

**ME4182**

**Understanding People, Products and Context:  
Industrial Design Lite for Engineering**

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Georgia Tech

Slides by Profs. Wayne Li and Kate Fu

# Agenda

## Special Topic: Basic Industrial Design (ID) Concepts

*basic concepts you need to know to communicate with industrial designers*

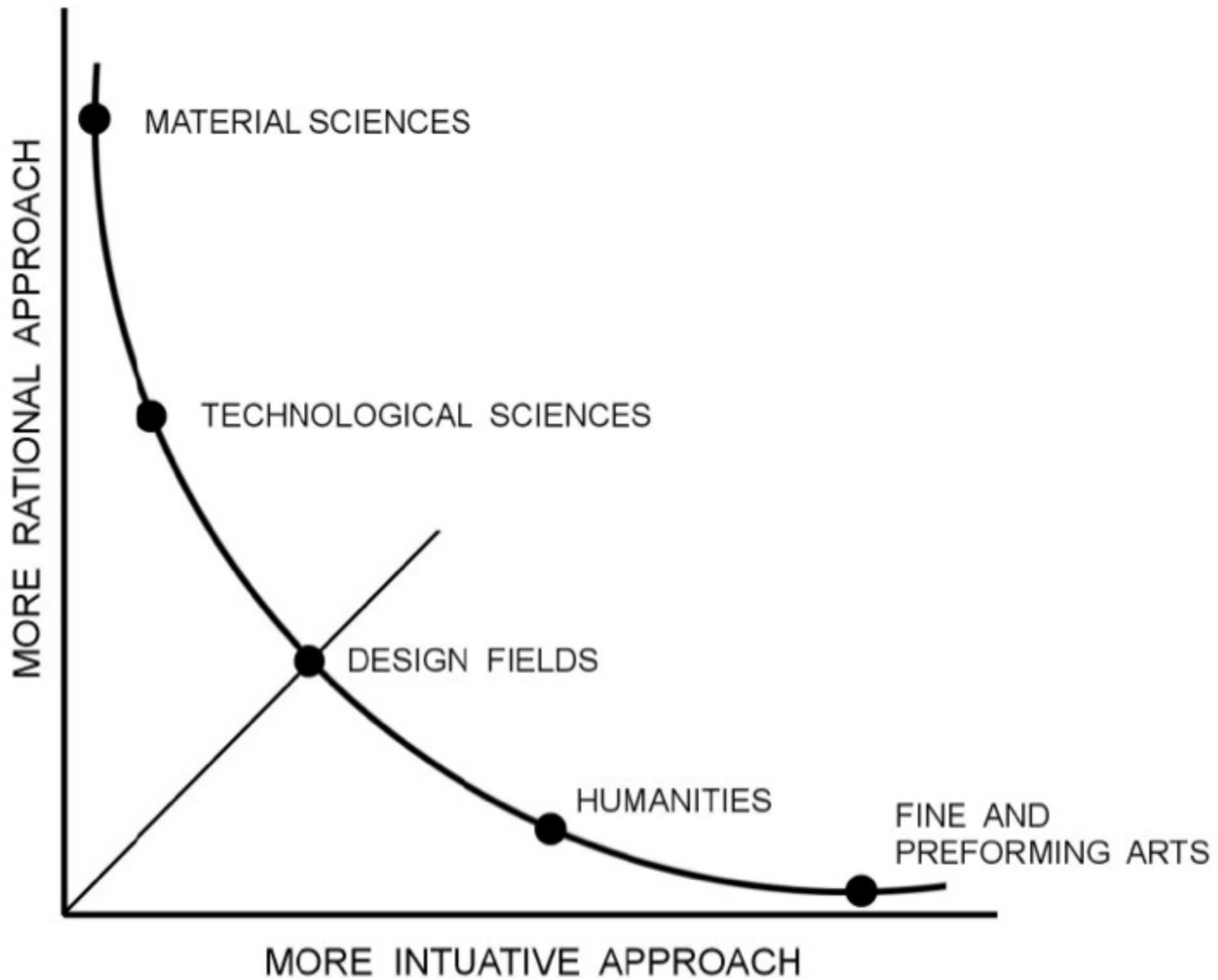
- Setting the Stage
- Concepts
- Toolkits and Techniques
- Q&A

# Setting the Stage

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- Though engineering sciences are often exceptional tools for optimizing subsystems of products, engineers often fail to ask broader questions and challenge design assumptions.
- Design teams need to better understand people, product use, and human context in order to better arrive at “black box” design constraints.
- Industrial Designers, working with business groups (marketing and product planning) conceptualize the product, early in its development. The results are often handed off to engineering.



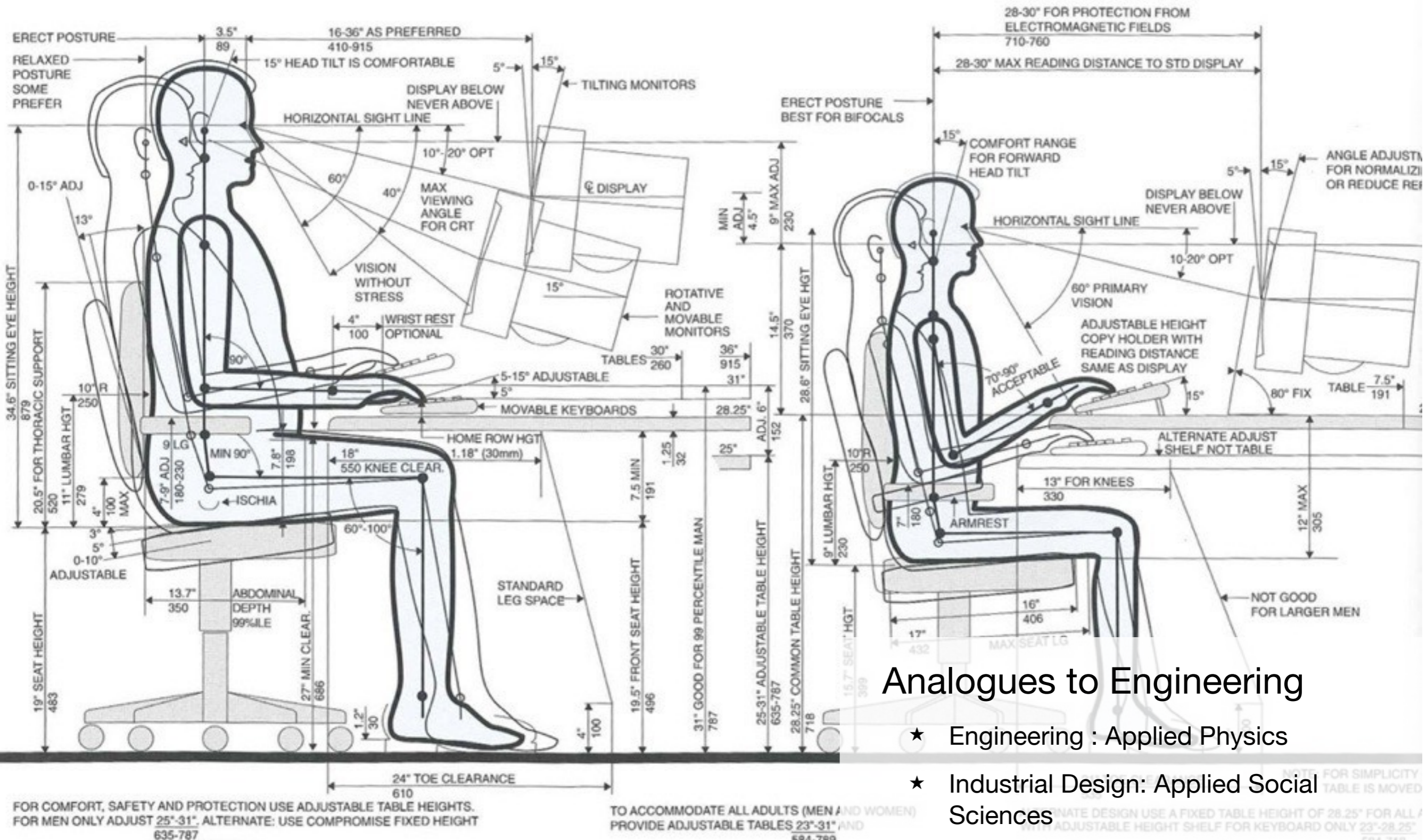


Concepts

Between science and art

## LARGE MAN 99 PERCENTILE US POPULATION

## SMALL MAN 1 PERCENTILE US POPULATION



## Analogue to Engineering

- ★ Engineering : Applied Physics
- ★ Industrial Design: Applied Social Sciences

- Cognitive Psychology (aesthetics)
- Anthropology (human factors / ethnography)
- Sociology (context / narrative)

# Concepts



# Human Factors: Cognitive Load

Mental processes as they effect interaction with products/systems

- Perception
- Memory
- Reasoning
- Motor Response

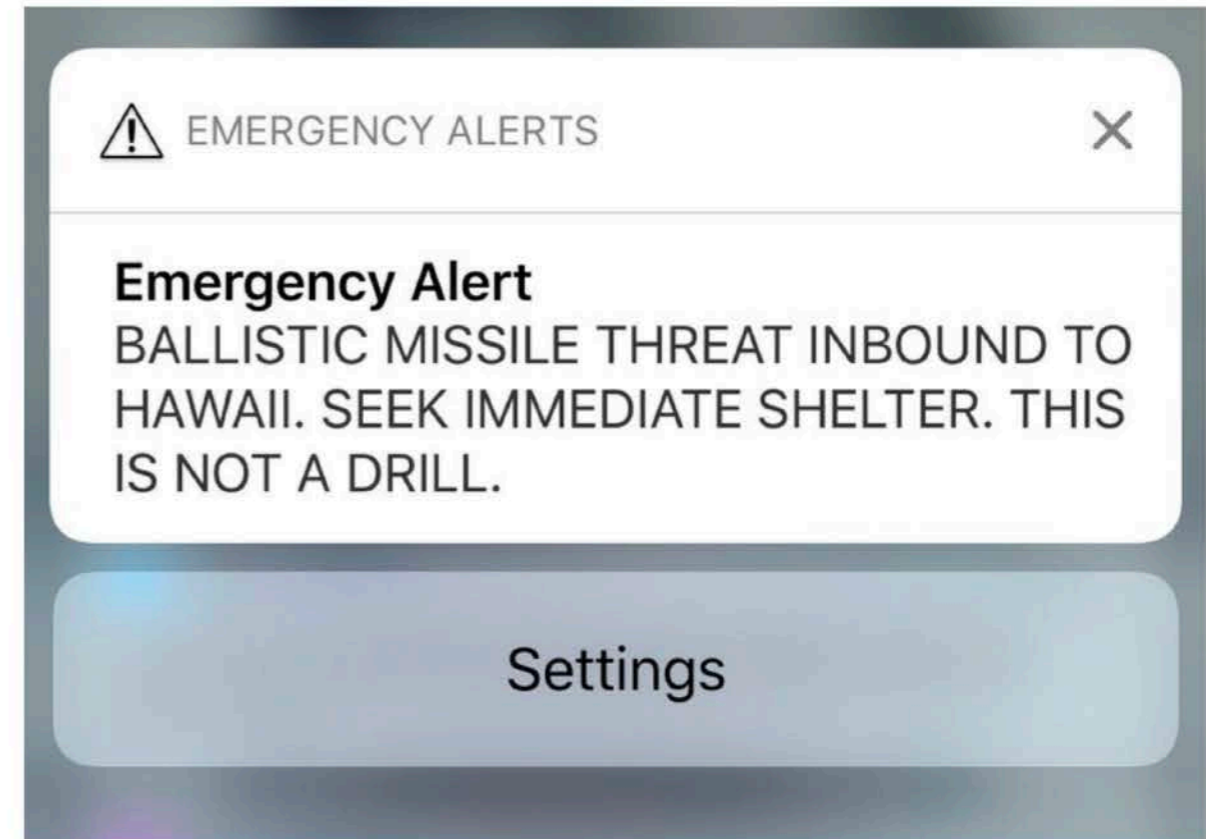
The image shows a screenshot of the website [www.ARNGREN.net](http://www.ARNGREN.net). The website features a navigation menu at the top with links for "23 Butikker", "Teknologi & Gadgets", "Index", and "el-retur". The main content area is filled with numerous product listings, each with a small image, a title, and a price. The products include:

- Walkere**: QR X350 PRO, RC-Drone m/ Kamera
- el-moped med skilt (16 år)**: 16.998,-
- Forbruker Elektronikk**: 6,7hk, Ingen alders-grense, Elektrisk-scooter, Uten skilter 7998,-
- el-ATV med Skilt (16 år)**: kr. 16.998,-
- Gressklipper**: kr. 3998,-
- EI-ATV til Barn & Voksne**: fra kr. 3998,-
- Mercedes SUV m/ Gummi-Hjul**: fra kr. 2998,-
- el-Bil ; Cross-Rider**: fra kr. 99.998,-
- el-Bil**: 4WD, kr. 79.998,-
- el-bil (16 år & moped Lappen)**: kr. 29.998,-
- Luft-jekk (4.2 tonn) til Bil eller Båt**: fra kr. 998,-
- el-sykkel m/Oljestyrt skivebrems**: fra kr. 6.998,-
- Luft-jekk**: 44 praks talende norsk Oversetter fra kr. 298,-
- Alarm Wi-Fi GSM & kamera**: 1.999,-
- Star-I selv-balanse En-hjul el-scooter**: 9.998,-
- RC Fiskebåt med Fish-Finder**: kr. 3.998,-
- Laser-Show**: fra kr. 599,-
- Kikkert 20-144x, Teleskop**: 1998,-
- Elektrisk-Fat**: link

The website also includes a search bar at the bottom left and various other product categories like "Akvarium", "Alarm", "Alkotester", "ATV (el.)", "Bildefliser", "Bil (elektrisk) gas", "Bilbane", "Conrad-elektronik", "Digital-Kikkert", "Disko-Lys", "Dummy-Kamera", "DVD-Spiller", "Elektronikk & DAB", "EL-Scooter & Bil", "Figurer", "Golf-biler (m/skilt)", "Hobby & RC", "Hoverpod", "HP-Måler (Bil)", "Isbitmaskin", "Kamera (trådløst)", "Kino (bærbart)", "Kompass (Bil/Båt)", "Laser-Jamer (Bil)", "Luft-Jekk", "Lykt (oppladbar)", "Mobil-telefon-1, 2", "Motorsykkle-Mini", "Omfomer (110V)", "Oversetter (44 sprk)", "PC-mini (9 ")", "2.", "Rakett-Fly", "RC Produkter", "Robot-Hund", "Robot-Støvsuger", "Roboter", "Solcelle-Ryggsek", "Star Wars", "Sykkle-PC s.h.", "Togbane (til PC)", "Traktor (elektrisk)", "TV-Ur & Armbr. Ur", "Walkie Talk", and "Elektronikk".

# Human Factors: Cognitive Ergonomics Gone Wrong

- Cognitive “overload”
- Attention tunneling
- Warning systems
- Information systems
- Alarm systems
- User interfaces....



An agency spokesman told *The Washington Post* that the employee prompted to choose between the options "test missile alert" and "missile alert", had selected the latter, initiating the alert sent out across the state.



# Human Factors: Organizational Models

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Optimization of systems involving humans and how they organize, work and play

- Structures
- Policies
- Procedures
- Communication
- Resource management
- Community



# Human Factors: Methods

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- **Activity mapping/task analysis** – watching how humans go about their lives / tasks
- **Iterative design** – prototype and test with humans for fit / comfort/ understanding
- **Cognitive walkthrough** – putting yourself in the end user's shoes to experience /evaluate the design
- **Personas** – design with an intended user in mind – define that user with concrete characteristics that most users would share
- **Scenarios** – develop problem situations that could be addressed or solved with design solutions – take the form of a narrative



Understand

Express

Test

Cycle

Empathy

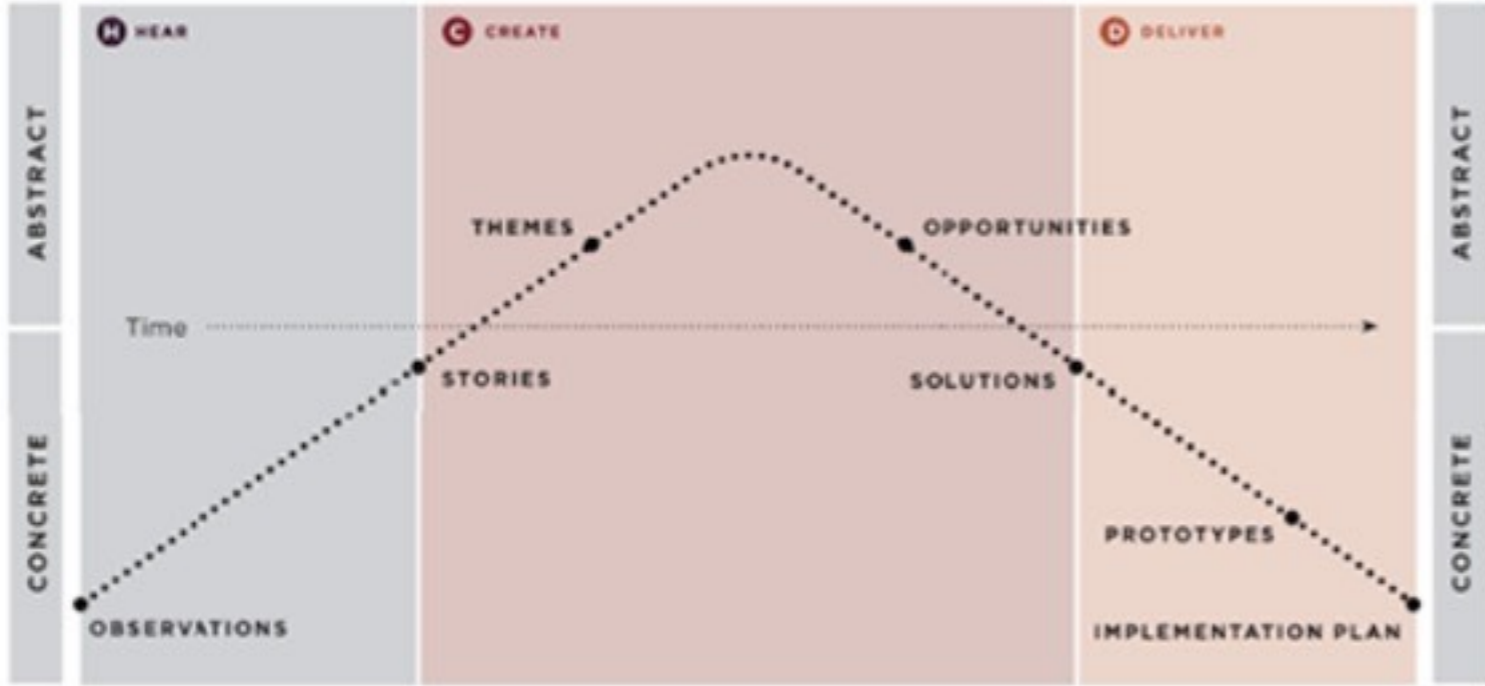
Creativity

Execution

Hear

Create

Deliver



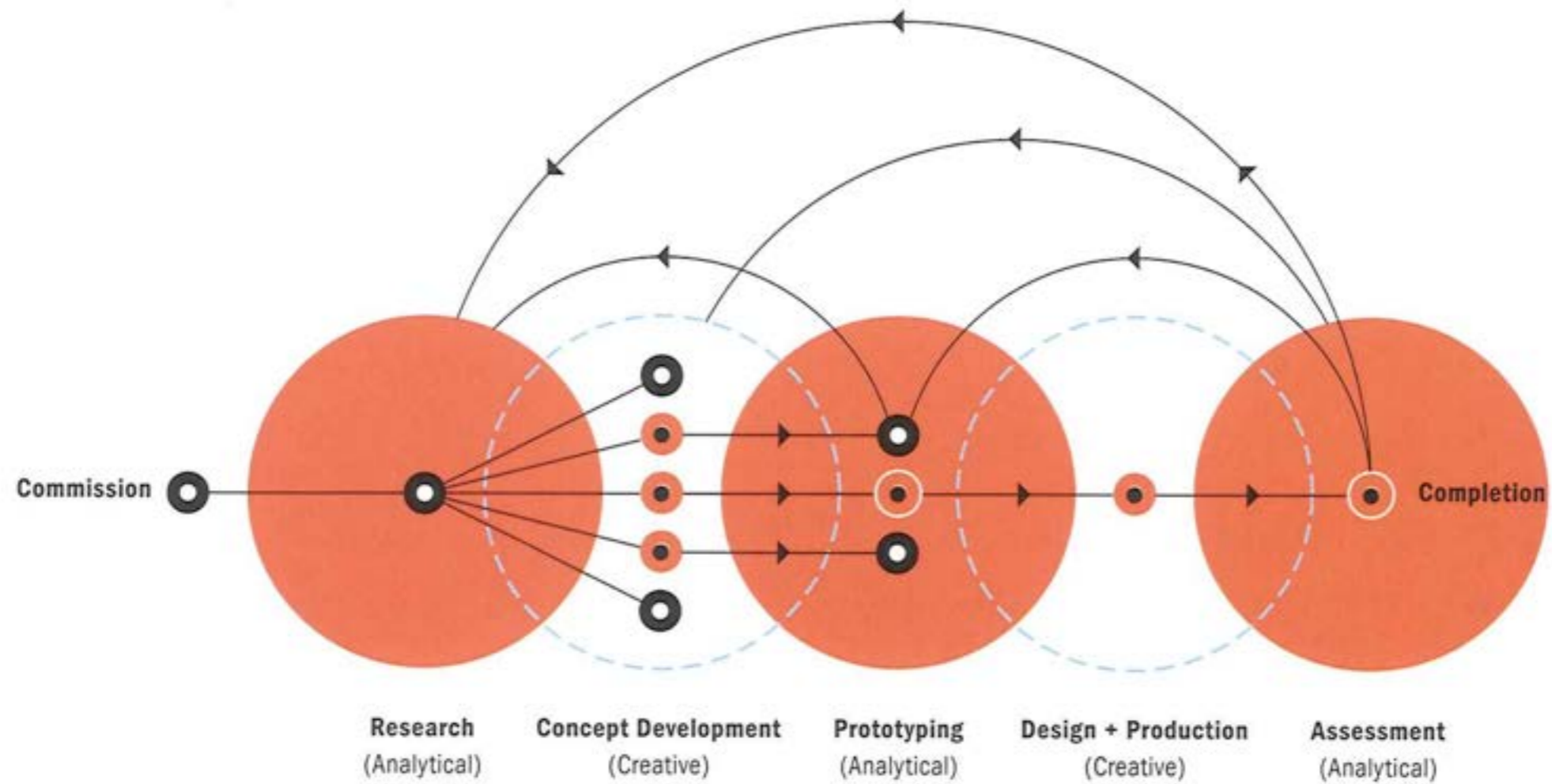
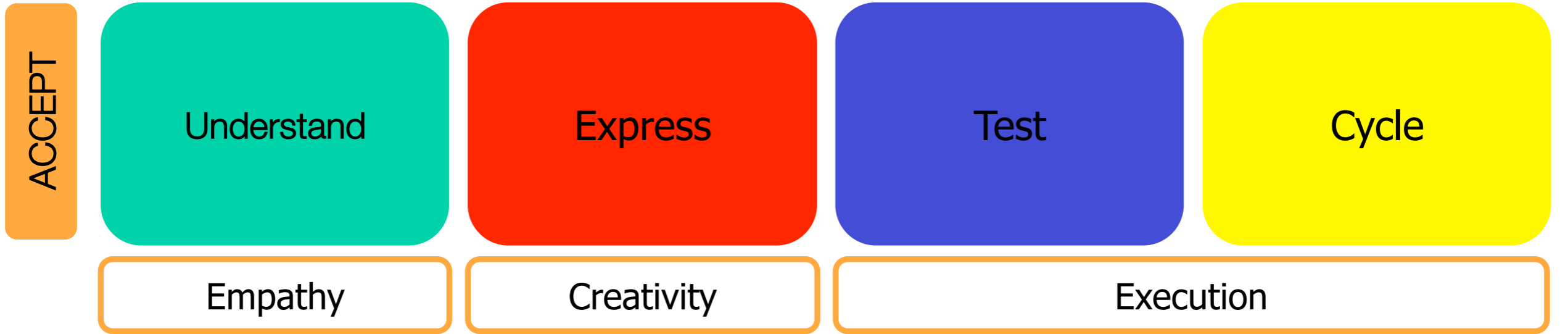
©2009 IDEO

Both Engineering and ID share the design process:

- Explore & Understand
- Express a Design (hypothesis)
- Test the Prototype
- Refine and Iterate

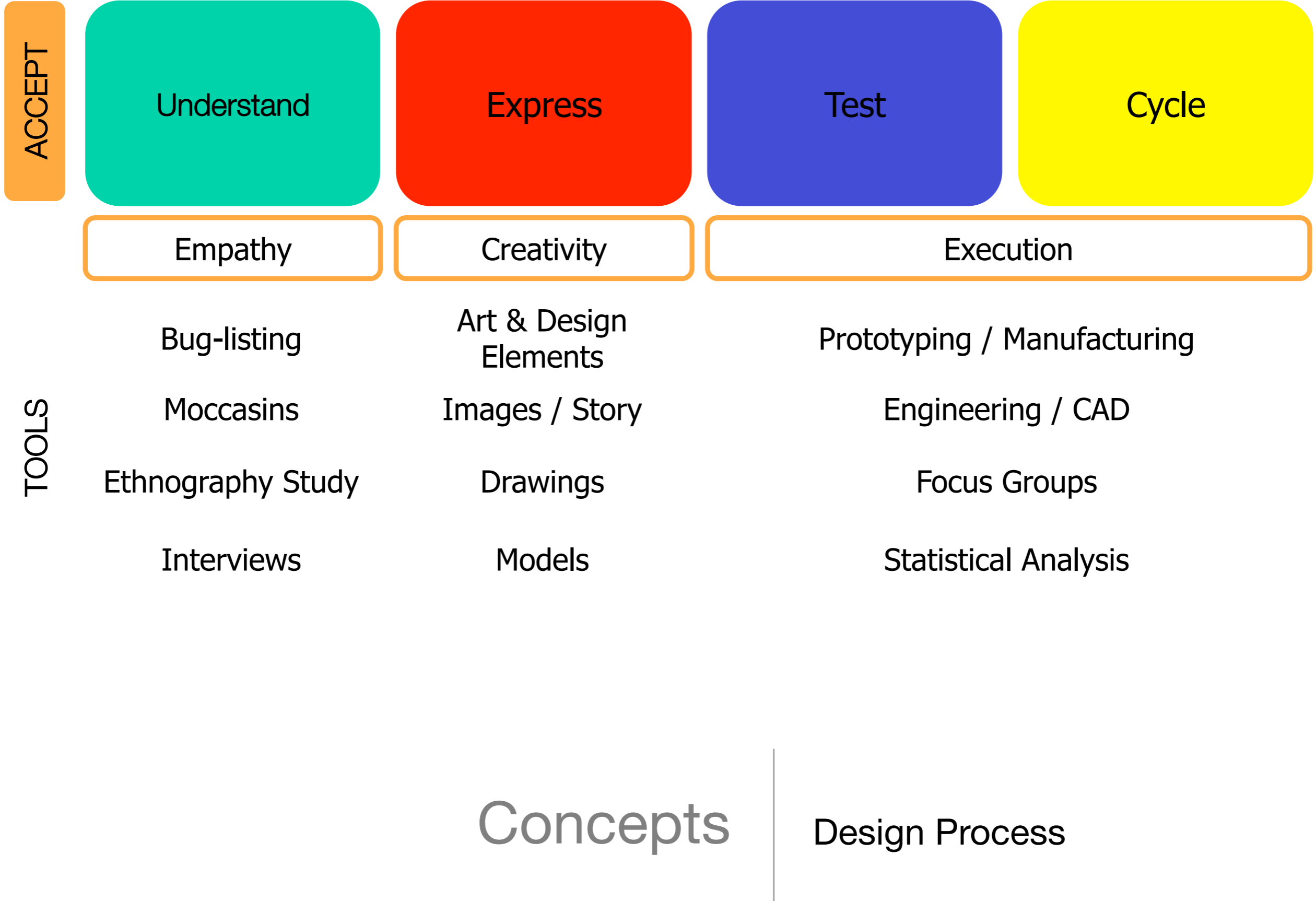
Concepts

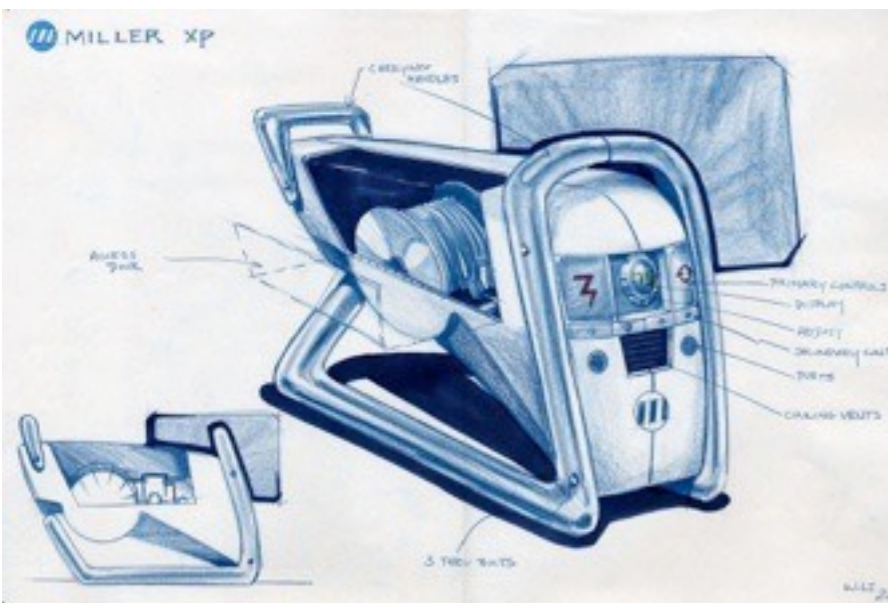
Design Process



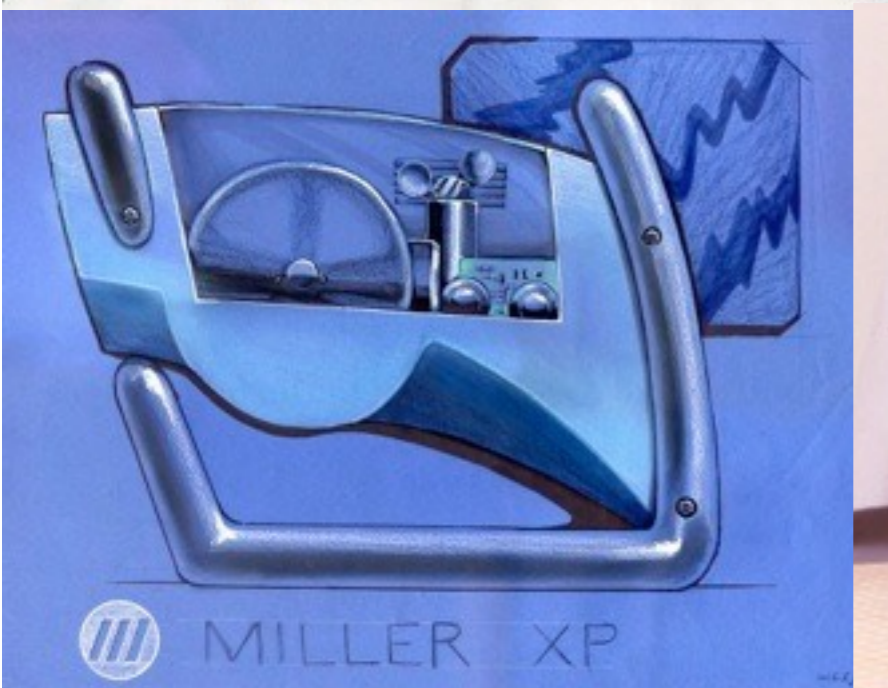
Concepts

Design Process





PCB size 37mmx29mm


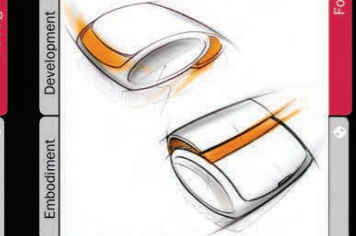
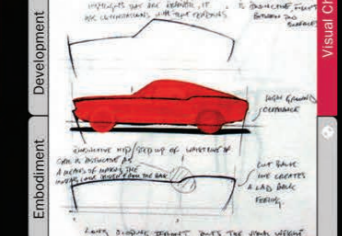


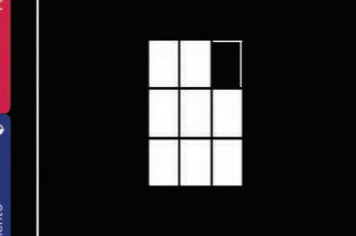
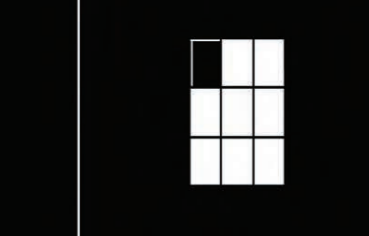
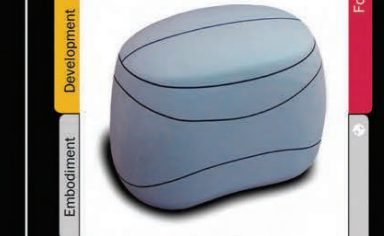

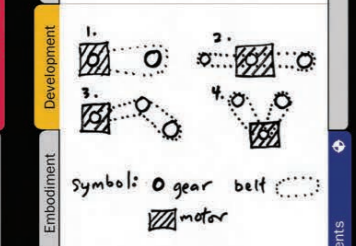



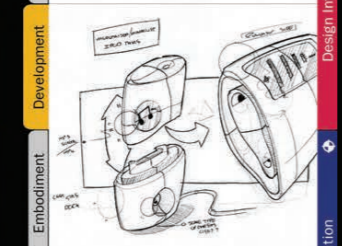

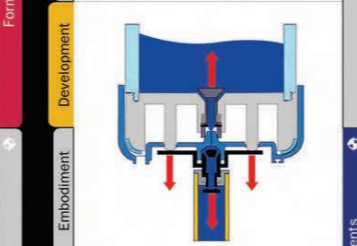


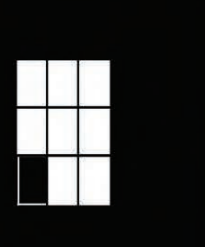

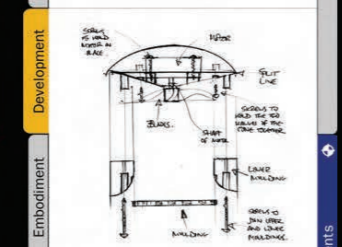

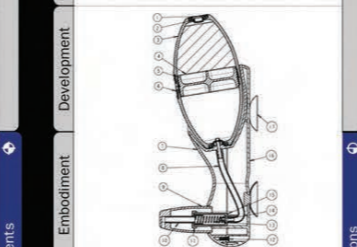

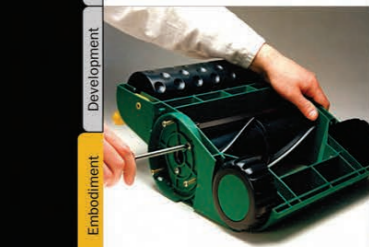



# Concepts

## Product Visualization

Several Techniques to quickly prototype product concepts

- Sketches
- Paper Prototypes / Foam Models
- Appearance Models
- Functional Models
- Computer 3D Modeling

<p><b>1 Idea Sketch</b></p>  <p>Used at a personal level to quickly capture thoughts using simple lines. Also known as a Thumbnail, Quick or Napkin Sketch.</p> <p>Loughborough University</p>	<p><b>2 Study Sketch</b></p>  <p>Used to investigate appearance, proportion and scale in greater detail than an Idea Sketch. Often supported by the loose application of tone/colour.</p> <p>Loughborough University</p>	<p><b>3 Referential Sketch</b></p>  <p>Used to record images of products, objects, living creatures or any relevant observations for future reference or as a metaphor.</p> <p>Loughborough University</p>	<p><b>9 Scenario &amp; Storyboard</b></p>  <p>Describes interaction between user and product, sometimes in an appropriate context.</p> <p>Loughborough University</p>	<p><b>10 Layout Rendering</b></p>  <p>Defines the product proposal as a third angle orthographic projection with precise line and colour.</p> <p>Loughborough University</p>	<p><b>Drawings</b></p>  <p>iD CARDS</p>	<p><b>Models</b></p>  <p>iD CARDS</p>	<p><b>17 Sketch Model</b></p>  <p>Informal, relatively low definition 3D model that captures the key characteristics of form. Also known as a Foam Model or 3D Sketch.</p> <p>Loughborough University</p>
<p><b>4 Memory Sketch</b></p>  <p>Expands thoughts during the process using mind maps, notes and annotations.</p> <p>Loughborough University</p>	<p><b>5 Coded Sketch</b></p>  <p>Symbol:  gear  belt  motor</p> <p>Informal coded representation that categorises information to demonstrate an underlying principle or scheme.</p> <p>Loughborough University</p>	<p><b>6 Information Sketch</b></p>  <p>Quickly and effectively communicates features through the use of annotation and supporting graphics. Also known as an Explanatory or Talking Sketch.</p> <p>Loughborough University</p>	<p><b>11 Presentation Rendering</b></p>  <p>Contains a high level of realism to fully define product appearance as a perspective view. Particularly useful for decision making by non-designers.</p> <p>Loughborough University</p>	<p><b>12 Diagram</b></p>  <p>Schematic representation of the operating principle or relationship between components. Also known as a Schematic or Diagrammatic Drawing.</p> <p>Loughborough University</p>	<p><b>13 Perspective Drawing</b></p>  <p>Descriptive three-quarter view produced using a perspective drawing technique. Created using line only without the application of colour or tone.</p> <p>Loughborough University</p>	<p><b>19 Functional Model</b></p>  <p>Captures the key functional features and underlying operating principles. Has limited or no association with the product's final appearance.</p> <p>Loughborough University</p>	<p><b>20 Operational Model</b></p>  <p>Communicates how the product is used with the potential for ergonomic evaluation.</p> <p>Loughborough University</p>
<p><b>Drawings</b></p>  <p>iD CARDS</p>	<p><b>7 Sketch Rendering</b></p>  <p>Clearly defined proposal produced by controlled sketching and use of colour/tone to enhance detail and realism. Also known as a First Concept.</p> <p>Loughborough University</p>	<p><b>8 Prescriptive Sketch</b></p>  <p>Informal sketch for the exploration of technical details such as mechanisms, manufacturing, materials and dimensions.</p> <p>Loughborough University</p>	<p><b>14 General Arrangement Drawing</b></p>  <p>Exterior view of all components using line only and with sufficient detail to produce an Appearance Model if required. Usually drawn in third angle projection.</p> <p>Loughborough University</p>	<p><b>15 Detail Drawing</b></p>  <p>Contains detail of components for the manufactured product. Also known as a Technical, Production or Construction Drawing.</p> <p>Loughborough University</p>	<p><b>16 Technical Illustration</b></p>  <p>Communicates technical detail with a high degree of realism that is sometimes supported with symbols. Includes exploded views.</p> <p>Loughborough University</p>	<p><b>22 Assembly Model</b></p>  <p>Enables the evaluation and development of the methods and tools required to assemble product components.</p> <p>Loughborough University</p>	<p><b>23 Production Model</b></p>  <p>Used to evaluate and develop the location and fit of individual components and sub-assemblies.</p> <p>Loughborough University</p>

Concepts

Visual Communication

# Concepts

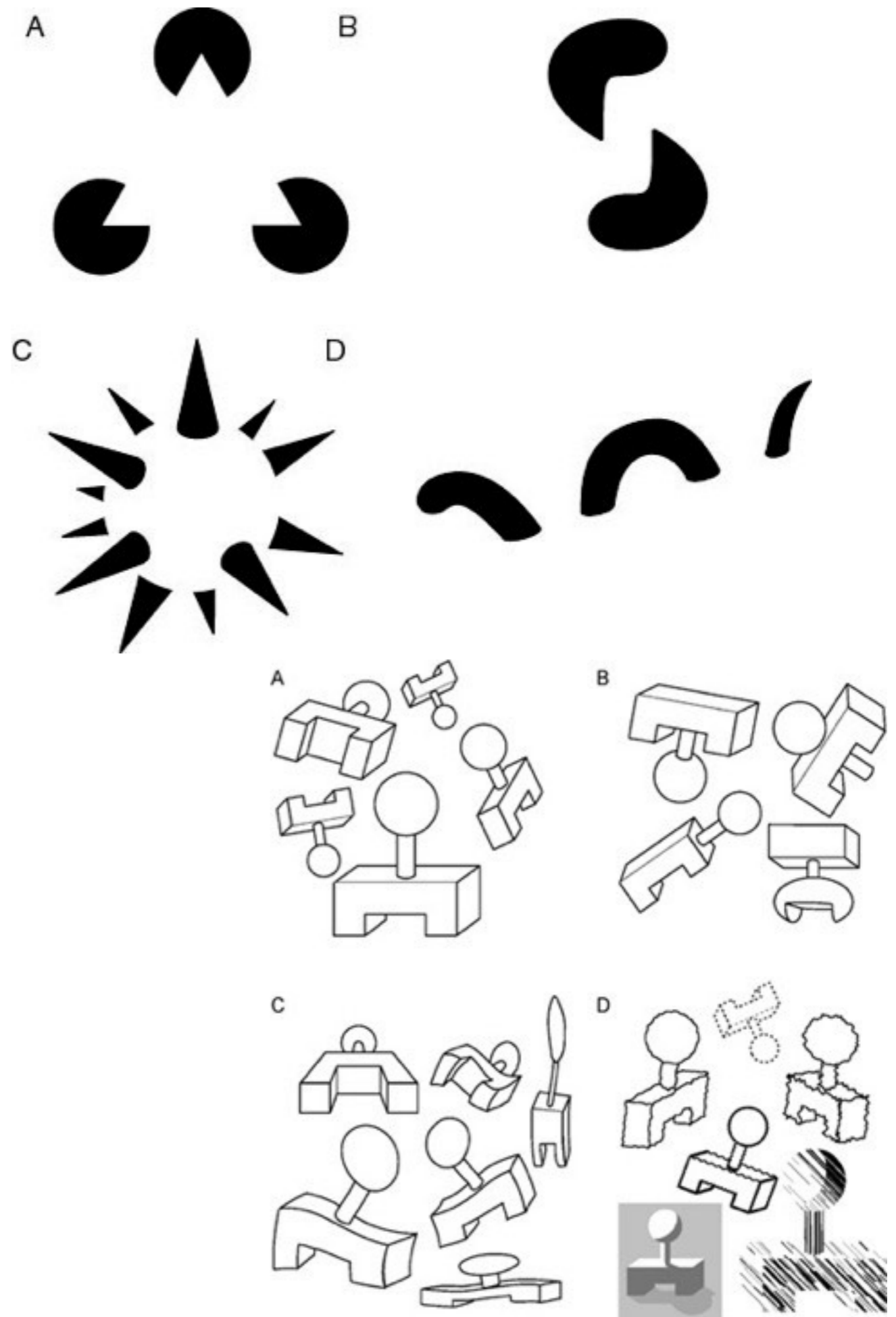
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## • Gestalt Principles:

early 19th cent. Cognitive Psychology

★ *is a theory of mind and brain of the Berlin School*

- the brain is holistic, parallel and analog with self organizing tendencies
- based on theories by Von Goethe, Hume, Kant, and Ernst Mach
- has formed the basis of further research into the perception of patterns and objects and of research into behavior, thinking, and problem solving



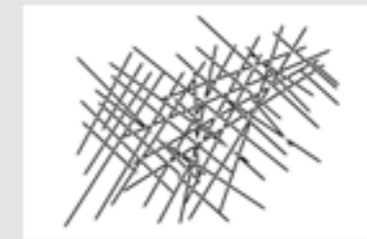


# Toolkits and Techniques: Elements of Art

- LINE
  - **Line can be considered in two ways. The linear marks made with a pen or brush or the edge created when two shapes meet.**
    - Horizontal - structure or calm
    - Vertical - reverence or balance
    - Diagonal and/or Zigzag- dynamic, movement
    - Curved - soft, organic
    - Line Weight as well as Line character
- SHAPE
  - **A shape is a self contained defined area, which are comprised of lines or edges. A positive shape in a design automatically creates a negative shape.**
    - Two dimensional - Flat
    - Geometric vs. Organic
    - Positive Shape vs. Negative Shape



Ben Shahn (Lithuanian) 1889-1968, Supermarket, serigraph



Joan Miro (Spanish) 1893-1983, The Policeman, Oil on canvas

# Toolkits and Techniques: Elements of Art

- FORM
  - **Form refers to three-dimensional shapes that have length, width and depth.**
    - Three dimensional - Volume (in sculpture) or the illusion of volume (in 2D work)
    - Full Round
    - Bas Relief
    - Shading: Light / Shadow
  
- SPACE
  - **Defined and determined by shapes and forms. Positive space is where shapes and forms exist; negative space is the empty space around shapes and forms.**
    - Collection of single or multiple shapes / forms
    - Positive Space: the object(s) itself aka the subject
    - Negative Space: the environment aka the ground



Michelangelo Buonoratti (Italian )  
1475-1564

David, Marble sculpture



Sandy Skoglund (American) b.1946,

Radioactive Cats, 1980, Chicken wire  
and plaster cats, furniture, live  
models



Henry Moore, (British) 1895-1986

Reclining Figure, Elmwood,



Salvador Dali (Spanish) 1904-1989

The Deterioration of The Persistence Of  
Memory, Oil on wood

# Toolkits and Techniques: Elements of Art

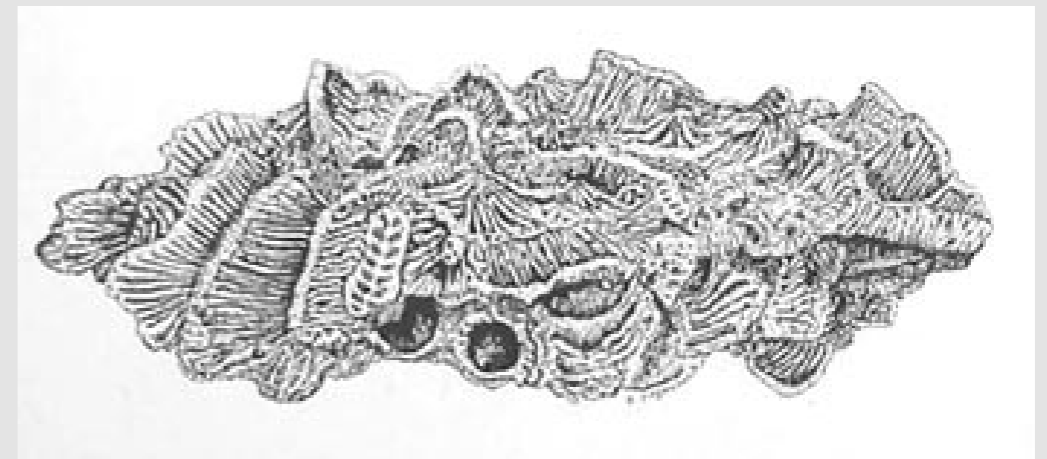
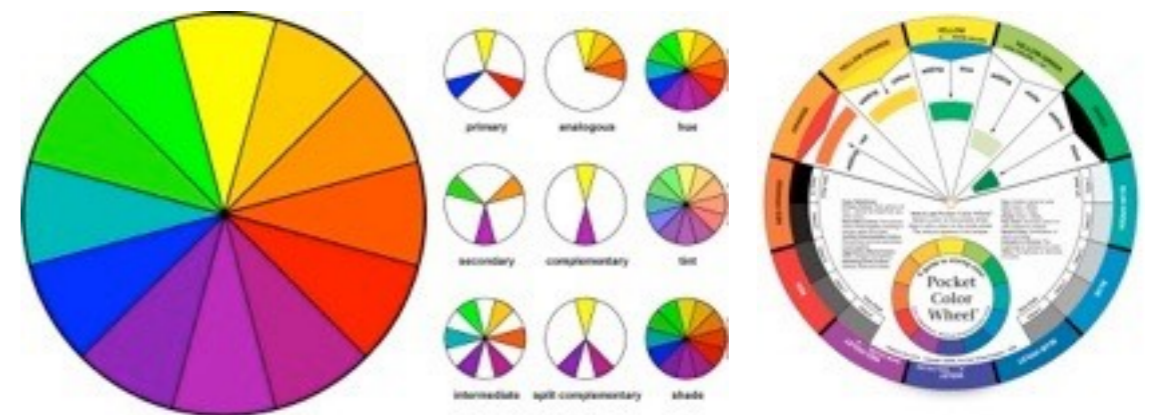
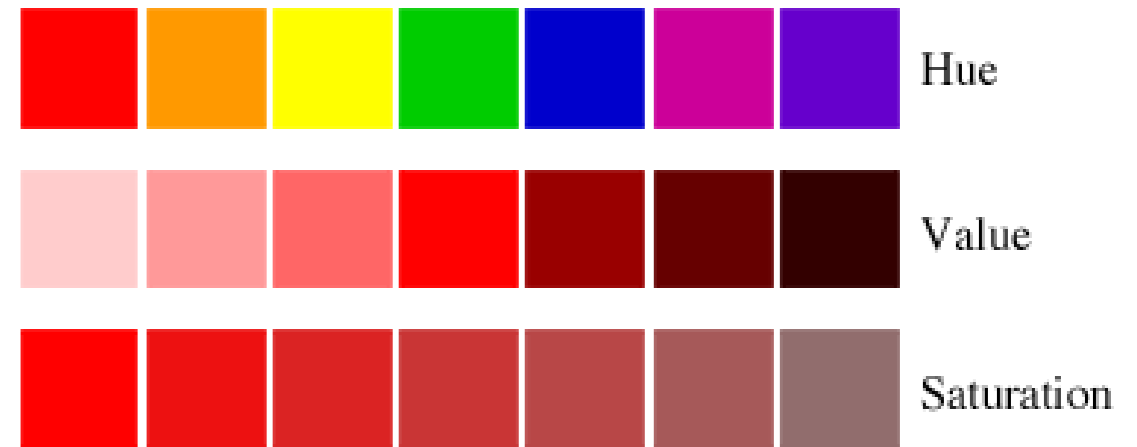
- COLOR

- **Color is produced when light strikes an object and reflects back in our eyes.**

- **Hue:** Where the color is positioned on the color wheel. Terms such as red, blue-green, and mauve all define the hue of a given color.
- **Value:** The general lightness or darkness of a color. How close to black or white a given color is.
- **Saturation:** The intensity, or level of chroma, of a color. The more gray a color has in it, the less chroma it has.

- TEXTURE

- refers to the surface quality or "feel" of an object - smooth, rough, soft, etc.
- Textures may be actual (felt with touch - tactile) or implied (suggested by the way an artist has created the work of art -visual)

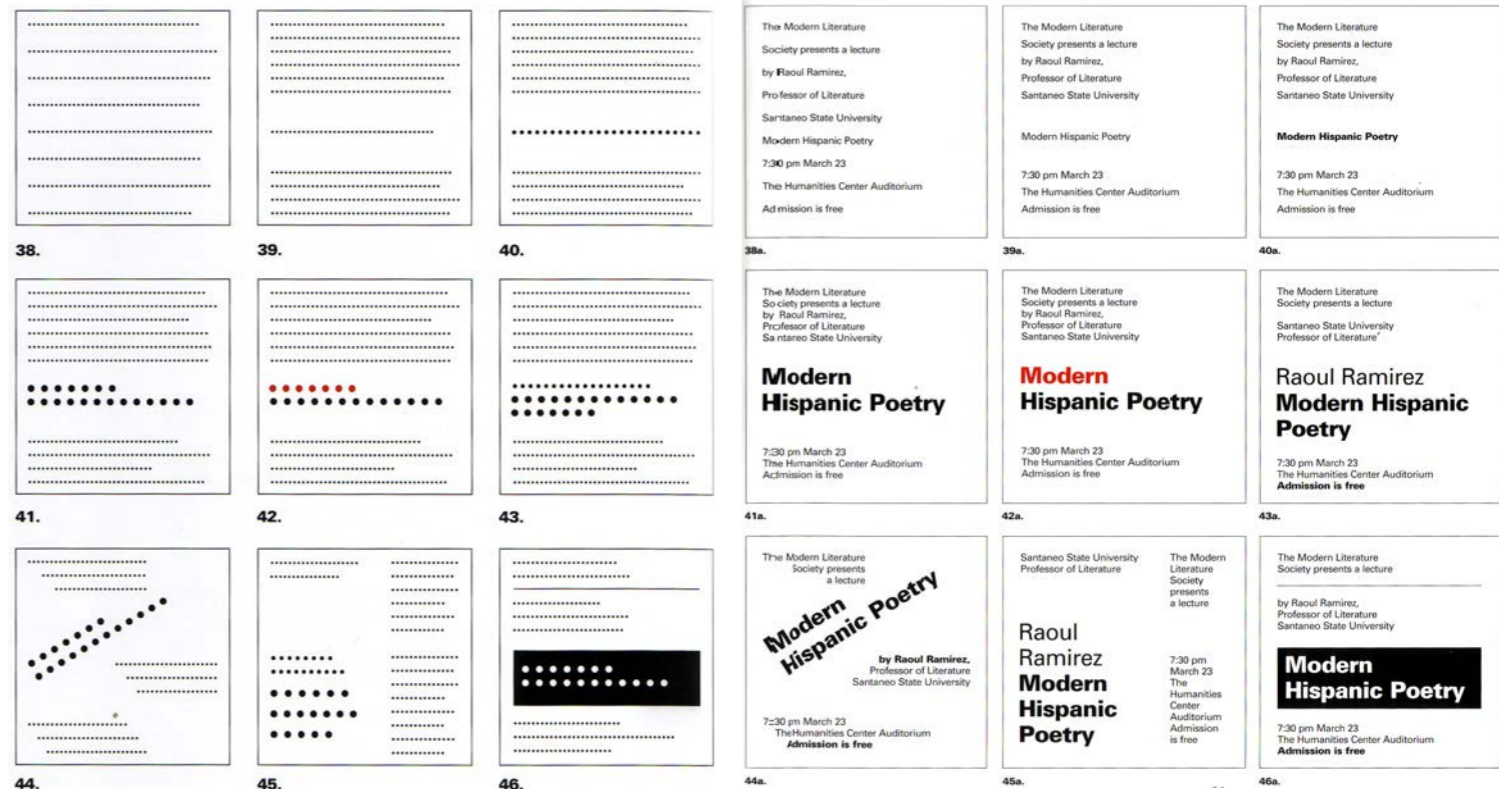


Shanon Fitzpatrick, 11th Grade, Coral Study , Pen and Ink

# Concepts

## Visual Hierarchy and Language

- Definition
  - is the order in which the human eye perceives what it sees. This order is created by the visual contrast between forms in a field of perception. Objects with highest contrast to their surroundings are perceived first.
  - Color
  - Size
  - Alignment
  - Character
- Basis
  - Based on 20th century German Gestalt psychological theory
    - innate in the human brain
    - to “structure individual elements, shapes or forms into a coherent, organized whole.”
    - Designers attempt to control visual hierarchy to guide the eye to information in a specific order for a specific purpose.



# Toolkits and Techniques:

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## Principles of Design

- RHYTHM (MOVEMENT)

- **is the repetition or alternation of elements, often with defined intervals between them. Rhythm can create a sense of movement, and can establish pattern and texture. There are many different kinds of rhythm, often defined by the feeling it evokes when looking at it.**

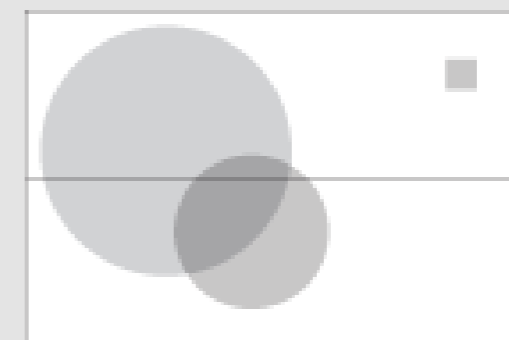
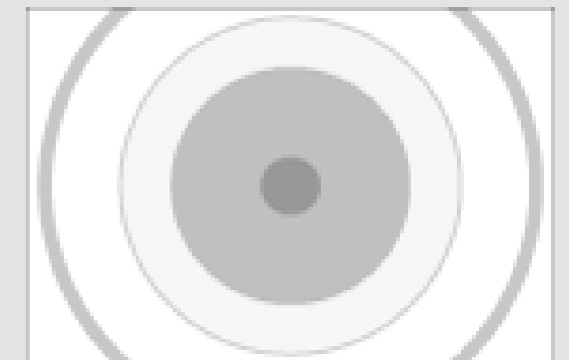
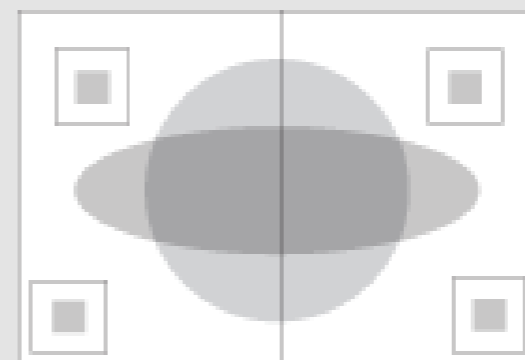
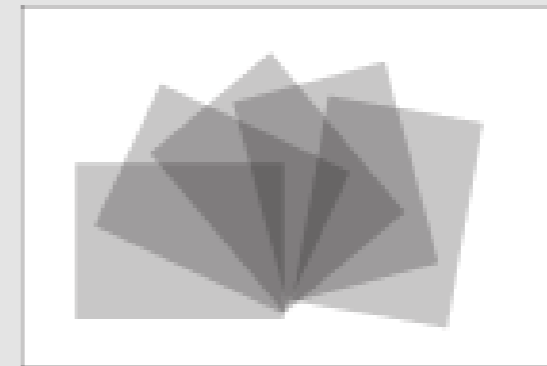
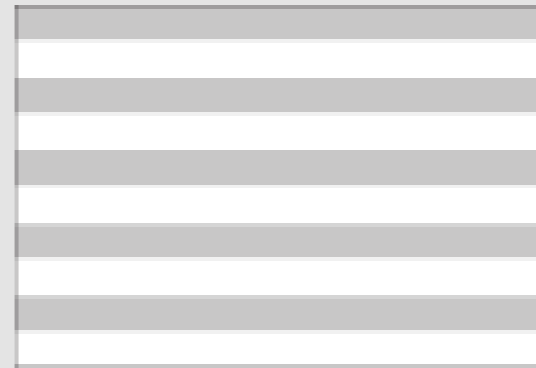
- Regular: A regular rhythm occurs when the intervals between the elements, and often the elements themselves, are similar in size or length.
- Flowing: A flowing rhythm gives a sense of movement, and is often more organic in nature.
- Progressive: A progressive rhythm shows a sequence of forms through a progression of steps.

- BALANCE

- **is the arrangement of the objects in a given design as it relates to their visual weight within a composition.**

**Balance usually comes in two forms: symmetrical and asymmetrical.**

- Symmetrical balance occurs when the weight of a composition is evenly distributed around a central vertical or horizontal axis or radially from a central point.
- Asymmetrical balance occurs when the weight of a composition is not evenly distributed around a central axis or point.



# Toolkits and Techniques:

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## Principles of Design

- PROPORTION

- is the comparison of dimensions or distribution of forms. It is the relationship in scale between one element and another, or between a whole object and one of its parts.

- Inherent
- Comparative
- Overall

- EMPHASIS or DOMINANCE

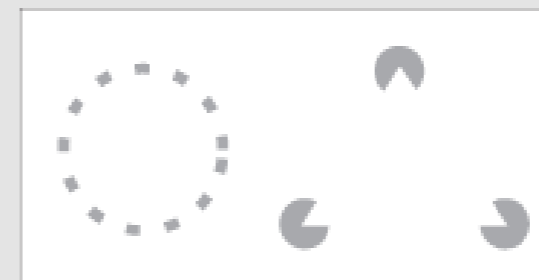
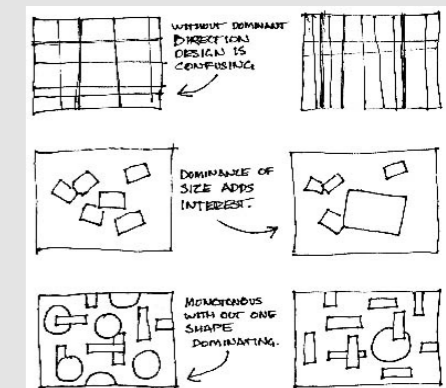
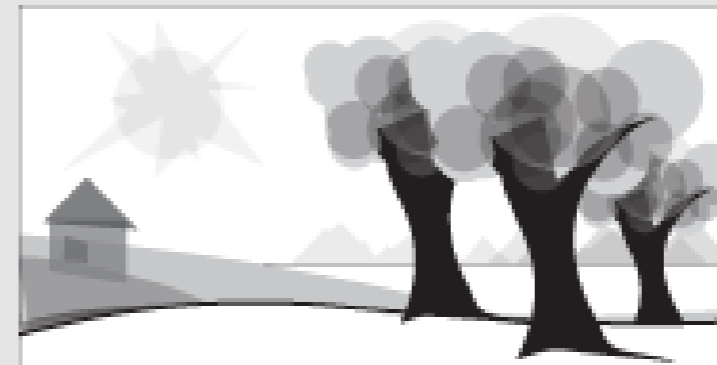
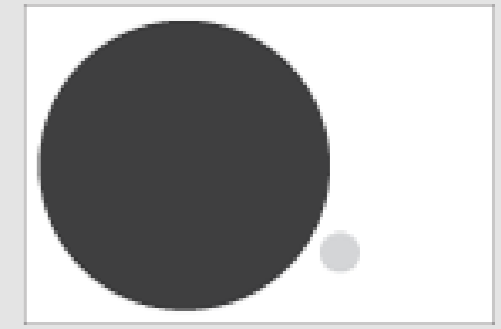
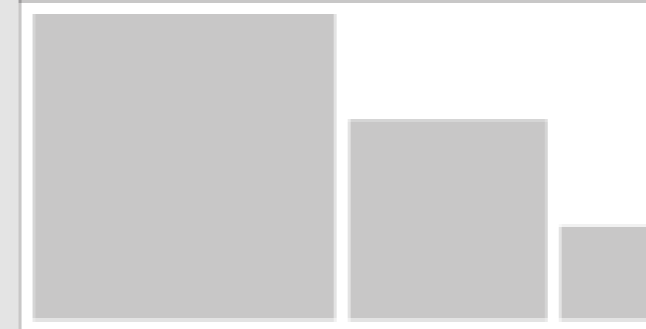
- determines the visual weight of a composition, establishes space and perspective, and often resolves where the eye goes first when looking at a design.

- Through the various elements and principles: shape, line, rhythm etc.
- Focus/depth of field pushes/pull your attention/the eye

- HARMONY or UNITY

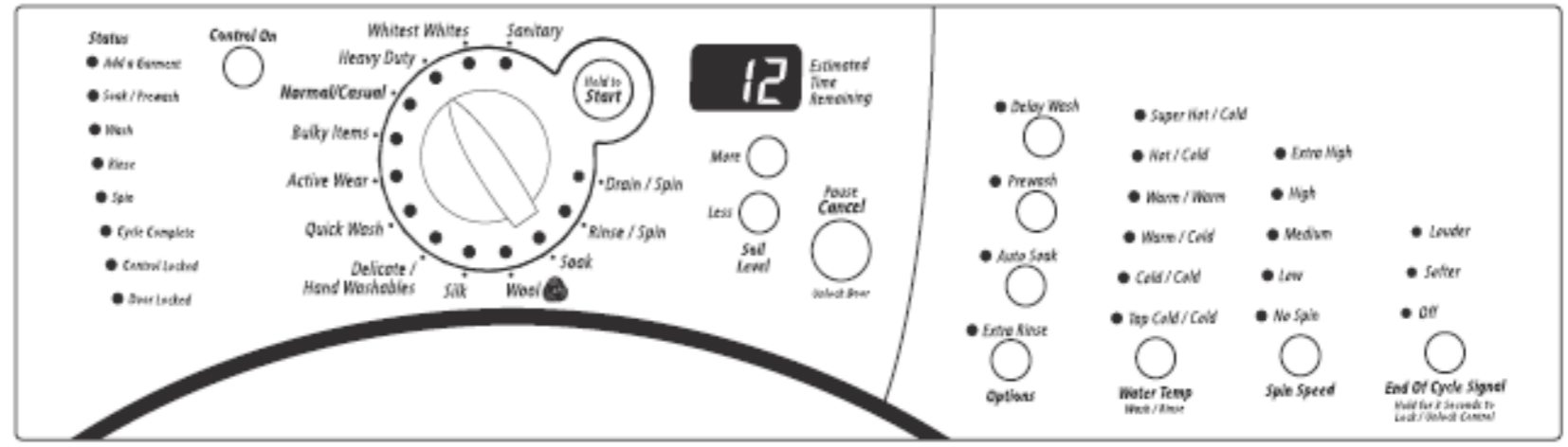
- describes the relationship between the individual parts and the whole of a composition. Closure

- Continuance
- Similarity, Proximity and Alignment





## WASHER USE



Application

Principles of design

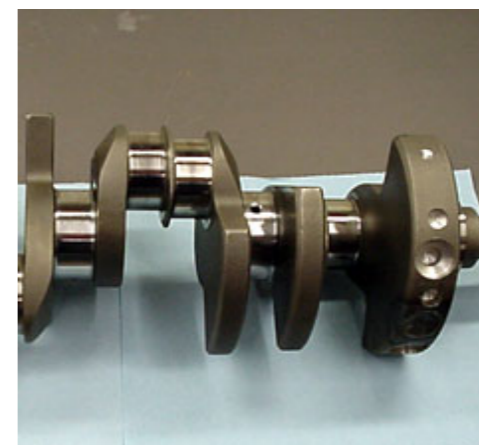
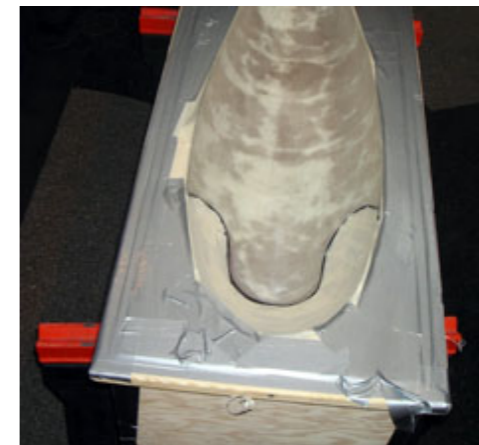
# Concepts

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## Materials and Manufacture

*Understanding the cognitive implication and perception of materials wrt aesthetics*

- Color Choice and Materials
- Surface Feeling / Texture
- Sustainability and Environmental Impact
- Aesthetic Consistency / Quality Assurance
- Manufacturing Processes





# Concepts

## Systems + Visual Language



- Definition
  - **visual language is a system of communicating using visual elements**
    - utilizes same concepts for visual hierarchy (color, size, shape etc), but orders the weighting of the hierarchy.
    - Gauges the use of contrast relative to multiple applications
- Considerations
  - used effectively, systems can retain a consistent aesthetic, tone or meaning
  - used often in branding and marketing materials
  - can establish visual, graphic rules whereby further variants of a design are constructed



# Systems - Visual Language



# Concepts

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## Ethnography: User Observation

- the rigorous study of the routine daily lives of a group of people

## Key Attributes

- People make sense
- Accessing implicit and explicit information
- Multiple Perspectives
- Natural Environment

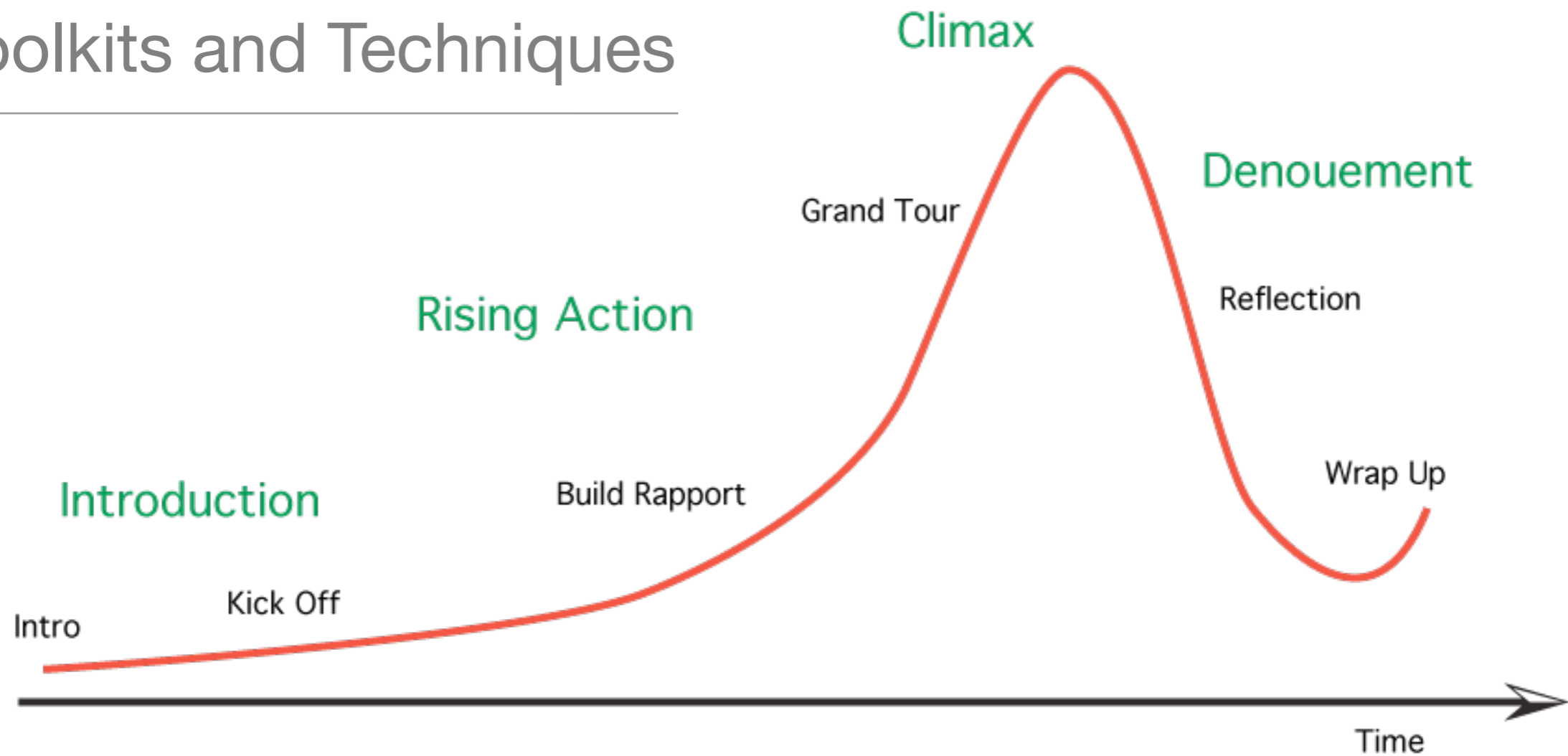
## Process

- Watch what people do
- Listen to what people say
- Listen to what people say about what they do
- Look more for what people are thinking and doing than the words they say



# Toolkits and Techniques

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## Interview Structure

### Introduction and Kick Off

- Set up a comfortable place for the interview
- Describe your purpose
- Let them know their knowledge is important

### Build Rapport:

- Ease defensiveness through reassurance
- Start with general concrete questions, then explore their experiences
- Let them tell the stories they want to

### Grand Tour

- Ask interviewee for a narrated tour of the setting
- Ask questions, act out scenarios

### Reflection

- At end of interview explore more abstract feelings and thoughts

### Wrap-Up

- Expect important information after interview is "over"

# Concepts

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## Narratives and Story Structure

- are the stories that sustain and transmit culture; cultural vessels
- pass through generation to generation; they are timeless
- are representative of our values and belief systems

## Stories are highly effective

- memorable, natural
- very informative: news (visual/verbal)
- spread quickly (word of mouth to the twitter feed)
- highlight social tensions or injustice

## Examples:

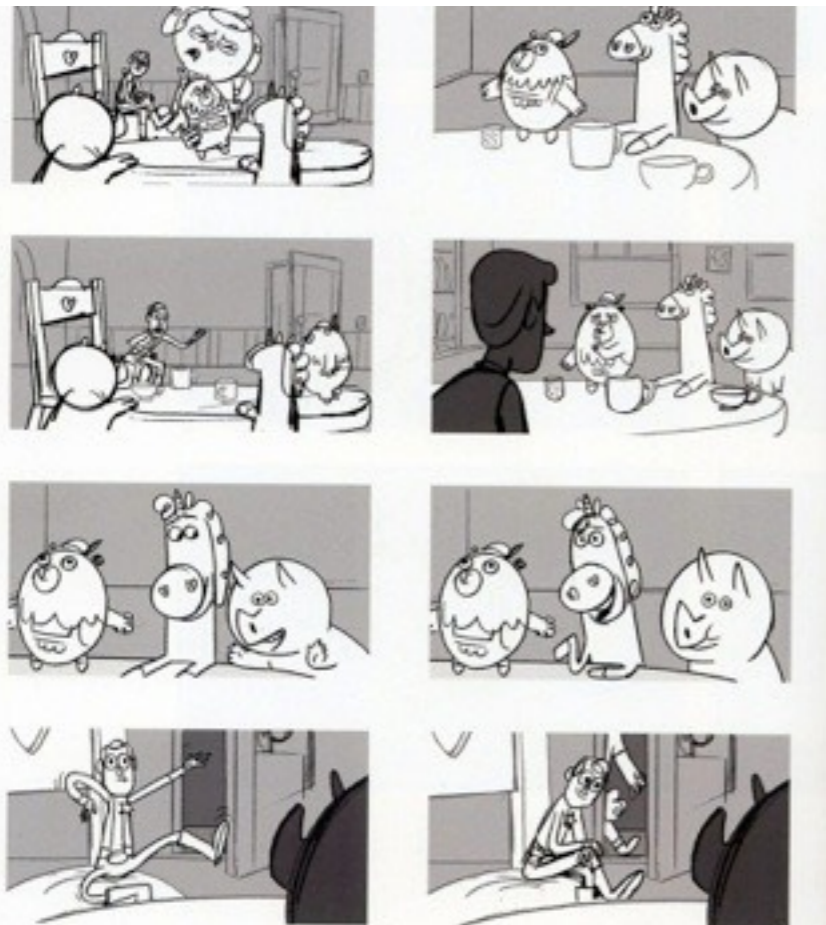
- Religious / Bible Stories: “Great Flood”
- Spoken / Oral tradition: “the Odyssey”
- Books / Novels: Bradbury / Orwell
- Plays / Movies: Batman Dark Knight: Crime drama, morality play



# Toolkits and Techniques

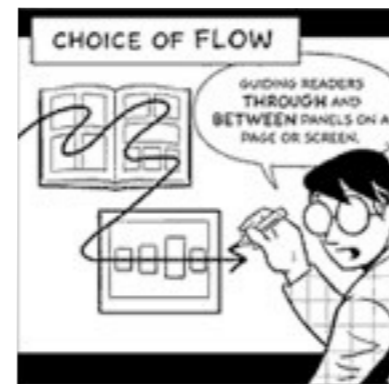
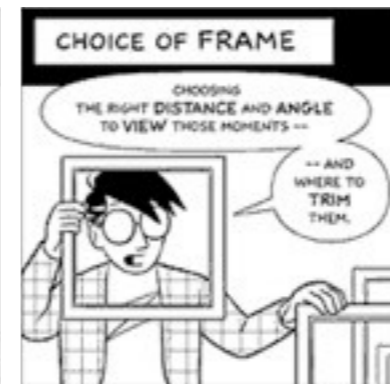
## Storyboarding

- Comic Book vernacular
- Basic, Visual Story Structure (1st draft)
- Moquette & Animatics



above:  
Erik Benson  
Storyboard  
Toy Story 3  
Digital

opposite:  
James Robertson  
Storyboard  
Fire effects by Andrew Jimenez  
Toy Story 3  
Digital



CLOSE-UP



CLOSE-UP



BUST



SILHOUETTE



PANARAMA



OPEN

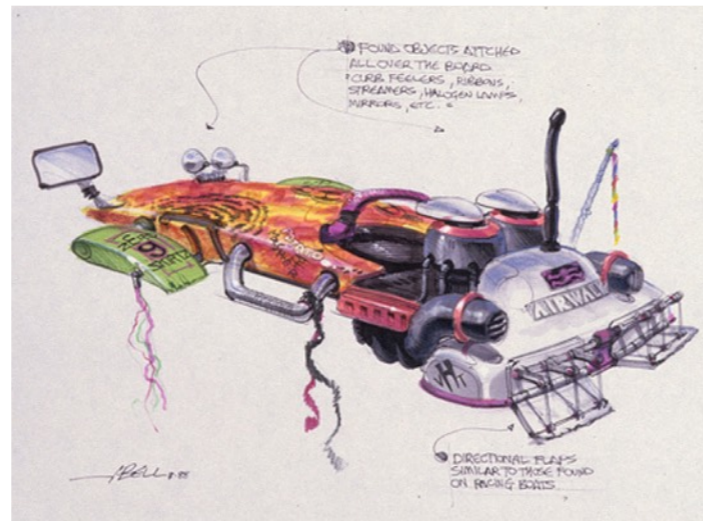
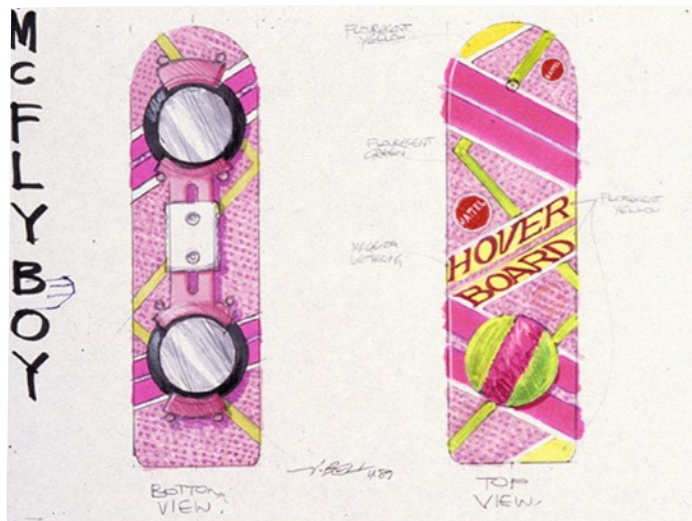
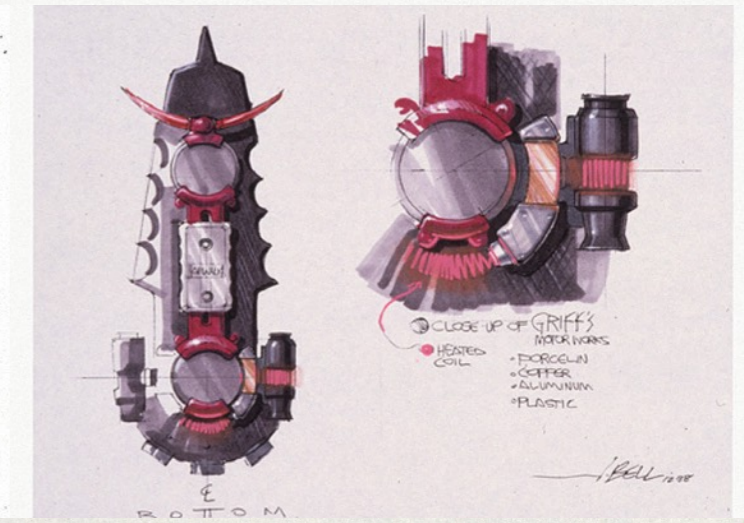
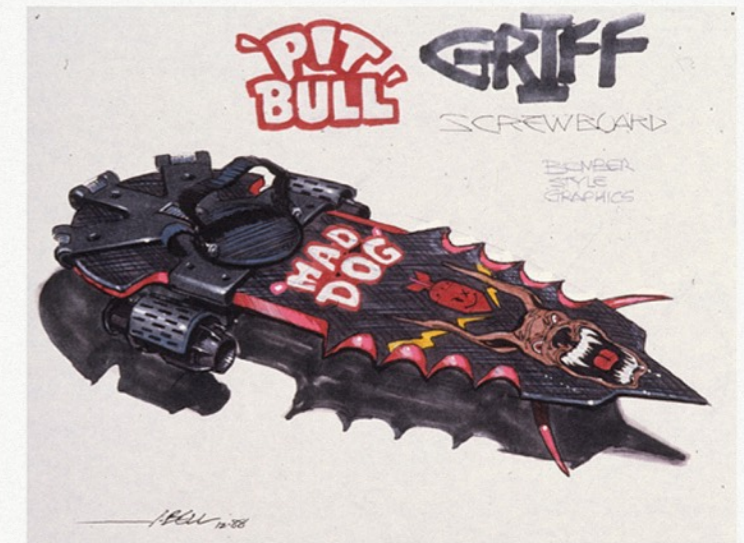


FLASH BACK



① MARTY GETS CHASED ON AN AIRSKATE AROUND CIVIC SQUARE. AT THIS POINT THEY'RE SKIMMING ACROSS THE REFLECTIVE POOL IN FRONT OF THE CLOCK TOWER.

# Q & A



# Think about Electives in the School of ID

ID 3320 Design Methods  
Wayne Li, [wayne.li@coa.gatech.edu](mailto:wayne.li@coa.gatech.edu)

ID 2401 Visual Design Thinking  
ID 4418 Design Sketching

ID 4106 Parametric Product Modeling

