Human Computer Interaction
week 5: Usability of Interactive Systems
HCI

• What happens when a human and a computer system interact to perform a task?
  – Any tasks?

• Why is this important?
  1. Computer systems affect every person
  2. Safety, satisfaction, utility is critical
  3. Product success depends on ease of use
Interfaces in the Real World

- Not just computers!
  - VCR
  - Wristwatch
  - Phone
  - Copier
  - Car
  - Plane cockpit
  - Airline reservation
  - Air traffic control
  - Running shoes!
GOOGLE'S FOOTWEAR OF THE FUTURE: HOW IT WORKS

IN THE TONGUE
- Microprocessor: Takes the information from the sensors and calculates the wearer's activity levels, feeding audio messages to the speaker
- Speaker: Plays recorded clips from a selection of 250 phrases

If you're being lazy, the shoe may say:
This is super boring

IN THE SOLE
- Pressure sensor: Measures activity by recording strike of sole on the ground
- Accelerometer: Senses changes of speed and movement
- Gyroscope: Monitors changes of direction and balance

ON YOUR PHONE
- The shoes can send data to a smartphone. An app analyses the information and can use GPS to plot running routes and places on Google maps

I love the feeling of wind in my laces

When you're out running, walking, or biking, it's inconvenient and potentially hazardous to keep your eyes glued to the map on your phone. Imagine if your shoes told you which way to go without you ever having to take your eyes off the road or sidewalk. That's the idea behind the Lechal smart shoes and insoles from Ducere Technologies.

https://www.youtube.com/watch?v=ucK6jhdRIUY
Goals of HCI

• Allow users to carry out tasks
  – Safely
  – Effectively
  – Efficiently
  – Enjoyably
Usability

• Crucial issue in this area!

• Combination of
  – Ease of learning
  – High speed of user task performance
  – Low user error rate
  – Subjective user satisfaction
  – User retention over time
HCI How?

• How do we improve interfaces?

1. Educate software professionals

2. Draw upon fast accumulating body of knowledge regarding H-C interface design

3. Integrate UI design methods & techniques into standard software development methodologies now in place
UI Design/Develop Process

• Tao of User-Centered Design
  – Analyze user’s goals & tasks
  – Create design alternatives
  – Evaluate options
  – Implement prototype
  – Test
  – Refine
Above All Else...

• Know the User!
  – Physical & cognitive abilities (& special needs)
  – Personality & culture
  – Knowledge & skills
  – Motivation

• Two Fatal Mistakes:
  1. Assume all users are alike
  2. Assume all users are like the designer
Design Evaluation

• “Looks good to me” isn’t good enough!
• Both subjective and objective metrics
• Some things we can measure
  – Time to learn
  – Speed of performance
  – Rate of errors by user
  – Retention over time
  – Subjective satisfaction
Usability of Interactive Systems

Introduction

• The Interdisciplinary Design Science of Human-Computer Interaction (HCI) combines knowledge and methods associated with professionals including:
  – Psychologists (incl. Experimental, Educational, Social and Industrial Psychologists)
  – Computer Scientists
  – Instructional and Graphic Designers
  – Technical Writers
  – Human Factors and Ergonomics Experts
  – Anthropologists and Sociologists
Introduction (continued)

• What are the Ramifications?
  – Success Stories: Microsoft, Linux, Amazon.com, Google
  – Competition: Firefox vs. Internet Explorer
  – Copyright Infringement Suits - Apple vs. Microsoft (Windows) and Napster vs. The music industry
  – Mergers: AOL and Time Warner
  – Corporate Takeovers: IBM's seizure of Lotus
  – Privacy and Security issues: identification theft, medical information, viruses, spam, pornography, national security
Introduction (continued)

• Individual User Level
  – Routine processes: tax return preparation
  – Decision support: a doctor’s diagnosis and treatment
  – Education and training: encyclopedias, drill-and-practice exercises, simulations
  – Leisure: music and sports information
  – User generated content: social networking web sites, photo and video share sites, user communities
  – Internet-enabled devices and communication
Introduction (continued)

• Communities
  – Business use: financial planning, publishing applications
  – Industries and professions: web resources for journals, and career opportunities
  – Family use: entertainment, games and communication
  – Globalization: language and culture
Introduction (continued)

• The new “look and feel” of computers (Mac)
Introduction (continued)

• The new “look and feel” of computers (Vista)
Introduction (concluded)

• And smaller devices doing more...
Usability requirements

• Synonyms for “user-friendly” in Microsoft Word 2002 are easy to use; accessible; comprehensible; intelligible; idiot proof; available; and ready.

• But a “friend” also seeks to help and be valuable. A friend is not only understandable, but understands. A friend is reliable and doesn’t hurt. A friend is pleasant to be with.

• These measures are still subjective and vague, so a systematic process is necessary to develop usable systems for specific users in a specific context.
Usability requirements (cont.)

• The *U.S. Human Engineering Design Criteria for Military Systems* (1999) states these purposes:
  – Achieve required performance by operator, control, and maintenance personnel
  – Minimize skill and personnel requirements and training time
  – Achieve required reliability of personnel-equipment/software combinations
  – Foster design standardization within and among systems

• Should improving the user’s quality of life and the community also be objectives?

• Usability requires project management and careful attention to requirements analysis and testing for clearly defined objectives
Goals for requirements analysis

• **Ascertain the user’s needs**
  – Determine what tasks and subtasks must be carried out
  – Include tasks which are only performed occasionally. Common tasks are easy to identify.
  – Functionality must match need or else users will reject or underutilize the product
Goals for requirements analysis

- **Ensure reliability**
  - Actions must function as specified
  - Database data displayed must reflect the actual database
  - Appease the user's sense of mistrust
  - The system should be available as often as possible
  - The system must not introduce errors
  - Ensure the user's privacy and data security by protecting against unwarranted access, destruction of data, and malicious tampering
Goals for requirements analysis

• Promote standardization, integration, consistency, and portability
  – Standardization: use pre-existing industry standards where they exist to aid learning and avoid errors (e.g. the W3C and ISO standards)
  – Integration: the product should be able to run across different software tools and packages (e.g. Unix)
  – Consistency:
    • compatibility across different product versions
    • compatibility with related paper and other non-computer based systems
    • use common action sequences, terms, units, colors, etc. within the program
  – Portability: allow for the user to convert data across multiple software and hardware environments
Goals for requirements analysis

• Complete projects on time and within budget

Late or over budget products can create serious pressure within a company and potentially mean dissatisfied customers and loss of business to competitors

From Designing the User Interface: Strategies for Effective Human-Computer Interaction Fifth Edition by Ben Shneiderman & Catherine Plaisant in collaboration with Maxine S. Cohen and Steven M. Jacobs
Usability measures

• Define the target user community and class of tasks associated with the interface

• Communities evolve and change (e.g. the interface to information services for the U.S. Library of Congress)

• 5 human factors central to community evaluation:
  – *Time to learn*  
    How long does it take for typical members of the community to learn relevant task?
  – *Speed of performance*  
    How long does it take to perform relevant benchmarks?
  – *Rate of errors by users*  
    How many and what kinds of errors are made during benchmark tasks?
  – *Retention over time*  
    Frequency of use and ease of learning help make for better user retention
  – *Subjective satisfaction*  
    Allow for user feedback via interviews, free-form comments and satisfaction scales
Usability measures (cont.)

• Trade-offs in design options frequently occur.
  – Changes to the interface in a new version may create consistency problems with the previous version, but the changes may improve the interface in other ways or introduce new needed functionality.

• Design alternatives can be evaluated by designers and users via mockups or high-fidelity prototypes.
  – The basic tradeoff is getting feedback early and perhaps less expensively in the development process versus having a more authentic interface evaluated.
Usability motivations

Many interfaces are poorly designed and this is true across domains:

• Life-critical systems
  – Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems, medical equipment
  – High costs, reliability and effectiveness are expected
  – Length training periods are acceptable despite the financial cost to provide error-free performance and avoid the low frequency but high cost errors
  – Subject satisfaction is less an issue due to well motivated users

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Usability motivations (cont.)

- Industrial and commercial uses
  - Banking, insurance, order entry, inventory management, reservation, billing, and point-of-sales systems
  - Ease of learning is important to reduce training costs
  - Speed and error rates are relative to cost
  - Speed of performance is important because of the number of transactions
  - Subjective satisfaction is fairly important to limit operator burnout

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Usability motivations (cont.)

• **Office, home, and entertainment applications**
  – Word processing, electronic mail, computer conferencing, and video game systems, educational packages, search engines, mobile device, etc.
  – Ease of learning, low error rates, and subjective satisfaction are paramount due to use is often discretionary and competition fierce
  – Infrequent use of some applications means interfaces must be intuitive and easy to use online help is important
  – Choosing functionality is difficult because the population has a wide range of both novice and expert users
  – Competition cause the need for low cost
  – New games and gaming devices!
  • For example, Nintendo Wii
Usability motivations (cont.)

- Exploratory, creative, and cooperative systems
  - Web browsing, search engines, artist toolkits, architectural design, software development, music composition, and scientific modeling systems
  - Collaborative work
  - Benchmarks are hard to describe for exploratory tasks and device users
  - With these applications, the computer should be transparent so that the user can be absorbed in their task domain
Usability motivations (cont.)

• Social-technical systems
  – Complex systems that involve many people over long time periods
  – Voting, health support, identity verification, crime reporting
  – Trust, privacy, responsibility, and security are issues
  – Verifiable sources and status feedback are important
  – Ease of learning for novices and feedback to build trust
  – Administrators need tools to detect unusual patterns of usage
Universal Usability

• **Physical abilities and physical workplaces**
  – Basic data about human dimensions comes from research in *anthropometry*
  – There is no average user, either compromises must be made or multiple versions of a system must be created
  – Physical measurement of human dimensions are not enough, take into account dynamic measures such as reach, strength or speed
Universal Usability (cont.)

– Screen-brightness preferences vary substantially, designers customarily provide a knob to enable user control
– Account for variances of the user population's sense perception
– Vision: depth, contrast, color blindness, and motion sensitivity
– Touch: keyboard and touchscreen sensitivity
– Hearing: audio clues must be distinct
– Workplace design can both help and hinder work performance
Universal Usability (cont.)

- The standard *ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations* (2007) lists these concerns:
  - Work-surface and display-support height
  - Clearance under work surface for legs
  - Work-surface width and depth
  - Adjustability of heights and angles for chairs and work surfaces
  - Posture - seating depth and angle; back-rest height and lumbar support
  - Availability of armrests, footrests, and palmrests
Universal Usability (cont.)

• Cognitive and perceptual abilities
  – The human ability to interpret sensory input rapidly and to initiate complex actions makes modern computer systems possible
  – The journal *Ergonomics Abstracts* offers this classification of human cognitive processes:
    • Long-term and semantic memory
    • Short-term and working memory
    • Problem solving and reasoning
    • Decision making and risk assessment
    • Language communication and comprehension
    • Search, imagery, and sensory memory
    • Learning, skill development, knowledge acquisition, and concept attainment

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Universal Usability (cont.)

They also suggest this set of factors affecting perceptual and motor performance:

- Arousal and vigilance
- Fatigue and sleep deprivation
- Perceptual (mental) load
- Knowledge of results and feedback
- Monotony and boredom
- Sensory deprivation
- Nutrition and diet
- Fear, anxiety, mood, and emotion
- Drugs, smoking, and alcohol
- Physiological rhythms

But note, in any application, background experience and knowledge in the task domain and the interface domain play key roles in learning and performance.
Universal Usability (cont.)

• Personality differences
  – There is no set taxonomy for identifying user personality types
  – Designers must be aware that populations are subdivided and that these subdivisions have various responses to different stimuli
  – Myers-Briggs Type Indicator (MBTI)
    • extroversion versus introversion
    • sensing versus intuition
    • perceptive versus judging
    • feeling versus thinking
Universal Usability (cont.)

- **Cultural and international diversity**
  - Characters, numerals, special characters, and diacriticals
  - Left-to-right versus right-to-left versus vertical input and reading
  - Date and time formats
  - Numeric and currency formats
  - Weights and measures
  - Telephone numbers and addresses
  - Names and titles (Mr., Ms., Mme.)
  - Social-security, national identification, and passport numbers
  - Capitalization and punctuation
  - Sorting sequences
  - Icons, buttons, colors
  - Pluralization, grammar, spelling
  - Etiquette, policies, tone, formality, metaphors
Universal Usability (cont.)

• Users with physical challenges
  – Designers must plan early to accommodate users with disabilities
  – Early planning is more cost efficient than adding on later
  – Businesses must comply with the "Americans With Disabilities" Act for some applications

• Older Adult Users
  – Including the elderly is fairly easy
    • Designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc. with less distracting animation
Universal Usability (concluded)

• Younger users
Goals for our profession

• Potential research topics
  – Reducing anxiety and fear of computer usage
  – Graceful evolution
  – Specification and implementation of interaction
  – Direct manipulation
  – Social media participation
  – Input devices
  – Online assistance
  – Information exploration
Goals for our profession (cont.)

• Providing tools, techniques, and knowledge for system implementers
  – Rapid prototyping is easy when using contemporary tools
  – Use general or self-determined guideline documents written for specific audiences
  – To refine systems, use feedback from individual or groups of users

• Raising the computer consciousness of the general public
  – Many novice users are fearful due to experience with poor product design
  – Good designs help novices through these fears by being clear, competent, and nonthreatening
Guidelines, Principles, and Theories
Guidelines

• Shared language
• Best practices
• Critics
  – Too specific, incomplete, hard to apply, and sometimes wrong
• Proponennts
  – Encapsulate experience
Navigating the interface

• Sample of the National Cancer Institutes guidelines:
  – Standardize task sequences
  – Ensure that embedded links are descriptive
  – Use unique and descriptive headings
  – Use check boxes for binary choices
  – Develop pages that will print properly
  – Use thumbnail images to preview larger images
Accessibility guidelines

• Provide a text equivalent for every nontext element
• For any time-based multimedia presentation synchronize equivalent alternatives
• Information conveyed with color should also be conveyed without it
• Title each frame to facilitate identification and navigation
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
Getting the user’s attention

- Intensity
- Marking
- Size
- Choice of fonts
- Inverse video
- Blinking
- Color
- Audio
Principles

• More fundamental, widely applicable, and enduring than guidelines
• Need more clarification
• Fundamental principles
  – Determine user’s skill levels
  – Identify the tasks
• Five primary interaction styles
• Eight golden rules of interface design
• Prevent errors
• Automation and human control
Determine user’s skill levels

• “Know thy user”
• Age, gender, physical and cognitive abilities, education, cultural or ethnic background, training, motivation, goals and personality
• Design goals based on skill level
  – Novice or first-time users
  – Knowledgeable intermittent users
  – Expert frequent users
• Multi-layer designs
Identify the tasks

- Task Analysis usually involve long hours observing and interviewing users
- Decomposition of high level tasks
- Relative task frequencies

<table>
<thead>
<tr>
<th>Job Title</th>
<th>Task: Query by Patient</th>
<th>Task: Update Data</th>
<th>Task: Query Across Patients</th>
<th>Task: Add Relations</th>
<th>Task: Evaluate System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse</td>
<td>0.14</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>0.06</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisor</td>
<td>0.01</td>
<td>0.01</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appointment personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Medical-record maintainer</td>
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<td>0.04</td>
<td>0.04</td>
<td>0.01</td>
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<tr>
<td>Clinical researcher</td>
<td></td>
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<td></td>
<td></td>
<td>0.08</td>
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<tr>
<td>Database programmer</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

From Designing the User Interface: Strategies for Effective Human-Computer Interaction Fifth Edition by Ben Shneiderman & Catherine Plaisant in collaboration with Maxine S. Cohen and Steven M. Jacobs
Choose an interaction style

- Direct Manipulation
- Menu selection
- Form fillin
- Command language
- Natural language

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Spectrum of Directness

An example of progression towards more direct manipulation: less recall/more recognition, fewer keystrokes/fewer clicks, less capability to make errors, and more visible context.

a. Command line

b. Form fill-in to reduce typing

c. Improved form fill-in to clarify and reduce errors

d. Pull-down menus offer meaningful names and eliminate invalid values

e. 2-D menus to provide context, show valid dates, and enable rapid single selection

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The 8 golden rules of interface design

1. Strive for consistency
2. Cater to universal usability
3. Offer informative feedback
4. Design dialogs to yield closure
5. Prevent errors
6. Permit easy reversal of actions
7. Support internal locus of control
8. Reduce short term memory load
Prevent errors

- Make error messages specific, positive in tone, and constructive
- Mistakes and slips (Norman, 1983)
- Correct actions
  - Gray out inappropriate actions
  - Selection rather than freestyle typing
  - Automatic completion
- Complete sequences
  - Single abstract commands
  - Macros and subroutines
### Automation and human control

<table>
<thead>
<tr>
<th>Humans Generally Better</th>
<th>Machines Generally Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense low-level stimuli</td>
<td>Sense stimuli outside human's range</td>
</tr>
<tr>
<td>Detect stimuli in noisy background</td>
<td>Count or measure physical quantities</td>
</tr>
<tr>
<td>Recognize constant patterns in varying situations</td>
<td>Store quantities of coded information accurately</td>
</tr>
<tr>
<td>Sense unusual and unexpected events</td>
<td>Monitor prespecified events, especially infrequent ones</td>
</tr>
<tr>
<td>Remember principles and strategies</td>
<td>Make rapid and consistent responses to input signals</td>
</tr>
<tr>
<td>Retrieve pertinent details without <em>a priori</em> connection</td>
<td>Recall quantities of detailed information accurately</td>
</tr>
<tr>
<td>Draw on experience and adapt decisions to situation</td>
<td>Process quantitative data in prespecified ways</td>
</tr>
<tr>
<td>Select alternatives if original approach fails</td>
<td>Reason deductively: infer from a general principle</td>
</tr>
<tr>
<td>Reason inductively: generalize from observations</td>
<td>Perform repetitive preprogrammed actions reliably</td>
</tr>
<tr>
<td>Act in unanticipated emergencies and novel situations</td>
<td>Exert great, highly controlled physical force</td>
</tr>
<tr>
<td>Apply principles to solve varied problems</td>
<td>Perform several activities simultaneously</td>
</tr>
<tr>
<td>Make subjective evaluations</td>
<td>Maintain operations under heavy information load</td>
</tr>
<tr>
<td>Develop new solutions</td>
<td>Maintain performance over extended periods of time</td>
</tr>
<tr>
<td>Concentrate on important tasks when overload occurs</td>
<td></td>
</tr>
<tr>
<td>Adapt physical response to changes in situation</td>
<td></td>
</tr>
</tbody>
</table>

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Automation and human control (cont.)

• Successful integration:
  – Users can avoid:
    • Routine, tedious, and error prone tasks
  – Users can concentrate on:
    • Making critical decisions, coping with unexpected situations, and planning future actions

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Automation and human control (cont.)

- Supervisory control needed to deal with real world open systems
  - E.g. air-traffic controllers with low frequency, but high consequences of failure
  - FAA: design should place the user in control and automate only to improve system performance, without reducing human involvement

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Automation and human control (cont.)

• **Goals for autonomous agents**
  – knows user's likes and dislikes
  – makes proper inferences
  – responds to novel situations
  – performs competently with little guidance

• **Tool like interfaces versus autonomous agents**

• **Aviators representing human users, not computers, more successful**
Automation and human control (cont.)

• User modeling for adaptive interfaces
  – keeps track of user performance
  – adapts behavior to suit user's needs
  – allows for automatically adapting system
    • response time, length of messages, density of feedback, content of menus, order of menu items, type of feedback, content of help screens
  – can be problematic
    • system may make surprising changes
    • user must pause to see what has happened
    • user may not be able to
      – predict next change
      – interpret what has happened
      – restore system to previous state

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Automation and human control (cont.)

• Alternative to agents:
  – user control, responsibility, accomplishment
  – expand use of control panels
    • style sheets for word processors
    • specification boxes of query facilities
    • information-visualization tools
Automation and human control (concluded)

Features to aid in universal access

Above: Mac OS X system preference settings
Right: Windows Vista Control Panel

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Theories

• Beyond the specifics of guidelines
• Principles are used to develop theories
• Descriptions/explanatory or predictive
• Motor task, perceptual, or cognitive
Explanatory and predictive theories

• **Explanatory theories:**
  – Observing behavior
  – Describing activity
  – Conceiving of designs
  – Comparing high-level concepts of two designs
  – Training

• **Predictive theories:**
  – Enable designers to compare proposed designs for execution time or error rates
Perceptual, Cognitive, & Motor tasks

• **Perceptual or Cognitive subtasks theories**
  – Predicting reading times for free text, lists, or formatted displays

• **Motor-task performance times theories:**
  – Predicting keystroking or pointing times
Taxonomy
(explanatory theory)

– Order on a complex set of phenomena
– Facilitate useful comparisons
– Organize a topic for newcomers
– Guide designers
– Indicate opportunities for novel products.
Conceptual, semantic, syntactic, and lexical model

• Foley and van Dam four-level approach
  – **Conceptual level:**
    • User's mental model of the interactive system
  – **Semantic level:**
    • Describes the meanings conveyed by the user's command input and by the computer's output display
  – **Syntactic level:**
    • Defines how the units (words) that convey semantics are assembled into a complete sentence that instructs the computer to perform a certain task
  – **Lexical level:**
    • Deals with device dependencies and with the precise mechanisms by which a user specifies the syntax

• Approach is convenient for designers
  – Top-down nature is easy to explain
  – Matches the software architecture
  – Allows for useful modularity during design
Stages of action models

• Norman's seven stages of action
  1. Forming the goal
  2. Forming the intention
  3. Specifying the action
  4. Executing the action
  5. Perceiving the system state
  6. Interpreting the system state
  7. Evaluating the outcome

• Norman's contributions
  – Context of cycles of action and evaluation.
  – *Gulf of execution*: Mismatch between the user's intentions and the allowable actions
  – *Gulf of evaluation*: Mismatch between the system's representation and the users' expectations
Stages of action models (cont.)

- **Four principles of good design**
  - State and the action alternatives should be visible
  - Should be a good conceptual model with a consistent system image
  - Interface should include good mappings that reveal the relationships between stages
  - User should receive continuous feedback

- **Four critical points where user failures can occur**
  - Users can form an inadequate goal
  - Might not find the correct interface object because of an incomprehensible label or icon
  - May not know how to specify or execute a desired action
  - May receive inappropriate or misleading feedback
Consistency through grammars

Consistent user interface goal

– Definition is elusive - multiple levels sometimes in conflict
– Sometimes advantageous to be inconsistent.

<table>
<thead>
<tr>
<th>Consistent</th>
<th>Inconsistent A</th>
<th>Inconsistent B</th>
</tr>
</thead>
<tbody>
<tr>
<td>delete/insert character</td>
<td>delete/insert character</td>
<td>delete/insert character</td>
</tr>
<tr>
<td>delete/insert word</td>
<td>remove/bring word</td>
<td>remove/insert word</td>
</tr>
<tr>
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<td>destroy/create line</td>
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Consistency through grammars (cont.)

Inconsistent action verbs

– Take longer to learn
– Cause more errors
– Slow down users
– Harder for users to remember
The disappearance of syntax

• Users must maintain a profusion of device-dependent details in their human memory.
  – Which action erases a character
  – Which action inserts a new line after the third line of a text file
  – Which abbreviations are permissible
  – Which of the numbered function keys produces the previous screen.
The disappearance of syntax (cont.)

• Learning, use, and retention of this knowledge is hampered by two problems
  – Details vary across systems in an unpredictable manner
  – Greatly reduces the effectiveness of paired-associate learning
• Syntactic knowledge conveyed by example and repeated usage
• Syntactic knowledge is system dependent
The disappearance of syntax (concluded)

• Minimizing these burdens is the goal of most interface designers
  – Modern direct-manipulation systems
  – Familiar objects and actions representing their task objects and actions.
  – Modern user interface building tools
  – Standard widgets
Contextual Theories

• User actions are situated by time and place
  – You may not have time to deal with shortcuts or device dependent syntax, such as on mobile devices, when hurried
  – Physical space is important in ubiquitous, pervasive and embedded devices, e.g. a museum guide stating information about a nearby painting

• A taxonomy for mobile device application development could include:
  – Monitor and provide alerts, e.g. patient monitoring systems
  – Gather information
  – Participate in group collaboration
  – Locate and identify nearby object or site
  – Capture information about the object and share that information
Assignment

• Find the best User Interface for small devices like watch or bracelet