans because it is attention-grabbing, and in order to survive, humans had to be able to spot predators that wore contrasting colours to the environment in which they tried to camouflage (Chatterjee, 2011).

As humans have evolved from their earlier forms, neural structures that originally developed to respond to specific visual stimuli have adapted to react more intensely to the fundamental primitives of those forms. The peak shift phenomenon vividly illustrates this concept. For instance, seagull chicks exhibited a stronger response to a red-striped, disembodied stick, which represented a simplified and exaggerated version of a seagull beak, than to their mother's actual beak (Chatterjee, 2011). Abstract artists make use of these simple, exaggerated representations in evoking aesthetic responses, by using more simplified shapes and forms to convey a message to the viewer. They create art to grasp onto these biological biases, deeply rooted within our human nature, to elicit a reaction. Within these biological responses, artists are

able to breach into more specific behaviours that arise from aesthetic experiences, namely, aesthetic chills, which will be discussed in the next section.

1.1a - Aesthetic Chills

Visual perception occurs when neural projections of retinal images are sent to the brain's visual cortex. Frisson, chills, or more specifically, aesthetic chills are one type of aesthetic emotion that appear universal, quantifiable, and related to strong subjective feelings. Aesthetic chills occur from a small oscillation of skeleton muscles producing heat, ordinarily allowing an organism to maintain core temperature at a constant level (Schoeller et al., 2017). Individuals often experience aesthetic chills while listening to music, viewing artworks or designed objects, and engaging with narratives. Chills are also associated with dopamine releases in the reward systems of the brain, such as the ventral striatum and nucleus accumbens (Brattico & Pearce, 2013). The fact that these chill responses are activated by the reward systems suggests that chills are activated alongside the brain's reward system, or as a result of the activation of the reward system. This connection between chills and the reward system paves the way for a deeper exploration of neurobiology in neuroaesthetics, which broadly examines the brain's role in aesthetics.

1.3 - Neurobiological basis of aesthetics

Although researchers often focus on specific parts of the brain, neuroimaging and neurophysiological methods show aesthetic experiences are related to activity of large-scale neural networks rather than in specific regions. The evaluation of art, music, and other cultural objects (e.g. money) that carry potential for aesthetic appraisal relies on the same neural mechanisms that mediate reward derived from food or drink, which would imply a "common currency: for choice (Pearce et al., nd).

Furthermore, art is most appealing if it produces heightened activity in a single dimension (e.g. through grouping) rather than a lot of modules. The grouping of features in viewing a piece of art synchronizes neurons that extract those features. The effectiveness of outline drawings and sketches is an example of single dimensionality being more appealing. This can be observed in musical composition as well, as musical consonance often involves harmonics (Hirstein & Ramachandran, 1999). Isolating a single area (e.g. form or depth) allows viewers to direct their attention more effectively to this singular source of information.

Similarly, savant syndrome is a phenomenon where someone shows extreme aptitude in one domain, such as art or mathematics, despite social or intellectual impairment. (Treffert, 2009). Individuals with savant syndrome utilize this aptitude in a single area and apply it to single dimensionality. They experience a distortion of 'salience landscapes'—the shutting out of many important sensory channels, and therefore, directed attention on a single channel.

1.4 - Disorders and the perception of art

As with savant syndrome causing individuals to create more aesthetic art, it is intriguing to note that the presence of other, similar disorders can bring forth new artistic talents as well. For example, individuals with obsessive-compulsive disorder traits acquired through patients of diseases like front-temporal dementias tend to produce art that is very realistic, visual, and highly detailed (Chatterjee, 2011).

Additionally, those who have experienced damage to their right brain hemisphere experience left spatial neglect, where patients are left unaware of left sides of space (Chatterjee, 2011). Artists that end up leaving out these left spaces tend to create shockingly appealing art –their colours are composed more aesthetically, their strokes are less consistent, and the artwork is made rawer. This could be inferred to stem from the disparity between elements, and how the contrast in their art makes it more appealing to the human eye.

2.1 - Consumer Aesthetics

In the realm of aesthetic preferences, the study of consumer aesthetics examines the interplay between visual, sensory, and emotional elements that influence purchasing decisions and product satisfaction. Gestalt psychologists, those that emphasize that the whole of anything is greater than its parts, follow holistic processing, which asserts that objects are primarily perceived as a whole rather than atomistically. According to these theorists, humans inherently prefer objects with symmetry, unity, and harmony—the same principles that are major principles of aesthetic artwork. However, an additional property that is now stacked onto these principles is proportion. This concept stems from classic Greeks, who originated the concept of the golden section—a proportion that humans naturally prefer. This occurs when a line is divided into two line segments, so that the smaller segment is in the same proportion to the larger as the larger is to the whole (Krishna et al., 2016). As well, it is found that complex designs and those with conflict among elements tend to elicit the most elaborate cognitive processing. This draws on the evolutionary human heuristic for contrast between elements, and how complexity and conflicting elements are more likely to draw in consumers.

A product's aesthetic principles are less subjective than elements of a design because they are easily manipulated and measured, and can therefore be studied more consistently. An example is the principle of harmony, which can be evaluated objectively. Consumers appraise moderate levels of harmony as more pleasant than extreme levels, because the complexity of the design can cause over-stimulation, and therefore decreases their pleasantness toward the product (Kumar & Garg, 2010). Surprisingly, this is a direct contrast to the science behind the appreciation of facial beauty in humans, as complexity is linked to increased attention and increased liking. Thus, exploring the neural underpinnings of aesthetic preferences in consumer behaviour provides valuable insights into the intricate balance of perception and desire in consumers.

In consumer aesthetics, reward is the positive value a person ascribes to an object, so the consumer would desire to own the aesthetic product. Sensory marketing and everyday aesthetics were introduced to gauge consumers' senses and affect their perception, judgment, and

behaviour and to highlight the shift of focus on art objects to common objects. Sensory marketing can be used effectively to create triggers that characterize the consumer's perceptions of abstract notions of products. On the other hand, everyday aesthetics provides marketers insight, opportunity, and power to design goods and services in a way that can improve the quality of life and well-being of consumers and the environment (Patrick, 2015; Krishna et al., 2016). For example, a match between handedness and product orientation increases product interaction because the consumer's mental simulation requires resources similar to those involved in their actual perception of the product (Krishna et al., 2016). Apple's circular apple effectively catches the attention of consumers as the logo creates dynamic imagery, and though there is not much symmetry in the design, there is balance in the design of the bitten apple. A contrast of black and white colours is usually seen in their marketing of the logo, and unity and harmony can be viewed in the smooth lines of their packaging, design, and overall marketing platform. Thus, Apple's logo shows a harmonious brand image, drawing in consumers with dynamic visuals and a balanced aesthetic.

Building upon the dynamic nature of Apple's logo, dynamic imagery—perceived movement—is able to evoke automatic imagery responses like orientation. This is evident in the marketing of logos and pictures in ads; the dynamic imagery allows static images to continue their motion in the viewer's perception, creating a higher engagement for the viewer. This is a positive correlation, as an eye tracker study shows that more dynamic logos lead to participants fixating more on the brand, and higher engagement with the ad in turn led to more favourable attitudes towards it (Krishna et al., 2016).

As the impact of sensory marketing on consumer engagement and attitudes is explored, it is essential to recognize that in the realm of product design, packaging holds a parallel significance as the initial point of interaction between consumers and the product.

2.2 - Packaging and Specifics

In product design and marketing, packaging serves as the first tangible encounter consumers have with a product. It is the outermost layer that conveys brand identity, functionality, and desirability.

So, context in aesthetic judgment plays a crucial role. When given context that a city has higher crime rates, individuals gazed at the faces of men—beautiful or not—for the same amount of time while the faces of attractive women were gazed at longer than their less attractive counterparts. This bias is rooted within the cognitive association with men and cringe triggered, and exemplifies the effect of a negative emotion (i.e. fear) on aesthetic judgments (Leder, 2013).

Another instance of the context-dependent judgments associated with aesthetic appraisals in viewers is comparing a study which compared their reactions to art generated by AI, or those said to have originated from museums. Overall, subjects rated abstract 'art-like' images as more attractive if they were labelled as being from a museum rather than AI-generated. Mean aesthetic ratings for 'gallery' labelled artwork were higher than rating for 'computer' labelled artwork,

and increased activity was found in brain areas generally more associated with aesthetic cognition when seeing 'gallery' images (Kirch et al., 2009). As well, the brains of participants were more responsive when told the 'art status' than to actual content of visual images (Chatterjee & Vartarian, 2014). This shows that the connotation of luxury that comes alongside the gallery-labelled artwork has more of an effect on the participants' rating than the actual painting.

Psychometric and neuroimaging findings show aesthetically pleasing package design can activate the brain's reward circuitry (Patrick, 2015). The brain cortices recruited by aesthetic judgments are biased by the subject's prior expectations about the likely hedonic value of the stimuli according to their source (Kirch et al., 2009). Overall, individuals in a study measuring the effectiveness of aesthetic packaging on product perception were more attracted to the aesthetic packaging than the product itself and experienced significant increases in brain activation than when viewing the product itself (Reimann et al., 2010).

The infusion of art in the packaging can also favourably influence the extent to which products are perceived as more luxurious and as better products overall (Patrick, 2015). 'Art infusion' is the general influence of the presence of art on consumer perception and evaluations of products with which it is associated. This influence does not depend on the content of the artwork, (i.e. what is depicted in the artwork) but rather the general connotations of luxury associated with visual art (Hagtvedt & Patrick, 2008). However, when it comes to other aspects of packaging, results can be varied. When food items are smaller and more visually attractive, transparent food packaging increases consumption, but this has the opposite effect when the food items are larger and less visually appealing (Patrick, 2015). Yet, as a general rule of thumb, smaller package sizes increase perception of quality, especially when the product is costlier (Patrick, 2015).

2.3 - The 'Ideal' Product

Many elements that increase positive aesthetic perception have been explored through various sections of the paper. Though this requires a multifaceted approach, it can be interesting to ponder what the 'ideal' product may be. Objectively, a product would be considered ideal if it had small, minimalist packaging, high atypicality, high harmony and complexity, circular/dynamic designs, art infusion, and symmetry. This could be a lot to consider, but there exists an example of such a product that incorporates most, if not all, the aforementioned factors—namely, the Rolex, a luxury watch brand. These luxury watches often come in small, elegant packaging, designs tend to be unique and distinctive. They hold intricate and complex designs, use dynamic logos and imagery in their circular dials, and both item and package are symmetrical. As well, some papers received within the Rolex box contain artworks relating to the watch itself, which can be estimated to increase appeal upon opening the box. Though the example may not quite be exact, this brand can help visualize what ideal aesthetic appraisal in packaging and item design can look like within our own markets.

2.4 - Functionality vs. Aesthetics

In the ever-evolving world of design, a debate persists between the pursuit of functionality and the allure of aesthetics. While functionality seeks to meet the practical needs of a product, aesthetics aim to captivate and inspire. One theory is that when aesthetic features are perceived to impede product performance, bias in the direction of unattractive products emerges. The use of aesthetics can sometimes backfire, and over styling products can negatively influence perceived functionality (Patrick, 2015).

Another claim is that aesthetics is more effective than functionality, as designs are said to be major differentiating attributes in the choice and performance of consumer goods. A 1995 study seeking the most influential determinants of products that consumers considered found that 60% of respondents preferred the product's design over anything, and only 17% considered price most important (Bloch, 1995). Furthermore, aesthetic designs trigger positive responses in consumers, which draws out their desire to own the product (link to liking vs. wanting), higher willingness to pay for it, and an inclination later on to show off the product.

Overall, however, aesthetics is more effective than functionality, as designs are said to be the major differentiating attributes in the choice and performance of consumer goods. Aesthetic designs trigger positive responses in consumers, which draws out their desire to own the product, higher willingness to pay for it and an inclination later on to show off the product. If this is linked to the liking vs. wanting aspect of consumer aesthetics, the reward—or positive aesthetic value—a consumer ascribes to the object would result in them wanting to own the product. Products that are aesthetic can be cherished even after they are rendered useless, while products that are functional with no aesthetic properties lose their appeal when becoming technically obsolete (Reimann et al., 2010). The prevalence of aesthetics in the biases of consumers when purchasing products can be accredited to a phenomenon called the aesthetic-usability effect, which refers to a consumer's tendency to view attractive products as more usable (Moran, 2017). Therefore, when presented with two products that perform the same function, consumers will naturally gravitate toward the one holding more aesthetic appeal, as they would assume it functions better than the other.

The use of aesthetics to trigger the very linked liking vs. wanting system in the brain's reward system through using the overlapping neural pathways is still useful in today's marketing. Though 'over styling' products can negatively influence perceived functionality, it is essential to consider that this exact 'over styling' does increase complexity but also decreases the harmony of the product. Depending on what the product actually is, could definitely result in misestimation— this would go against objective aesthetic standards in its essence, and therefore the argument falls flat.

Conclusion

Ultimately, the interaction between our brain's neural mechanisms and human aesthetic sensibilities is intricately reflected in consumer preferences, shaping everyday consumer choices and perceptions. Aesthetics is a multifaceted realm that delves into the tapestry of emotions and

sensations that arise from our engagement with objects labelled ‘beautiful’. These aesthetic experiences encompass a broad spectrum, from the perception of beauty to the creative act of producing art and the emotional responses evoked in viewers. The perception of beauty is influenced by a complex interplay of factors; thus, neuroaesthetics—the study exploring how the brain engages with aesthetics—reveals that aesthetic appraisals involve large-scale neural networks rather than specific regions. Our deep-rooted evolutionary heuristics significantly shape the way consumers make decisions in the modern world, as they provide insight into our preference for symmetry, contrast, and other aesthetic principles. Additionally, not only do aesthetic experiences influence our perception of art, but can provide a basis for explaining consumer behaviour and product design as well. The packaging of products, art infusion into products, and logo design can all influence consumer judgments, by evoking increased neural activity in areas associated with aesthetic judgment. Lastly, aesthetics is not just a superficial aspect of consumer behaviour; it often takes precedence over functionality. Aesthetically pleasing designs trigger positive emotional responses in consumers, fuelling their desire to own the product and encourages them to proudly display their acquisitions. This preference for aesthetics over functionality is evidenced by the phenomenon known as the aesthetic-usability effect, where attractive products are perceived as more usable, even when functionality remains constant.

As this exploration comes to a close, it becomes evident that neuroaesthetics holds vast potential for future research and inquiries. To further advance our understanding, future studies might delve into the cultural backgrounds and contexts impacting consumer choices. Exploring how different countries are able to successfully market products, and the similarities and differences within this approach, would be interesting to examine within different environmental and historical contexts. Furthermore, the ever-evolving nature of technology and its influence on aesthetics, from augmented reality to digital art, pose a fascinating avenue for exploration, as they have recently emerged and can hold far different implications from the traditional mediums of art that neuroaesthetics primarily explored. The intersection of neuroscience, psychology, art, and marketing offers a rich field for future research, with the potential to reshape our understanding of how aesthetics permeates every facet of our lives.

Works Cited

Bloch, P. H. (1995). Seeking the ideal form: Product design and consumer response. *Journal of Marketing*, *59*(3), 16. https://doi.org/10.2307/1252116

Brattico, E., & Pearce, M. (2013). The neuroaesthetics of music. *Psychology of Aesthetics, Creativity, and the Arts*, *7*(1), 48–61. https://doi.org/10.1037/a0031624

Chatterjee, A. (2011). Neuroaesthetics: A coming of age story. *Journal of Cognitive Neuroscience*, *23*(1), 53–62. https://doi.org/10.1162/jocn.2010.21457

Chatterjee, A., & Vartanian, O. (2014). Neuroaesthetics. *Trends in Cognitive Sciences*, *18*(7), 370–375. https://doi.org/10.1016/j.tics.2014.03.003

Cinzia, D. D., & Vittorio, G. (2009). Neuroaesthetics: A Review. *Current Opinion in Neurobiology*, *19*(6), 682–687. https://doi.org/10.1016/j.conb.2009.09.001

Hagtvedt, H., & Patrick, V. M. (2008). Art infusion: The influence of visual art on the perception and evaluation of Consumer Products. *Journal of Marketing Research*, *45*(3), 379–389. https://doi.org/10.1509/jmkr.45.3.379

Higgs, K. (2022, February 24). *How the world embraced consumerism*. BBC Future. https://www.bbc.com/future/article/20210120-how-the-world-became-consumerist

Kumar, M., & Garg, N. (2010). Aesthetic principles and cognitive emotion appraisals: How much of the beauty lies in the eye of the beholder? *Journal of Consumer Psychology*, *20*(4), 485–494. https://doi.org/10.1016/j.jcps.2010.06.015

Leder, H. (2013). Next steps in neuroaesthetics: Which processes and processing stages to study? *Psychology of Aesthetics, Creativity, and the Arts*, *7*(1), 27–37. https://doi.org/10.1037/a0031585

Patrick, V. M. (2016). Everyday consumer aesthetics. *Current Opinion in Psychology*, *10*, 60–64. https://doi.org/10.1016/j.copsyc.2015.12.007

Pearce, M. T., Zaidel, D. W., Vartanian, O., Skov, M., Leder, H., Chatterjee, A., & Nadal, M. (2016). Neuroaesthetics. *Perspectives on Psychological Science*, *11*(2), 265–279. https://doi.org/10.1177/1745691615621274

Ramachandran, V. S., & Hirstein, W. (1999). The science of art: A neurological theory of aesthetic experience. *Journal of consciousness Studies, 6*(6-7), 15-51.

Reimann, M., Zaichkowsky, J., Neuhaus, C., Bender, T., & Weber, B. (2010). Aesthetic Package Design: A behavioral, neural, and psychological investigation. *Journal of Consumer Psychology*, *20*(4), 431–441. https://doi.org/10.1016/j.jcps.2010.06.009

Schoeller, F., Perlovsky, L., & Arseniev, D. (2018). Physics of mind: Experimental confirmations of theoretical predictions. *Physics of Life Reviews*, *25*, 45–68. https://doi.org/10.1016/j.plrev.2017.11.021

Treffert, D. A. (2009). The savant syndrome: An extraordinary condition. A synopsis: Past, present, future. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1522), 1351–1357. https://doi.org/10.1098/rstb.2008.0326

van Dongen, N. & Zijlmans, J. (2017). The Science of Art: The Universality of the Law of Contrast. The American Journal of Psychology. 130. 283. 10.5406/amerjpsyc.130.3.0283.