

CPT208 Human-Centric Computing

04. Design Principles and Design Alternatives

Dr Teng Ma

Lecture Syllabus

1. Introduction
2. Discovering requirements
3. Conceptual Prototyping and Practical Guide
4. **Design Principles and Design Alternatives**
5. Heuristic Evaluation, Questionnaire, and interview
6. Prototyping Fidelity and Dimensions
7. SAT reading week
8. Group Project Demonstration Day
9. Usability Testing & Experimental Design
10. Interfaces and Research Considerations
11. Field Study and Analytics
12. Flipped Classroom: Selected Coursework Demonstration
13. Revision

Learning Outcomes

1. Additional considerations on
2. Understand the use and details of design principles
3. Understand the use and details of Shneiderman's Eight Golden Rules of Interface Design
4. How to generate and choose among alternative designs



Accessibility and Inclusiveness

Chapter 1



At the beginning of the 20th century, due to the call of humanitarianism, a new architectural design method - barrier-free design came into being in the architectural field. It uses modern technology to build and transform the environment to provide mobility and safe space for the masses of disabled people.

International standards for accessibility design require that ramps should be installed at the entrance of all public buildings instead of steps, with a gradient of no more than 1/12. The design of the ramp in the picture clearly violates this requirement.

The bad design can lead to injury and inconvenience for people with disabilities.

Accessibility and inclusiveness

- **Accessibility:** the extent to which an interactive product is accessible by as many people as possible
 - Focus is on people with **disabilities**; for instance, those using android OS or apple voiceover
- **Inclusiveness:** making products and services that accommodate the widest possible number of people
 - For example, smartphones designed for all and made available to everyone regardless of their disability, education, age, or income

Understanding disability

- Disabilities can be classified as:
 - Sensory impairment
 - such as loss of vision or hearing
 - Physical impairment
 - having loss of functions to one or more parts of the body after a stroke or spinal cord injury
 - Cognitive
 - including learning impairment or loss of memory/cognitive function due to old age

Understanding disability

- Each type can be further defined in terms of capability:
 - For example, someone might have only peripheral vision, be color blind, or have no light perception
- Impairment can be categorized:
 - **Permanent**
 - such as long-term wheelchair user
 - **Temporary**
 - that is, after an accident or illness
 - **Situational**
 - for example, a noisy environment means that a person can't hear

Being cool about disability

- Prosthetics can be designed to move beyond being functional (and often ugly) to being desirable and fashionable
- People now refer to “wearing their wheels,” rather than “using a wheelchair”



Fashionable leg cover designed by Alleles Design Studio

More about accessibility and inclusiveness

- 「小白测评」盲人用手机什么感觉？9大品牌无障碍测试 关注视障人群
<https://www.bilibili.com/video/BV1qg4y1v7zT>



- 汶川截肢舞者廖智：我用假肢跳街舞 | 闪光少女023
<https://www.bilibili.com/video/BV11J411J7A2>



Why this matters?

- You can't **imagine** the real situation of their daily lives
- More importantly, satisfying only the need is **not** **enough**
- These force you to know more about them, not only what they **need**, but also what they **want**

Design Principles

Chapter 1

Design principles

- Generalizable abstractions for thinking about different aspects of design
- The **do's and don'ts** of interaction design
- What to provide and what not to provide at the interface
- Derived from a mix of
 - theory-based knowledge
 - experience, and
 - common-sense

Design principles

- We start with some common ones (there are more!)
 - Visibility
 - Feedback
 - Constraints
 - Consistency
 - Affordance
 - ...

Visibility

- This is a control panel for an elevator
- How does it work?
- Push a button for the floor you want?
- Nothing happens. Push any other button?
Still nothing. What do you need to do?
- It is not visible as to what to do!



www.baddesigns.com

Visibility

- ...with this elevator, you need to insert your room card in the slot by the buttons to get the elevator to work!
- How would you make this action more visible?



www.baddesigns.com



Visibility

If the customer does not find an attendant to swipe his card, even if he enters the elevator, he cannot go to the corresponding floor. In this case, if you can't find the service staff, it will take a lot of time for customers; if customers accidentally remember the wrong floor, they don't have the authority to change the number of floors even if they need to return to the first floor.





Visibility



Needle in a haystack



Watch your
step!

Feedback

- Sending information back to the user about what has been done
- Includes sound, highlighting, animation, and combinations of these
 - For example, when screen button is clicked, it provides sound or red highlight feedback:

[Previous](#) → “ccclichhk”

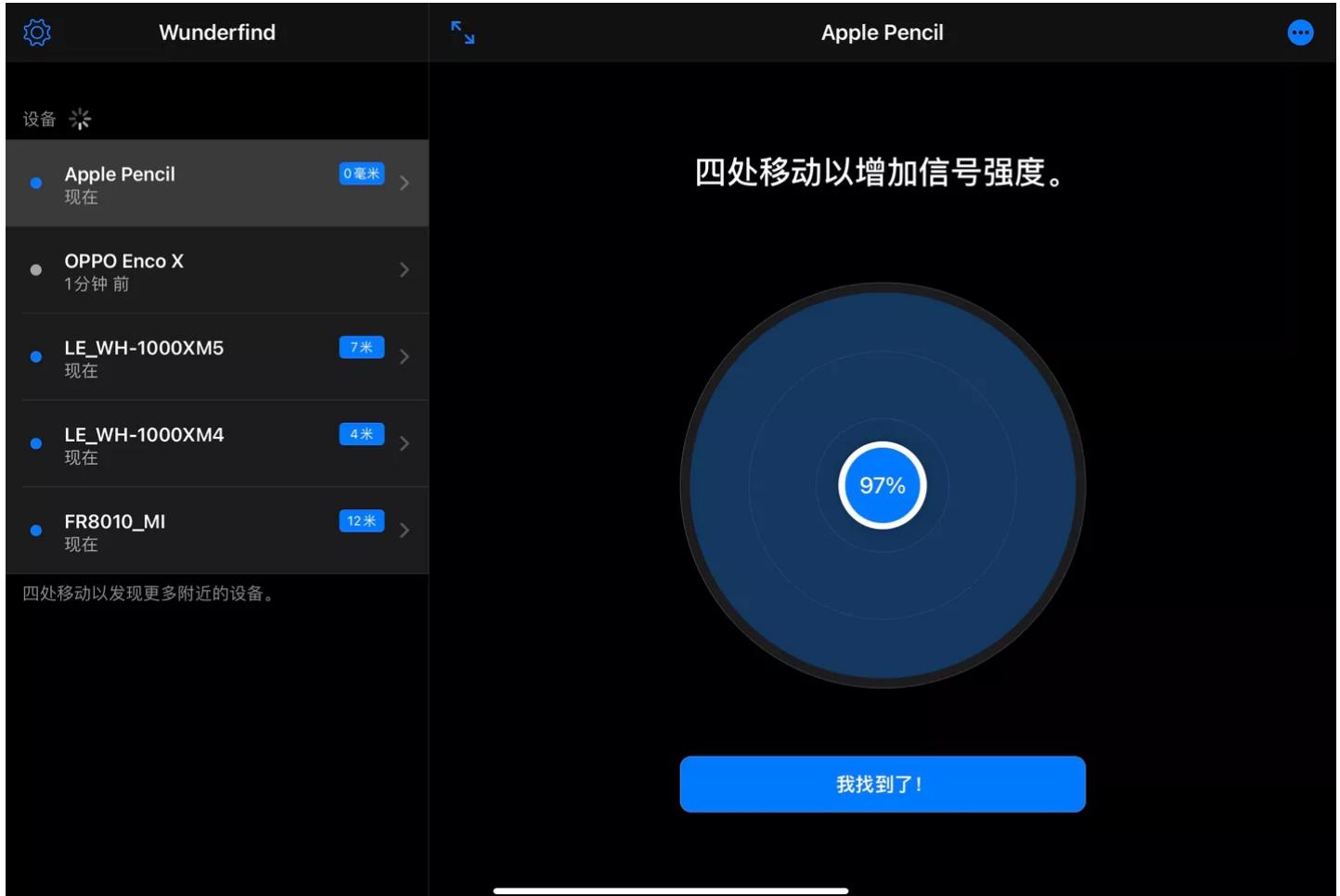
[Previous](#) → [Previous](#)



Feedback

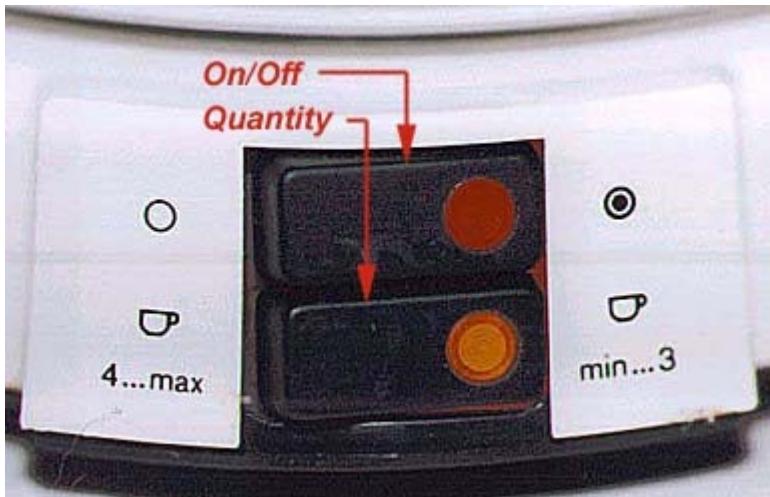
This is a good design because it has a clear interface that allows you to move around depending on the strength of the signal to find the lost device.

Yizhou Zhu (2034284)

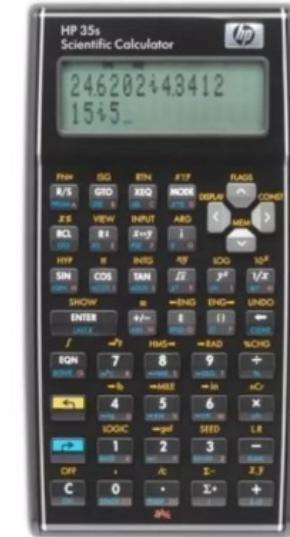




Feedback

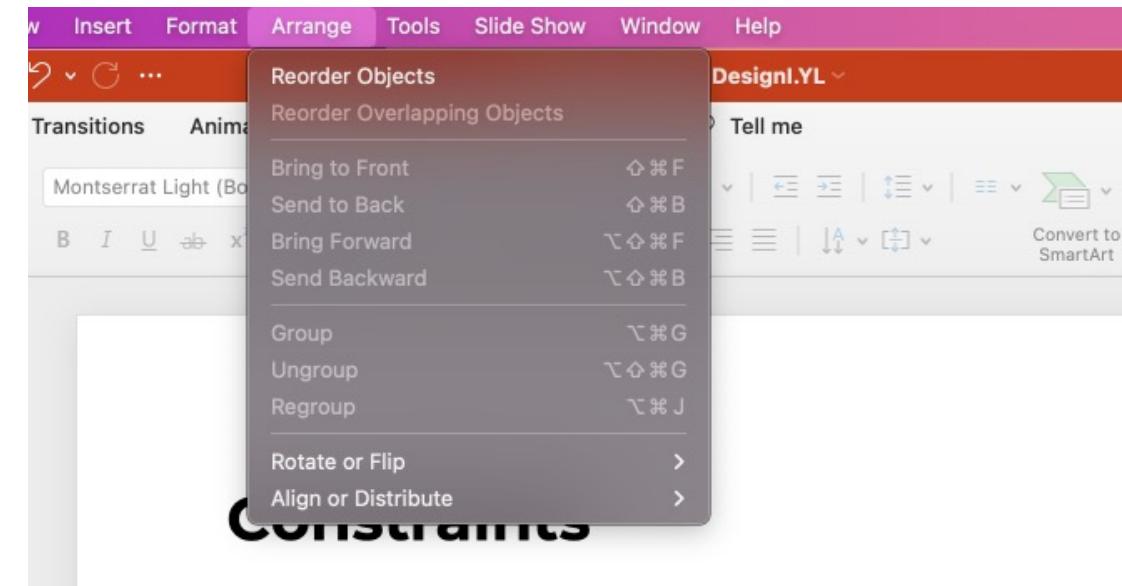


More coffee or less



Constraints

- **Restricting** the possible actions that can be performed
- Helps prevent user from selecting incorrect options
- Physical objects can be designed to constrain things
 - for example, there being only one way you can insert a key into a lock



Constraints

- Where do you plug the mouse?
- Where do you plug the keyboard, in the top or bottom connector?
- Do the color-coded icons help?
- *How to design them more logically?*



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Constraints

(A) provides direct adjacent mapping between icon and connector



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(B) provides color coding that associates the connectors with the labels



www.baddesigns.com





Constraints

- Blocked sockets





Constraints



Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks.
 - For example, always use Ctrl key plus first initial of the command for an operation: Ctrl+c, Ctrl+s, Ctrl+o
 - What are these and why?
 - What about Ctrl+p, Ctrl+v, and Ctrl+x?
- The main benefit is that consistent interfaces are easier to learn and use

Consistency

- What happens if there is more than one command starting with the same letter? (for example, save, spelling, select, style)
- You have to find other initials or combinations of keys, thereby breaking the consistency rule (for example, Ctrl+s, Ctrl+Sp, Ctrl+shift+l)
- Increases learning burden on user, making them more prone to errors



Consistency



Think more about shortcuts

- Ask yourself
 - Do you use these shortcuts?
 - If so, how did you learn and memorise these?
- Ask your parents and grandparents
 - Do they use these shortcuts?
 - How easy was it for them to learn these shortcuts?
 - Again, cultural differences!



Consistency

This is a bad design because the -1 button panel is separate from the other panels, so it is very likely that people will not find their way to the -1 floor, especially when there are many people in the elevator.

Ye Fang (2033996)



Internal consistency

- Internal consistency refers to designing operations to behave the same **within** an application
 - Consistency with other elements in the system
 - Cultivates a sense of orientation and trust
 - Indicate the system is well thought out and planned
 - Difficult to achieve with complex interfaces



External consistency

- External consistency refers to designing operations, interfaces, and so on to be the same across applications and devices
 - Consistency with other elements in the environment
 - Extends the benefits of internal consistency across multiple, independent systems
 - More difficult to achieve because different systems rarely observe the same design standards

Finder File Edit View Go Window Help

Safari File Edit View History Bookmarks Window Help

Photoshop File Edit Image Layer Select Filter View Window Help

Keypad numbers layout

→ A case of external inconsistency

(a) phones, remote controls

1	2	3
4	5	6
7	8	9
0		

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		

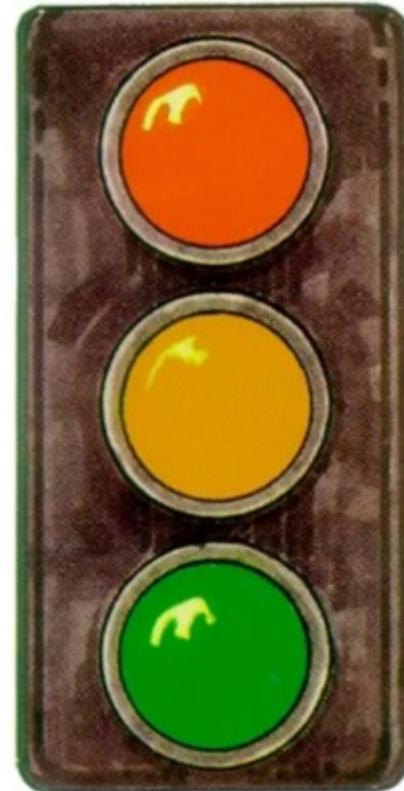
Aesthetic consistency

- Aesthetic consistency refers to the style and appearance is repeated enhance recognition, communicates membership and sets emotional tone
 - Mercedes Benz vehicles are instantly recognizable because the company consistently feature its logo on all its vehicles
 - Associated with quality and prestige, respected and admired, fine craftsmanship and reliable



Functional consistency

- Functional consistency refers to the meaning and action are consistent to improve learnability and understanding
 - Consistent use of symbols to represent similar concepts, leverages prior knowledge and makes new things easier to learn
 - Traffic always turns yellow before red

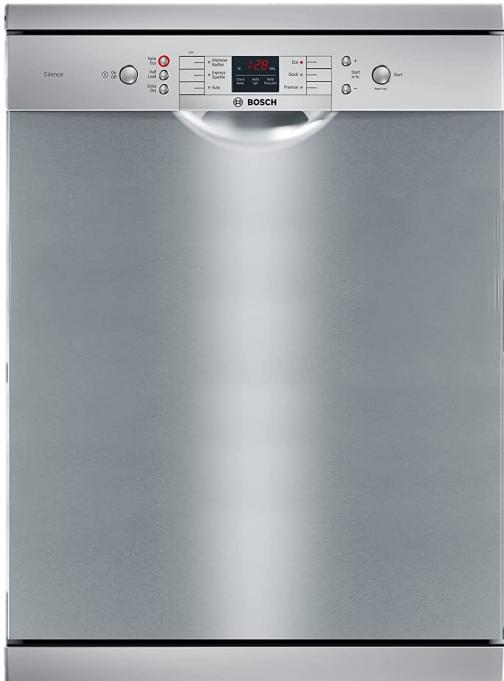


Affordances

- Refers to an attribute of an object that allows people to know how to use it.
 - For example, a mouse button invites pushing, a door handle affords pulling
- Norman (1988) used the term to discuss the design of everyday objects
- Has since been popularized in interaction design to discuss how to design interface objects
 - For example, scrollbars to enable moving up and down

Affordances

- How to open it?
- What about this?
- It's also related to people's
mental models.



Affordances

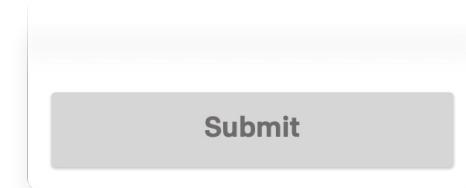
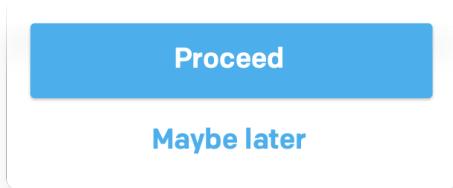
- Interfaces are virtual and do not have affordances like physical objects
- Norman argues that it does not make sense to talk about interfaces in terms of 'real' affordances
- Instead, interfaces are better conceptualized as '**perceived affordances**:
 - Learned conventions of arbitrary mappings between action and effect at the interface
 - Some mappings are better than others

Affordances



Virtual Affordances

- How do these screen objects afford?
- What if you were a novice user?
- Would you know what to do with them?



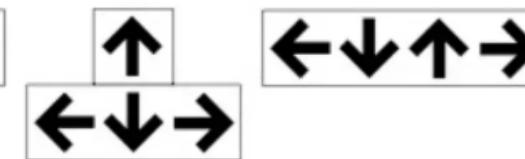
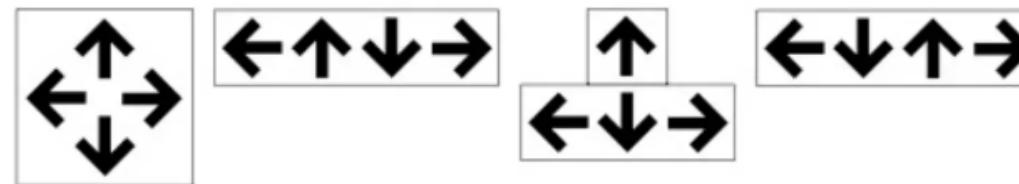
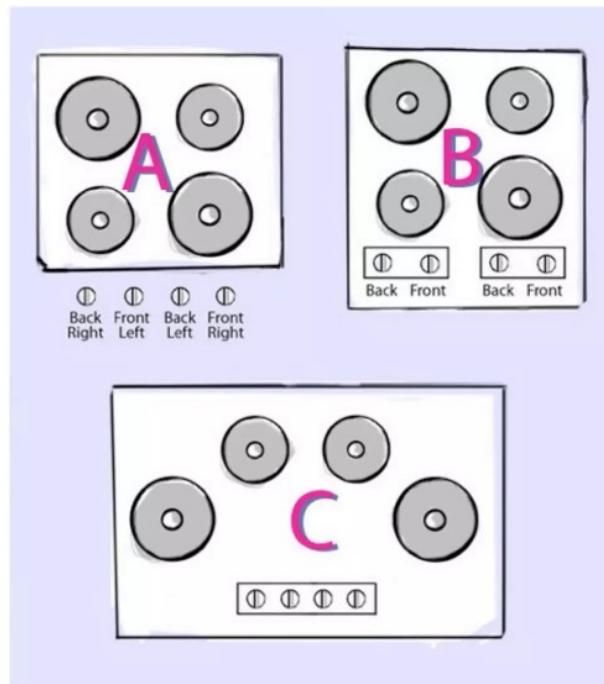
Design principles

- We talked about
 - Visibility
 - Feedback
 - Constraints
 - Consistency
 - Affordance
- There are a lot more
 - Natural mappings
 - Mental model
 - ...



Mapping

- Relationship between controls and their effects





Mapping

This is a bad design because when I put the water cup in the center of the circle, the water doesn't flow into my cup.

Yumeng Zhang(2035352)



Elevators in SD

- Visibility issue
- Feedback issue
- Consistency issue
- Bad mapping
- Mental model
- ...



Learning Mall Login Page



Invalid login, please try again

yue.li

.....

Forgotten your username or password?

Log in

Remember username

Log in using your:

XJTLU Account

Learning Mall Core

Welcome to XJTLU online learning and teaching system!

Please log in to access your XJTLU account and degree courses:

XJTLU Account

If you are a non-XJTLU user (without an XJTLU email address), please log in here:

NON-XJTLU Account

If you don't have the account above, you will need to create a new account by clicking [HERE](#). Please note: You need to use an enrolment key given by XJTLU staff to be authorised to create the new account.

Shneiderman's Eight Golden Rules

Chapter 1

Shneiderman's Eight Golden Rules of Interface Design

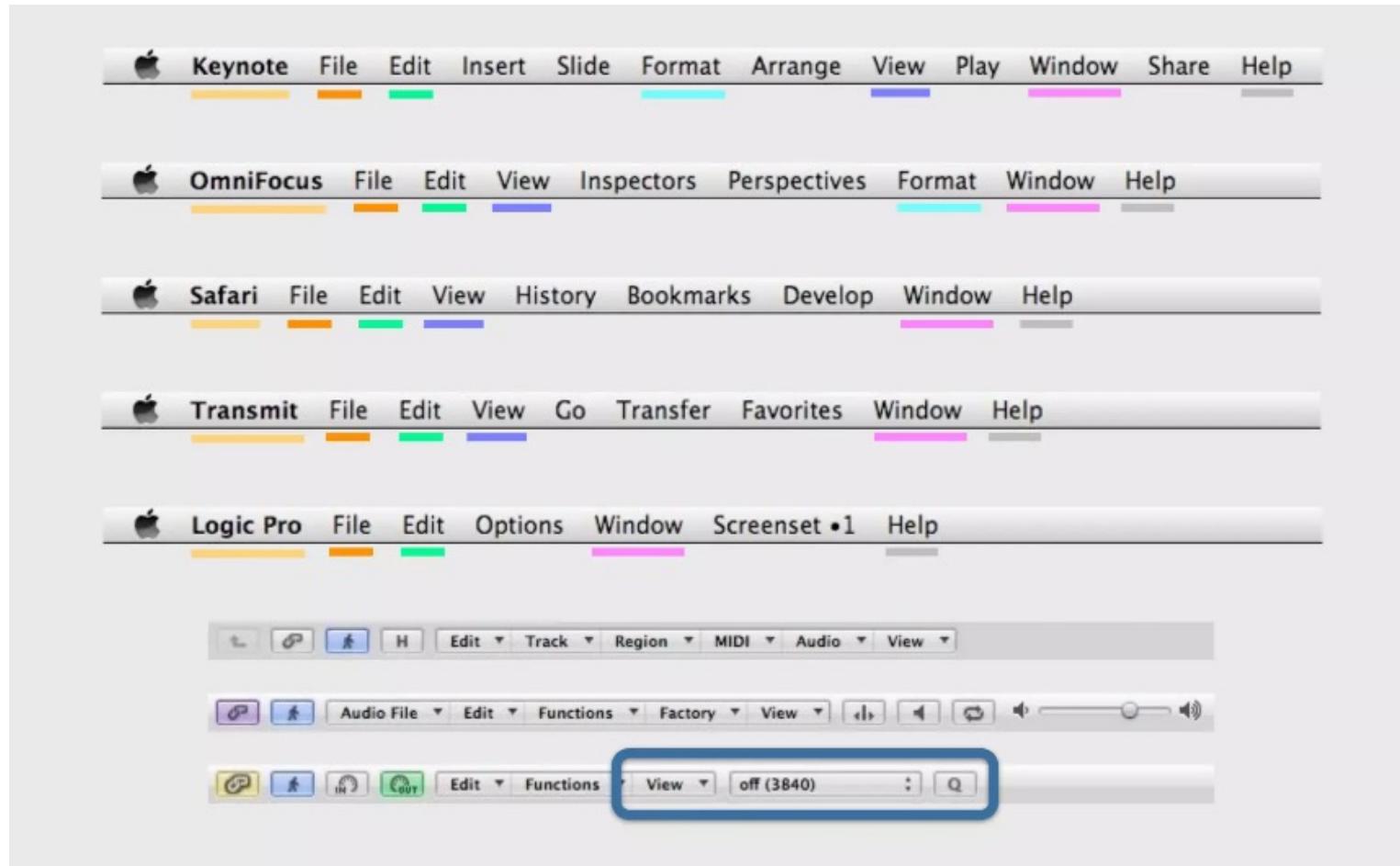
1. Strive for consistency
2. Enable frequent users to use shortcuts
3. Offer informative feedback
4. Design dialog to yield closure
5. Offer simple error handling
6. Permit easy traversal of actions
7. Support internal locus of control
8. Reduce short-term memory load

See more details in <https://www.interaction-design.org/literature/article/shneiderman-s-eight-golden-rules-will-help-you-design-better-interfaces>

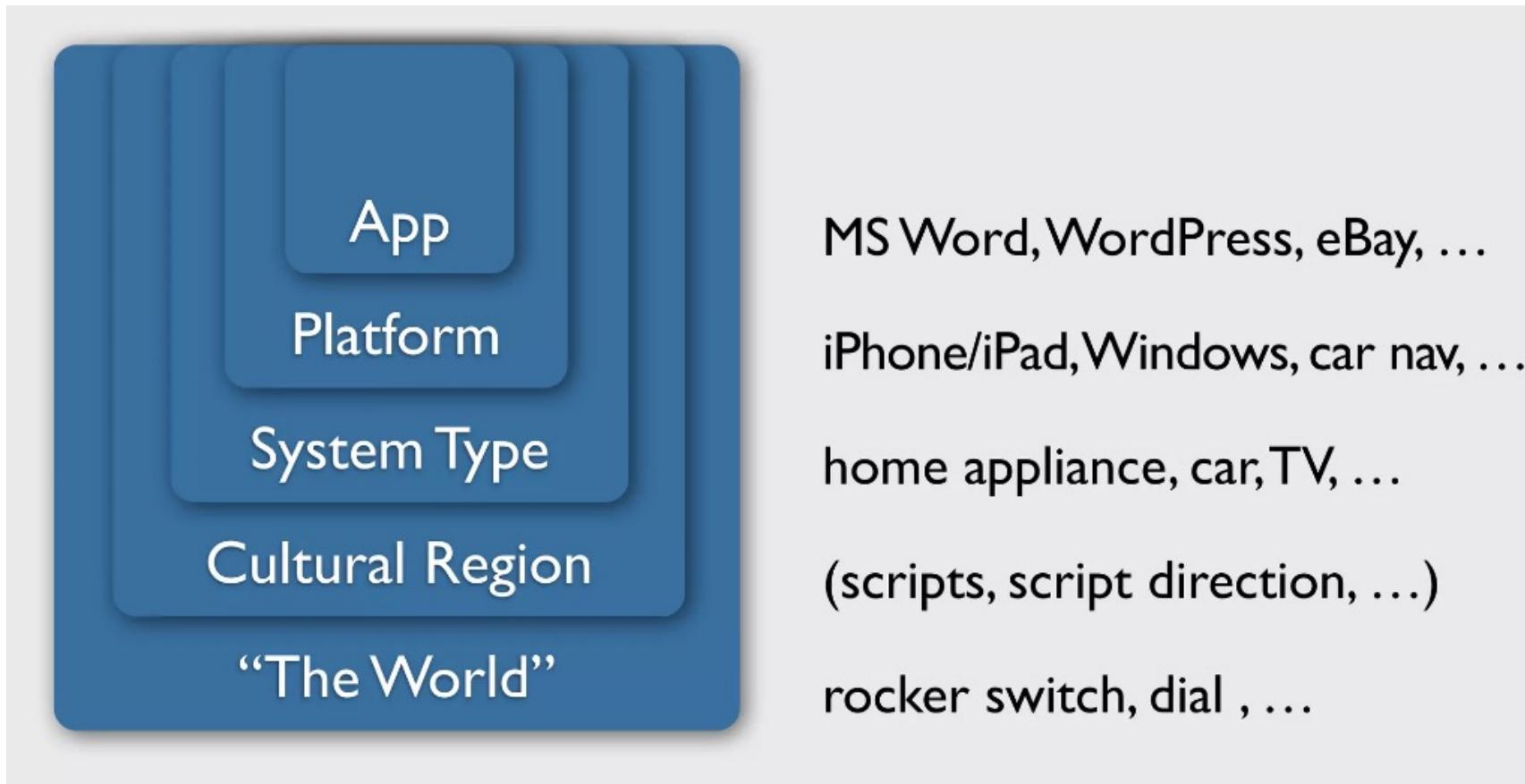
Strive for consistency

- Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent commands should be employed throughout.
 - Workflows/Processes
 - Functionality
 - Appearance
 - Terminology

Strive for consistency



Strive for consistency

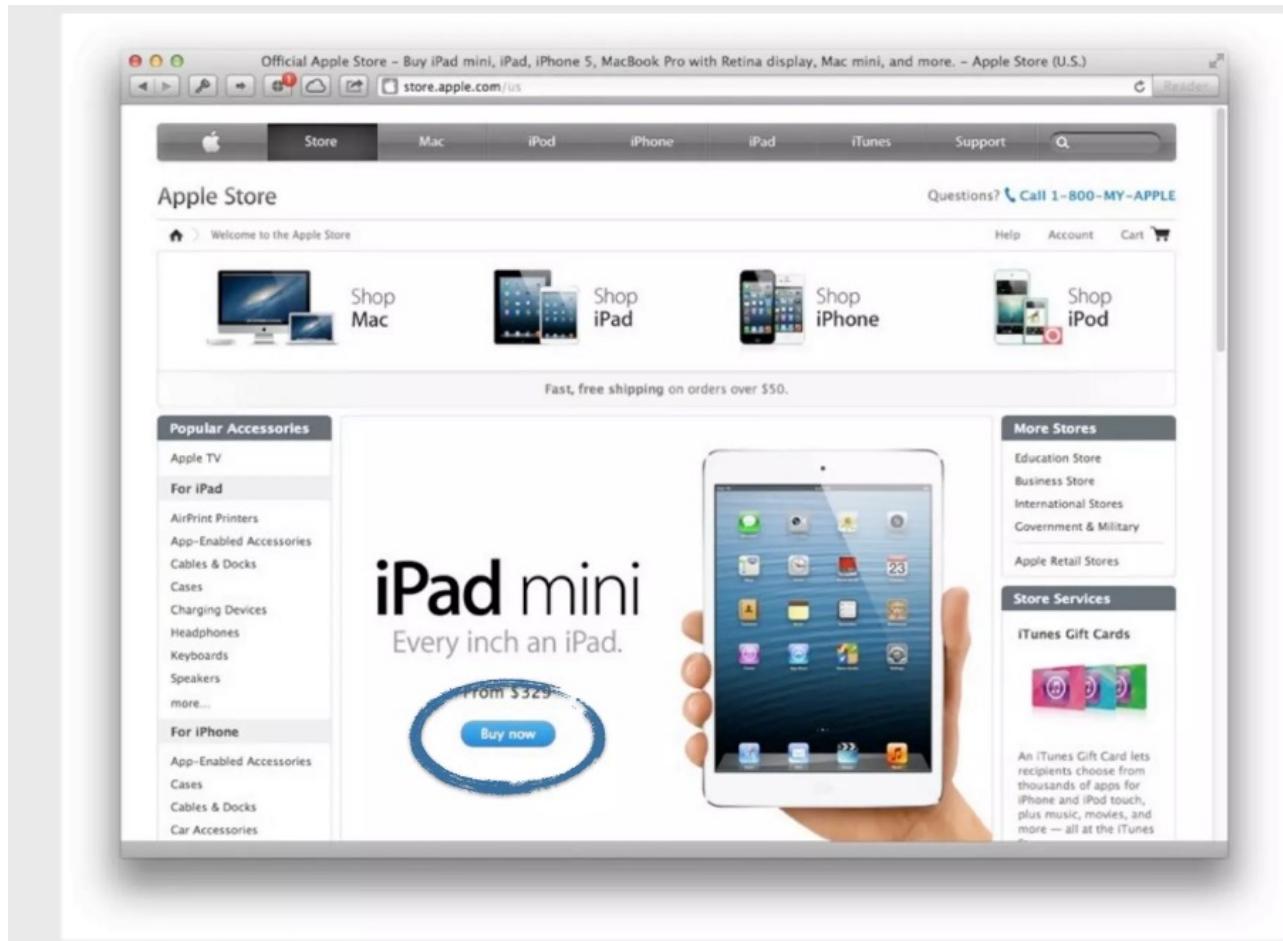


Strive for consistency



“information scent”

– consistent terminology



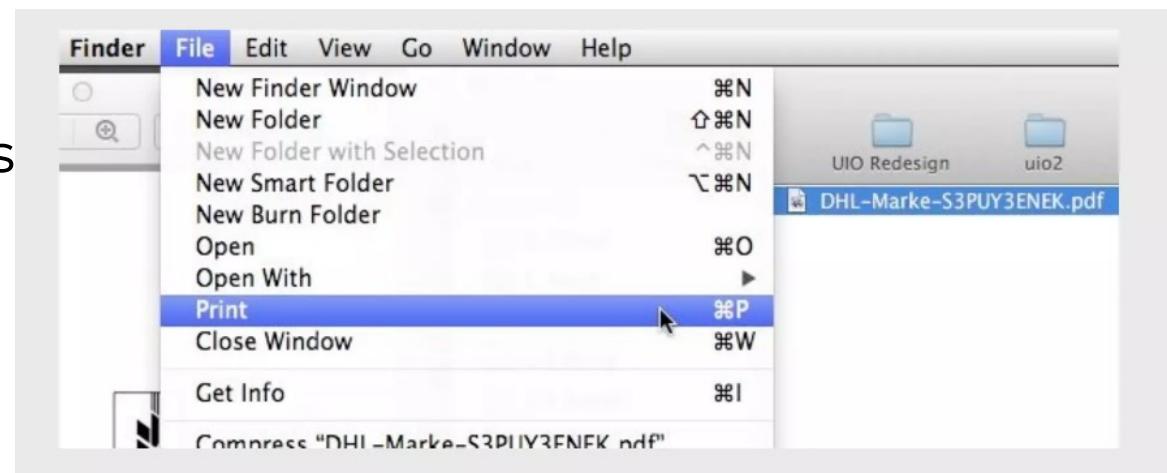
“information scent”

– consistent terminology



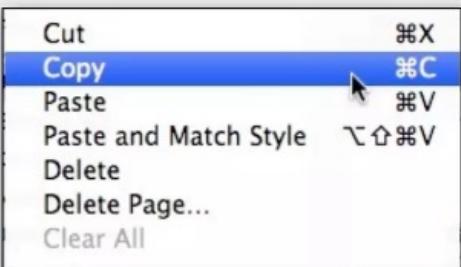
Enable frequent users to use shortcuts

- As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations, function keys, hidden commands, and macro facilities are very helpful to an expert user.
 - Keyboard shortcuts
 - Hidden “power user” features
 - Automation



Enable frequent users to use shortcuts

Level 1



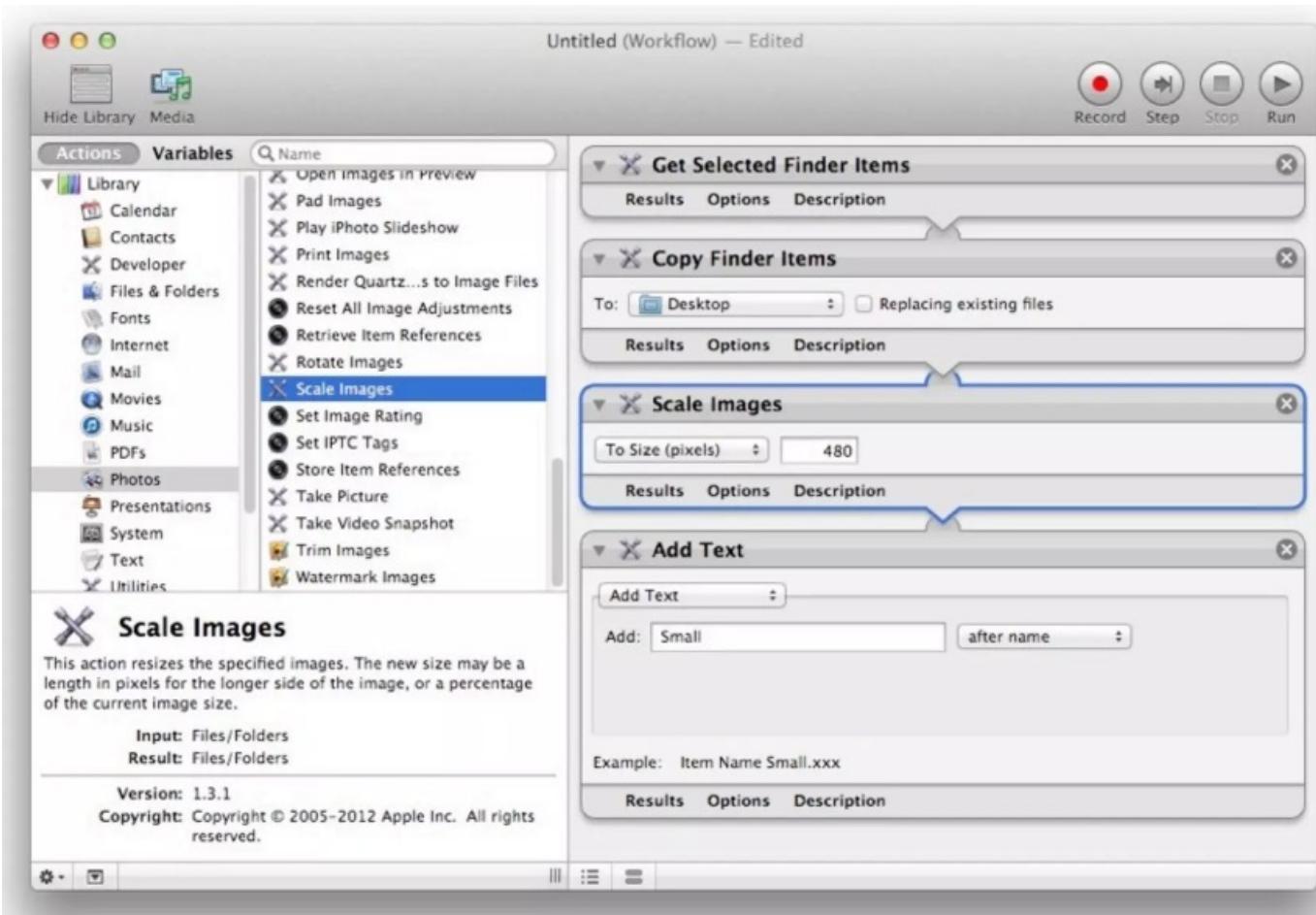
Level 2 ⌘C / ⌘V

Level 3

[Golden Rules for Website Design](#), and what they mean for your web business' bottom line
Golden Rules for Website Design

A website's ease of use has a direct, measurable impact on its success. The easier it is for

Enable frequent users to use shortcuts



Offer informative feedback

- For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.
 - Relevant
 - Fits importance and urgency
 - Comprehensible and meaningful
 - Within appropriate context (time and place)

Offer informative feedback

0, I s

I,0 s

I0 s

Experiencing
cause and effect

Taking turns in
a conversation

Typical human
attention span

Respond to
mouse click,
key press, ...

Open window,
bring up progress
bar / spinner, ...

Wake machine,
load file into app,
start printing, ...

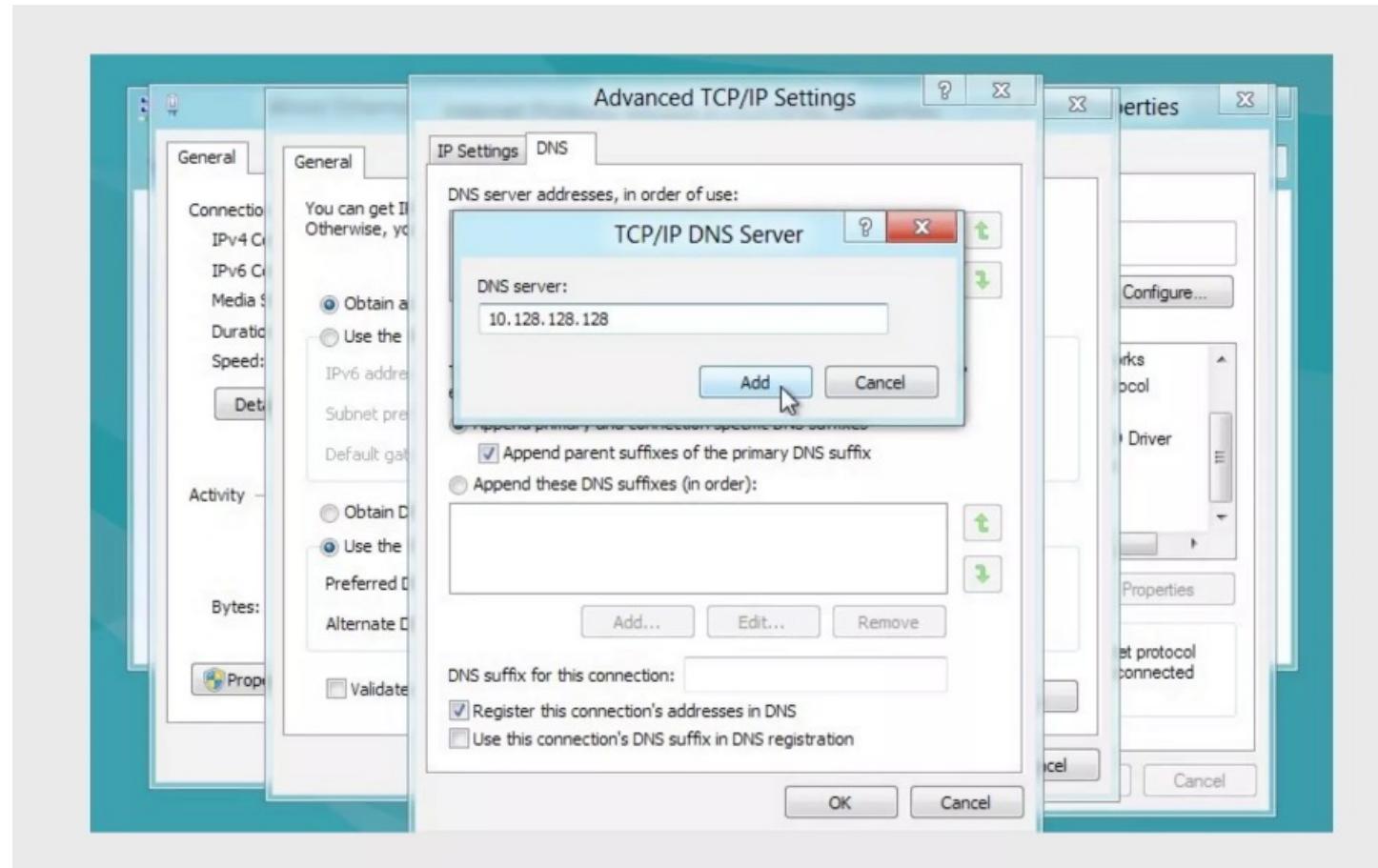
Offer informative feedback



Design dialog to yield closure

- Sequence of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.
 - Grouping of actions
 - Explicit completion of an action
 - Well-defined options for the next step

Design dialog to yield closure



Design dialog to yield closure



A screenshot of a web-based checkout process. The top navigation bar includes "cart", "checkout", and "receipt" with arrows between them. Below it are icons for "safe", "easy", and "fast". The main area starts with "Cancel and Continue Shopping" and "step 1: your email". It shows an email input field with "jochen@polytropia.com" and a note: "That email address doesn't belong to any previously saved accounts. Please select "create an account" below if you'd like to save your details for your next visit." There are radio buttons for "Checkout as a Guest" (unchecked) and "Create an Account" (checked). Below are fields for "Password" and "Retype Password", both currently empty. The right side shows a summary table:

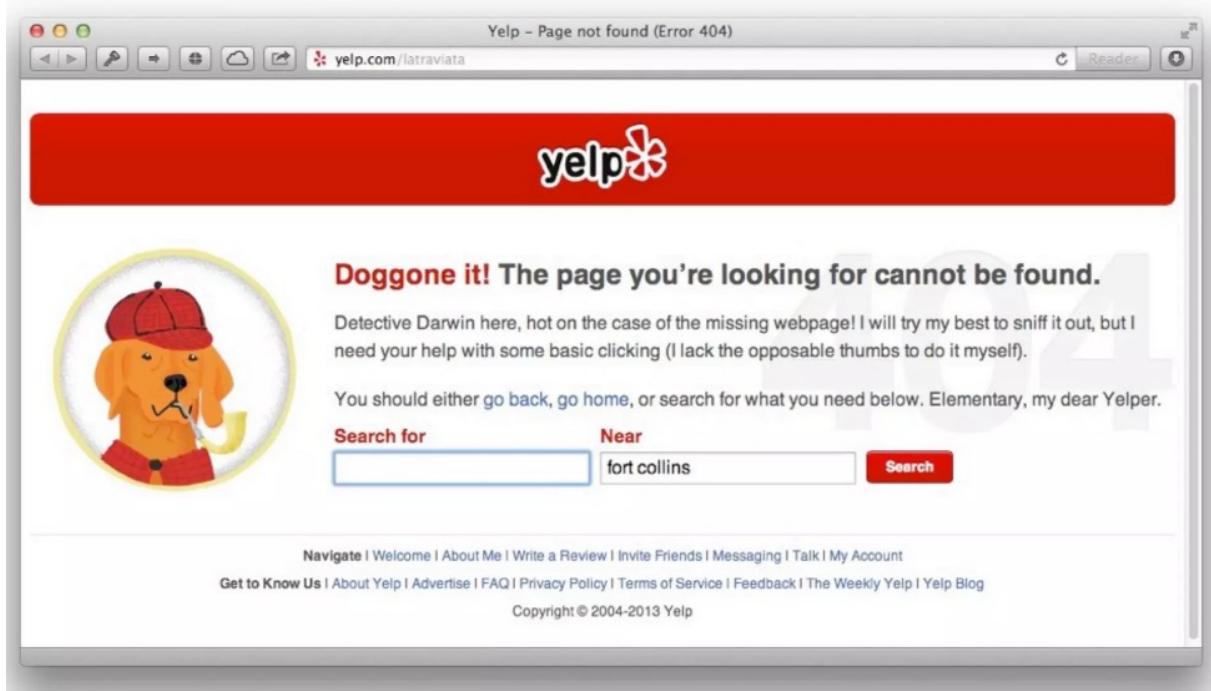
item	quantity	price
AKG Q460 Quincy Jones -Black	1	\$109.00
Code: 002-012-0461		
Weight: 1.1 LBS		
Subtotal:	\$109.00	
Shipping & Handling:	\$6.00	
Order Total:	\$115.00	

Offer simple error handling

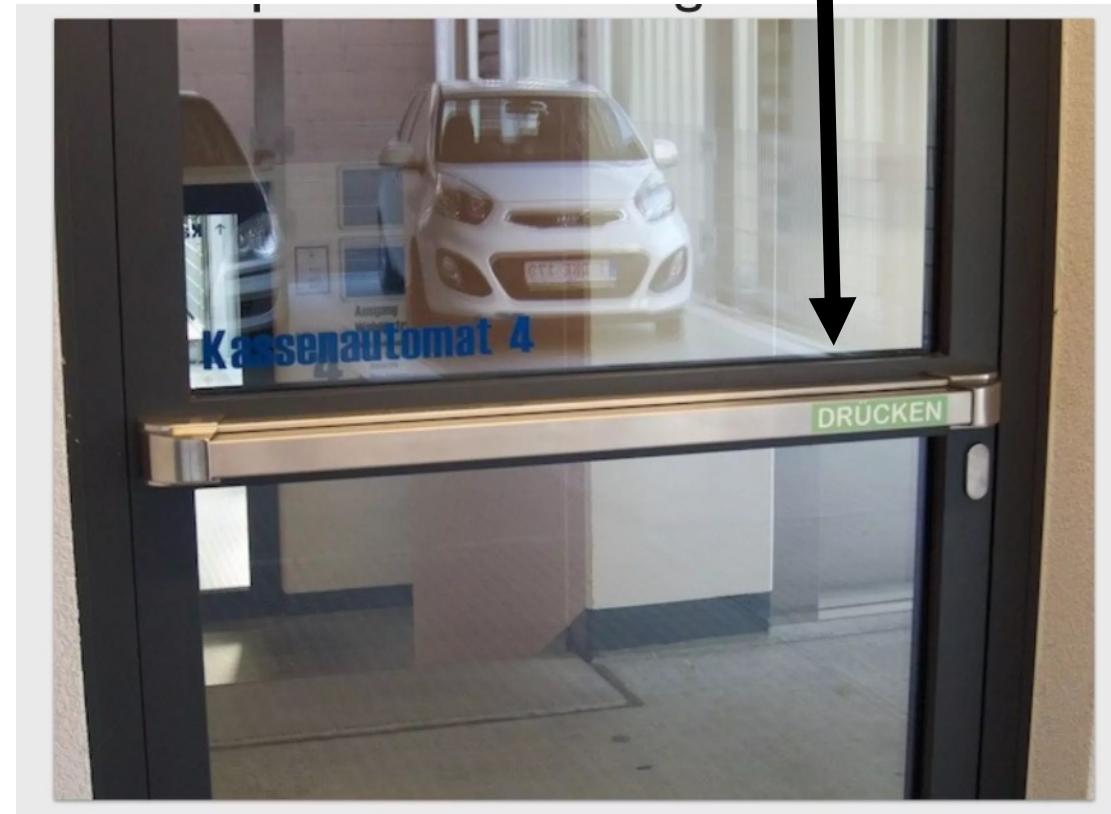
- As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanism for handling the error
 - Error prevention over error correction
 - Automatic detection of errors
 - Clear error notifications
 - Hints for solving the problem



Offer simple error handling



Press



Offer simple error handling

The screenshot shows a user interface for creating a new Apple ID. At the top, there is a field labeled "Your Name" containing "Andy Geschäftsleitung" with an "Edit" button next to it. Below this, there is a field labeled "Apple ID and Primary Email Address" containing "abc@something.com". A tooltip-like callout box is positioned over this field, containing the text "Apple ID must:" followed by three green circular bullet points: "Be a valid email address", "Not already be in use", and "Not use a domain owned by Apple". At the bottom of the screen, there is a note: "You'll use your new Apple ID to sign in to services such as iTunes, App Store, Online Store, and Game Center. Please note that you might be required to verify your email address before you can start using your new Apple ID".

Your Name

Andy Geschäftsleitung

Edit

Apple ID and Primary Email Address

abc@something.com

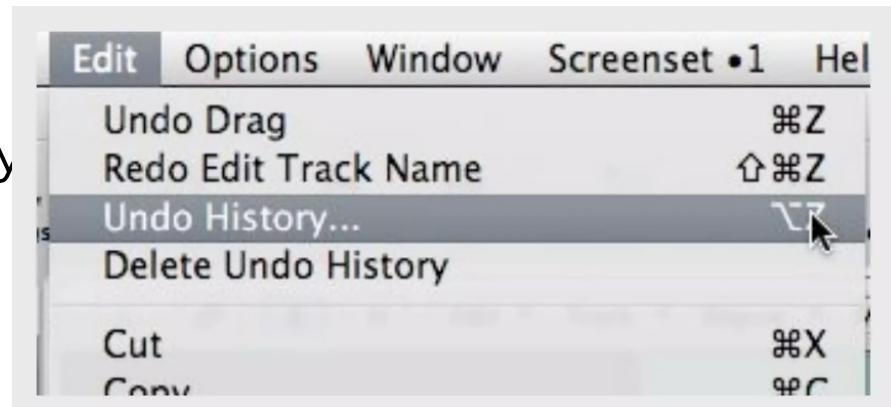
Apple ID must:

- Be a valid email address
- Not already be in use
- Not use a domain owned by Apple

You'll use your new Apple ID to sign in to services such as iTunes, App Store, Online Store, and Game Center. Please note that you might be required to verify your email address before you can start using your new Apple ID.

Permit easy reversal of actions

- This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry, or a complete group of actions.
 - No interference with workflow
 - More freedom for the user
 - Single-action undo vs. action history



Permit easy reversal of actions

The image contains four screenshots illustrating design principles for easy reversal of actions:

- Screenshot 1: Undo History Table**
A screenshot of a table titled "The Numbers Game - Undo History". The table has columns for Number, Action, Date, and Time. The rows show the following data:

Number	Action	Date	Time
1	Loop "Chuck Vox.2" in "The Numbers Game", Size = 23 kB	17.10.2012	13:03:37
2	Delete "Trumpet 1.2" in "The Numbers Game", Size = 32 kB	17.10.2012	13:03:43
3	Drag , Size = 267 kB	17.10.2012	13:03:46
4	Edit Track Name	17.10.2012	13:03:53

A cursor points to the third row.
- Screenshot 2: Context Menu**
A screenshot of a context menu for a file named "webcon2012 Pres.key". The menu items are: Lock, Duplicate, Revert to Last Saved Version, and Browse All Versions... (which is highlighted with a blue background).
- Screenshot 3: Design dialog to yield closure**
A screenshot of a design dialog titled "4. Gestalte in sich abgeschlossene Dialoge". It contains the following text:

Sequences of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.

Gruppierung von Arbeitsabläufen
Klarer Abschluss eines Arbeitsschrittes
Eindeutige Alternativen für den nächsten Schritt
- Screenshot 4: Double-click to edit**
A screenshot of a dialog box with the title "Double-click to edit". It contains the following text:

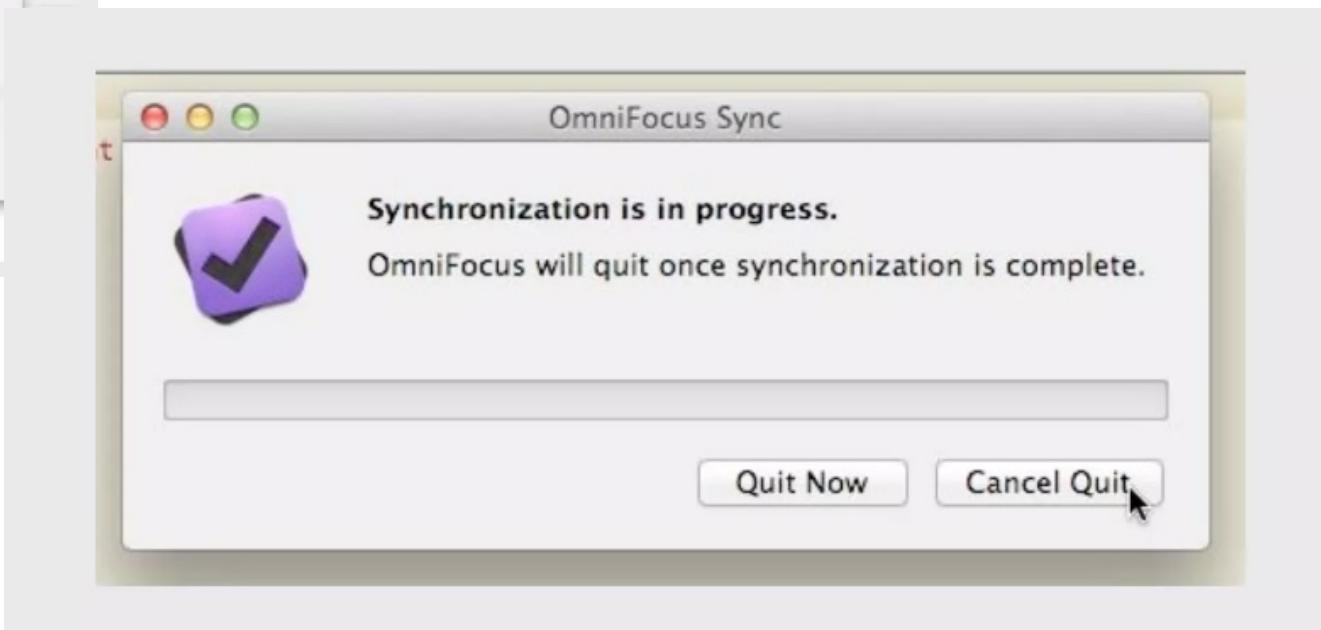
Beispiel: Keyboard Shortcuts
Speziell Cmd-P im Finder → Öffnet dokument in der entsprechenden Anwendung und innerhalb der Anwendung gleich den Drucken-Dialog ==> Abkürzung für jedermann!!!

Support internal locus of control

- Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders
 - The user commands, the system obeys
 - Strongly relies on the informative feedback
 - “The principle of least surprise”



Support internal locus of control



Support internal locus of control



Reduce short-term memory load

- The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes and sequences of actions.
 - Clear structure: windows, dialogs, app in its entirety
 - “Recognition over recall”
 - Implicit help

Understanding a simple sentence can — if interrupted with a tangent like this one, which contains just twenty words, but already noticeably challenges your short-term memory — become a problem.

Reduce short-term memory load

The image illustrates various examples of how to reduce short-term memory load:

- Amazon.com Shopping Cart:** A screenshot of the Amazon.com website showing a shopping cart icon with a number 1 inside, indicating one item in the cart. The cart icon is positioned above the "PLACE ORDER" button.
- Parking Garage Doors:** Three photographs of parking garage doors with directional signs:
 - A red door labeled "Parkebene 2 Orange 1 - 44".
 - A blue sign pointing to "Deck 3" with an arrow.
 - A blue door labeled "Parkebene 3 Blau 158-214".
- Mac OS X File Search Results:** Two screenshots of a Mac OS X "Searching 'Documents'" window.
 - Top Window:** Shows a search bar with "QThis Year KIND PDF Document shneider". A tooltip indicates "Name matches: shneider". The results list "GoldenRulesForWebsiteDesign.pdf" with details "Portable...at (PDF)" and "Thursday, March 14, 2013 12:12:12".
 - Bottom Window:** Shows a search bar with "Name matches: j". A tooltip indicates "Name matches: j". The results list "Objective-J file" and "JPEG image".
 - Details Panel:** Shows "Sent By Jochen Wolters".
 - Downloaded From Panel:** Shows "Downloaded From jordanmechner.com".

Alternative designs

Chapter 2

Alternative designs

- How to generate alternative designs?
- How to choose among alternatives?

How to generate alternatives?

- Humans tend to stick with something that works
- Considering alternatives helps identify better designs
- Where do alternative designs come from?
 - 'Flair and creativity': research and synthesis
 - Cross-fertilization of ideas from different perspectives
 - Users can generate different designs
 - Product evolution based on changing use
 - Seek inspiration: similar products and domain, or different products and domain
- Balancing constraints and trade-offs

How to choose among alternatives?

- Interaction design focuses on **externally-visible** and **measurable** behavior
 - Use of PC v.s. CPU, GPU, memory, etc.
- Technical feasibility
- **Evaluation** with users and stakeholders
 - Prototypes, not static documentation, because behaviour is key
- A/B Testing: inform the choice between alternatives
- Quality thresholds
 - Think of the photo-taking experience

Case: hotel search in different apps



→ Different ways in entering the map mode

How to choose among alternatives

- A/B Testing
 - Online method to inform choice between alternatives
 - Nontrivial to set appropriate metrics and choose user group sets
- Quality thresholds
 - Different stakeholder groups have different quality thresholds (think of photo taking on the phone)
 - Usability and user experience goals lead to relevant criteria

Any Questions?

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