GUIDELINES, PRINCIPLES AND THEORIES

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Introduction

- Guidelines – specific and practical
  - prescribe good practices
  - caution against dangers
- Principles – mid-level
  - Analyze and compare design alternatives
- Theories and models – high level
  - describe objects and actions with consistent terminology
  - make predictions regarding times for pointing, reading or typing
Guidelines

• Guideline docs are common and useful
• Early Apple and Microsoft guidelines influenced guidelines for web and mobile devices
• Provide common language for describing UI
• Promote consistency amongst designers regarding:
  • Terminology usage
  • Appearance
  • Action sequences
• Describes best practices
  • Based on experience or experiments
  • Contains examples and counterexamples
Guidelines

• Pros
  • Contribute to steady improvements

• Cons
  • Too specific
  • Incomplete
  • Hard to apply
  • Sometimes wrong

• Both sides recognize lively discussions are positive for promoting awareness.
Guidelines

• Exist for different aspects of the UI
  • Interface navigation
  • Organizing the display
  • Getting the user’s attention
  • Facilitating data entry
Navigating the interface

• National Cancer Institute (2006)
  • 388 guidelines to assist gov’t agencies’ website design
  • Supported by lots of research
    • Cognitive psychology, CS, human factors, technical communication, usability
• Some examples
  • Standardize task sequences
  • Embedded links should be descriptive
  • Headings should be unique and descriptive
  • Radio buttons for mutually exclusive choices
  • Pages should print properly
  • Thumbnail images to preview larger images
National Cancer Institute

- 2013 - Updating guidelines to cover current trends and topics
  - Responsive design
  - Mobile strategy
  - Apps
  - Social media
Navigating the interface

- Users with disabilities – US Rehabilitation Act
- Adopted by W3C (http://www.w3.org/TR/WCAG20/)
  - Provide non-text alternatives for all text elements
    - Large print, braille, speech, symbols
  - Provide synchronized alternatives for time-based media
    - Captions, audio
  - Info conveyed with color also be conveyed without it
Organizing the display

Smith and Mosier (1986) offer five high-level goals:
- Consistency of data display
- Efficient information assimilation by the user
- Minimal memory load on the user
- Compatibility of data display with data entry
- Flexibility for user control of data display
Organizing the display

- Consistency of data display
- Terminology
- Abbreviations
- Formats
- Capitalization

http://contextualscience.org/system/files/train%20ticket%20machine%20display.JPG
Organizing the display

- Efficient information assimilation by the user
  - Info format – familiar to user and related to tasks
    - Neat columns
    - Justification
    - Decimals lined up
    - Proper spacing
Organizing the display

- Minimal memory load on the user
  - Should not be required to memorize info between screens
  - Tasks should be completed in few actions
    - Less chance of forgetting a step
- Compatibility of data entry with data display
  - e.g., SSN, phone number, date
- Examples: travel and hotel websites
Organizing the display

- Flexibility for user control of data display
  - e.g., sorting and ordering
Getting the user’s attention

- Make users aware for exceptional or time-dependent conditions
  - Intensity – 2 levels only
  - Marking – underline, enclose in box, asterisk, bullet…
  - Size – up to 4 sizes
  - Fonts – up to 3 fonts
  - Blinking – 2-4 Hz, blinking color changes
  - Color – up to 4 standard colors
  - Audio – soft tones for positive, harsh tones for emergency
Getting the user’s attention

• Caution!!! Keep it simple – don’t clutter the display
• Examples
  • http://www.angelfire.com(super/badwebs/)
  • http://www.theworldsworstwebsiteever.com/
  • http://www.electrifyingtimes.com/
• Novices: simple, logical labels, well-organized
• Experts: shorter labels, subtle highlighting of changed values
• Test with users!!!
Facilitating data entry

- Requires substantial portion of user’s time
- Minimal input actions by user
  - Increases productivity and reduces chances for error
- Avoid redundant data entry (e.g., autocomplete for same shipping / billing address)

http://www.acrnet.org/workarea/help/Resources/Images/eComm_MyAccount_ShippingAddress_Edit_Example.gif
Principles

• Less narrowly focused than guidelines
  • More fundamental, widely applicable, and enduring
  • Tend to need more clarification \ interpretation
  • Example: “principle of recognizing user diversity”

http://www.dailypilot.com/media/photo/2011-03/59999737.jpg
Principles covered

• Eight Golden Rules
• User skill levels and task analysis
• 5 primary interaction styles
• Error prevention
Eight Golden Rules of Interface Design

1. Strive for consistency
   • Identical terminology in prompts, menus, help screens
   • Consistent colour, layout, capitalization, etc.

2. Cater to universal usability
   • Novice\expert, age, disability, technological diversity

3. Offer informative feedback
   • Every user action should have system feedback

4. Design dialogs to yield closure
   • e.g. confirmation page on eCommerce websites
Eight Golden Rules of Interface Design

5. Prevent errors (e.g. gray out menu items)
   • Design system such that designers cannot make errors

6. Permit easy reversal of actions
   • Relieves anxiety, users know errors can be undone
   • Encourages exploration

7. Support internal locus of control
   • User should feel in control, unsurprised

8. Reduce short-term memory load (e.g. 7 ± 2 chunks of info)
   • Humans have limited capacity for short-term memory information processing
Determine user skill levels

- Know thy user!
- Simple idea but difficult, undervalued goal
- Assumptions made about users and tasks
- Differences in learning, thinking, problem solving
Determine user skill levels

• Build population profile
  • **Primary variables:** Age, gender, physical and cognitive abilities, education, cultural or ethnic background, training, motivation, goals and personality
  • **Secondary variables:** location, economics, attitudes

• Design goals based on skill level
  • Novice or first-time users
  • Knowledgeable intermittent users
  • Expert frequent users
Novice/first-time users

- **Novice**: Grandparents sending first email first
- **First-time**: Airport check-in kiosks
- Both inexperienced with interfaces
- Causes anxiety!
- What’s the design solution?
  - Restrict vocabulary – familiar, consistently used terms
  - Few actions – for successful task completion
  - Feedback on task completion
  - Specific error messages
  - Video demos
  - Online tutorials

http://michaeldeckysdesign.com/images/kiosk1.jpg
Knowledgeable intermittent users

- Managers with word processors, frequent travelers
- Understand task concepts and interface basics
- Difficulty retaining menu structure, location of features
- What’s the design solution?
  - Orderly structure of menus
  - Consistent terminology
  - Consistent sequences of actions
  - Meaningful messages
Expert frequent users

• Very familiar with task and interface concepts
• Goal is efficiency (high speed, low error)
• What’s the design solution?
  • Rapid response time
  • Brief feedback
  • Shortcuts
  • Macros
Determine user skill levels

• Often multiple user classes for one system
• Multi-layer approach to learning
  • Let novices learn minimal subset, training-wheels interface, progress from there
  • Ex. Cellphones
    • Novices: phone calls easy to make
    • Experts: store #s, web, contact info
  • Design of manuals, help screens, error messages, tutorials, feedback
Identify the tasks

- Task analysis – too often done informally or incompletely
  - Observing & interviewing users, long process
  - Establishes action frequency and sequences
  - Simplicity over clutter
    - E.g. PalmPilot – very limited functionality (calendar, contacts, to-do list, notes)

- High-level, middle-level, atomic tasks
  - Choosing atomic tasks is difficult
    - Too small = too many steps (inefficient, frustrating)
    - Too large = need special cases, inflexible, frustrating

- Task frequency
  - High frequency = simple, quick, even if it slows other tasks down
  - Special keys (frequent) vs. Ctrl + key vs. menu selections
Choose an interaction style

• Direct manipulation
• Menu selection
• Form fill-in
• Command language
• Natural language
Choose an interaction style

- **Direct manipulation**
  - Manipulate visual representations
  - **Ex.** Desktop metaphor, air-traffic control systems, CAD, games
  - **Pros:** tasks accomplished quickly, results immediate, feedback, easy to understand and retain (ex. icons on your desktop), exploration encouraged, good for novices, and can be good for other classes, visual data
  - **Cons:** hard to program, interaction devices are harder to design or modify (require graphics display)

- **Menu Selection**
  - User reads a list of items, and selects one
  - **Pros:** no memorization, few actions, clear structure, tools for validity and consistency exist
  - **Cons:** may slow frequent users, requires careful task analysis, danger of too many menus
Choose an interaction style

- **Form Fill-in**
  - Data entry into fields
  - **Pros:** rapid, for more advanced users, tools available for forms
  - **Cons:** must understand labels and request format, be able to respond to errors, training may be required

- **Command Language**
  - **Pros:** feeling of control, most advanced users like it, rapid, histories and macros are easy
  - **Cons:** high error rates, training required, poor retention rate, hard to create error messages
Choose an interaction style

• **Natural language**
  - Little success so far
  - **Pros:** relieves burden of learning syntax
  - **Cons:** frequently requires clarification, slower and more cumbersome than menu selection

• **Blending** interaction styles may be appropriate
  - When required tasks and users are diverse
  - e.g. Form fill-in interface for shopping checkout
    - Menu items for accepted credit cards
    - Direct manipulation to select a color
    - Form fill in for personal information
Prevent errors

• **Extremely important**, 5\(^{\text{th}}\) golden rule
  • e.g. Experienced analysts make mistakes in half their spreadsheets, even those involving important business (Panko 2008)

• How can we design software to reduce errors?
  • Improve error messages
    • Higher success rate in repairing errors
    • Lower future errors
    • Increase subjective satisfaction
Prevent errors

- Great error messages are…
  - More specific
  - Positive in tone, not hostile
  - Constructive (provide solution)
- More effective approach: prevent errors from occurring
  - Organize info, screens, menus
  - Commands and menu choices should be distinctive
  - State of the interface should be known (change cursor when busy)
  - Consistency of actions (e.g. order of yes/no buttons always same)

E.g. “Printer is off, please turn on” instead of “Illegal operation”
Prevent Errors

• Correct actions
  • Elevator – can’t open doors until not moving
  • Aircraft engines – can’t go in reverse unless landing gear has touched down
  • Choose a date from a visual calendar instead of typing it in
  • Cellphones let you choose from recently dialed #s or received calls instead of manual entry
  • Automatic command completion, e.g. Visual Basic and others
Prevent errors

- **Complete sequences**
  - Offer sequence of required steps as a single action
  - e.g. Car signal causes both front and back signal lights to flash
    - Same concept for interfaces
    - e.g. macros, word processor commands
  - Designers study users’ sequences of commands, error patterns, user preferences

Ensuring human control while increasing automation

• Automation
  • Increases over time
  • Improves speed
  • Reduces error

• Why have humans if we can automate tasks?
  • Real world is an *open system*
  • Computers are a *closed system*

• Humans are there for
  • Unexpected situations
  • Preserve safety
  • Avoid failures
  • Increase product quality
Ensuring human control while increasing automation

- Air traffic control example
  - Easy to automate
  - But humans need to be present for unpredictable events
    - weather, emergencies, etc
    - can’t jump in cold – must be involved for ‘context’
- Train users when to question automation!
Integrating automation with human control

- Create tools to help with interfaces?
- Create anthropomorphic agents that track user tendencies
  - Based on human-human interaction
  - Apple’s bow-tied helper – knowledge navigator
  - Microsoft’s BOB and Clippy
  - Ananova news reader
  - Actually a long line of failures (ATMs, cars, online help)
- Change interface based on user choices
  - Adaptive menus
    - Pros: If using a few choices, makes it faster
    - Cons: Retention is poor, users might miss an interface change
  - e.g. Email SPAM filters
Theories

• Tested, reliable, broadly useful
• Descriptive theories
  • Develop consistent terminology for objects and actions
• Explanatory theories
  • Describe sequences of events and cause and effect
• Prescriptive theories
  • Give designers clear guidance for their choices
• Predictive theories
  • Enable designers to compare proposed designs for execution times and error rates
Theories

• Theories can be grouped by type of skills involved
  • Motor
    • pointing with a mouse
    • Fitts’ Law (1954)
  • Perceptual
    • finding an item on a display
    • predicting reading times for texts, visual or auditory tasks
  • Cognitive
    • planning sequence of steps needed to pay a bill
    • memory of actions
    • productivity as a function of response time (i.e. longer response time = lower productivity)
Theories

- Taxonomies
  - Useful for descriptive and explanatory theories
  - Impose order by classifying things into understandable categories
  - e.g. input devices, user interface styles
- Users’ individual differences
  - Personality
  - Technical aptitudes
  - User experience
Design by levels

• Approach to developing descriptive theories
• 4 level model (Foley et al 1995)
  • **Conceptual level** – user’s mental model. High level of what we are working with. (ex. painting programs – either pixel or object based [Powerpoint vs. paint])
  • **Semantic level** – meanings conveyed by user input and computer output (ex. ways to delete an object. delete-object action OR undo)
  • **Syntactic level** – how user actions that convey semantics assembled into sentences instructing computer to perform tasks (ex. select files, hit delete key OR click file->edit->delete, then confirm)
  • **Lexical level** – deals with device dependencies and with the precise mechanisms by which a user specifies the syntax (ex. a function key)
• Not as useful for today’s GUI based systems
Stages of action

- Donald Norman (1988)
- Simulate the stages of action that users go through
  - Form the goal
  - Form the intention
  - Specify the action
  - Execute the action
  - Perceive the system state
  - Interpret the system state
  - Evaluate the outcome

- Cycle of action and evaluation
- **Gulf of execution** (what you want vs. what’s allowed)
- **Gulf of evaluation** (what you got vs. what you wanted)
Stages of action

• Norman derived four principles from this model
  1. Make the system state and all action alternatives visible
  2. Good conceptual model with consistent system image
  3. Interface should have good mappings between stages
  4. Continuous feedback

• Errors occur when transitioning from goals->intentions->actions->outcome
  1. User forms inadequate goals
  2. Cannot find the correct interface action to accomplish goal
  3. Do not know how to specify correct set of actions
  4. User receives poor feedback
Stages of action – other domains

- Information-seeking
  - Recognize and
  - Accept an information problem
  - Formulate and
  - Express the query/search
  - Examine the results
  - Make judgments and reformulate the problem
  - Iterate/stop
  - Use the results
- Think about searching on the internet for a document or looking for a restaurant
- Amazon.com’s check-out process
  - (1) sign-in (2) shipping & payment (3) gift-wrap (4) place order
Challenges to HCI theories

• Theories should be more central to research and practice
  • Understand relationship between concepts and results
  • Help designers understand tradeoffs
• Theories should lead rather than lag behind practice
  • Too often theories are used to explain practice, instead of guiding it

• A good theory should:
  • Be understandable, produce similar results for different users, help solve practical problems