

# IDI – Universal Design Principles & Perception Laws

Professors IDI – Dept. Computer  
Science – UPC

# Design Principles & Usability

- Usability: Defined in ISO 9241 standard as
  - The ability in which a product may be used by **specific** users in order to carry out **specific** tasks *effectively, efficiently, and with satisfaction* in a **specific** use environment.
  - **Usability is always referred to a concrete user group and a concrete user application**
    - *Efficacy* is the ability of correctly and completely achieving a certain goal.
    - *Efficiency* is the relation of used resources and the completeness and correctness of achieved goals.
    - *Satisfaction* is the comfort and acceptation of a system by the users and other people that are affected by its use.

# Usability Principles (Bruce Tognazzini)

- Fashion should never trump usability (**Aesthetics**)
- Bring to the user all the information and tools needed for each step of the process (**Anticipation**)
- Computer interface, and task environment all “belong” to the user (**Autonomy**):
  - Customized interfaces,
  - Keep user informed: status, errors, progress indicators,...
- When using color to convey information in the interface, also use clear, secondary cues (**Color**)
- **Consistency**: levels of consistency, induced inconsistency, continuity, with user expectations
- **Default Values**: easy to blow away, not everything default,
- **Discoverability**: Any attempt to hide complexity will serve to increase it, if user cannot find it, it does not exist:
  - Controls should be visible, communicate the gestural vocabulary, use active discovery,..
- Look at the user’s productivity, not the computer’s (**Efficiency**):
  - formularies, error messages, latency reduction
- **Explorable interfaces**: Actions reversible
  - always allow undo, back to home page, visible navigation
- **Good Metaphors**
- **Protect Users’s work**: Ensure that users never lose their work

# Universal Principles & Perception Laws in Design

- **Principle concepts of Design**

From the “Universal Principles of Design” book

*by William Lidwell, Kritina Holden, Jill Butler*

- Perception Laws in Design: Gestalt Laws
- Color perception

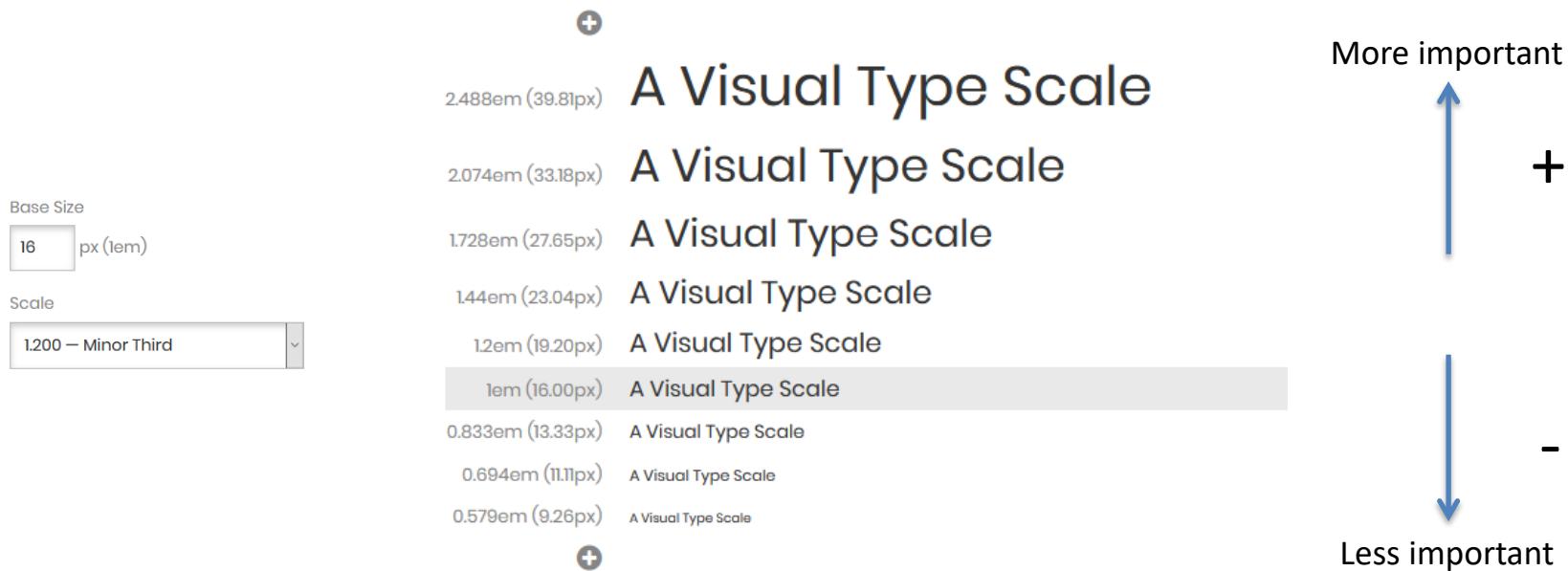
# Universal Principles of Design

- Aesthetic-Usability Effect
  - Aesthetics play an important role in the way designs are used
  - Aesthetic designs look easier to use, and encourage its use more than non aesthetic designs
  - This effect produces the perception that an aesthetic design is easier to use than a non-aesthetic design

We must devote important efforts to improving our designs.

# Universal Principles of Design

- Fix a visual hierarchy.
- Modular scale guarantees harmonious proportions. How to make a modular scale:
  - Choose a ratio (for example, the golden ratio, 1:1.618)
  - Choose a base size (i.e. 10), then multiply and divide to get many resonant numbers:



Captured from a font scale generator: <https://type-scale.com/>

# Universal Principles of Design

- Correct alignment
  - Elements must be aligned, this creates a sense of unity and cohesion, as well as facilitates reading.
  - More later..

## Confusion over Palm Beach County ballot

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

(REPUBLICAN)	GEORGE W. BUSH - PRESIDENT DICK CHENEY - VICE PRESIDENT	3 →
(DEMOCRATIC)	AL GORE - PRESIDENT JOE LIEBERMAN - VICE PRESIDENT	5 →
(LIBERTARIAN)	HARRY BROWNE - PRESIDENT ART OLIVIER - VICE PRESIDENT	7 →
(GREEN)	RALPH NADER - PRESIDENT WINONA LaDUKE - VICE PRESIDENT	9 →
(SOCIALIST WORKERS)	JAMES HARRIS - PRESIDENT MARGARET TROWE - VICE PRESIDENT	11 →
(NATURAL LAW)	JOHN HAGELIN - PRESIDENT NAT GOLDHABER - VICE PRESIDENT	13 →
<b>Punching the second hole</b> casts a vote for the Reform Party.		
4 →		
6 →		
8 →		
10 →		
WRITE-IN CANDIDATE To vote for a write-in candidate, follow the directions on the long stub of your ballot card.		

1 1-8

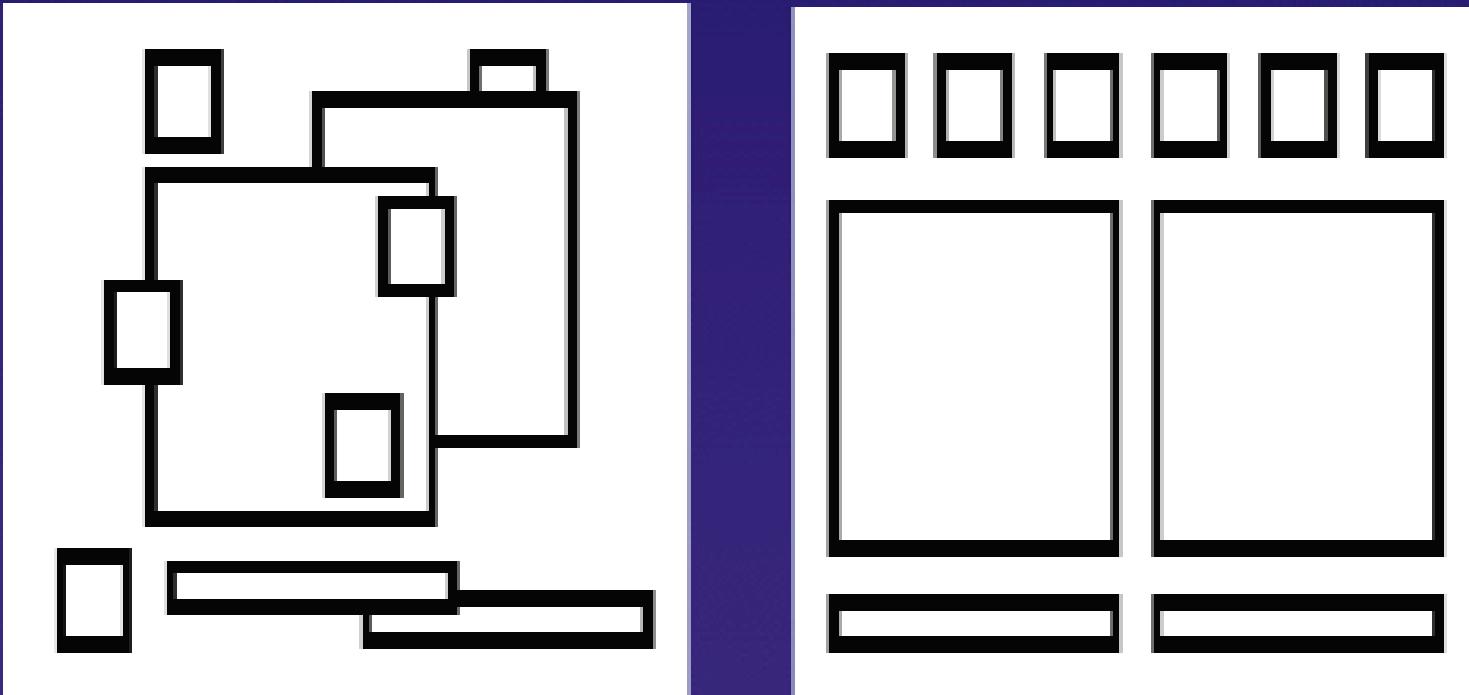
OFFICIAL BALLOT, GENERAL ELECTION  
PALM BEACH COUNTY, FLORIDA  
NOVEMBER 7, 2000

A

REPUBLICAN  
GEORGE W. BUSH - PRESIDENT AND DICK CHENEY - VICE PRESIDENT 3 →  
DEMOCRATIC  
AL GORE - PRESIDENT AND JOE LIEBERMAN - VICE PRESIDENT 4 →  
LIBERTARIAN  
HARRY BROWNE - PRESIDENT AND ART OLIVIER - VICE PRESIDENT 5 →  
GREEN  
RALPH NADER - PRESIDENT AND WINONA LaDUKE - VICE PRESIDENT 6 →  
SOCIALIST WORKERS  
JAMES HARRIS - PRESIDENT AND MARGARET TROWE - VICE PRESIDENT 7 →  
NATURAL LAW  
JOHN HAGELIN - PRESIDENT AND NAT GOLDHABER - VICE PRESIDENT 8 →  
REFORM  
PAT BUCHANAN - PRESIDENT AND EZOLIA FOSTER - VICE PRESIDENT 9 →  
SOCIALIST  
DAVID McREYNOLDS - PRESIDENT AND MARY CAL HOLLIS - VICE PRESIDENT 10 →  
CONSTITUTION  
HOWARD PHILLIPS - PRESIDENT AND J. CURTIS FRAZER - VICE PRESIDENT 11 →  
WORKERS WORLD  
MONICA MOOREHEAD - PRESIDENT AND GLORIA La RIVA - VICE PRESIDENT 12 →  
WRITE-IN CANDIDATE To vote for a write-in candidate, follow the directions on the long stub of your ballot card.

ELECTORS  
FOR PRESIDENT  
AND  
VICE PRESIDENT  
(A vote for the candidates will  
actually be a vote for their electors.)  
(Vote for Group)

# Universal Principles of Design



# Universal Principles of Design

- Define a grid. There are infinite options:

	<b>Grid systems</b> A grid can be simple or complex, specific or generic, tightly defined or loosely interpreted. Typographic grids are all about control. They establish a system for arranging content within the space of page, screen, or built environment. Designed in response to the internal pressure of content (text, image, data) and for some edge or frame (page, screen, window), an effective grid is not a rigid formula but a flexible and intelligent structure that moves in concert with the modular mass of content. Grids belong to the technical framework of typography, from the concern with the modular mass of content, rules, guides, and coordinate systems of graphic design, to the concern with the ubiquitous language of the digital interface. Although software generates illustrations of modularity, it does not generate them—contradicting ultimately from a theoretical perspective—the ubiquitous language of the grid. The ubiquitous language of the grid is a guided space in which windows overlay windows. In addition to their place in the background of design production, grids have become explicit theoretical tools. Josef Müller-Brockmann's designs in the 1960s and 1970s proposed the mechanical grid of perspective as a way to map the potential surface of the page. In
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## Column grid.

Josef Müller-Brockmann's *Grid Systems in Graphic Design*, 1961. (Image credit: <http://thinkingwithtype.com/grid/>)

# Universal Principles of Design

- Modular grid. One element can occupy several neighboring cells.

The diagram illustrates a modular grid system with four columns and four rows. It features several content blocks, including a large yellow square containing the Chinese character '刷' (Shu), a grid of letters (A-T), and a grid of numbers (1-9). Red grid lines define the structure, and small text boxes provide detailed explanations of the grid's characteristics and its evolution in design.

**Grid systems**

A grid can be simple or complex, specific or generic, tightly defined or loosely interpreted. They establish a system for arranging content within the space of page, screen, or built environment. Designed in response to the internal pressures of content (text, image, data) and the outer edge or frame (page, screen, window), an effective grid is not a rigid formula but a flexible and resilient structure, a skeleton that moves in response to the content it contains and the environment in which it is placed. Grids belong to the technological framework of typography, from the concrete modularity of letterpress to the ubiquitous rulers, guides, and coordinate systems of graphics applications. Although grids have become explicit in design production, they are also the invisible language of the gulf (graphical user interface) that creates a gridded space in which windows overlay windows. In addition to their place in the background of design production, grids have become explicit in design politics, programming, and interfaces, where grids are used to accommodate columns. The typographic grid is a proportional modular system for composing white spaces on a page that provides a way to accommodate a column of text.

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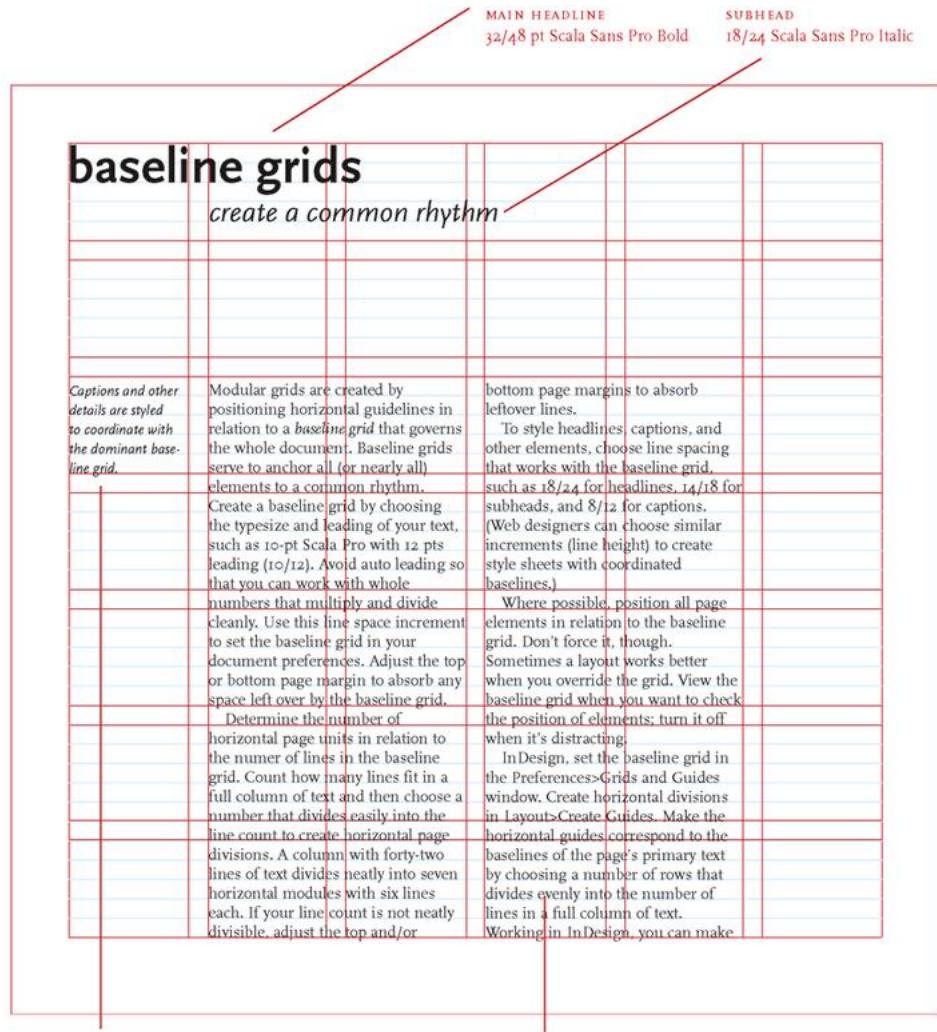
**Grid systems**

This modular grid has four columns and four rows. An image or a text block can occupy one or more modules.

Endless variations are possible.

# Universal Principles of Design

- Base line grids ensure the vertical rhythm between columns.
- The font sizes, line heights and margins are fixed to fit in a base grid of fixed height.
- Try [gridlover](#) for grid generation!



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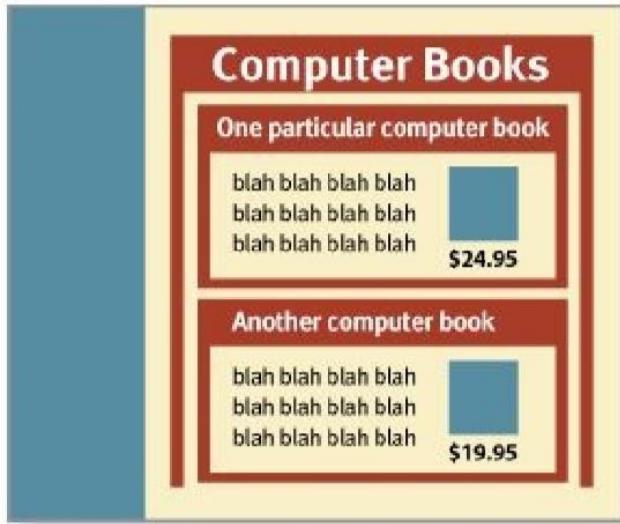
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**Trådløs Kamera m/ Alarm & GSM 1999,-**

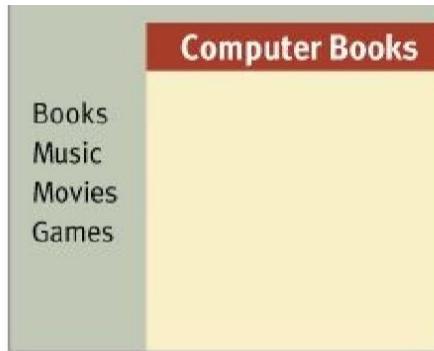
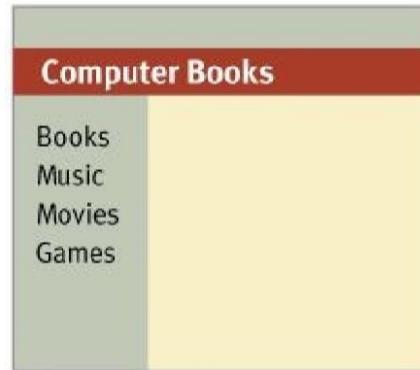
# Universal Principles of Design

- Nesting

Nesting is also a visual queue of the hierarchy of the information shown.



We need to be careful when designing the visual nesting dependences.



Images: *Don't Make Me Think, Revisited*, 3rd Edition

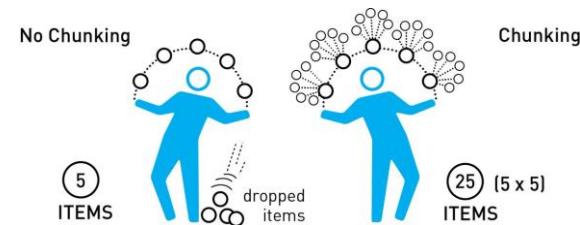
# Universal Principles of Design

- **Chunking**

- A chunk is a unit of information in short-term memory
- Chunking is a technique that seeks to place the information in a way that accommodates to the limits the humans have to process bits of information.
- Smaller chunks are easier to remember than larger lists

Most people can remember a list of 5 words for 30 seconds,  
but few can remember a list of 10 words for 30 seconds.

654563465  
654 – 56 – 34 – 65



- Magical number:  $7+/-2$  (contemporary estimation  $4+/-1 \rightarrow 5$ )
- It refers to elements that must be memorize:
  - Menu items, telephone numbers...
- But it is not required to divide all the elements in a screen or page in groups of 5 or so, just the information to be memorized.
  - Elements such a dictionary pages must not be chunked.

# Universal Principles of Design

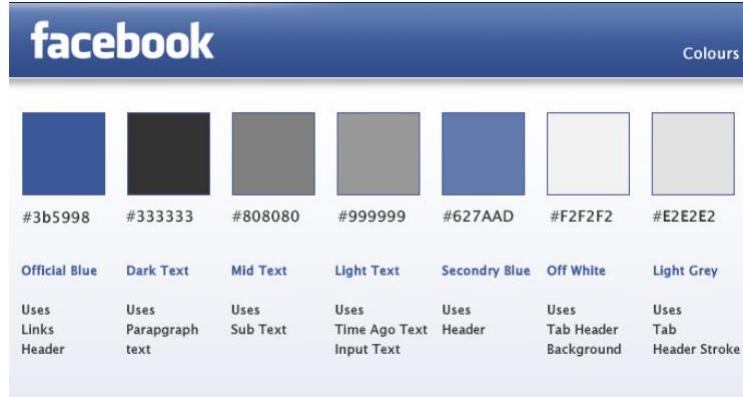
- Colour
  - It is an important feature that can make a design *more visually pleasing and aesthetic*
  - Can be used to *reinforce layout design and the meaning of elements*

# Universal Principles of Design

- Colour: Aspects to consider:
  - Number of colours:
    - Keep it low, up to five. Define a **COLOR PALETTE**.
    - Use a second cue.
  - Colour combinations (more later):
    - Analogous (neighbours), complementary, or combinations of colours found in nature
  - Saturation: Attracts attention
    - When performance and efficiency are important,  
the use of **desaturated colours may help, perceived as more professional**
    - **Saturated colours attract attention** and are perceived as **more exciting and dynamic**  
(but may increase eye fatigue)
  - Symbolism:
    - The meanings of colours may vary among cultures

# Perception Laws in Design. Universal Principles of Design

## COLOR PALETTE



## CORPORATIVE PALETTE



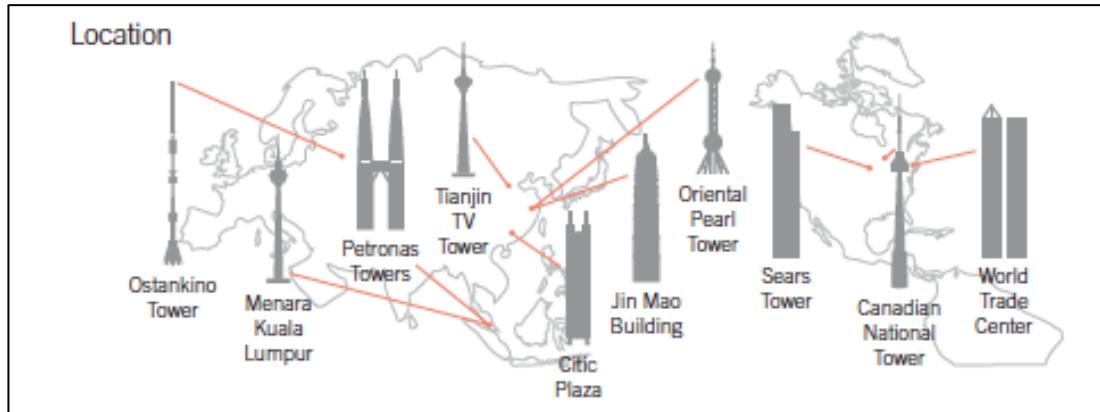
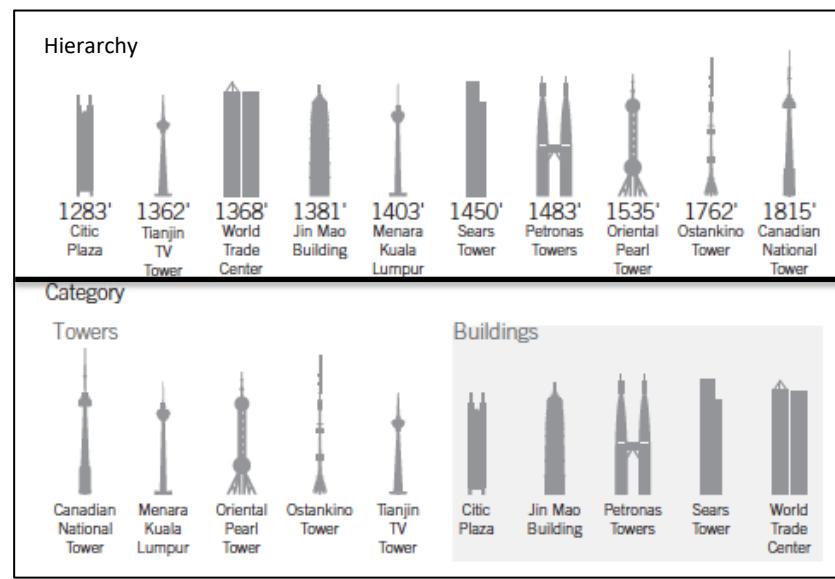
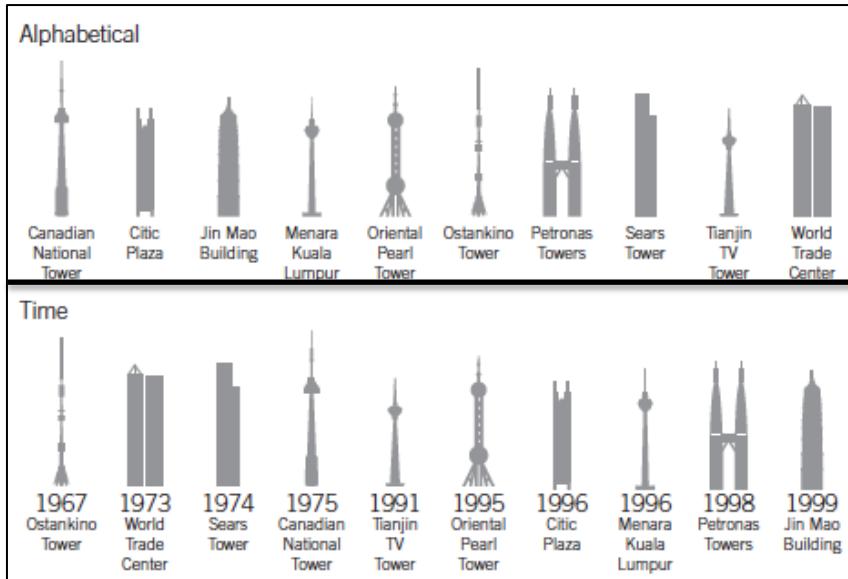
## COLOR HARMONY



# Perception Laws in Design. Universal Principles of Design

- **LATCH principle.** Information is organized according to:
  - **Location:** Information comes from different places (medicine: location of the body,).
  - **Alphabet:** Usually for large amounts of data (words in dictionary... )
  - **Time:** Events with fixed durations. (meeting schedules).
  - **Category:** To classify goods/elements of similar importance. Suitable for shops...
  - **Hierarchy:** By magnitude, order of importance

# LATCH principle.



# Perception Laws in Design. Universal Principles of Design

- Garbage-in garbage-out (GIGO):

Computer scientists have long known that

inadequate input information often generates bad results

- **Type error:** The input is provided in an incorrect type (*mistakes*).

If undetected, it may generate large amounts of garbage.

Ex.: Numerical fields filled with a phone number or credit card number...

Type checks, input formatting, default values, example of inputs

- **Quality error:** The input has the correct type but has some defects (*slips*).

Ex.: Amounts of money in a money transfer.

May be alleviated with confirmations and previews.

## Original Form

### Order Form: Billing and Shipping Information

page 2 of 2

#### Shipping Address:

Name
Street Address
Street Address
City, State and Zip Code

#### Billing Address:

Name	<input type="radio"/>
Street Address	
Street Address	
City, State and Zip Code	

- Unconstrained fields increase the probability of garbage input.

#### Credit Card Information:

Name on Credit Card	Type of Credit Card	Credit Card Number	Exp. Date
---------------------	---------------------	--------------------	-----------

#### Shipping Method:

--

#### Date to Ship:

--

[continue >>](#)

## Redesigned Form

**Order Form: Billing and Shipping Information** page 2 of 2

click here to use the information saved with your account

**Shipping Address:**

First Name	Last Name
Street Address	
City      State      Zip Code	

**Billing Address**

First Name	Last Name
Street Address	
City      State      Zip Code	

- Allow users to automate input by accessing stored information.

**Credit Card Information:**

Name on Card	Type of Card	Month	Year
Credit Card Number		Expiration Date	

- Constrain input when a specific amount of information is required.

**Shipping Method:**

Standard Shipping \$7.00
--------------------------

**Date to Ship:**

Month	Day	Year
-------	-----	------

Your order will not be placed until you review the information you entered and click the "submit order" button.

March 21, 2003

1 dozen chocolate chip cookies

Ship to:  
Randy Williams  
101 Main Street  
Houston, TX 90990

Ship on:  
March 30, 2003

Bill to:  
Kristen Johnson  
211 Elm Blvd.  
Columbus, OH 44356

VISA: \*\*\*\* \* 3041  
Exp. Date 5/2006  
Name on Card: Kristen J. Johnson

- Constrain input using menus of options.

- Allow users to preview information before they complete transactions.

# Input control: avoid errors

- Choose the appropriate input for each field:

What's your favorite fruit?

Select

Don't

What's your favorite fruit?

Apple   Banana   Orange

Do

Price Range

From \$10 To \$1,000

Don't

Price Range

\$10   \$1 000

Do

- Masked textboxes are a great option:

Phone Number

Card

Expiry

Order Code

- Use location services

STREET ADDRESS \*

APARTMENT/SUITE #

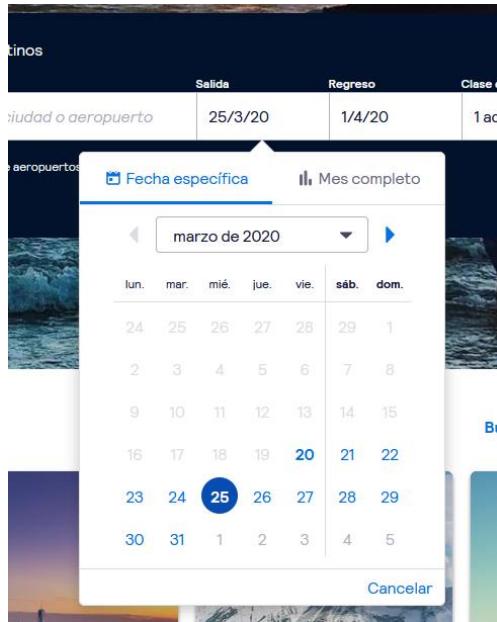
CITY \*

STATE \*

ZIP \*

▼

# Input control: avoid errors



<http://en.kremlin.ru/>

01.06.2017

Enter date

Specify the desired date. After filling the fields, press Enter.  
Examples of how you can set the date and time periods.

Examples

26 January 2015  
26.01.2015  
26.01.2015 - 12.02.2015  
January-February  
January 2015  
yesterday

April	29	2014
May	30	2015
June	31	2016
July	1	2017
August	2	2018
September	3	2019
October	4	2020

# Input control: avoid errors

- Use placeholders to inform of the correct format of the inputs.
- Activate the proper keyboard for each field.

Tracking Number

Don't

Tracking Number

e.g. EZ987654321XX

Do

User Name

Phone Number

I The I'm

q w e r t y u i o p	a s d f g h j k l	z x c v b n m
123	space	return
4 GHI	5 JKL	6 MNO
7 PQRS	8 TUV	9 WXYZ
+ * #	0	✖

Don't

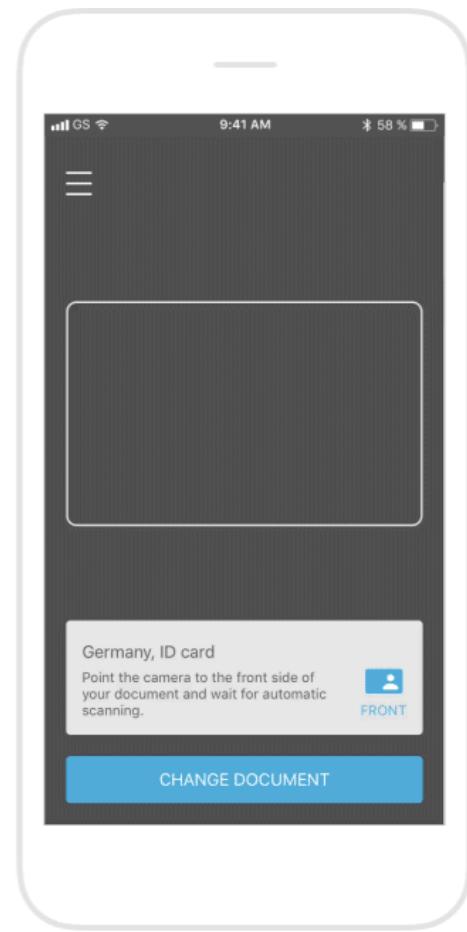
User Name

Phone Number

1 2 3  
4 5 6  
7 8 9  
+ \* # 0

Do

- And....use the camera!



# Universal Principles of Design

- **Ionic representation:** Images try to represent objects or actions.

Four types:

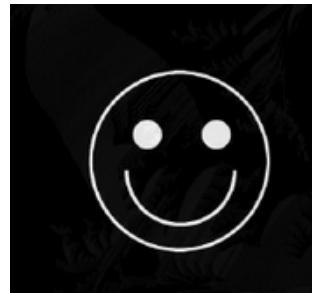
- **Similarity:** The icon is visually similar to the action/object to be represented. Adequate for simple objects (turn right) 
- **Example:** Elements can be related to the image (plane for airport) 
- **Symbolic:** High level of abstraction (unlock icon) 
- **Arbitrary:** No relationship with element or action (nuclear symbol) 

# Universal Principles & Perception Laws in Design

- Principle concepts of Design  
From the “Universal Principles of Design” book  
*by William Lidwell, Kritina Holden, Jill Butler*
- **Perception Laws in Design: Gestalt Laws and more**
- Color perception

# Perception Laws in Design. Gestalt Laws

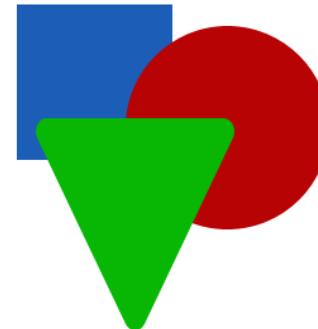
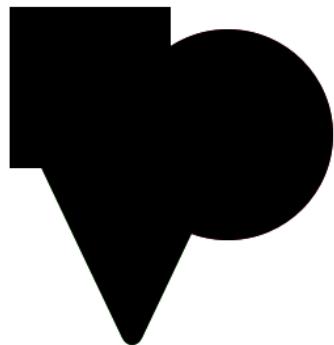
- Gestalt Laws relevant for visual design.
- Gestalt is a Psychology term, it hypothesises that people tend to organize visual elements into groups when certain principles are applied.
- Gestalt Laws are:
  - Prägnanz Law
  - The law of closure
  - The law of similarity
  - The law of proximity
  - The law of symmetry
  - The law of continuity
  - The law of common fate



# Perception Laws in Design. Gestalt Laws

- **Pragnänz Law:** Law of good figure, simplicity.

We tend to perceive simpler shapes because it is the interpretation that requires the least cognitive effort to us.





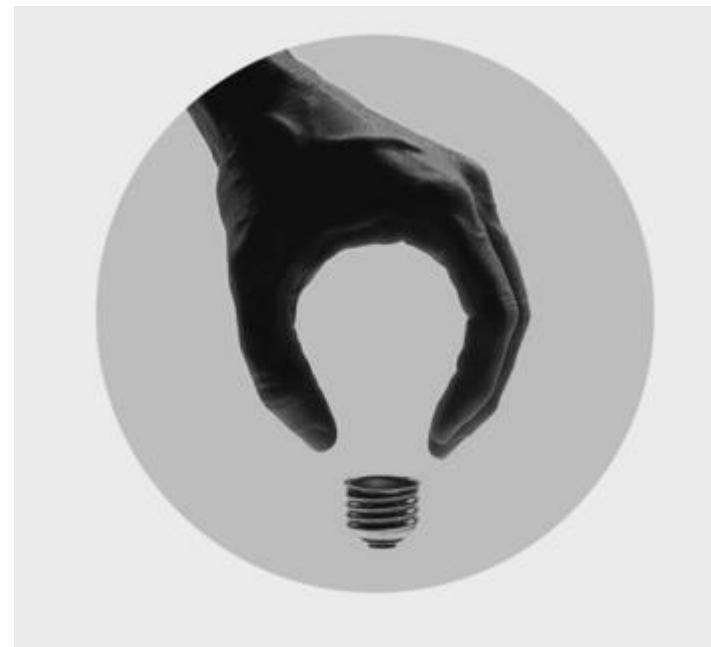
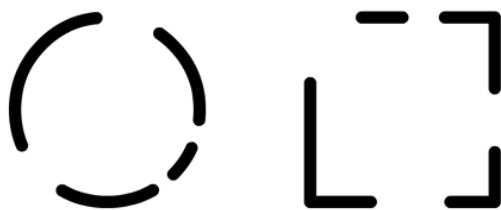
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# Perception Laws in Design. Gestalt Laws

- **The law of closure:**

The mind may experience elements it does not perceive through sensation, in order to complete a regular figure

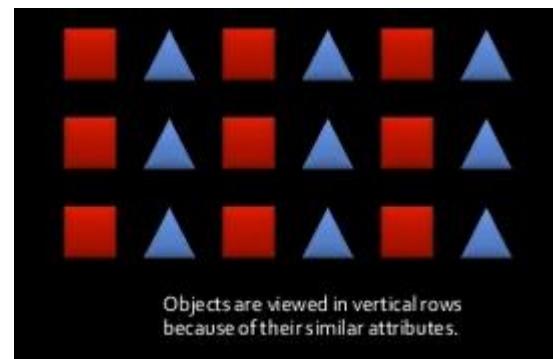
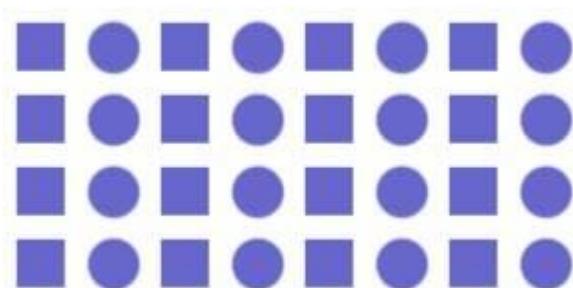


# Perception Laws in Design. Gestalt Laws

- **The law of similarity:**

The mind groups similar elements into collective entities or totalities.

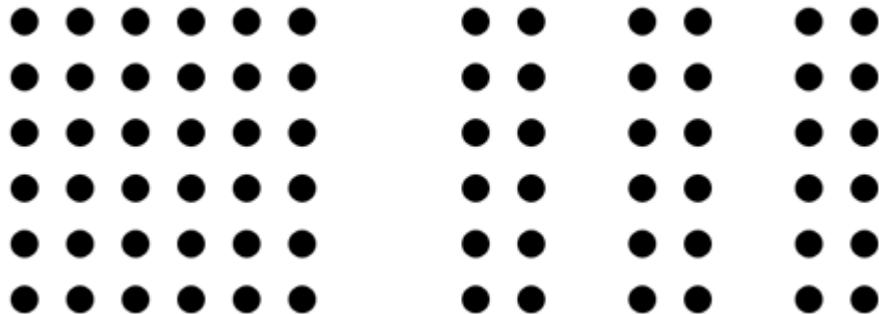
This similarity might depend on relationships of form, colour, size, or brightness.



# Perception Laws in Design. Gestalt Laws

- **The law of proximity:**

Spatial or **temporal proximity** of elements **may induce the mind** to perceive a **collective** or totality.



# Perception Laws in Design. Gestalt Laws

- **The law of symmetry:**

Symmetrical images are perceived collectively, even in spite of distance.

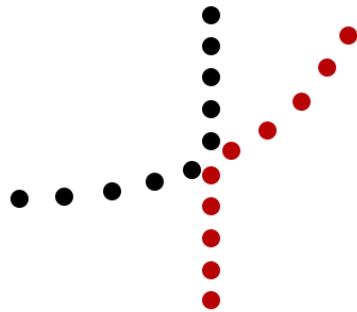


# Perception Laws in Design. Gestalt Laws

- **The law of continuity:**

The mind continues visual, auditory, and kinetic patterns.

Elements on a line/curve may be perceived as more related than elements not on the line/curve.



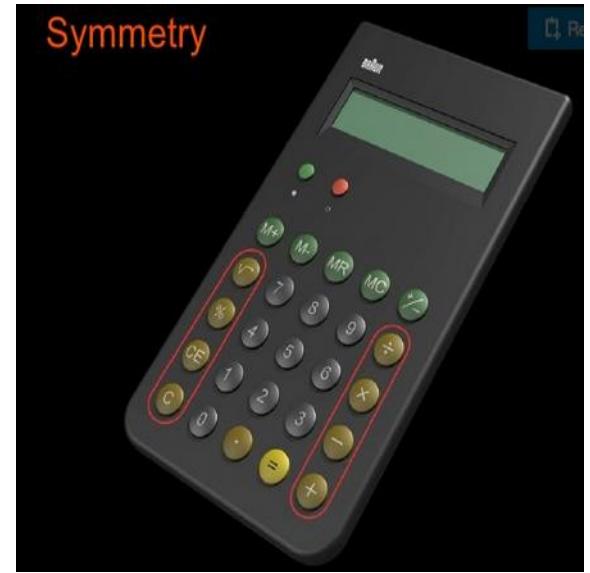
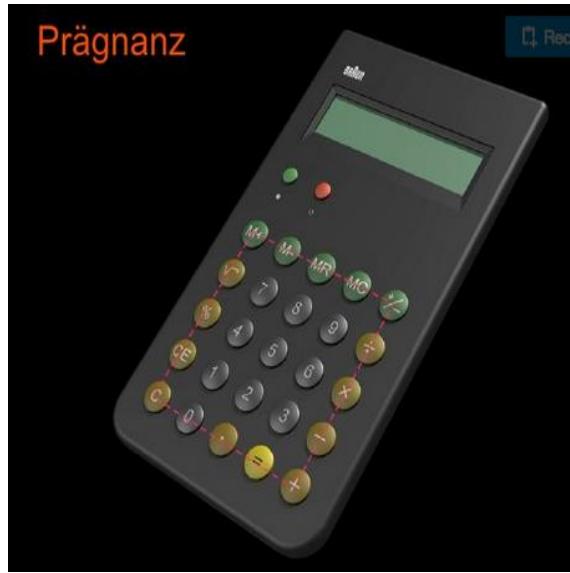
# Perception Laws in Design. Gestalt Laws

- **The law of common fate:** Elements with the **same** moving direction **are perceived as a collective** or unit.

<https://vimeo.com/151103562>



# Example

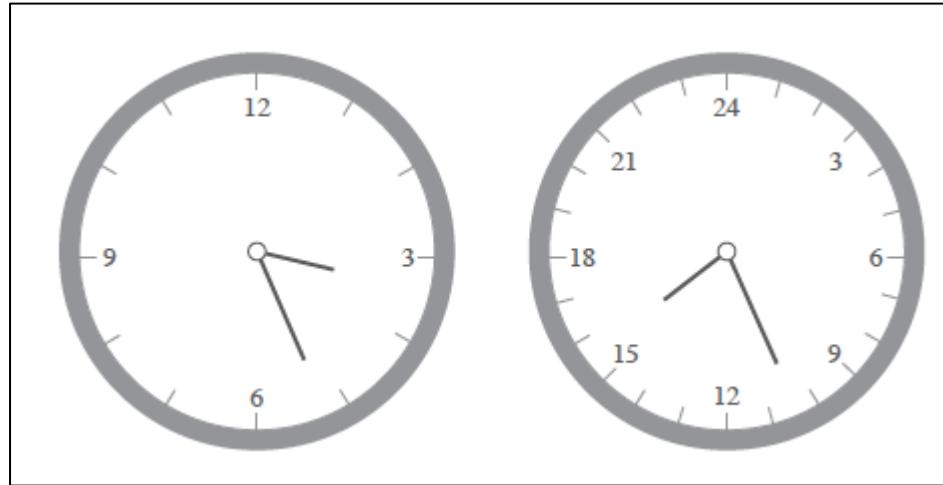
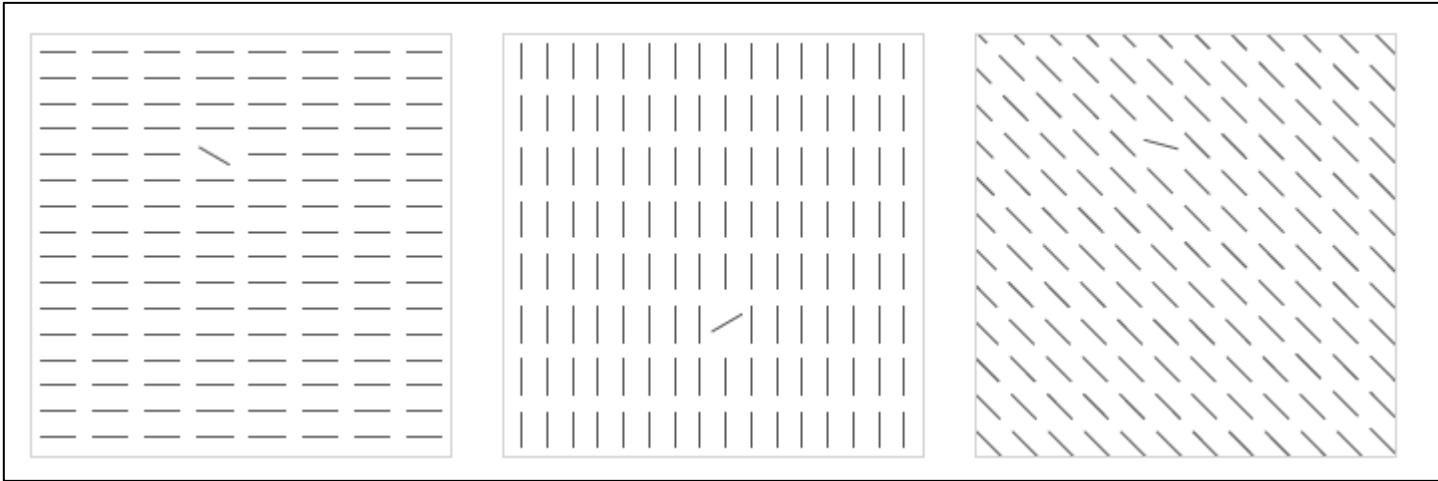


# Example



# Perception Laws in Design.

- **Orientation Sensitivity:** *Efficient perception of line orientation is highly limited.*
  - Vertical or horizontal orientations are ok, while oblique orientations are more difficult to distinguish ( $30^\circ$  is de minimum recommended).
  - Due to two main phenomena in visual perception:
    - **Oblique effect:** The relative deficiency in perceptual performance of our neurons for oblique contours as compared to the performance for horizontal or vertical contours.
    - **Pop-out effect:** It is the tendency of certain elements in a display to pop out as figure elements, and therefore be easily detectable. Better if they differ minimum  $30^\circ$



# Perception Laws in Design.

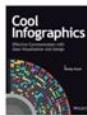
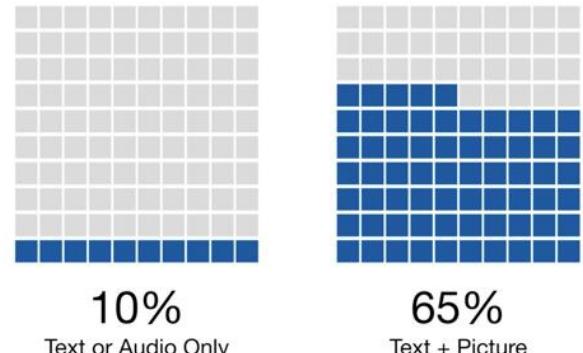
- Pictorial superiority effect:

Concepts are much more likely to be remembered experientially if they are presented as pictures rather than as words.

- After 30 seconds
- Before 30 seconds, the same amount of information can be recalled in text than in pictures

## Picture Superiority Effect

Memory retention after 3 days



From Chapter 1: The Science of Infographics

**Cool Infographics**  
Effective Communication with Data Visualization and Design  
By Randy Krum

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of its components down to the weight distribution, which is another reason that only a STIHL cuts like a STIHL. And those are just the things you can see. There are a bevy of technological advancements that reinforce this machine's leadership position in the industry.

And such attention to detail has resulted in the company earning ISO 9001 and ISO 14001 certifications. Which means it meets rigid international manufacturing, environmental and quality standards. On another gratifying level, STIHL products win quality and engineering design awards regularly.

For instance, the introduction of the new MS 171 chain saw marks the debut of a new generation of cutting machine. The MS 171 features a greener, reduced-emission engine and utilizes an advanced anti-vibration system plus conveniences

were taken in the construction of a new guide bar assembly plant at the 100-acre campus. STIHL demonstrated its commitment to socially responsible environmental stewardship when the company built this 60,000-square-foot facility.

The plant's roof boasts the largest privately funded "green roof" in Virginia. The more than 56,000 sedum plants on the roof cool the building in the warmer months and help it retain heat in the cooler months, lowering energy usage.

How many chain saw manufacturers have their own lumberjack competitions? Each year, athletes from around the world compete in time-honored events such as the STIHL loggers, olive harvesters and plane

TIMBERSPORTS® Series loggers—

the STIHL® TIMBERSPORTS®

Collection.

real benefits 100%.

It's this kind of

formula that will create

product concepts. Products

like handi gasoline-powered drill

machines, coffee harvesters

world compete in time-honored

events such as the STIHL

loggers, olive harvesters and plane

TIMBERSPORTS® Series loggers—all of which already

have the STIHL®

name on them.

Product innovation is

the cornerstone of our

success. It will be as it

it is with STIHL.

When the STIHL®

name is attached to a

product, it will be a

product that is

designed to last.

That's what we do.

We're here to help you do

more with less.

More power. More

control. More efficiency.

More value. More

versatility. More

durability. More

reliability. More

innovation. More

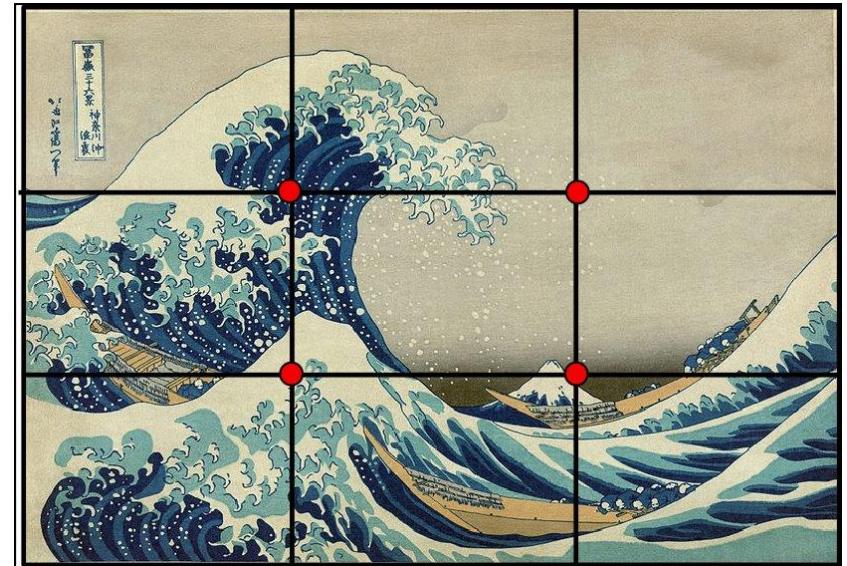
experience. More

knowledge. More

and more.

# Perception Laws in Design.

- Rule of thirds





[www.uselt.com](http://www.uselt.com)

*F-shaped pattern: how people scan texts online*

# Perception Laws in Design.

- **Signal to noise ratio:**

Measure used in science and engineering that compares the level of a desired signal to the level of background noise.

- A ratio higher than 1:1 indicates more signal than noise.
- *The goal of communication is maximizing signal and minimizing noise.*

Keep de design simple => enhance perception

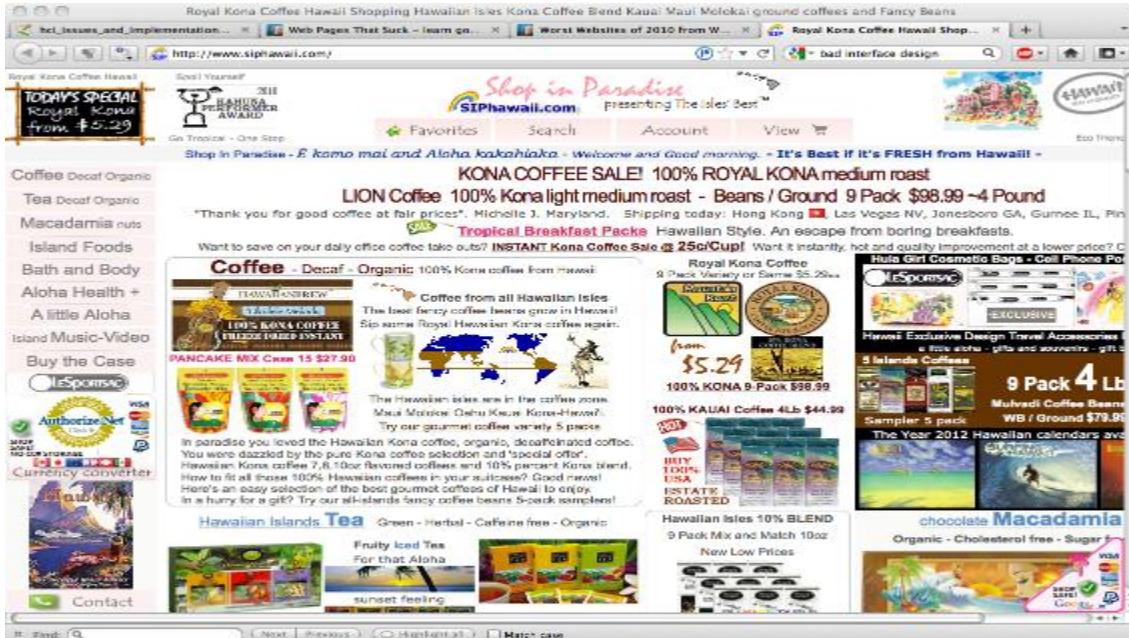
We can enhance information by using redundant coding and highlighting.

Remove noise by eliminating unnecessary elements.

# Design Mistakes. Web pages

## Problems

- White space?



# Are you kidding?

I live inside my car leasing website all day Monday to Friday 9am-8pm. Lease the cheapest HGV and contract hire cars in the UK! - I am Ling, accept no substitutes.

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Leader of the Pack - The UK's favorite car leasing website!  
Contract hire cars from Ling Valentine, LINGS CARS is the UK's favourite car leasing website - On 2016 I leased over £85 million in cars!

\*\*\* I'll find you a car quickly. But, don't be too fussy...  
If the Virus means you need to cancel, I'll fully support you. \*\*\*

### LEASE A NEW CAR

### ...OR I'LL SNEEZE ON YOU!

**LING'S BREXIT BORIS PROMISE:** If the UK leaves the EU with "no deal", tariffs may apply to EU built cars landing in the UK after Brexit day (31st Dec). If this is the case with YOUR car, and IF the price increases due to tariffs, YOU will be able to cancel the car order at **NO COST** to you. **YOU can order a new car from me, with NO BREXIT RISK**, - Ling

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**ABARTH**

124 Spider  
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YOU CAN  
TRUST ME**

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TO CHAT  
LIVE**

**Menu**

Home  
Cars  
Vans  
Customers  
About Ling  
Fun stuff  
Free stuff  
Live staff

**3 DELIVERIES  
TODAY**

Seat Tarraco Estate  
To Loz  
KINGS LANGLEY, WD4

Peugeot 208  
To Darren  
GLASGOW, G71

Audi A4 Saloon  
To Surj  
BEDFORD, MK41

**15 DELIVERIES IN  
LAST WEEK**

Seat Arona  
To Rich  
SUENDERLAND, SR40

Mercedes GLA Class  
To Sabrina  
ENFIELD, EN2

Citroen C5 Aircross  
To Martin  
ABERGAVENNY, NP7

Peugeot 5008 Estate  
To Andy  
STEVENAGE, SG12

Ford Mondeo Estate  
To Michael  
KIDLINGTON, OX51

Peugeot 208  
To EII  
STANFORD-LE-VAUX, ES1

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# Universal Principles & Perception Laws in Design

# Usability

- Usability: Defined in ISO 9241 standard as
  - The ability in which a product may be used by **specific** users in order to carry out **specific** tasks **effectively, efficiently, and with satisfaction** in a **specific** use environment.
  - **Usability is always referred to a **concrete user group** and a **concrete user application****