



# User-Centered Design

## **Human factors relevant to the visual design of software**

Based on

- Designing with the Mind in Mind - Simple Guide to Understanding User Interface Design Rules by Jeff Johnson
- Training Material HFI-Certified Usability Analyst by Human Factors International

„People have not changed fundamentally in thousands of years.

Technology changes constantly.  
It's the one that must adapt to us.“

- Michael L. Dertouzos -



# Outline

- The Human Memory
- Attention
- Visual Processing
- Color Usage
- Accessibility

# What are the goals of this class?

Know human aspects relevant for UI design

- attention, visual perception, intellect, memory and motor

Understand the issues the user has to manage when interacting with an interface

Know design implications for human aspects to create a „good“ design solution



File Actions Options Help

100923-Chandigarh-  
 100927-Kharar  
 101007-Kharar-Hardiv  
 101015-Jaipur-Jaisalr  
 101019-Jaisalmer-Jod  
 101031-Udaipur-Goa  
 101102-Goa  
 dia-abend

Name	New Name	Sub...	Type	Size	Created	Mo
01-delhi-erstes-photo.JPG	01-delhi-erstes-photo.JPG		JPG F...	2 MB	21.11...	11.
02-delhi-imbau.JPG	02-delhi-imbau.JPG		JPG F...	3 MB	21.11...	11.
03-delhi-eis.JPG	03-delhi-eis.JPG		JPG F...	2 MB	21.11...	11.
04-delhi-ventilator.JPG	04-delhi-ventilator.JPG		JPG F...	3 MB	21.11...	11.
05-delhi-northem-palace-fe...	05-delhi-northem-palace-fens...		JPG F...	3 MB	21.11...	11.
06-delhi-northem-palace-ve...	06-delhi-northem-palace-versi...		JPG F...	3 MB	21.11...	11.
07-delhi-hotel-panchayat.JPG	07-delhi-hotel-panchayat.JPG		JPG F...	2 MB	21.11...	12.

A Better Finder Rename 9 [Registered]

Category: Sequence Numbers Action: Produce sequence number list

Prefix: Holiday Snapz Suffix:

Start with: 1 Step value: 1 Padding: 2 digits minimum

Padding refers to the minimum number of digits in a number. If the number has fewer digits, leading zeros will be inserted.

Sort first: By EXIF digital camera date (from oldest to newest) Then: By name (from A to Z)

Sort each folder separately

Change: only the file name

Process:  Files  Folders  Subfolders and their contents

16 out of 16 items need renaming.

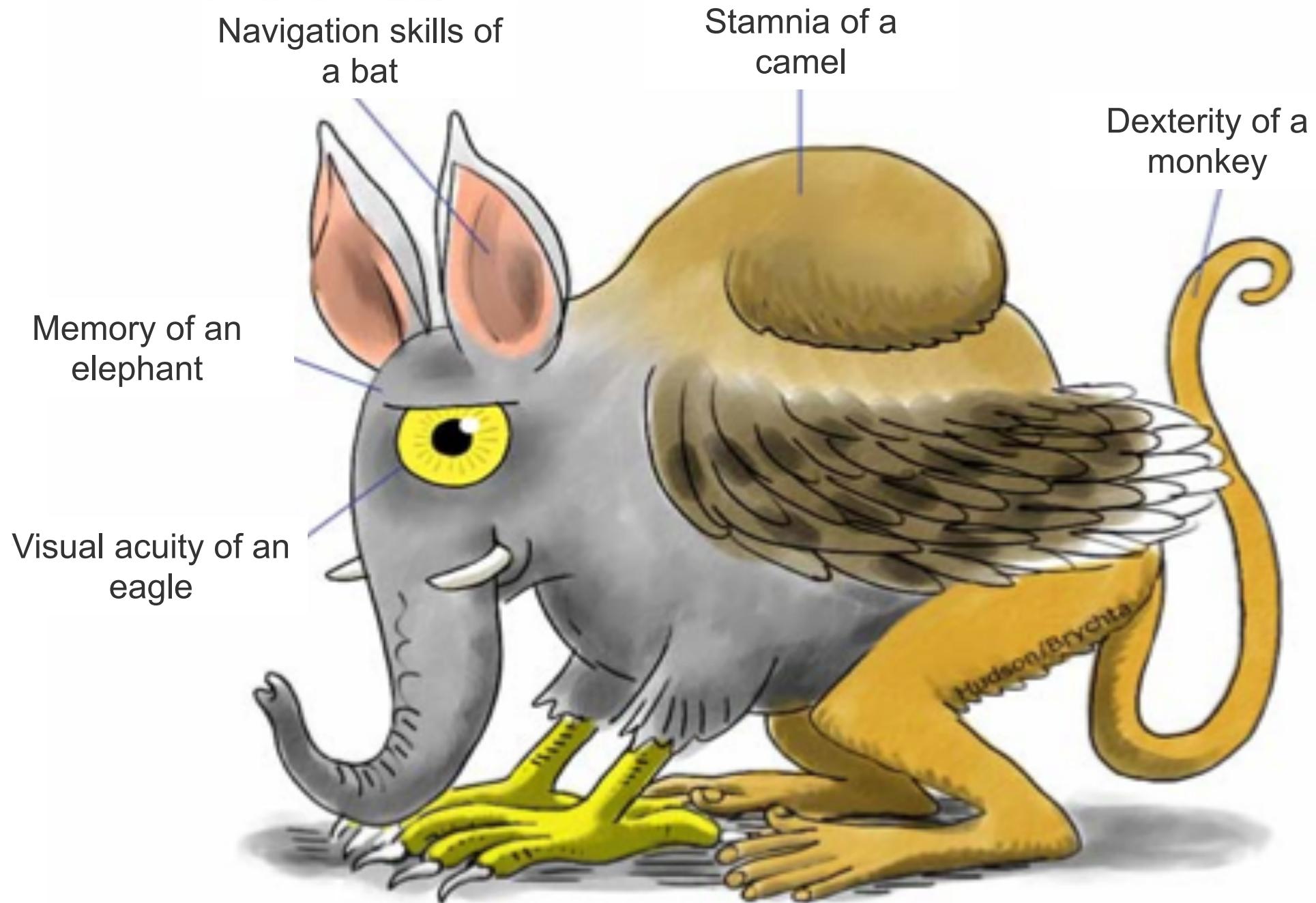
Create Droplet... Save File List... Show Multi-Step Interface Perform Renames

187 Objects (0 Selected) Favourite D:\bilder\2010-Max-Indien\dia-abend.blog

„I need to rename files ... and I found this freeware utility to do it. Unfortunately, its user interface makes me feel lost – and as I have "no time" (read: no intention) for reading the manual, I'll use something else.“



# The Perfect User



Human factors relevant to the visual design of software

# **HUMAN FACTORS IN INTERFACE DESIGN**

# Human Factors in Interface Design



## Memory

- Sort and recall information
- Minimize memory load by
  - Making options visible
  - Designing for recognition vs. recall

## Visual

- Extraction and interpretation of objects and relations
- Optimize visual comprehension by
  - Easy Object extraction and perception
  - Good Grouping and Labeling
  - Careful Use of Color

## Intellect

- Understanding and processing of information
- Simplify decision making by
  - Providing previews and easy escapes
  - Using controls consistently
  - Providing good system feedback

## Motor

- Perform physical actions
- Minimize movement time and interactions by
  - Using short distances and large targets
  - Optimizing for the input device
  - Reducing windows and steps

# Human Factors in Interface Design



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Human factors relevant to the visual design of software  
**THE HUMAN MEMORY**

# Our Short-Term Memory has Limited Capacity

1 5 3 4 8 5 0 9 2 4 6 3 4 7 6 4 3 7

3 4 6 7 3 4 3 6 8 6 4 6 4 3 9 8 4 6 9

753 685 392 463 476 437

## Capacity of short-term memory:

- George Miller, 1956:
- Broadbent, 1975:
- J. Brown:
  - „The amount you can remember is equal to about what you can say in 20 seconds. And you can remember that amount for about the same amount of time.“

Short-term memory: subset of all of the available information from our perceptual systems and our long-term memories that we are conscious of right now.

7 +2  
4 +2  
**20/20 Rule**

# Short-term Memory - Design Implications



Help people remember information from one moment to the next.

- **Search Results:** Show search terms in addition to results list
- **Instructions:** Display instructions for multistep operations.
- **Chunking:** Try to keep the number of things to remember at three or four
  - **3-4 rule:** the ideal chunking is 3-4 chunks with 3-4 items per chunk.

# Long-Term Memory: Recognition is Easy; Recall is Hard

Eat or be eaten.

Recognition vs. Recall.

## Recognition

- Neural patterns **activated by sensory input**:
  - perception and context similar to an earlier situation
  - easily stimulates a similar pattern of neural activity
  - „Search by address“

## Recall

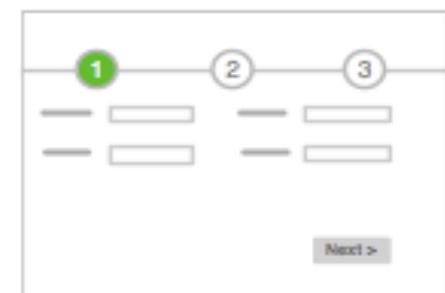
- Neural patterns **activated by brain activity**
  - without immediate similar perceptual input
  - risk of activating wrong pattern or only subset of the right pattern
  - „Search by content“

Situations are assessed very quickly.

Requires coordination and time.

# Recognition vs. Recall - Design Implications

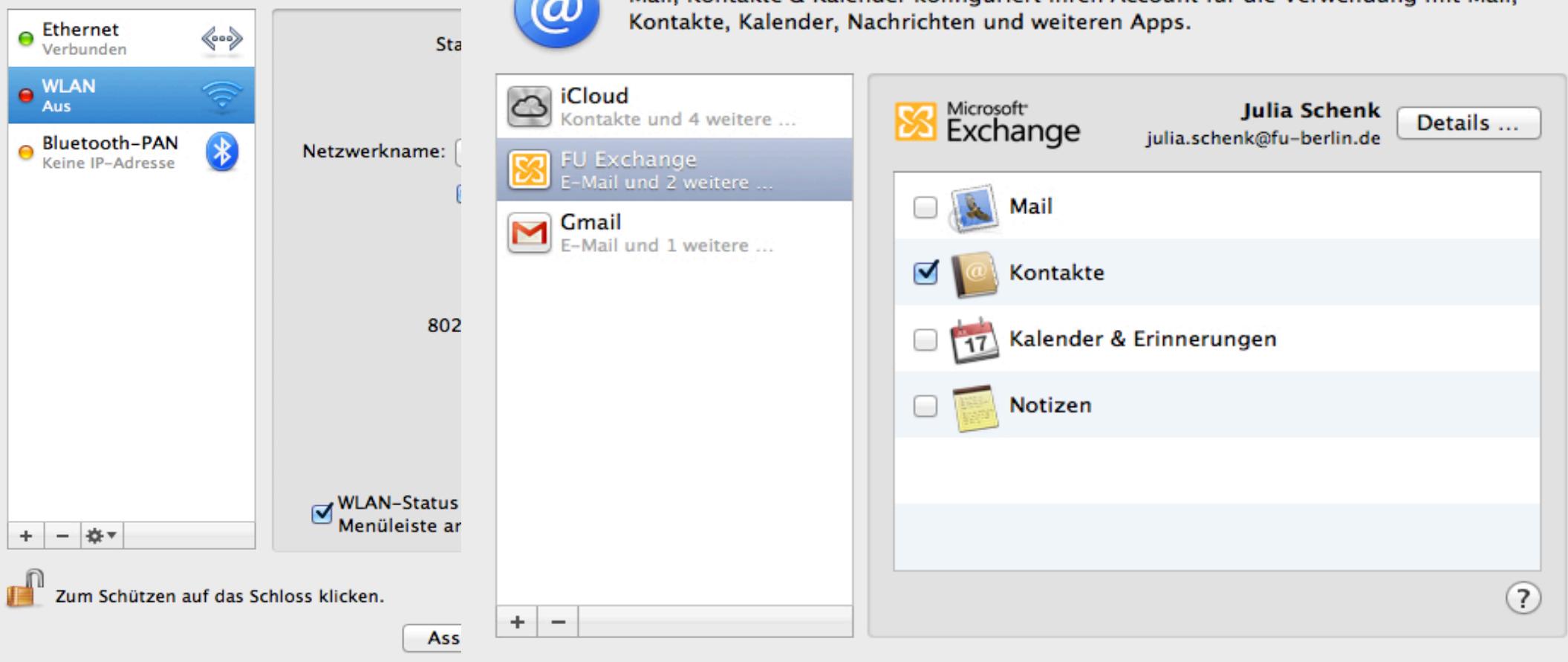
- **Show options and let users choose among them**
  - do not force users to recall their options
- **Use graphics where possible to convey function.**
  - (Good) graphics are recognized very quick
  - (Good) graphics stimulate the recall of associated information
  - Use thumbnails to depict full-sized images compactly
- **Make functions that many people need highly visible**
  - users can see and recognize their options rather than having to recall them
- **Hide functionality that few people will use**
  - “Details” panels, context menus, or special key combinations
  - design for the Perpetual Intermediates
- **Give visual cues to let users recognize where they are**

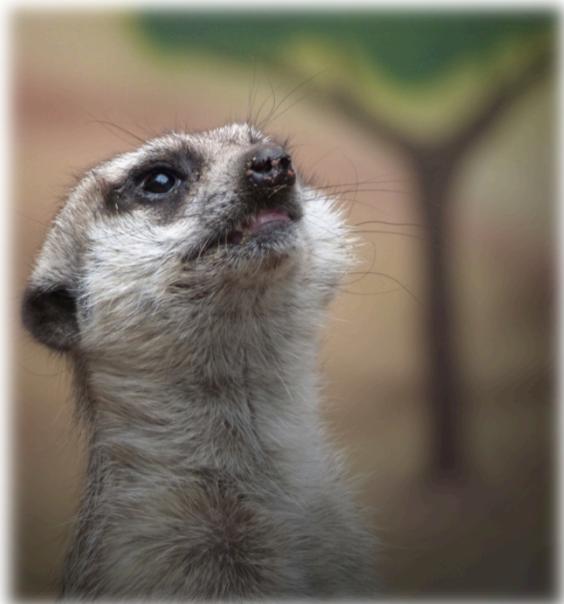


# Long-Term Memory - Design Mantra

## Consistent Interfaces

"If everything worked the same way, you would not have to remember much."





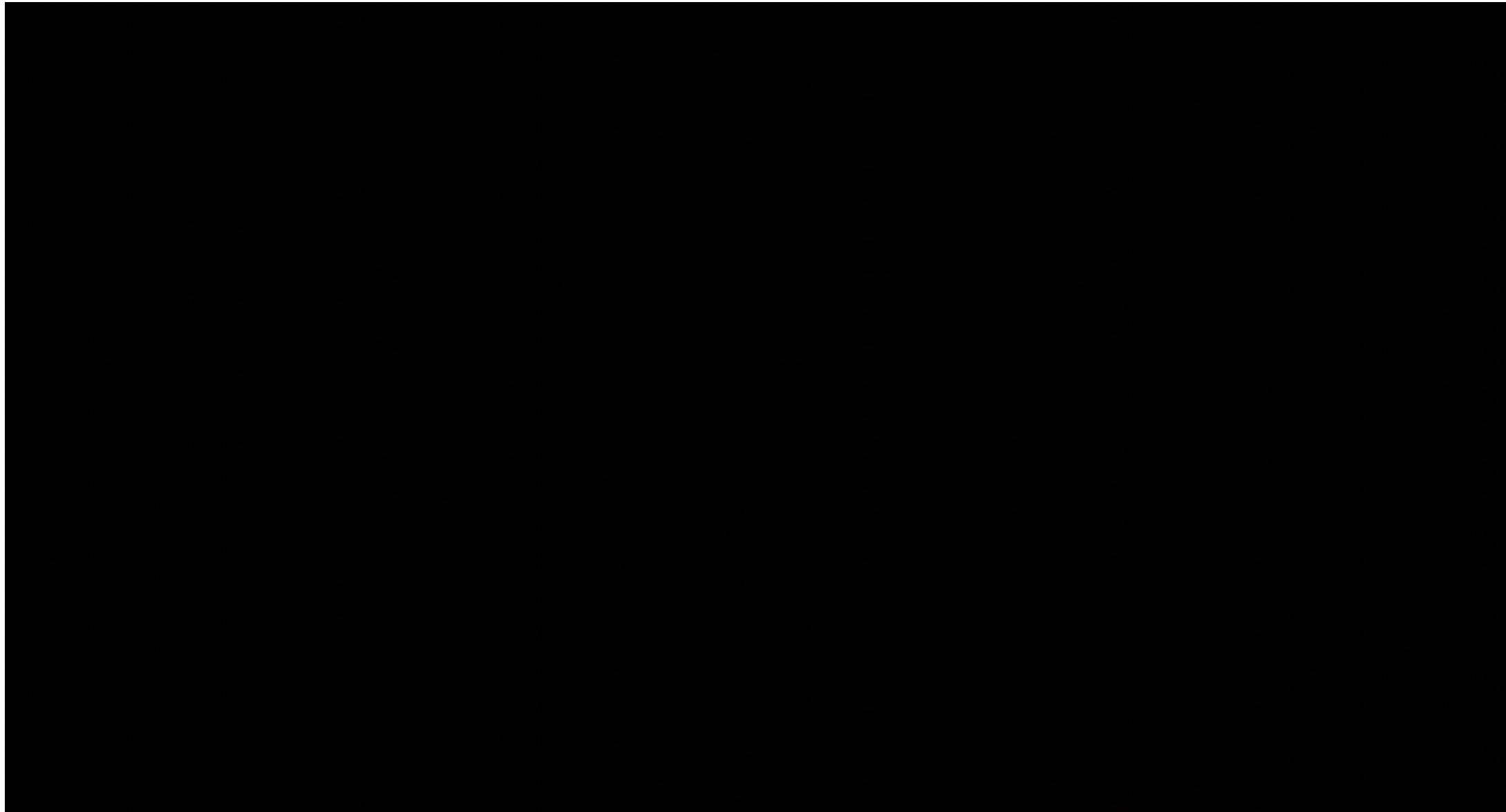
Human factors relevant to the visual design of software  
**ATTENTION**

# Inattentional Blindness

„Gorillas in our midst: sustained inattentional blindness for dynamic events“

by Simon and Chabris, 1999

- **Out of all 192 observers across all conditions, 54% noticed the unexpected event and 46% failed to notice the unexpected event,**



# Attention

Our attention mechanisms

- **focus** our awareness on a **very small subset of the perceptions** and
- activated **long-term memories** while
- **ignoring everything else.**

**Focusing attention on new information turns it away from some of what it was focusing on.**

# Change Blindness – „The Door Study“

„Failure to detect changes to people during a real-world interaction“

by Levin und Simons, 1998

- **only 7 of the 15 pedestrians reported noticing the change of experimenters**

UNIVERSITÄTS  
BIBLIOTHEK

DIGITALE BIBLIOTHEK

Anmelden | Hilfe | QuickSets | Suche | Datenbanken | E-Zeitschriften | Meine Digitale Bibliothek | Gast

Suche | Ergebnisse

## Suche

Suchbegriff(e) eingeben

Alle Felder ▾ Usability Engineering und ▾  
Alle Felder ▾

Fachgebiet wählen **⚠ Bitte wählen Sie ein Fachgebiet in dem gesucht werden soll!**

Durch Klicken auf das jeweilige Fachgebiet erfahren Sie, welche Datenbanken dort enthalten sind.  
Weitere Datenbanken zu Ihrem Fachgebiet finden Sie unter dem Menüpunkt Datenbanken.

[Alte Geschichte / Archäologie](#)     [Geowissenschaften](#)     [Philosophie](#)  
 [Amerikanistik](#)     [Germanistik](#)     [Physik](#)  
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Fachbereich-übergreifende Datenbanken:

[FU-Kataloge](#)  
 [Deutsche Nationalbibliothek](#)  
 [Zeitschriftenartikel](#)

Suchen

# Change Blindness & Inattentional Blindness – Design Implications

You can't assume that just because something is on the screen means that people see it.

- This is especially true when you refresh a screen and make one change on it.
  - People may not realize, they are even looking at a different screen.
- **Error and validation messages** are **unexpected** results / events; therefore, they must be prominently displayed.
  - Proper animation and user action may be required to grab a user's attention.



**Decrease cognitive load: Reduce Complexity → Consistent, simple Design**

- Increased cognitive load decreases user awareness; therefore, **screens must be kept simple** and straight forward.
  - Complex data entry should be broken up into smaller steps. Consider using multiple screens, collapsible areas, or wizards.
- Take advantage of **familiarity** by connecting directly with users.
  - For instance, provide a hyperlink to a user's settings by using their name as the text. Users are naturally drawn to their own names.
- **Attentional capacity is very important in design.**
  - Seldomly accessed screens require simpler designs due to their unfamiliarity. Commonly used areas can have increased functionality due to their lower cognitive load.

# Human Factors in Interface Design



## Memory

- Sort and recall information
- Minimize memory load by
  - Making options visible
  - Designing for recognition vs. recall

## Visual

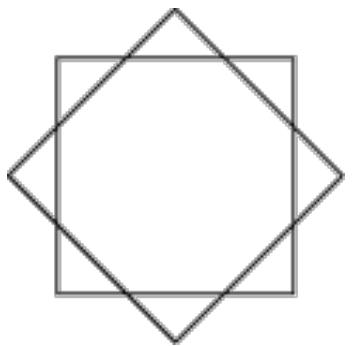
- Extraction and interpretation of objects and relations
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## Motor

- Perform physical actions
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  - Optimizing for the input device
  - Using natural response mappings
  - Reducing windows and steps



Human factors relevant to the visual design of software

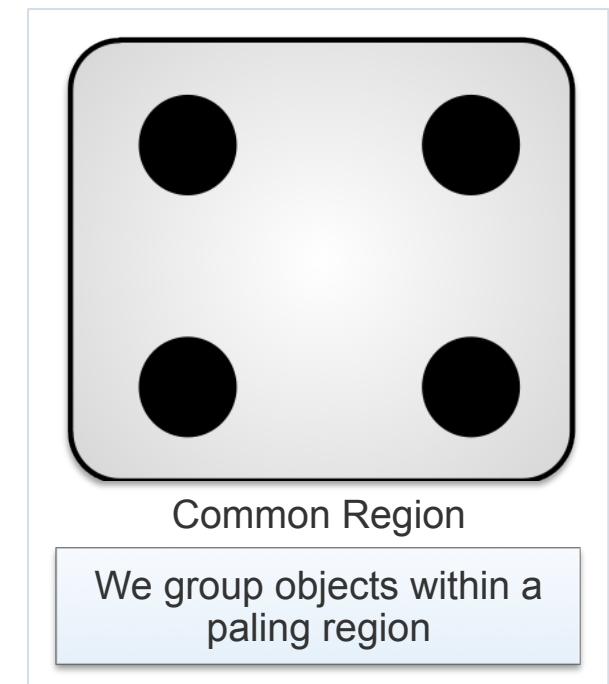
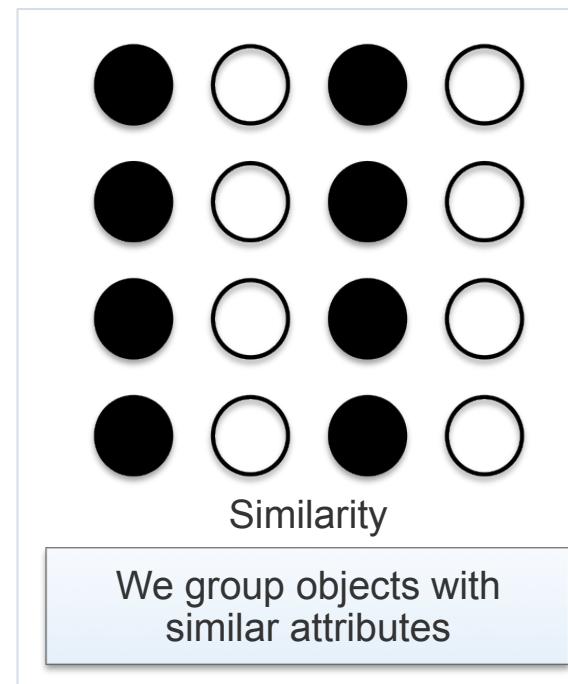
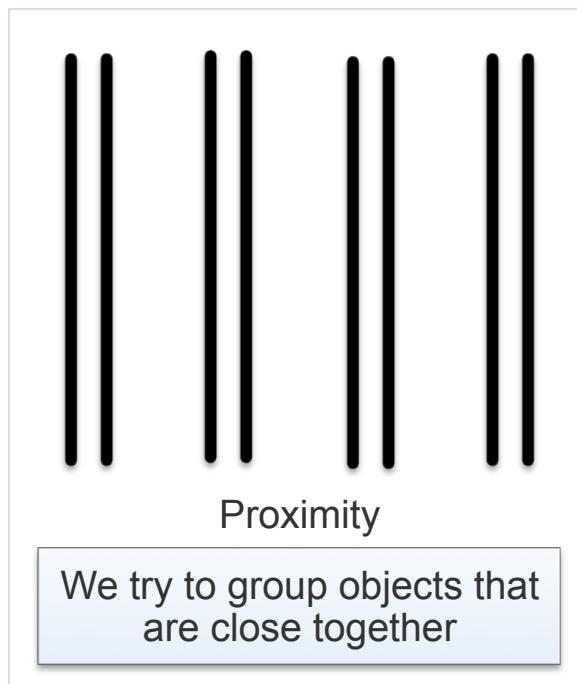
## **GESTALT PRINCIPLES**

# Our Vision is Optimized to See Structure

## Grouping of objects

„[...] human vision is holistic: **Our visual system automatically imposes structure on visual input and is wired to perceive whole shapes, figures, and objects rather than disconnected edges, lines, and areas.** Today's perceptual and cognitive psychologists regard the Gestalt theory of perception as more of a *descriptive* framework than an *explanatory* and *predictive* theory.“

*Designing with the Mind in Mind by Jeff Johnson*



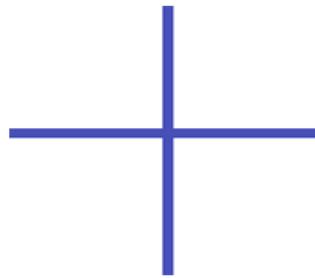
# Gestalt Principles in Interface Design

<https://robots.thoughtbot.com/gestalt-principles>

<http://architectingusability.com/2011/05/26/using-the-gestalt-laws-of-perception-in-ui-design/>

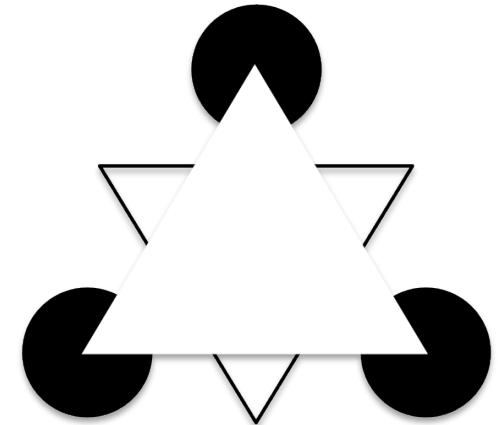
# Our Vision is Optimized to See (whole) Objects

Perception of (whole) objects  
→ fill in missing data



Continuity

We tend to see continuous forms rather than disconnected segments.



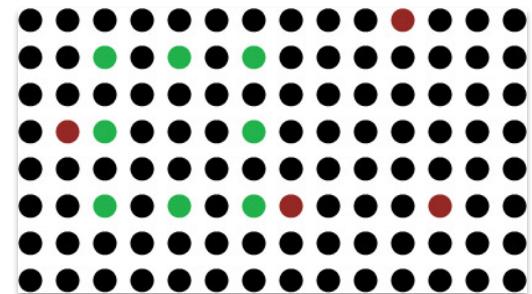
Closure

We tend to see complete forms rather than collection of incomplete forms



Figure / Ground

We automatically separate perceived objects into figures and their ground

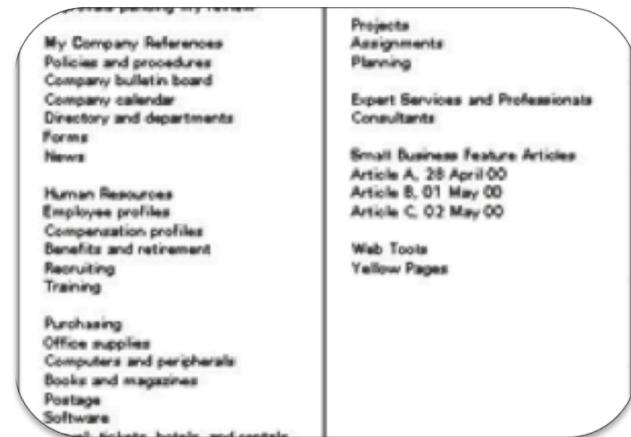
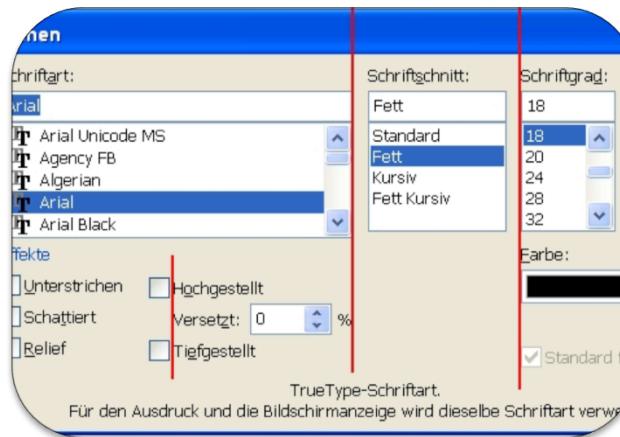
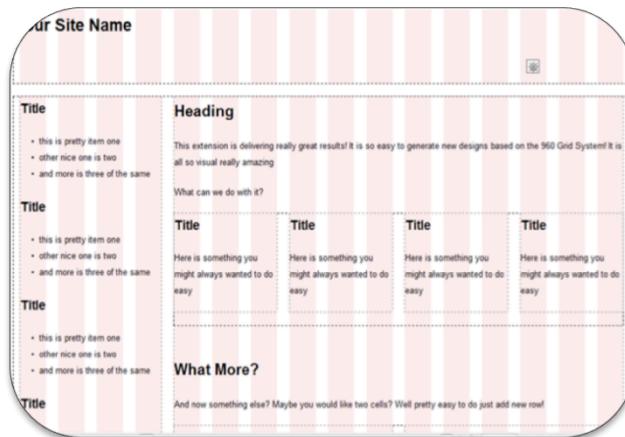


Symmetry

Objects that are symmetrically arranged are perceived better

# We Seek and Use Visual Structure

Visual hierarchy lets people focus on the relevant information



## Grid level

- Overall structure

## Layout level

- Arrangement of elements

## Text Level

- Paragraph structuring

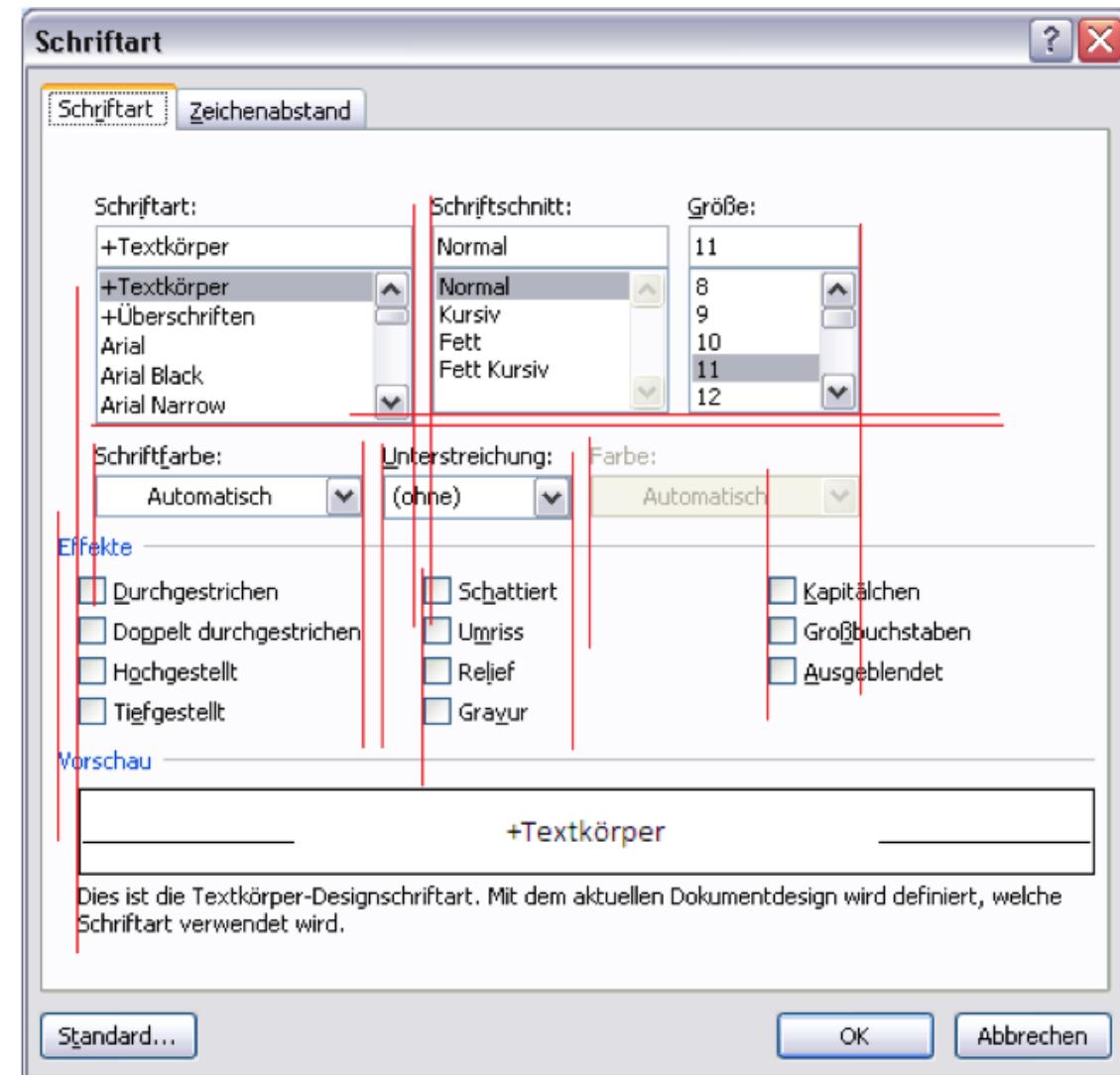
# Layout: Arrangement of Elements

Alignment lines (horizontal and vertical)

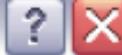
- reduce complexity for the human eye
- provide optical structure
- facilitate finding of elements

Cluttered Screens encourage unconscious eye movements → eye strain

**Use as less as possible arrangement lines.**



## Schriftart



### Schriftart

### Zeichenabstand

#### Schriftart:

- +Textkörper
- +Textkörper
- +Überschriften
- Arial
- Arial Black
- Arial Narrow

#### Schriftschnitt:

- Normal
- Normal
- Kursiv
- Fett
- Fett Kursiv

#### Größe:

- 11
- 8
- 9
- 10
- 11
- 12

#### Schriftfarbe:

- Automatisch

#### Unterstreichung:

- (ohne)

#### Farbe:

- Automatisch

#### Effekte

- |  |                                     |   |
|--|-------------------------------------|---|
| <input type="checkbox"/> Durchgestrichen         | <input type="checkbox"/> Schattiert | <input type="checkbox"/> Kapitälchen    |
| <input type="checkbox"/> Doppelt durchgestrichen | <input type="checkbox"/> Umriss     | <input type="checkbox"/> Großbuchstaben |
| <input type="checkbox"/> Hochgestellt            | <input type="checkbox"/> Relief     | <input type="checkbox"/> Ausgeblendet   |
| <input type="checkbox"/> Tiefgestellt            | <input type="checkbox"/> Grayur     |   |

#### Vorschau

+Textkörper

Dies ist die Textkörper-Designschriftart. Mit dem aktuellen Dokumentdesign wird definiert, welche Schriftart verwendet wird.

Standard...

OK

Abbrechen

The screenshot shows the homepage of the ab-in-den-urlaub.de website. At the top, there's a banner for "Travel 24 Last Minute" with a "Angebote finden" button. Below the banner, there's a navigation bar with links for Urlaubsreisen, Lastminute, Flug, Hotel, DEAL des TAGES, Städtereisen, Ferienwohnungen, Kurz-mal-weg, Mietwagen, and Hotelbewertung. A promotional banner for a "50€ Geld-zurück-Gutschein" is visible. On the right side, there are sections for "Last Minute Reisen" with deals like "Jamaika ab 307€", "Lanzarote ab 257€", "Bulgarien ab 1009€", and "Mexiko ab 283€". A large central area is dedicated to a travel search form with four steps: 1. Wonach möchten Sie suchen? (with radio buttons for Pauschalreise, All Inclusive, Flug, etc.), 2. Reisedaten (with dropdowns for Abflughafen, Reiseziel, Späteste Abreise, Reisedauer), 3. Personenanzahl (with dropdowns for Reisende, Kinder), and 4. Unterkunft. To the right of the search form, there's a "NEU! DEAL des TAGES" section featuring a deal for "2 Tage für zwei im Hilton Frankfurt Airport Hotel \*\*\*\*" at €179,-.

# Colors

# Colors...

- ... are a major contributory factor to quickly get the meaning of information.
- ... facilitate the emphasis of elements.
- ... have to be used subtle.



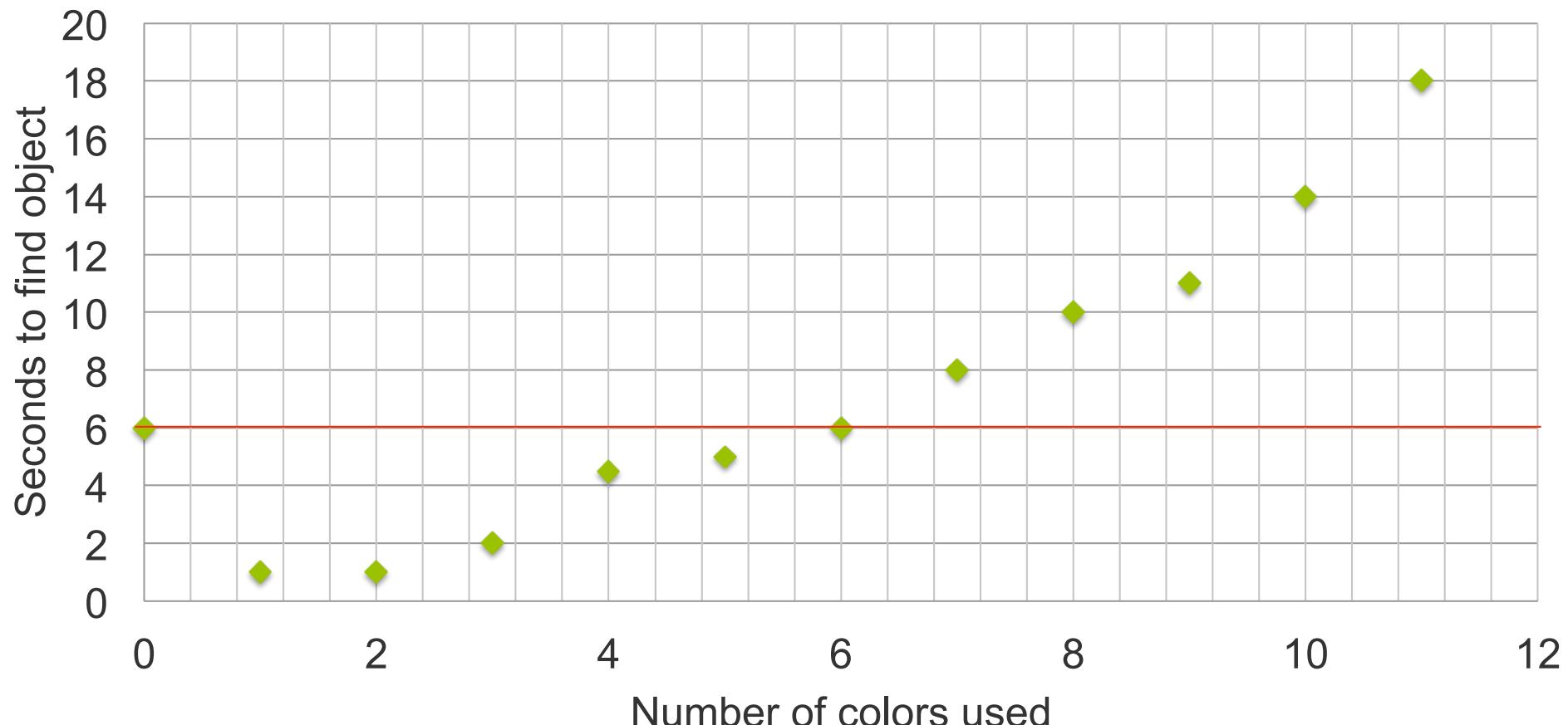
The image shows two side-by-side registration forms. Both forms have a red 'X' icon in the top right corner. The left form has red text above the input fields: "Info in red is required:" followed by three input fields labeled "Name", "Phone number", and "E-mail". The right form has red text below the input fields: "\* = required information:" followed by three input fields labeled "\* Name:", "Phone number:", and "\* E-mail:". Both forms have a green checkmark icon in the bottom right corner.

Be aware: the wrong or excessive use of colors has a distractive effect on the user and though a negative impact concerning the usability (see last slide).

# Guidelines for Using Color

*Never use color as the only visual cue  
→ use redundant cues*

**Limit the number of colors used to 5 – 6**





Human factors relevant to the visual design of software  
**ACCESSIBILITY**

*What „can we do“ to discriminate people with disabilities?*

# What is the Problem?

- ① The person cannot walk.
- ② There is no ramp provided.

The stairs are the barrier, not the person's disability of not being able to walk.

Disability is if a person cannot do something due to a barrier.

If there is no barrier the person is not handicapped.

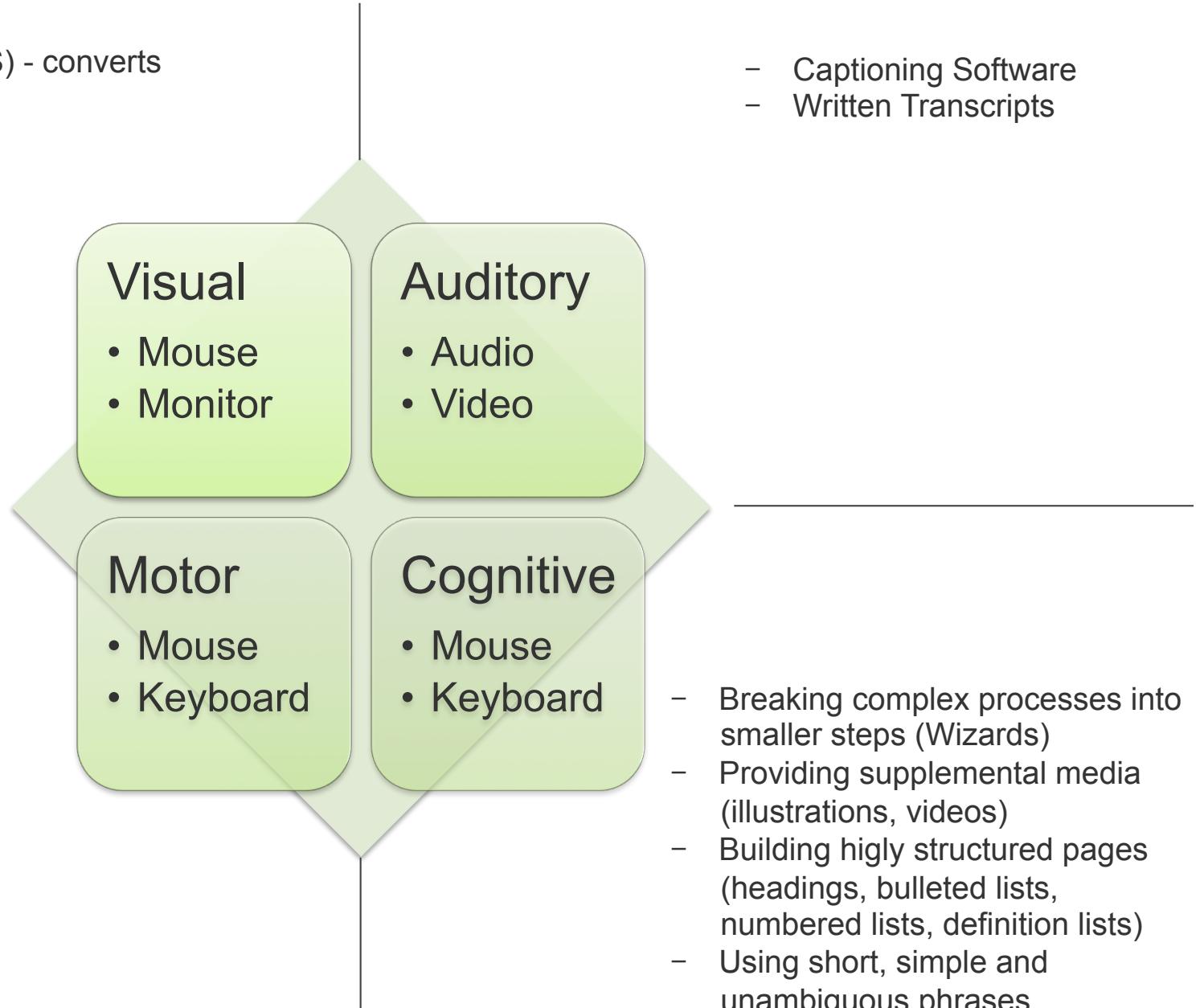


# What is Accessibility?

- Accessibility means **access** to a Web site/application by **everyone**, regardless of ability.
- Accessibility ensures that **people with disabilities** can **perceive, understand, navigate, and interact with web sites and applications**;
  - the Web sites and applications **work well with assistive technologies** that some people with disabilities use.

# Disabilities and Assistive Technologies

- Job Access with Speech (JAWS) - converts text into synthesized speech
- Screen magnifiers
- Electronic Braille readers
- Voice recognition systems



# Web Design and Screenreaders

why "Click Here" should die  
&  
why Skipnav should live

Liz Stover, University of Arkansas - Fayetteville, 2008

# Screenreader Simulation

<http://99vips.de/blog/2012/01/webaim-screenreader-simulation/>

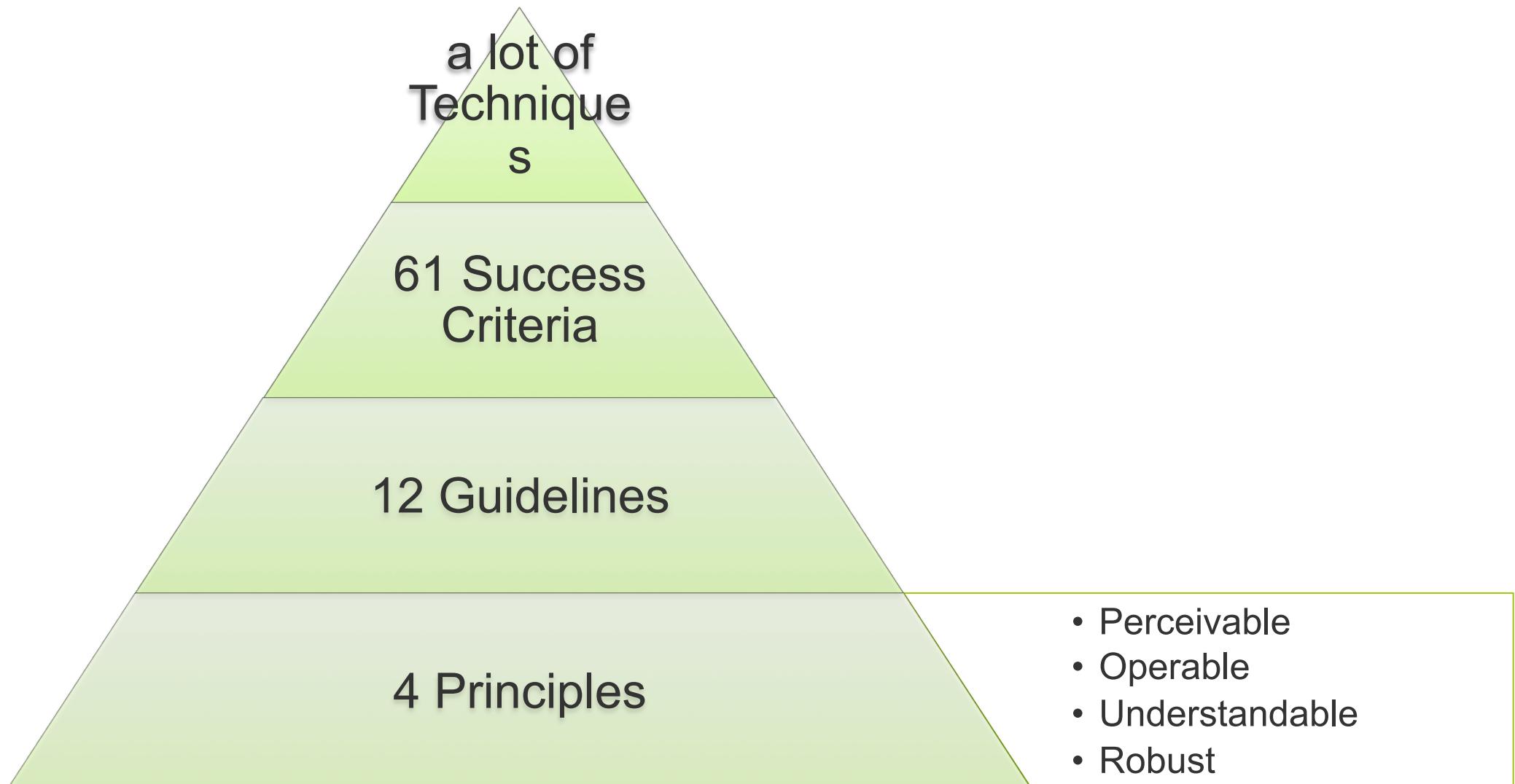
- s = stop sound
- r = read page from current location
- t = move to next link
- Shift + t = move to previous link
- d = move down one line
- Shift + d = page down
- u = move up one line
- Shift + u = page up
- ENTER = follow link
- c = show/hide captions
- i = hide/show screenshot
- b = back
- f = forward
- q = quit simulation

## Tasks

1. Find the last name of the founder of the University of the Antarctic.
2. Find the phone number of the University of the Antarctic.
3. Find the current enrollment for the Biology 250 class.

# How to Implement Accessibility?

# Web Content Accessibility Guidelines (WCAG) 2.0



# WCAG 2.0 at a Glance

## Perceivable

- Provide [text alternatives](#) for non-text content.
- Provide [captions and other alternatives](#) for multimedia.
- Create content that can be [presented in different ways](#), including by assistive technologies, without losing meaning.
- Make it easier for users to [see and hear content](#).

## Operable

- Make all functionality available from a [keyboard](#).
- Give users [enough time](#) to read and use content.
- Do not use content that causes [seizures](#).
- Help users [navigate and find content](#).

## Understandable

- Make text [readable and understandable](#).
- Make content appear and operate in [predictable](#) ways.
- Help users [avoid and correct mistakes](#).

## Robust

- Maximize [compatibility](#) with current and future user tools

# WCAG – 10 Quick Tips

1. **Images & animations:** Use the **alt** attribute to describe the function of each visual.
2. **Image maps.** Use the client-side **map** and text for hotspots.
3. **Multimedia.** Provide captioning and transcripts of audio, and descriptions of video.
4. **Hypertext links.** Use text that makes sense when read out of context. For example, avoid "click here."
5. **Page organization.** Use headings, lists, and consistent structure. Use **CSS** for layout and style where possible.
6. **Graphs & charts.** Summarize or use the **longdesc** attribute.
7. **Scripts, applets, & plug-ins.** Provide alternative content in case active features are inaccessible or unsupported.
8. **Frames.** Use the **noframes** element and meaningful titles.
9. **Tables.** Make line-by-line reading sensible. Summarize.
10. **Check your work.** [Validate](#). Use tools, checklist, and guidelines at  
<http://www.w3.org/TR/WCAG>

Source: <http://www.w3.org/WAI/quicktips/>

# Accessability Evaluation I

**Automated Tools:** <http://www.w3c.org/WAI/ER/tools>

## Check your site with WCAG compliance

- Become familiar with the guidelines
- Decide which level of compliance (A, AA, AAA) your organization will strive for
- Manually check your pages for compliance
- Use the WCAG techniques to help you comply with the guidelines

## Testing by Usability/Accessibility Experts

- Review with respect to principles and guidelines
- Tab through the pages
  - Can all **forms** be completed and submitted **without using the mouse**? Try all the UI controls, especially list boxes.
  - Can every link be followed **using only the keyboard**?
  - If content is displayed by a mouse rollover, is that content available via the keyboard? For rollover menus be sure the links available in the rollover menu are also available if the user clicks on the main navigation link.

# Accessibility Evaluation II

## Test with a Screen Reader

- Listen to the entire page to see if all content is included and makes sense
- Were link **labels descriptive?** Screen reader users sometimes bring up a list of links, so "read more" or "click here" is not helpful and out of context.
- Could you understand table information?
- **Remember that the screen reader is used by only one group of people with disabilities; if your site works with a screen reader that doesn't necessarily mean it is accessible**

## Conduct usability tests with people with disabilities when possible!!!

- Recruit people with a variety of disabilities
- Learn about interacting with people with disabilities
- Be sure your facility is free of barriers if you are bringing people on site

# Thank You!

# Bibliography

- <http://www.memory-key.com/memory/emotion>
- Designing with the Mind in Mind - Simple Guide to Understanding User Interface Design Rules by Jeff Johnson
- Training Material HFI-Certified Usability Analyst by Human Factors International
- <http://www.theteamw.com/2009/10/25/100-things-you-should-know-about-people-1-inattention-blindness/>
- <http://zacgery.blogspot.de/2012/09/inattentional-blindness-missing-in.html>

# Images

- <http://www.flickr.com/photos/illbethesun/2404416901/>
- <http://www.flickr.com/photos/carbonnyc/496721450/>
- [http://www.iconfinder.com/icondetails/3507/128/lreminder\\_icon](http://www.iconfinder.com/icondetails/3507/128/lreminder_icon) (Designer Everaldo Coelho - <http://www.everaldo.com/> )
- <http://www.flickr.com/photos/kronny/7833240204/>
  
- [http://imageafter.com/image.php?image=b20objects\\_circuits019.jpg](http://imageafter.com/image.php?image=b20objects_circuits019.jpg)
- <http://www.flickr.com/photos/lexnger/4596784697/sizes/o/in/photostream/>
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