Chapter 8

Interface Design: Visual Aspect, Multimodality and Mixed Reality

Introduction

1. The design of the interface that mediates the interaction of people with devices is a crucial characteristic of the overall interaction design.
2. This is often referred to as the user interface (UI) and it consists of everything in the system that people come into contact with whether that is physically, perceptually or conceptually.
3. Physically people interact with systems in many different ways such as by pressing buttons, touching a screen, moving a mouse over a table so that it moves a cursor over the screen, clicking a mouse button, rolling your thumb over a scroll wheel.
4. Perceptually people interact with a system though what they can see, hear and touch. The visual aspects of interface design concern designing so that people will see and notice things on a screen.
5. Conceptually people interact with systems and devices through knowing what they can do and how knowing how they can do it.

Conceptual Interaction

1. Conceptually people employ a 'mental model' of what the device is and how it works.
2. People need know that certain commands exist that will allow them to do things.
3. They need to know that certain data is available and the form that that data takes.
4. They need to find their way to particular pieces of information (undertake navigation).
5. They need to be able to find details of things, see an overview of things and focus on particular areas.
6. Interface design is about creating an experience that enables people to make the best use of the system being designed.

Command Languages

- The vast majority of personal computers and many small devices have graphical user interfaces (GUIs), with variants on Microsoft's Windows technologies dominating the market.
- However, many computers are used as Web, network or database servers and a number of these are UNIX-based.
- UNIX is a well-established operating system that exists in a number of different forms, with Linux and BSD.
- A command language is simply a set of words with an associated syntax.
- Command languages have been criticized because people have to recall the name of a particular command and to recall the syntax of the command.

Graphical User Interfaces

- Graphical user interfaces (GUIs), which are found on every personal computer, on smart phones, on touch screen displays and so on, have had an interesting though brief history.
- The Microsoft range of Windows GUIs were influenced by those on the Macintosh, which in turn was inspired by work at Xerox PARC, During the 1980s and 1990s a number of different designs of GUIs were produced, but gradually Windows and Apple Macintosh came to dominate the GUI operating system market.
- GUIs is simply a program interface that takes advantages of the computer's graphics capabilities to make the program easier to use.
- A GUI uses windows, icons, menus and pointers (WIMP) to carry out commands, such as opening, deleting, and moving files.

Windows

- Windows allow a workstation's screen to be divided into areas which act like separate input and output channels that can be placed under the control of different applications.
- This allows people to see the output of several processes at the same time and to choose which one will receive input by selecting its window, using a pointing device such by clicking on it with a mouse, or touching a touch screen.
- This is referred to as changing the focus.

Icons

- Icons are used to represent features and functions on everything from software applications, DVD players and public information kiosks to clothing.
- Icons are generally regarded as being useful in helping people to recognize which feature they need to access.
- Icons make use of three principle types of representation – metaphor, direct mapping and convention.
- Metaphor relies on people transferring knowledge from one domain and applying to another.
- The use of direct mapping involves creating a more or less direct image of what the icon is intended to represent.
- Finally convention refers to a more or less arbitrary design of an icon in the first instance, which has become accepted as standing for what is intended over time.

Horton's Icon Checklist

1. Understandable. Does the image spontaneously suggest the intended concept to the viewer?
2. Familiar. Are the objects in the icon ones familiar to the user?
3. Unambiguous. Are additional cues (label, other icons documentation) available to resolve any ambiguity?
4. Memorable. Where possible, does the icon feature concrete objects in action? Are actions shown as operations on concrete objects?
5. Informative. Why is the concept important?
6. Few. Is the number of arbitrary symbols less than 20?
7. Distinct. Is every icon distinct from all others?
8. Attractive. Does the image use smooth edges and lines?
9. Legible. Have you tested all combinations of colour and size in which the icon will be displayed?
10. Compact. Is every object, every line, every pixel in then icon necessary?
11. Coherent. Is it clear where one icon ends and another begins?
12. Extensible. Can I draw the image smaller? Will users still recognize it?

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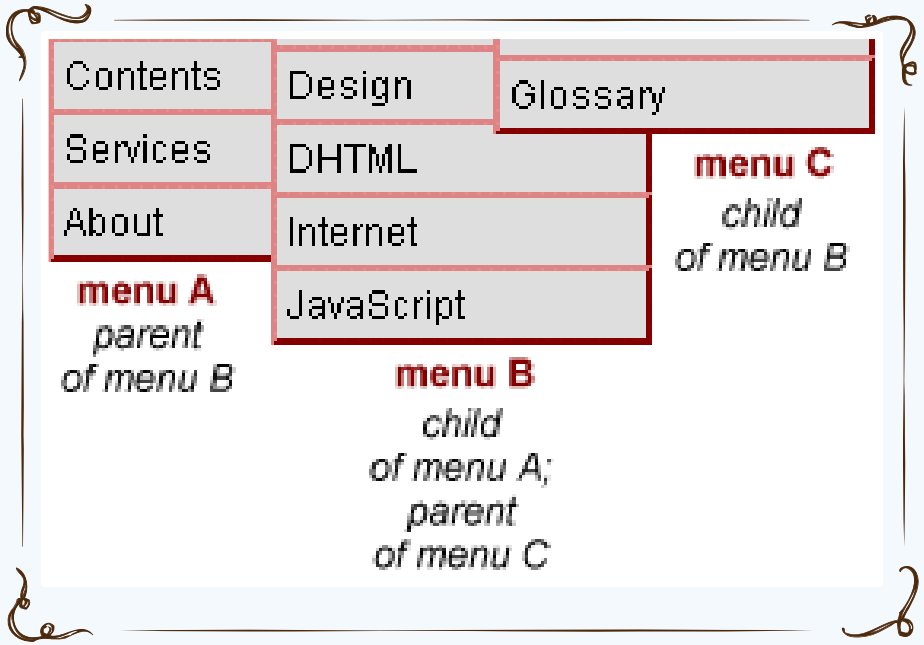
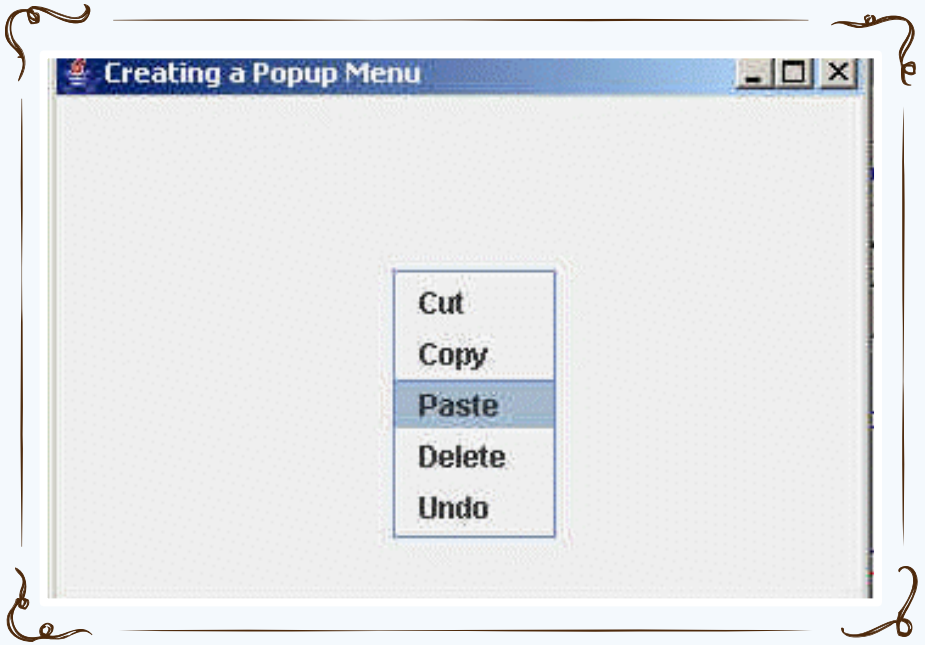
Menu

- When creating menus, commands should be grouped into menu topics, which are a list of menu items. When a command or option (menu item) is selected from the list, an action is performed.
- Menus are also used extensively on web sites to structure information and to provide the main method of navigation of the site's content.
- Hierarchical menus are also called cascading menus. In a cascading menu, the sub-menu appears to cascade out when a choice is made from the higher-level menu.
- A pop-up menu is distinguished from a standard menu in that it is not attached to a menu bar in a fixed location.
- Also in this case it is also a contextual menu. The make-up of contextual menus varies according to the context from which they are invoked. If a file is selected, the contextual menu offers file options. If instead a folder is selected, folder options are displayed.

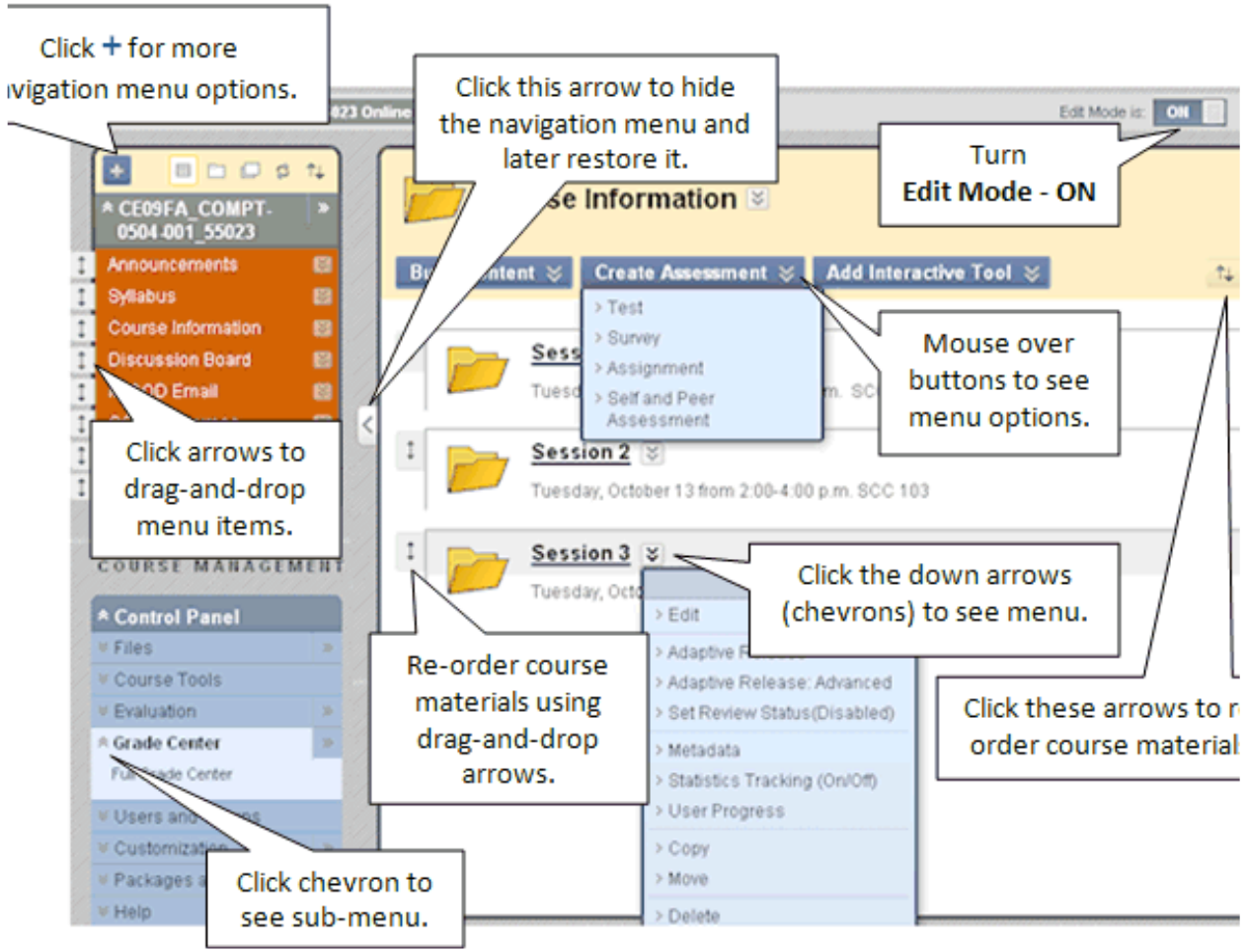
Menu (cont..)



Hierarchical Menus



Pop-Up Menus



Contextual Menus

Screen shot with explanations of different contextual menu options.

Pointer

- The most common is the mouse, but joysticks are also common, for example in game controllers.
- On mobile phones and PDAs, a stylus is often provided as the pointer and on touchscreen system the finger used.
- Remote pointers include the Wii wand and other infra-red pointers, for example for doing presentations.
- The arrival of multitouch surfaces has enabled a wide range of gestures to be recognized in addition to a simple point and select operation.

A Miscellany of Widgets

- Radio buttons – Use a series of radio buttons to allow the user make exclusive choices.
- Checkboxes – Checkboxes should be used to display individual settings that can be switched (checked) on and off.
- Toolbars – A toolbar is a collection of buttons grouped according to function (in this respect they are conceptually identical to menus). Passing the mouse pointer over an icon will usually trigger the associated 'tool tip' which is a short textual label describing the function of the button.
- List boxes – take a variety of forms and within these forms they offer different ways of viewing the contents – as lists (with more or less detail), as icons or as thumbnails (little pictures of the files' contents.
- Sliders – A widget which can return analogue values. Sliders are ideally suited to controlling or setting such things as volume or brightness or scrolling through a document.

Form Fill Interfaces

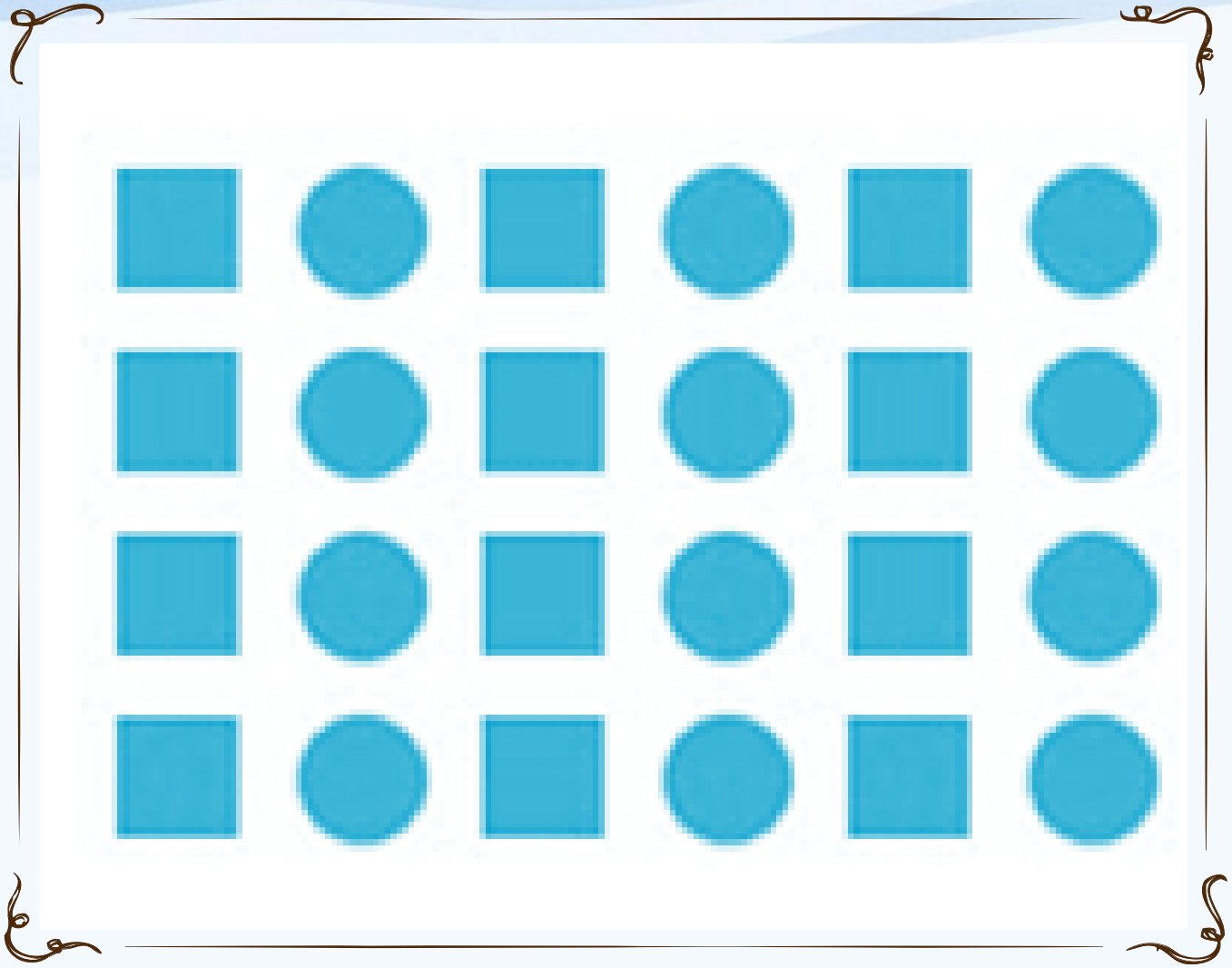
- Form filling is an interface style that is particularly popular with Web applications. Form fill interfaces are used to gather information such as name and address.
- The individual boxes are called fields and are frequently marked with an asterisk (*) to indicate that an entry is mandatory.
- Form fill interfaces are best used when structured information is required. They can sometimes be automatically updated from a set of structured data stored on a personal computer.

Interface Design Guidelines

- Cooper (2007) argues that visual interface design is a central component of interaction design as it combines graphic design, industrial design and visual information design.
- Designers need to know about graphic design such as what shape, size colour, orientation and texture screen objects should be.
- Designs should have a clear and consistent style.
- The design language will be learnt and adopted by people, so they will expect things that look the same to behave the same and, conversely ifthings behave different make sure they look different.

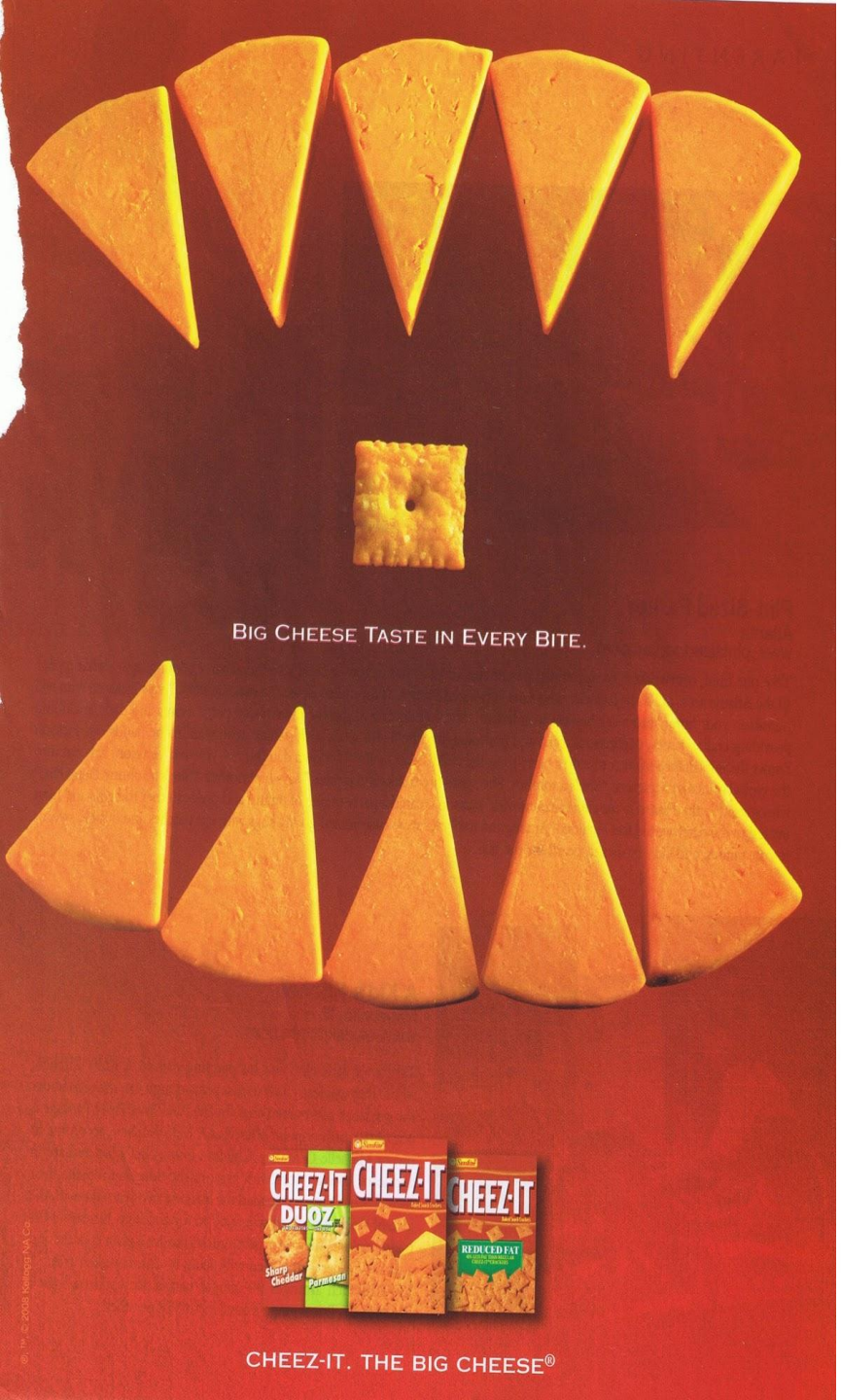
Gestalt Laws

- Gestalt psychology was founded by German thinkers Max Wertheimer, Wolfgang Kohler and Kurt Koffka and focused on how people interpret the world. The Gestalt perspective formed partially as a response to the structuralism of Wilhelm Wundt, who focused on breaking down mental events and experiences to the smallest elements.
- This set of principle was known first as Prägnanz, it is argued that these principles exist because the mind has an innate disposition to perceive patterns in the stimulus based on certain rules or the whole is different from the sum of its parts.
- However, it is important to note that while Gestalt psychologists call these phenomena "laws," a more accurate term would be "principles of perceptual organization." These principles are much like heuristics, which are mental shortcuts for solving problems.



Law of Similarity

It suggests that similar things tend to appear grouped together. Grouping can occur in both visual and auditory stimuli. In the image besides, for example, you probably see the groupings of squares and circles as columns.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DUOZ
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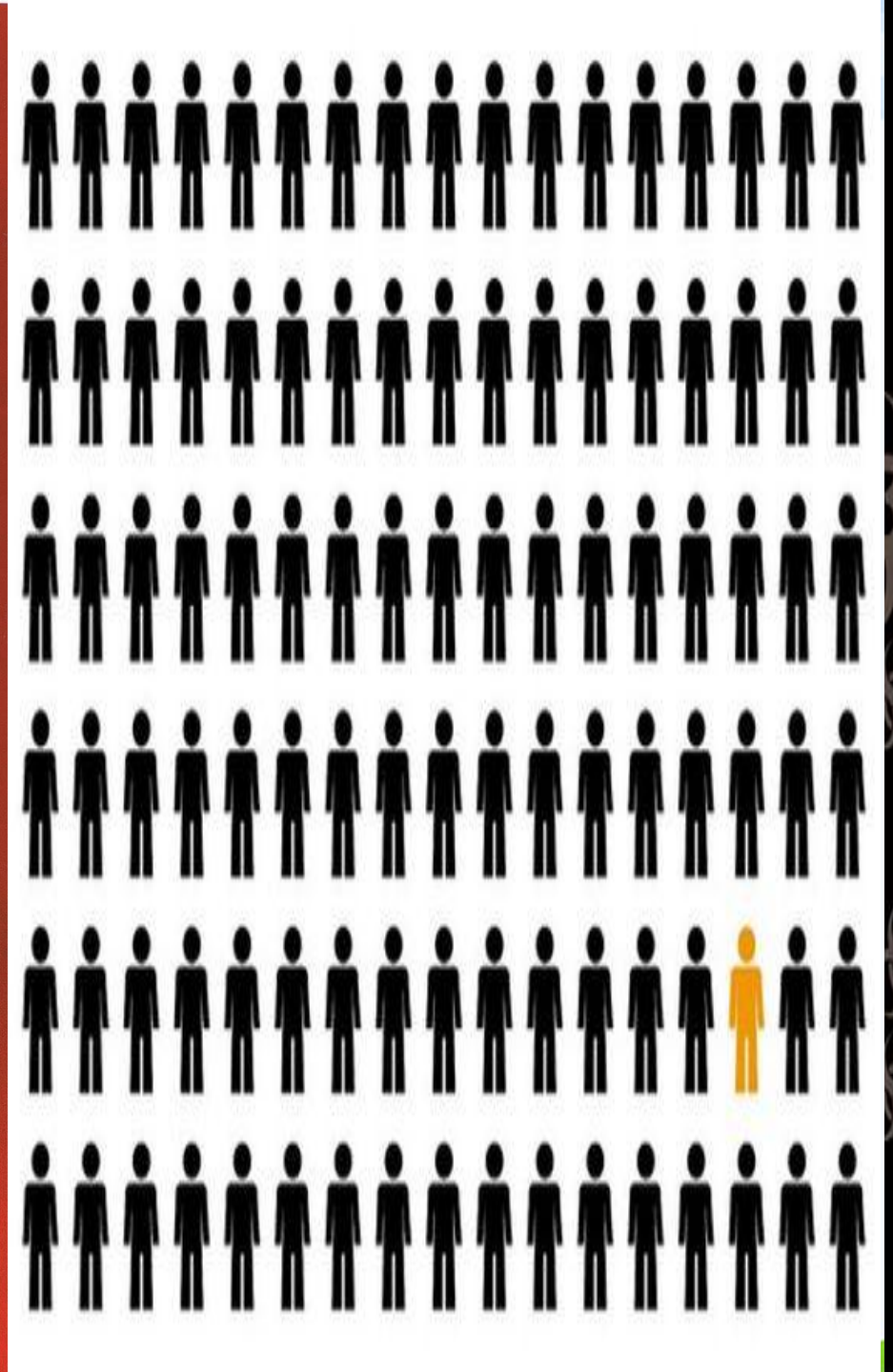
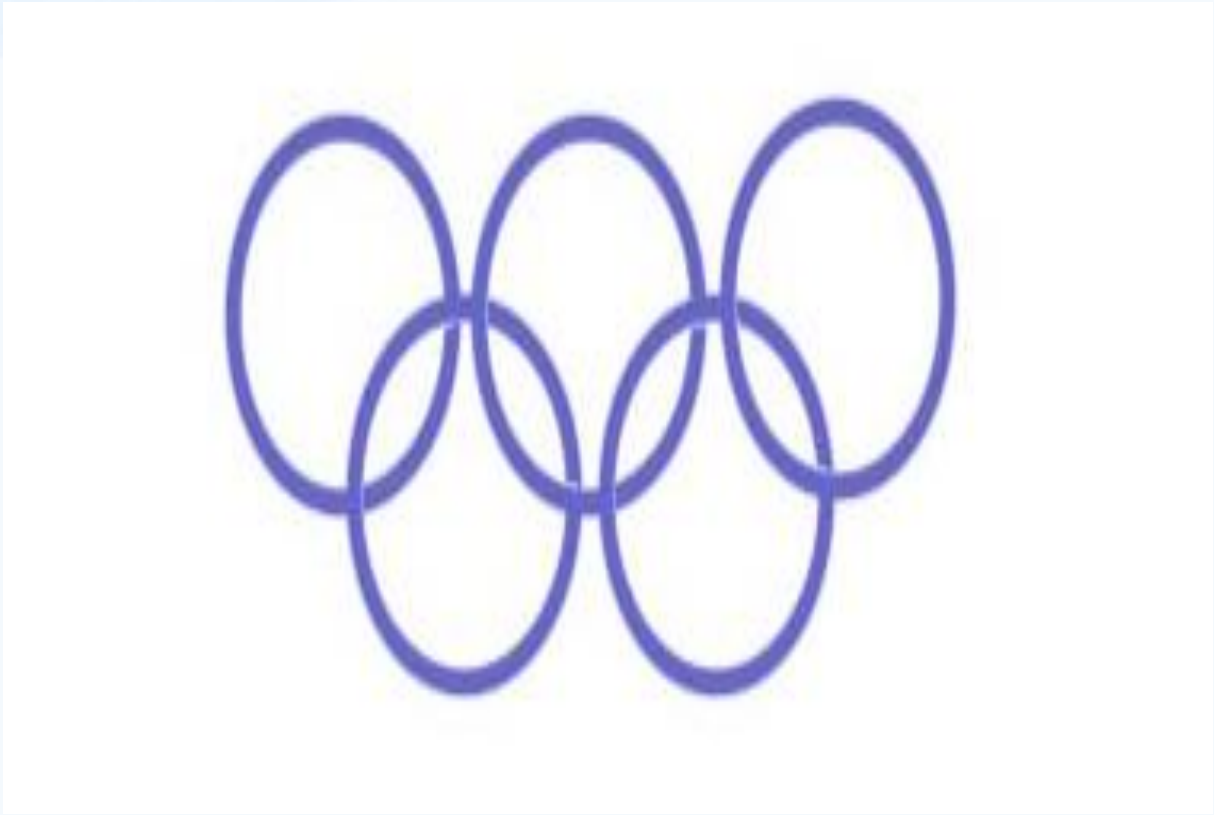



WAR ON POLLUTION



Law of Pragnanz

Reality is organized or reduced to the simplest form of possible. You see the image above as a series of overlapping circles rather than an assortment of curved, connected lines.

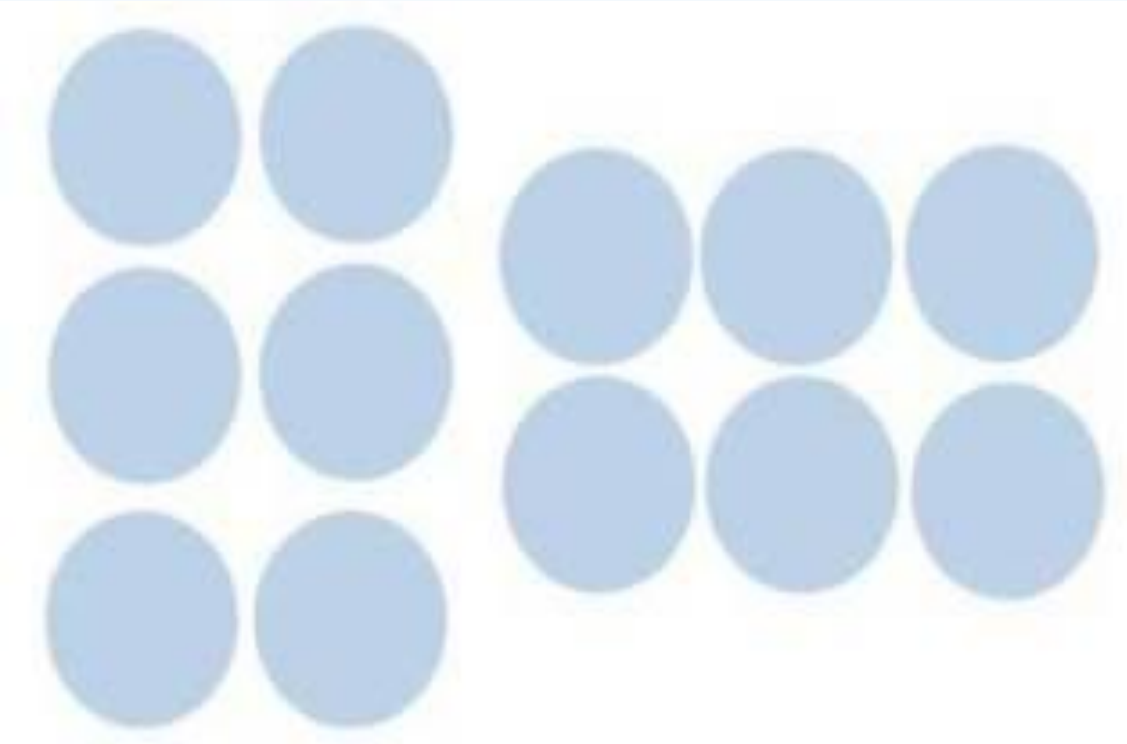
LEGO

imagine...

No one grows Ketchup like Heinz.

No one grows Ketchup like

HEINZ

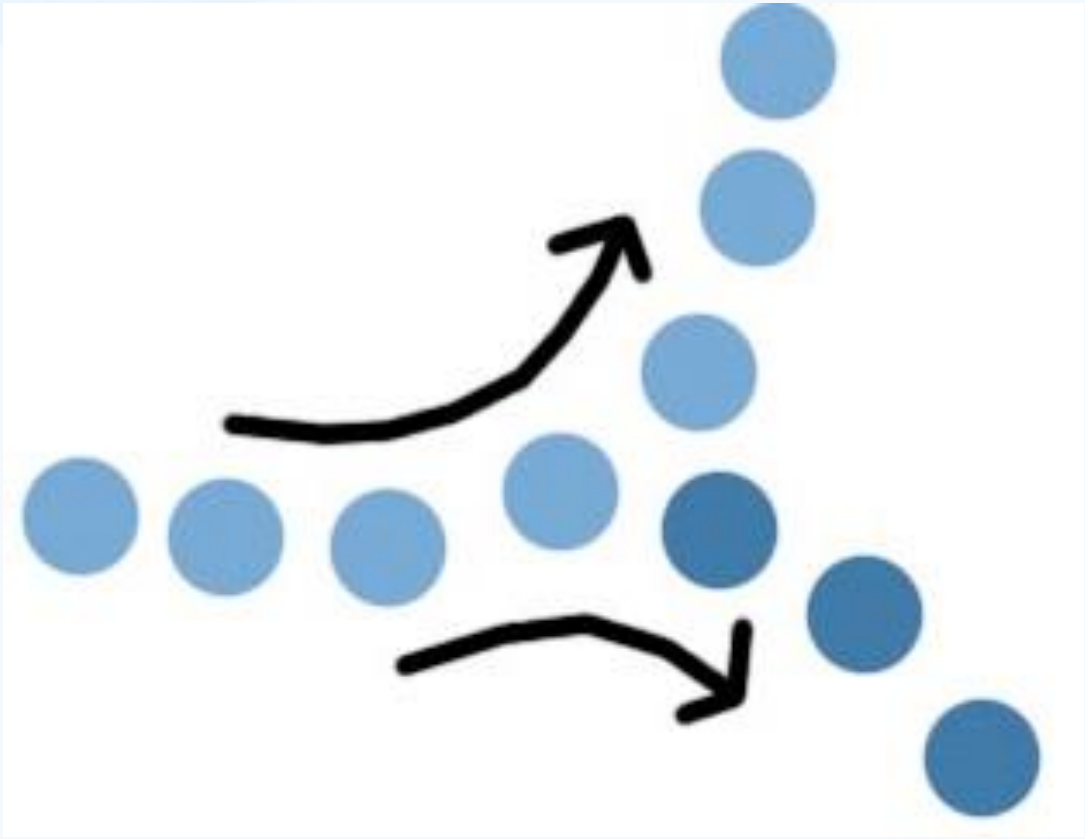


Law of Proximity

Things that are near each other seem to be grouped together. In the image besides, the circles on the left appear to be part of one grouping while those on the right appear to be part of another. Because the objects are close to each other, we group them together.

21st june, happiest day of 2013

Unilever



Law of Continuity

It holds that points that are connected by straight or curving lines are seen in a way that follows the smoothest path. Rather than seeing separate lines and angles, lines are seen as belonging together.


CONTINUOUS QUALITY
IS QUALITY YOU TRUST
Coca-Cola
TRADE MARK REGISTERED
Coca-Cola
REG. U. S. PAT. OFF.
"Coke"
REG. U. S. PAT. OFF.
Ask for it either way . . . both trade-marks mean the same thing.
5¢
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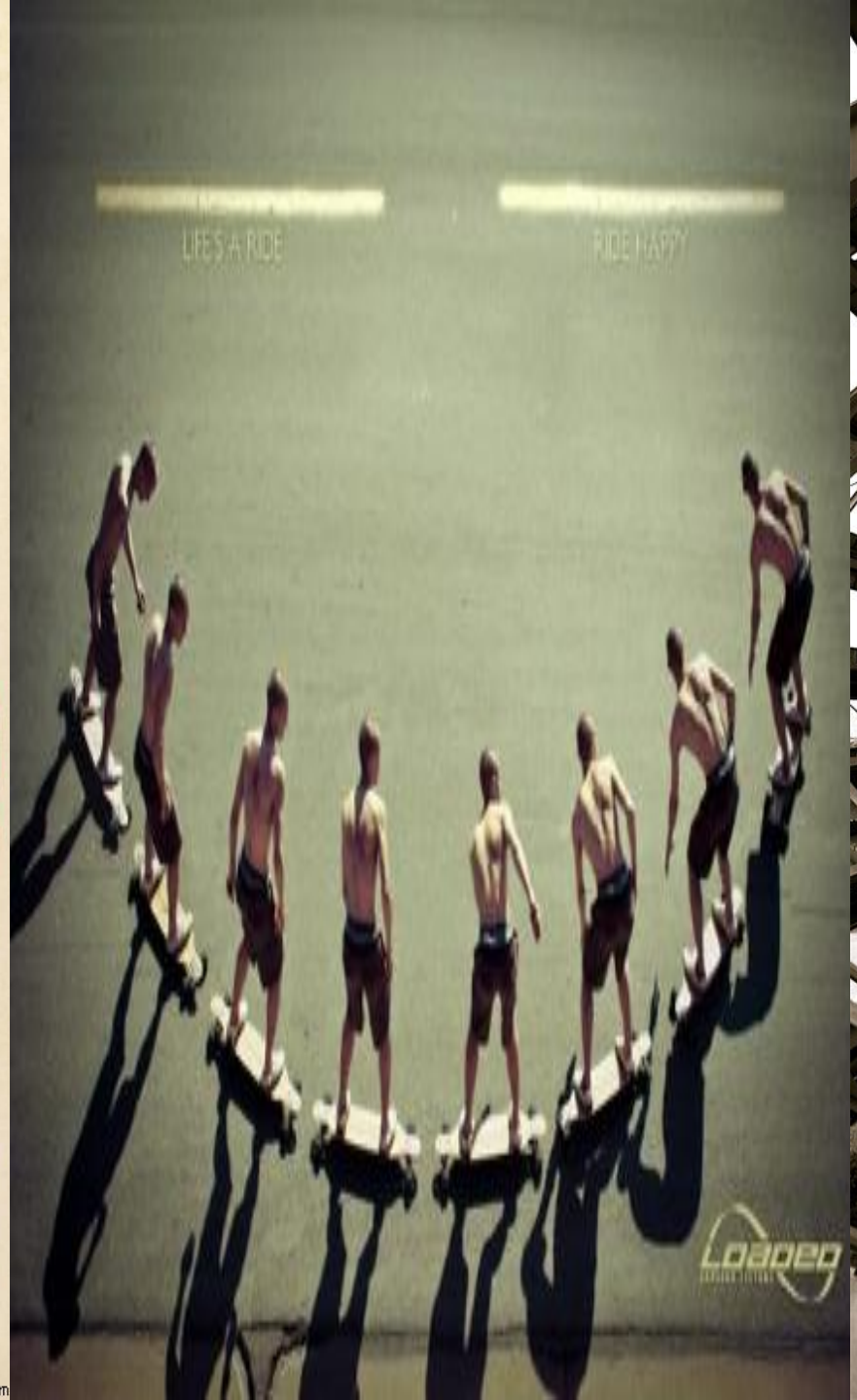
LIFE'S A RIDE
RIDE HAPPY
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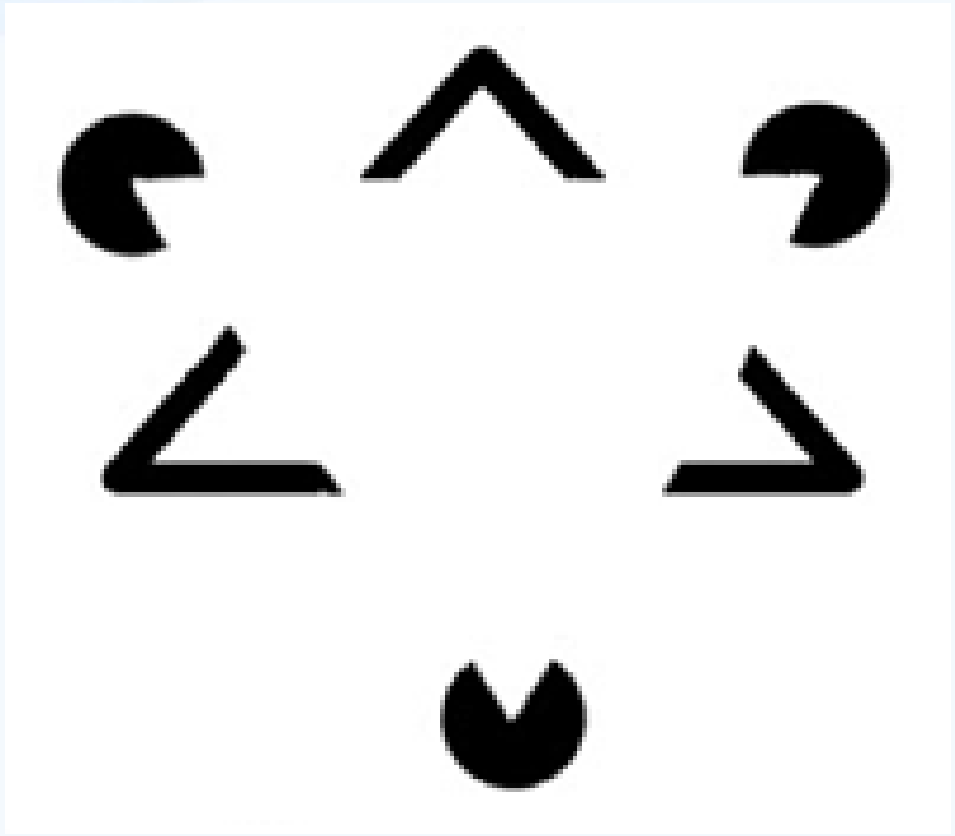
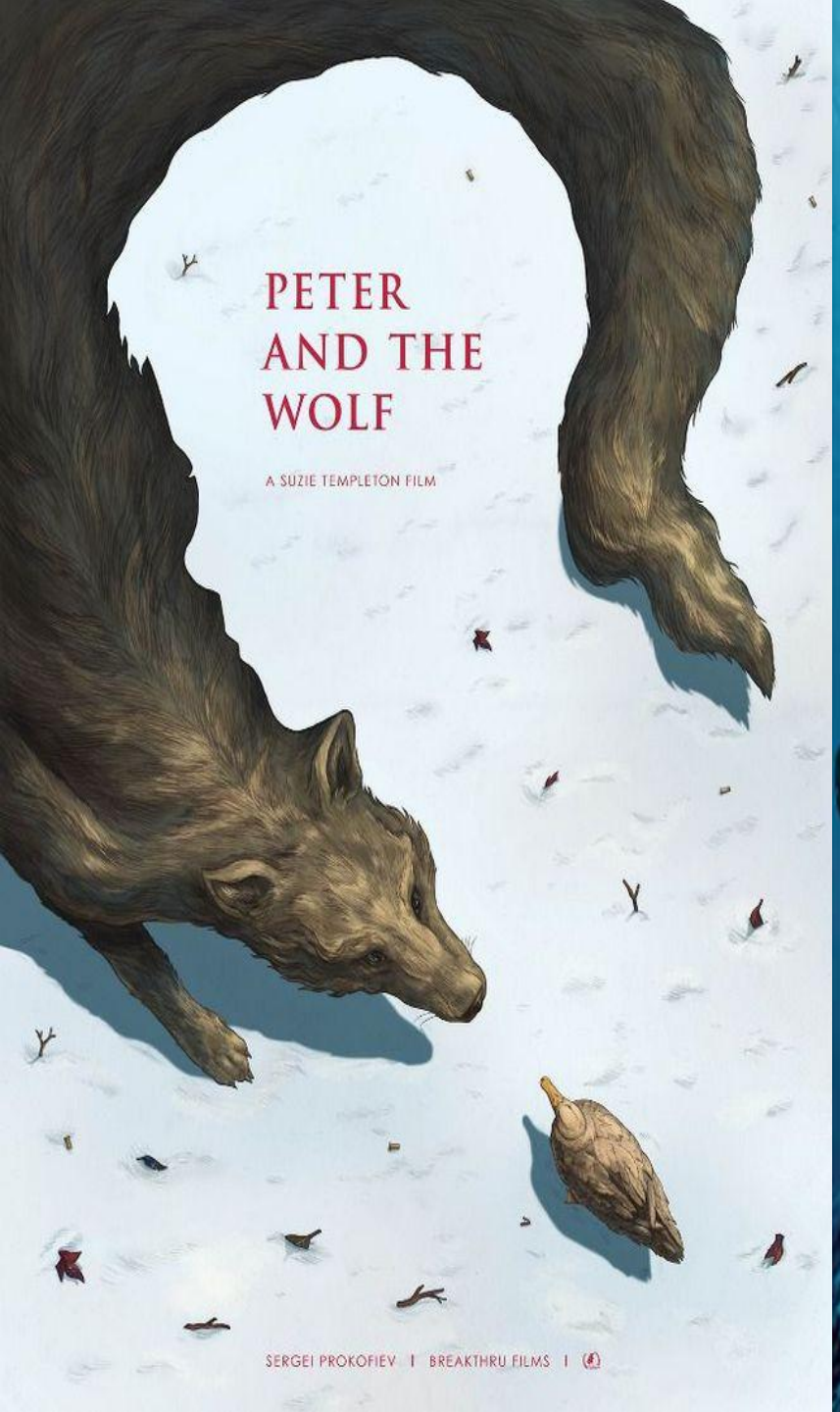


Law of Closure

Things are grouped together if they seem to complete some entity. Our brains often ignore contradictory information and fill in gaps in information. In the image besides, you probably see a white triangle in the foreground because your brain fills in the missing gaps in order to create a meaningful image.


PETER
AND THE
WOLF
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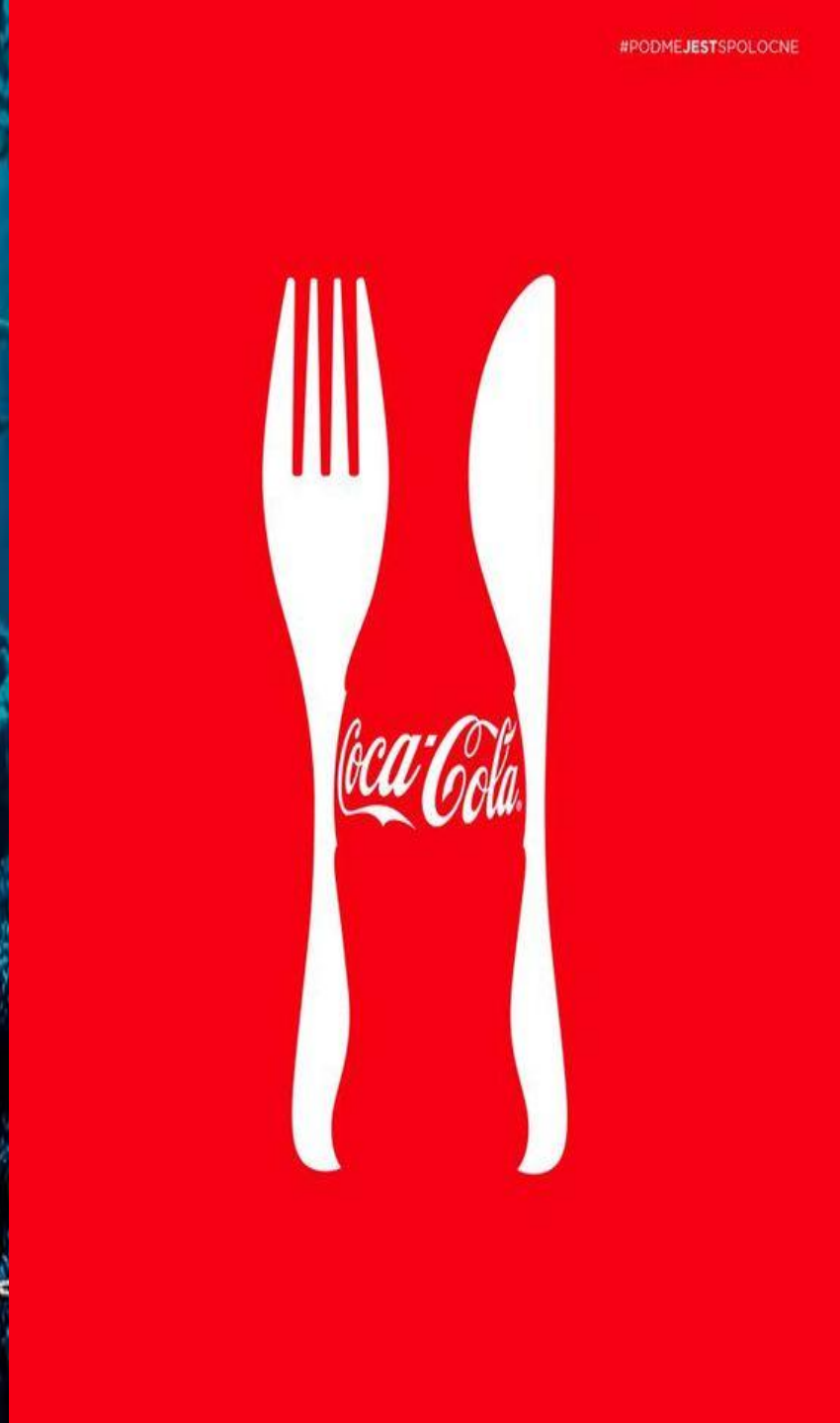
IT'S NOT WHERE YOU GO,
IT'S WHO YOU MEET.
Club Med


#PODMEJESTSPOLOCNE
Coca-Cola

Gestalt Laws (cont..)

- The principles of similarity and proximity often work together to form a Visual Hierarchy. Either principle can dominate the other, depending on the application and combination of the two.
- Grouping of proximity also can be achieved with: tone, value, color, shape, size or other physical attributes.
- Closure is also thought to have evolved from ancestral survival instincts in that if one was to partially see a predator their mind would automatically complete the picture and know that it was a time to react to potential danger even if not all the necessary information was readily available.
- Over the years, Gestalt psychologists have come up with lists to summarize basic principles of visual perception, which have become invaluable tools for designers in which add more layers to the principles such as simplicity, figure ground, symmetry, common fate, illusion, parallelism, common region and element connectedness.

Element Connectedness

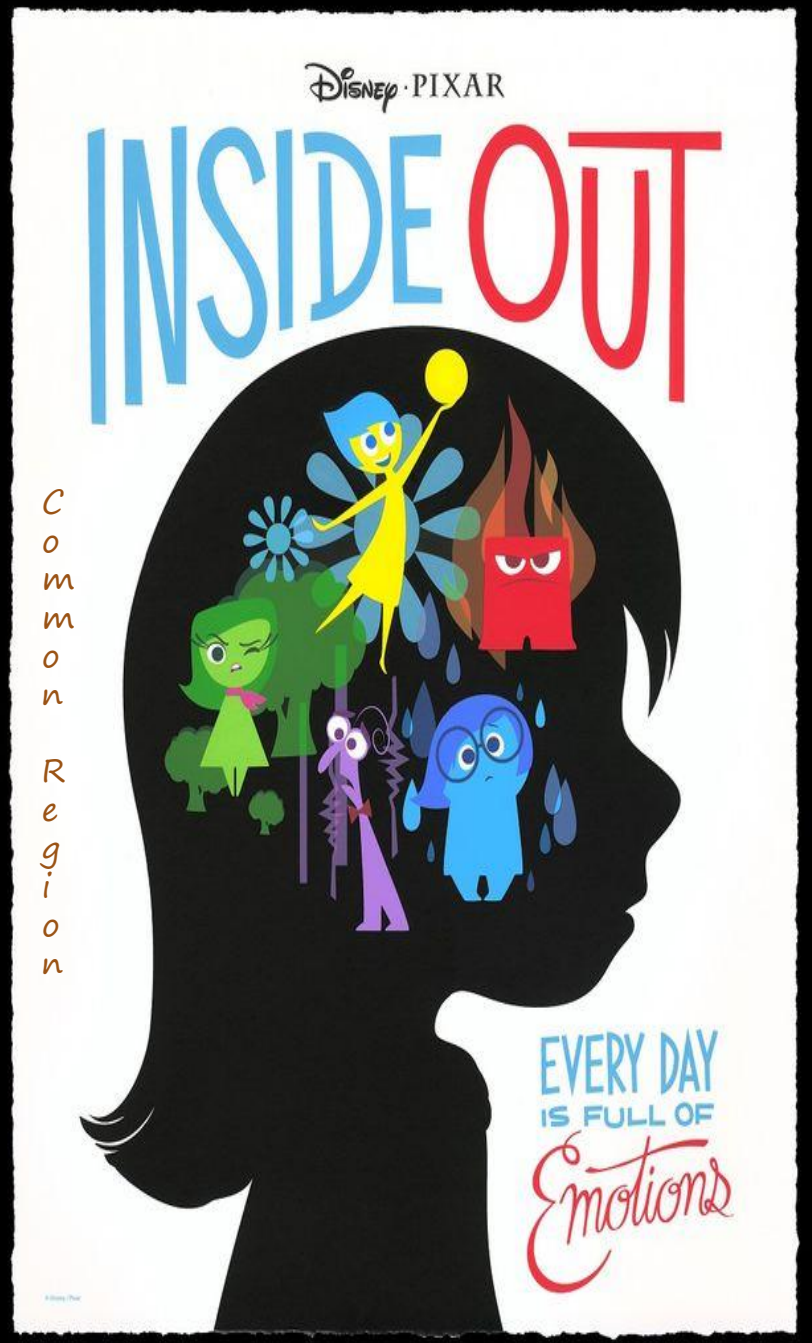
Parallelism

The Bauhaus the constructivists art deco movement san serif type since 1927

FUTURA

It is derived from simple geometric forms designed by Paul Renner

Common Region




pixelo

Memory and Attention

- There is a widely quoted design guideline based on Miller and his magic number. George Miller (1956) found that short-term memory is limited to only 7 2 'chunks' of information. This principle has been used in HCI to suggest that menus should be restricted to about seven items, or web navigation bars should be seven items. Whilst these are perfectly reasonable heuristics for designers to use, they do not derive from a limitation of short-term memory which is to do with how much most people can remember.

- The central observation, however, that you should not expect people to remember lots of detail is well made.

- Chunking is the process of grouping information into larger, more meaningful units, thus minimizing the demands on working memory. Memories, particularly those in short-term or working memory are surprisingly short-lived, and even in ideal conditions they will persist for only 30 seconds. So, it is essential to make important information presented persist

- Another guideline derived from our knowledge of memory is to design for recognition rather than recall. Recall is the process whereby individuals actively search their memories to retrieve a particular piece of information. Recognition involves searching your memory and then deciding whether the piece of information matches what you have in your memory store. Recognition is generally easier and quicker than recall.

Designing with Colour

(Marcus, 1992) provides the following rules.

- Rule 1. Use a maximum of 5 +/- 2 colours.
- Rule 2. Use foveal (central) and peripheral colours appropriately.
- Rule 3. Use a colour area that exhibits a minimum shift in colour and/or size if the colour area changes in size.
- Rule 4. Do not use simultaneous high-chroma, spectral colours.
- Rule 5. Use familiar, consistent colour codings with appropriate references.
- Colour connotations can vary dramatically even within a culture. Marcus notes that the colour blue in the United States is interpreted different by different groups – for healthcare professionals it is taken to indicate death; for movie-goers it is associated with pornography; for accountants it means reliability or corporateness (think of the 'Big Blue' – IBM).

Error Avoidance Guidelines

- Use knowledge both in the world and in the head in order to promote a good conceptual model of the system; this requires consistency of mapping between the designer's model, the system model and the user's model.
- Simplify the structure of tasks so as to minimize the load upon vulnerable cognitive processes such as working memory, planning or problem solving.
- Make both the execution and the evaluation sides of an action visible. Visibility in regard to the former allows users to know what is possible and how things should be done; visibility on the evaluation side enables people to gauge the effects of their actions.
- Exploit natural mappings between intentions and possible actions, between actions and their effects on the system, between the actual system state and what is perceivable, and between the system state and the needs, intentions and expectations of the user.
- Exploit the power of constraints, both natural and artificial. Constraints guide people to the next appropriate action or decision.
- Design for errors. Assume that they will happen, then plan for error recovery. Try to make it easy to reverse operations and hard to carry out non-reversible ones. Exploit forcing functions such as wizards that constrain people to use a limited range of operations.
- When all else fails, standardize actions, outcomes, layouts, displays, etc. The disadvantages of less than perfect standardization are often compensated for by the increased ease of use. But standardization for its own sake is only a last resort. The earlier principles should always be applied first.

Error Message Design Guidelines

- Take care with the wording and presentation of alerts and error messages.
- Avoid using threatening or alarming language in messages (e.g. fatal error, run aborted, kill job, catastrophic error).
- Do not use double negatives as they can be ambiguous.
- Use specific, constructive words in error messages (e.g. avoid general messages such as 'invalid entry' and use specifics such as 'please enter your name').
- Make the system 'take the blame' for errors (e.g. 'illegal command' versus 'unrecognized command').
- DO NOT USE ALL UPPERCASE LETTERS as it looks like you are shouting – instead, use a mixture of uppercase and lowercase.
- Use attention grabbing techniques cautiously (e.g. avoid over-using 'blinks' on Web pages, flashing messages, 'you have mail', bold colours, etc.).
- Do not use more than four different font sizes per screen.
- Do not over-use audio or video.
- Use colours appropriately and make use of expectations (e.g. red = danger, green = ok).

Information Design

- In technical communication, information design refers to creating an information structure for a set of information aimed at specified audiences. It can be practiced on different scales.
- On a large scale, it implies choosing relevant content and dividing it into separate manuals by audience and purpose.
- On a medium scale, it means organizing the content in each manual and making sure that overviews, concepts, examples, references, and definitions are included and that topics follow an organizing principle.
- On a fine scale, it includes logical development of topics, emphasis on what's important, clear writing, navigational clues, and even page design, choice of font, and use of white space.
- Simplicity is a major concern in information design with the aim is clarity. Simplification of messages may imply quantitative reduction but is not restricted to that. Sometimes more information means more clarity.
- Simplicity can be easy when following five simple steps when it comes to information design: 1. Tell the truth. 2. Get to the point. 3. Pick the right tool for the job. 4. Highlight what is important. 5. Of course, keep it simple.

Communication

- Message is the content of a communication between a sender and a receiver
- Medium is the means by which a message is delivered, at how the message is represented
- Modality, the sense by which a message is sent or received by people or machines
- A message is conveyed by a medium and received through a modality.

Mixed Reality

- The term Mixed Reality was coined by Milgram, Tekemura, Utsumi & Kishino in 1994 to encompass a number of simulation technologies including augmented reality (digital information added to the real world) and augmented virtuality (real information added to the digital world). The result was the Reality-Virtuality continuum
- The continuum can be described as „the landscape between the real and the virtual" where the two are blended together.

Augmented Reality (AR)

- By far the most common blending in AR is that of visual stimuli. Here a live video stream can be enhanced with computer generated objects (rendered so that they appear to be within the actual scene).
- Methods of presenting this visual information fall into the two main categories of immersive (where people no view other than that of the mixed reality environment) and non-immersive (where the mixed reality environment only takes up a portion of the field of view).
- The later method can make use of a vast range of displays including computer monitors, mobile devices and large screen displays. For immersive presentations people will generally wear a special helmet which incorporates a display, and which excludes any other view of the outside world.
- These head mounted displays (HMDs) are split into two categories of *video see-through (where the real world is recorded by a video camera and people are presented with a digital display) and optical see-through (where the display screens are semi-transparent, allowing a direct view of the real world and only adding computer graphics on top).*

Other Augmentation

- The second most common (and often used in conjunction with the previous) is auditory simulation.
- In this case computer generated sounds can be supplied in such a way that they appear to originate from locations within the real environment.
- Common methods include the use of headphones or speaker arrangements, but there are more exotic technologies such as a *hypersonic sound device that can target a specific location and make it appear that the sound is originating from there*
- Of the remaining three senses the sense of touch (or haptics) is the most developed field, with work ranging from the physical sensation of holding objects to simulating the sensation of touching different
- Smell has been simulated, but with limited success.
- Developments are even being made at the University of Tsukuba in simulating the sensation of eating.

Alignment

- Interaction tools used in virtual reality are "spacemice", which expand the 2 degrees of freedom in traditional mice (horizontal and vertical movement) to 6 degrees of freedom (horizontal, vertical, depth movements and Yaw, Pitch and Roll rotations).
- "data gloves", where a glove is fitted with sensors to track hand location and finger positions and allows the grabbing and manipulation of virtual objects.
- "wands", which is a stick again with six degrees of freedom and various input controls (buttons and scrollers) on the These tools offer full three-dimensional input.

Immersive Virtual Reality

- Immersive virtual reality requires the people to wear a light-excluding helmet (an HMD – head-mounted display) which houses the display, and a data glove which facilitates the manipulation of virtual objects within virtual reality.
- An HMD consists of two colour displays located in line with one's eyes and a pair of stereo earphones.
- An HMD also has a head tracker which provides information about the wearer's position and orientation in space.
- Data gloves are used to „grasp" objects in virtual environments or to "fly" through virtual scenes.

Immersive Virtual Reality (cont..)

- Head-referenced viewing provides a natural interface for navigation in three-dimensional space and allows for look-around, walk-around and fly-through capabilities in virtual environments.
- Stereoscopic viewing enhances the perception of depth and the sense of space.
- The virtual world is presented in full scale and relates properly to the human size.
- Realistic interactions with virtual objects via data glove and similar devices allow for manipulation, operation and control of virtual worlds.
- The convincing illusion of being fully immersed in an artificial world can be enhanced by auditory, haptic and other non-visual technologies.

Multimodal Systems

- Multimodal systems that do not mix realities, but combine gesture, speech, movement and sound are increasingly common and raise their own issues to do with the synchronizing the modalities.
- One of the earliest systems was "Put That There" (Bolt, 1980) that combined speech and gesture.
- More recent examples include the "Funky Wall" interactive moodboard
- Multitouch surfaces of all types are rapidly becoming a central part of the interactive experience.

Using Sound at the Interface

- Sound is an increasingly important part of interface design in both mixed reality and multimodal systems.
- Vision and hearing are interdependent – Sight is a narrow, forward-facing, richly detailed picture of the world, while hearing provides information from all around us.
- Reduce the load on the visual system. To reduce this sensory overload, key information could be displayed using sound, again to redistribute the processing burden to other senses.
- Reduce the amount of information needed on screen.
- Reduce demands on visual attention and the auditory sense is under-utilized
- Sound is attention grabbing especially to make computers more usable by visually disabled users

Auditory Displays

- Earcons are musical sounds designed to reflect events in the interface. For example, a simple series of notes may be used to indicate the receipt of an SMS message on a mobile phone. A different sound is used when an SMS is sent.
- In contrast, auditory icons reflect the argument that we make use of many sounds in the everyday world without thinking about their musical content. The sounds used in these interfaces are caricatures of everyday sounds, where aspects of the sound's source correspond to events in the interface. The sound for an SMS being sent on my phone is a „whoosh"; off it goes.

Sound Design Guidelines

- Timbre. Use synthesized musical instrument timbres. Where possible use timbres with multiple harmonics. This helps perception and avoids masking.
- Pitch. Do not use pitch on its own unless there are very big differences between those used. Some suggested ranges for pitch are maximum 5 kHz (four octaves above middle C) and minimum 125–150 Hz (an octave below middle C).
- Register. If this alone is to be used to differentiate earcons which are otherwise the same, then large differences should be used. Three or more octaves difference give good rates of recognition.
- Rhythm. Make rhythms as different as possible. Putting different numbers of notes in each rhythm was very effective. Very short notes might not be noticed, so do not use less than eighth notes or quavers.
- Intensity. Some suggested ranges are maximum 20 dB above threshold and minimum 10 dB above threshold. Care must be taken in the use of intensity. The overall sound level will be under the control of the user of the system. Earcons should all be kept within a close range so that if the user changes the volume of the system no sound will be lost.
- Combinations. When playing earcons one after another, leave a gap between them so that users can tell where one finishes and the other starts. A delay of 0.1 second is adequate.

Soundscapes

- The term "soundscape" is derived from "landscape" and can be defined as the auditory environment within which a listener is immersed.
- This differs from the more technical concept of "soundfield", which can be defined as the auditory environment surrounding the sound source, which is normally considered in terms of sound pressure level, duration, location and frequency range.
- There are a number of open questions about how well we can distinguish between different tones in context (in a busy office or a noisy reception area) and this is made worse by the obvious fact that sounds are not persistent.
- One of the strengths of the graphical user interface is the persistence of error messages, status information, menus and buttons.
- Auditory user interfaces are, in contrast, transient.

Speech-based Interfaces

- Speech-based interfaces include speech output and speech input.
- Speech output has developed over the last few years into a robust technology and is increasingly common in such things as satellite navigation systems in cars ("sat navs") and other areas such as announcements at railway stations, airports, etc.
- Speech output uses a system that converts text to speech, TTS.
- Speech input has not quite reached the level of sophistication of speech output, but it too is becoming a technology that has reached levels of usability that the interaction system designer can now consider it to be a real option.
- This paves the way for natural language systems (NLS) where people can have conversations with their devices.

Tangible Interaction

- Tangible means being able to be touched or grasped and being perceived through the sense of touch.
- Tangible interaction has given rise to TUIs – tangible user interfaces, which have a structure and logic both similar to and different from GUIs.
- With the introduction of multi-touch displays, TUIs promise to be increasingly important as they lead to interaction through physical objects and through gesture recognition.
- "Tangible Bits seeks to build upon these skills by giving physical form to digital information, seamlessly coupling the dual worlds of bits and atoms".

Tangible User Interfaces (TUIs)

- TUIs use physical representations – such as modeling clay, physical pens and so on and physical drawing boards rather than pictures of them displayed on monitors. So, for example, instead of having to manipulate an image using a mouse and keyboard on a screen, people can draw directly onto surfaces using highlighter pens.
- As these tangible, graspable elements cannot, of course, perform computation on their own, they must be linked to a digital representation. As Ullmer and Ishii put it, playing with mud pies without computation is just playing with mud pies.
- TUIs integrate representation and control which GUIs keep strictly apart. GUIs have a MVC structure – Model–View–Control. In traditional GUIs we use peripheral devices such as a mouse or keyboard to control a digital representation of what we are working with (the model), the results of which are displayed on a screen or printer or some other form of output (the view).

Gesture Recognition (KUIs)

- With the arrival of multi-touch surfaces - table tops, mobiles and walls that recognize multiple touch points – a whole new era of interaction design is just beginning with kinetic user interfaces or gesture recognition.
- A number of sessions at the CHI2009 conference were devoted to exploring these issues.
- The iPhone introduced gestures for "making things bigger" (pinch with two fingers and draw them out) and "making things smaller" (touch an object with two fingers and draw them in.
- Experimental systems such as CityWall introduced gestures for rotating objects, "flicking" gestures to move objects from one location to another.
- Interactive surfaces can be interacted with through direct touch, sweeping movements, rotation and flicking, which can be mapped onto specific functions.
- Interaction can also take place using physical objects that represent functions, or other objects. Similar to earcons these have been called "phicons".
- Combinations of phicons, virtual on-screen buttons, slides and other widgets and natural gestures (such as a tick gesture for "OK", or a cross gesture for cancel) promise to open up new applications and new forms of operating system that support different gestures.

Getting a feel for tangible computing

- The Bricks system is a good example of a graspable user interface (for graspable read tangible). It was designed to allow the manipulation of digital objects by way of physical 'bricks'.
- In the Illuminating Clay system, the physical, tangible objects are made of clay. The coupling between clay and its digital representation is managed by means of a ceiling-mounted laser scanner and digital projector.
- The Actuated Workbench (AW) is a device that uses an array of magnets to move objects on a table in two dimensions. It is intended for use with existing tabletop tangible interfaces, providing an additional feedback loop for computer output, and helping to resolve inconsistencies that otherwise arise from the computer's inability to move objects on the table.

Natural User Interfaces (NUIs)

- "Until now, we have always had to adapt to the limits of technology and conform the way we work with computers to a set of arbitrary conventions and procedures. With NUI, computing devices will adapt to our needs and preferences for the first time and humans will begin to use technology in whatever way is most comfortable and natural for us." —Bill Gates, co-founder of Microsoft

- User interfaces that you interact with using modalities such as touch, gestures or voice are often referred to as Natural User Interfaces (NUI), which have 8 principles: Principle of Performance Aesthetics, Direct Manipulation, Scaffolding, Contextual Environments, Super Real, Social Interaction, Spatial Relationships and Seamlessness.

- The advantage of NUIs is that the user interaction feels fun, easy and natural because the user can use a broader range of basic skills compared to more traditional graphical user interface interaction – which mainly happens through a mouse and a keyboard.

Organic User Interfaces (OUIs)

- In human–computer interaction, an organic user interface (OUI) is defined as a user interface with a non-flat display.
- After Engelbart and Sutherland's graphical user interface (GUI), which was based on the cathode ray tube (CRT), and Kay and Weiser's ubiquitous computing, which is based on the flat panel liquid-crystal display (LCD), OUI represents the third wave of display interaction paradigms, pertaining to multi-shaped and flexible displays. In an OUI, the display surface is always the locus of interaction, and may actively or passively change shape upon analog (i.e., as close to non-quantized as possible) inputs, it was first introduced in a special issue of the *Communications of the ACM* in 2008.
- Early examples of OUIs include Gummi, PaperWindows, Microsoft Sphere, DisplayObjects, PaperPhone, MorePhone, Morphees, Nokia Kinetic and Samsung Youm.

Organic User Interfaces (cont..)

According to Vertegaal and Poupyrev, there are three general types of organic user interface:

- Flexible (or deformable) user interfaces: When flexible displays are deployed, shape deformation, e.g., through bends, is a key form of input for OUI. Flexible display technologies include flexible OLED (FOLED) and flexible E Ink, or can be simulated through 3D active projection mapping.
- Shaped user interfaces: Displays with a static non-flat display. The physical shape is chosen so as to better support the main function of the interface. Shapes may include spheres, cylinders or take the form of everyday objects.
- Actuated (or kinetic) user interfaces: Displays with a programmable shape controlled by a computer algorithm. Here, display shapes can actively adapt to the physical context of the user, the form of the data, or the function of the interface. An extreme example is that of Claytronics: fully physical 3D voxels that dynamically constitute physical 3D images.

Natural User Interfaces (NUIs)

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Wearable Computing

Next invention is by having computers built into clothing

1. *Unmonopolizing of people's attention.* That is, they do not detach the wearer from the outside world. The wearer is able to pay attention to other tasks while wearing the kit. Moreover, the wearable may provide enhanced sensory capabilities.

2. *Unrestrictive.* The wearer can still engage with the computation and communication powers of the wearable computer while walking or running.

3. *Observable.* As the system is being worn, there is no reason why the wearer cannot be aware of it continuously.

4. *Controllable.* The wearer can take control of it at any time.

5. *Attentive to the environment.* Wearable systems can enhance environmental and situational awareness.

Summary

- There is no doubt that sound, touch and mixed reality will play an important role in the design of future interactions.
- Across the spectrum of virtual worlds mixing with the real world are opportunities for new and novel experiences.
- Gesture and multitouch surfaces are changing the nature of computing and interaction design.
- TUIs offer a new way of thinking about and interacting with computers.
- Wearables, while very much in their infancy, offer an interesting hands-free way of interacting with both computers and the environment.