

## **Module IV**

### **Supporting Tools**

### **Objective**

- To know how to use text in the interface
- To understand the concept of internationalism
- To get the importance of Feedback and guidance
- To know the usage of icons, multimedia and color

### **Write Clear Text and Messages**

- The wording of the interface and its screens is the basic form of communication with the user.
- Clear and meaningfully crafted words, messages, and text lead to greatly enhanced system usability and minimize user confusion that leads to errors and possibly even system rejection.

### **Words, Sentences, Messages, and Text**

- Like all aspects of interface design, knowing the user is the first step in choosing the proper words and creating acceptable messages and text.

### **Words**

- Do not use:
  - Jargon, words, or terms:
    - Unique to the computer profession.
    - With different meanings outside of the computer profession.
    - Made up to describe special functions or conditions.
  - Abbreviations or acronyms.
    - Unless the abbreviation or acronym is as familiar as a full word or phrase.
  - Word contractions, suffixes, and prefixes.
- Use:
  - Short, familiar words.
  - Standard alphabetic characters.
  - Complete words.
  - Positive terms.
  - Simple action words; avoid noun strings.
  - The “more” dimension when comparing.
  - Consistent words.
- Do not:
  - Stack words.
  - Hyphenate words.
  - Include punctuation for abbreviations, mnemonics, and acronyms.

### **Sentences and Messages**

- Sentences and messages must be:
  - Brief and simple.
  - Directly and immediately usable.

- An affirmative statement.
- In an active voice.
- In the temporal sequence of events.
- Structured so that the main topic is near the beginning.
- Of parallel construction.
- Sentences and messages must be of the proper tone:
  - Nonauthoritarian: Imply that the system is awaiting the user's direction, not that the system is directing the user. For example, phrase a message as *"Ready for the next command,"* not *"Enter the next command."*
  - Nonthreatening: errors are often the result of a failure to understand, mistakes, or trial-and-error behavior, the user may feel confused, inadequate, or anxious. Blaming the user for problems can heighten anxiety, making error correction more difficult and increasing the chance of more errors. Therefore, harsh words like "illegal," "bad," or "fatal" should be avoided.
  - Nonanthropomorphic: The best advice at this moment is do not give a human personality to a machine. Imply that the system is awaiting the user's direction, not vice versa. Say, for example, *"What do you need?"* not *"How can I help you?"*
  - Nonpatronizing: Patronizing messages can be embarrassing. *"Very good, you did it right"* may thrill a fourth-grader, but would be somewhat less than thrilling to an adult.
  - Nonpunishing: messages should remain factual and informative, and should not be punishable. Punishment is never a desirable way to force a change in behavior, especially among adults.
  - Cautious in the use of humor: Humor is a transitory and changeable thing. What is funny today may not be funny tomorrow, and what is funny to some may not be to others.

## Messages

- Messages are communications provided on the screen to the screen viewer.
- Screen messages fall into two broad categories: system and instructional.
- System messages are generated by the system to keep the user informed of the system's state and activities.
- Instructional messages, sometimes referred to as prompting messages, are messages that tell the user how to work with, or complete, the screen displayed.

## System messages.

- System messages are of several types, each reflecting a different purpose. Common message types are:
- Status messages. A status message is used for providing information concerning the progress of a lengthy operation.
- Informational messages. Informational messages, also called *notification* messages, provide information about the state of the system when it is not immediately obvious to the user.
- Warning messages. Warning messages call attention to a situation that may be undesirable. They are usually identified by an "!" icon to the left of the message.
- Critical messages. Critical messages, sometimes called *action* messages, call attention to conditions that require a user action before the system can proceed. A message describing an erroneous situation is usually presented as a critical message.

- Question messages. Question messages are another kind of message type sometimes seen. A question message asks a question and offers a choice of options for selection. It is designated by a “?” icon preceding the message text.

## Writing Message Box Text

- Title bar:
  - Clearly identify the source of the message.
    - The name of the object to which it refers.
    - The name of the application to which it refers.
  - Do not include an indication of message type.
  - Use mixed case in the headline style.
- Message box:
  - Provide a clear and concise description of the condition causing the message box to be displayed.
    - Use complete sentences with ending punctuation.
    - State the problem, its probable cause (if known), and what the user can do about it.
    - Avoid contractions.
    - Avoid technical jargon and system-oriented information.
    - Provide only as much background information as necessary for the message to be understood.
    - Show only one message box about the cause of condition in a single message.
    - Make the solution an option offered in the message.
    - Avoid multistep solutions.
    - Use consistent words and phrasing for similar situations.
    - Use the word “please” conservatively.
  - Do not exceed two or three lines.
  - Include the relevant icon identifying the type of message to the left of the text.
  - Center the message text in window.

## Message Box Controls

- Command buttons:
  - If a message requires no choices to be made but only acknowledgment:
    - Include an *OK* button.
  - If a message requires a choice be made, provide a command button for each option:
    - Include *OK* and *Cancel* buttons only when the user has the option of continuing or stopping the action.
    - Include *Yes* and *No* buttons when the user must decide how to continue.
    - If these choices are too ambiguous, label the command buttons with the names of specific actions.
  - If a message allows initiation of an action to correct the situation described:
    - Include a properly labeled button initiating the corrective action.
  - If a message describes an interrupted process whose state cannot be restored:
    - Provide a *Stop* button.
  - If a message offers an opportunity to cancel a process as well as to perform or not perform an action:
    - Provide a *Cancel* button.

- If more details about a message topic must be presented:
  - Provide a *Help* button.
- Designate the most frequent or least destructive option as the default.
- Display a message box only when the window of an application is active.
- Display only one message box for a specific condition.
- Close box:
  - Enable the title bar *Close* box only if the message includes a Cancel button.

### **Message Location**

- Use the message line for messages that must not interfere with screen information.
- Pop-up windows may be used for all kinds of messages, if available.
- Pop-up windows should always be used for critical messages.

### **Other Message Considerations**

- Abbreviated, more concise versions of messages should be available.
- Something that must be remembered should be at the beginning of the text.
- Do not include code numbers with messages.

### ***Instructional Messages***

- Provide instructional information at the depth of detail needed by the user.
- Locate it at strategic positions on the screen.
- Display it in a manner that visually differentiates it from other screen elements.
- In writing, follow all relevant writing guidelines for words, sentences, and messages.

### **Text**

Text, by a very general definition, is any textual element that appears on a screen, including field captions, headings, words, sentences, messages, and instructions.

### ***Presenting Text***

- Fonts:
  - Use plain and simple fonts.
  - Choose a minimum point size of 12 to 14.
  - Use proportional fonts.
- Width:
  - Include no more than 40 to 60 characters on each line.
    - A double column of 30 to 35 characters separated by five spaces is also acceptable.
  - Do not right-justify.
  - Do not hyphenate words.
- Content:
  - Use headings to introduce a new topic.

- Separate paragraphs by at least one blank line.
- Start a fresh topic on a new page.
- Use lists to present facts.
- Emphasize important things by:
  - Positioning.
  - Boxes.
  - Bold typefaces.
  - Indented margins.
- Miscellaneous:
  - Use paging (not scrolling).
  - Provide a screen design philosophy consistent with other parts of the system.

### ***Writing Text***

- Sentences and paragraphs:
  - Use short sentences composed of familiar, personal words.
    - Cut the excess words.
    - Try to keep the number of words in a sentence to 20 or less.
  - Cut the number of sentences.
  - Use separate sentences for separate ideas.
  - Keep the paragraphs short.
  - Restrict a paragraph to only one idea.
- Style:
  - Use the active writing style.
  - Use the personal writing style, if appropriate.
  - Write as you talk.
  - Use subjective opinion.
  - Use specific examples.
  - Read it out loud.

### ***Window Title***

- All windows must have a title located in a centered position at the top.
  - Exception: Windows containing messages.
- Clearly and concisely describe the purpose of the window.
- Spell it out fully using an uppercase or mixed-case font.
- If title truncation is necessary, truncate it from right to left.
- If presented above a menu bar, display it with a background that contrasts with the bar.

### ***Conventions***

- Establish conventions for referring to:
  - Individual keyboard keys.
  - Keys to be pressed at the same time.
  - Field captions.
  - Names supplied by users or defined by the system.
  - Commands and actions.

## ***Sequence Control Guidance***

- Consider providing a guidance message telling how to continue at points in the dialog when:
  - A decision must be made.
  - A response needs to be made to continue.
- Consider indicating what control options exist at points in the dialog where several alternatives may be available.
- Permit these prompts to be turned on or off by the user

## **Provide Effective Feedback and Guidance and Assistance**

### **Providing the Proper Feedback**

To be effective, feedback to the user for an action must occur within certain time limits. Excessive delays can be annoying, interrupt concentration, cause the user concern, and impair productivity as one's memory limitations begin to be tested.

### **Response Time**

- System responsiveness should match the speed and flow of human thought processes.
  - If continuity of thinking is required and information must be remembered throughout several responses, response time should be less than one or two seconds.
  - If human task closures exist, high levels of concentration are not necessary, and moderate short-term memory requirements are imposed; response times of 2 to 4 seconds are acceptable.
  - If major task closures exist, minimal short-term memory requirements are imposed; responses within 4 to 15 seconds are acceptable.
  - When the user is free to do other things and return when convenient, response time can be greater than 15 seconds.
- Constant delays are preferable to variable delays.

### **Dealing with Time Delays**

- Button click acknowledgement:
  - Acknowledge all button clicks by visual or aural feedback within one-tenth of a second.
- Waits up to 10 seconds:
  - If an operation takes 10 seconds or less to complete, present a “busy” signal until the operation is complete.
    - Display, for example, an animated hourglass pointer.
- Waits of 10 seconds to 1 minute:
  - If an operation takes longer than 10 seconds to complete, display:
    - A rolling barber's pole or other large animated object.

- Additionally, a progress indicator, percent complete message, or elapsed time message.
- Waits over 1 minute:
  - Present an estimate of the length of the wait.
  - Display a progress indicator, percent complete message, or elapsed time message.
  - When a long operation is completed, present an acknowledgment that it is completed.
    - A significantly changed screen appearance.
    - An auditory tone.
  - If an operation is very time-consuming:
    - Consider breaking the operation into subtasks and providing progress indicators for each subtask.
    - Allow users to start a new activity while waiting.
- Long, invisible operations:
  - When an operation not visible to the user is completed, present an acknowledgment that it is completed.
    - A message.
    - An auditory tone.
- Progress indicator:
  - A long rectangular bar that is initially empty but filled as the operation proceeds.
    - Dynamically fill the bar.
    - Fill it with a color or shade of gray.
    - Fill it from left to right or bottom to top.
- Percent complete message:
  - A message that indicates the percent of the operation that is complete.
  - Useful if a progress indicator takes too long to update.
- Elapsed time message:
  - A message that shows the amount of elapsed time that the operation is consuming.
  - Useful if:
    - The length of the operation is not known in advance.
    - A particular part of the operation will take an unusually long time to complete.
- Web page downloads:
  - For pages requiring download times greater than 5 seconds, give the user something to do while waiting.
    - Quickly present, at the top of the downloading page, some text or links.

### Blinking for Attention

- Attract attention by flashing an indicator when an application is inactive but must display a message to the user.
  - If a window, flash the title bar.
  - If minimized, flash its icon.
- To provide an additional message indication, also provide an auditory signal (one or two beeps).



- Very useful if:
  - The window or icon is hidden.
  - The user's attention is frequently directed away from the screen.
- Display the message:
  - When the application is activated.
  - When requested by the user.

## Use of Sound

- Always use in conjunction with a visual indication.
- Use no more than six different tones.
  - Ensure that people can discriminate among them.
- Do not use:
  - Jingles or tunes.
  - Loud signals.
- Use tones consistently.
  - Provide unique but similar tones for similar situations.
- Provide signal frequencies between 500 and 1,000 Hz.
- Allow the user to adjust the volume or turn the sound off altogether.
- Test the sounds with users over extended trial periods.
- Use sounds sparingly because they:
  - Are annoying to many people, including other users and nonusers in the vicinity.
  - Can easily be overused, increasing the possibility that they will be ignored.
  - Are not reliable because:
    - Some people are hard of hearing.
    - If they are not heard, they leave no permanent record of having occurred.
    - The user can turn them off

Sounds, sometimes called *earcons*, are useful for alerting the user:

- To minor and obvious mistakes.
- When something unexpected happens.
- Where visual attention is directed away from the screen and immediate attention is required.
- When a long process is finished.

## Guidance and Assistance

### Preventing Errors

- Errors can be classified as slips or mistakes. A *slip* is automatic behavior gone awry. Slips are usually, but not always, corrected fairly easily. Slips can be reduced through proper application of human factors in design
- A *mistake* results from forming a wrong model or goal and then acting on it. A mistake may not be easily detected because the action may be proper for the perceived goal—it is the goal that is wrong.



## Problem Management

- Prevention:
  - Disable inapplicable choices.
  - Use selection instead of entry controls.
  - Use aided entry.
  - Accept common misspellings, whenever possible.
  - Before an action is performed:
    - Permit it to be reviewed.
    - Permit it to be changed or undone.
  - Provide a common action mechanism.
  - Force confirmation of destructive actions.
    - Let expert users disable this.
  - Provide an automatic and continuous Save function.
- Detection:
  - For conversational dialogs, validate entries as close to point of entry as possible.
    - At character level.
    - At control level.
    - When the transaction is completed or the window closed.
  - For high speed, head-down data entry.
    - When the transaction is completed or the window closed.
  - Leave window open.
  - Maintain the item in error on the screen.
  - Visually highlight the item in error.
  - Display an error message in a window.
    - Do not obscure item in error.
  - Handle errors as gracefully as possible.
    - The greater the error, the more dramatic should be the warning.
  - Use auditory signals conservatively.
- Correction:
  - Preserve as much of the user's work as possible.
  - At window-level validation, use a modeless dialog box to display an error list.
    - Highlight first error in the list.
    - Place cursor at first control with error.
    - Permit fixing one error and continuing to next error.
  - Always give a person something to do when an error occurs.
    - Something to enter/save/reverse.
    - A Help button.
    - Someone to call.
  - Provide a constructive correction message saying:
    - What problem was detected?
    - Which items are in error?
    - What corrective action is necessary?
  - Initiate a clarification dialog if necessary.

## Providing Guidance and Assistance

- Guidance in the form of the system's hard-copy, online documentation, computer-based training, instructional or prompting messages, and system messages serves as a cognitive development tool to aid this process. So does assistance provided by another form of online documentation, the Help function.

- Useful guidance and assistance answers the following questions:
  - What is this?
  - What does it do?
  - How do I make it do it?
  - What is its role in the overall scheme of things?

## Problems with Documentation

Poor products, however, suggest that being a native speaker of the language is not a sufficient qualification to ensure communicative success. Rather, four other factors contribute to bad design.

- **Organizational factors.** First are organizational factors including management decisions concerning who does the writing: product developers or specialist technical authors. Another organizational factor
- is the frequency and nature of the contact between writers and developers.
- **Time scale.** Second is the time scale allocated for the writing process. Successful writing also involves detailed early planning, drafting, testing, and considerable revising.
- **Theoretical rationale.** Third, there is not yet a clear theoretical rationale about what content should be included in documentation and how this information should be presented.
- **Resources.** Finally, Wright concludes, there are the resources. Adequate resources are needed to include people with different skills in the documentation development process.

Another problem with documentation is created by the need for translation in our shrinking world.

## How Users Interact with Documentation

There are three broad stages through which a reader interacts with documentation:

- Finding information is enhanced through use of contents pages and index lists.
- Pictures and symbols can also be used to draw the reader's attention to particular kinds of information.
- Understanding can also be maximized through testing and revision of materials as necessary.

## Instructions or Prompting

- Instructional or prompting information is placed *within the body* of a screen. Prompting is provided to assist a person in providing what is necessary to complete a screen.
- Inexperienced users find prompting a valuable aid in learning a system.
- Since instructions or prompting can easily create screen noise, be cautious in placing it on a screen. Use it only if all screen usage will be casual or infrequent.

## Help Facility

- The most common form of online documentation is the Help system. The overall objective of a Help facility is to assist people in remembering what to do.
- One potential danger of the Help facility, as one study found, is that a person's recall of command operations is related to frequency of Help facility access; fewer Help requests were associated with better command recall.
- The specific design characteristics that enhance an online Help are still being identified. Three broad areas of Help that must be addressed in creating Help are: its content, its presentation, and its access mechanisms.
- The content (and structure) of an effective online Help can be specified using the GOMS (goals, operators, methods, selection rules) model

## Help Facility Guidelines

- Kind:
  - Collect data to determine what types of Help are needed.
- Training:
  - Inform users of availability and purpose of Help.
- Availability:
  - Provide availability throughout the dialog.
  - If no Help is available for a specific situation, inform the user of this and provide directions to where relevant Help may exist.
- Structure:
  - Make them as specific as possible.
  - Provide a hierarchical framework.
    - Brief operational definitions and input rules.
    - Summary explanations in text.
    - Typical task-oriented examples.
- Interaction:
  - Provide easy accessibility.
  - Leave the Help displayed until:
    - The user exits.
    - The action eliminating the need for Help is performed.
  - Provide instructions for exiting.
  - Return to original position in dialog when Help is completed.
- Location:
  - Minimize the obscuring of screen content.
  - If in a window, position priorities are: right, left, above, and below.
- Content:
  - Minimize the Help's length.
  - Develop modular dialogs that can be used to describe similar and dissimilar procedural elements of the interface.
  - Provide step-by-step interface procedures to assist the user with specific problems.
  - Provide procedural demonstrations of interface procedures to aid quick learning of simple operations.
  - Provide information to help users select between multiple interface methods.
  - Provide users with an understanding of representative tasks to increase their knowledge of when to apply specific skills.

- **Style:**
  - Provide easy browsing and a distinctive format.
    - Contents screens and indexes.
    - Screen headings and subheadings.
    - Location indicators.
    - Descriptive words in the margin.
    - Visual differentiation of screen components.
    - Emphasized critical information.
  - Use concise, familiar, action-oriented wording.
  - Refer to other materials, when necessary.
  - Never use Help to compensate for poor interface design.
- **Consistency:**
  - Provide a design philosophy consistent with other parts of the system.
- **Title:**
  - Place the word “Help” in all Help screen titles.

## **Contextual Help**

Contextual Help provides information within the context of a task being performed, or about a specific object being operated upon. Common kinds of contextual Help include Help command buttons, status bar messages, and ToolTips.

### ***Help Command Button***

- **Description:**
  - A command button.
- **Purpose:**
  - To provide an overview of, summary assistance for, or explanatory information about the purpose or contents of a window being displayed.
- **Design guidelines:**
  - Present the Help in a secondary window or dialog box.

### ***Status Bar Message***

- **Description:**
  - An abbreviated, context-sensitive message related to the screen item with the focus.
  - Appears in window’s status bar when the primary mouse button is pressed over an item (or keyboard focus is achieved).
- **Purpose:**
  - To provide explanatory information about the object with the focus.
  - Use to:
    - Describe the use of a control, menu item, button, or toolbar.
    - Provide the context of activity within a window.
    - Present a progress indicator or other forms of feedback when the view of a window must not be obscured.

- Do not use for information or access to functions essential to basic system operations unless another form of Help is provided elsewhere in the Help system.
- If extended Help is available and must be presented, place “Press F1 for Help” in bar.
- Writing guidelines:
  - Be constructive, not simply descriptive.
  - Be brief, but not cryptic.
  - Begin with a verb in the present tense.
  - If a command has multiple functions, summarize them.
  - If a command is disabled, explain why.

### ***ToolTip***

- Description:
  - A small pop-up window that appears adjacent to control.
  - Presented when the pointer remains over a control a short period of time.
- Purpose:
  - Use to display the name of a control when the control has no text label.
- Design guidelines:
  - Make application-specific ToolTips consistent with system-supplied ToolTips.
  - Use system color setting for ToolTips above to distinguish them.

### ***What's This? Command***

- Description:
  - A command located on the Help drop-down menu on a primary window.
  - A button on the title bar of a secondary window.
  - A command on a pop-up menu for a specific object.
  - A button on a toolbar.
- Purpose:
  - Use to provide contextual information about any screen object.
- Design guidelines:
  - Phrase to answer the question “What is this?”
  - Indicate the action associated with the item.
  - Begin the description with a verb.
  - Include “why,” if helpful.
  - Include “how to,” if task requires multiple steps.
  - For command buttons, use an imperative form: “Click this to...”

### ***Task-Oriented Help***

- Description:
  - A primary window typically accessed through the Help Topics browser.
  - Includes a set of command buttons at the top; at minimum:
    - A button to display the Help Topics browser dialog box.
    - A Back button to return to the previous topic.
    - Buttons that provide access to other functions such as Copy or Print.
- Purpose:

- To describe the procedural steps for carrying out a task.
- Focuses on *how* to do something.
- Design guidelines:
  - Provide one procedure to complete a task, the simplest and most common.
  - Provide an explanation of the task's goals and organizational structure at the start.
  - Divide procedural instructions into small steps.
  - Present each step in the order to be executed.
  - Label each step.
  - Explicitly state information necessary to complete each step.
  - Provide visuals that accurately depict the procedural steps.
  - Accompany visuals with some form of written or spoken instructions.
  - Begin any spoken instructions simultaneously with or slightly after a visual is presented.
  - Segment any animation to focus attention on specific parts.
  - Segment instructions.
  - Delay the opportunity to perform the procedure until all the procedure's steps have been illustrated.
- Presentation guidelines:
  - The window should consume a minimum amount of screen space, but be large enough to present the information without scrolling.
  - Normally, do not exceed four steps per window.
  - Use a different window color to distinguish task-oriented Help windows from other windows.
- Writing guidelines:
  - Write simply and clearly, following all previously presented guidelines.
  - Focus on *how* information, rather than *what* or *why*.
  - Do not include introductory, conceptual, or reference material.
  - Limit steps to four or fewer to avoid scrolling or multiple windows.
  - If a control is referred to by its label, bold the label to set it off.
  - Include the topic title as part of the body.

## Reference Help

- Description:
  - An online reference book.
  - Typically accessed through a:
    - Command in a Help drop-down menu.
    - Toolbar button.
- Purpose:
  - To present reference Help information, either:
    - Reference oriented.
    - User guide oriented.
- Design guidelines:
  - Provide a consistent presentation style, following all previously presented guidelines.
  - Include a combination of contextual Help, and task-oriented Help, as necessary.

- Include text, graphics, animation, video, and audio effects, as necessary.
- Make displayed toolbar buttons contextual to the topic being viewed.
- Provide jumps, a button or interactive area that triggers an event when it is selected, such as:
  - Moving from one topic to another.
  - Displaying a pop-up window.
  - Carrying out a command.
- Visually distinguish a jump by:
  - Displaying it as a button.
  - Using a distinguishing color or font to identify it.
  - Changing the pointer image when it is over it.
- Presentation guidelines:
  - Provide a nonscrolling region for long topics to keep the topic title and other key information visible.
- Writing guidelines:
  - Write simply and clearly, following all previously presented guidelines.
  - Provide meaningful topic titles.

## Wizards

- Description:
  - A series of presentation pages displayed in a secondary window.
  - Include:
    - Controls to collect input.
    - Navigation command buttons.
  - Typically accessed through:
    - Toolbar buttons.
    - Icons.
- Purpose:
  - To perform a complex series of steps.
  - To perform a task that requires making several critical decisions.
  - To enter critical data and for use when the cost of errors is high.
  - To perform an infrequently accomplished task.
  - The necessary knowledge or experience to perform a task is lacking.
  - Not suited to teaching how to do something.
- Design guidelines:
  - Provide a greater number of simple screens with fewer choices, rather than a smaller number of more complex screens with too many options or too much text.
  - Provide screens of the exact same size.
  - Include on the first page:
    - A graphic on the left side to establish a reference point or theme.
    - A welcoming paragraph on the right side to explain what the wizard does.
  - Include on subsequent pages:
    - A graphic for consistency.
    - Instructional text.
    - Controls for user input.
  - Maintain consistent the locations for all elements.



- Make it visually clear that the graphic is not interactive.
  - Vary from normal size or render it as an abstract representation.
- Include default values or settings for all controls when possible.
- For frequently used wizards, place a check box with the text “Do not show this Welcome page again” at the bottom of the Welcome page.
- Include a Finish button at the point where the task can be completed.
- Do not require the user to leave a wizard to complete a task.
- Make sure the design alternatives offered yield positive results.
- Make certain it is obvious how to proceed when the wizard has completed its process.
- Presentation guidelines:
  - Display the wizard window so it is immediately recognized as the primary point of input.
  - Present a single window at one time.
  - Do not advance pages automatically.
- Writing guidelines:
  - Clearly identify the wizard’s purpose in title bar.
  - At the top right of the wizard window, title the Welcome page “Welcome to the *Wizard Name* Wizard.”
    - Use mixed case in headline style and no ending punctuation.
  - Write simply, concisely, and clearly, following all previously presented guidelines.
  - Use a conversational rather than instructional style.
  - Use words like “you” and “your.”
  - Start most questions with phrases like “Which option do you want . . .” or “Would you like . . .”

### Hints or Tips

- Description:
  - A command button labeled Hints or Tips.
- Purpose:
  - To provide a few important contextual, but specific, items of information related to a displayed screen.
- Design guidelines:
  - Provide guidance on only two or three important points.
  - Locate the button near where its guidance applies.
  - Write concisely and to the point.

### Provide Effective Internationalization and Accessibility

To make a product acceptable worldwide, it must be internationalized. A system must also be designed to be usable by an almost unlimited range of people, being accessible to anyone who desires to use it. The design concepts used to achieve these goals are called internationalization and accessibility.

## International Considerations

- To create a product for use internationally may involve two steps, *internationalization* and *localization*
- Internationalization is the process of isolating culturally specific elements from a product. Localization is the process of infusing a specific cultural context into a previously internationalized product.

## Localization

- When to do it:
  - When the market includes few or no English speakers.
  - When translation is required by law or by custom.
  - When the widest possible market is desired.
- When not to do it:
  - When the audience already reads English.
  - When the cost of retrofitting or rewriting the software is prohibitive.

## Words and Text

- Use very simple English.
  - Develop a restricted vocabulary.
  - Restrict the sentence structure using: noun-verb-object.
- Avoid:
  - Acronyms and abbreviations.
  - Stringing three nouns together.
  - Local or computer jargon.
  - A telegraphic writing style.
  - An over-friendly writing style.
  - Culturally specific examples.
  - References to national, racial, religious, and sexist stereotypes.
- Adhere to local user language idioms and cultural contexts.
- Keep the original term for words that cannot be translated.
- Allow additional screen space for the translation.
  - Horizontally, using Table 10.1.
  - Vertically.
- When translating to other languages, first do:
  - European: German.
  - Middle East: Arabic.
  - Far East: Japanese.
- Position icon captions outside of the graphic.
- Modify mnemonics for keyboard access.
- Adhere to local formats for date, time, money, measurements, addresses, and telephone numbers.

## Images and Symbols

- Adhere to local cultural and social norms.
- Use internationally accepted symbols.
- Develop generic images.

- Be particularly careful with:
  - Religious symbols (crosses and stars).
  - The human body.
  - Women.
  - Hand gestures.
  - Flags.
  - The cross and check for check boxes.
- Review proposed graphical images early in the design cycle.

### Color, Sequence, and Functionality

- Adhere to local color connotations and conventions.
- Provide the proper information sequence.
- Provide the proper functionality.
- Remove all references to features not supported.

**Table 10.2** Some Cultural Color Associations

	RED	YELLOW	GREEN	BLUE	WHITE
China	Happiness	Birth Wealth Power	Ming Dynasty Heavens Clouds	Heavens Clouds	Death Purity
Egypt	Death	Happiness Prosperity	Fertility Strength	Virtue Faith Truth	Joy
France	Aristocracy	Temporary	Criminality	Freedom Peace	Neutrality
India	Life Creativity	Success	Prosperity Fertility		Death Purity
Japan	Anger Danger	Grace Nobility	Future Youth Energy	Villainy	Death
United States	Danger Stop	Cowardice Caution	Safety Go	Masculinity	Purity

### Requirements Determination and Testing

- Establish international requirements at the beginning of product development.
- Establish a relationship within the target culture.
- Test the product as if it were new.

### Accessibility

- *Accessibility*, in a general sense, means a system must be designed to be usable by an almost unlimited range of people, essentially anyone who desires to use it.
- Design objectives in creating accessibility for users with disabilities are:
  - Minimize all barriers that make a system difficult, or impossible, to use.
  - Provide compatibility with installed accessibility utilities.

## Types of Disabilities

Disabilities can be grouped into several broad categories: visual, hearing, physical movement, speech or language impairments, cognitive disorders, and seizure disorders.

- *Visual* disabilities can range from slightly reduced visual acuity to total blindness.
- *Hearing* disabilities range from an inability to detect certain sounds to total deafness.
- *Physical movement* disabilities include difficulties in, or an inability to, perform certain physical tasks such as moving a mouse, pressing two keyboard keys simultaneously, or accurately striking a single keyboard key.
- People with *speech or language* disabilities may find it difficult to read and write (as with dyslexia).
- *Cognitive* disabilities include memory impairments and perceptual problems.
- People with *seizure* disorders are sensitive to visual flash rates, certain rates triggering seizures.

## Accessibility Design

- Consider accessibility issues during system planning, design, and testing.
- Provide compatibility with installed accessibility utilities.
- Provide a customizable interface.
- Follow standard Windows conventions.
- Use standard Windows controls.

## Visual Disabilities

- Utilities:
  - Ensure compatibility with screen-review utilities.
  - Ensure compatibility with screen-enlargement utilities.
- Screen components:
  - Include meaningful screen and window titles.
  - Provide associated captions or labels for all controls, objects, icons, and graphics.
    - Including graphical menu choices.
  - Provide a textual summary for each statistical graphic.
  - Allow for screen element scalability.
  - Support system settings for high contrast for all user interface controls and client area content.
    - When a “high contrast” setting is established, hide any images drawn behind the text to maintain screen information legibility.
  - Avoid displaying or hiding information based on the movement of the pointer.
    - Exception: Unless it’s part of the standard interface (Example: ToolTips).
- Keyboard:
  - Provide a complete keyboard interface.
  - Provide a logical order of screen navigation.

- Color:
  - Use color as an enhancing design characteristic.
  - Provide a variety of color selections capable of producing a range of contrast levels.
    - Create the color combinations based on the system colors for window components.
    - Do not define specific colors.

### ***Hearing Disabilities***

- Provide captions or transcripts of important audio content.
- Provide an option to display a visual cue for all audio alerts.
- Provide an option to adjust the volume.
- Use audio as an enhancing design characteristic.
- Provide a spell-check or grammar-check utility.

### ***Physical Movement Disabilities***

- Provide voice-input systems.
- Provide a complete and simple keyboard interface.
- Provide a simple mouse interface.
- Provide on-screen keyboards.
- Provide keyboard filters.

### ***Speech or Language Disabilities***

- Provide a spell-check or grammar-check utility.
- Limit the use of time-based interfaces.
  - Never briefly display critical feedback or messages and then automatically remove them.
  - Provide an option to permit the user to adjust the length of the time-out

### ***Cognitive Disabilities***

- Permit modification and simplification of the interface.
- Limit the use of time-based interfaces.
  - Do not briefly display critical feedback or messages and then automatically remove them.
  - Provide an option to permit the user to adjust the length of the time-out.

### ***Seizure Disorders***

- Use elements that do not blink or flicker at rates between frequency ranges of 2 Hz and 55 Hz.
- Minimize the area of the screen that is flashing.
- Avoid flashing that has a high level of contrast between states.
- Provide an option to enable users to slow down or disable screen flashing.

## ***Documentation***

- Provide documentation on all accessible features.
- Provide documentation in alternate formats.
- Provide online documentation for people who have difficulty reading or handling printed material.

## ***Testing***

- Test all aspects of accessibility as part of the normal system testing process.

## **Create Meaningful Graphics, Icons and Images**

### **Icons**

Icons are most often used to represent objects and actions with which users can interact with or that they can manipulate

### **Kinds of Icons**

Icons fall into these categories by Marcus:

- **Icon.** Something that looks like what it means.
- **Index.** A sign that was caused by the thing to which it refers.
- **Symbol.** A sign that may be completely arbitrary in appearance.

An expanded definition by Roger's icon kinds are

- **Resemblance**—An image that looks like what it means. a book, for example , to represent a dictionary
- **Symbolic**—An abstract image representing something. A cracked glass, for example, can represent something fragile
- **Exemplar**—An image illustrating an example or characteristic of something. a knife and fork has come to indicate a restaurant
- **Arbitrary**—An image completely arbitrary in appearance whose meaning must be learned.
- **Analogy**—An image physically or semantically associated with something. a wheelbarrow full of bricks for the move command

### **Characteristics of Icons**

An icon possesses the technical qualities of syntactics, semantics, and pragmatics

- *Syntactics* refers to an icon's physical structure.
- *Semantics* is the icon's meaning.
- *Pragmatics* is how the icons are physically produced and depicted.

### **Icon Usability**

- Provide icons that are:
  - Familiar.
  - Clear and Legible.

- Simple.
- Consistent.
- Direct.
- Efficient.
- Discriminable.
- Also consider the:
  - Context in which the icon is used.
  - Expectancies of users.
  - Complexity of task.

## Choosing Icons

### *A Successful Icon*

- Looks different from all other icons.
- Is obvious what it does or represents.
- Is recognizable when no larger than 16 pixels square.
- Looks as good in black and white as in color.

### *Size*

- Supply in all standard sizes.
  - 16 X 16 pixels.
    - 16- and 256-color versions.
  - 32 X 32 pixels
    - 16- and 256-color versions.
    - Effective: 24 X 24 or 26 X 26 in 32 X 32 icon.
  - 48 X 48 pixels
    - 16- and 256-color versions.
- Use colors from the system palette.
- Use an odd number of pixels along each side.
  - Provides center pixel around which to focus design.
- Minimum sizes for easy selection:
  - With stylus or pen: 15 pixels square.
  - With mouse: 20 pixels square.
  - With finger: 40 pixels square.
- Provide as large a hot zone as possible.

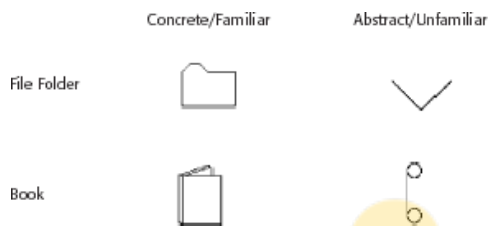
## Choosing Images

- Use existing icons when available. The International Standards Organization (ISO), for example, has developed standard shapes for a variety of purposes. Always consult all relevant reference books before inventing new symbols or modifying existing ones.
- Use images for nouns, not verbs.
- Use traditional images.
- Consider user cultural and social norms. Improper design of icons can create problems internationally. Social norms vary, so great variations exist in what is recognizable and acceptable throughout the world.

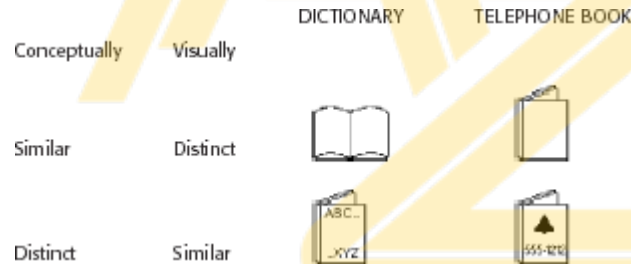


## Creating Images

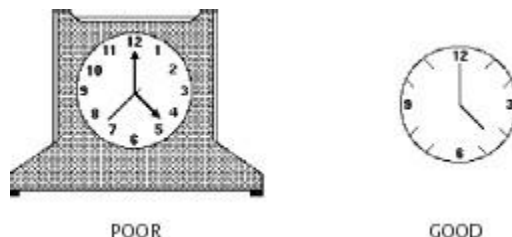
- Create familiar and concrete shapes. an icon's meaning should be self-evident. This is enhanced when concrete shapes are provided, those that look like what they are. An icon should also be intuitive or obvious, based upon a person's preexisting knowledge.
- Familiar shapes are those images that are well learned.



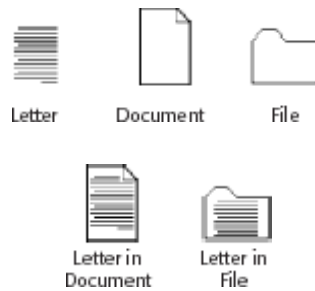
- Create visually and conceptually distinct shapes.
  - Incorporate unique features of an object.
  - Do not display within a border.
- Differentiation is aided when icons are visually different from one another. It is also aided when icons are conceptually different—that is, when they portray specific features of an object that are relatively unique within the entire set of objects to be displayed.



- Clearly reflect objects represented.
- Simply reflect objects represented, avoiding excessive detail. Construct icons with as few graphical components as necessary, using no more than two or three, if possible. Also, use simple, clean lines, avoiding ornamentation.



- Create as a set, communicating relationships to one another through common shapes. When icons are part of an overall related set, create shapes that visually communicate these relationships. Objects within a class, for example, may possess the same overall shape but vary in their other design details,



- Provide consistency in icon type.
- Create shapes of the proper emotional tone.

### Drawing Images

- Provide consistency in shape over varying sizes.
- Do not use triangular arrows in design to avoid confusion with other system symbols.
- When icons are used to reflect varying attributes, express these attributes as meaningfully as possible.
- Provide proper scale and orientation.
- Use perspective and dimension whenever possible.
- Accompany icon with a label to assure intended meaning.

### Icon Animation and Audition

- Animation:
  - Animation can take two forms, best described as static and dynamic.
  - A *static* icon's appearance is unchanged over a period of time and changes only at the moment that a system event occurs. An example would be the open door of a mailbox shutting when an electronic message is received.
  - A *dynamic* icon's movement is independent of a system event, changing appearance to represent functions, processes, states, and state transitions. An example is an icon that begins movement to illustrate an action when a pointer is moved close to it.
  - Use:
    - To provide feedback.
    - For visual interest.
  - Make it interruptible or independent of user's primary interaction.
  - Do not use it for decoration.
  - Permit it to be turned off by the user.
  - For fluid animation, present images at 16 or more frames per second.
- Audition:
  - Consider auditory icons.
  - It may be well suited to providing information:
    - About previous and possible interactions.
    - Indicating ongoing processes and modes.
    - Useful for navigation.
    - To support collaboration.

## The Design Process

- Define the icon's purpose and use.
- Collect, evaluate, and sketch ideas.
- Draw in black and white.
- Draw using an icon-editing utility or drawing package.
- Test for user:
  - Expectations.
  - Recognition.
  - Learning.
- Test for legibility.
- Register new icons in the system's registry.

## Screen Presentation

- Follow all relevant **general guidelines** for screen design.
- Limit the number of **symbols** to 12, if possible, and at most 20.
- Arrange icons:
  - In a **meaningful way**, reflecting the organization of the real world.
  - To facilitate **visual scanning**.
  - Consistently.
- Place object and action icons in different groups.
- Present an **interactive icon** as a raised screen element.
- Ensure that a selected icon is **differentiable from unselected icons**.
- Permit arrangement of icons by the user.
- Permit the user to choose between **iconic** and text display of objects and actions.

## Multimedia

- The graphical flexibility of the Web permits inclusion of other media on a screen, including images, photographs, video, diagrams, drawings, and spoken audio.
- Multimedia can hold the user's attention, add interest to a screen, entertain, and quickly convey information that is more difficult to present textually.
- Good interface design employs multimedia in a conservative and appropriate manner.

## Graphics

- Use graphics to:
  - Supplement the textual content, not as a substitute for it.
  - Convey information that can't be effectively accomplished using text.
  - Enhance navigation through:
    - Presenting a site overview

- Identifying site pages.
- Identifying content areas.
- Limit the use of graphics that take a long time to load.
- Coordinate the graphics with all other page elements.

## Images

- General:
  - Use standard images.
  - Use images consistently.
  - Produce legible images.
  - Provide descriptive text or labels with all images.
  - Distinguish navigational images from decorative images.
  - Minimize:
    - The number of presented images.
    - The size of presented images.
  - Restrict single images to 5K.
  - Restrict page images to 20K.
  - Provide thumbnail size images.
    - Image animation.
  - Avoid extraneous or gratuitous images.
- Color:
  - Minimize the number of colors in an image.
- Format:
  - Produce images in the most appropriate format.
    - GIF.
    - JPEG.
- Internationalization:
  - Provide for image internationalization.
- Screen design:
  - Reuse images on multiple pages.

## Image Maps

- Use:
  - To provide navigation links to other content.
- Advantages:
  - Can be arrayed in a meaningful and obvious structure.
  - Faster to load than separate images.
- Disadvantages:
  - Consume a significant amount of screen space.
  - “Hot spots” not always obvious.
  - One’s location within image map is not always obvious.
- Guidelines:
  - Use with caution.
  - Provide effective visual cues and emphasis to make it easy to identify link boundaries.
  - Ensure image maps are accessible to the vision impaired.

## Photographs/Pictures

- Use:
  - When every aspect of the image is relevant.
- Guidelines:
  - Use JPEG format.
  - On the initial page:
    - Display a small version.
  - A thumbnail size image.
  - Zoom-in on most relevant detail.
    - Link to larger photos showing as much detail as needed.

## Video

- Uses:
  - To show things that **move** or change over time.
  - To show the proper **way** to perform a task.
  - To provide a **personal message**.
  - To grab attention.
- Disadvantages:
  - Expensive to **produce**.
  - Slow to **download**.
  - Small and difficult to discern detail.
- Guidelines:
  - Never **automatically** download a video into a page.
  - Create **short** segments.
  - Provide **controls**, including those for **playing**, **pausing**, and **stopping**.
  - Consider using:
    - Existing video.
    - Audio only.
    - A slide show with audio.

## Diagrams

- Uses:
  - To show the structure of objects.
  - To show the relationship of objects.
  - To show the flow of a process or task.
  - To reveal a temporal or spatial order.
- Guidelines:
  - Provide simple diagrams.
  - Provide cutaway diagrams or exploded views to illustrate key points.

## Drawings

- Use:
  - When selective parts need to be emphasized or represented.
- Guidelines:
  - Provide simple drawings showing minimal detail.
  - Provide a link to a complete drawing.

## Animation

- Uses:
  - To explain ideas involving a change in:
    - Time.
    - Position.
  - To illustrate the location or state of a process.
  - To show continuity in transitions.
  - To enrich graphical representations.
  - To aid visualization of three-dimensional structures.
  - To attract attention.
- Disadvantages:
  - Very distracting.
  - Slow loading.
- Guidelines:
  - Use only when an integral part of the content.
  - Create short segments.
  - Provide a freeze frame and stop mode.
  - Avoid distracting animation.

## Audition

- Uses:
  - As a supplement to text and graphics.
  - To establish atmosphere.
  - To create a sense of place.
  - To teach.
  - To sample.
- Advantages:
  - Does not obscure information on the screen.
  - Shorter downloading time than video.
- Disadvantages:
  - Is annoying to many people, including users and nonusers in the vicinity.
  - Can easily be overused, increasing the possibility that it will be ignored.
  - Is not reliable because:
    - Some people are hard of hearing.
    - If it is not heard, it may leave no permanent record of having occurred.
    - The user can turn it off.
    - Audio capability may not exist for the user.
- Guidelines:

- When words are spoken:
  - The content should be simple.
  - The speed of narration should be about 160 words per minute.
- When used to introduce new ideas or concepts the narration should be slowed.
- Off-screen narration should be used rather than on-screen narration.
- Unless the narrator is a recognized authority on the topic.
  - Create short segments.
  - Provide segments of high quality.
  - Provide audio controls.
  - Play background audio softly.

### Combining Mediums

- Combinations:
  - Use sensory combinations that work best together:
    - Auditory text with visual graphics.
    - Screen text with visual graphics.
- Integration:
  - Closely integrate screen text with graphics.
- Relevance:
  - Both the visual and auditory information should be totally relevant to the task being performed.
- Presentation:
  - Visual and auditory textual narrative should be presented simultaneously, or the visuals should precede the narrative by no more than 7 seconds.
  - To control attention, reveal information systematically.
    - Limit elements revealed to one item at a time and use sequential revelations for related elements.
  - Animation must show action initiation as well as the action's result.
  - Avoid animation that distracts from other more important information.
- Downloading times:
  - Consider downloading times when choosing a media.
- Testing:
  - Thoroughly test all graphics for:
    - Legibility.
    - Comprehensibility.
    - Acceptance.

### Importance of combining multimedia

- **The proper multimedia combinations can improve learning and performance.** Hearing spoken text combined with a visual graphic is an especially useful combination, especially for complex tasks. All studies found this pairing useful.
- **Visual graphics do enhance learning and performance.** In the Bowers and Lee study, the various graphical combinations yielded the higher learning rates.



- **Single-dimensional textual media are not as successful when used alone.** In the Bowers and Lee study, viewing text or hearing spoken text alone yielded the lowest learning rates.
- **Hearing spoken text and viewing text at the same time may not be great, but it may not be terrible, either.** This combination yielded “middle-of the- road” results in the Bowers and Lee study. The dual code theory would suggest, however, that its use be minimized. Exercise caution in this area.
- **Visual text should always be integrated with related visual graphics.** Tindall-Ford et al. found much better user performance when visual text was closely integrated with, or adjacent to, related visual graphics. It will be much easier for user to coordinate and integrate the visual materials. Presenting spatially separated text and related graphics places greater demands on working memory.

## Choose the Proper Colors

### What is a color?

- A color can only be described in terms of a person’s report of his or her perceptions.
- The visual spectrum of wavelengths to which the eye is sensitive ranges from about 400 to 700 milli microns.
- Objects in the visual environment often emit or reflect light waves in a limited area of this visual spectrum, absorbing light waves in other areas of the spectrum.
- The dominant wavelength being “seen” is the one that we come to associate with a specific color name. The visible color spectrum and the names commonly associated with the various light wavelengths
 

Red	700
Orange	600
Yellow	570
Yellow-green	535
Green	500
Blue-green	493
Blue	470
Violet	400
- A color posses three properties
  - *Hue* is the spectral wavelength composition of a color. It is to this we attach a meaning such as green or red.
  - *Chroma* or *saturation* is the purity of a color in a scale from gray to the most vivid version of the color. The more saturated a hue is, the more visible it is at a distance.
  - saturated, the less visible it is. *Value* or *intensity* is the relative lightness or darkness of a color in a range from black to white.
- The long-wavelength colors (red) are commonly referred to as warm, and shortwavelength colors (blue) as cool.
- Color, then, is a combination of hue, chroma, and value.(HSV) or primary wavelength colors RGB

## Dithering

- The eye is never steady, instead trembling slightly as we see.
- If pixels of different colors are placed next to each other, this tremor combines the two colors into a third color. This is referred to as *dithering*, and sometimes *texture mapping*.
- Taking advantage of this phenomena, an optical illusion, a third color can be created on a screen. Dithering is often used to create a gray scale when only black and white pixels are available to work with.

## Color Uses

- Use color to assist in formatting a screen:
  - Relating or tying elements into groupings.
  - Breaking apart separate groupings of information.
  - Associating information that is widely separated on the screen.
  - Highlighting or calling attention to important information by setting it off from the other information.
- Use color as a visual code to identify:
  - Screen components.
  - The logical structure of ideas, processes, or sequences.
  - Sources of information.
  - Status of information.
- Use color to:
  - Realistically portray natural objects.
  - Increase screen appeal.

## Possible Problems with Color

- When used improperly, color may even impair performance by distracting the viewer and interfering with the handling of information.
- Possible problems may be caused by the perceptual system itself or the physiological characteristics of the human eye.
- **High Attention-Getting Capacity**
  - This quality causes the screen viewer to associate, or tie together, screen elements of the same color, whether or not such an association should be made.
  - The result is often bewilderment, confusion, and slower reading.
- **Interference with Use of Other Screens**
  - Indiscriminate or poor use of color on some screens will diminish the effectiveness of color on other screens.
- **Varying Sensitivity of the Eye to Different Colors**
  - All colors are not equal in the eye of the viewer. The eye is more sensitive to those in the middle of the visual spectrum (yellow and green), which appear brighter than those at the extremes (blue and red). Thus, text composed of colors at the extremes is thought to be more difficult to read.

- The wavelengths of light that produce blue are normally focused in front of the eye's retina, the red wavelengths behind it. Simultaneous or sequential viewing of red and blue causes the eye to continually refocus to bring the image directly onto the retina, thereby increasing the potential for eye fatigue.
- The perceived appearance of a color is also affected by a variety of other factors, including the size of the area of color, the ambient illumination level, and other colors in the viewing area.
- Also, larger changes in wavelength are needed in some areas of the visual spectrum for a color change to be noticed by the eye. Small changes in extreme reds and purples are more difficult to detect than small changes in yellow and blue-green.
- **Color-Viewing Deficiencies**
  - A red viewing deficiency is called *protanopia*, a green deficiency is called *deutanopia*, and a blue deficiency is called *tritanopia*.
  - These common color deficiencies, their results, and the percentage of people who experience these problems are given below

ACTUAL COLOR	COLOR SEEN WITH:		
	RED-VIEWING DEFICIENCY (2.04%)	GREEN-VIEWING DEFICIENCY (6.39%)	BLUE-VIEWING DEFICIENCY (0.003%)
Red	Brown	—	—
Yellow	Greenish-Yellow	Orange	Deeper Yellow
Purple	Dark Blue	Red	Deep Red
Green	—	Light Brown	—
Brown	—	Reddish-Brown	—
Blue	—	—	Green

### Cross-Disciplinary and Cross-Cultural Differences

- Colors can have different meanings in different situations to different people.
- The same color may also have a different connotation, depending upon its viewer. The color blue has the following quite different meanings:
  - For financial managers—Corporate qualities or reliability.
  - For health care professionals—Death.
  - For nuclear reactor monitors—Coolness or water.
  - For American movie audiences—Tenderness or pornography.
- Color appeal is also subjective. People have different tastes in color, what is pleasing to one person may be distasteful or unusable by someone else

### Color and Human Vision

- To understand how color should be used on a screen, it is helpful to know something of the physiology of the human eye.

## The Lens

- Muscles control the lens of the eye. These muscles focus received wavelengths of light on the retina.
- The lens itself is not color corrected. The wavelengths of light that create different colors are focused at different distances behind the lens, the longer wavelengths (red) being focused farther back than the shorter wavelengths (blue).
- The result is that colors of a different wavelength from the color actually being focused by the lens will appear out of focus. To create a sharp image of the out-of-focus colors requires a refocusing of the eye.
- Very pure or saturated colors require more refocusing than less pure or unsaturated colors. Therefore, a color with a large white component will require less refocusing.
- The lens does not transmit all light wavelengths equally. It absorbs more wavelengths in the blue region of the spectrum than those in the other regions.

## The Retina

- The retina is the light-sensitive surface of the eye.
- It comprises two kinds of receptors, rods and cones, which translate the incoming light into nervous impulses.
- Rods are sensitive to lower light levels and function primarily at night.
- Cones are stimulated by higher light levels and react to color. The sensitivity of cones to colors varies, different cones possessing maximum sensitivity to different wavelengths of light.
- Rods and cones vary in distribution across the retina. The center is tightly packed with cones and has no rods. Toward the periphery of the retina, rods increase and cones decrease.
- Thus, color sensitivity does not exist at the retina's outer edges, although yellows and blues can be detected further into the periphery than reds and greens.
- The brightness sensitivity of the eye to different colors also varies. It is governed by output from the red and green cones.
- The greater the output, the higher the brightness, which results in the eye being most sensitive to colors in the middle of the visual spectrum and less sensitive to colors at the extremes.
- The components of the eye—the lens and retina—govern the choices, and combinations, of colors to be displayed on a screen. The proper colors will enhance performance; improper colors will have the opposite effect,

## Choosing Colors

- When choosing colors for display, one must consider these factors:
  - the human visual system,
  - the possible problems that the colors' use may cause,
  - the viewing environment in which the display is used,
  - the task of the user, how the colors will be used, and
  - the hardware on which the colors will be displayed

## Choosing Colors for Categories of Information

- Choosing colors for categories of information requires a clear understanding of how the information will be used.
- Some examples:
  - If different parts of the screen are attended to separately, color-code the different parts to focus selective attention on each in turn.
  - If decisions are made based on the status of certain types of information on the screen, color-code the types of status that the information may possess.
  - If screen searching is performed to locate information of a particular kind or quality, color-code these kinds or qualities for contrast.
  - If the sequence of information use is constrained or ordered, use color to identify the sequence.
  - If the information displayed on a screen is packed or crowded, use color to provide visual groupings.
- Use color as a redundant screen code.

## Colors in Context

Colors are subject to contextual effects. The size of a colored image, the color of images adjacent to it, and the ambient illumination all exert an influence on what is actually perceived.

At the normal viewing distance for a screen, maximal color sensitivity is not reached until the size of a colored area exceeds about a 3-inch square.

Adjacent images can influence the perceived color. A color on a dark background will look lighter and brighter than the same color on a light background.

Colors also change as light levels change. Higher levels of ambient light tend to desaturate colors. Saturated colors will also appear larger than desaturated colors.

## Usage

- Design for monochrome first.
  - in shades of black, white and gray.
  - Doing this will permit the screen to be effectively used:
    - By people with a color-viewing deficiency.
    - On monochrome displays.
    - In conditions where ambient lighting distorts the perceived color.
    - If the color ever fails.
- Use colors conservatively.
  - Do not use color where other identification techniques, such as location, are available.

## Discrimination and Harmony

- For best absolute discrimination, select no more than four or five colors widely spaced on the color spectrum.
  - Good colors: red, yellow, green, blue, and brown.

- For best comparative discrimination, select no more than six or seven colors widely spaced on the color spectrum.  
— Other acceptable colors: orange, yellow-green, cyan, violet, and magenta.
- Choose harmonious colors.  
— One color plus two colors on either side of its complement.  
— Three colors at equidistant points around the color circle.
- For extended viewing or older viewers, use brighter colors.

### Emphasis

- To draw attention or to emphasize elements, use bright or highlighted colors. To deemphasize elements, use less bright colors.  
— The perceived brightness of colors from most to least is white, yellow, green, blue, red.
- To emphasize separation, use contrasting colors.  
— Red and green, blue and yellow.
- To convey similarity, use similar colors.  
— Orange and yellow, blue and violet.

### Common Meanings

- To indicate that actions are necessary, use warm colors.  
— Red, orange, yellow.
- To provide status or background information, use cool colors.  
— Green, blue, violet, purple.
- Conform to human expectations.  
— In the job.  
— In the world at large.
- Some common color associations are the following:
  - Red—Stop, fire, hot, danger.
  - Yellow—Caution, slow, test.
  - Green—Go, OK, clear, vegetation, safety.
  - Blue—Cold, water, calm, sky, neutrality.
  - Gray—Neutrality.
  - White—Neutrality.
  - Warm colors—Action, response required, spatial closeness.
  - Cool colors—Status, background information, spatial remoteness.
- Some typical implications of color with dramatic portrayal are:
  - High illumination—Hot, active, comic situations.
  - Low illumination—Emotional, tense, tragic, melodramatic, romantic situations.
  - High saturation—Emotional, tense, hot, melodramatic, comic situations.
  - Warm colors—Active, leisure, recreation, comic situations.
  - Cool colors—Efficiency, work, tragic and romantic situations.

### Location

- In the center of the visual field, use red and green.

- For peripheral viewing, use blue, yellow, black, and white.
- Use adjacent colors that differ by hue and value or lightness.

## Ordering

- Order colors by their spectral position.
  - Red, orange, yellow, green, blue, indigo, violet.

## Foregrounds and Backgrounds

- Foregrounds:
  - Use colors that highly contrast with the background color.
  - For text or data, use:
    - Black.
    - Desaturated or spectrum center colors such as white, yellow, or green.
    - Warmer more active colors.
  - Use colors that possess the same saturation and lightness.
  - To emphasize an element, highlight it in a light value of the foreground color, pure white, or yellow.
  - To deemphasize an element, lowlight it in a dark value of the foreground color.
- Backgrounds:
  - Use a background color to organize a group of elements into a unified whole.
  - Use colors that do not compete with the foreground.
  - Use:
    - Light-colored backgrounds of low intensity: Off-white or light gray.
    - Desaturated colors.
    - Cool, dark colors such as blue or black.
    - Colors on the spectral extremes.

## Three-Dimensional Look

- Use at least five colors or color values to create a 3-D look on a screen.
  - Background: The control itself and the window on which it appears.
  - Foreground: Captions and lines for buttons, icons, and other objects.
    - Usually black or white.
  - Selected mode: The color used when the item is selected.
  - Top shadow: The bezel on the top and left of the control.
  - Bottom shadow: The bezel on the bottom and right of the control.
- Motif has created an algorithm to automatically calculate the top and bottom shadows, and the select color based upon the background (Kobara, 1991). Briefly, it recommends the following:
  - **Background.** Midrange colors, 155–175 on the RGB scale.
  - **Foreground.** Black or white, depending on the lightness or darkness of the background.
  - **Selected mode.** About 15 percent darker than the background color, halfway between
  - the background and bottom shadow. (Calculate this by multiplying the background color's RGB value by 0.85.)



- **Top shadow.** About 40 to 50 percent brighter than the background color. (Calculate this by multiplying the background color's RGB by 1.50.)
- **Bottom shadow.** About 45 to 60 percent darker than the background color. (Calculate this by multiplying the background's RGB values by 0.50.)

### **Color Palette, Defaults, and Customization**

- Permit users to customize their colors.
- Provide a default set of colors for all screen components.
- Provide a palette of six or seven foreground colors.
  - Provide 2 to 5 values or lightness shades for each foreground color.
- Provide a palette of six or seven background colors.
- Never refer to a screen element by its color.

### **Gray Scale**

- For fine discriminations use a black-gray-white scale.
  - Recommended values are white, light gray, medium gray, dark gray, black.

### **Text in Color**

- When switching text from black to color:
  - Double the width of lines.
  - Use bold or larger type:
    - If originally 8 to 12 points, increase by 1 to 2 points.
    - If originally 14 to 24 points, increase by 2 to 4 points.
- Check legibility by squinting at text.
  - Too-light type will recede or even disappear.

### **Monochromatic Screens**

- At the standard viewing distance, white, orange, or green are acceptable colors.
- At a far viewing distance, white is the best choice.
- Over all viewing distances, from near to far, white is the best choice.

### **Cultural, Disciplinary, and Accessibility Considerations**

- Consider the impact of specific colors on:
  - Users of various cultures.
  - Users of various disciplines.
  - Users with color-viewing deficiencies.
  - Users relying on accessibility utilities.

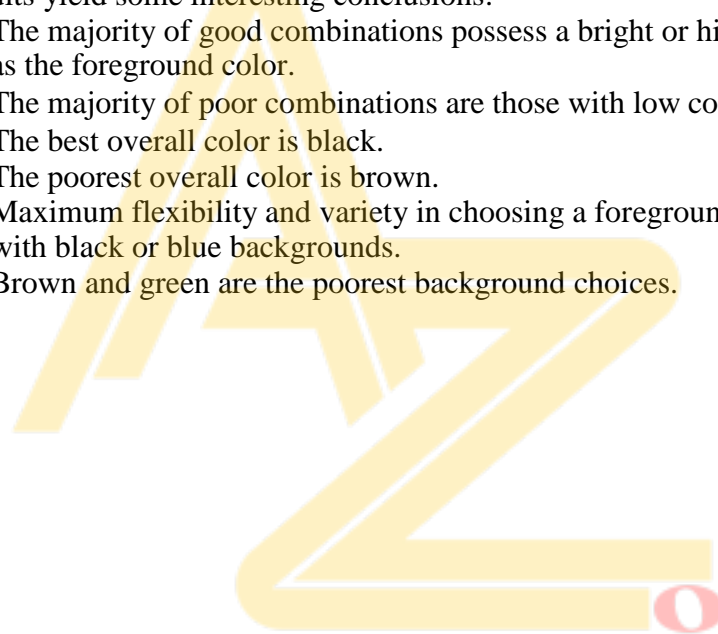
### **Choosing Colors for Textual Graphic Screens**

- For displaying data, text, and symbols on a textual graphical screen colors selected should have adequate visibility, meaning, contrast, and harmony.
- Use effective foreground/background combinations.
- Use effective foreground combinations.
- Choose the background color first.

- Display no more than four colors at one time.
- Use colors in toolbars sparingly.
- Test the chosen colors.

### **Effective Foreground/Background Combinations**

- Lalomia and Happ (1987) established effective foreground/background color combinations
- From a color set of 16 different foregrounds and 8 different backgrounds, 120 color combinations were evaluated for (1) response time to identify characters, and (2) subjective preferences of users.
- The results from each measure were ranked and combined to derive an overall measure of color combination effectiveness.
- The best and poorest color combinations are summarized in Table given below
- The results yield some interesting conclusions:
  - The majority of good combinations possess a bright or high-intensity color as the foreground color.
  - The majority of poor combinations are those with low contrast.
  - The best overall color is black.
  - The poorest overall color is brown.
  - Maximum flexibility and variety in choosing a foreground color exists with black or blue backgrounds.
  - Brown and green are the poorest background choices.



FOREGROUND	BACKGROUND							
	BLACK	BLUE	GREEN	CYAN	RED	MAGENTA	BROWN	WHITE
BLACK	x			Good		Good		Good
BLUE		x			Poor			Good
H.I. BLUE			Poor	Poor			Poor	Poor
CYAN	Good		Poor	x			Poor	
H.I. CYAN	Good	Good		Good	Good	Good		
GREEN	Good	Good	x	Poor	Good		Poor	Poor
H.I. GREEN		Good						
YELLOW	Good	Good		Good		Good		
RED			Poor		x	Poor	Poor	
H.I. RED			Poor					
MAGENTA			Poor		Poor	x	Poor	
H.I. MAGENTA	Good		Good			Poor		
BROWN			Poor			Poor	x	
GRAY		Poor			Poor		Poor	
WHITE		Good		Poor				x
H.I. WHITE	Good		Good	Good				

(H.I. = High Intensity)

From Lalomia and Happ (1987).

- Bailey and Bailey (1989), in their screen creation utility Protoscreens, have a table summarizing research-derived good foreground/background combinations.

BACKGROUNDS	ACCEPTABLE FOREGROUNDS	
Black	Dark Cyan Dark Yellow Dark White	Light Green Light Cyan Light Magenta Light Yellow Light White
Blue	Dark Green Dark Yellow Dark White	Light Green Light Cyan Light Yellow Light White
Green	Black Dark Blue	Light Yellow Light White
Cyan	Black Dark Blue	Light Yellow Light White
Red		Light Green Light Cyan Light Yellow Light White
Magenta	Black	Light Cyan Light Yellow Light White
Yellow	Black Dark Blue Dark Red	
White	Black Dark Blue	

### Uses of Color to Avoid

- Relying exclusively on color.
- Too many colors at one time.
- Highly saturated, spectrally extreme colors together:
  - Red and blue, yellow and purple.
- Low-brightness colors for extended viewing or older viewers.
- Colors of equal brightness.
- Colors lacking contrast:
  - For example, yellow and white; black and brown; reds, blues, and browns against a light background.
- Fully saturated colors for text or other frequently read screen components.
- Pure blue for text, thin lines, and small shapes.
- Colors in small areas.
- Color for fine details.
- Non-opponent colors.
- Red and green in the periphery of large-scale displays.
- Adjacent colors that only differ in the amount of blue they possess.
- Single-color distinctions for color-deficient users.
- Using colors in unexpected ways.
- Using color to improve legibility of densely packed text.