
Interação Pessoa-Máquina

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Design

Design rules

- Design rules for interactive systems can be supported by psychological, cognitive, ergonomic, sociological, economical or computational theory.
- Designers do not always have relevant background in these areas.
- Design rules are used to apply the theory in practice.

Design rules

- Suggest methods to increase the usability of a software product.
- These rules can be categorized in two dimensions:
 - Authority
 - indication of whether a rule must be followed or whether it is just a suggestion.
 - Generality
 - indication of whether the rule can be applied to many design situations or whether it can be only applied in some particular situations.
- Design rules
 - Standards (+ authority, - generality)
 - Guidelines (- authority, + generality)



Design rules

- Rules may not be complete compatible.
- Usually, the more general a design rule is, the greater possibility of it having a conflict with other rules.
- The theory underlying the design rules can help the designer understand the trade-offs between different rules.

Design rules

- Standards
 - Set by national or international institutions to ensure compliance with a set of design rules by a large community (uniformity, compatibility).
 - Requires consistent underlying theory (stable).
 - Hardware/software standards.
 - High authority.

Design rules

- ISO 9241 – usability specification
 - Usability: The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.
 - Effectiveness:
 - Accuracy and completeness with which specified users achieve specified goals in particular environments.
 - Efficiency :
 - The resources expended in relation to the accuracy and completeness of goals achieved.
 - Satisfaction:
 - Comfort and acceptability of the work system to its users and other people affected by its use.

Some metrics from ISO 9241

| Usability objective | Effectiveness measures | Efficiency measures | Satisfaction measures |
|-------------------------------|---|--|---|
| Suitability for the task | Percentage of goals achieved | Time to complete a task | Rating scale for satisfaction |
| Appropriate for trained users | Number of power features used | Relative efficiency compared with an expert user | Rating scale for satisfaction with power features |
| Learnability | Percentage of functions learned | Time to learn criterion | Rating scale for ease of learning |
| Error tolerance | Percentage of errors corrected successfully | Time spent on correcting errors | Rating scale for error handling |

From Dix, 2003

Design rules

- Guidelines
 - Suggestive and more general
 - Several books and technical reports contain huge catalogues of guidelines.
 - Ex: [Apple human interface guidelines](https://developer.apple.com/design/)
<https://developer.apple.com/design/>

Design rules

1. Data Entry

1.1 Position Designation

1.1-1 Distinctive Cursor

For position designation on an electronic display, provide a movable cursor with distinctive visual features (shape, blink, etc.).

Exception When position designation involves only selection among displayed alternatives, highlighting selected items might be used instead of a separately displayed cursor.

Comment When choosing a cursor shape, consider the general content of the display. For instance, an underscore cursor would be difficult to see on a display of underscored text, or on a graphical display containing many other lines.

Comment If the cursor is changed to denote different functions (e.g. to signal deletion rather than entry), then each different cursor should be distinguishable from the others.

Comment If multiple cursors are used on the same display (e.g. one for alphanumeric entry and one for line drawing), then each cursor should be distinguishable from the others.

Reference Whitfield, Ball and Bird, 1983

See also 1.1-17 Distinctive multiple cursors
4.0-9 Distinctive cursor

From Alain Dix et. al,
Human-Computer Interaction, 1998

Figure 5.7 Sample guideline from Smith and Mosier [224]

Golden rules and heuristics

- “Broad brush” design rules
- Useful check list for good design
- Better design using these than using nothing!
- Different collections e.g.
 - Nielsen’s 10 Heuristics (addressed later)
 - Shneiderman’s 8 Golden Rules
 - Norman’s 7 Principles

Schneiderman’s 8 Golden Rules

1. *Strive for consistency*
2. *Seek universal usability*
3. *Offer informative feedback*
4. *Design dialogs to yield closure*
5. *Prevent errors*
6. *Permit easy reversal of actions*
7. *Keep users in control*
8. *Reduce short-term memory load*

Shneiderman et al. 2016

Norman's 7 Principles

1. *Use both knowledge in the world and knowledge in the head.*
2. *Simplify the structure of tasks.*
3. *Make things visible: bridge the gulfs of Execution and Evaluation.*
4. *Get the mappings right.*
5. *Exploit the power of constraints, both natural and artificial.*
6. *Design for error.*
7. *When all else fails, standardize.*



HCI Design Patterns

- An approach to reusing knowledge about successful design solutions
- A pattern is an invariant solution to a recurrent problem within a specific context.
- Examples
 - Light on Two Sides of Every Room (architecture)
 - A wizard breaks a task down into a linear sequence of steps, often presented as a sequence of dialog boxes.
 - Go back to a safe place; center stage pattern (HCI)
 - Martijn van Welie, <http://www.welie.com/patterns>

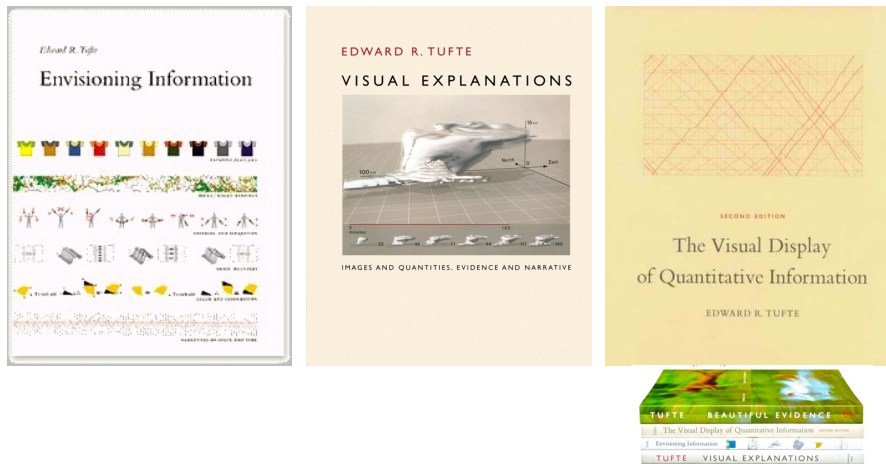
Visual information

Visual information

“Information consists of differences that makes the difference.”

Edward Tufte, Envisioning information, 2003

Visual information



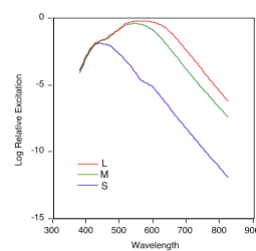
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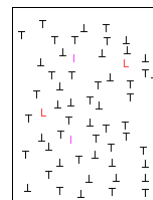
Use of colours

For labelling

For grouping



For highlight

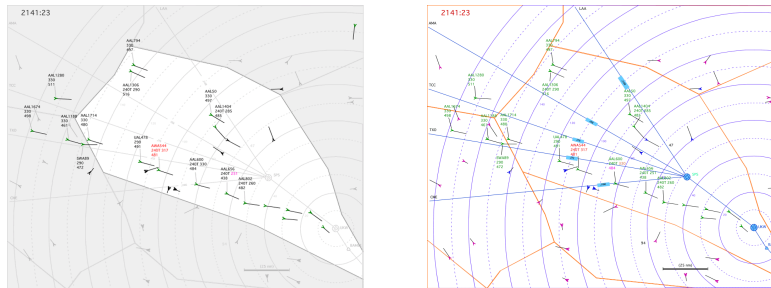


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Some colour design guidelines

- **Use colours sparingly**, for specific purposes

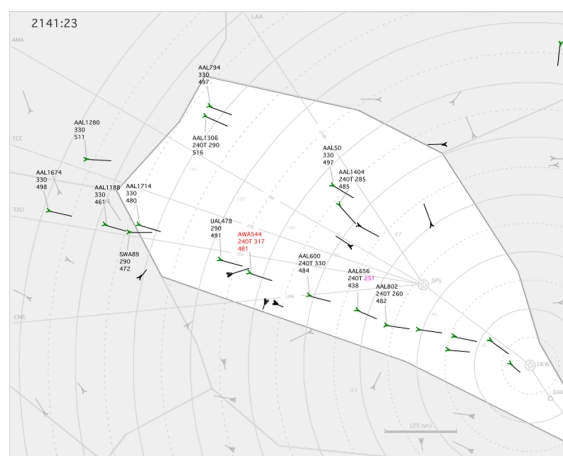


From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Some colour design guidelines

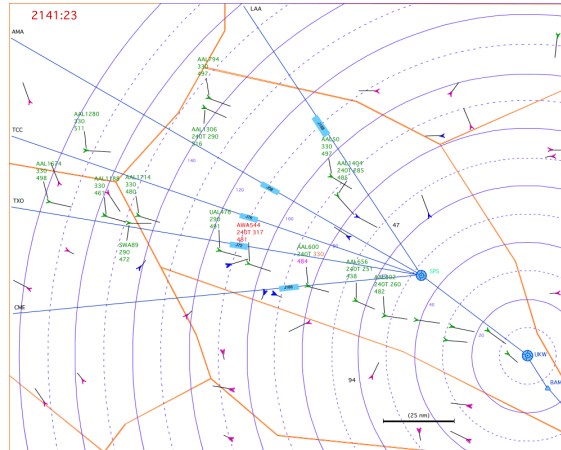


From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Some colour design guidelines



From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

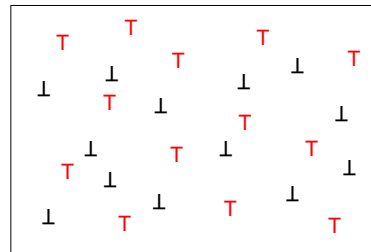
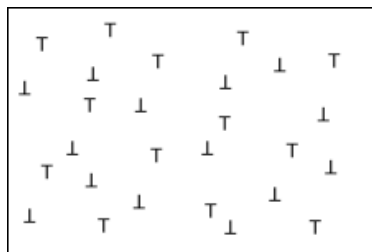
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Some colour design guidelines

- **Use colour consistently** across all of the user's applications

= meaning = colours
≠ meaning ≠ colours



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Some colour design guidelines

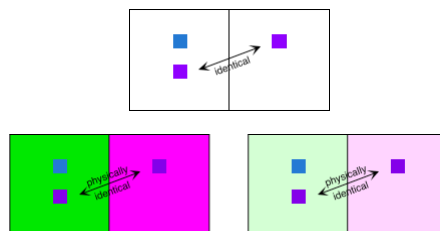
- **Avoid overuse of saturated colours** and for small fields
 - Visual fatigue, because the eye must keep refocusing on different wavelengths
 - The apparent colour of a target is always affected by the physical colour of adjacent areas, in space and time.
 - Simultaneous contrast
 - Successive contrast

Colour Interaction

- Simultaneous contrasts

The 3 small squares in the lower left panel are the same physical lights as in the top panel. The labelled squares are physically identical.

- In the top panel they have roughly the same appearance.
- In the lower left panel, however, the pair that are physically identical have different colour appearances due to the simultaneous contrast effects of the green and magenta backgrounds.

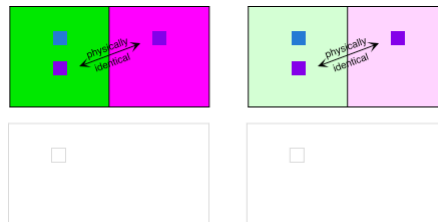


From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

Colour Interaction

- Successive contrasts

Successive contrast is the effect of previously-viewed colour fields ("inducing fields") on the appearance of the currently-viewed test field.



From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Colour Interaction

- Spatial proximity

The effects of the inducing fields are largest when they are immediately adjacent to the test fields, and they fall off rapidly with increasing spatial separation of the fields.



- Temporal proximity

The effects of inducing fields are largest when they are viewed immediately prior to viewing the test field. Most of the after effect usually fades within several seconds, but in the majority of graphic applications this is long enough to be a serious problem.

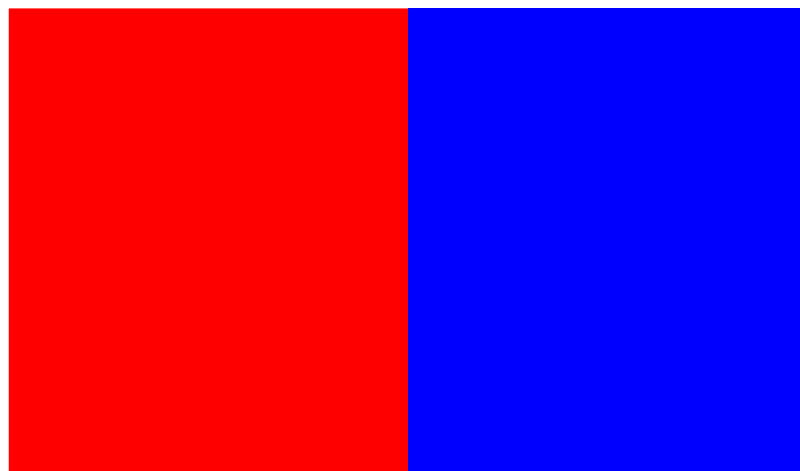
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Colour Interaction

- Symbols drawn with longwave light (reds) appear different in depth from shortwave (blues) symbols.
 - Different wavelengths of light focus at slightly different depths in the eye.
 - It is difficult to focus on an image that combines red and blue, because each colour is fuzzy when the other colour is in focus. (Don't use red-on-blue text)
 - This problem can be avoided by creating an image without both colours side-by-side, by using black or white boundaries, and by increasing the contrast (difference in brightness) between the two colours.

Colour Interaction



Colour Interaction

RED TEXT SEEMS
NEARER?
BLUE TEXT SEEMS
FARTHER?
RED TEXT SEEMS
NEARER?
BLUE TEXT SEEMS
FARTHER?
WHITE TEXT IS ON THE
BACKGROUND

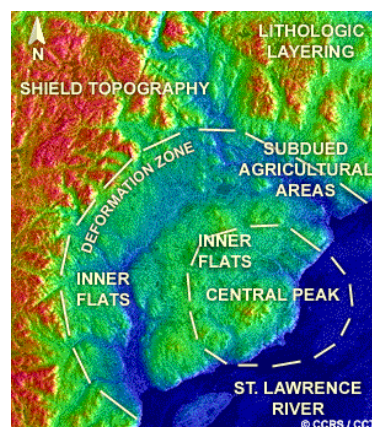
BUT NOT WHEN THE
BACKGROUND
IS BRIGHTER THAN THE
TEXT
BUT NOT WHEN THE
BACKGROUND
IS BRIGHTER THAN THE
TEXT
THIS TEXT IS GREY

From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Colour Interaction



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Colour Interaction

- Experiments

- RED

there will have one different red in each of your minds

- Coca-Cola

you still think of many different reds

- Would you be able to select Coca-Cola red from a set of 100 different reds?
 - Even if all of you were looking at the Coca-Cola logo, no one can be sure whether each has the same perception.

Colour Interaction

- Experiments



Legibility

- Users' ability to read and discriminate the shapes of the symbols in the graphic.
- Luminance contrast:
 - brightness difference between symbols and their backgrounds. A symbol with the same luminance as its background will usually be illegible. Get adequate luminance contrast.
- Large hue differences between the text and background aren't enough to overcome insufficient luminance contrast.



Human-Computer Interaction
Human-Computer Interaction
Human-Computer Interaction
Human-Computer Interaction
Human-Computer Interaction

Legibility



Human-Computer Interaction
Human-Computer Interaction
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Human-Computer Interaction



Human-Computer Interaction
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Human-Computer Interaction

From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

Legibility

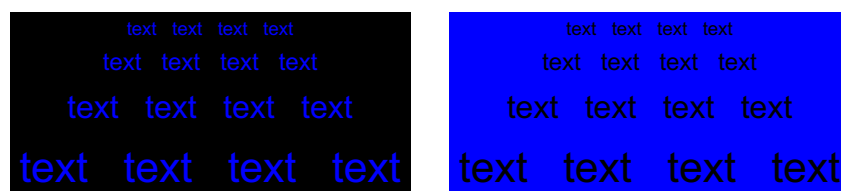
- Blue primary
 - **Pure blue should not be used for fine detail or background**
 - Visual resolution of fine detail is poor for blue. There are fewer blue receptors than green or red in the human retina, and none at all in the central fovea, which is the point of highest acuity.
 - Lens and aqueous humor slowly grow yellower, filtering out the blue wavelengths.
 - Lens gets weaker with age. Blue is at one extreme of its focusing range.
 - **Any graphics that differ from the background only in the blue primary will be hard to read.**

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Legibility

- Blue primary



barely legible at any size

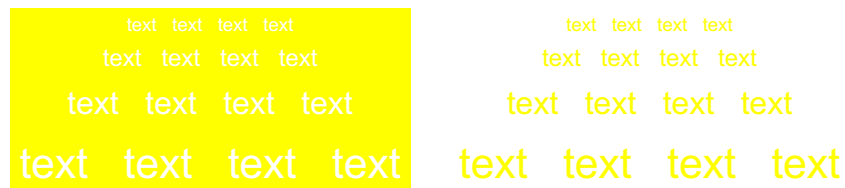
From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Legibility

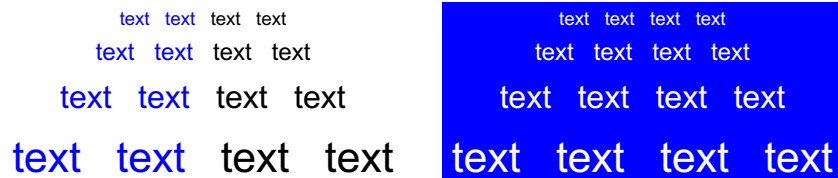
- Blue primary
 - Yellow differs from white only in the absence of the blue primary, so they also make poor symbol/background combinations.



From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

Legibility


- Blue primary
 - **Blue can be used in most contexts if care is taken to achieve adequate luminance contrast**
 - **Substitute black by white (or some other high luminance colour). Blue text on the white background is nearly as legible as the black text**



From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

Legibility

- Blue primary
 - **Blue can be used in most contexts if care is taken to achieve adequate luminance contrast**
 - Use a pale blue (adding yellow light, increasing the luminance but decreasing the purity) on the black or outline the text



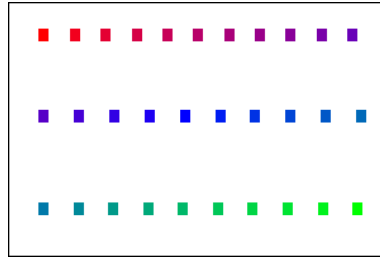
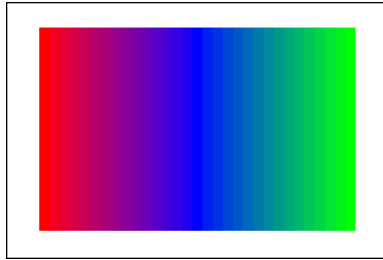
text text text text text text text text
text text text text text text text text

From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

Colour discrimination and identification

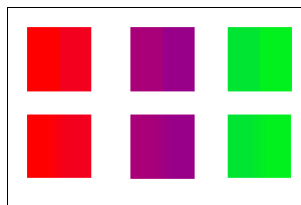
- Users need to be able to **discriminate** among any colours used to distinguish data
 - ...sometimes they also need to be able to **identify** the colours
 - Small colour differences can be distinguished when the areas to be discriminated are:
 - large,
 - immediately adjacent to each other (share an edge near the viewed point)
 - displayed at the same time.
- Ex: visualization of quantized continuous data as in maps of weather or terrain.

Colour discrimination and identification

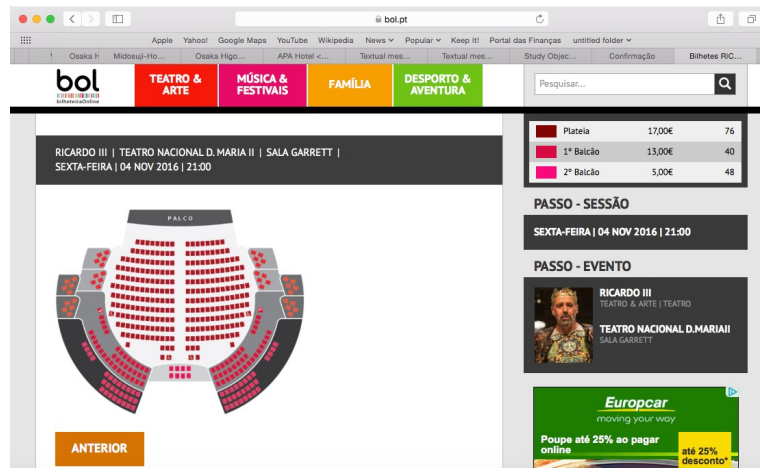


Colour discrimination and identification

- Colour discrimination is best when a sharp edge separates the colours to be discriminated.
- When a smooth gradient separates two colours, the difference of colour appearance is reduced.



Colour discrimination and identification



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Colour discrimination and identification

- Guidelines
 - Use no more than six colours to label graphic elements

| | |
|---------------|--------------|
| red | green |
| red-orange | green-blue |
| orange | cyan |
| orange-yellow | blue |
| yellow | blue-magenta |
| yellow-green | magenta |
| | red-magenta |

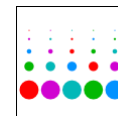
From http://colorusage.arc.nasa.gov/guidelines_ov_design.php

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Colour discrimination and identification

- Guidelines (cont.)
 - Use colours in conformity with cultural conventions
 - Use colour coding consistently across displays and pages
 - Use colour coding redundantly with other graphic dimensions
 - Don't use colour coding on small graphic elements
 - Use neutral grey surrounds where colour judgments are critical
 - Avoid saturated colours

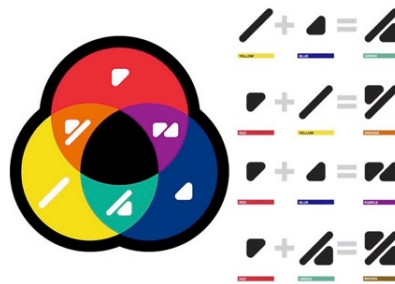


Colour discrimination and identification

- Colour blindness affects a significant fraction of human beings.
- There are online tools for checking your interface against various kinds of colour blindness:
 - <http://www.vischeck.com/vischeck/>
 - <https://www.toptal.com/designers/colorfilter>
- Color Oracle - free color blindness simulator for Window, Mac and Linux

Colour discrimination and identification

- ColorADD (<http://www.coloradd.net/>)
language that enables the colorblind to identify colors



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Colour discrimination and identification

- ColorADD implementation



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Colour discrimination and identification

- ColorADD implementation



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Colour discrimination and identification

- ColorADD implementation



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Chosing Colour

- Use colours schemes that seem to work well in other interfaces
- Pick one colour and several shades of grey
 - Two colours at most (ask opinions)
- Use colour tools
 - Colour Lovers (<http://www.colourlovers.com/>)
 - Canva (<https://www.canva.com/colors/color-palettes/>)
 - Colormind (<http://colormind.io/>)
- Check how it looks in grey scale
- Extract colours from a natural scene photograph

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Graphic design

Graphic design

- Graphic design is the first and the last part of the user interface observed by the user.
- Would you like to have your bedroom painted in an ugly combination of purple and brown?
 - you spend far more time looking at the visual interface elements of your working software.
 - You can buy the house and paint it again in different colours,... but you cannot leave the user interface design to the users!

Graphic design

- Designers are constantly asked to resolve conflicting demands imposed by the problem, the budget, the schedule, and the desired quality level
 - trade-offs must be continuously identified, evaluated, and decided on the basis of the best information available.
- Design must always solve a particular real-world problem
 - **Functional** criteria govern the range of possibilities that can be explored
 - **Aesthetic** possibilities that are not compatible with this minimum standard of usability must be discarded.

Graphic design

- Guidelines:
 - Simplicity
 - Contrast
 - White space
 - Balance
 - Alignment

From Mullet and Sano, 1995

Graphic design

- Simplicity
 - “Perfection is achieved not when there is nothing more to add, but when there is nothing more to take away.”
(Antoine St-Exupery)
 - “Less is more.”
 - “Keep it simple, stupid.” (KISS)
 - When in doubt, leave it out.”

Graphic design

- Simplicity
 - “Less is more.”



Graphic design

- Simple designs can be immediately recognized and understood with a minimum of conscious effort.
- Anything that is not essential to the communication task must be removed.
- Good design is simple, bold and direct. It ensures that significant design elements will be noticed by removing insignificant elements whenever possible.

Graphic design

- Techniques for simplicity
 - Reduction
 - remove inessential elements
 - Regularity
 - Use regular patterns
 - Limit inessential variations among elements
 - Make sure critical elements intended to stand out in the display are not regularized
 - Combining elements for maximum leverage
 - Let elements play multiple roles
 - Example: title bar, “thumb” in the scroll bar.
 - Too much leverage can cause problems if it introduces complex mappings that must be remembered by the user.



Graphic design

- **Simplicity, it's complicated**

By John Boykin, UX Magazine

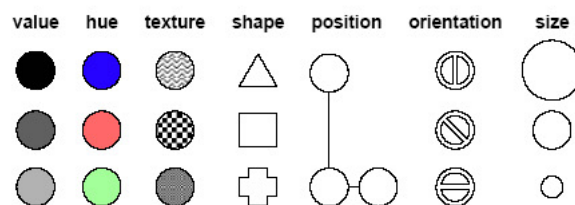
<http://uxmag.com/articles/simplicity-its-complicated>

"The goal is not simplicity for its own sake. Simplicity is only a means to an end. The goal is ease."

Graphic design

- **Contrast**

- Perceivable differences along a visual dimension
- Irregularities that highlight elements and convey information.
- Should be strong, but few in numbers
- Theory of visual variables – Jacques Bertin 1983



based on Mullet and Sano, 1995.

Graphic design

- Characteristics of visual variables
 - Scale = possible kinds of comparisons
 - Nominal (equality comparison)
 - All variables
 - Ordered (> < comparison)
 - Position, size, value, texture granularity
 - Quantitative (compare amount of difference)
 - Position and size
 - Length – number of possible values on each dimension
 - Shape: long (infinite variety)
 - Position: long (limited by display size and resolution) and fine-grained
 - Orientation: very short (~ 4 levels)
 - Other variables ~10 levels

Graphic design

- Interaction among visual variables
 - Associative perception: can a variable be ignored when looking at others?
 - Size and value are dissociative (they dominate perception and disrupt the processing of other correlated dimensions).
 - It is difficult to determine the hue of a very small dot or thin line
 - Selective perception: can a variable be picked out to exclusion of others?
 - Shape is not selective

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N | Z | K | M | N | N | Z | K | M | N |
| M | Z | N | Z | | | M | Z | N | Z |
| N | K | K | K | Z | | N | K | K | K |
| M | N | Z | M | | | M | N | Z | M |
| Z | N | K | N | Z | | Z | N | K | N |

Graphic design

- Techniques for contrast
 - Choose appropriate visual variables.
 - Use as much length as possible (but minimize the number of distinct values)
 - Sharpen distinctions for easier perception
 - Multiplicative scaling, not additive
 - Redundant coding when needed
 - Cartoonish exaggeration when need
 - “Squint test”

Graphic design

Title

Heading

Body text is smaller and longer in line length. It uses a serif font, because it makes small text easier to read. Redundant encoding produces an effective contrast.

Graphic design

- White space
 - Use white space to group interface elements.
 - Use margins around interface elements.
 - Integrate figure and ground
 - Objects should be scaled proportionally to its background.
 - Do not crowd controls together
 - Crowding creates spatial tension and inhibits scanning

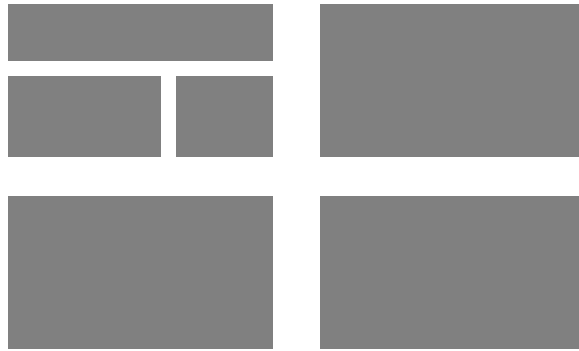
Graphic design

- White spaces
 - to separate



Graphic design

- White space
 - to structure



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Graphic design

- White space
 - to highlight

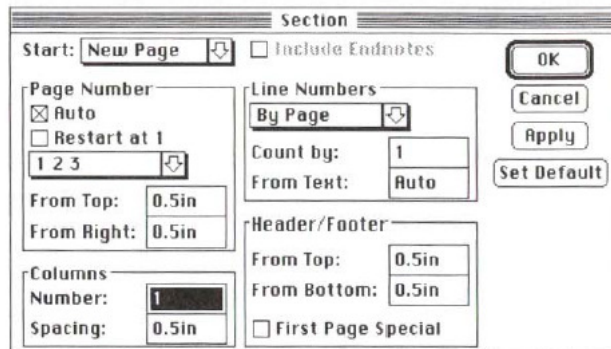


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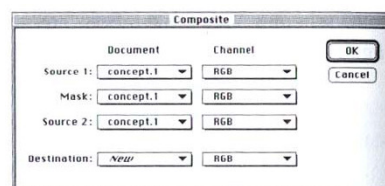
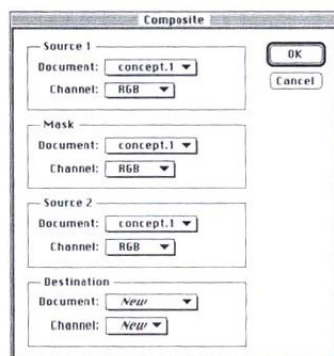
Graphic design

- Crowded dialog



From Mullet and Sano, 1995.

Graphic design



From Mullet and Sano, 1995.

Graphic design

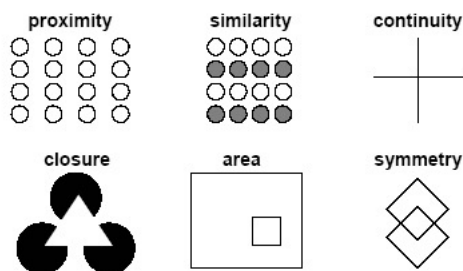
- White space

Space separates groups of items



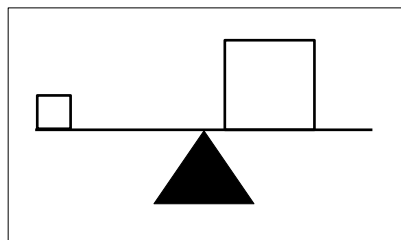
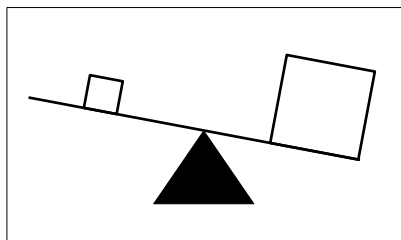
Graphic design

- Gestalt principles explain group recognition



Graphic design

- Balance and Symetry
 - Choose an axis (usually vertical)
 - Distribute elements equally around the axis



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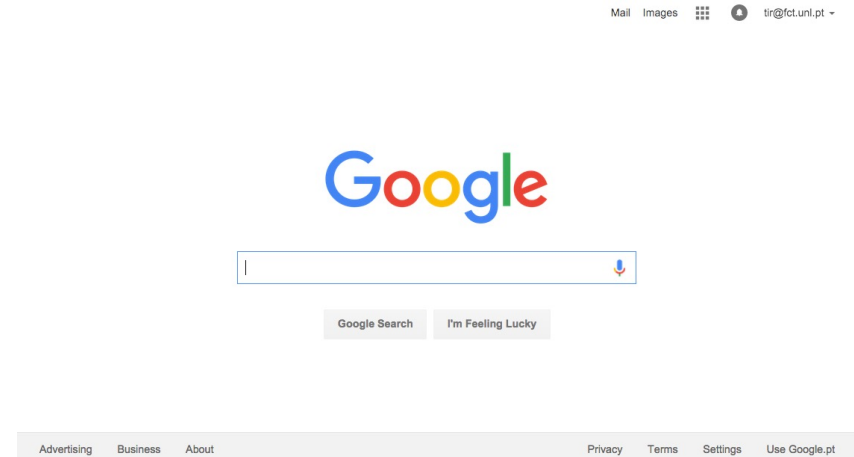
Graphic design



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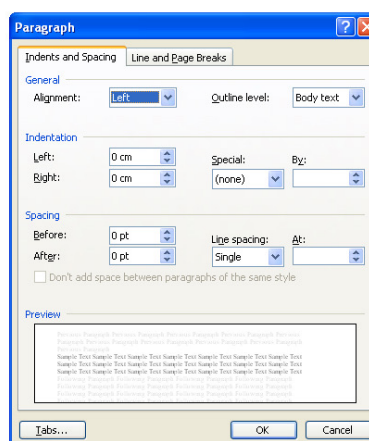
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Graphic design

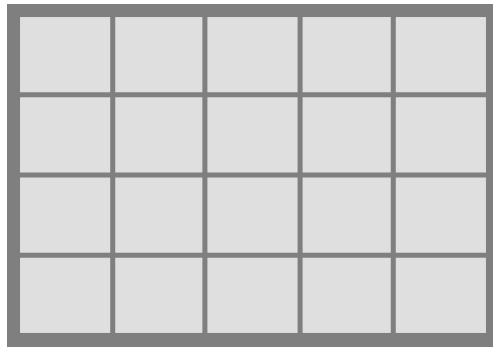


Graphic design

- Alignment
 - Align labels
 - Left or right
 - Align controls
 - Left and right
 - Align text
 - baseline



Visual hierarchy

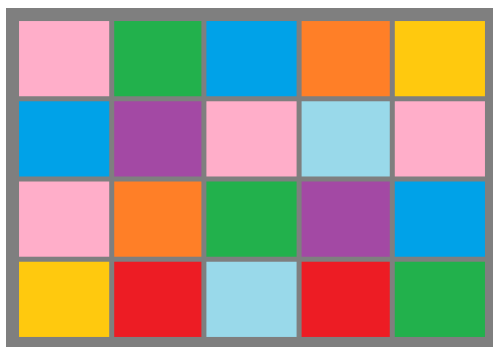


Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

89

Visual hierarchy

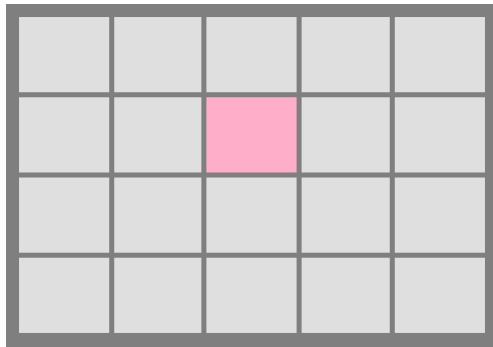


Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

90

Visual hierarchy

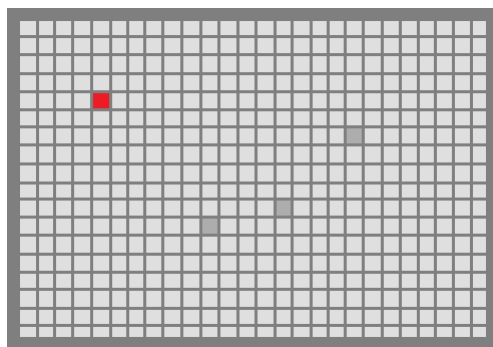


Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

91

Visual hierarchy

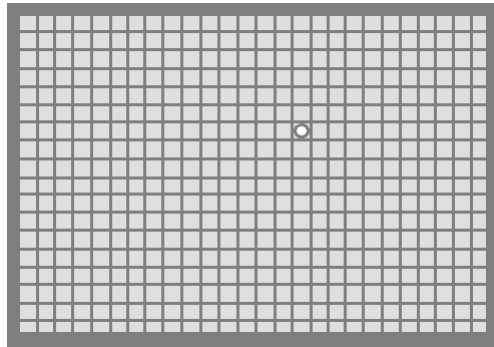


Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

92

Visual hierarchy

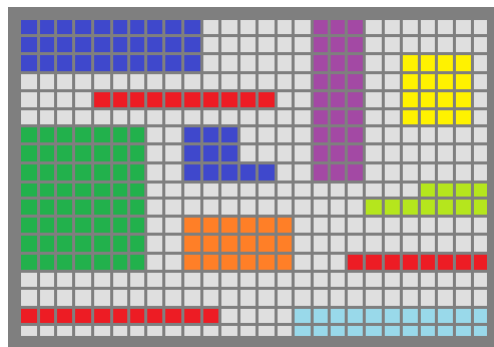


Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

94

Visual hierarchy



Based on: <http://simplerisbetter.wordpress.com/2010/03/07/explaining-visual-hierarchy/>

Interação Pessoa-Máquina (DI-FCT/UNL)

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Typography

- Displaying text on screen
 - Key decisions: font and spacing
- Reading process: fixation and saccades
- Readability – effectiveness of the whole reading process - usability of a display of text
 - Metrics: Speed, comprehension, error rate, subjective preference

Typography

- Font – typeface, size and style
- Font size = ascent + descent (typically)
 - Denoted in points = 1/72 inch
(a 12-point font occupies 1/6 of an inch vertically – 1 inch = 72 points).



From Wikipedia

Typography

- Typeface

- Family of fonts sharing the same design features and main name (ex: Arial)

- **Serif** (body text) / **SanSerif** (display text)
Times, Georgia Arial, Verdana

Typography

- Typeface

- **Proportional** / **Monospace**
(different character width) (same character width)

Abci
Arial

Abci
Times New roman

Abci
Courier New

Abci
Verdana

Abci
Georgia

Abci
Garamond

Typography

- Proportional (Arial)

There was more than athletic talent being pressed to peak performance at the 1984 Olympic Games in Los Angeles. Behind the scenes, a multilingual Olympic Message System ran round-the-clock keeping more than 10,000 athletes and officials in contact with families and friends, both far and near.

- Monospace (Courier New)

There was more than athletic talent being pressed to peak performance at the 1984 Olympic Games in Los Angeles. Behind the scenes, a multilingual Olympic Message System ran round-the-clock keeping more than 10,000 athletes and officials in contact with families and friends, both far and near.

Typography

- Font style

- *Italic* (contrast in orientation)
- **Bold** (contrast in value)

Abpg

Abpg ← *Slanted*

Abpg

Abpg

Abpg ← *Italic style*

Abpg

Typography

- CAPS

INTERAÇÃO

All caps

Interação

Mixed caps

- All-caps should be reserved only for display text, ... and even then should be used very sparingly.

Typography

- CAPS

THERE WAS MORE THAN ATHLETIC TALENT BEING PRESSED TO PEAK PERFORMANCE AT THE 1984 OLYMPIC GAMES IN LOS ANGELES. BEHIND THE SCENES, A MULTILINGUAL OLYMPIC MESSAGE SYSTEM RAN ROUND-THE-CLOCK KEEPING MORE THAN 10,000 ATHLETES AND OFFICIALS IN CONTACT WITH FAMILIES AND FRIENDS, BOTH FAR AND NEAR.

- Mixed

There was more than athletic talent being pressed to peak performance at the 1984 Olympic Games in Los Angeles. Behind the scenes, a multilingual Olympic Message System ran round-the-clock keeping more than 10,000 athletes and officials in contact with families and friends, both far and near.

Typography

- Font selection
 - Don't use more than 2 or 3 typefaces (simplicity)
 - body and display text
 - Use size, style and colour to establish contrast
 - Size - hierarchy

Typography

- Spacing

Vol rnm
Vol rnm

 Kerning

- Character spacing
 - Kerning is the process of adjusting character spacing for particular pairs of characters
- Word spacing - allow the word shape to be easily recognized.
- Line spacing – leading: distance between baselines of adjacent lines.
 - Print designers: “12 point type on 14 points of leading” (or “12/14”)

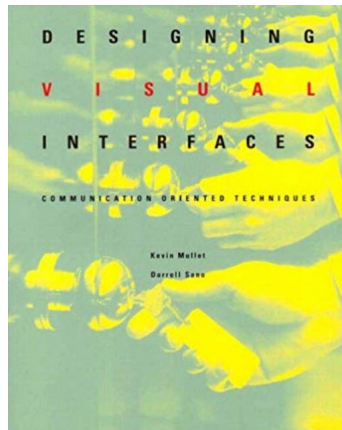
Typography

- Guidelines for spacing
 - Use whitespaces
 - Always leave margins around text
 - Be generous with leading (but not too much)
 - 120% of font size
 - Keep text paragraphs narrow
 - 60-75 characters (12 points)!

Typography

- Butterick's Practical Typography
<http://practicaltypography.com>
- WhatTheFont
 - Identify the fonts in photos or websites
- Identifont
 - Online typeface identifier (by appearance, name, similarity...)

Further reading



Recommended reading

- Lawrence J. Najjar, [Using Color Effectively](#) (IBM TR52.0018). Atlanta, GA: IBM Corporation
- Kahn P. and Lenk Krzysztof, [Principles of Typography for User Interface Design](#), Interactions, 1998, pp. 15-29.

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- Mullet, K. And Sano, D., Designing Visual Interfaces, Prentice-Hall, 1995.
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- Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., and Elmqvist, N., Designing the User Interface: Strategies for Effective Human-Computer Interaction: Sixth Edition, Pearson (May 2016).
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