Chapter 4 / Capítulo 4

Check for updates

Sustainable balance between usability and aesthetics in hardware and software design within the organizational context
ISBN: 978-9915-9966-9-1
DOI: 10.62486/978-9915-9966-9-1.Ch04
Pages: 21-27

© 2026 The authors. This is an open access book chapter distributed under the terms of the Creative Commons Attribution (CC BY) 4.0 License.

Aesthetics, visual design and emotional responses

Estética, diseño visual y respuestas emocionales

Yennifer Díaz Romero[1]
Melissa Edith Salazar Echeagaray[1]
Víctor Manuel Martínez García[1]
Gonzalo Javier Llamas Rios[1]
Manuel Iván Tostado Ramírez[1]
Jesús Alejandro Vázquez Meza[1]
Rogelio Estrada Lizárraga[1]

1 Universidad Autónoma de Sinaloa, Vicerrectoría. Mazatlán, México.

ABSTRACT

Context: The aesthetic dimension of interactive design in hardware and software used to be conceived as a decorative element. As human-computer interaction advances, the formal properties of the graphical interface become an epistemological scaffolding that coordinates selective attention, guides the cognition of the corporate operator and alleviates the discomfort that technology may cause. Objective: The epistemology underlying technological aesthetics is analyzed in terms of the Gestalt laws, the three levels of Donald Norman's emotional design (visceral, behavioral and reflective) and the neuropsychological evidence underpinning consumer behavior. Method: A theoretical-descriptive and systematic review of frontier literature in neuroaesthetics, perceptual psychology and neuromarketing was carried out, through the structuring of qualitative matrices of biological responses and perceptual attribution biases. Results: According to the reviewed literature, harmonious visual stimuli reduce cognitive load and activate dopaminergic reward areas, and users tend to rate the system with the better visual appearance as easier to use. On the other hand, the difficulty of balancing the visceral effect with actual usability is identified, so that apparent usability does not conceal logical flaws in the system. Conclusions: Visual aesthetic perception influences the formation of perceived value and purchase intention. It is proposed that incorporating Gestalt laws and spatial balance into the design of interactive environments and equipment mitigates work fatigue and strengthens the competitive advantage of the organization.

Keywords: Consumer behavior; Visual aesthetics; Gestalt laws; Perceived value

RESUMEN

Contexto: La dimensión estética del diseño interactivo en hardware y software solía concebirse como un elemento decorativo. Conforme avanza la interacción humano-computadora, las propiedades formales de la interfaz gráfica se constituyen como un andamiaje epistemológico que coordina la atención selectiva, orienta la cognición del operador corporativo y alivia el malestar que la tecnología puede provocarle. Objetivo: Se analiza la epistemología subyacente a la estética tecnológica en función de las leyes de la Gestalt, los niveles del diseño emocional de Donald Norman y la evidencia neuropsicológica que fundamenta el comportamiento del consumidor. Método: Se realizó una revisión teórico-descriptiva y sistemática de la literatura de frontera en neuroestética, psicología de la percepción y neuromarketing, mediante la estructuración de matrices cualitativas de respuestas biológicas y sesgos de atribución perceptual. Resultados: Según la literatura revisada, los estímulos visuales armoniosos disminuyen la carga cognitiva y activan áreas de recompensa dopaminérgicas. Por otro lado, se identifica la dificultad de equilibrar el efecto visceral con la usabilidad real, de modo que la usabilidad aparente no oculte fallas lógicas del sistema. Conclusiones: La percepción estética visual incide en la formación del valor percibido y de la intención de compra. Se plantea que la incorporación de las leyes gestálticas y del equilibrio espacial en el diseño de entornos y equipos interactivos mitiga la fatiga laboral y refuerza la ventaja competitiva de la organización.

Palabras clave: Comportamiento del consumidor; Estética visual; Leyes de la Gestalt; Valor percibido

4.1. EPISTEMOLOGY OF AESTHETICS IN THE TECHNOLOGICAL ENVIRONMENT

Based on the literature review, an epistemological foundation is needed for studying the impact of visual aesthetics on the design of hardware and software interfaces. Throughout the history of engineering and computer science, aesthetics has been regarded as something merely ornamental, cosmetic or secondary, with its technical function rigidly subordinated to the rationalist maxim: form follows function (Norman, 2004; Sutil, 2023).

However, theories of Human-Computer Interaction (HCI) have shown that the aesthetic dimension of a technological artifact is not a mere accessory but an epistemic mediating factor that regulates intelligibility, appropriation of the tool, and the construction of human knowledge.

From a classical philosophical perspective, aesthetics can be defined as the branch of philosophy that studies the nature of beauty, sensory perception and the judgment of taste. However, if this construct is transferred to another domain, aesthetics can begin to be seen as an operational, pragmatic and instrumental element.

Aesthetics in technology does not refer to a picture to be looked at; rather, it designates the formal qualities of design (color mixing, typeface grid, spatial symmetry, and the combination of graphic elements) that make the computer system easier to use and understand. It is grounded in the phenomenology of perception, as argued by Sutil in 2023.

Users have no direct contact with the abstract backend code or the hardware microprocessor; their contact is instead with the visual and formal representation that the interface projects (IONOS, 2021). Therefore, based on their experience, workers refer to a graphical user interface to attribute meaning to the operational technology.

This component refers to the creation of works of art in relation to something else.

•Visceral Level (Immediate Perception): This is the instantaneous biological and affective reaction to the product's appearance. A harmonious and intuitive visual design generates positive emotional responses that predispose the user favorably toward using it, thereby avoiding technological anxiety and situational stress.

•Behavioral (aesthetic usability). This dimension concerns how aesthetic cues are interpreted as clear guidelines for use. A design that seeks balanced spatial distribution, typographic contrast and a correct hierarchy of navigation elements is highly appealing to the eye and also shows the operator how to perform the task, so that the task is carried out predictably and without the use of text.

• Según Norman y Shi et al, (2021), in the case of hardware or software products, long-term subjective satisfaction has significant effects on perceived value. In this regard, aesthetics blends with corporate identity and is tied to brand reputation, which ensures user trust and loyalty in highly competitive markets.

Aesthetics has scientific importance because we humans process information holistically and in an embodied way. Cutting-edge research in cognitive neuroscience applied to digital design has moved beyond the traditional dichotomy between cognition and emotion, indicating that the two systems interact constantly during decision-making.

According to research by Norman (2004), an attractive work environment can increase the operator's cognitive flexibility. This positive emotional state induces more creative thinking, greater tolerance of minor software glitches, and the resolution of complex system problems.

In today's technology business environment, aesthetics has ceased to be an "embellishment" added after engineering and has become a "high-order design requirement." The mental processing load required of users to decipher an interface is drastically reduced when it is designed according to principles of symmetry, brand consistency and visual simplicity. Users can then devote more attentional resources to the organization's productive tasks. It follows that visual aesthetics is the necessary epistemic core in which form and function are integrated to ensure the viability and competitiveness of technology.

4.2. UNIVERSAL AESTHETIC PRINCIPLES AND APPLIED GESTALT LAWS

If the visual aesthetics of a graphical user interface (GUI) are no longer to be regarded as a purely subjective or artistic exercise in appreciation, contemporary hardware and software design must be grounded in universal aesthetic principles and psychophysical laws of perception. Within this theoretical framework, Gestalt psychology (a German school of thought from the early twentieth century focused on the study of visual perception) provides the ideal scientific foundation for understanding how the human brain organizes, groups and decodes the complex

https://doi.org/10.62486/978-9915-9966-9-1.Ch04

visual stimuli projected onto the screens of technological devices (Interaction Design Foundation [IxDF], 2021; Jvarela, 2025).

The ontological idea of Gestalt, which holds that "the whole is different from the sum of its parts," clearly explains how the overall design of a user interface significantly modifies its perceived usability and aesthetics. By designing logical and physical products according to structural principles that match the brain's cognitive biases and shortcuts, organizations are able to create smoother user experiences and reduce operators' attentional fatigue.

Applying Gestalt laws to the design of human–computer interaction (HCI) makes it possible to provide a scientific rationale for the placement of each GUI element. The laws most relevant to organizational workflows and interfaces are outlined below:

- Law of Proximity. Elements that are spatially closer to one another tend to be perceived as part of the same group or as sharing a common function. In enterprise software design, this law governs the grouping of input fields in data-entry forms and the physical proximity between an action button and its corresponding text label, thereby reducing visual scanning time.
- Law of Similarity. The brain automatically groups objects that share visual characteristics, such as shape, color, size, or typeface. This principle governs color coding in interface design; for example, specifying that all primary command buttons (such as "OK" or "Save") have the same color and identically rounded borders allows users to instantly identify clickable elements.
- Law of Common Region. Perceptual grouping is strengthened when a group of elements is enclosed within a visual boundary, such as a small card or an interface box. In enterprise dashboards that handle large volumes of data, this makes it possible to clearly separate sections assessing the financial dimension from operational variables without filling the screen with dividing lines.
- Law of Continuity When we scan an interface with our eyes, we prefer to follow the simplest, most continuous and fluid visual path rather than jump abruptly between unconnected elements. Structuring navigation flows and aligning data columns according to this law allows fast reading and prevents task interruption.
- Law of Figure and Ground. The cognitive system naturally separates the object of interest (figure) from the rest of the surface (ground). In current digital systems, using subtle shadows to overlay pop-up windows, confirmation errors or drop-down navigation menus on the content, with a blur effect, immediately focuses the mechanic's attention.

As with the Gestalt laws, the design of high-performance hardware and software requires universal aesthetic principles, namely symmetry, the golden ratio, the use of white space, and compositional simplicity. The distribution of visual weight, that is, the portion of the screen an object occupies, has a striking immediate effect. Symmetry and balance on screens thus create a sense of order, stability, and institutional professionalism that enhances the credibility of the technology brand.

In turn, the strategic use of white space (or negative space) is one of the most powerful aesthetic mechanisms for managing cognitive load. Contrary to the functionalist view that regards empty areas of the screen as a "waste of material space," the psychology of interaction shows that free space acts as a visual lung that enables the brain to structure information, identify hierarchies and mitigate data overload during complex tasks (IONOS, 2021; Norman, 2004).

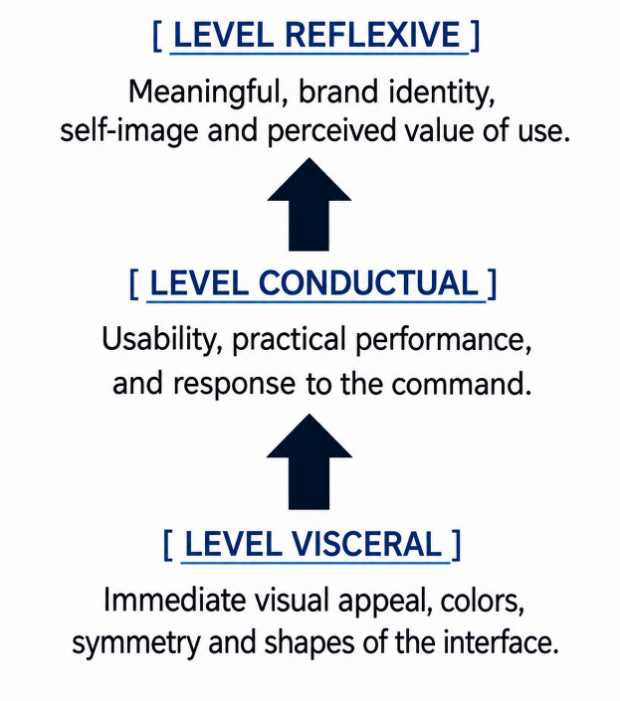
When an interactive product combines the perceptual delight of the Gestalt laws with principles of structural simplicity, aesthetics ceases to be a decorative add-on and establishes itself as an indispensable enabler of performance and usability in corporate technology (Nielsen, 2020; Sutil, 2023).

4.3. EMOTIONAL DESIGN AND DON NORMAN'S THREE LEVELS OF CONNECTION

To understand why visual aesthetics is not merely a superficial attribute but should instead be conceived as a first-order interactive pillar, the scientific literature on Human-Computer Interaction (HCI) draws primarily on Donald Norman's (2004) theory of emotional design.

In his foundational book Emotional Design: Why We Love (or Hate) Everyday Things, Norman upends technological design by showing that the mind operates on interactive objects and systems through three interconnected visceral levels: the visceral, the behavioral, and the reflective. Each of these levels of connection shapes, in its own way, the perception, usability, adoption, and competitive success of hardware and software developments in the corporate environment (Grigoryan, 2024; Moran, 2024).

https://doi.org/10.62486/978-9915-9966-9-1.Ch04



The visceral level is the most basic, biological and immediate level in humans. The system is triggered automatically, within milliseconds, at the first perceptual contact with the product, whether physical or digital. It responds to formal design features such as symmetry, color palette, typography and the harmony of visual proportions (Grigoryan, 2024).

This level is pre-competential and pre-linguistic: the user does not think about the system but reacts instinctively upon experiencing immediate sensations of attraction, liking, rejection or distrust.

In developing software interfaces or designing hardware exteriors, a viscerally deficient design (for example, an interface with saturated colors and visual clutter, or hardware made of plastic that feels flimsy to the touch) can trigger an instant negative response that predisposes the user to reject the system.

Conversely, a visually neat, clean and harmonious environment elicits a positive visceral response that stimulates the release of neurotransmitters associated with pleasure and comfort. This neurochemical activation reduces attentional anxiety, predisposes the user favourably and makes them more tolerant of minor performance failures or logical difficulties during subsequent navigation.

The behavioral level focuses exclusively on operational performance, efficiency, ease of use, and the effectiveness with which the hardware or software executes the required task. Unlike the visceral level, which is purely perceptual, the behavioral level is fundamentally interactive and practical. At this level, the operator's positive emotions stem from the sense of control, immediate feedback, success in completing a business transaction, and the absence of technical frustration during the workflow.

A system that is highly functional and usable but viscerally unpleasant may achieve its objective at the behavioral level, yet it will produce an arid work experience and low voluntary retention of the system. Best practices in technology take both the behavioral and the visceral aspects into account; that is, the metaphors used in visual design are also aesthetic indicators of the operational action. This makes it possible to reduce the cognitive load the user perceives.

The reflective level is the highest on Norman's (2004) scale and is associated with higher-order conscious thought, long-term memory, self-image and cultural values, as well as pride of ownership. At this stage, the user analytically processes the interaction after it has ended, evaluating the meaning that the software or hardware has in their personal or professional life and the cost–benefit ratio of its use.

In the technology business, the reflective level is where customer loyalty and brand recognition are won. Industry leaders such as Apple have mastered this level: their users do not buy their products because they work well (behavioral) or because they look good (visceral), but because they feel that owning and using the device gives them a reflective sense of status,

https://doi.org/10.62486/978-9915-9966-9-1.Ch04

professionalism, belonging, and creative sophistication.

Technology organizations seeking to compete in high-value global markets face a major strategic challenge: achieving a design that satisfies all three levels of emotional design harmoniously and at the same time. A recurring imbalance is the failure to design systems that adequately address the visceral and reflective levels, even when the behavioral level is optimally resolved (Moran, 2024).

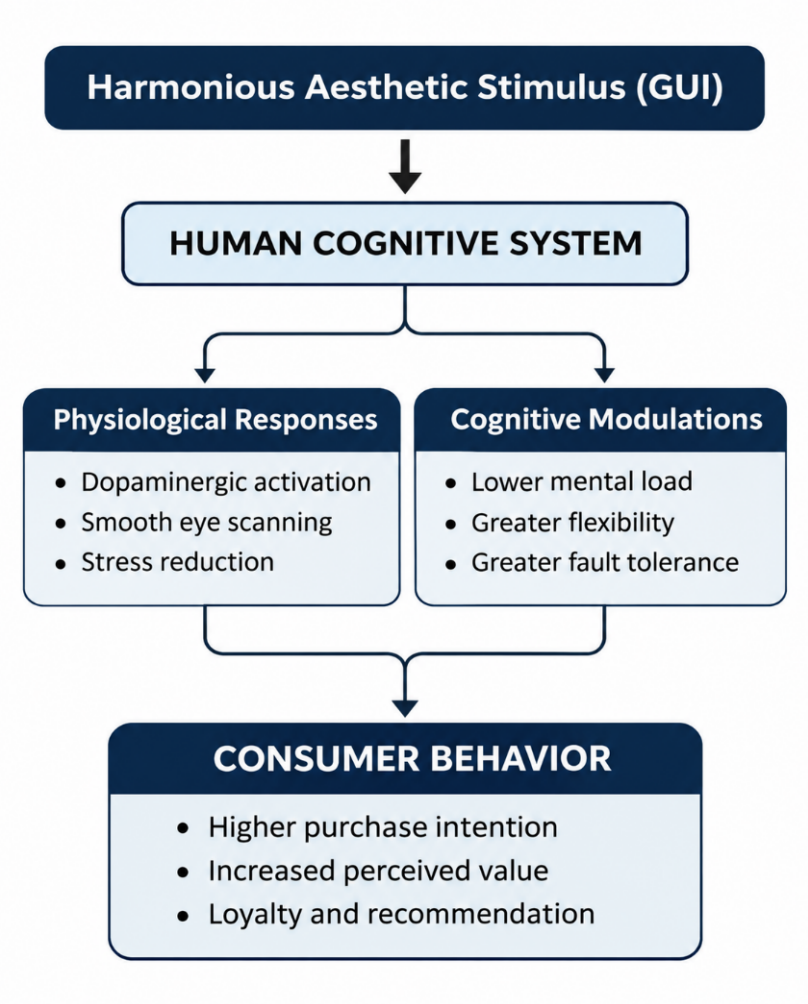
Norman's theory demonstrates that emotions and affect are not decorative elements that hinder the user's capacity to reason, but rather adaptive processing systems that guide the individual's decisions about purchasing, technology adoption and social recommendation.

By incorporating, first, visceral aesthetics and design and, second, a robust behavioral usability system together with a reflective proposition about what is to be communicated, organizations can move beyond the instrumental and functional use of conventional engineering. They can then offer genuine experience ecosystems that safeguard their value proposition in today's market.

4.4. NEUROPSYCHOLOGICAL AND EMPIRICAL EVIDENCE OF VISUAL APPEAL IN CONSUMERS

Consolidating visual aesthetics as a first-order variable in hardware and software design requires going well beyond the now-classic perceptual theories and grounding this effort in the body of empirical evidence provided by neuromarketing, cognitive neuroscience, and neuroaesthetics.

The most recent studies demonstrate, through direct physiological measurements, that the visual appeal of an interface is not a secondary matter of opinion but a powerful biological stimulus that modifies neural reward networks, selective attention processes and consumer decisions about technology products.



https://doi.org/10.62486/978-9915-9966-9-1.Ch04

According to studies using functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), the medial orbitofrontal cortex and the striatum, neuroanatomical structures involved in the brain's reward system and in dopamine release, are activated immediately upon exposure to interfaces and products with high visual appeal (García-Madariaga et al, 2021).

The dopaminergic response produces a state of biological pleasure that not only shapes the affective appraisal of the product but also, as dopamine acts on the amygdala, does not trigger the frustration that certain technical frictions provoked in the user.

Eye-tracking studies have also provided valuable evidence on how aesthetic structure and visual balance coordinate selective attention. Visual stimuli organized according to principles of symmetry, clear hierarchy and a good balance of empty space facilitate more fluid and orderly visual scanning. They prevent uncontrolled eye fixations and optimize the operator's use of cognitive resources when performing a highly critical corporate task.

The first step in a project of this nature concerns the intellectual property of the works generated by this initiative, for which a licensing-based arrangement should prevail.

Consumers often subconsciously transfer the aesthetic value they see in a product to its internal effectiveness. This is a heuristic phenomenon whereby hardware made with premium materials or software with an elegant, modern graphical user interface (GUI) is systematically perceived as more reliable, more powerful and more professional before any active evaluation of its mechanical or algorithmic components takes place.

This shift in positive perception is complemented by the attribution of apparent usability (Kurosu and Kashimura, 1995; Moran, 2024). Controlled experiments have shown that when two systems have similar technical capabilities, users tend to rate the better-looking alternative as "easier to use."

In the current corporate context, aesthetic factors do not compete with usability; rather, they are a "layer of neuropsychological induction that increases user acceptability and consolidates the product's commercial positioning in the global market" (García-Madariaga et al., 2021; Shi et al., 2021).

https://doi.org/10.62486/978-9915-9966-9-1.Ch04