

Learning from an Extended Context of Patterns in Science of Design

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ABSTRACT

In this position paper, we present an interdisciplinary approach to patterns and pattern languages in HCI-design. Our work is grounded on a theoretical framework, tailored for use in early design stages. It incorporates ideas from pattern methodology, Gestalt theory and visual language. As an ideal final result in the field of human-computer interaction (HCI), our work intends to establish intuitive user interfaces. Basically, we try to achieve this goal through a problem-oriented, interdisciplinary knowledge transfer by means of pattern methodology.

Author Keywords

HCI, Gestalt psychology, art, visual language, patterns, knowledge transfer.

ACM Classification Keywords

H5.2. Information interfaces and presentation (e.g., HCI): theory and methods, user-centered design.

INTRODUCTION

In previous work we have introduced ideas, foundations and a conceptual framework of a descriptive pattern language based on Gestalt theory, visual language, and semiotics [5], [6]. Context can be regarded as the large family of meanings and estimations that is the basis for conscious evaluations. Human perception as well as cognition seem to be founded upon the existing (perceptual) knowledge in a particular context. During human-computer interaction (HCI), top-down processing is based upon a prior knowledge of the world. This knowledge-driven perception involves the notion that our preexisting concepts, knowledge, ideas, and anticipations influence the way a stimulus is interpreted. Knowledge presented at higher levels and intellectual abilities determine what is perceived. Since learning is based on the strengthening of

associations, ideas that do not relate to existing knowledge simply cannot be learnt [8]. Therefore, when designing interactive software components, the users' cognitive processes as well as their cognitive limitations must be taken into account. As a result, the nature and causes of the problems users encounter need to be identified and explained. We believe that this could be done best with patterns and pattern languages. In contrast to documenting very specifically (technical) needs or even idioms we prefer a more general approach including also questions of *why*, rather than questions of *how* to convey interdisciplinary knowledge. Within our pattern language framework, we aim to discuss the effects of Gestalt principles and visual language components comprehensively. As examples we establish parallel notions taken from multiple disciplines, predominantly from art. Through this "chunking aside" we aim to convey symbolic qualities. Thereby, we follow a more narrative form, easy to understand by the end user in an interdisciplinary context [15]. Consequently, we try to foster a convergence of science and art.

VISUAL LANGUAGE HISTORY

First attempts of visual language as a matter of design can be found with artists. KLEE [12] and KANDINSKY [10] tried to identify an abstract and universal grammar of visual expression. KLEE'S grammar of elements involves a metaphor between visual and verbal form: the relationship between point, line, and plane is compared to active and passive "voice" in language. Later, two books by KEPES [11] and MOHOLY-NAGY [14] elaborated the theory of visual language and gave it a scientific rationale. Influenced by the Bauhaus and by Gestalt theory [13], [18], KEPES'S work, for example, verified and expanded on the notion of an autonomous faculty of visual communication. His studies also included psychological phenomena, such as figure-to-ground relationship, consequences of similarity, closure, inclusiveness, and submergence.

HORN [9] described visual language as "*the tight integration of words and visual elements and as having characteristics that distinguish it from natural languages as a separate communication tool as well as a distinctive subject of research*". In his analysis of the properties of visual language, he uses well-established categories of linguistics: *morphology*, *syntax*, *semantics*, and *pragmatics*. Morphology involves a set of basic elements, syntax

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establishes rules for combining these elements, semantics is concerned with the meaning of combined elements, and the actual use of elements for specific communicative purposes is defined by pragmatics. Their integration creates visual language. When visual language, Gestalt principles, and pattern mining are interlinked, in our opinion something new, which is able to increase our human knowledge, can be created.

MOTIVATION: THE CHANGE OF VIEWS ON PATTERNS

CHRISTOPHER ALEXANDER is regarded as the founder of patterns and pattern languages [1], [2]. He attempted to combine the *scientific* worldview with an adequate view of *art* and *architecture* [2]. Parts of the software engineering community have enthusiastically embraced his pattern concept, amongst others, due to the book [7]. These patterns of object-oriented software provide design solutions that are concrete enough to put them immediately into practice, limited only by the imagination and skill of the pattern user. However, in the field of human-computer interaction, the community’s understanding of this technology-oriented design pattern concept and its application in HCI has undergone some changes. TIDWELL pulled the work of GAMMA ET AL. and their fellows to pieces arguing “we badly need the benefits of such a pattern language in the field of HCI design” [17]. One reason for this clash might be that in HCI good design rather than good programming is the key to success. According to [16], resistance often comes from technology enthusiasts who rate mathematical or technical formalism as more important than psychological experimentation. As a result, arguments in favor of a user-centered approach are far too often neglected. This seems to be a universal problem that leads to the characteristics of our two brain hemispheres, right and left, characterized by many specialized functions. With our work, we aim to convey knowledge between disciplines, symbolically speaking between the brain hemispheres. In the following enumeration by [4], not yet complete, we give examples. The first feature mentioned of each pair is attributed to the right and the second one to the left brain hemisphere:

- Separation of *emotions* and *rationality*
- *Artistic abilities* and *logical thinking*
- *Holistic* and *detail-oriented* approaches
- Sensitivity to *sets* or *sequences*
- Perception of *whole melodies* or *separate notes*
- Talent for *manual creativity* or *verbal expression*
- *Spatial* and *temporal* perception

PATTERN FRAMEWORK OUTLINE

Starting with the generic or high-level pattern *Gestalt whole-parts*, we discuss the elusive and philosophical challenge of our work. We formulated the pattern in the context of systems thinking. A good *whole*, a metaphor taken from Gestalt theory, is characterized by the quality of

Prägnanz or simplicity. An appropriate translation might be “easy to memorize”. In addition, we describe why and under which limitations Prägnanz can be perceived. Associated with the idea of “the whole” is a principle called *emergence* [3]: The mutual interaction of a system’s parts results in new characteristic features, which cannot be found as original characteristics of any of the individual parts. When a system is dissected, either physically or theoretically, its complexity on a higher system level gets destroyed.

At the next level of abstraction we have established the patterns *Gestalt Prägnanz*, *Gestalt figure & ground*, *Gestalt focal point* and *Gestalt isomorphic correspondence* (Figure 1). Because of their ability to express semantics, we assign the linguistic category *semantics* to these patterns. Moreover, the integration of verbal and visual elements is accomplished at this level. The key question of the pattern *Gestalt Prägnanz*, for example, is how to organize morphemes of a visual language to achieve “good form” or Prägnanz? The forces occurring range from perceptual factors, the capacity of our brain, the quality of visual elements, to usability concerns, and semantic aspects. The underlying Gestalt principles contribute as elementary units to the overall goodness of *perceptual grouping* and accordingly *figure-ground segregation*.

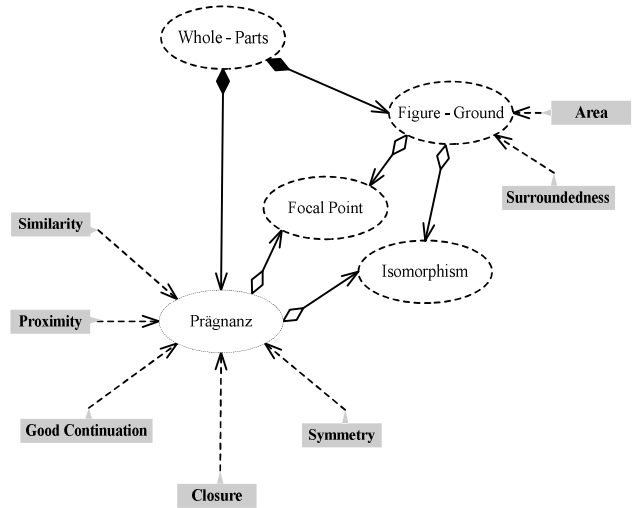


Figure 1. The proposed pattern language web.

Gestalt Principles Involved

The term *principle* is often used for referring to universal principles that describe the fundamental nature of something, for referring to universal properties and relationships between things. Principles express the most basic ideas in science, establishing a framework or methodology for problem-solving. Basically, principles should be simple, almost to the point of self-evident. A design principle, for example, is a rule to follow in design decision-making. The most common Gestalt principles and/or segregation factors state the following rules:

- Similarity – our mind groups similar things together
- Proximity – things that are close together are seen as belonging together
- Good Continuation – our mind continues a pattern even after it stops
- Closure – if something is missing, our mind adds it
- Symmetry – symmetrical images are seen as belonging together regardless of the distance
- Area – when two figures overlap, the smaller one will be regarded as the figure while the larger one will be perceived as the ground
- Surroundedness – the elements of an image seen as surrounded will be perceived as the figure, and the elements creating the surrounding will be perceived as the ground

The most basic Gestalt principles of perceptual grouping (similarity, proximity, good continuation, closure, and symmetry) as well as the segregation factors surroundedness and area state the essential findings of Gestalt psychologists in our pattern language. Through different sections, we discuss the consequences of applying these Gestalt principles. In a certain context, forces guide the reader from the problem area to the solution area. Consequences summarize the pros and cons based on the proposed solution. As we believe, these principles correspond to the category syntax in visual language.

Finally, let us have a closer look at the Gestalt principle *symmetry* or balance, which is one of the basic Gestalt principles: Morphological elements and Gestalt phenomena show signs of symmetry and a lack of symmetry at the same time. While a thing is symmetric in one or more aspects, it is asymmetric in others. On the one hand, there is no perfect symmetry in the sense that all properties are preserved; on the other hand, there neither is perfect asymmetry in the sense that no property is preserved. A very symmetric scene might be boring; a very asymmetric scene would be ugly. Formal symmetries can be found in many things – from molecules and crystals to (architectural) design and artwork.

Thumbnail of a Pattern Proposal

Within this section, we provide an excerpt of the pattern proposal *Gestalt figure & ground*.

Archetype. Every pattern should benefit from an original model, an ideal example of a type – an archetype. Most often, this is a representative picture. We made use of an artist’s work, resembling real-world entities in the context of figure and ground.

Context. Generally, user interface designers are required to stimulate creative and analytic thought. In particular, they have to deal with a clear differentiation between an object (figure) and its background (ground).

Problem. The key question of the pattern *Gestalt figure & ground*, for example, is how the selective attention between figure (foreground) and ground (background) can be supported best? Forces are the cognitive background, multi-stability, properties, semantic activation and others.

Solution (excerpt corresponding to properties). A picture without emphasis is like wallpaper; the eye has no particular place to look at and no reward for having tried. Similarly, pictures which are uniformly light appear drab and lifeless. By determining the quantity, placement and intensities of morphological elements, the designer directs the viewer’s attention by giving them something interesting to look at, but without overwhelming them by providing too many good things.

Different *properties* of morphological elements can either support or rather hinder the user to distinguish between figure and background. Therefore, we can depict the following characteristics:

- Usually, a figure has a shape and is perceived as more prominent than a less well-defined two-dimensional ground. Areas of closed shapes are more likely to be seen as the figure. The ground is usually open and shapeless;
- Objects that appear more convex are most often viewed as figures, while concave objects are viewed as background;
- Symmetrical figures tend to be viewed as figures;
- If an area has parallel contours, it is usually viewed as the figure. Our mind supplies missing information to construct a figure;
- Smaller units tend to be seen as figures against a larger background;
- An adequate contrast between figure and ground is especially important when a small or less dominant visual element, for example text, is placed against a more dominant background or image. A darker unit is more likely to be noticed as a figure in front of a brighter background than a brighter figure in front of a dark background;
- Similar elements (figure) are contrasted with dissimilar elements (ground) to give the impression of a whole;
- A spatially centered unit will rather be perceived as the figure than a peripheral one;
- Vertically or horizontally oriented areas are often viewed as the figure. A unit with a vertical or horizontal axis (centerline) is more likely to be perceived as the figure. The effect of a vertical axis is stronger than that of a horizontal axis;
- In rivalry, also brightness, contrast, and spatial frequency content can serve to strongly influence the balance of dominance and suppression;
- The most salient cognitive feature will be perceived as the figure.

Consequences (excerpt).

- If each part of a visual scene is provided with appropriate features, it will be easy to distinguish prominent areas (figures) from ground (background).
- Even though perception may alternate between two possible interpretations, the parts of the illustration are constant. This idea supports the Gestalt position that the whole is not solely determined by its parts.
- The interpretation of what the figure and what the ground is depends on the individual and is therefore never objective, because people have different memories and experiences that influence their perception of images.

Example. Prominent rhythmic and melodic ideas are heard as *figure on ground*. The performing medium and texture are elements of this ground, helping to establish an environment that influences the meaning of the figure. Changes in this ground often support basic changes in the pattern and structure of a composition – the form of the composition. The textural map of a composition is an aspect of its form. J.S. BACH'S "Two-Part Invention" is an example for polyphonic texture. In contrast to homophony, emphasis is placed upon the interplay between lines rather than on a single melody or a stream of chord sounds. The interplay of contour, motives, continuity features, and rhythms are important factors in polyphonic texture.

DISCUSSION

By combining pattern methodology, psychological findings based on Gestalt theory, and visual language we have established a theoretical framework, intended to convey knowledge between different domains. One of the most basic ideas was to bring people with different focuses closer together. By providing examples from artwork and literature, which are considered as aesthetical ideals, we try to give answers to questions of *why* and put them in the context of Gestalt psychology and design rationale. Within this architecture of words, symbols, and perception, the mutual relationships will emphasize the role of intuition and creativity in science of design. The current state of this work is an experimental one. Compared to the process of innovation, we are in the early stages of generating and accepting ideas. The workshop participants are invited to judge if and under which conditions some of these ideas can be accepted.

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