

Our Vision is Optimized to See Structure

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Early in the twentieth century, a group of German psychologists sought to explain how human visual perception works. They observed and cataloged many important visual phenomena. One of their basic findings was that human vision is holistic—our visual system automatically imposes structure on visual input and is wired to perceive whole shapes, figures, and objects rather than disconnected edges, lines, and areas. The German word for “shape” or “figure” is *Gestalt*, so these theories became known as the *Gestalt principles of visual perception*.

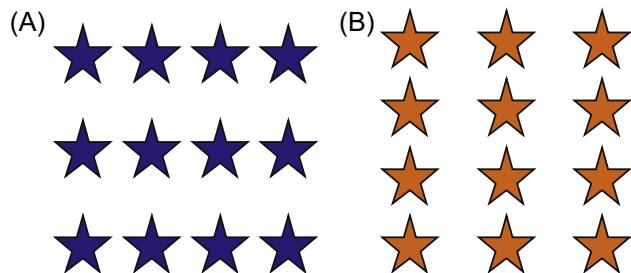
Today’s perceptual and cognitive psychologists regard the Gestalt theory of perception more as a *descriptive* framework than as an *explanatory* and *predictive* theory. Current theories of visual perception are based heavily on the neurophysiology of the eyes, optic nerve, and brain (see Chapters 4–7).

Not surprisingly, the findings of neurophysiological researchers support the observations of the Gestalt psychologists. We really are—along with other animals—“wired” to perceive our surroundings in terms of whole objects (Stafford and Webb, 2005; Ware, 2008). Consequently, the Gestalt principles are still valid—if not as a fundamental explanation of visual perception, at least as a framework for describing it. They also provide a useful basis for guidelines for graphic design and user-interface design (Soegaard, 2007).

For this book, the most important Gestalt principles are Proximity, Similarity, Continuity, Closure, Symmetry, Figure/Ground, and Common Fate. The following sections describe each principle and provide examples from both static graphic design and user-interface design.

GESTALT PRINCIPLE: PROXIMITY

The Gestalt principle of *Proximity* is that the relative distance between objects in a display affects our perception of whether and how the objects are organized into

**FIGURE 2.1**

Proximity: items that are closer appear grouped as rows (A) and columns (B).

**FIGURE 2.2**

Proximity: even dissimilar objects that are close together appear grouped.

groups and subgroups. Objects near each other (relative to others) appear grouped, while those farther apart do not.

In Fig. 2.1A, the stars are closer together horizontally than they are vertically, so we see three rows of stars, while the stars in Fig. 2.1B are closer together vertically than they are horizontally, so we see three columns.

Although the stars in Fig. 2.1 are similar looking, objects need not look similar for them to appear grouped when placed near each other. For example, in Fig. 2.2, the groups are defined by how close together the objects are, not by how they look.

The Proximity principle is useful when laying out control panels or data forms in software, websites, and electronic appliances. Designers who don't know about Proximity sometimes use group boxes and horizontal or vertical lines to separate groups of controls and data displays. For example, Outlook's Distribution List Membership dialogue box groups the **Add ...**, **Remove**, and **Properties ...** buttons together using Proximity but then associates that group with the listbox using an unnecessary

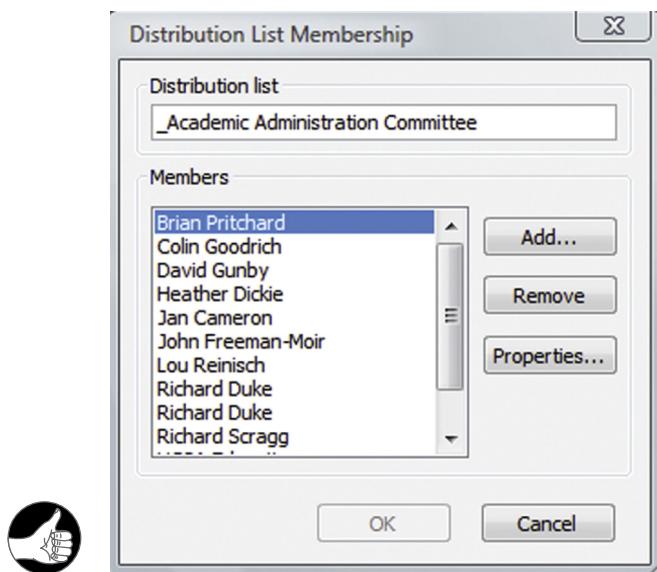


FIGURE 2.3

In Outlook's Distribution List Membership dialogue box, group boxes are used unnecessarily. Simple proximity—spacing—would be enough.

group-box widget (see Fig. 2.3). Even less necessary is the group-box labeled “Distribution list,” since it contains only a single combo-box. “Group box around one item” is a common UI design bloopers (Johnson, 2007).

Using Proximity, items on a display can be visually grouped simply by spacing them closer to each other than to other controls without using group-boxes or visible borders. Furthermore, Proximity can be applied hierarchically to define groups of subgroups. For example, in Firefox's keyboard text preferences dialogue box, the three checkboxes to control spell-checking, autocapitalization, and automatic addition of periods are grouped (see Fig. 2.4), and those are grouped with other controls as well as a table control. Graphic design experts recommend using Proximity to avoid visual clutter (Mullet and Sano, 1994), cut wasted ink or pixels that add no data to the presentation (Tufte, 2001), and reduce the amount of code needed to implement it.

Proximity also governs perception of the labels on controls. Too much space between a label and the item it labels, and people won't connect the label with the item. Conversely, if a label is too close to a different item, people may connect it with *that* item instead of the intended one. For example, poor spacing of radio button labels in a form at Delta.com (2015) could easily cause people to choose the wrong button (see Fig. 2.5A), whereas the spacing of radio button labels at United.com (2020) shows clearly which label goes with which button (see Fig. 2.5B).

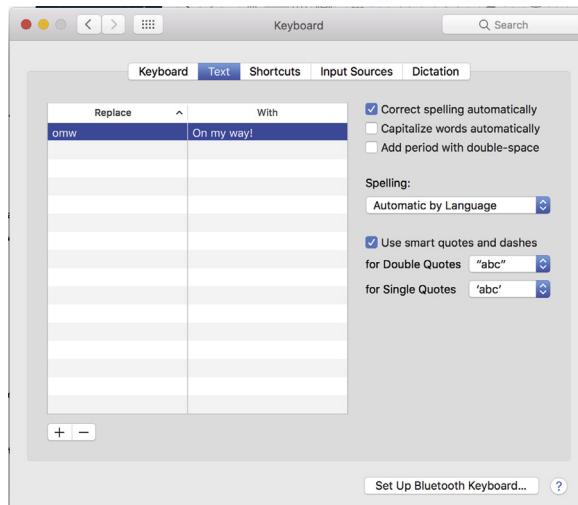


FIGURE 2.4

In Firefox’s keyboard text preferences dialogue box, controls are grouped using the Proximity principle without group boxes and borders.

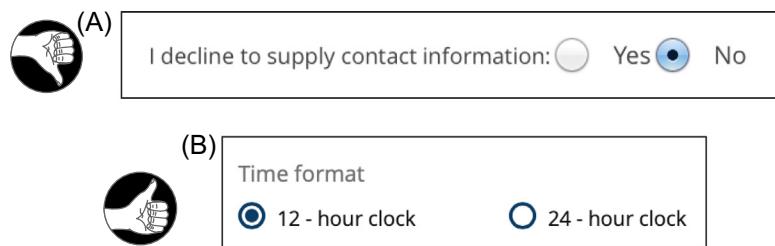


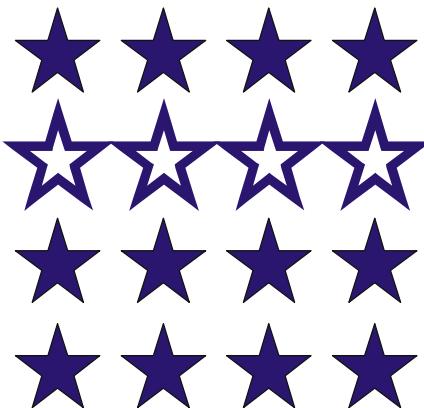
FIGURE 2.5

Radio button labels: (A) Poor placement; (B) Good placement.

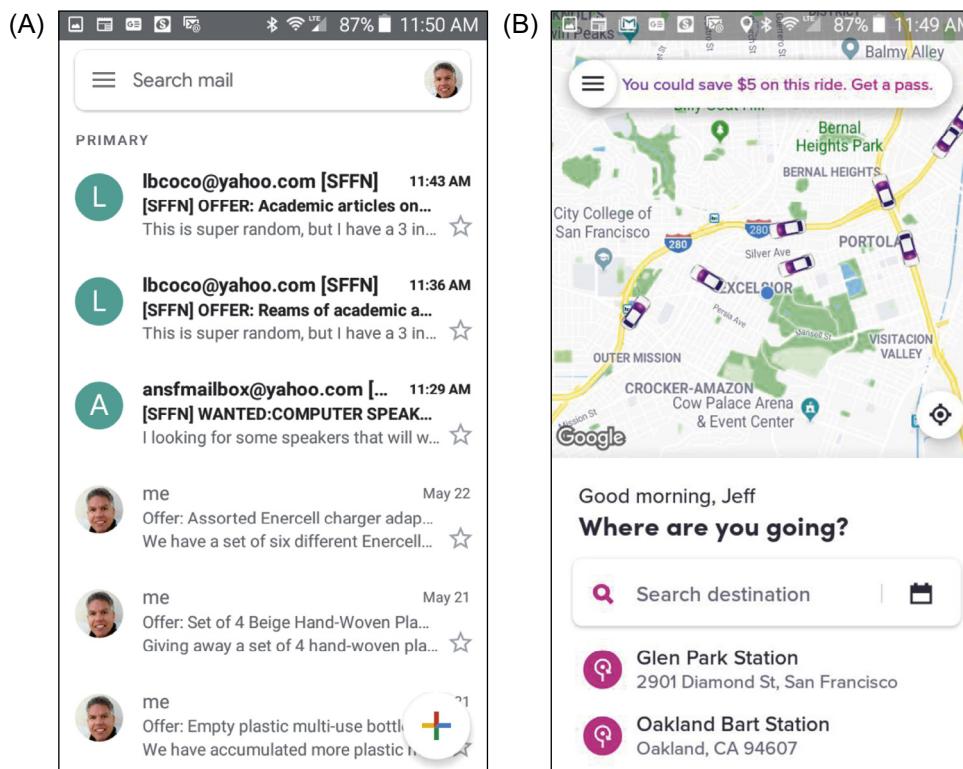
GESTALT PRINCIPLE: SIMILARITY

Another factor that affects our perception of grouping is expressed in the Gestalt principle of *Similarity*, which states that similar-looking objects appear grouped, all other things being equal. In Fig. 2.6, the slightly larger, “hollow” stars are perceived as a group.

Gmail uses similarity—**bold** versus nonbold text—to help users perceive unread emails as a distinct group from already-read ones (see Fig. 2.7A). Lyft’s smartphone app uses similarity—car shapes—to let users see at a glance how many of its drivers are available in a potential rider’s vicinity (see Fig. 2.7B).

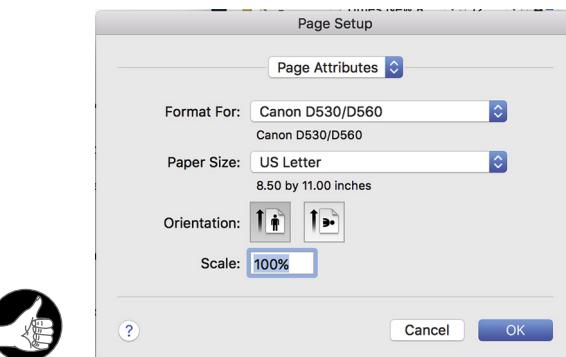
**FIGURE 2.6**

Similarity: items appear grouped if they look more similar to each other than to other objects.

**FIGURE 2.7**

Similarity is used: (A) by Gmail to make unread emails stand out from already-read ones and (B) by Lyft to provide a quick overview of available rides.

The Page Setup dialogue box in Mac OS applications uses both Similarity and Proximity to convey groupings (see Fig. 2.8). The two very similar and tightly spaced Orientation settings are intended to appear grouped. The two menus are not so tightly spaced but look similar enough that they appear grouped even though that probably wasn't intended. The Cancel and OK buttons are positioned together, away from everything else. Even without the separator line, they would appear to be a group.

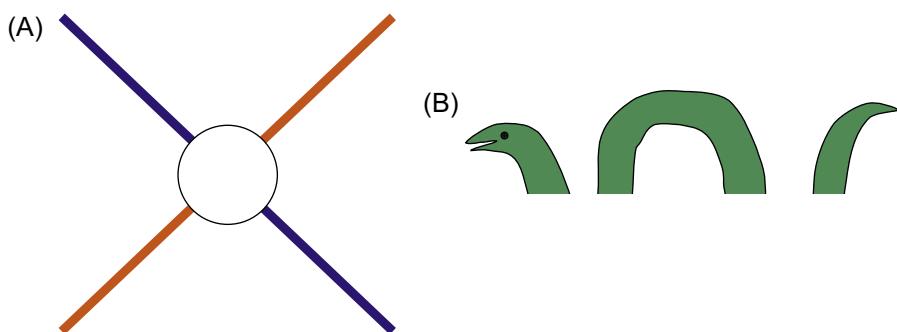
**FIGURE 2.8**

Mac OS Page Setup dialogue box. Similarity and Proximity are used to group settings and controls.

GESTALT PRINCIPLE: CONTINUITY

Several Gestalt principles describe our visual system's tendency to resolve ambiguity or fill in missing data so we perceive whole objects. The first such principle, the principle of *Continuity*, states that when visual elements are aligned with each other, our visual perception is biased to perceive them as continuous forms rather than disconnected segments.

For example, in Fig. 2.9A, we automatically see two crossing lines—one blue and one orange. We don't see two separate orange segments and two separate blue ones,

**FIGURE 2.9**

Continuity: Human vision is biased to see continuous forms, even adding missing data if necessary.

and we don't see a blue-and-orange V on top of an upside-down orange-and-blue V. In Fig. 2.9B, due to the vertical alignment of the pieces and the fact that they are spaced to match the curvature of the visible pieces, we see a sea monster in water, not three pieces of one. If we misaligned the pieces or spaced the pieces further than the curvature suggests, the illusion of continuity would disappear.

A well-known example of the use of the continuity principle in graphic design is the IBM logo. It consists of disconnected blue patches, and yet it is not at all ambiguous. The blue rectangles are stacked vertically with horizontal space between the stacks, so we see three bold letters, perhaps viewed through something like venetian blinds (see Fig. 2.10).

Slider controls are a user-interface example of the Continuity principle. We see a slider as depicting a single range controlled by a handle that appears somewhere on the slider, not as two separate ranges separated by the handle (see Fig. 2.11A). Even displaying different colors on each side of a slider's handle doesn't completely "break" our perception of a slider as one continuous object, although ComponentOne's choice of strongly contrasting colors (gray vs. red) certainly strains that perception a bit (see Fig. 2.11B).

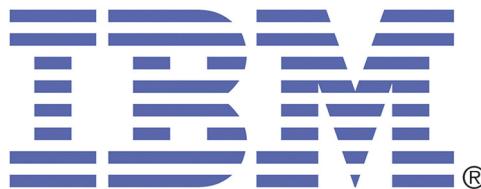


FIGURE 2.10

The IBM company logo uses the Continuity principle to form letters from disconnected patches.

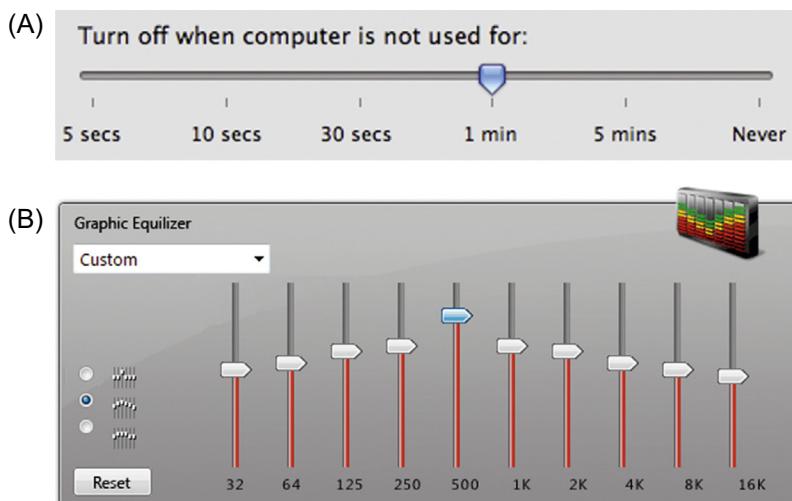


FIGURE 2.11

Continuity: we see a slider as a single slot with a handle somewhere on it, not as two slots separated by a handle: (A) Mac OS and (B) ComponentOne.

GESTALT PRINCIPLE: CLOSURE

Related to Continuity is the Gestalt principle of *Closure*: our visual system automatically tries to close open figures so they are perceived as whole objects rather than separate pieces. Thus, we perceive the disconnected arcs in Fig. 2.12A as a circle.

Our visual system is so strongly biased to see objects that it can even interpret a totally blank area as an object. We see the combination of shapes in Fig. 2.12B as a white triangle overlapping another triangle and three black circles, even though the figure really only contains three V shapes and three black Pac-Men.

The Closure principle is often applied in graphical user interfaces (GUIs). For example, GUIs often represent collections of objects (e.g., documents or messages) as *stacks* (see Fig. 2.13). Just showing one whole object and the edges of others “behind” it is enough to make users perceive a stack of objects, all whole.

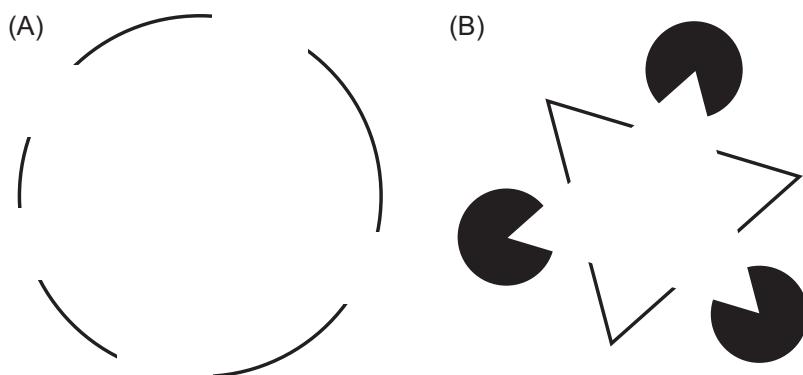


FIGURE 2.12

Closure: Human vision is biased to see whole objects, even when they are incomplete.

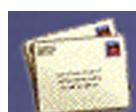


FIGURE 2.13

Desktop icons depicting stacks of objects exhibit the Closure principle: partially visible objects are perceived as whole.

GESTALT PRINCIPLE: SYMMETRY

A third fact about our tendency to see objects is captured in the Gestalt principle that in German is named “prägnanz,” which literally means “good Figure” but is often translated to Simplicity or *Symmetry*. It states that we tend to parse complex scenes in a way that reduces the complexity. The data in our visual field usually has more than one possible interpretation, but our vision automatically organizes and interprets the data to simplify it and give it symmetry, making it easier to comprehend.

For example, we see the complex shape on the far left of Fig. 2.14 as two overlapping diamonds, not as two touching corner bricks or a pinch-waist octahedron with a square in its center. A pair of overlapping diamonds is simpler than the other two interpretations shown on the right—it has fewer sides and more symmetry than the other two interpretations.

The Symmetry principle also predicts that we will see Fig. 2.15 as five overlapping rings and not as a jumble of interconnected arcs.

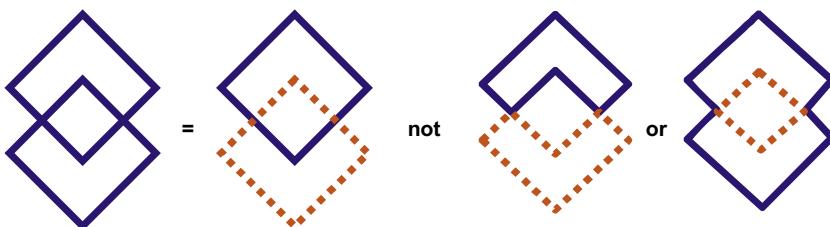


FIGURE 2.14

Symmetry: the human visual system tries to resolve complex scenes into combinations of simple, symmetrical shapes.

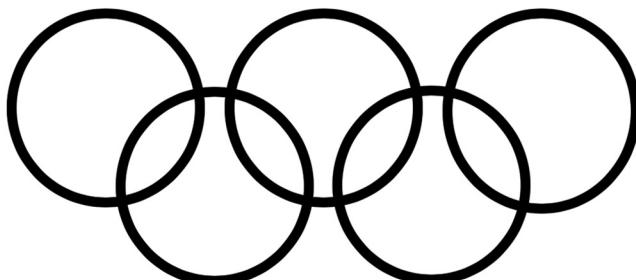


FIGURE 2.15

Symmetry predicts that people will perceive this figure as five overlapping rings.

Our visual system's reliance on symmetry can be exploited to make complex information easier to scan and understand. For example, presenting information in a table—a symmetric way to present data—makes it easier to extract the desired information (see [Table 2.1](#)).

Table 2.1 Tables Use Symmetry to Make Data Easier to Scan Than a Prose Presentation Would.

Student	Quiz 1	Quiz 2	Quiz 3	Quiz 4
Fred (B)	95	92	98	90
Susan H.	99	98	97	95
Sergei L.	83	91	92	88
Hannah N.	75	87	92	83

GESTALT PRINCIPLE: FIGURE/GROUND

The next Gestalt principle that describes how our visual system structures the data it receives is *Figure/Ground*. This principle states that our mind separates the visual field into the figure (the foreground) and ground (the background). The foreground consists of the elements of a scene that are the object of our primary attention, and the background is everything else.

The Figure/Ground principle also specifies that the visual system's parsing of scenes into figure and ground is influenced by characteristics of the scene. For example, when a small object or color patch overlaps a larger one, we tend to perceive the smaller object as the figure and the larger object as the ground (see [Fig. 2.16](#)).

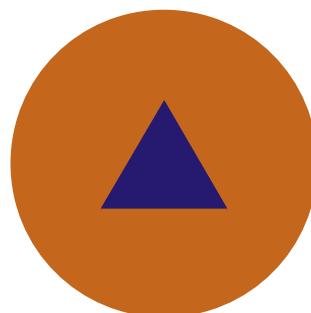


FIGURE 2.16

Figure/Ground: when objects overlap, we see the smaller as the figure and the larger as the ground.

However, our perception of figure versus ground is not completely determined by scene characteristics. It also depends on the viewer's focus of attention, as illustrated by Fig. 2.17. Is it a vase or two faces?

In user-interface and Web design, the Figure/Ground principle is often used to place an impression-inducing background "behind" the primary displayed content. The background can convey information, such as where the user is in the system as in the Android desktop in Fig. 2.18, or it can suggest a theme, brand, or mood for interpretation of the content.

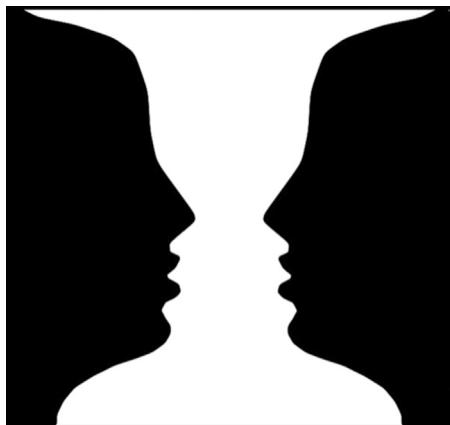


FIGURE 2.17

Vase or faces? Perception of figure versus ground depends on a viewer's focus of attention.



FIGURE 2.18

Figure/Ground is used in mobile phones, tablets, and computers to display a device's "home" or "desktop" screen.

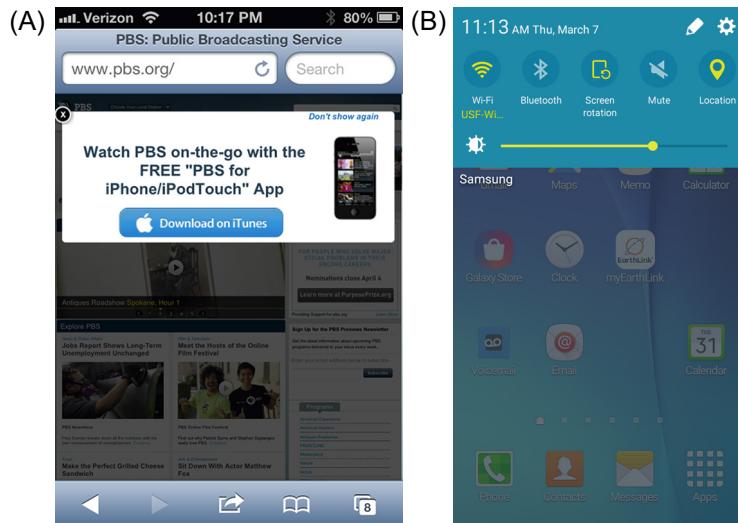


FIGURE 2.19

Figure/Ground can be used to display temporary information “over” the page content: (A) call-to-action at PBS.org’s mobile website and (B) Android settings pulldown.

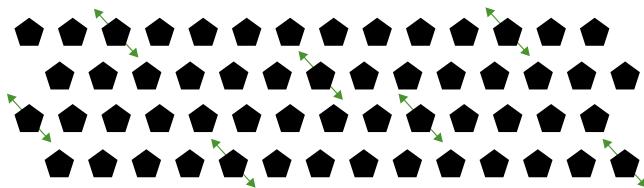
Figure/Ground is also often used to pop up information over other content. Content that was formerly the figure—the focus of the user’s attention—temporarily becomes the *background* for new information, which appears briefly as the new *figure* (see Fig. 2.19). This approach is usually better than temporarily *replacing* the old information with the new information, because it provides context that helps keep people oriented regarding their place in the interaction.

GESTALT PRINCIPLE: COMMON FATE

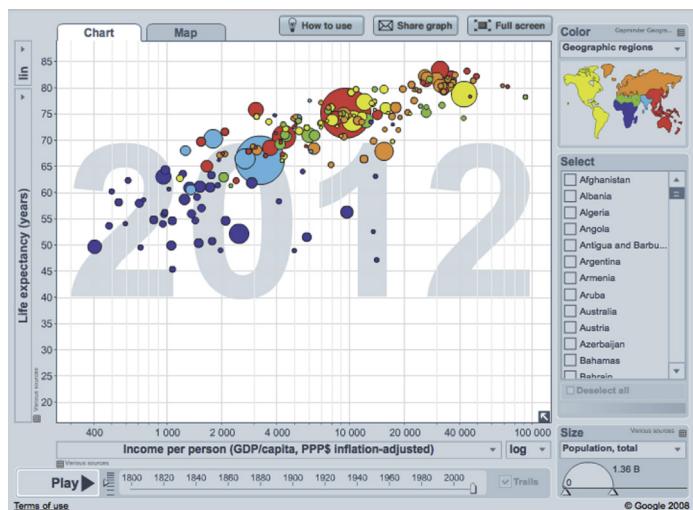
The previous six Gestalt principles concerned perception of static (unmoving) figures and objects. One final Gestalt principle—Common Fate—concerns moving objects. The Common Fate principle is related to the Proximity and Similarity principles—like them, it affects whether we perceive objects as grouped. The Common Fate principle states that objects that move together are perceived as grouped or related.

For example, in a display showing dozens of pentagons, if seven of them wiggled in synchrony, people would see them as a related group, even if the wiggling pentagons were separated from each other and looked no different from all the other pentagons (see Fig. 2.20).

Common motion—implying common fate—is used in some animations to show relationships between entities. For example, Google’s Gapminder graphs animate dots representing nations to show changes in various factors of economic development over time. Countries that move together share development histories (see Fig. 2.21).

**FIGURE 2.20**

Common Fate: items appear grouped or related if they move together.

**FIGURE 2.21**

Common fate: Gapminder animates dots to show which nations have similar development histories (for details, animations, and videos, visit Gapminder.org).

GESTALT PRINCIPLES: COMBINED

Of course, in real-world visual scenes, the Gestalt principles work in concert, not isolation. For example, a typical Mac OS desktop usually exemplifies six of the seven principles described here, excluding Common Fate: Proximity, Similarity, Continuity, Closure, Symmetry, and Figure/Ground (see Fig. 2.22). On a typical desktop, Common Fate is used (along with Similarity) when a user selects several files or folders and drags them as a group to a new location (see Fig. 2.23).

With all these Gestalt principles operating at once, a design may imply *unintended* visual relationships. A recommended practice after designing a display is to view it with each of the Gestalt principles in mind—Proximity, Similarity, Continuity, Closure, Symmetry, Figure/Ground, and Common Fate—to see if the design suggests any relationships between elements that you do *not* intend.

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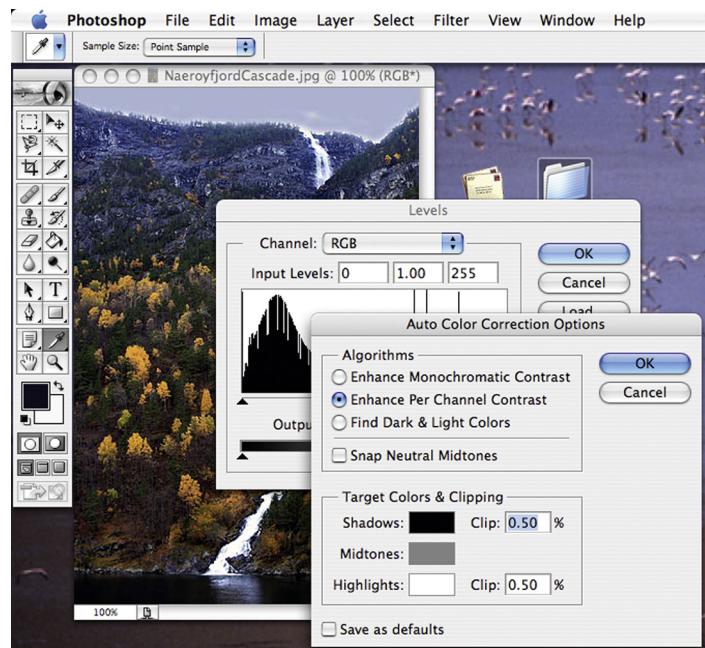


FIGURE 2.22

All of the Gestalt principles except Common Fate play a role in the Mac OS desktop.

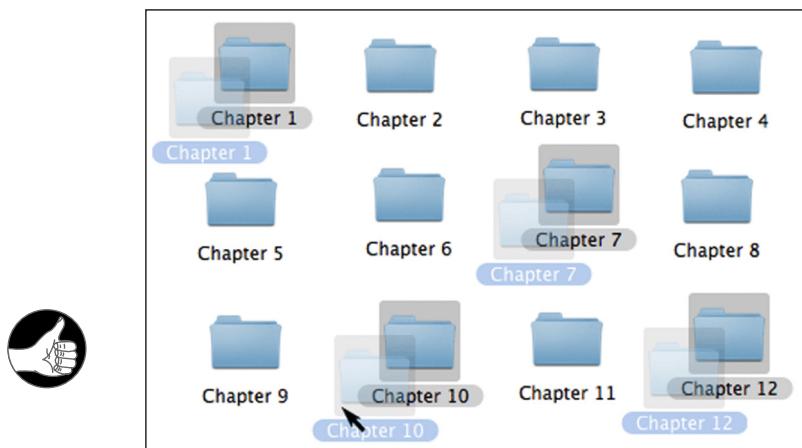


FIGURE 2.23

Similarity and Common Fate: when users drag folders that they have selected, common highlighting and motion make the selected folders appear grouped.

IMPORTANT TAKEAWAYS

For easy reference, here are the Gestalt principles of visual perception covered in this chapter, which are those most relevant to user-interface design:

- **Proximity:** Objects near each other (relative to other objects) appear grouped, while those farther apart do not.
- **Similarity:** Objects that look similar appear grouped.
- **Continuity:** Our visual perception is biased to perceive continuous forms rather than disconnected segments.
- **Closure:** Our visual system automatically tries to close figures that are open so they are perceived as whole objects rather than separate pieces.
- **Symmetry:** Our visual system parses complex scenes in a way that reduces their complexity by recognizing symmetries in the scene.
- **Figure/Ground:** Our mind separates the visual field into the figure (the foreground) and ground (the background).
- **Common Fate:** Objects that move together are perceived as grouped or related.