Designing Visual Interfaces

Communication
Oriented
Techniques

Kevin Mullet
Darrell Sano

SunSoft Press
A Prentice Hall Title

Prentice Hall
PTR

Organization and Visual Structure

4

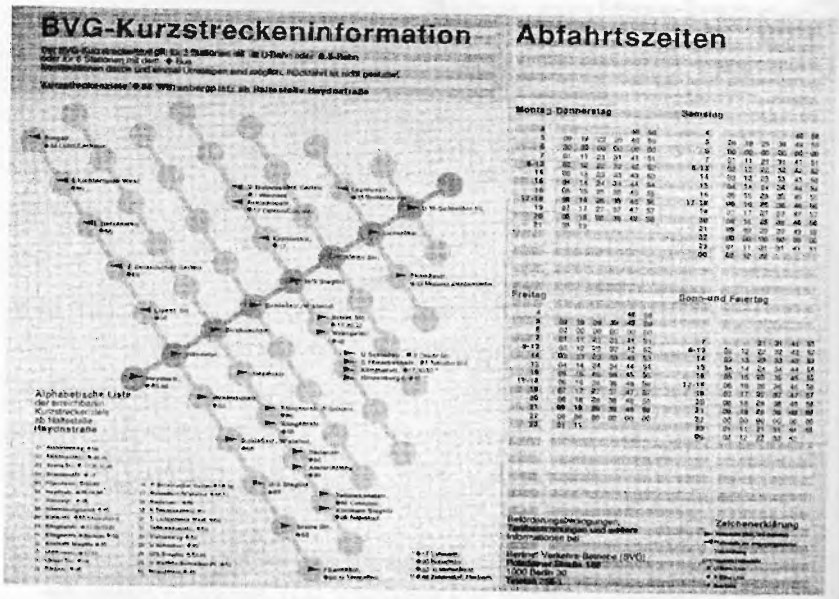
> The eye travels along the paths cut out for it in the work.
>
> **Paul Klee**
> Pedagogical Sketchbook

Organization and visual structure provide the user with the visual pathways needed to experience a product in a systematic way. Structure affects the visual experience at its most primitive level because it is the first aspect of the display to be perceived as information is extracted and used to guide subsequent interaction. Because they are experienced effortlessly and automatically, phenomena at this level provide critical communication channels that can be used to supplement or interrupt the user's higher level activities.

Organized structure does not occur naturally in man-made artifacts, so it must be consciously induced by establishing relationships among the components of the design. Effective use of structure allows individual elements to work in concert without being diminished in their own right. The eye craves structure and will seek to impose its own organization onto a design whose structure is not readily apparent. This breakdown threatens communication, since the designer is no longer in control of the message.

Without the integrity provided by a coherent visual structure, a design quickly becomes impossible to interpret and understand. The cost is functional as well as aesthetic, since progress toward any goal is continually impeded – even for expert users. Structure introduces several key benefits:

Unity. Visual structure ties even highly disparate design elements together and allows them to work in concert toward a common communication



96: Structural elements designed to aid the user engaged in typical reading tasks play a crucial role in organizing the large quantity of information presented in these posters, which explain a special mass transit fare system based on distance traveled. Courtesy of MetaDesign, Berlin.

goal. The lightly screened bars forming the background of the timetable in Figure 96 serve not only to reinforce the tabular structure of the layout at a global level, but also to simplify the local reading of the tabular display.

Integrity. A strong and coherent structure keeps the design focused on the communication goal by creating an emergent form that contributes to the meaning of the ensemble. The strong repeating element of the screened bars helps integrate the design on both the horizontal and vertical axes. On the horizontal dimension, the bars tie the rows strongly together and make it easy to make comparisons across columns. On the vertical dimension, the bars establish a rhythm that leads the eye down the page and makes it easy to scan ahead by a predetermined number of rows.

Readability. Structure enhances readability by dividing the information content of the entire display into manageable subsets that can be processed separately or in parallel, according to the designer's wishes. The discontinuity created by simply removing the screened bars from the timetable is itself a powerful structural element.

Control. Structure allows users to predict areas of interest and eases their navigation through the composition. Control of structure allows the designer to influence this process of exploration and ensure that the information is delivered effectively. The large scale of the timetable's headlines captures the viewer's attention and ensures that no time is wasted in looking at the wrong display. Four smaller labels identifying the denser tabular areas serve the same function at that level of detail as the viewer progressively focuses on the appropriate cell.

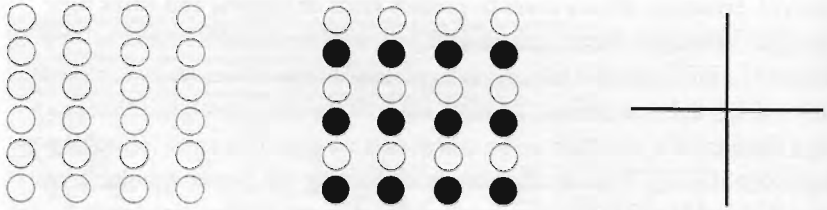
Information intensive applications such as timetables for transportation systems are among the best and most familiar applications of visual structure. Although the information they present is primarily tabular, powerful visual cues are used to guide the user to the relevant portion of the display. We turn now to a brief review of the early visual processes that support the processing of these cues and the separation of the display into figure and ground.

Background: Perceptual Organization

Several general principles of perceptual organization were first described in the 1920's by psychologists of the *Gestalt* school. The gestalt psychologists were interested in describing the processes by which individual elements were grouped into *gestalts* (wholes) during early visual perception (Wertheimer, 1958). By describing how the global structure of the whole emerges from the finer-grained local structure of the parts, the Gestalt principles can explain the success of many visual design techniques.

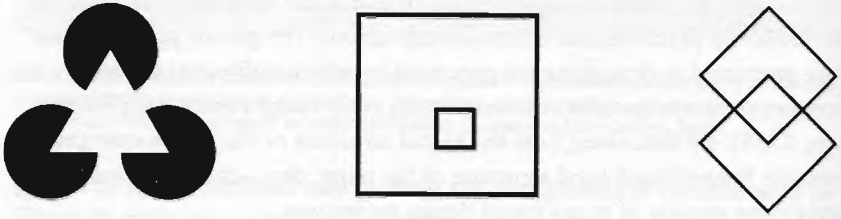
The principle of *proximity* describes the tendency of individual elements to be associated more strongly with nearby elements than with those that are farther away. This phenomenon can be observed on two different levels in Figure 97(a). They eye organizes the dots first into four vertical columns because the horizontal separation is much greater than the vertical separation. Then, because the separation between the middle two "columns" is greater than the outer gaps, the whole figure is seen as two groups of two columns each.

The principle of *similarity* observes that elements will be associated more strongly when they share basic visual characteristics (such as the visual variables of shape, size, color, texture, value, and orientation described previously) than when they differ along these dimensions. Thus, the figure in 97(b) again appears as two groups of two columns each, despite the fact that the inter-element and inter-column spacings have now been equalized.



97: Gestalt grouping phenomena: proximity (a), similarity (b), and continuity (c).

The principle of *continuity* describes the preference for continuous, unbroken contours with the simplest possible physical explanation, rather than more complex but equally plausible combinations of more irregular figures. The form in Figure 97(c) is thus perceived as two crossing lines rather than four abutting lines or two (or even four) opposing angles. The related principle of *closure* describes the powerful human tendency to interpret visual



98: Gestalt phenomena in form perception: closure (a), area (b), and symmetry (c).

stimuli as complete, closed figures, even when some of the necessary contour information is absent. Figure 98(a) is easily seen as a triangle superimposed on three complete circles even though neither of these forms is technically present. This example also has the interesting quality of *figure-ground reversal*, in which the viewer's visual attention alternates between the white triangle and notched black circles (98-a). Either (or both) can be viewed as the *figure* – the object of interest – or the ground on which the figure rests. As we shall subsequently see, this phenomenon can be used to great effect in producing engaging graphical identities and effective window layouts.

Returning to the grouping principles, the principle of *area* states that the as a smaller of two overlapping figures will tend to be interpreted as figure while the larger is interpreted as ground. In Figure 98(b), the inner square is

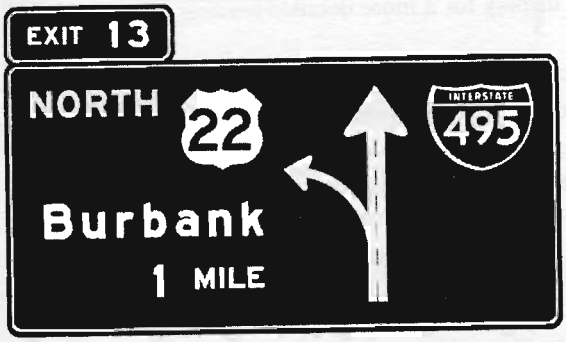
perceived as a distinct form in front of a larger square instead of a hole in the larger form. Since these phenomena appear in virtually every design problem, the successful designer must take care to ensure that the emergent structure works to reinforce the function of the display.

Finally, the principle of *symmetry* describes grouping based on the emergent properties of the form instead of the characteristics of its constituent parts. The greater the symmetry of a possible figure, the more likely we are to use it as our interpretation of the gestalt. Figure 98(c) is thus seen as two (overlapping) rather than three objects. This claim has received solid empirical support in recent years (Hochberg and McAlister, 1953, Hemenway and Palmer, 1978). Forms with a high degree of "figural goodness" are rated more highly and perceived more readily than weaker, more ambiguous forms.

Principles

Grouping
Hierarchy
Relationship
Balance

Organization and visual structure are the staples of successful communication-oriented design. Whereas scale, contrast, and proportion can be elusive, unpredictable, even capricious, organization and visual structure are based on steady, reliable methods that can be applied time and again in the same familiar way. Organization begins with classification, which involves *grouping* related elements and establishing a *hierarchy* of importance for elements and groups. When this hierarchy is clear, the display itself can be structured to reflect the *relationships* between the elements while maintaining a pleasing *balance* in the resulting composition.



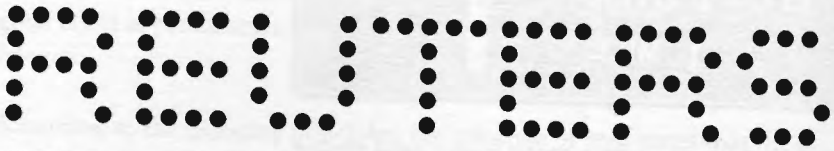
99: The U.S. Interstate Highway signage program makes effective use of perceptual grouping and information hierarchy. The eye is drawn immediately to the city name and route numbers.

100: The button layout in this Sony Mini-Disc player illustrates effective grouping based on proximity, similarity, and continuation. Some groupings are reinforced by physical borders. Courtesy of Sony Electronics, Inc.

Grouping

The first step in the development of structure is the grouping of display elements into higher-order units. The words in a book, for example, are grouped into columns, sections, pages, etc. By grouping similar elements together, the designer helps the user deal with a complex information display by reducing it to a manageable number of units. Higher level structures orient the user and help them establish a plan for moving the attention to some interesting portion of the display for a more detailed reading.

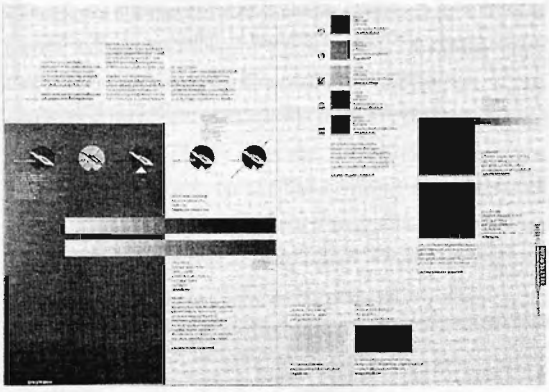
Several of the *gestalt* effects – including proximity and continuity – are exploited in the Reuters logotype (101), which brings to mind the punched tape motif from the early news ticker. In addition to producing a unique graphical effect, the forms underscore the historical cachet of the well-



101: The familiar logotype for the Reuters news service depends on several Gestalt grouping phenomena (proximity and continuation) that turn a dot pattern into a word. Design by Pentagram.

known firm. Effective perceptual grouping is always based on the Gestalt principles. Powerful grouping of individual elements can be seen in the Sony MiniDisc recorder (100). The controls on this device group naturally due to the high degree of similarity (in terms of shape, size, color, and surface texture) within groups and the generous spatial separation between groups (i.e., proximity *within* groups). The shallow, dished-out "bounding boxes" surrounding each control group serve more as a sensuous accent than a functional grouping device in this product design.

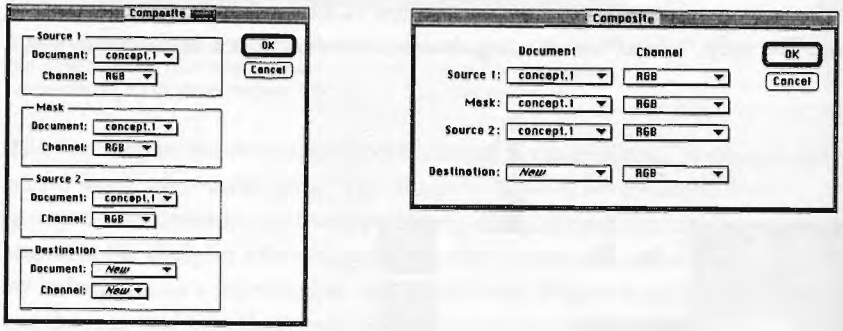
The standards manual for the Berlin Transit Authority (BVG) in Figure 102 also makes heavy use of proximity and similarity (the two most powerful and general grouping principles), but it shows effective perceptual grouping based on continuity as well. The groups break the page up into several regions of interest, allowing the viewer to easily select a "topic" for more detailed examination. Because the types of information in each group are fairly obvious – even at a distance it is easy to recognize groups dealing with color schemes, identity symbols, etc. – there is little need for explicit labeling. The only "added" structuring device is the dark block in the lower left-



102: Elements group naturally based on similarity and alignment ("common fate") in this spread from a standards manual for the BVG Potsdam lines. Courtesy of MetaDesign.

hand corner. This element shows the effect of the visual identity on a dark background and is exploited compositionally as an important part of the spread's overall structure. Note the operation of continuity in allowing the eye to group the horizontal rows of circular identity marks and the value scales below them as individual objects extending "over" the darker field.

The user interface designer rarely enjoys the luxury of negative space to the extent seen in the BVG standards manual. Proper use of spacing and alignment, however, can produce grouping that is just as effective. This dialog box from Adobe Photoshop (103–a) uses explicit bounding boxes to organize eight vertically stacked controls into four pairs. This arrangement is difficult to scan because the alternating displays cannot be easily isolated perceptually. Because the task may involve comparing adjacent rows or ignoring intervening rows, there is no ordering of the controls that would not produce some interference. The problem, however, is easily solved by simply realigning the controls into a two-column layout (103–b) that puts the image components on the left-hand column and the corresponding alpha channels in a right-hand column. The improved *spatial logic* of this reorganized display allows the bounding boxes to be removed, the secondary labels consolidated, and the group labels moved into the right-hand margin, where they are much easier to scan.



103: This before-and-after example shows ineffective grouping with explicit bounding boxes (a) and effective grouping without explicit reinforcement (b). Spatial logic (i.e., coding based on position) is always more powerful than graphical embellishment at producing effective perceptual grouping.

Grouping in interface design is always used to bind functional units tightly together while distinguishing them from the surrounding controls. The same Gestalt principles can be applied to ensure effective grouping without heavy boxes and borders. When properly established, groupings can be recognized immediately and effortlessly by the user because they depend on visual phenomena operating below the level of conscious attention.

104: Strong scale contrasts in the typographic elements of this booklet cover lead the eye through the composition to create an effective information hierarchy. Courtesy of MetaDesign.

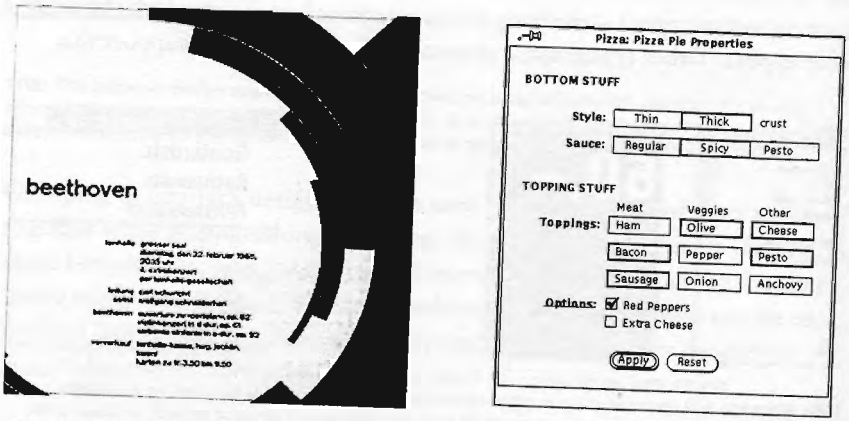
Hierarchy

As groupings are established, they must–by manipulating the visual variables described by Bertin (1985)–be ordered in a hierarchy of perceptual prominence corresponding to the intended reading sequence. These examples from the public information system for the Berlin Transit Authority (BVG) show a clear typographic hierarchy reinforced by strong graphical elements. The booklet above (104) uses the monumental scale and oblique orientation of the "B" letterform to set the context for the rest of the design. This is the most important signal identifying the geographical region to which the timetable applies. Other typographic elements in the background support this

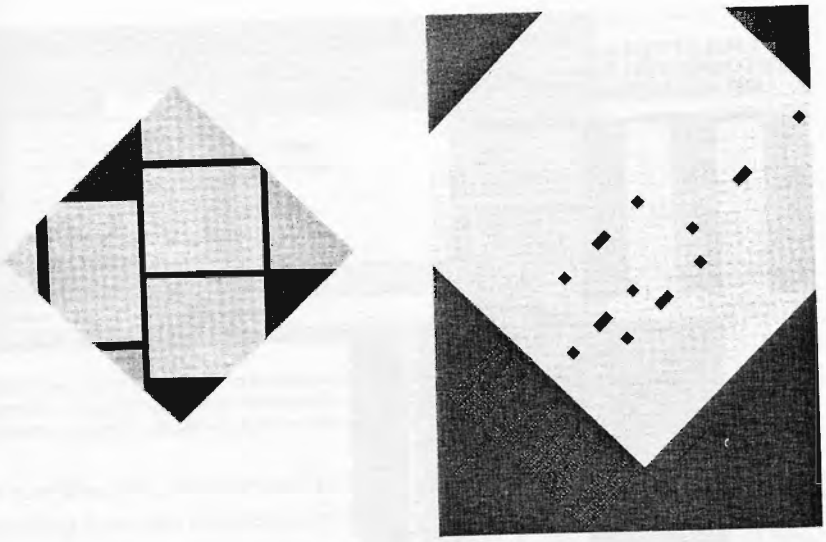
105: Although size contrast is the most powerful tool for creating visual hierarchies, contrasts in position and value (the other *ordered* variables in human vision) can be used as well. In these print collateral (a,b) and signage (c) examples from MetaDesign's BVG program, the prominence of the yellow bar depends on position and value, both of which are superceded by the large "60,-" in (b).

global reading with more detailed information at a lower level of perceptual prominence. The yellow rectangular element at the upper right is a motif recurring throughout the program (see examples in 105 also). It groups visually in the middle of the information hierarchy with the BVG mark appearing directly below and the marks for the various modes of transportation covered in this booklet. Finally, two additional levels of typographic coding based on size appear in white superimposed against the larger background elements to specify the precise content and applicable dates. The printed materials below (105) show comparable hierarchies based on contrasts in position and value.

Poster design has always been focused on the creation of effective information hierarchies. The most important elements must be large enough to draw the viewer in close, to a point where the specifics can be presented. This detail from a concert poster by Josef Müller-Brockmann (106–a) shows an elegant typographic hierarchy with three levels based on contrasts in size and position/alignment. These same typographic conventions can be adapted directly to the presentation of information hierarchies in user interfaces The standard labeling practice for property windows in the OPEN LOOK GUI (106–b), for example, is remarkably similar. Though the contrasts in typographic scale are less extreme, the global context is again established by the larger, darker label in the upper left of each region, while the shorter, right-aligned labels provide a local context for the denser, left-aligned information on the right.



106: An effective typographic information hierarchy based on size and position is apparent in this detail from a poster by Josef Müller-Brockmann (a). The same approach is used to visually encode the information hierarchy in the labeling standards for the OPEN LOOK property window (b).



107: Structural relationships in, *Lozenge with Blue, Red, and Yellow*, by Piet Mondrian (a) are made explicit by the lines dividing the composition. © 1993 Estate of Piet Mondrian/E.M. Holtzman Irrevocable Trust.Though entirely implicit, relationships between elements are equally important in this concert poster from the Musica Viva series by Josef Müller-Brockmann (b). (See also color plate 6).

Relationship

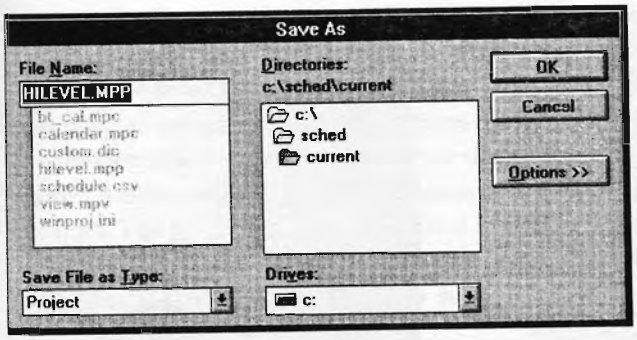
Grouping and hierarchy are both supplemented and reinforced when elements are visually related to one another. Relations between elements can be based on any of the visual variables, but the dominance of position, size, and value provide the most effective visual cues. Of these variables, position in the two-dimensional plane is the most useful. The eye is very sensitive to alignment, as witnessed by the Gestalt phenomena of "good continuation" and "common fate" (97). Position can also be manipulated independently of each element's semantics, since other visual variables have a larger impact on the salience of the elements to which they are applied.

The De Stijl painter Piet Mondrian made visible all of the structure in his abstract compositions using explicit lines (107–a). The seemingly simple forms are in fact carefully related to one another in size, proportion, and position within the composition. The concert poster by Josef Müller-Brockmann (107–b) occupies the opposite extreme by implicitly suggesting strong relationships even across large amounts of space without the use of explicit internal structure. Subtle alignment of the poster's elements is enough to suggest the structured aspect of music without reducing the sense of freedom and energy. Even more complex internal structure is apparent in the poster

108: Relationships among elements in this poster by Piet Zwart create a captivating internal structure providing many pathways for the eye. © Piet Zwart/VAGA, New York 1993.

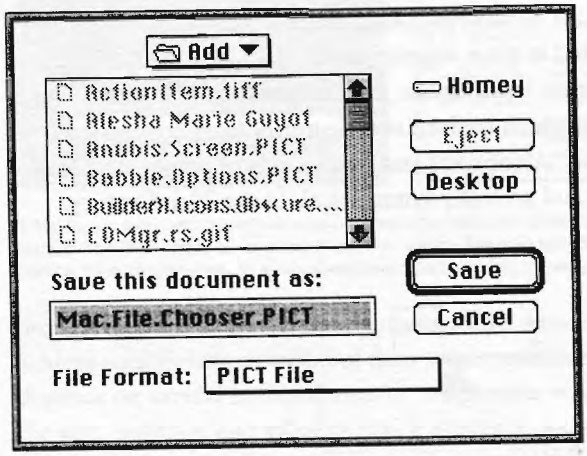
for a film festival by Piet Zwart (108). Every element is related to at least one other element, but the relationships are always implied, based on alignment along critical margins, rather than explicitly reinforced through the introduction of external elements.

Window layouts in graphical user interfaces can make use of the same principles of visual relationship based on alignment and similarity of form. While these effects are exploited automatically at the lowest levels (the items in a scrolling list, for example, are pre-aligned by the UI toolkit), developers must establish higher level relationships themselves. The spatial logic of a layout can help reveal the underlying semantic relationships of the individual components, but only if the visual relationships are carefully manipulated. When properly executed, the meaning of each element is implied by its location relative to its surrounding elements, and the need for explicit labeling is reduced.

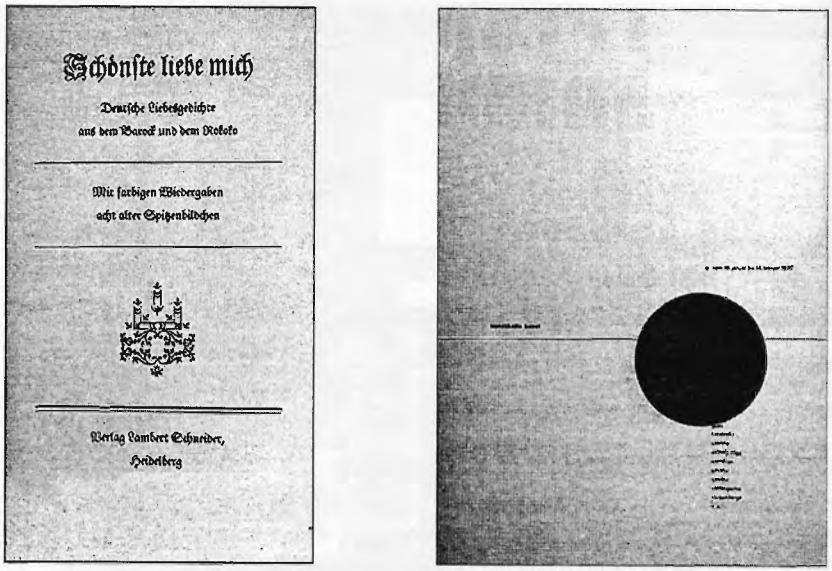


109: Poor use of *spatial logic* in the layout of components can obscure their semantic relationships. In the Windows file selector, the spatial ordering of filename, directory, and drive reverses the concepts' logical precedence.

In the Windows File selector (109), for example, the sequence of controls (reading from top to bottom) provides a poor spatial analog to the logical information hierarchy (volume, directory path, directory contents, and filename). Its ordering of components is the reverse of the normal scanning order for the window, and additional, lateral motion is needed to take in the entire hierarchy. The Macintosh equivalent (110)uses a more compact, natural arrangement in which elements are scanned in an order corresponding to their position in the hierarchy. The perceptual salience of the pre-selected filename draws the eye "through" the hierarchy on its way to the textfield.



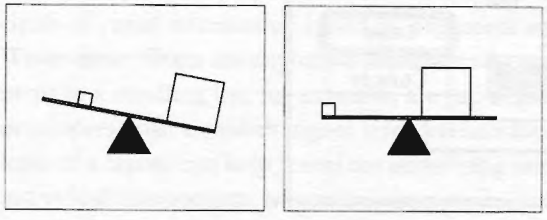
110: The Macintosh file selector places directory, contents, and filename in the correct spatial relationship. It also relates the Save command to its argument and the directory to its containing volume.



111: Balance in classical composition (a) is purely symmetrical, restful, and monumental. The *New Typography* of the 20th century (b) uses asymmetrical layouts to create more complex, task-oriented relationships among elements, but balance must still be maintained. Both designs by Jan Tschichold.

Balance

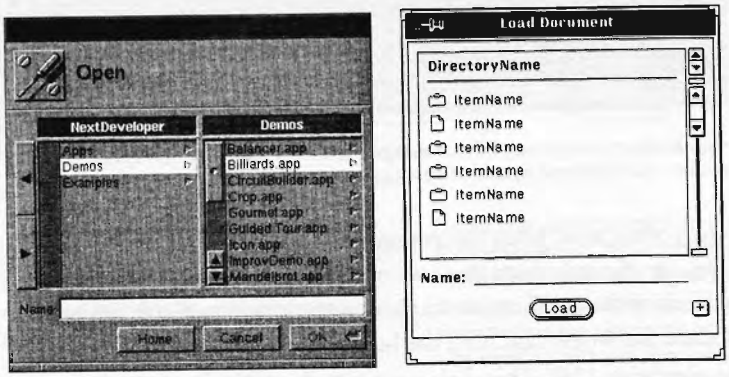
All of the previous goals must be accomplished while maintaining an harmonious global arrangement of the elements in the composition. The quality of *balance* ensures that the display remains stable in its position on the page or screen. Balance can be achieved using either symmetric or asymmetric layout, as demonstrated in these sharply contrasting yet equally striking designs by the great German typographer Jan Tschichold (111). Classic display typography (111–a), which evolved over centuries from conventions originating in monumental inscriptions and other forms of public proclamation, is simple, centered, and perfectly symmetrical. In the 20th Century,



112: Balance in a composition is analogous to balance in physical quantities. Smaller elements can offset the "visual weight" of larger elements if placed higher in the picture plane and farther from the compositional center of balance.

typographic designers discovered the greater vitality and inherent visual interest provided by active, asymmetric layouts. The resulting "New Typography" introduced the revolutionary form language seen in Tschichold's poster for an exhibition on Constructivist art (111–b), which exploits a dynamic asymmetrical composition to create an appropriate (for the subject matter) tension without producing a sense of instability within the space it occupies. The *felt axis* of the composition is moved well to the right of center, but the horizontal rule and outlying element on the left provide the counterweights needed for a well-balanced display.

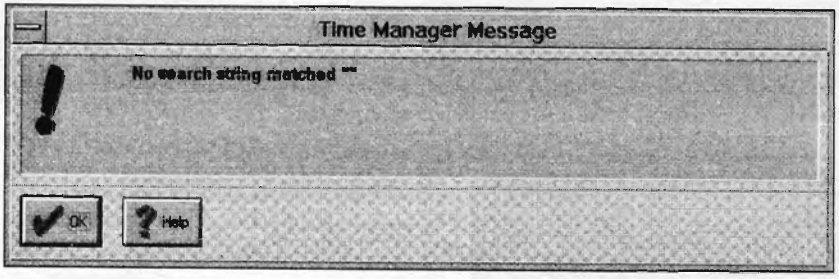
Balance in display design is analogous to balance in everyday physics. A composition is balanced when the visual weight of design elements on either side of the composition are approximately equal. The visual weight of the composition is distributed across the center of balance (the "fulcrum" in the physical analogy) like the weights on a scale (112). When the visual weight and distance from the center of elements on each side of this axis are physically equal, the impression of balance is guaranteed. Symmetrical layouts



113: Axially symmetrical layouts ensure acceptable balance in these secondary window layouts from NeXTStep (a) and the OPEN LOOK GUI (b). The axis of symmetry can be vertical (b) or diagonal (a), so long as elements are balanced properly about it.

provide this visual equilibrium automatically. Asymmetrical layouts can achieve equilibrium as well, but their tenser, more dramatic form of balance, depends on careful manipulation to compensate visually for differences in the size, position, and value of major elements. As with a physical balance, lighter elements can balance heavier elements if their size or value (visual weight) is increased, or if they are moved farther from (or the heavier element moved closer to) the center of balance (112-b).

Window layout brings balance issues to the forefront of GUI design. Button placement policies, in particular, can affect the balance of the resulting displays. The large icon in the upper left-hand corner of the NeXTStep File selector (113-a) effectively balances the dialog's response buttons in the lower right-hand corner to produce a layout that is balanced along on a diagonal, rather than a vertical axis of symmetry. Other GUI standards such as OPEN LOOK (and particularly OSF/Motif) favor highly symmetrical window layouts by distributing response buttons in secondary windows and dialog boxes evenly across the bottom of the window (113–b). In practice, windows in most GUI applications are so over-crowded that balance is outweighed by more serious problems.

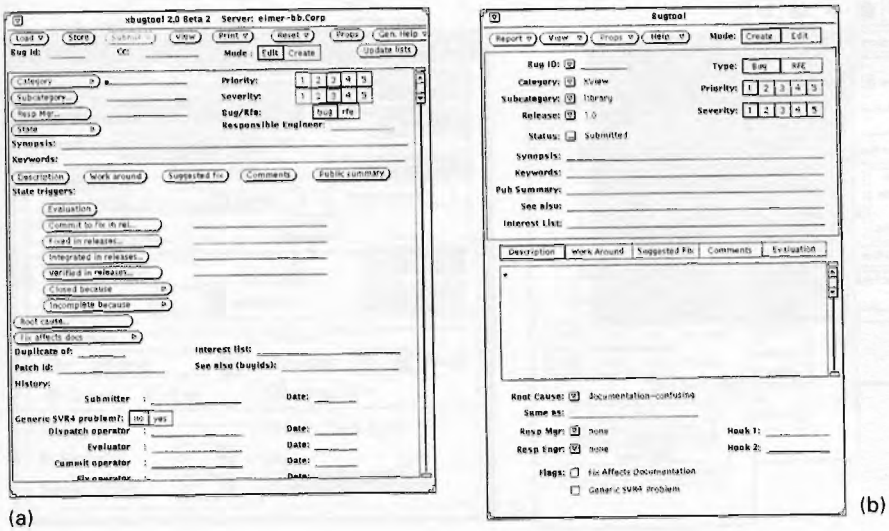


114: Using a "worst case" window size for all messages, as in this dialog from Time Manager for Windows, often leads to unbalanced layouts when messages are very short.

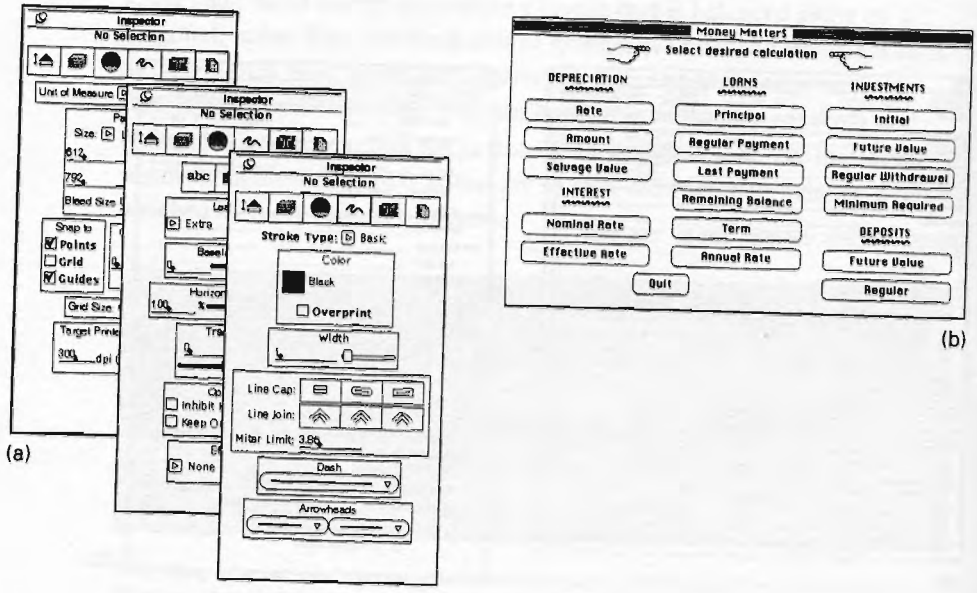
An exception is often seen when the amount of information presented in a window varies significantly from one presentation to the next. This problem is especially likely if the application employs a static window size designed to accommodate the worst case (i.e., the largest amount of information) presentation scenario (114). This dialog always places the response buttons and condition code on the left-hand side of the dialog. It leaves plenty of room for the text of the error message or warning. Unfortunately, this means that the window will go out of balance occasionally, particular when the message is as brief as the example shown here. Balance can be improved in these situations by *anticipating* the potential for empty space in the variable portion of the display and adjusting the fixed elements accordingly. Simply repositioning the response buttons in this dialog in the lower right-hand corner, while it would not address the problem of an overly lengthy default dialog size, would effectively balance the window even for messages as short as the one shown here.

Common Errors

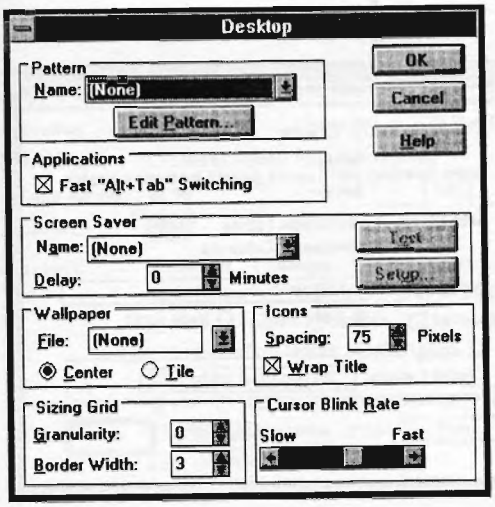
Common shortcomings in organization and visual structure result from a failure to establish high-level regularities in the display by relating individual components. Some typical mistakes include:



115: *Haphazard layout.* The most common problem of visual organization is without a doubt the failure to establish or reinforce logical relationships among components by establishing spatial relationships within the design. This original window layout (a) for an internal software defect tracking system (essentially the front-end to a highly structured database) suffers from a poorly organized structure in which weak relationships are established within the major component groups and practically none are established across groups. Note especially the distracting effect of the varying widths of the vertically stacked buttons. The existing design was improved considerably by reorganizing its contents and establishing stronger relations among the elements (b). Alignment was used to create a strong vertical axis along which the primary fields were positioned, as well as a subordinate axis on the right-hand side of the window for secondary controls.



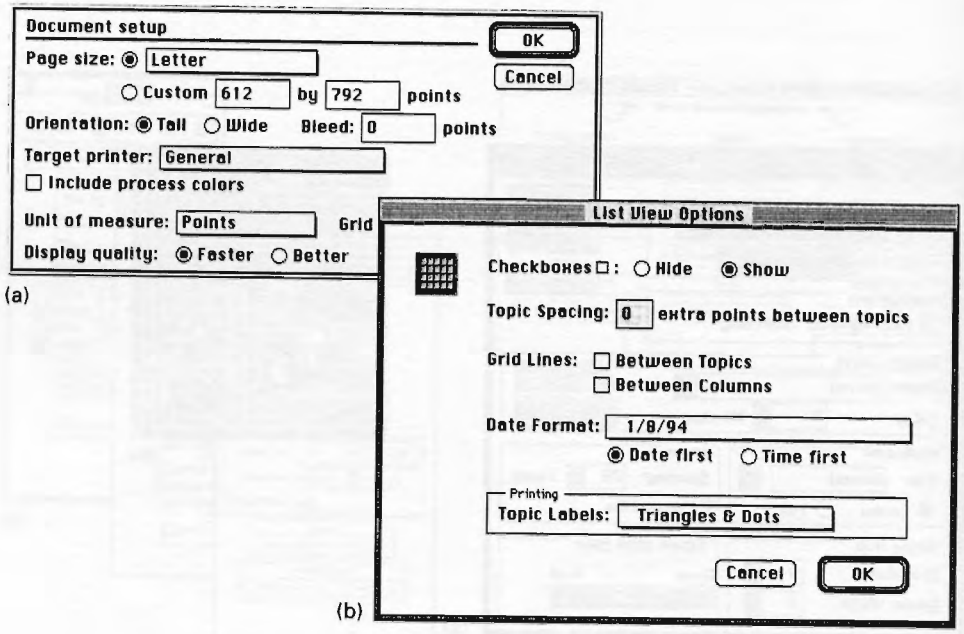
116: *Conflicting symmetries.* While symmetry can be useful as an organizing technique, it will not rescue a display from more serious internal problems. In both of these examples, the perceptual interaction between the information content and the closely spaced boundaries (button labels on the right and bounding boxes on the left) create a distracting "beat" that prevents the symmetry of the overall display from emerging. Unlike Tschichold's monumental frontispiece (111) the example on the left (a) features elements whose boundaries–but not their contents–are arranged symmetrically. In addition, the distraction produced by the unrelated widths of these hard-edged borders is heightened by their spatial proximity. The eye is drawn involuntarily to the mesmerizing outer contour of the centered bounding boxes, where sharp contrasts and intriguing spatial tensions have been unintentionally created. While the button labels on the right do not share a similarly noisy contour, they nevertheless how difficult scanning a column of vertically-centered labels becomes as soon as the labels are placed inside of buttons in multiple columns.



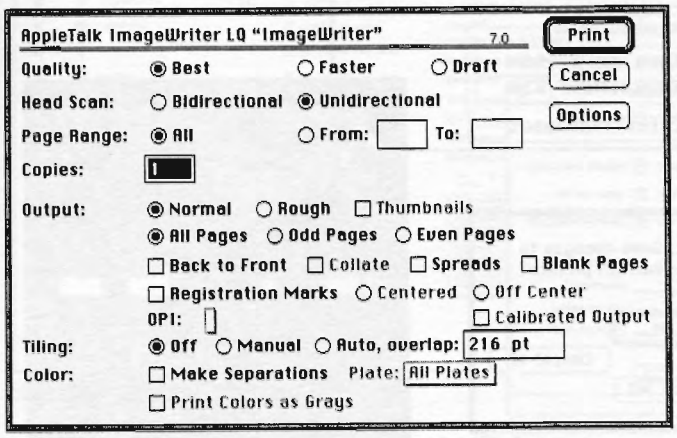
(a)

(b)

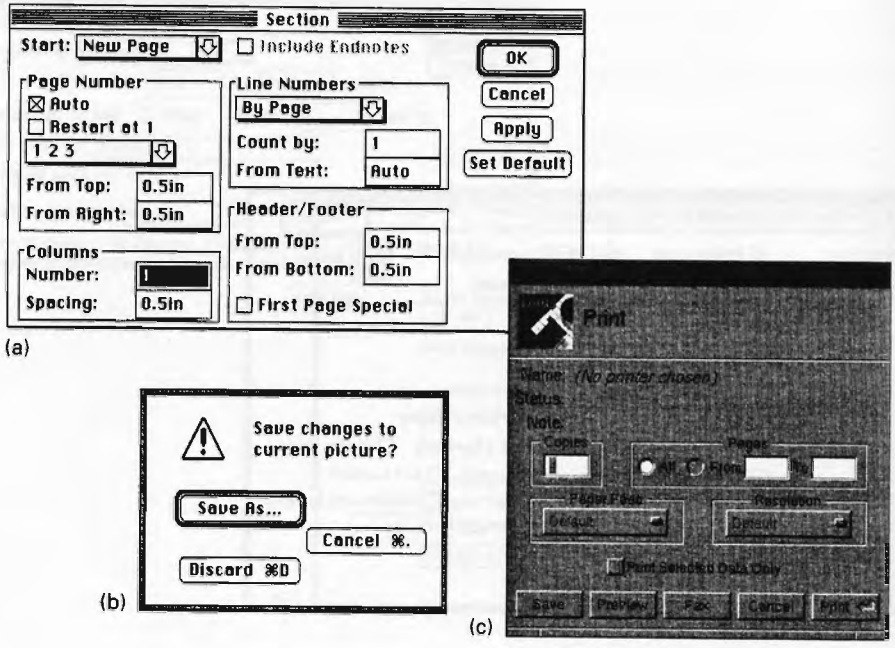
117: *Ambiguous internal relationships.* Both of these examples contain elements whose sizes and positions are similar, but not identical. The consistent placement of some internal margins only serves to increase the prominence of the many elements that are almost–but not quite–in alignment. In the Desktop Properties dialog (a), the careful alignment, both horizontally and vertically, of the bounding boxes is squandered in the completely haphazard arrangement of their contents. There is no apparent consistency in the size or placement of the individual controls, nor even in their spacing or separation from the enclosing border. In addition, the positions of many elements are similar enough to create the almost-alignment phenomenon. Labels within each group, for example, are inset ever-so-slightly from the position of the group label appearing in the bounding box. The difference is not great enough to produce an effective perceptual distinction, but it is enough to be noticeable and distracting. The same is true of the two pushbutton groups and the prominent "column" of three-dimensional controls in the middle of the window. The almost-alignments are even more pronounced in the detail from Dashboard for Windows (b). While the vertical divisions are relatively uniform, the horizontal divisions on which elements in the three "rows" are positioned are essentially random.



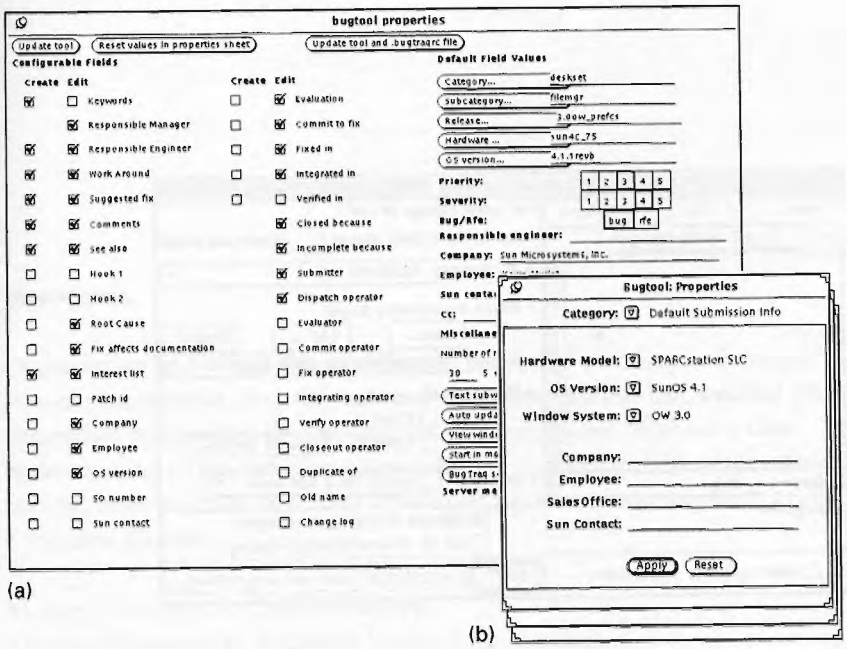
118: *Aligning labels but not controls.* Potentially useful internal structure is often squandered by failing to consider the natural margins within the layout. The controls in Aldus Freehand's Document Setup window (a) are dutifully aligned on the left (though note the intrusion of the check box) to make scanning for labels relatively straightforward. Unfortunately, the controls simply begin immediately after the label so that the controls themselves do not align with one another. This muddies the image of the dialog box and makes scanning for current values much more difficult than it needs to be. The List View Options window, from InControl (b) suffers from the same problem. In this case, however, the generous use of white space and otherwise sensible organization act to exacerbate the problem. Functionally, this arrangement is undoubtedly superior to the Document Setup example, but from an aesthetic standpoint, the general quality of the rest of the layout makes the failure to establish alignments even more prominent than it might otherwise have been.



119: *Alignment within but not across controls.* Even when strong margins are established for both labels and controls, problems can arise when potential margins within controls are ignored. The Apple Imagewriter LQ dialog shown here wastes the beginnings of a promising layout in the upper half of the window by permitting the internal control layouts to degenerate into total chaos in the lower half. Although the labels and controls have been neatly aligned at the highest level, the dialog is made unnecessarily difficult to scan by the density and lack of internal organization of the control groups themselves. Note too, the curious divergence from the standard Macintosh Print dialog ordering. Restoring the "Page Range" and "Copies" items to their standard positions on the first line would reclaim valuable space and allow the lower portion of the window to be structured more effectively.

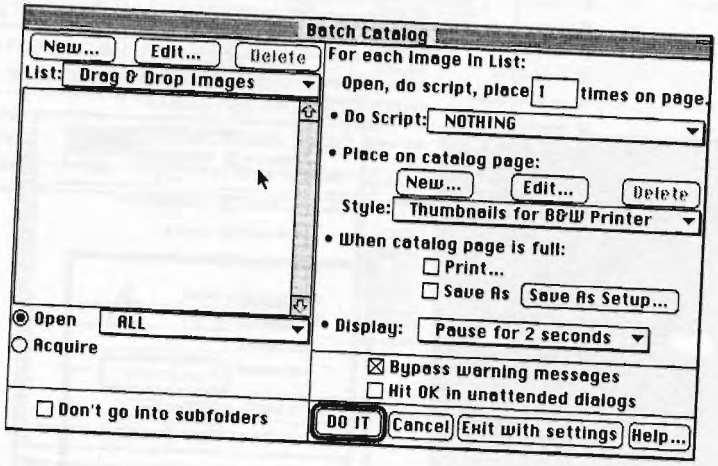


120: *False structure.* To relieve excessive display density (see facing page), many applications make heavy use of bounding boxes to more strongly group subsets of the window content. While the practice is encouraged by many environments, it should be used with restraint, since explicit structure is a very poor substitute for effective spatial segregation. This approach rarely rescues the layout and usually introduces new problems, such as the narrow gaps between the bottom of the textfields and the bounding boxes in the Section dialog from Microsoft Word (a). Under the influence of the black lines on either side, these 1-pixel gaps take on a gray tone and become emergent visual cues that compete for the user's attention as energetically as those denoting the relevant information. The bounding approach descends into absurdity when, as in the NeXTStep Print dialog (c), the boxes are used as grouping devices wherever an external label is required. Bounding boxes for single-item groups introduce more confusion than they alleviate. False structure can also arise from unintended configural effects, such as those seen in the strange confirmation dialog from DeBabelizer (b). While the layout succeeds in its main goal of being visually arresting, the highly unconventional button arrangement is exceedingly disruptive, since it breaks with both the visual language and the interaction pattern of the normal style.



(a) (b)

121: *Excessive display density.* Instead of increasing efficiency, forcing too much information into too little space typically results in a useless display. The large property window in the example above (a) originally filled an entire 19" workstation display. In an effort to circumvent this problem, the size for the controls and their label font was reduced to below normal so that the window consumed "only" 75% of the display. These changes, however, made the window harder to read and led to side effects in the alignment of elements in the right-hand column. The redesign (b) removed some functionality that had been rendered unnecessary by the restructuring of the primary window that was previously configured by these settings. The remainder of the information was reorganized into a single small window containing three separate "panes"–each containing a closely related subset of the information–between which the user can easily move using standard navigation techniques. (For views of the individual panes in the redesign, see Figure 175).



122: *All of the Above.* This amazingly unstructured layout violates nearly all of the principles we have described thus far. The exceedingly dense display has multiple areas of extreme spatial tension produced by elements that nearly touch the borders of one another or of their containing element. The radio buttons on the left, the pop-up menus on the right, and the buttons in every location, are all close enough to the adjacent visual elements to produce the kind of emergent perceptual effects seen in the Microsoft Word Section dialog (120-a). Dark patterns produced in the gaps between closely spaced elements begin to compete with the elements themselves for the viewer's attention. The presence of explicit structural elements (dividing lines) in the bottom portion of the display, far from clarifying the logical structure of the remaining elements, simply adds more spatial tension and nearly-aligned positioning to the confusion already rampant in the rest of the window.

> Just as in nature systems of order govern the growth and structure of animate and inanimate matter, so human activity itself has, since the earliest times, been distinguished by the quest for order.
>
> **Josef Müller-Brockmann**
> Grid Systems in Graphic Design

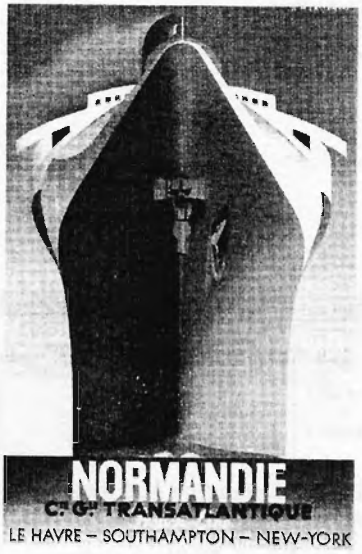
Techniques

Symmetry
Alignment
Optical Adjustment
Negative Space

Organization and visual structure depend on careful planning and meticulous implementation. It is also assumed that prior analysis has revealed the conceptual structure of the information being presented. Without a clear understanding of the, effective organization is impossible. Given this information, however, four important techniques for structuring the display can be applied directly:

- Using Symmetry to Ensure Balance
- Using Alignment to Establish Visual Relationships
- Optical Adjustment for Human Vision
- Shaping the Display with Negative Space

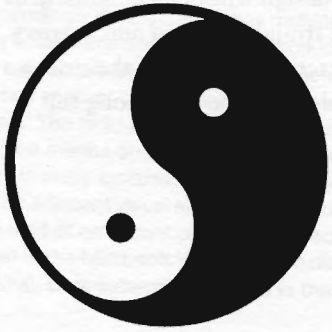
It is virtually impossible to practice competent design without a command of these techniques. Fortunately, the methods are straightforward and mastery comes quickly with even a small amount of practice. Because of their near-universal applicability to interface design problems, these are among the most valuable tools at the designer's disposal.



123: In this poster by A.M. Cassandre, a strong axial symmetry balances the composition and emphasizes the ship's prow. © 1993 ARS, New York/ADAGP, Paris.

Using Symmetry to Ensure Balance

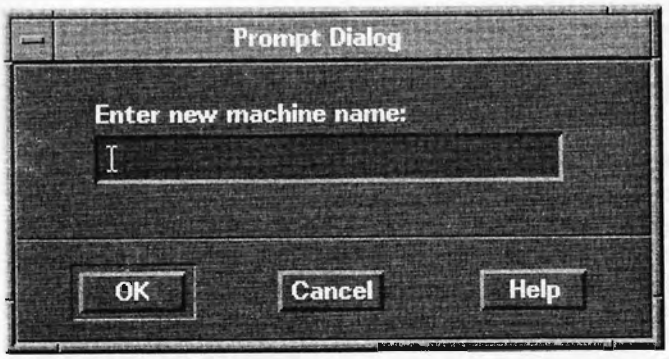
Symmetry – in all its forms – has a universal aesthetic appeal reflected in its most general connotation of *beauty as a result of balance or harmonious arrangement.* The ratio 1:1, which forms the basis of all symmetry, is easily recognized and inherently satisfying. Wherever a form is repeated, whether in translation (repetition), rotation, or reflection (mirror image), symmetry



124: The Chinese *yin-yang* symbol depends on *rotational symmetry* to evoke the impression of duality visible in its pair of opposing yet complementary forces.

acts to unify those parts of the configuration sharing similar formal characteristics. The rising popularity and effectiveness of asymmetrical layout in modern design reflects not a denial of the inherent qualities of symmetry, but rather, the need to present increasingly complex information in a task-oriented way. Symmetry remains a useful tool, particularly when the communication goal depends on balance, order, and simplicity.

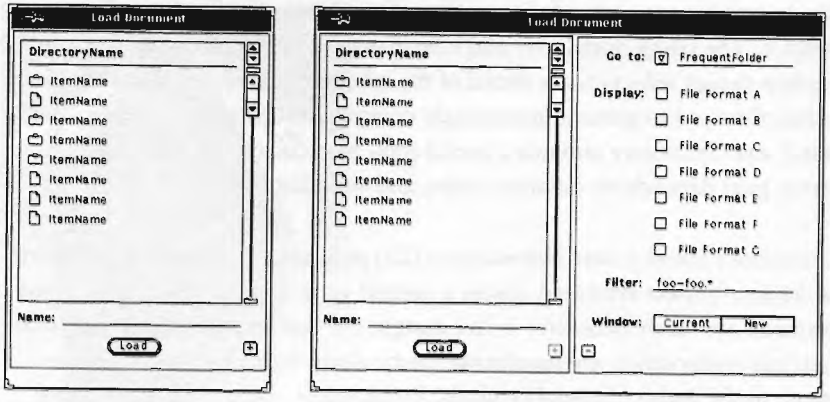
Cassandre's travel poster *Normandie* (123) presents a powerful image based on its near-perfect symmetry about a central vertical axis. While effects this dramatic are rarely necessary in GUI design, the unifying qualities of the symmetrical composition are invaluable, particularly for lower-level components. In the realm of visual symbols, for example, the most powerful and memorable signs are always highly symmetrical. The Chinese *yin-yang* (124) is a familiar symbol employing rotational, rather than axial symmetry. Other



125: GUI standards, such as OSF/Motif (others include OPEN LOOK and PenPoint), rely on axial symmetry to ensure adequately balanced dialog layouts. When toolkit-level support is provided, effective design can be surprisingly automatic.

archetypal examples are seen in the star, the arrow, the cross, the swastika, the pentagram, the smiley face. In each case, axial or rotational symmetry binds the participating visual elements together to produce a single integrated form.

Symmetry provides an effective default strategy for organizing information in GUI applications. Some GUI standards such as OSF/Motif (125) strongly encourage symmetrical arrangement of windows and dialog boxes throughout the environment. The results are practically guaranteed to succeed on an aesthetic level. When the information content is not overwhelming, the sym-



126: Symmetry about the axis of expansion enhances both the aesthetics and the understandability of multi-part windows. In the OPEN LOOK expandable window design, pressing the "+" button in the lower right(a) displays the secondary panel (b). When the widths of the panels are equalized, the axial balance of the window in its expanded state is virtually guaranteed. More importantly, the salience of the axis of symmetry enhances the division of space and accentuates the expansion and contraction buttons at the bottom-center of the window.

metrical layout provides a functionally appealing solution as well, since there is no need for emphasis or differentiation of subsets of the displayed information. Symmetrical layout simplifies the production process, whether manual or automated. For simple layout problems – such as the global organization of a dialog box – the approach is extremely effective.

For more complex layout problems, symmetry can encourage proper interpretation of the display at higher levels. The expandable pop-up window in Figure 126 divides its contents into basic (126-a) and advanced (126-b) functionality. By making the window layout symmetrical about the point of expansion, the functional division is reinforced as the visual division of the window into two equivalent spaces becomes more apparent. In addition, the symmetrical arrangement of the expansion and contraction (+/-) buttons across the axis at the bottom of the window makes their complementary role obvious without the need for intrusive verbal labels.

Symmetry ensures balance and clear organization, if sometimes at the expense of visual interest. Fortunately, the goal of effective interface design is not to entertain or excite, but to present information efficiently and non-intrusively, so the restful character of the symmetrical layout is often perfectly appropriate. Given the ease with which it can be applied, the technique is an invaluable starting point for effective design.

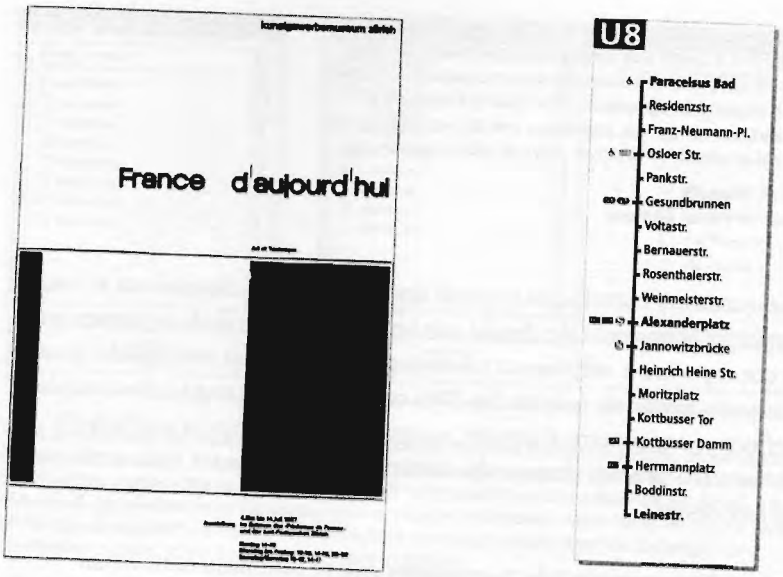
> [Symmetry] is a useful and almost foolproof method for the solution of compositional problems for the inexperienced and unskilled visual message-maker. The rules to follow are as simple and clear as can be, and if they are followed rigidly, the results are predictably attractive. You just cannot go wrong.
>
> **Donis A. Dondis**
> A Primer of Visual Literacy

Summary: Symmetry

Because symmetry contributes to good design on several dimensions at once, its prominent historical role should not be surprising. In fact, asymmetrical design concepts are a very recent phenomenon that found widespread acceptance in print materials only in the 20th century. In contrast to the complexity of effective asymmetrical layout, maintaining symmetry is a relatively straightforward process that can be used to ensure adequate balance in almost any design:

1. Identify the axes along which symmetry will be established. In visual interface design this decision usually boils down to whether horizontal and/or vertical symmetry.
2. Symmetry about the vertical axis is more prevalent in human perception and is generally more useful in visual displays.
3. Center the information on the axis of symmetry by carefully balancing the amount of information on each side of the axis. The information need not form a literal mirror image provided the mass and extent are equalized.
4. Make sure the axis of symmetry is itself centered within the overall display context (i.e., the window or icon in question).
5. Use the squint test to verify the results.

Symmetry (at least in the axial sense) need not be present in every design. It is merely the simplest of several compositional techniques for ensuring good balance. Because of their inherent stability and restfulness, heavy use of symmetrical layouts can lead to "unexciting" displays. While this may be a drawback for a poster series or a retail packaging, it is perfectly appropriate for a user interface.

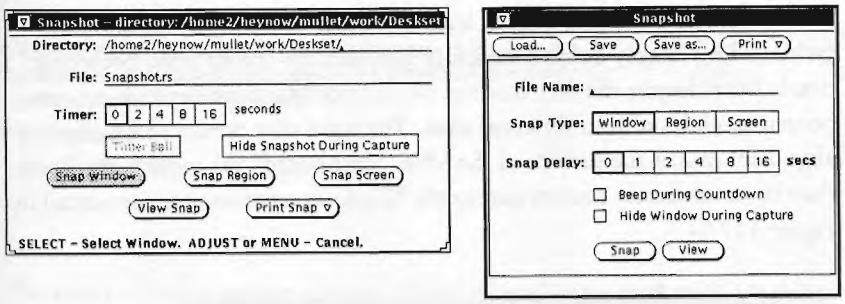


127: Alignment is used to relate elements visually in this poster by Swiss designer Gottlieb Soland (a) (From Graphic Design: Visual Comparisons by Fletcher/Forbes/Gill) and the diagram for a single *U-bahn* line(b) (courtesy of MetaDesign).

Using Alignment to Establish Visual Relationships

Effective design depends critically on meaningful global structure. Positional *alignment* of elements reduces the complexity of a display by making the global form cleaner and more understandable. By limiting exceptions to the positioning rules obeyed by elements within the composition, alignment makes intentional deviations more salient. Used in conjunction with negative space, alignment is an important tool for constructing visual hierarchies. The poster by Gottlieb Soland (127–a) uses one of the prominent internal margins in the French tricolor as a natural axis along which the bulk of the information in the poster is organized. The two pieces of text that hang to the left of this margin enjoy the highest degree of prominence available in the composition. Similarly, the route diagram for an U-bahn line on the BVG (127–b) uses vertical alignment to associate the station names to the right of the route line with the connection icons on the left.

Alignment is the most important means of establishing relationships among elements. In addition to providing the most general technique, it is among the most perceptually powerful and immediate. Objects in alignment create a strong attraction to one another even when separated by large distances. The eye exhibits a natural bias toward the perception of regular structure.



128: The redesigned layout (a) of an existing OpenWindows productivity application (b) shows the effectiveness of aligning elements to simplify the display. By re-factoring the haphazard group of five buttons at the bottom of the window (b) into two buttons and three settings–and by aligning the resulting groups–the functional organization of the tool is greatly clarified.

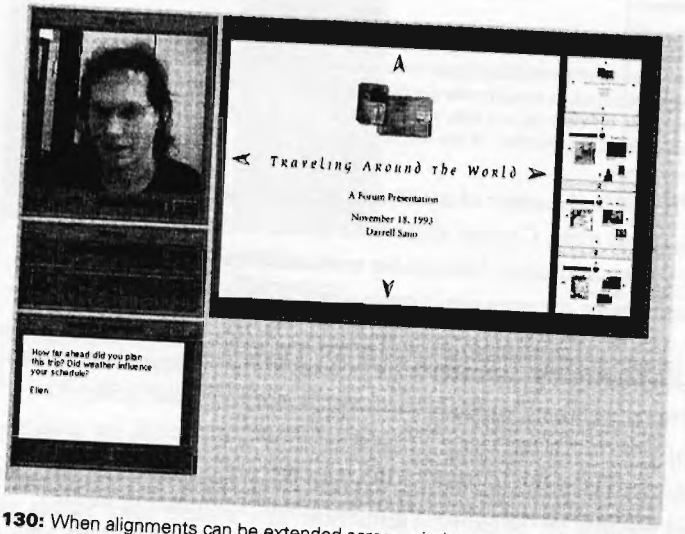
The viewer will try to make sense of an image by dividing it into regions along major structural axes. Careful alignment of elements in the display makes these axes crisp and clear. Noticeable tension results, however, when elements positioned near the axis don't quite align with it.

The additional "information" introduced by accidental and irrelevant variation in placement or sizing of interface elements is simply visual noise that inhibits communication. In the OpenWindows 2.0 Snapshot tool, for example (128-a), five buttons at the bottom of the window are positioned with no apparent spatial relation to the options and parameters appearing in the window above them. The redesigned layout created for OpenWindows Version 3 (128-b) shows the power of alignment in eliminating distracting irregularities and reinforcing meaningful relationships. In addition to replacing three of the buttons with the more appropriate exclusive settings, the design enhances the organization of the display by bringing all major commands, options, and parameters into alignment on the same vertical axis.

The tightly structured modular layout of the Workspace Manager in Hewlett-Packard's Visual User Environment (129) makes alignment almost automatic. With two minor exceptions in the lower corners, every major

129: A crisp module (see following chapter) ensures the clean alignment of elements in the *VUE Workspace Manager* from Hewlett-Packard. Compare the clear structure revealed here to the jostling confusion seen in the same company's *Dashboard for Windows* product seen in Figure 117 (b).

structural element aligns with at least one other in a simple, harmonious fashion. This crisply defined structure prevents the layout from becoming overly busy despite the fact that the Workspace Manager depends on component modules of four different sizes. The regularity produced by effective alignment makes the surface of the VUE "dashboard" far more transparent than its much busier counterpart in the Windows environment (see detail in Figure 117-b)



130: When alignments can be extended across windows in a multi-window application, the benefits of coherent visual organization accrue at a higher level.

Effective visual design establishes structural relationships wherever possible within an image or composition. When practical, structural relationships can even be extended across multiple windows in the application. The video conferencing application shown above is used to narrowcast live video over Sun's campus network. Because the individual windows are designed to relate to one another (and to the standard screen dimensions) at their default sizes, the application is far more unified, both functionally and aesthetically, than most multi-window applications. The control elements in the narrow windows on the left share a common width and internal subdivisions allowing vertical alignments to emerge naturally when the windows themselves are vertically aligned. The size and placement of the two upper windows relates them to the larger window (the main video screen) – with which they align horizontally – while helping to separate them from the transient lower window whose boundary falls on the same margin.

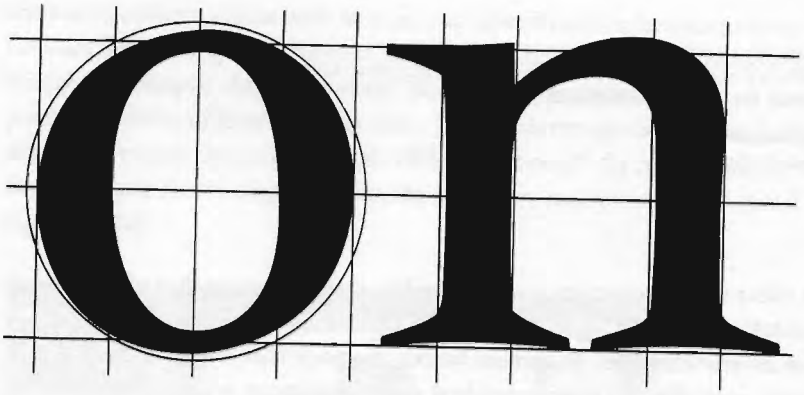
> A regulating line is a safeguard against arbitrariness. It is a way of checking a work created in enthusiasm; it is the schoolboy's proof positive, the mathematician's QED.
>
> **Le Corbusier**
> L'Esprit Nouveau

Summary: Alignment

The effect of alignment on a visual display is analogous to that of a conductor marking time for an orchestra. By coordinating the visual activity of many diverse elements, alignment works to ensure that all parts work together regardless of their individual roles. Alignment is a necessary (though not always sufficient) step toward a coherent display. This four-step technique is a good starting point:

1. Identify the major boundaries in the existing layout, and look for ways to enhance them by moving additional elements into alignment with them.
2. Look for elements and margins – both internal and external – that almost, but not quite, align with one another and bring them into alignment by altering the size or position of one or both elements.
3. Look for free-standing elements and make sure they are aligned with something else in the display – either a major margin or some other element to which they are related.
4. If an element cannot be related to anything else in the display, try to relate it to the proportions of the display itself by positioning the element to correspond to a regular division of the space.

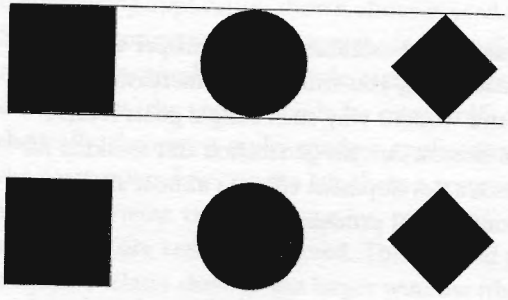
You will be surprised at how quickly the establishment of proper alignment become second nature to you. Moreover, you will become increasingly aware of disorganized layouts and wonder why such simple goals receive such a pathetic level of support in most current-generation GUI toolkits. As exasperating as it may be, the extra development effort is almost always rewarded in the visual quality of the final product.



131: Proper alignment of curvilinear elements to the typographic baseline and the x-height of a font requires compensation for optical effects. Curves must extend slightly *beyond* the point of physical alignment to create the appearance of alignment. After Ruder (1981).

Optical Adjustment for Human Vision

Visual design is grounded in perceptual, rather than physical phenomena, so compensation for the peculiarities of human vision is often required. Proper visual alignment depends critically on careful *optical adjustment* to compensate for differences in shape and contour of the elements being aligned. In typography, for example, characters with curved bottoms must extend slightly below the baseline or to the left of the column margin (131) or the line will appear to undulate in waves across the page. Optical adjustment is a general phenomenon that applies not only to alignment, but to *scaling* and *spacing* as well. Curved elements in general must project slightly farther beyond the margin than linear elements, while more acute angles must project even further to achieve the same effect. The more acute the angle, more compensation is needed to maintain the proper alignment.



132: With *physically equivalent* scaling, rounded or acute forms appear too small relative to rectangular elements.

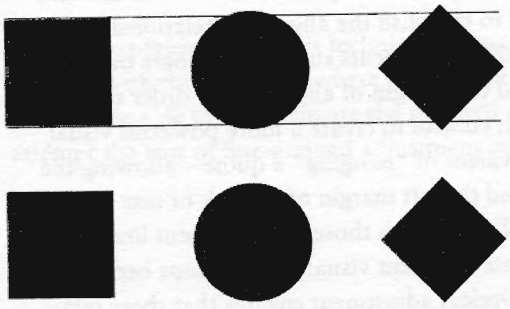
Typography Typography

Typography Typography

133: Optical spacing in typography depends not on equalizing the distance between characters (a), but on equalizing the area in the counterform between characters (b). Due to their larger counterforms, characters with curved edges must be spaced more tightly than those with straight edges.

In *optical spacing* (133), the rule of thumb is to equalize the area rather than the distance between elements. In typography, the tightest letterspacing is reserved for adjacent characters with curved edges or horizontally projecting strokes. The widest spacing is allotted to pairs with adjacent vertical stroke, with the remaining pairings falling somewhere in between. Although the phenomenon occurs most frequently in typography, the same set of issues arises whenever dissimilar forms must be evenly distributed across space.

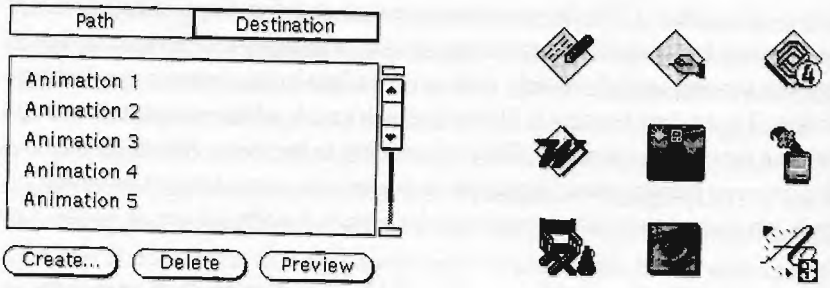
To produce *optically* equivalent scaling (132, 134), circles must be slightly larger than squares and diamonds slightly larger than circles. The examples below show the physically equivalent (132) and optically adjusted (134) versions of these shapes. This phenomenon arises frequently in icon design,



134: Extending rounded or acute elements slightly beyond the target dimension produces *optically equivalent* scaling.

where rounded or acute-edged images are combined with square images sharing the same maximum area (135). In order to match the scale of the rest of the program, square icons must be limited in size to substantially less than the maximum dimensions permitted by the icon format. The principle of acuteness applies here as well: the more acute the angle, the farther beyond the margin it must extend to be visually correct. Only icons with acute angles should be allowed to continue all the way to the limits of the image area.

Effective visual design accounts for the optical qualities of every design element and provides compensation where necessary. There is, unfortunately, no sure method for determining the necessary degree of adjustment mechanically. Careful observation and extended practice are the only routes to developing the necessary skills. Figure 135 shows examples of optical



135: Optical alignment requires that open or round-ended controls extend slightly beyond margins established by rectangular elements (a). Optical scaling suggests that rectangular images be held to less than the maximum size to avoid dominating curved or angular images in the ensemble (b).

adjustment in GUI design. The most prominent parallel axis within the interface component should be used to establish the alignment relationship. Note that for this reason, non-critical elements such as scrollbars or auxiliary buttons may project beyond the margin of alignment in order to allow the stronger contour of the main control to create a more powerful visual impression. This is the GUI equivalent of "hanging" a quote – allowing the quotation mark to extend beyond the left margin of a block of text so that the first letter of the first line will align with those in subsequent lines. The goal of effective design is to create apparent visual relationships between conceptually related elements. Optical adjustment ensures that these relationships arise when, and only when, the conceptual relationship makes it appropriate.

> Often inconspicuous, optical adjustment is the precise visual alignment of typographic elements in space... (that) is necessary for visual clarity.
>
> **Rob Carter, Ben Day, Phillip Meggs**
> Typographic Design: Form and Communication

Summary: Optical Adjustment

As evidenced by these examples, optical effects are inherent in most visual design problems. Even the familiar vocabularies of geometrical and typographic form, which we have long taken for granted, depend critically on subtle phenomena that continue to elude the naive viewer precisely *because* they are normally corrected in advance by the design professional. With the current explosion of design activity in non-traditional settings (such as software development organizations), a widespread understanding of these effects is becoming increasingly important. Regardless of the particular application, optical adjustment is a three-step process:

1. Determine the *true* point of alignment, dimension of extent, or unit of spacing required. Translate this into the "normal" margin that would be occupied by a rectangular element in the same position.
2. Extend elements beyond the margin according to the sharpness of their adjacent angle. The greater the acuteness of the angle, the farther it will need to extend beyond the "normal" margin.
3. Use a "close-up" version of the squint test encompassing only the elements in question to verify alignment with the intended margin or visual equivalence of the relevant intervals.

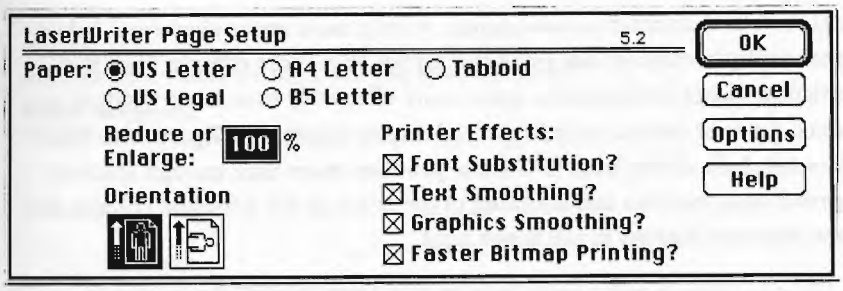
As your experience with this technique increases, you will quickly become familiar with the situations where adjustment is usually necessary. In time, you will be able to approximate the required compensation even before you attempt the sort of fine-grained adjustment described here.

131: Proper alignment of curvilinear elements to the typographic baseline and the x-height of a font requires compensation for optical effects. Curves must extend slightly *beyond* the point of physical alignment to create the appearance of alignment. After Ruder (1981).

Shaping the Display with Negative Space

Designers in every arena are frequently pressured by their clients to include as much information as possible on every page or in every screen. Particularly in user interface design, there is a heavy emphasis on utilizing every pixel. But apparently empty regions are, in fact, being utilized in a well-organized display. They play the crucial role of directing the viewer's attention to the regions where important information is provided and allowing the global structure of the composition to assume a meaningful configuration. Without *negative space* – which is simply another way of describing the figural qualities of the ground on which the figure appears – there can be no meaningful global structure.

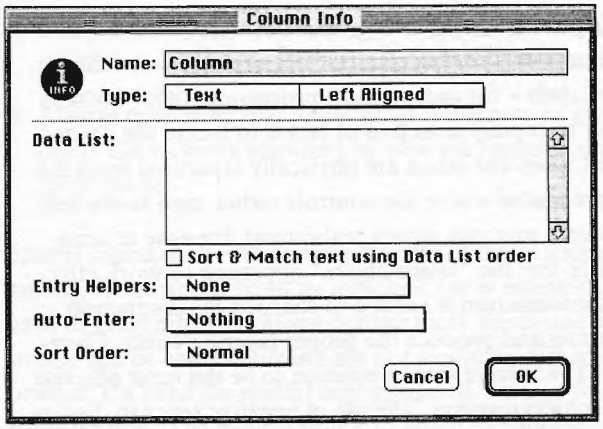
Negative space is often called "white space" in print design, where paper is the common, static background. Every competent designer knows that *white space is not wasted space* – it is a powerful tool that allows the designer to direct the viewer's attention to critical regions of the display. The "emptiness" of the left half of the poster by Josef Müller–Brockmann (136–a) focuses the viewer's attention almost involuntarily on a single line of text. Although the text is no larger or otherwise more prominent than the other information in the display its spatial isolation transforms it into the primary



137: Three large areas of negative space in the Apple LaserWriter Page Setup dialog effectively segregate the three major control groups to produce meaningful global structure.

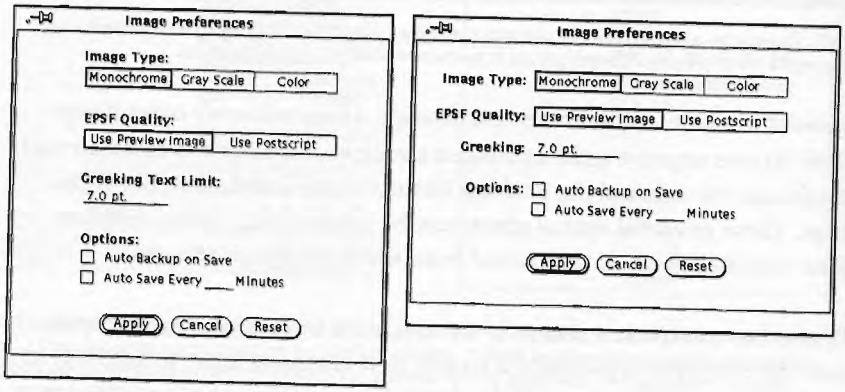
element (the title) of the entire composition. Herbert Bayer's cover design (136–b) uses negative space to create a strong vertical axis and to isolate and emphasize the title and the Bauhaus identity symbol at the bottom of the page. These powerful spatial effects can be achieved only when sufficient area remains as part of the ground from which the figure emerges.

Because screen space is always at a premium in GUI design, negative space must be employed judiciously. It's value is, if anything, greater than in print applications simply because of the dense displays. The use of negative space in the Macintosh Page Setup dialog box (137), while not as powerful as the examples on the facing page, is effective nonetheless. Here negative space is used to set off the response buttons, the printer effects options, and the criti-



138: The excellent use of negative space and alignment on the left side of this dialog (from the InControl to-do list manager) is enough to overcome the unsystematic control extents on the right-hand margin.

cal scale and orientation parameters. A little more space above and below the scaling control would make this layout even more effective, but the existing design uses negative space more effectively than most window layouts. An even more clearly organized display appears in Figure 138. The Column Info dialog from InControl provides more than enough space to permit easy location and scanning of the labels in the left-hand column and the response buttons in the lower right.



139: The importance of negative space (and alignment) in making labels easy to scan is clear in these examples. When labels are placed above controls (a), the eye must skip over the intervening elements, which can be difficult even if the labels share a selective perceptual cue (such as a bold font). Scanning is simplified when the labels are separated by non-confusable white space (b).

The OPEN LOOK property windows in the Figure 139 compare the use of value and spatial isolation in separating groups of information – in this case, controls and their labels – for independent processing. OPEN LOOK is designed to make it easy to rapidly scan lists of labels to locate the desired control. This works well when the labels are physically separated from the controls. When labels are placed above the controls rather than to the left, (as is often done to preserve precious screen real-estate), the ease of scanning suffers tremendously. For the "labels above" approach to work effectively, additional visual information is needed to sharpen the distinction between labels and controls and produce the proper layering effect. Cleveland and McGill (1984, 1985) have shown position to be the most effective coding dimension in graphical displays. The use of negative space in display design is simply the most effective means of contrasting different categories of items on the basis of their spatial location.

> Some space must be narrow so that other space may be wide,
> and some space must be emptied so that other space may be filled.
>
> **Robert Bringhurst**
> The Elements of Typographic Style

Summary: Negative Space

White space is needed for proper figure-ground integration as well as for the effective manipulation of local compositional dynamics. The eye must be directed – both globally and at each major stopping point – toward the cues needed to locate the information of interest. Careful allocation of white space is the most effective technique for achieving this goal:

1. Review the organization of the information into a prioritized set of chunks of manageable size. Note: the groups identified for techniques described previously serve this purpose as well.
2. Ensure spatial separation of independent units of information by adding extra white space between chunks. Extra space is needed even if explicit boundary delimiters are used!
3. Determine which elements – and these often include individual elements used as labels for larger, less important chunks – require additional visual emphasis.
4. Increase the white space surrounding critical elements by moving them into the margins, by moving other elements away from them.
5. Always remember that *white space is not wasted space!* Its role is to direct the viewer's attention to adjacent regions containing critical information.

Spatial segregation is the most powerful of the perceptual variables. It is also among the most costly, so its judicious use is essential. White space can be used to great effect in calling out the most important display elements when strong size or value contrasts are not available. When redundant coding is present, the need for spatial segregation decreases, though it rarely disappears entirely. The exact amount of space to allocate for display structuring is always a judgment call, but you will rarely go wrong by "calling out" the highest level of structure for which multiple tags exist within a given display.