Collective Intelligence and Iterative Design

**Inputs:** Two Concepts

<table>
<thead>
<tr>
<th>Starbucks</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>store, frappuccino</td>
<td>beach, sun, swim</td>
</tr>
</tbody>
</table>

- Brainstorm associations
  - Starbucks
  - Summer
- Find images of objects
  - Starbucks
  - Summer
- Annotate shapes
  - All of object
  - Part of object
- Annotate coverage
  - Part of object
- Synthesize blends
- Evaluate
  - Objects are integrated
  - Both objects are identifiable

**Output:** A visual blend

Prof. Lydia Chilton
From Data to Solutions Seminar
13 April 2018
Design: How to go from idea to product
Process #1: The Waterfall Model

Phone + iPod + Internet
- One Button
- Touch Screen
- Soft keyboard

Idea
Requirements
Design
Build
Fix bugs
Product
Process #2: Iterative Design

Idea
Phone + iPod + Internet

Touch Screen
Soft keyboard
One Button

Product
Open HCI Problem:
Can we make design easier?

• Can we automate it?
• Can we semi-automate it?
• Can we understand the steps better?
How to identify, instantiate, and evaluate domain-specific design principles for creating more effective visualizations.

BY MANEESH AGRAWALA, WILMOT LI, AND FLORAINE BERTHOUZOZ

Design Principles for Visual Communication

Visual communication via diagrams, sketches, charts, photographs, video, and animation is fundamental to the process of exploring concepts and disseminating information. The most-effective
LineDrive: Automatically design route maps based on design principles

Route Maps are hard to follow.

Hand-drawn maps are better designed for drivers.

Automatically design hand-drawn maps.

Step 1. Deduce Design Principles from Expert Examples

**Design Principles** of hand-drawn maps:
- Length of route lines can be warped.
- All turns should be visible
- Angles can be exaggerated
Step 2.
Define a constraint-based search problem

Define:

Search spaces:
Road lengths,
turn angles

Constraints:
Roads must be long enough to see their names
Angles must not exceed 90 degrees

Evaluation function:
Maximize visibility of roads of turns
Automatically Solve Design Problems as Constraint-Based Search Problems
Crowdsourcing:
Decompose a problem and let people do the tasks a computer can’t
Microtask Crowdsourcing
Pay people to do microtasks on Amazon’s Mechanical Turk
Problems too **hard** for one person

You (misspelled) (several) (words). Please spellcheck your work next time. I also notice a few grammatical mistakes. Overall your writing style is a bit too phoney. You do make some good (points), but they get lost amidst the (writing). (signature)
Iteratively Improve the Transcription: Allow people to build on the clues from the last person.

You (misspelled) (several) (words).

You (?) (?) (?) (work).

improve

vote

You (?) (?) (?) (work).

You (?) (?) (?) (work).
Many iterations of TurKit

version 1:
You (?) (?) (?) work. (?) (?) (?) work (not) (time). I (?) (?) a few grammatical mistakes. Overall your writing style is a bit too phoney. You do (?) have good (points), but they got lost amidst the (writing). (signature)

version 2:
You (?) (?) saved (work). (?) (?) (?) work (not) (time). I (?) (?) a few grammatical mistakes. Overall your writing style is a bit too phoney. You do (?) have good (points), but they got lost amidst the (writing). (signature)

version 4:
You (misspelled) (several) (words). (?) (?) (?) work next (time). I also notice a few grammatical mistakes. …

version 5:
You (misspelled) (several) (words). (Plan?) (spell-check) (your) work next time. I also notice a few grammatical mistakes. Overall your writing style is a bit too phoney. You do make some good (points), but they got lost amidst the (writing). (signature)

version 6:
You (misspelled) (several) (words). Please spell-check your work next time. I also notice a few grammatical …

"You (misspelled) (several) (words). Please spellcheck your work next time. I also notice a few grammatical mistakes. Overall your writing style is a bit too phoney. You do make some good (points), but they got lost amidst the (writing). (signature)"

According to our ground truth, the highlighted words should be "flowery", "get", "verbiage" and "B." respectively.
Can you decompose something “creative”?
Can we decompose the iterative design process to create visual blends?
An Interactive Pipeline for Creating VisuABlends

Wash your hands. It’s the smart move.

Lydia Chilton
Savvas Petridis
Brazil + Takes Off

The Economist

Brazil takes off

The decline of music piracy
Nigeria gets better
Farmers v greens in America
How drugs are being decriminalised
Bland bosses

A 14-PAGE SPECIAL REPORT
ON LATIN AMERICA'S BIG SUCCESS STORY
Brazil + Takes Off

Tabasco + Hot
Brazil + Takes Off

Tabasco + Hot

Earth + Melt
Brazil + Takes Off

Tabasco + Hot

Earth + Melt
Brazil + Takes Off

News

Tabasco + Hot

Advertisements

Earth + Melt

Public Service Announcements
We want to help people create visual blends for their own messages.

How can we decompose the *iterative design process* to make visual blends in independent microtasks?
Design Pattern: Single Shape Mapping

1. Two objects are integrated into one object
2. Both objects are individually identifiable
<table>
<thead>
<tr>
<th>Turn off</th>
<th>Cell phone</th>
<th>Turn off + Cell phone</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Light Switch" /> <img src="image2" alt="Click" /></td>
<td><img src="image3" alt="Cell Phone" /></td>
<td><img src="image4" alt="Empty" /></td>
</tr>
</tbody>
</table>
Starbucks + Summer
Inputs: Two Concepts

Starbucks

Summer
**Inputs:** Two Concepts

<table>
<thead>
<tr>
<th>Brainstorm associations</th>
<th>Starbucks</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>store, frappuccino</td>
<td></td>
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<tbody>
<tr>
<td>Find images of objects</td>
<td><img src="image1.png" alt="Image of Starbucks logo and frappuccino" /></td>
<td></td>
</tr>
<tr>
<td>Annotate shapes</td>
<td><img src="image2.png" alt="Annotated shapes" /></td>
<td></td>
</tr>
<tr>
<td>Brainstorm associations</td>
<td>Starbucks</td>
<td>Summer</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>------------------------</td>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td><strong>Brainstorm associations</strong></td>
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<td>-----------------------------</td>
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<td></td>
</tr>
<tr>
<td><strong>Starbucks</strong></td>
<td>beach, sun, swim</td>
<td></td>
</tr>
<tr>
<td><strong>Find images of objects</strong></td>
<td><img src="image.png" alt="Image of a popsicle and a sun icon" /></td>
<td></td>
</tr>
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</table>
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<tr>
<td><strong>Annotate</strong> shapes</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Annotate</strong> coverage</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

*Part of object Part of object*
**Inputs:** Two Concepts

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<table>
<thead>
<tr>
<th>Find images of objects</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Starbucks" /> <img src="image2" alt="Frappuccino" /> <img src="image3" alt="Beach" /> <img src="image4" alt="Sun" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annotate shapes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Starbucks" /> <img src="image6" alt="Frappuccino" /> <img src="image7" alt="Beach" /> <img src="image8" alt="Sun" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annotate coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of object</td>
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<td>store, frappuccino</td>
<td>beach, sun, swim</td>
</tr>
<tr>
<td>Annotate shapes</td>
<td><img src="logo" alt="Starbucks" /> <img src="frappuccino" alt="Coffee" /></td>
<td><img src="summer" alt="Ice cream" /> <img src="summer" alt="Sun" /></td>
</tr>
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<td>Annotate coverage</td>
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### Inputs: Two Concepts

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<td><img src="image3.png" alt="Beach" /> <img src="image4.png" alt="Sun" /></td>
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<td></td>
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**Prototype blend**

![Starbucks Summer Blend](image5.png)
<table>
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<td>beach, sun, swim</td>
</tr>
<tr>
<td>Annotate shapes</td>
<td><img src="image1.png" alt="Starbucks logo" /> <img src="image2.png" alt="Frappuccino" /> <img src="image3.png" alt="SummerPopsicle" /> <img src="image4.png" alt="Sun" /></td>
<td></td>
</tr>
<tr>
<td>Annotate coverage</td>
<td>All of object</td>
<td>Part of object</td>
</tr>
</tbody>
</table>

Prototype blend

Evaluate prototype

- Two objects are **integrated** into one object
- Both objects are identifiable
**Inputs:** Two Concepts

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<td>Annotate shapes</td>
<td><img src="image1" alt="Starbucks" /> <img src="image2" alt="Frappuccino" /></td>
<td><img src="image3" alt="Sun" /> <img src="image4" alt="Beach" /></td>
</tr>
<tr>
<td>Annotate coverage</td>
<td>All of object</td>
<td>Part of object</td>
</tr>
<tr>
<td>Prototype blend</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Output:** A visual blend

- Two objects are **integrated** into one object
- Both objects are **identifiable**
**Inputs:** Two Concepts

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<td><em>All of object</em></td>
<td><em>Part of object</em></td>
</tr>
<tr>
<td><em>Part of object</em></td>
<td><img src="image" alt="Starbucks" /></td>
<td><img src="image" alt="Summer" /></td>
</tr>
</tbody>
</table>

**Output:** A visual blend

- Two objects are integrated into one object
- Both objects are identifiable
Study 1: Independent Microtasks

First iteration: 11 of 16 blends
Study 1: Independent Microtasks

First iteration: 11 of 16 blends
Second iteration: 16 of 16 blends
Study 2: Blends for Messages

Public Service Announcement
“Wash your hands. It’s the smart move.”

Concept Pair:
Hand-washing + Smart
Study 2: Blends for Messages

Advertisement
“Joe’s Coffee: Open Late”

Concept Pair:
Joe’s Coffee + Night
Study 2: Blends for Messages

Advertisement
“Panel Discussion: Women in Computer Science”

Concept Pair:
Women + Computer Science
Study 2: Blends for Messages

Advertisement
“Join the Philosophy Dept’s Holiday Celebration”

Concept Pair:
Philosophy + Christmas
Study 2: Blends for Messages

News
“Football linked to lasting brain damage.”

Concept Pair:
Football + Dangerous
An Interactive Pipeline for Creating

Visual blends are images that help convey a message.

Wash your hands. It’s the smart thing to do.

The pipeline decomposes the iterative design process into independent microtasks.
Why do we need to iterate in the design process?
Lego + Valentine’s Day
Lego

Brainstorm associations

Find Images of objects

Annotate shapes

Evaluate

Are both objects identifiable?

Valentine’s Day

Blend

Shape covers All of object

Annotate shape coverage

Are two objects integrated into one object?

Evaluate

Shape covers Part of object

Blend

Are both objects identifiable?
<table>
<thead>
<tr>
<th>Brainstorm associations</th>
<th>Lego</th>
<th>Valentine’s Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Images of objects</td>
<td>![Lego brick] ![Lego brick] ![Lego brick]</td>
<td>![Rose] ![Teddy bear] ![Rings]</td>
</tr>
<tr>
<td>Annotate shapes</td>
<td>![Shape coverage] ![Shape coverage] ![Shape coverage]</td>
<td>![Shape covers Part of object]</td>
</tr>
<tr>
<td>Annotate shape coverage</td>
<td>Shape covers All of object</td>
<td>![Shape covers Part of object]</td>
</tr>
</tbody>
</table>

**Blend**

**Evaluate**
- Are both objects identifiable?
- Are two objects integrated into one object?
Football + Dangerous
Football

Dangerous

Brainstorm associations

Find Images of objects

Annotate shapes

Annotate shape coverage

Shape covers All of object

Blend

Evaluate

✔ Are both objects identifiable?

✗ Are two objects integrated into one object?
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Football</td>
<td>Dangerous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Shape covers **All** of object
- Shape covers **Part** of object

**Evaluate**
- Are both objects identifiable?
- Are two objects integrated into one object?
NYC + Healthy
Brainstorm associations
Find Images of objects
Annotate shapes
Annotate shape coverage
Blend
Evaluate

NYC

Healthy

No shape matches
<table>
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<th><strong>Blend</strong></th>
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<table>
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<tr>
<th><strong>Evaluate</strong></th>
<th></th>
</tr>
</thead>
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- Are both objects identifiable?
- Are two objects integrated into one object?
Lego + Healthy
Brainstorm associations

Find Images of objects

Annotate shapes

Annotate shape coverage

Blend

Evaluate

No shape matches
**Brainstorm associations**

**Find Images of objects**

**Annotate shapes**

**Annotate shape coverage**

**Blend**

**Evaluate**
- Are both objects identifiable?
- Are two objects integrated into one object?
Orange + Healthy
**Orange**

- **Brainstorm associations**
- **Find Images of objects**
- **Annotate shapes**
- **Annotate shape coverage**
- **Shape covers Part of object**

**Healthy**

- **Blend**
- **Evaluate**
  - Are both objects identifiable? **No**
  - Are two objects integrated into one object? **Yes**

**Shape covers All of object**
Orange

Brainstorm associations

Find Images of objects

Annotate shapes

Annotate shape coverage

Shape covers All of object

Healthy

Exercise equipment

Shape covers Part of object
Orange

Brainstorm associations

Find Images of objects

Annotate shapes

Annotate shape coverage

Healthy

Shape covers All of object

Shape covers Part of object

Blend

Evaluate

Are both objects identifiable?
Are two objects integrated into one object?
When do we need to iterate?

Improve object fit

No matches

Objects are not identifiable

Within same search space, meet other constraints.
Find versions of an object with different color, style, aspect ratio

Focus on meeting a specific constraint:
Find symbols with a different shape

Search in a new subspace
Find symbols with a different shape
Can computers do design?
Which part could we automate?
Can we automate finding images?
Finding images has some unusual rules

- **Objects**...
- **Not scenes**
- **Simple objects**...
- **Not fancy objects**

- **Object with one main shape**...
- **Not objects with multiple main shapes**
- **Objects**...
- **Not people or animals**
Could you just use Google image search?
Could you just use The Noun Project?
Can we automate blends?

**Inputs:** Two Concepts

- Starbucks: store, frappuccino
- Summer: beach, sun, swim

**Brainstorm associations**

**Find images of objects**

**Annotate shapes**

**Annotate coverage**

**Synthesize blends**

**Evaluate**
- Objects are integrated
- Both objects are identifiable

**Output:** A visual blend
Could you just use deep learning?
Could you just use **deep learning**?

Fast Style Transfer
Fast Style Transfer: Lego + Popsicle
Fast Style Transfer: Apple + Burger
Fast Style Transfer: Apple + Burger Parts
Can people work totally independently?
People make better decisions when they know how the entire pipeline operates.

How much of the object must be outside the shape to be part of a sphere?

**Enough to recognize it in a blend.**

How simple does the object have to be?

**Simple enough to be recognizable in a blend**

How diverse should the objects be?

**Diverse enough to find matches with another set of images.**

We can’t giving an explicit rule for everything.

If users know the process, they can answer their own questions implicitly.
Other problems with design patterns
Design patterns:
Abstract ways that parts fit

Music

Architecture

Rhetoric

Novels

Cinematography

Software
Finding new design patterns
Look at expert examples and focus on the features that are fundamental to cognition.

**LineDrive:**
Focus on what features make maps Visible to drivers.

**Visual Blends**
Focus on features that make objects Recognizable.
Shapes and silhouette

**Argumentation:**
Things that appeal to their values.
Summary
Collective Intelligence and Iterative Design

Inputs: Two Concepts

Starbucks
- store, frappuccino

Summer
- beach, sun, swim

Improve
- Brainstorm associations
- Find images of objects
- Annotate shapes
- Annotate coverage
- Synthesize blends
- Evaluate
  - Objects are integrated
  - Both objects are identifiable

Output: A visual blend

Prof. Lydia Chilton
From Data to Solutions Seminar
13 April 2018
Design: How to go from idea to product
Design is not linear. **Design is iterative.**
Design is a constraint-based search problem

Define:

Search spaces:
Road lengths, turn angles

Constraints:
Roads must be long enough to be visible
Angles must not exceed 90 degrees

Evaluation function:
Maximize visibility of roads of turns
Crowdsourcing: Decompose a task. Pay people to do the steps a computer can’t do.

You (misspelled) (several) (words).

improve

vote

You (?) (?) (?) (work).

You (?) (?) (?) (work).

You (?) (?) (?) (work).
An Interactive Pipeline for Creating VisualBlends

Wash your hands. It's the smart thing to do.

Visual blends are images that help convey a message.

The pipeline decomposes the iterative design process into independent microtasks.
Design Pattern: Single Shape Mapping

1. Two objects are integrated into one object
2. Both objects are individually identifiable
Visual Blends for Random Concept Pairs

- Bicycle + Fall
- McDonald’s + Energy
- McDonald’s + Healthy
- NYC + Fashion
Visual Blends for Messages

Wash your hands. It’s the smart move.

Joe’s Coffee
Open late

Football Linked to Lasting Brain Damage
DALLAS, Tex. — Reports show an increasing number of retired NFL players who have suffered concussions have developed cognitive issues

Panel discussion
Women in CS

Join the Philosophy Dept’s

Holiday Celebration
When do we need to iterate?

Improve object fit

No matches

Objects are not identifiable

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