Visual Design

SWE 632
Fall 2015

Administrivia

- HW 4 due 11/5

- Midterms returned in-class 11/5

Visual Design

Visual design

- *Solving **communications problems** in ways that are both functionally effective and aesthetically pleasing.*

- Creating a visual language containing a vocabulary of design elements characterized by

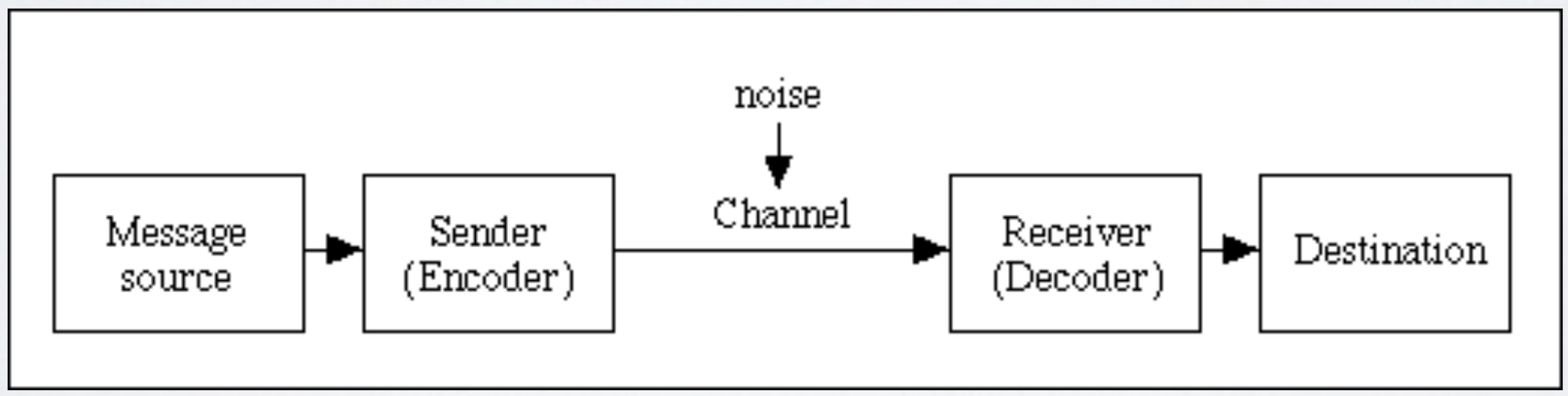
- Visual characteristics—shape, size, position, orientation, color, texture, …

- Organizational relations—balance, structure, proportion, …

- Visual syntax—rules for assembling elements w/in design language

Visual design as communication

- Goal: **efficiently** & accurately transmit information from system to user
- Visual characteristics & organization encode information



Goals for visual design

- Successfully **transmit** information
- Reduce visual **search** time through layout & organization
- Create desired **emotional** reactions through aesthetic choices
- Present coherent & consistent design that reduces ambiguity and potential confusion

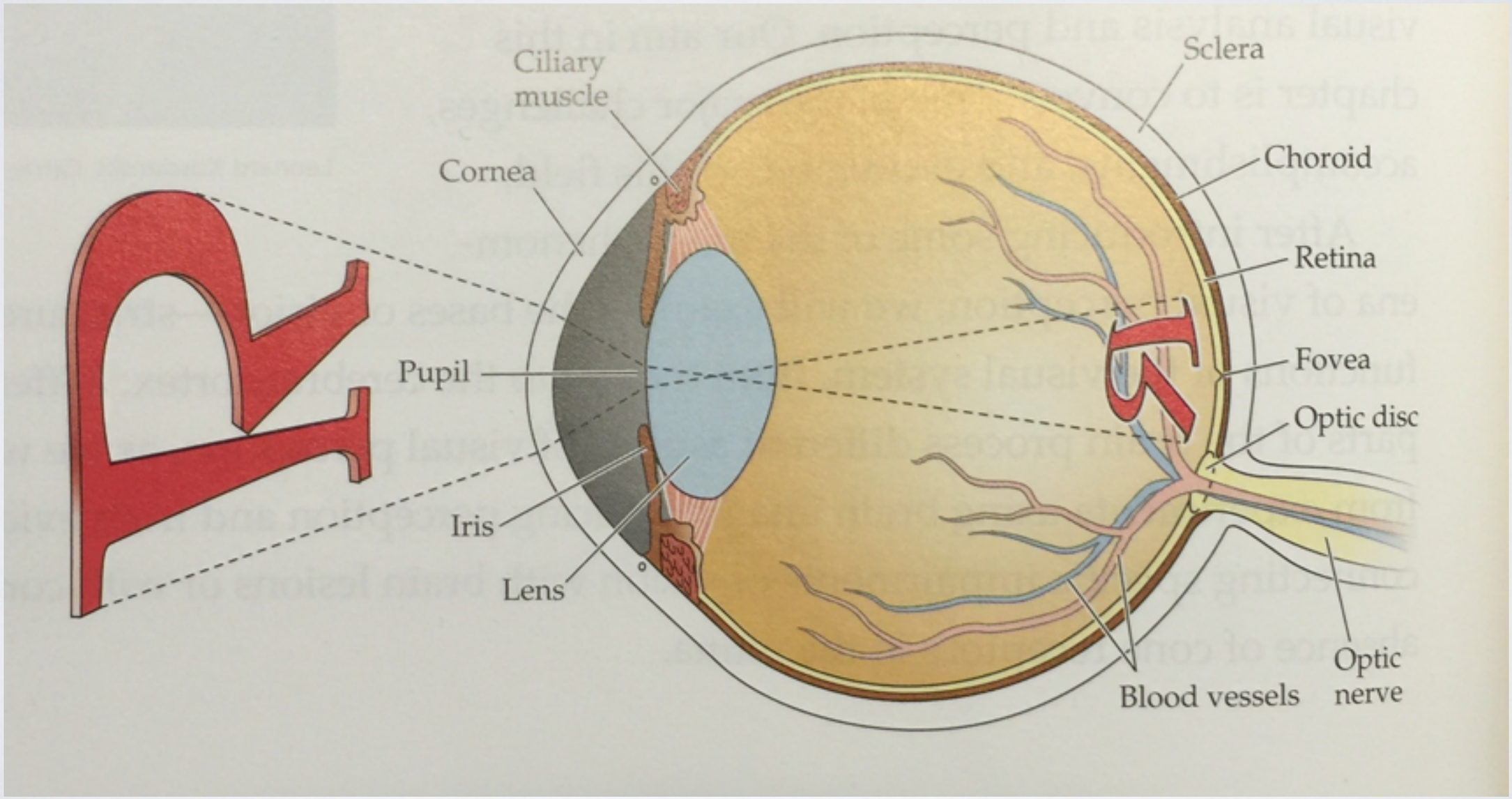
Aesthetic-Usability effect

- Humans perceive more aesthetic designs as **easier** to use [1]
- Aesthetics
  - influence first impressions and initial adoption
  - foster positive attitudes, which increases tolerance of problems & increases creativity in users

- [1] Masaaki Kurosu and Kaori Kashimura. (1995). Apparent usability vs. inherent usability: experimental analysis on the determinants of the apparent usability. *Conference on Human Factors in Computing Systems (CHI)*, 292-293.

Human vision

Human eye


Ciliary muscle
Sclera
Cornea
Choroid
Retina
Pupil
Fovea
Optic disc
Iris
Lens
Blood vessels
Optic nerve

Sensation & perception

- Sensation - process of converting photons perceived by the eye into electric **signals** traveling through neurons

- Perception - process of **interpreting** bitmap of visual stimuli into figures & concepts

Fixation

- Eyes constantly moving around, changing focus on elements in visual scene
    - Average fixation duration ranges from 200 - 250 milliseconds
- Certain environments have preset scanning order (e.g., English text is left to right, top to bottom)
- Important consideration in visual design is the order in which elements may receive focus
    - Strong contrasts & structure can help draw focus to specific elements

Elegance & Simplicity

Elegance & simplicity

- *Elegance*—derives from Latin eligere, to "select carefully"

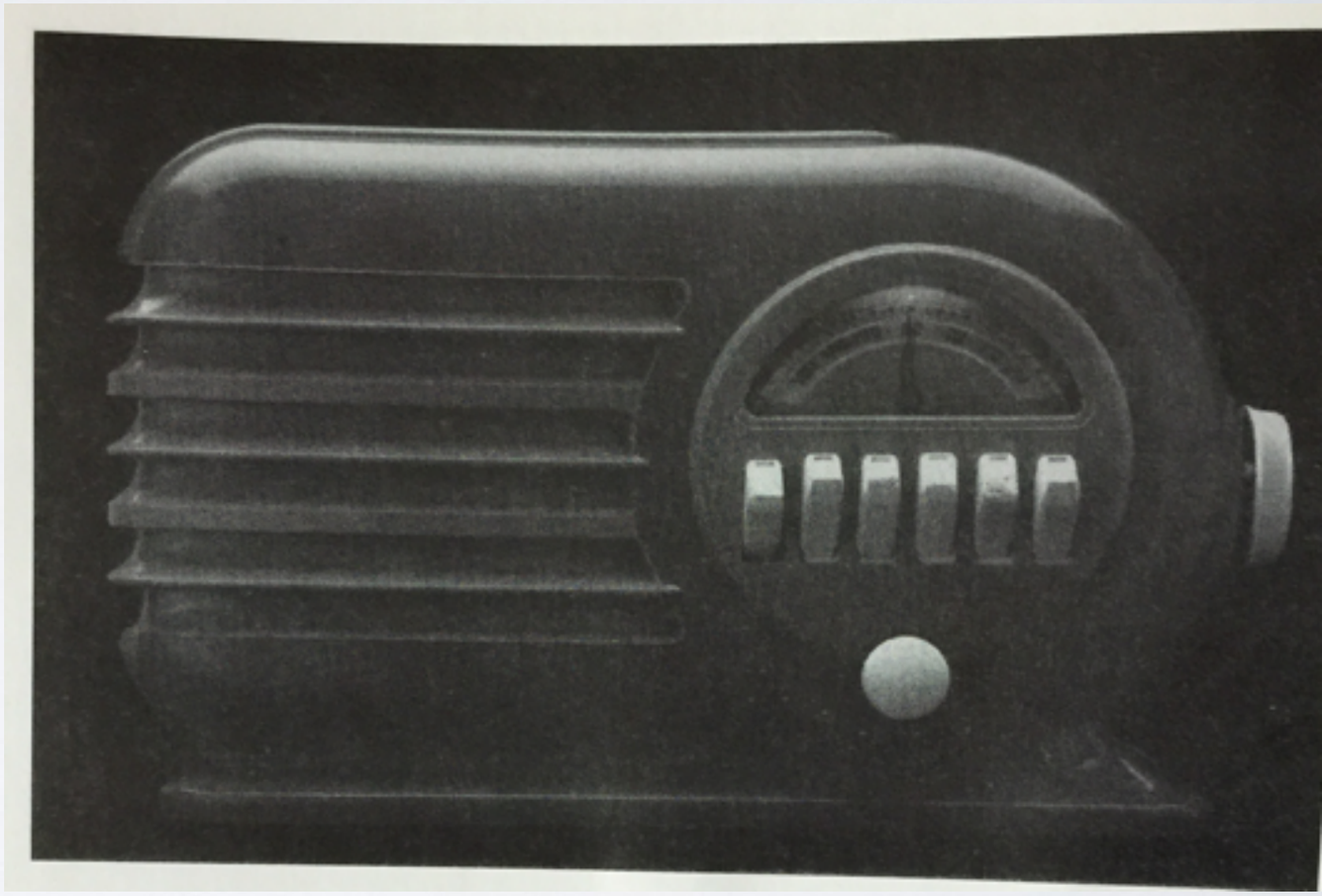
- **Judicious** selection of elements and economy of expression revealing an intimate understanding of problem

- Removing & combining superfluous elements until only the necessary remains

Benefits of simplicity

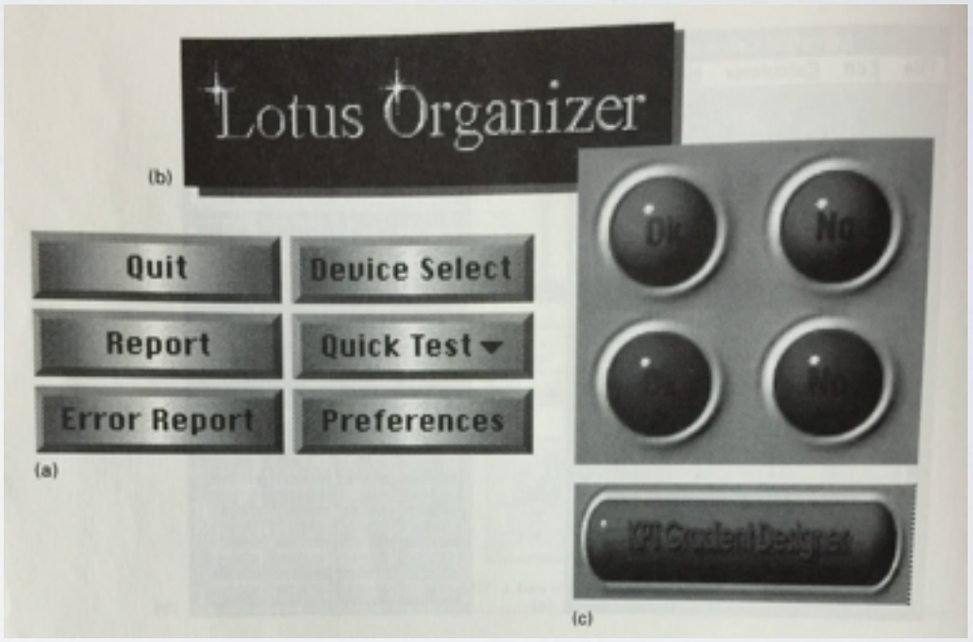
- Approachability - rapidly understood affordances, allowing glanceable understanding of possible interactions

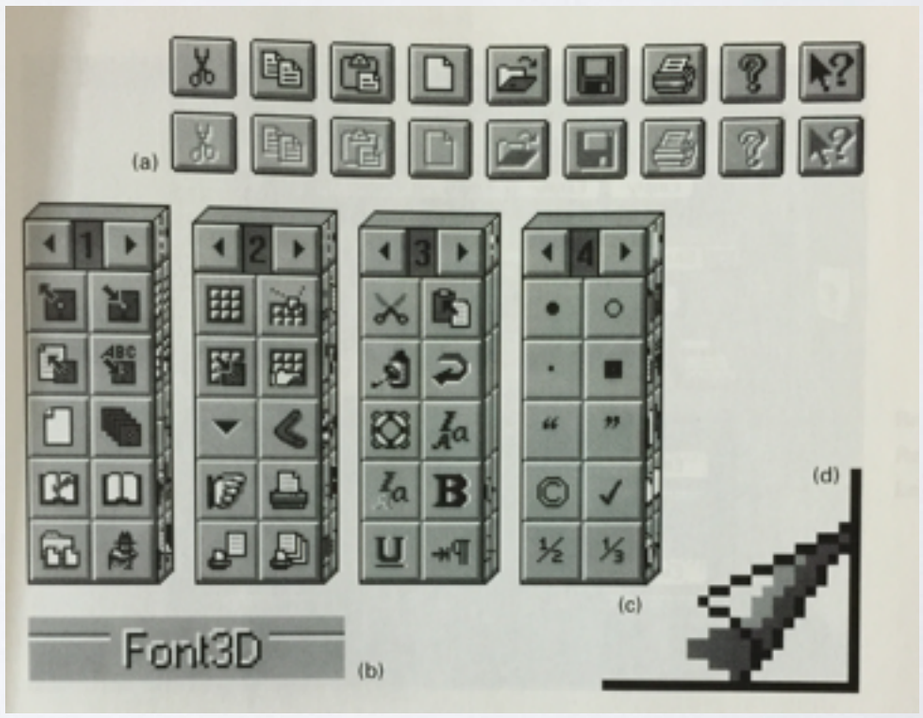
- Immediacy - greater emotional impact because interactions can be quickly understood



Error - excessive skeuomorphism

- Skeuomorphism - making visual design resemble reality
- Excessive skeuomorphism is distracting and wastes potential visual bandwidth that could encode meaningful information
  - (a.k.a. Tufte's "chart junk" — see next lecture)





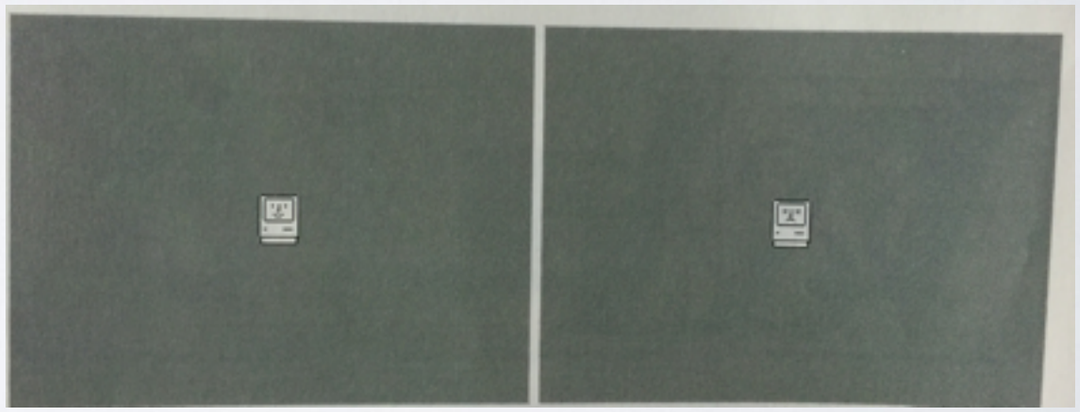
Reducing a design to its essence

- Make design simple, bold direct by removing inessential details & elements
  - Even essential elements may be suggested

1. Determine essential qualities & information to be conveyed

2. Critically examine each element & ask how design would suffer without it.

3. Try removing elements. What happens?



normal abnormal

Regularizing the elements of a design

- Reduce information by repeating elements according to a rule, principle or rhythm

- Enable user to scan ahead

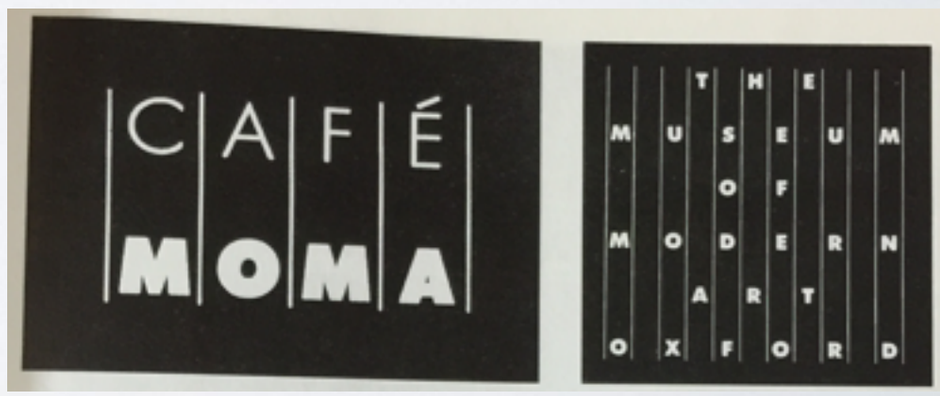
1. Use **regular** geometric forms, simplified controls, muted colors where possible

2. If multiple similar forms required, make them identical as much as possible in size, shape, color, texture, spacing, alignment

3. Limit variation in typography to a few sizes

4. Make sure critical elements intended to stand out are **not** regularized

train lines simplified
orientations of labels regularized with train lines



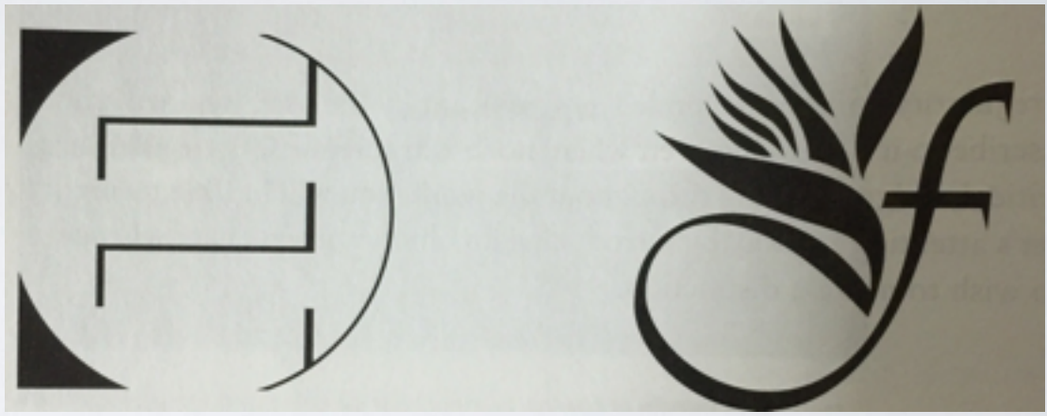
Combining elements for leverage

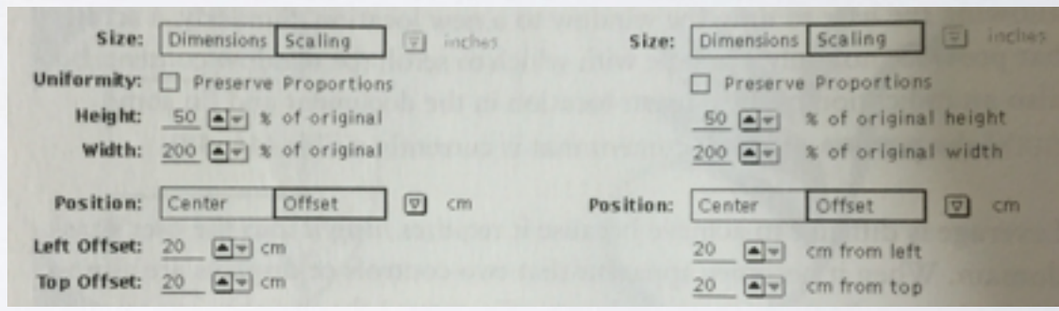
- Find points where one element can do the work of two

1. Review functional role played by each element.

2. Look for situations where multiple elements are filling the same role.

3. Combine redundant elements into single, simpler unit or common high-level idiom





labels can set context for several controls, reducing visual interference

Scale, Contrast, & Proportion

Scale, contrast, & proportion

Information consists of differences that make a difference. (Edward Tufte, Envisioning Information)

Individual visual attributes of design that encode information

Terminology

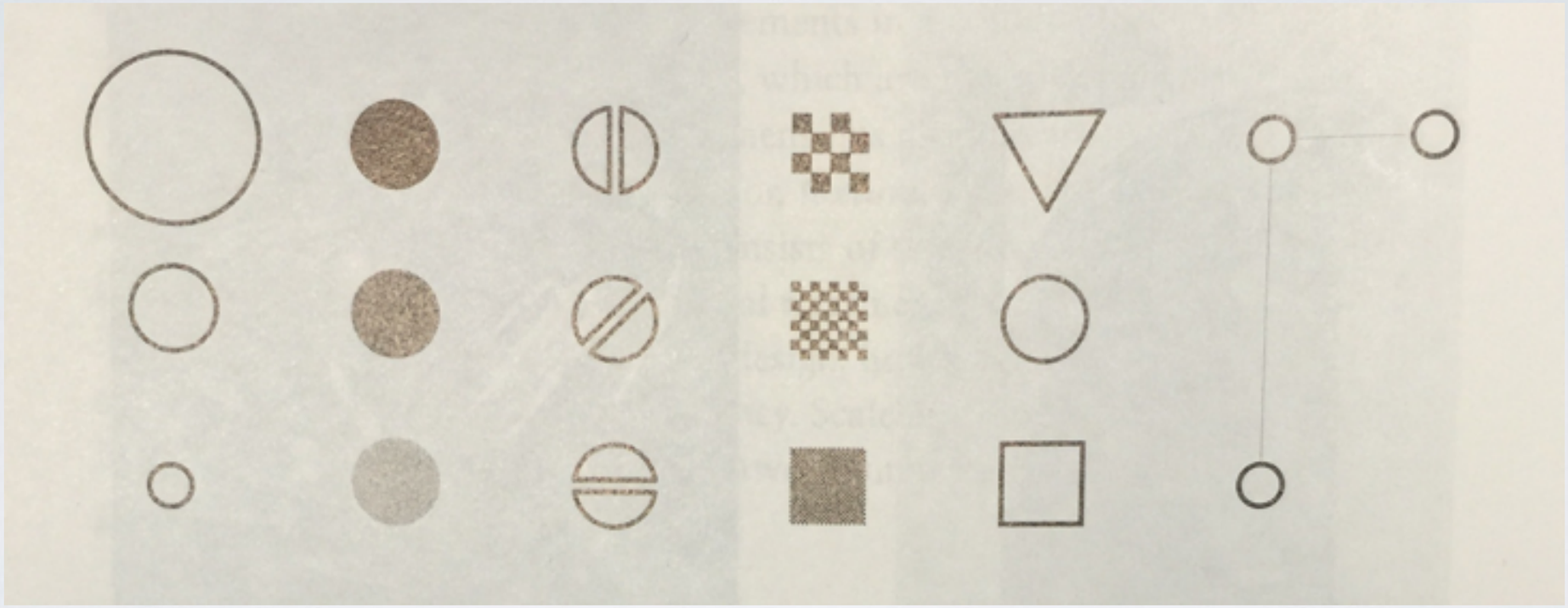
- Scale - **relative** size or magnitude of element in comparison to related elements

- Contrast - visually noticeable **distinctions** along a common visual dimension

- Proportion - ratio and **balance** between elements

- Emphasis - contrasts can emphasize important elements or areas & add visual **interest** by creating tension & drama

Retinal variables

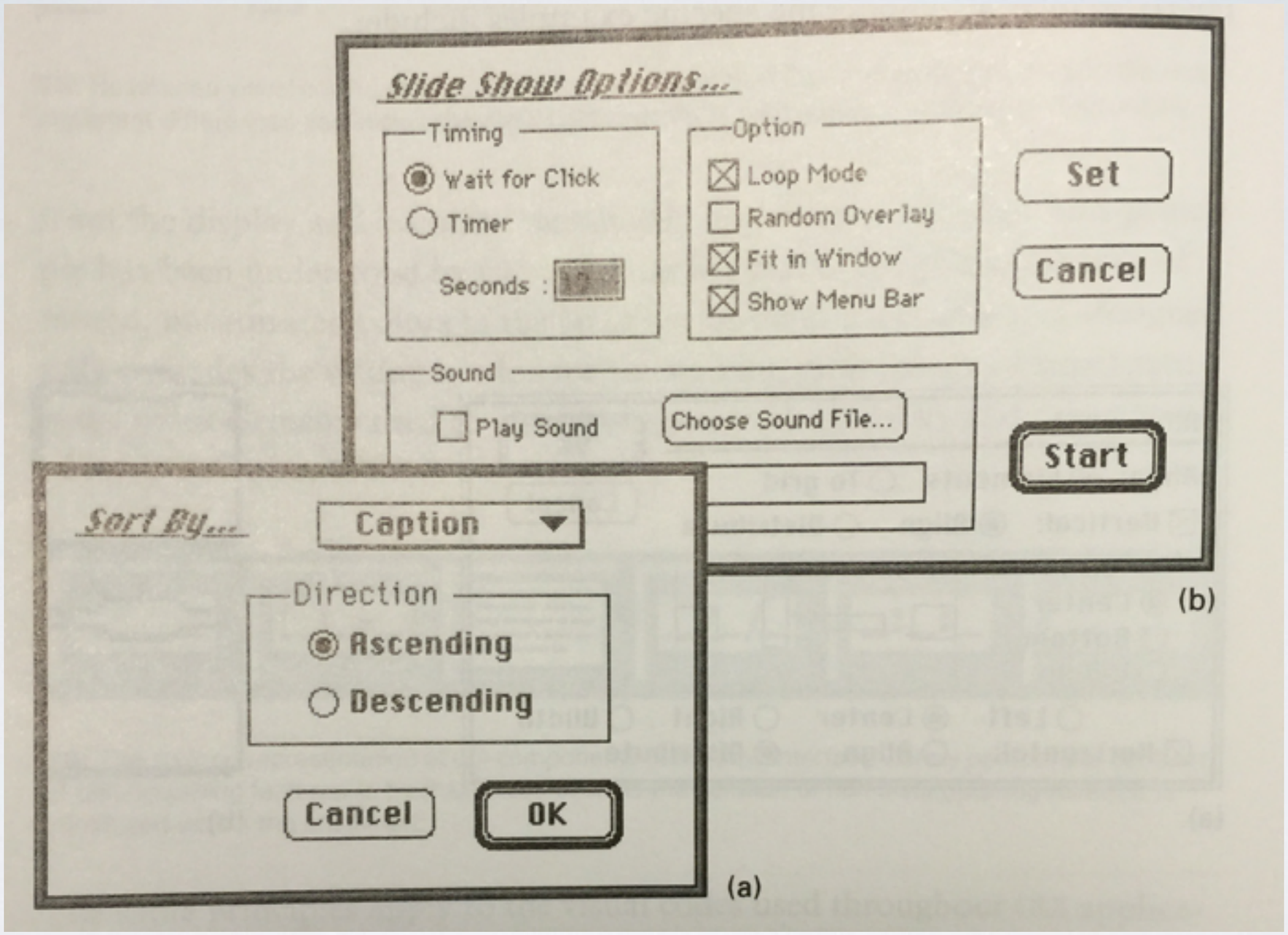


- Bertin's retinal variables: size, value, orientation texture, shape, position, and hue

Principles

- Clarity - contrasts should be clear and easily differentiated, not slight and subtle
- Harmony - proportions and ratios should be harmonious
- Activity - use contrasts to maintain orientation & context within design
- Restraint - contrasts should be conscious, strong, few in number, and never overwhelming

Error - excessive typographic contrasts



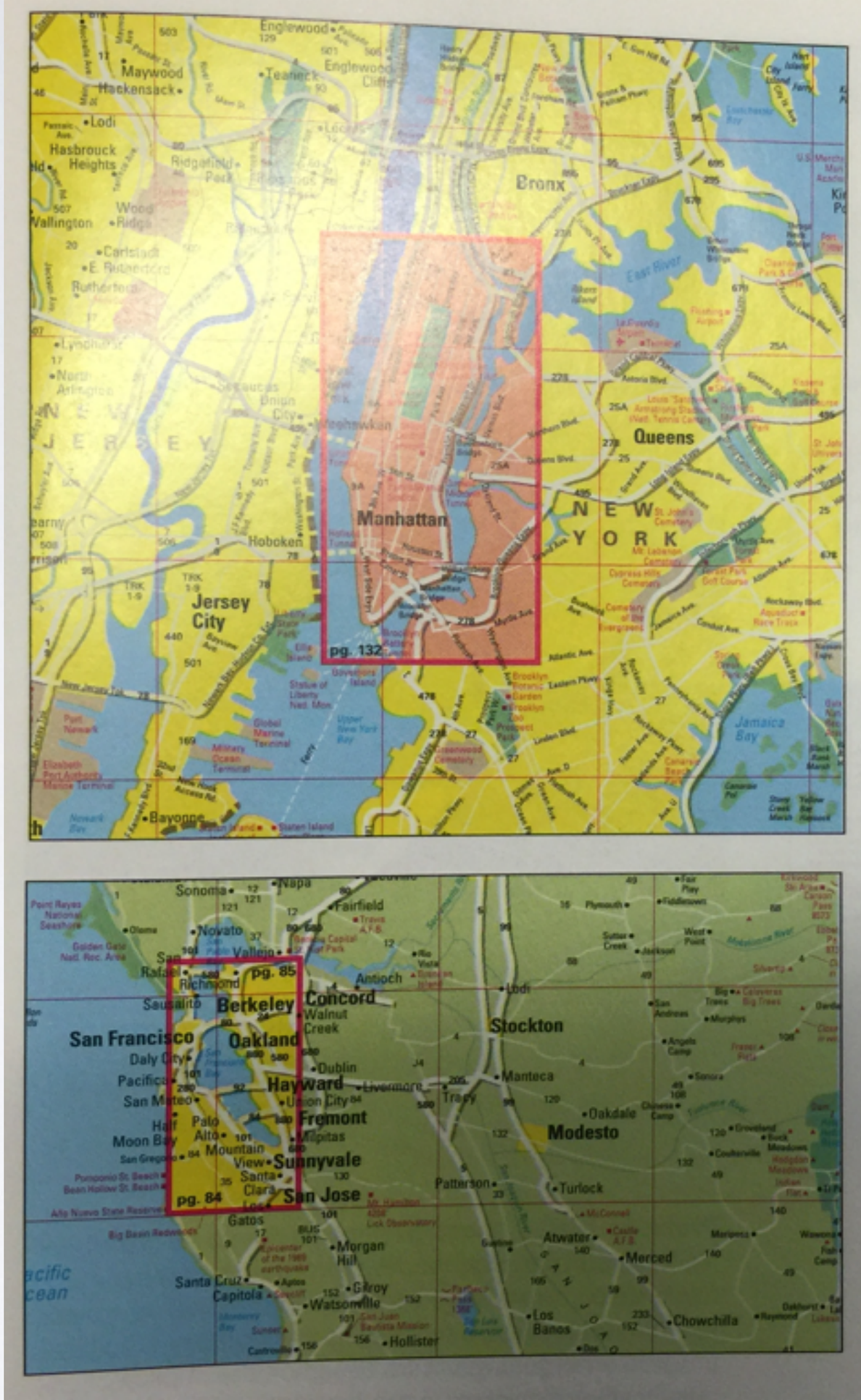
5 different types sizes in 3 different fonts (!!)

Layers

- Contrasting color, value, texture can segregate information into separate layers

- Supports **overlapping** information in displays, allowing selective processing of specific sets of elements

- Allows different layers to be read and interpreted **separately**



Creating layers

1. Group items into categories based on intended use

2. Determine rank & importance of groups

3. Use perceptual variables (size, value, hue, etc.) to establish layering effect

4. Maximize differences between groups while minimizing differences within groups

5. Use squint test to ensure elements in group retain together but visually separated

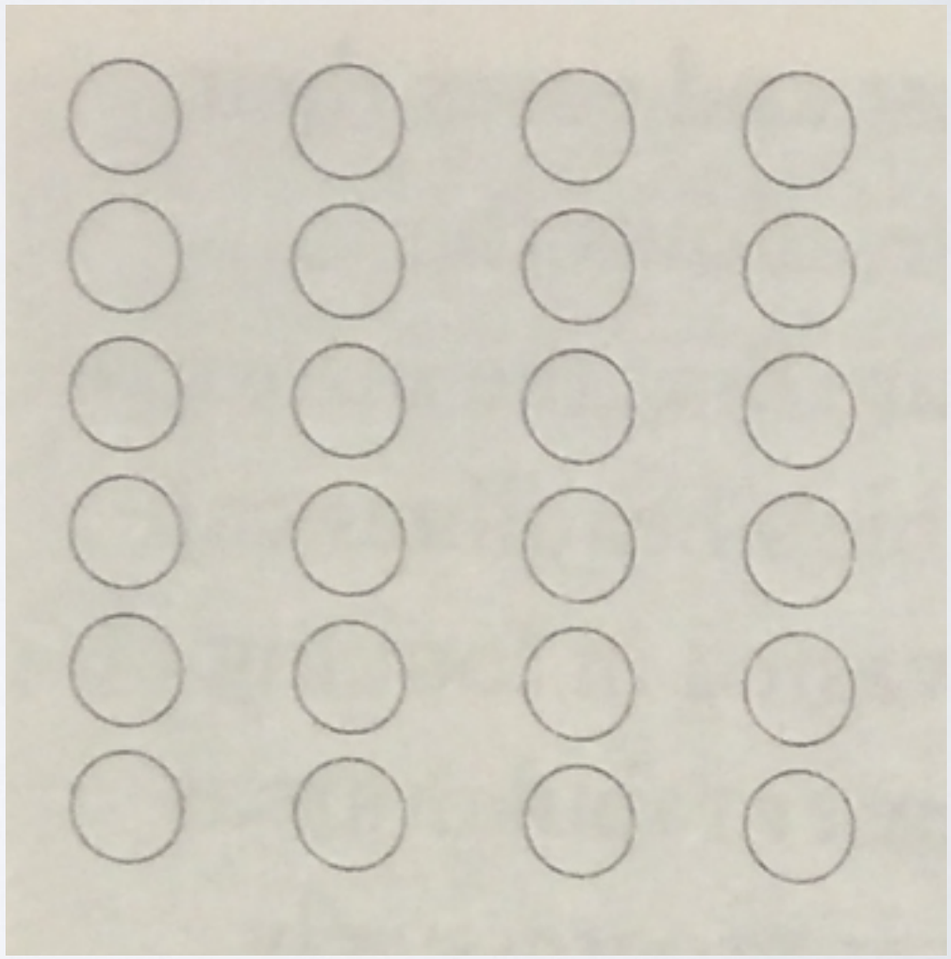
Organization & Structure

Organization & structure

- Benefits
  - Unity - ties together related elements so that they work **together**
  - Integrity & readability - offers structure that helps user to easily scan & make comparisons
  - Control - determines where user will focus **attention** in the design

Gestalt principle - Proximity

- Elements associated must strongly w/ **nearby** elements

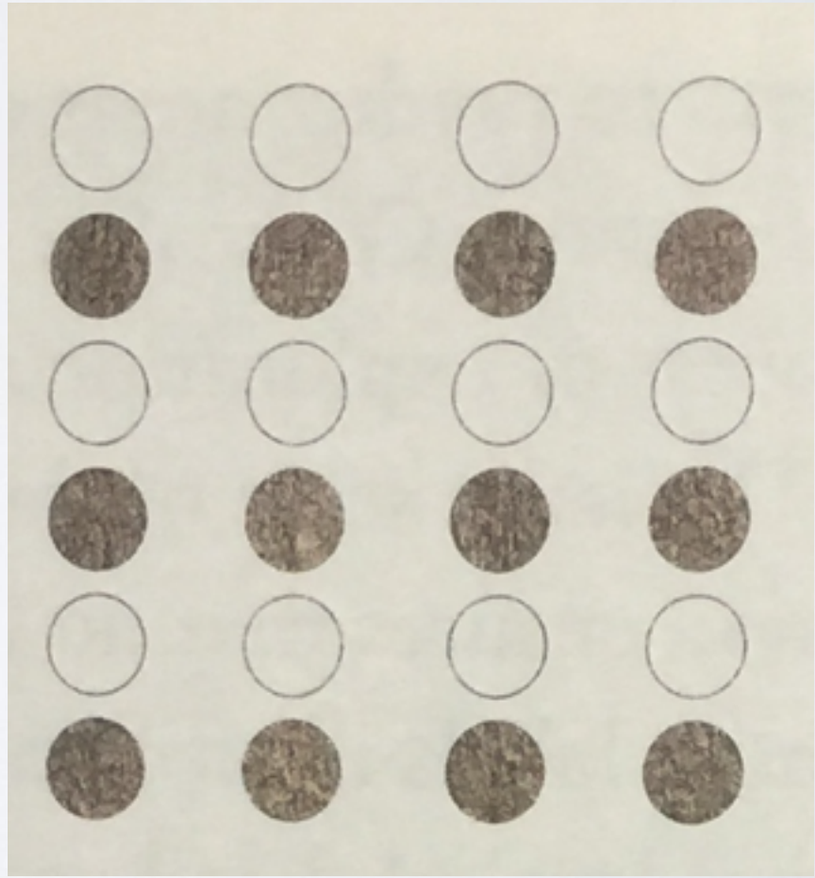


- parsed as 4 columns based on close vertical spacing
- then parsed as two sets of two columns based on spacing

Gestalt principle - Similarity

- Elements associated more strongly when share common visual attributes than when they differ

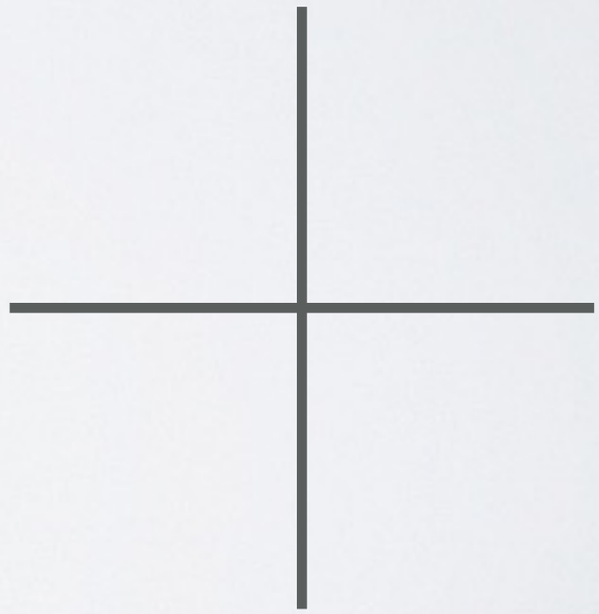
- parsed as rows based on fill similarity, despite closer column spacing



Gestalt principle - Continuity

- Preference for **simplest** physical explanation of complex figure

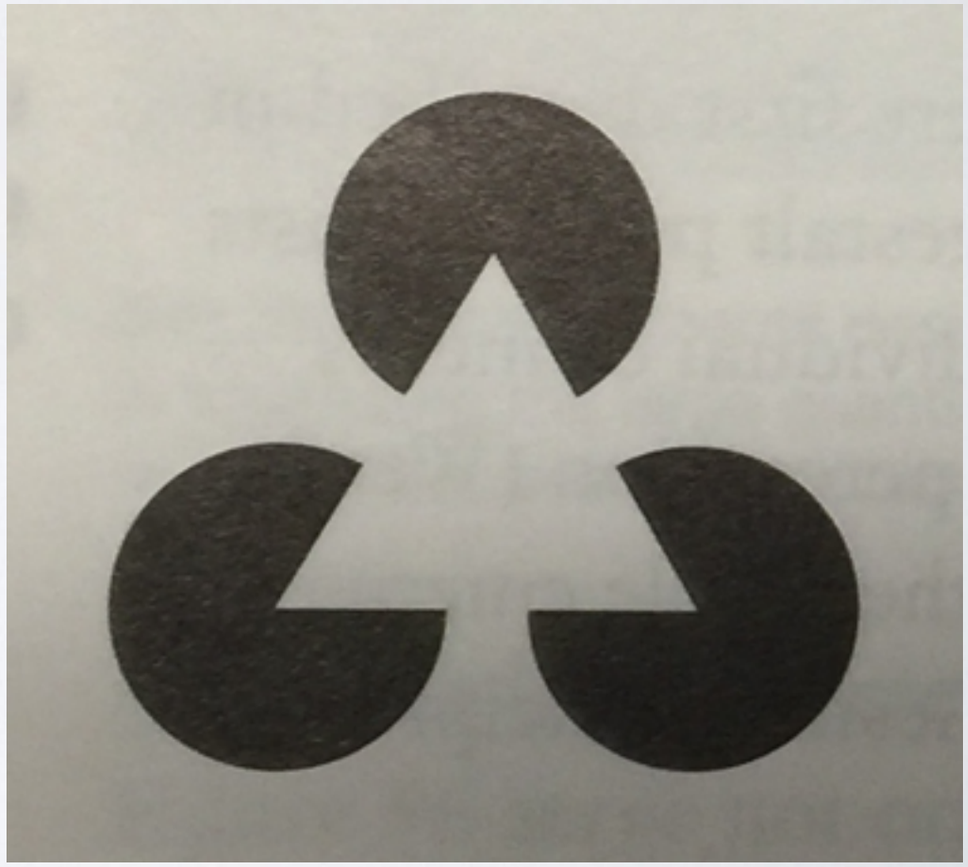
- parsed as two lines, rather than 4 separate lines or 4 opposing angles



Gestalt principle - Closure

- Preference to interpret figures as complete, even when missing information

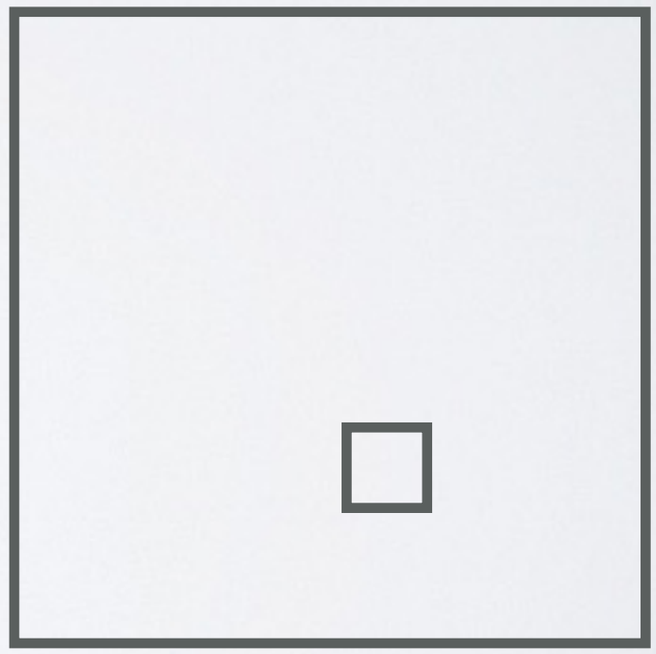
- Parsed as triangle superimposed on 3 complete circles, even though none of these is actually present



Gestalt principle - Area

- Preference to interpret smaller overlapping elements as figure, larger as ground

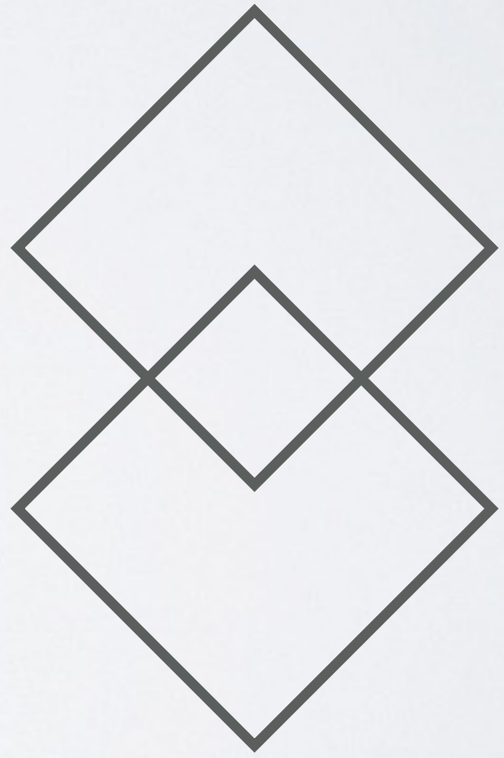
- Small rectangle parsed as small rectangle on top of larger, rather than hole



Gestalt principle - Symmetry

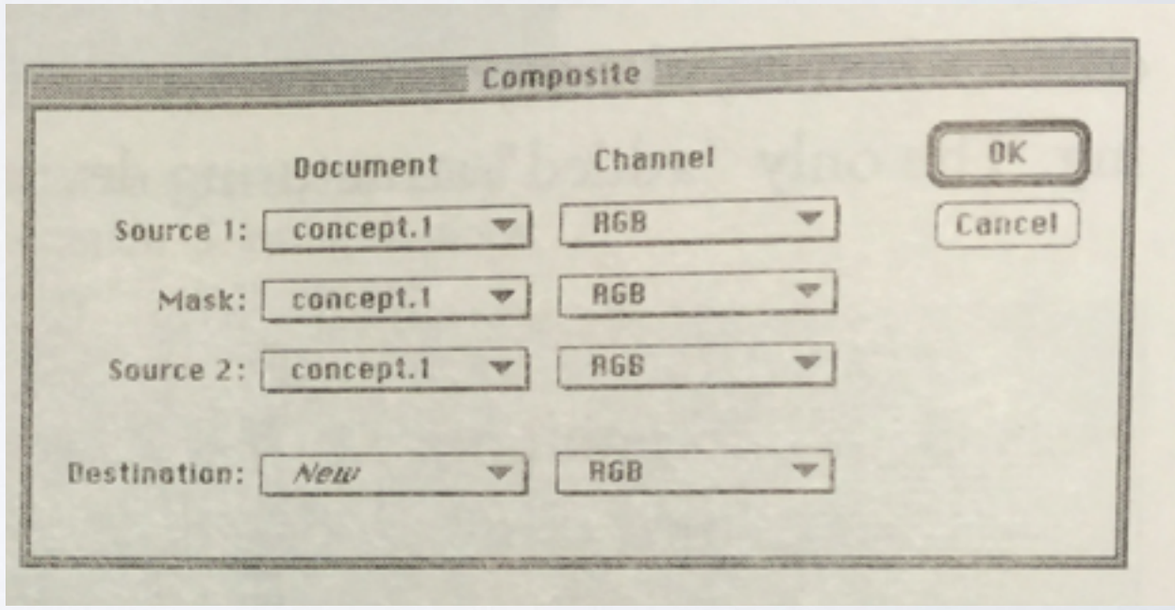
- Preference to interpret ambiguous form as multiple symmetric elements

- Parsed as two overlapping objects rather than 3 separate shapes



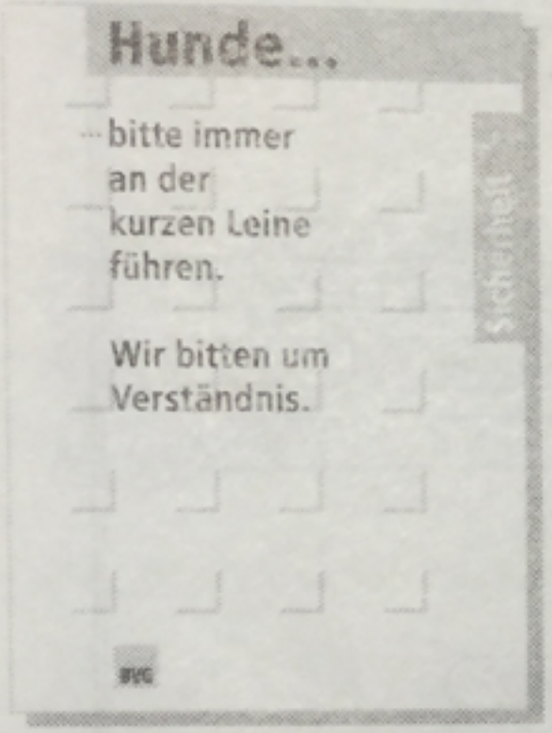
Grouping

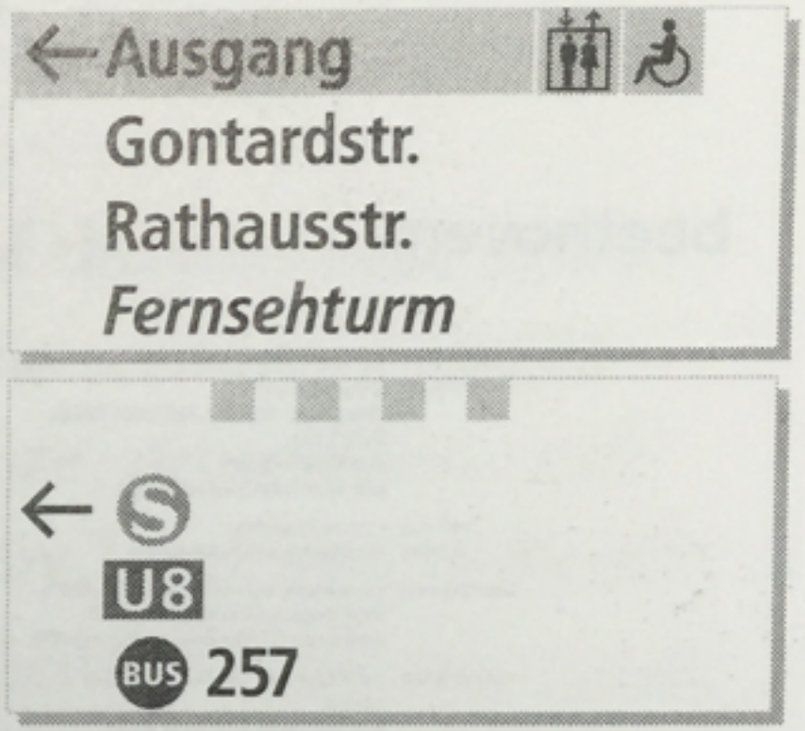
- Binding UI elements tightly together while distinguishing them from surrounding controls
- Can be achieved through
  - Bounding boxes (not recommended)
  - Negative space & contrasts
  - Arrangement & alignment



Hierarchy

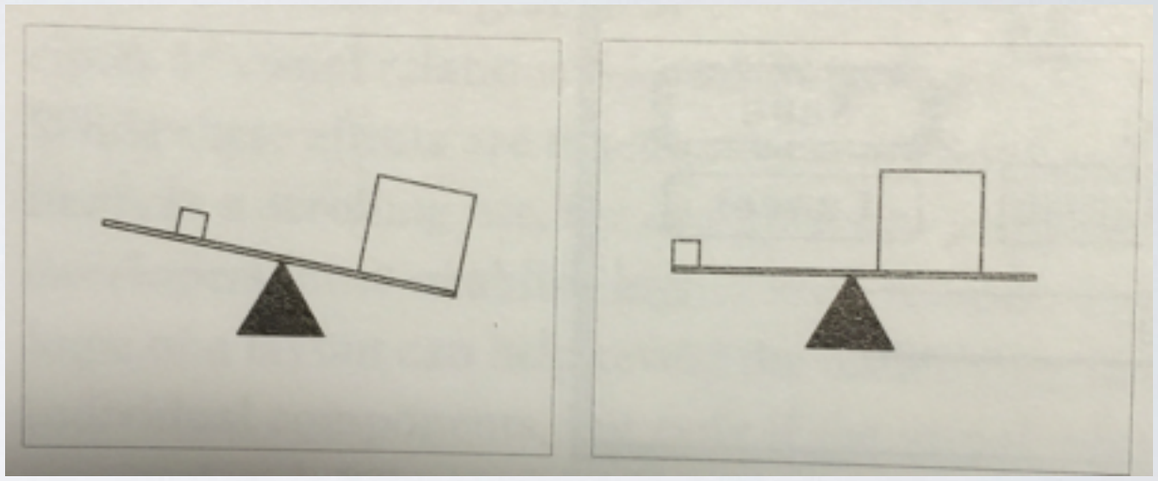
- Order groups based on perceptual prominence corresponding to intended reading sequence





Balance

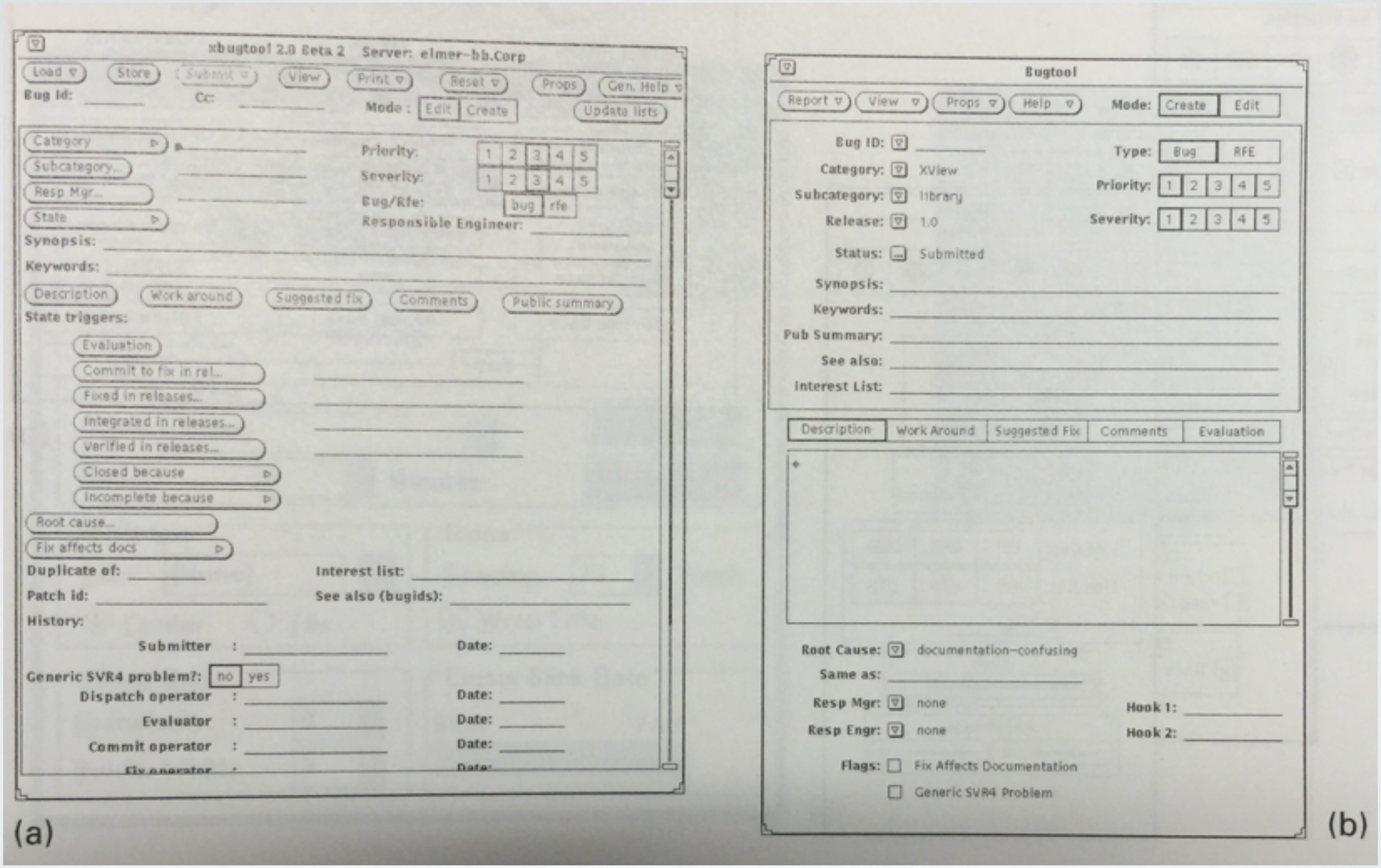
- Ensure that display remains stable in its position on screen by balancing visual weight on either side of diagram



- Can be done w/ asymmetric layouts by balancing heavier elements w/ lighter elements

off balance - too much on left

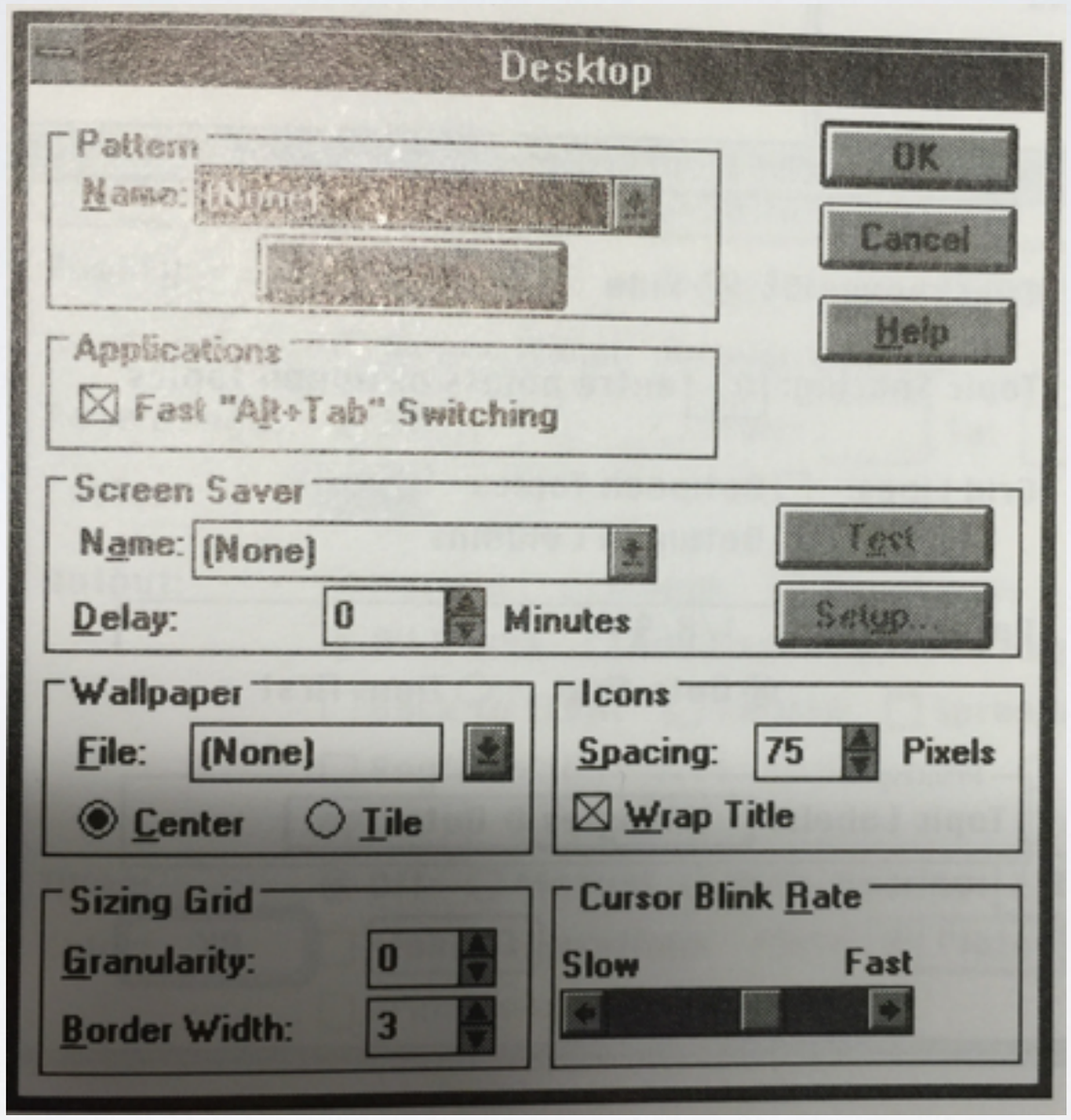
Error - Haphazard layout



weak relationships, varying widths

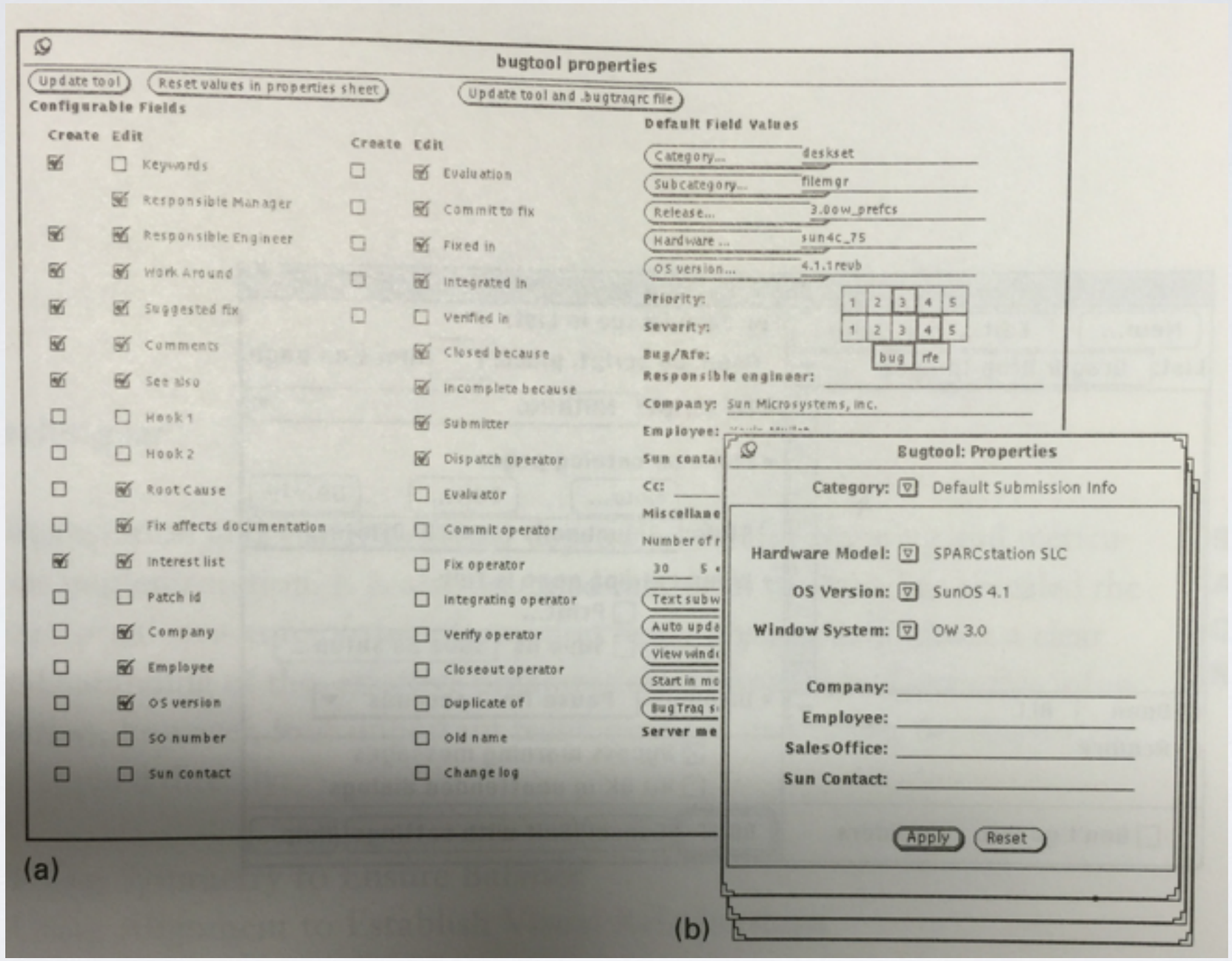
stronger relationships, constant axis

Error - Ambiguous internal relationships



items almost, but not quite, in alignment

Error - Excessive display density



fixed by breaking into separate panes

Using symmetry

- Repetition of a form in translation, rotation, or reflection that unifies configuration

1. Identify axes of symmetry (vertical more prevalent)

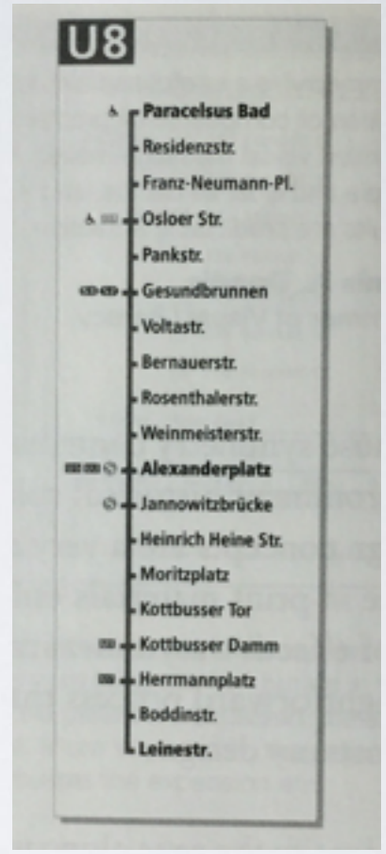
2. Balance information about each side of the axis

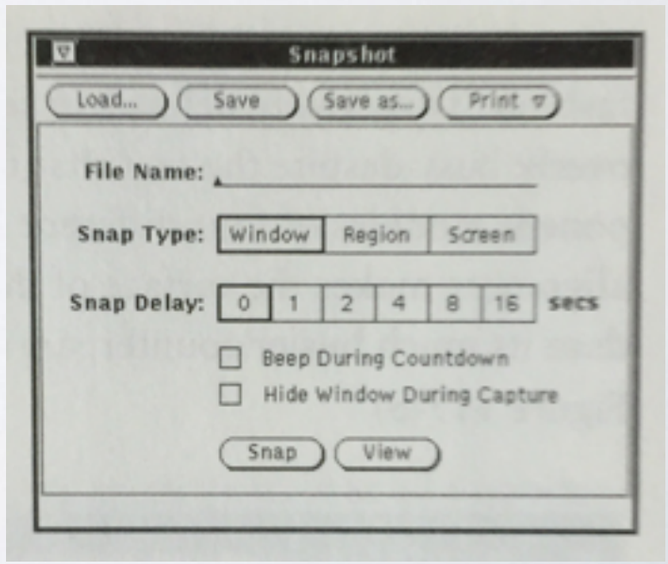
3. Ensure axis is centered within overall display context

Using alignment to establish relationships

- Alignment reduces visual **noise**, making intentional deviations more salient
- Establishes **relationships** between aligned elements

1. Identify major boundaries of existing layout
2. Look for for elements that are **almost** but not quite aligned
3. Look for **free-standing** elements and align
4. If no element to align with, align to overall display





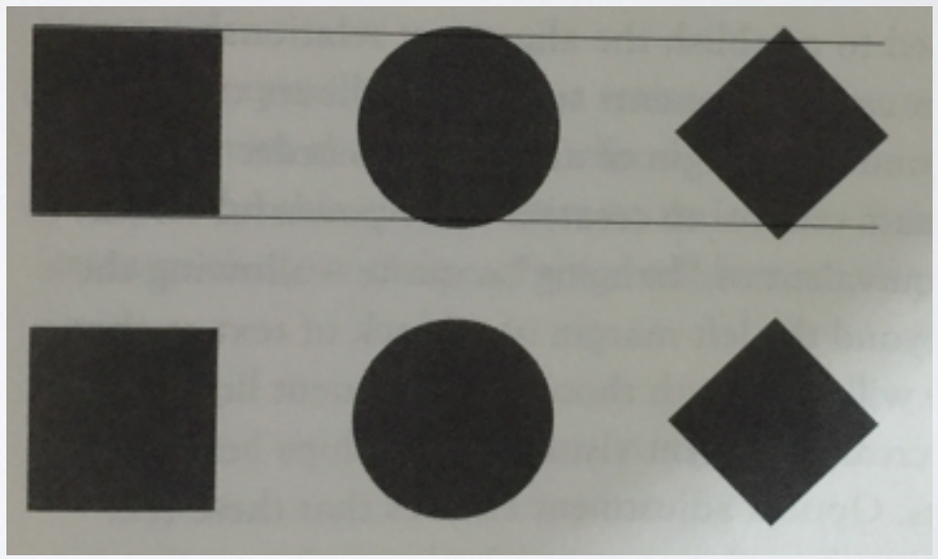
Optical adjustment for human vision

- Extend round or acute elements beyond target dimension to optically equivalent scaling

1. Determine **true** point of alignment

2. Extend elements beyond margin, according to acuteness of angle

physically equivalent scaling



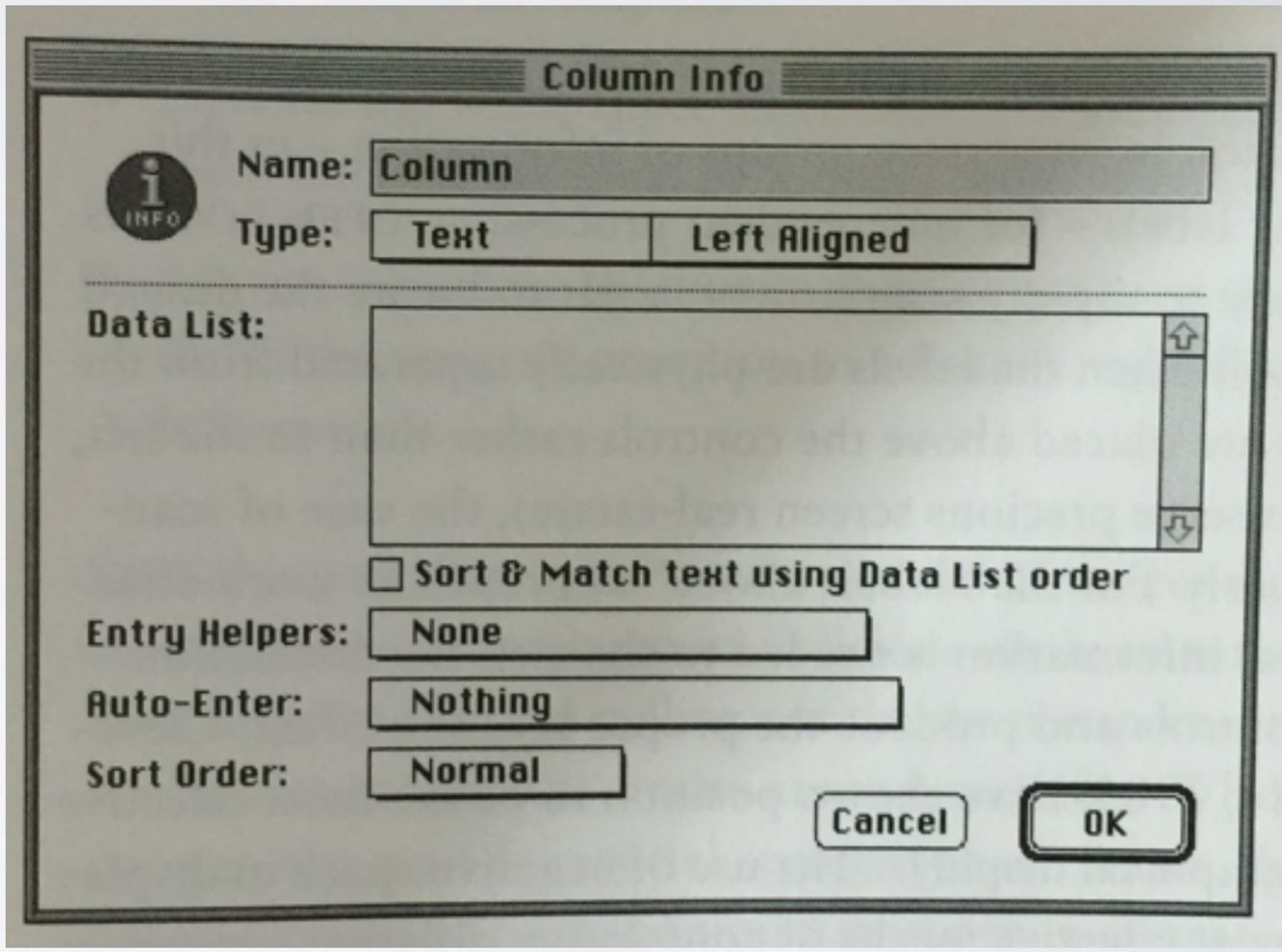
optically equivalent scaling

Use negative space

- Directs **attention** to critical regions of display

1. Review design, prioritizing groups

2. Add extra **space** to ensure spatial separation & emphasis, particularly for important elements



Module & Program

Module & program

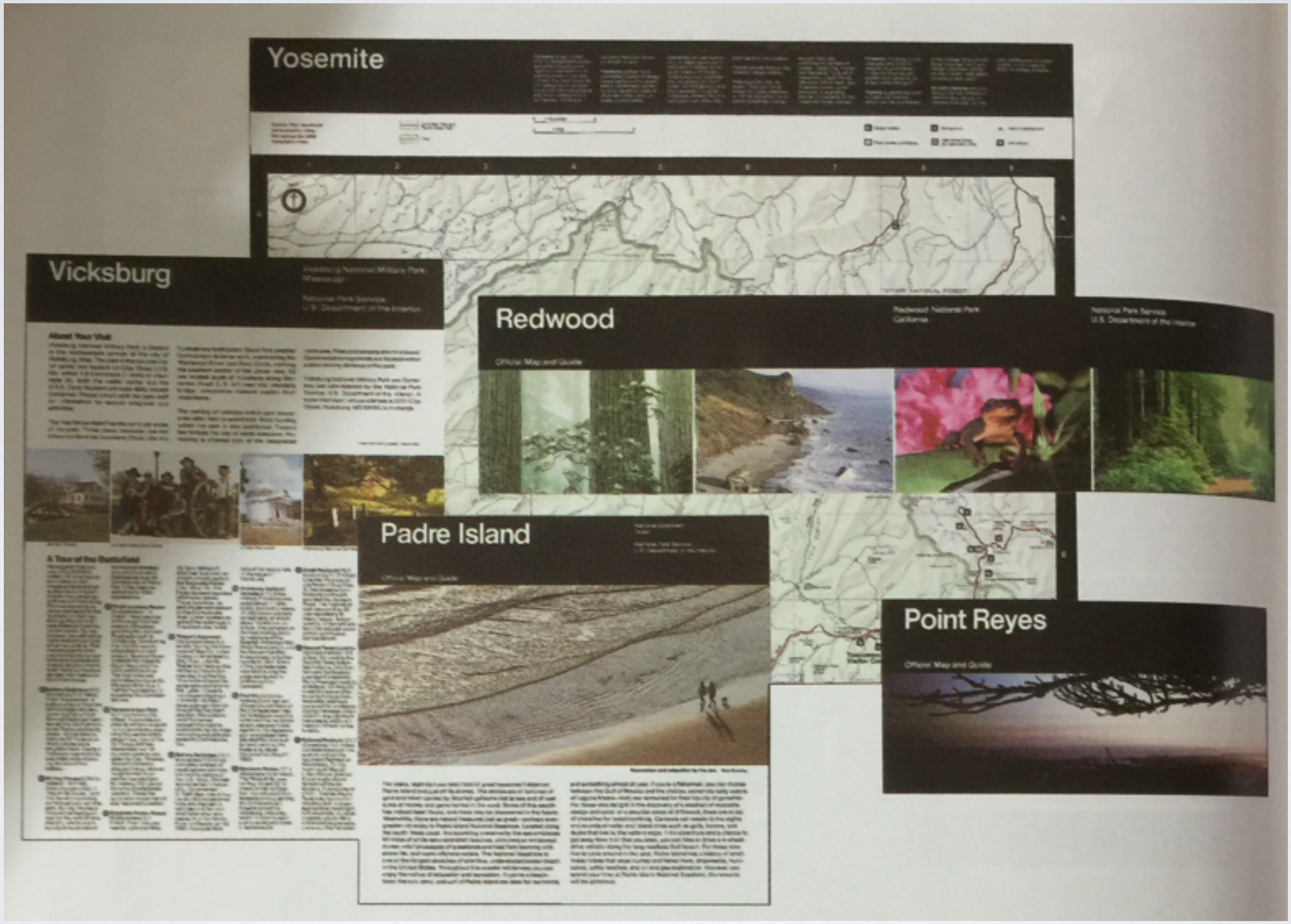
- Program - a comprehensive system of organization, using repeated sizes & proportions (modules) that bring **regularity** & structure

- Benefits

- Predictability - prepares the user to respond to a small number of familiar patterns in **predictable** ways (consistent mapping)

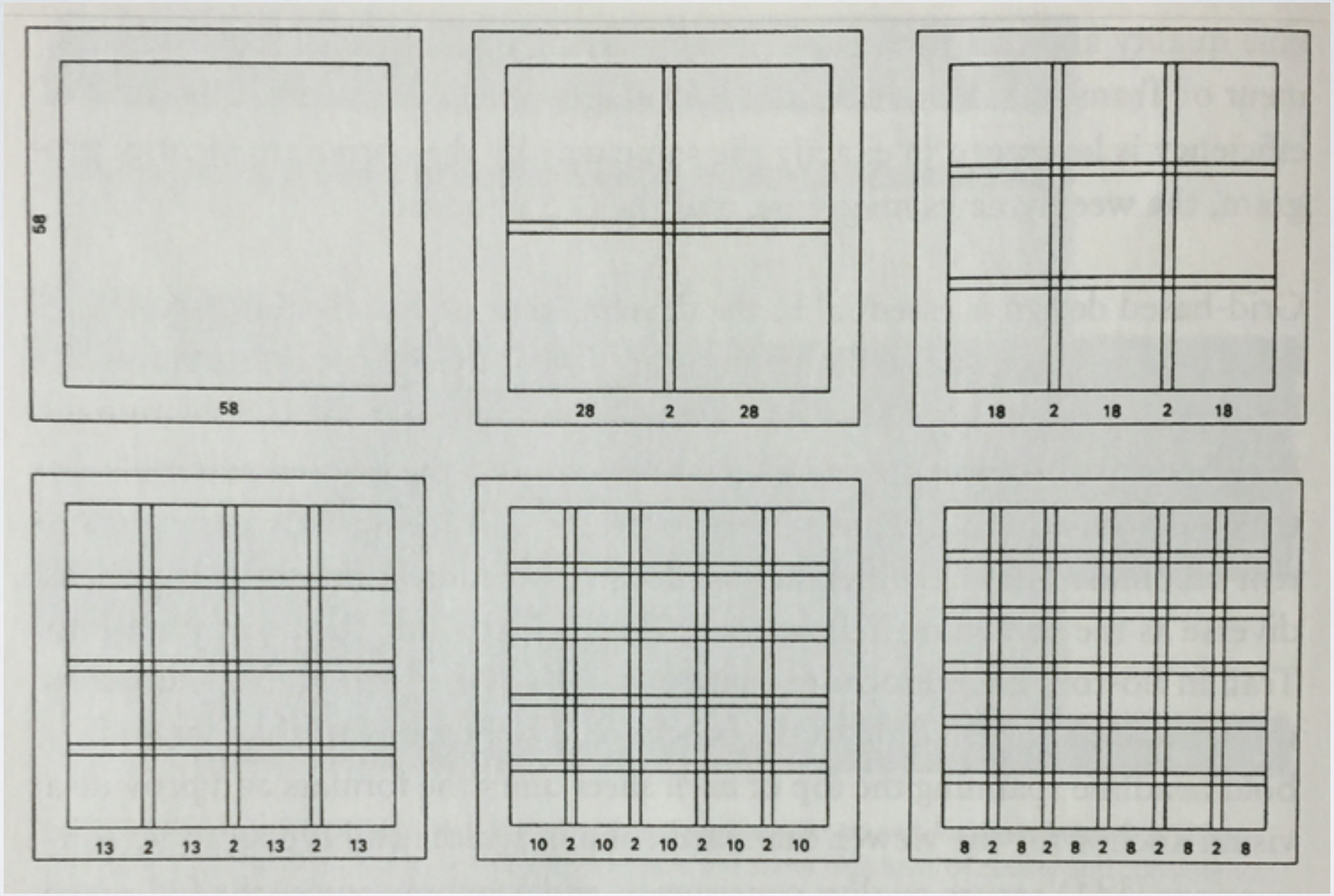
- Efficiency - enables lots of content to be quickly designed by reusing basic **underlying** structure

Grid layouts - example



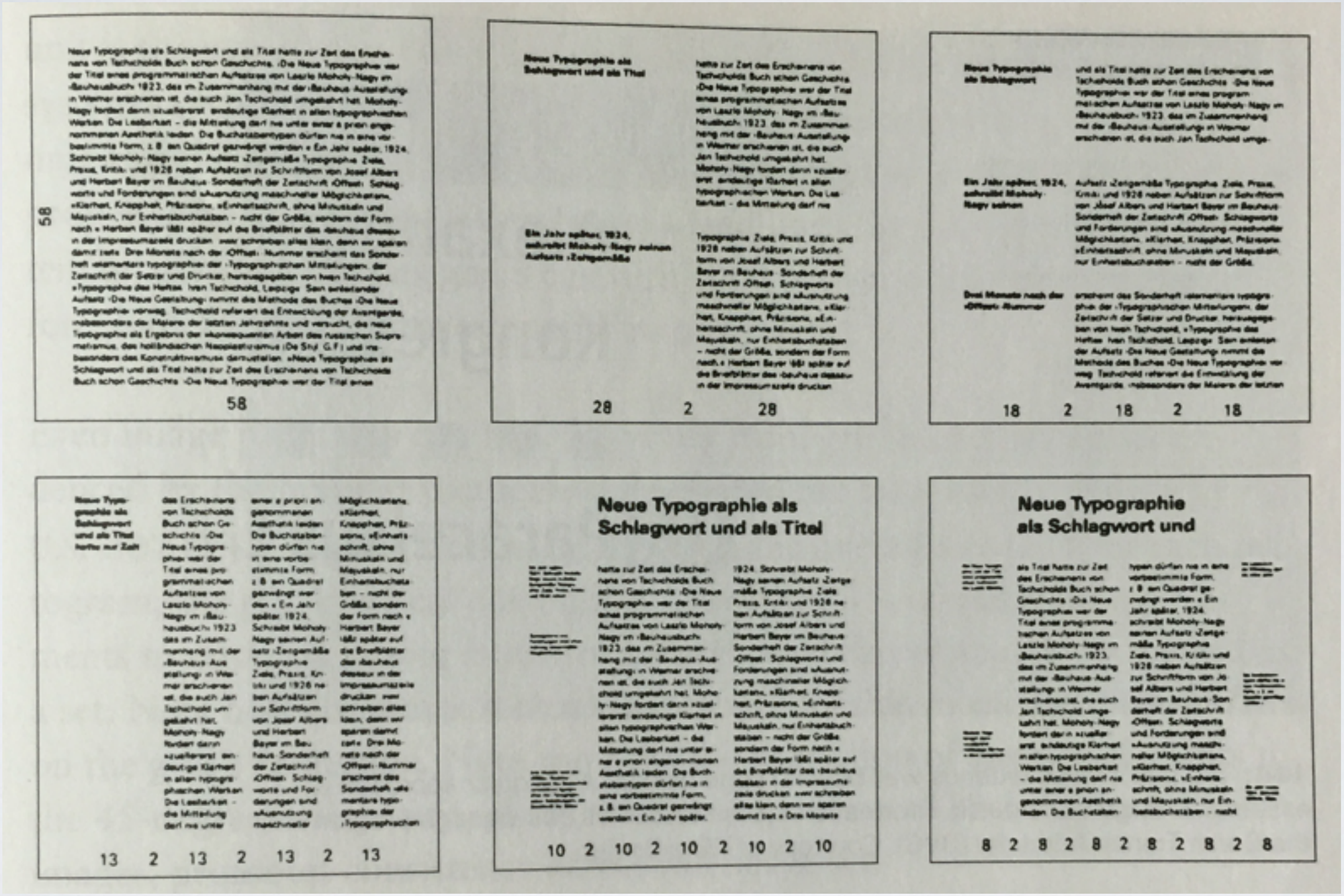
repetition of strong elements & use of identical modular units for text

Grid layouts - example



divides content into rows and columns

Grid layouts - examples



selecting a single layout provides unifying theme & expectations

Grid layout principles

- Focus - introduce a rhythm and regularity that makes structure **predictable** & explicit

- Flexibility - enable program to be used in multiple **contexts** (e.g., different number of columns)

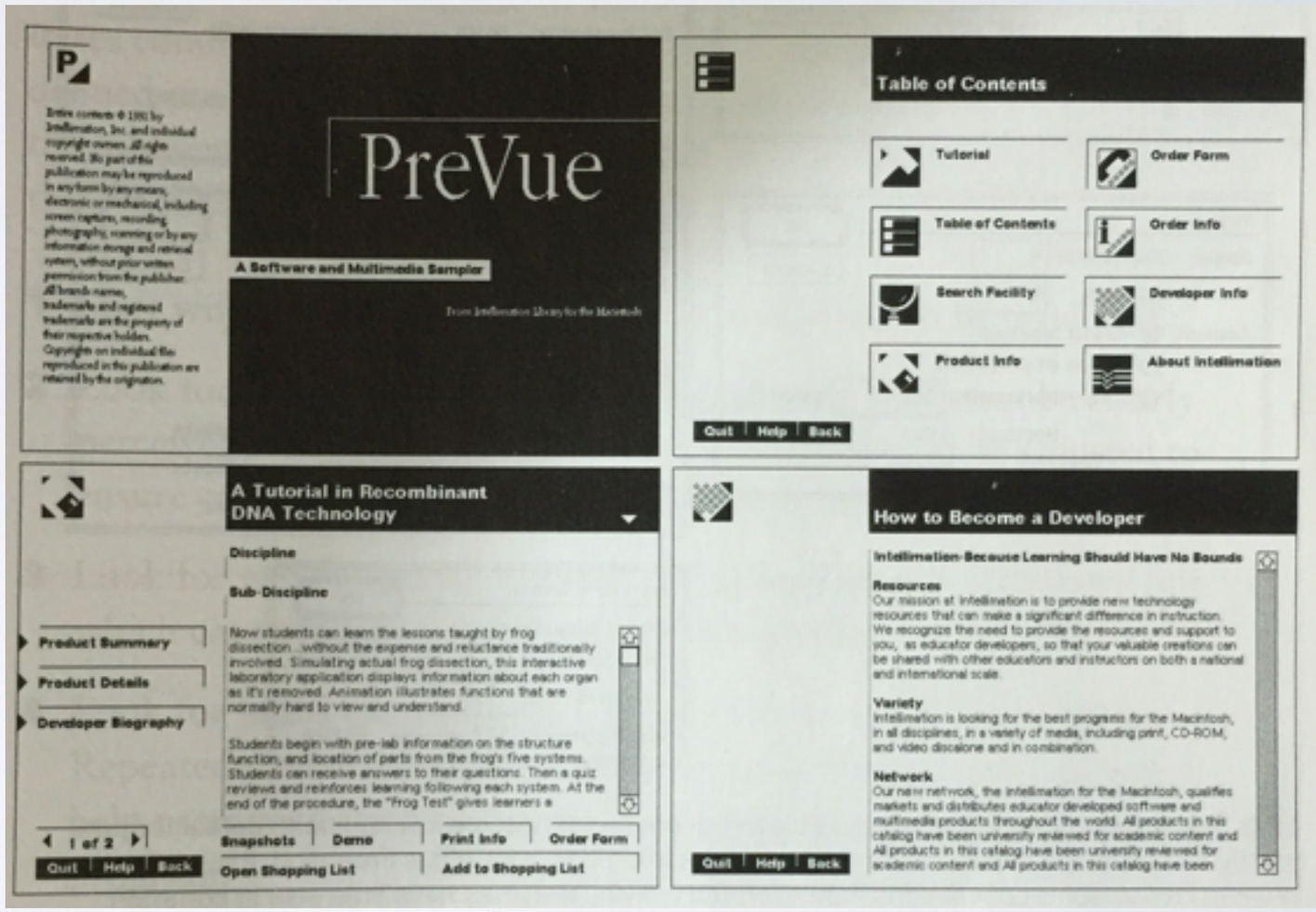
- Consistent application - used consistently to become expected & familiar

Reinforce structure through repetition

1. Look for common margins or functional **units**

2. Look for **paths** user's eye needs to follow, repeating structural elements to serve as landmarks

3. Use standard **locations** & consistent presentation style



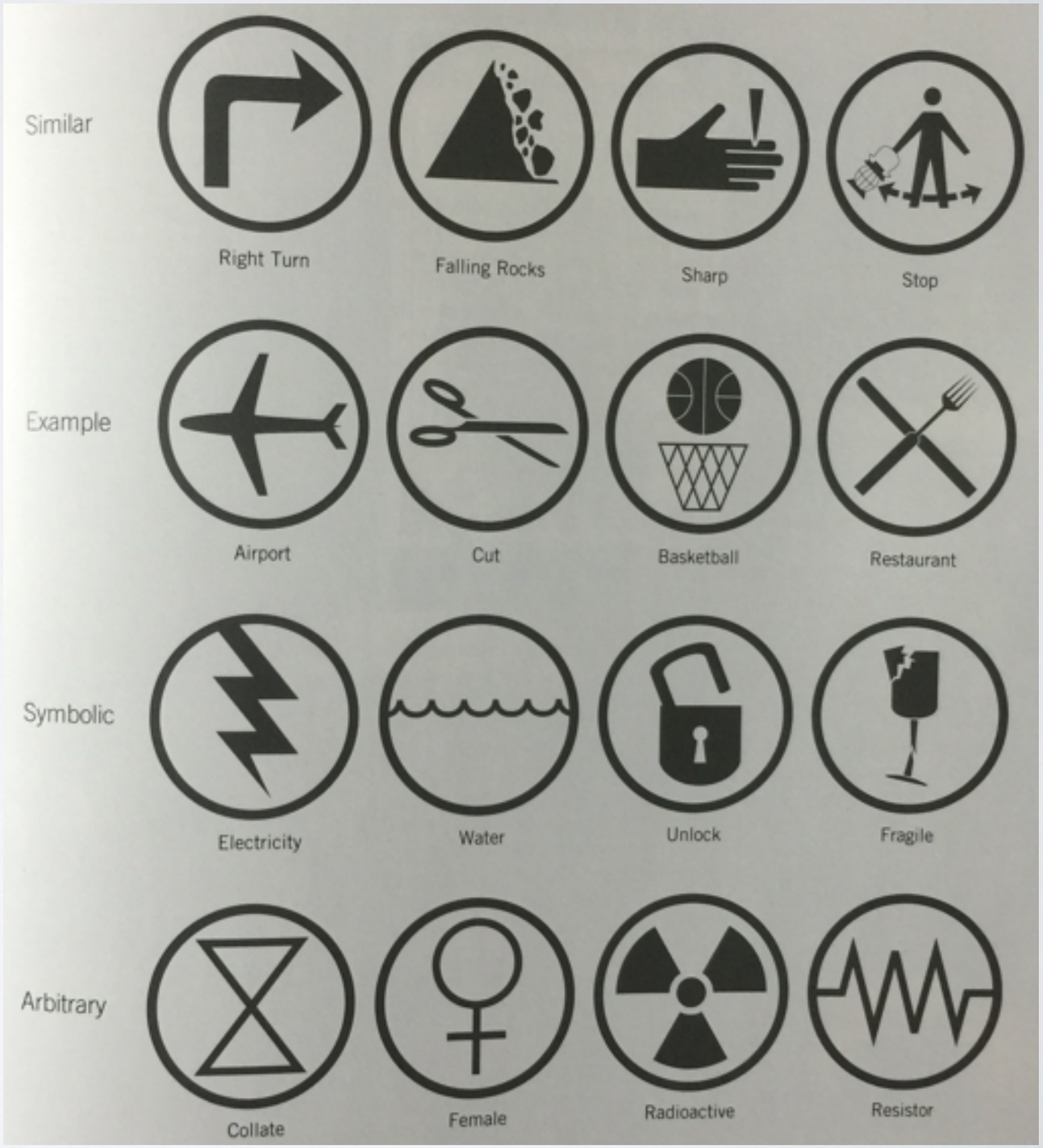
Images & Icons

Images & Icons

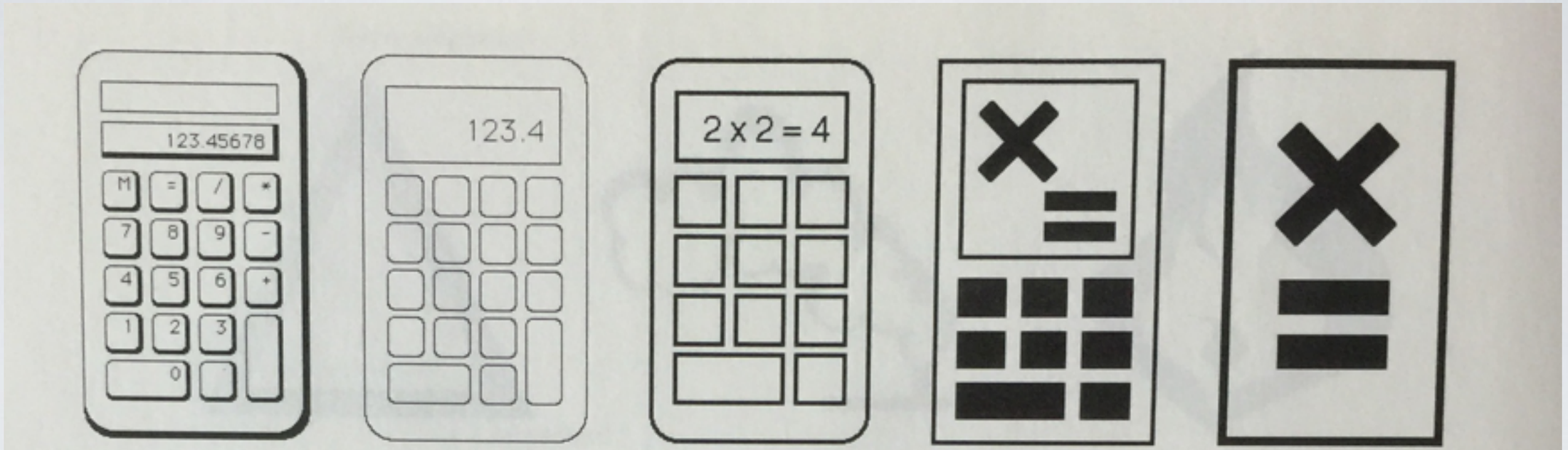
- Benefits
  - Identification - images are easy to recognize
  - Expression - breadth of artistic expression that can make design more engaging & enjoyable

Types of iconic representation

- Similar - visually **analogous** to action, object, concept
- Example - things that exemplify or are commonly associated
- Symbolic - represent concept at higher level of **abstraction**
- Arbitrary - little or no relationship to concept, must be learned through **standard**



Use of abstraction



- Simplifying highly concrete, realistic representations makes them easier to interpret up to the point at which further abstraction obscures icon's semantics
  - Makes icon more generic, more canonical, less complex

Principles of icon design

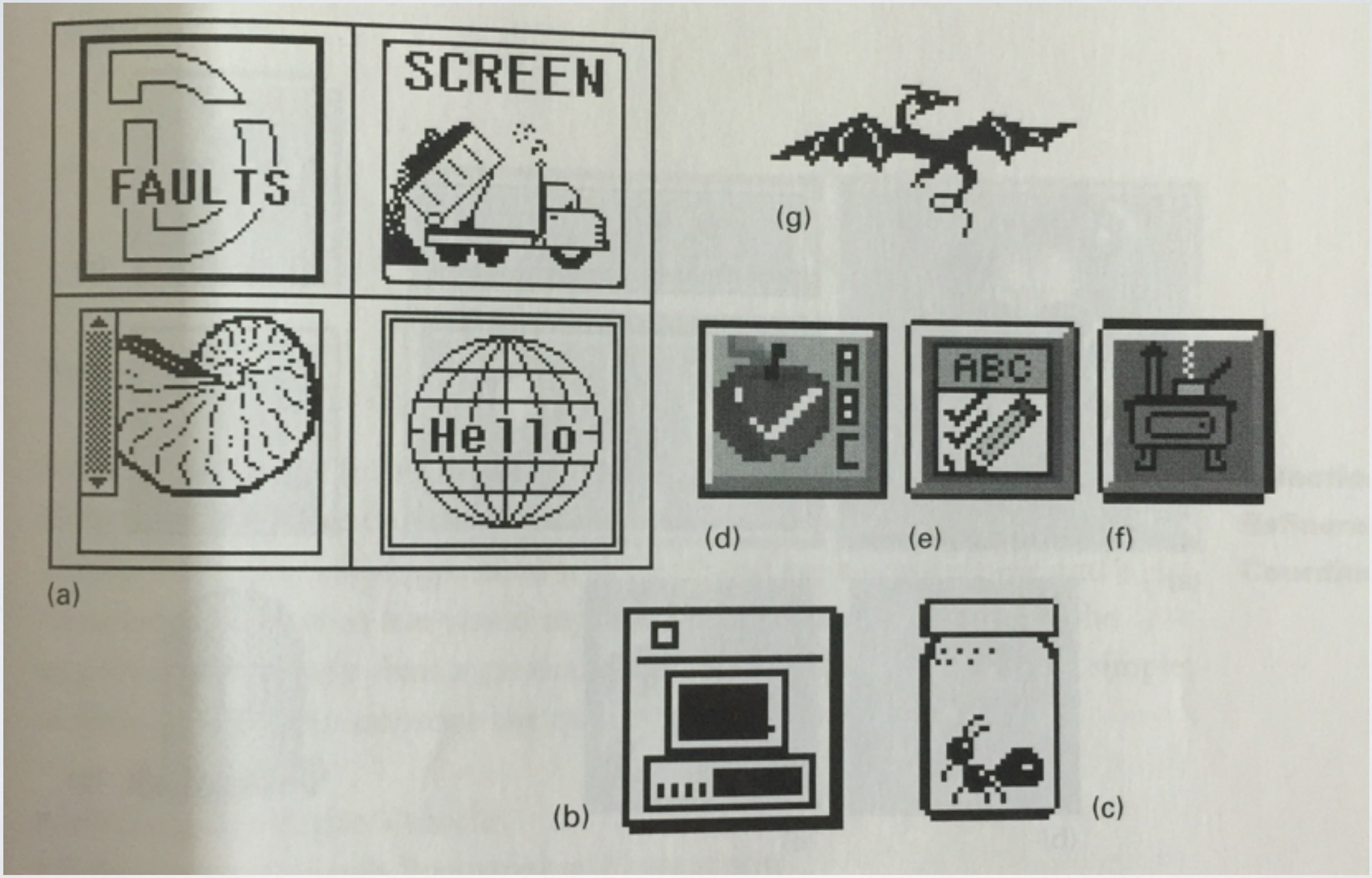
- Immediacy - can be perceived effortlessly & involuntarily by being **bold**, clear, balanced

- Generality - represents a **class** of items, rather than an individual element, by removing details that may vary

- Cohesiveness - set of icons that function **together** by sharing visual variables

- Characterization - call to mind one or more **distinctive** features

Error - Cultural or language dependence



Selecting the right type of icon

- If concept is concrete, familiar, tangible, use similar or example icon

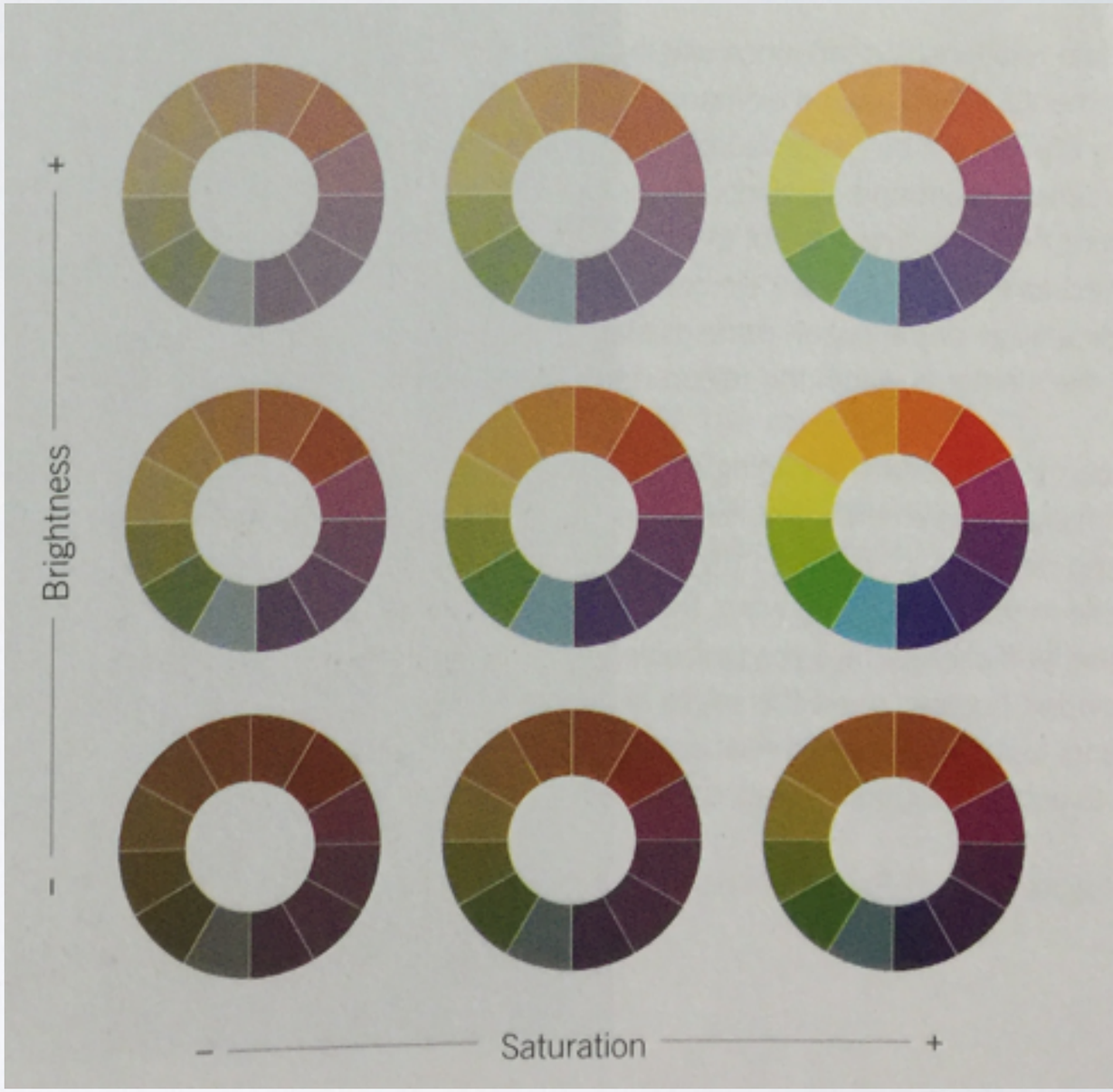
- If concept will be used repeatedly, consider using more symbolic or arbitrary icon based on convention

- If concept is abstract process or subtle, use textual label

Color

Color

- Hue: What we usually see as color
- Luminance: Amount of light entering eye
- Brightness: Perceived amount of light
    - (blue appears brighter than white)
- Saturation: Purity of color



Color combinations

Analogous

Example from Nature

Analogous color combinations use colors that are next to each other on the color wheel.

Triadic

Example from Nature

Triadic color combinations use colors at the corners of an equilateral triangle circumscribed in the color wheel.

Complementary

Example from Nature

Complementary color combinations use two colors that are directly across from each other on the color wheel.

Quadratic

Example from Nature

Quadratic color combinations use colors at that corners of a square or rectangle circumscribed in the color wheel.

Hues from yellow to red-violet on the color wheel are warm. Hues from violet to green-yellow are cool.

Guidelines on color use

- Number of colors - use color conservatively, limiting to ~5 colors; redundantly encode info to support color-blind

- Use appropriate color combinations

- Use warmer colors for foreground & colorer colors for background

- Use saturated colors to draw attention & for excited

- Use desaturated, dark colors for serious & professional

Guidelines on color use

- Avoid highly saturated opponent colors at the same time
- Older users need more brightness
- Do not require color discrimination in small areas
- Use color for relative differences, but not numeric information
- Use greater intensity for hues that indicate larger amounts