Computational Design

No screens

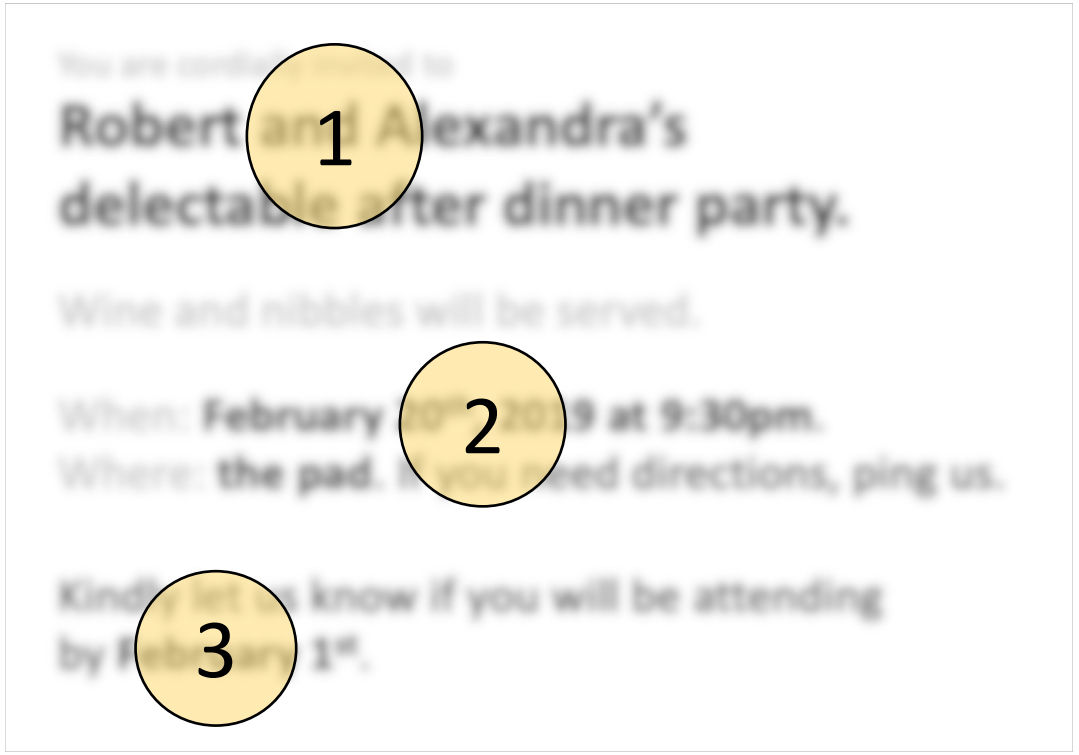
Prof. Lydia Chilton

COMS 4170

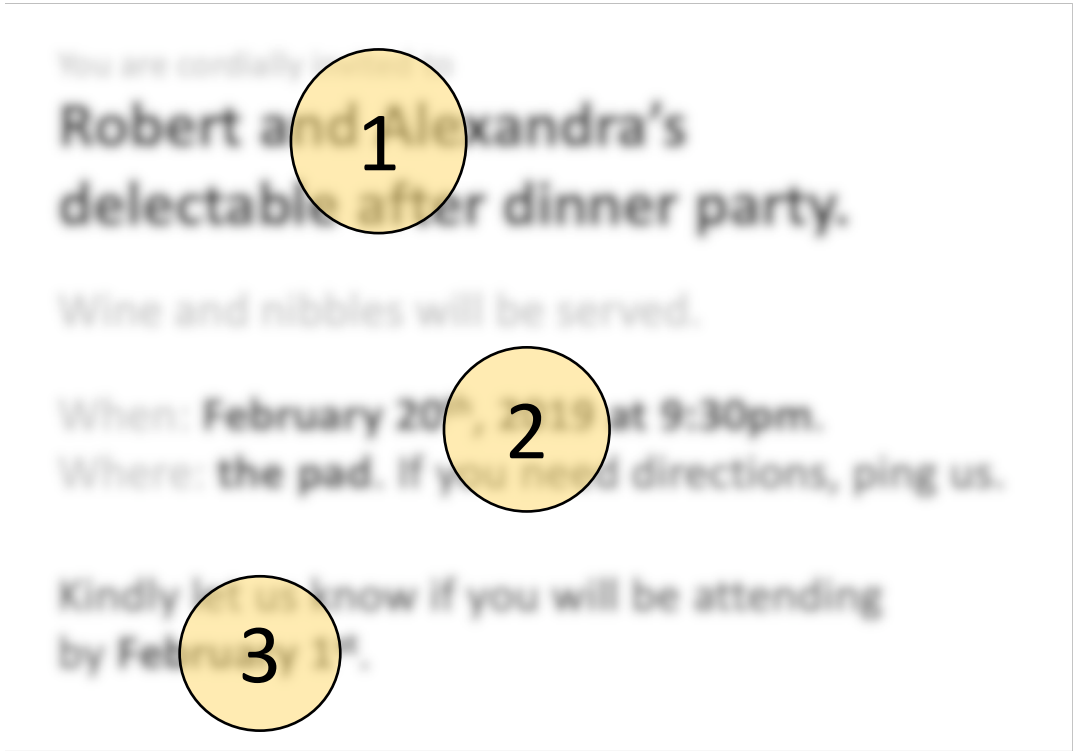
13 March 2019

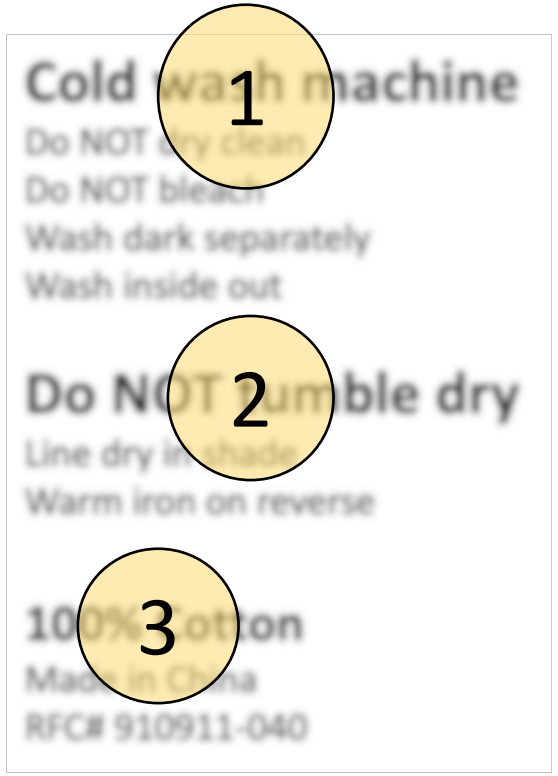
Goal: Design this information so it's easier to read the important bits.

You are cordially invited to Robert and Alexandra's delectable after dinner party. Wine and nibbles will be served. When: February 20th, 2018 at 9:30pm. Where: the pad. If you need directions, ping us. Kindly let us know if you will be attending by February 1st.



Multiple correct solutions





There are also incorrect answers

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Incorrect:
only uses conceptual grouping

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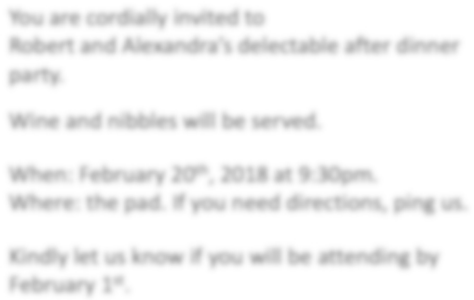
Incorrect:
Too many things are bold

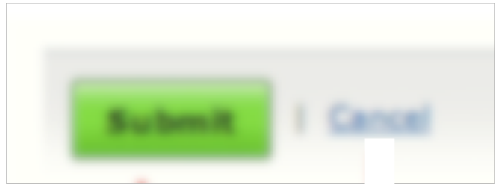
Tools for visually indicating importance



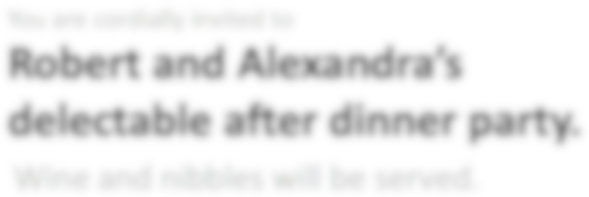
Conceptual grouping

Location

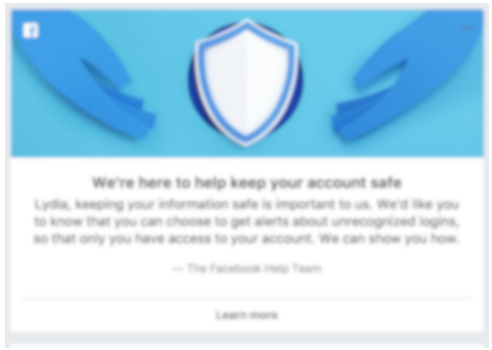
Whitespace



Size



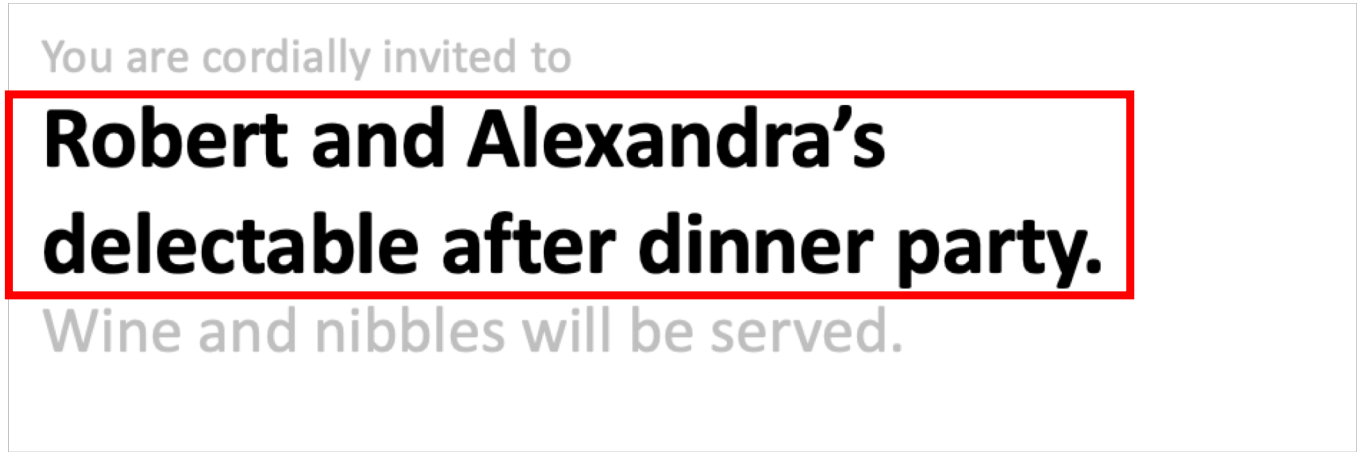
Contrast



Images

Color

Constraint: Use at least two tools within each conceptual group



1. Larger
2. Higher contrast
3. Darker color

Design problems have these signatures

- **Rules** derived from human cognition govern the design
- **Complex constraints** govern the answer. (Often the constraints are conflicting and you have to relax constraints to create an answer)
- **Multiple answers** satisfy the design. (But there are still wrong answers)

Step 1. Group related information into chunks

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Step 2. In each chunk, decide what's important to emphasize.

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You are cordially invited to

Robert and Alexandra's delectable after dinner party.

Step 3. Consolidate into 3 groups.

You are cordially invited to

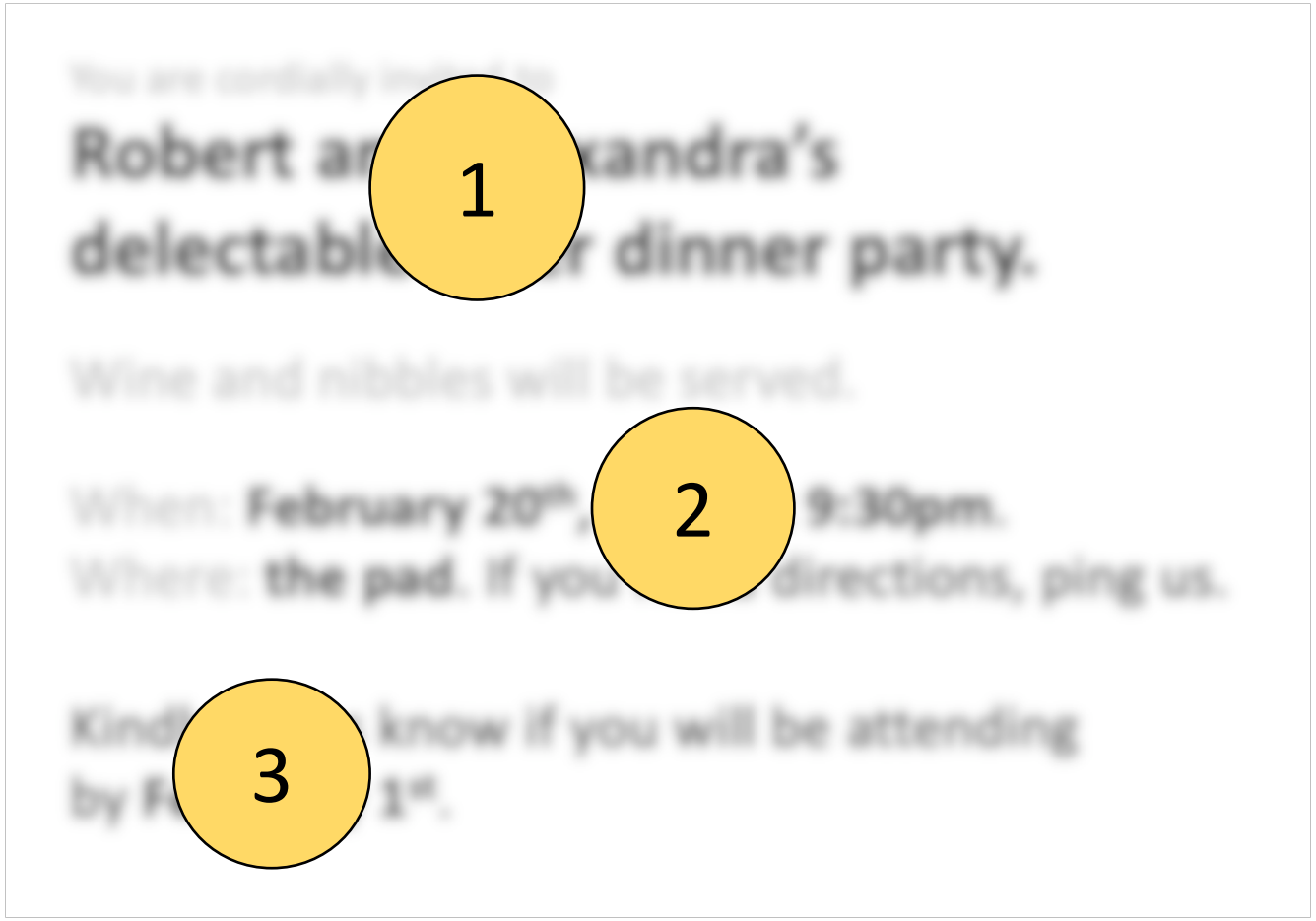
Robert and Alexandra's
delectable after dinner party.

Wine and nibbles will be served.

When: **February 20th, 2019 at 9:30pm**.
Where: **the pad**. If you need directions, ping us.

Kindly let us know if you will be attending
by **February 1st**.

Evaluation: The squint test



Did this linear process work for you?

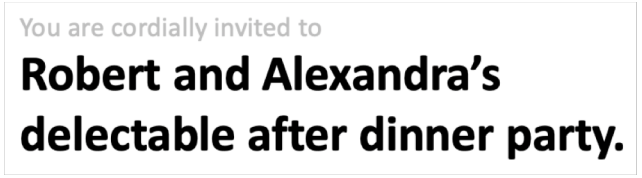
Step 1:
Group

You are cordially invited to Robert and Alexandra's delectable after dinner party.

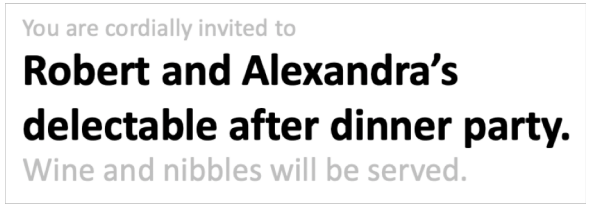
Wine and nibbles will be served.

When: February 20th, 2019 at 9:30pm.
Where: the pad. If you need directions, ping us.

Step 2:
Emphasize

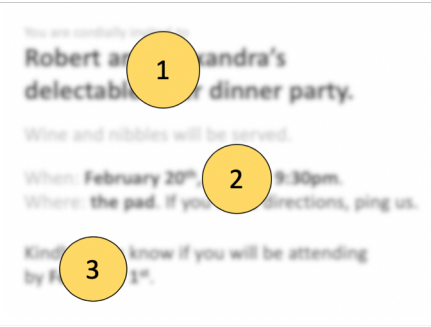


Step 3:
Consolidate



"Consolidate" is actually an iteration of step 1

Step 4:
Squint

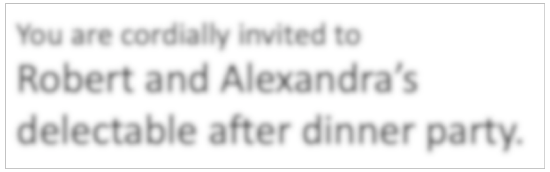


For design problems,
there is **no linear process** that guarantees a solution.

Try something

You are cordially invited to
Robert and Alexandra's
delectable after dinner party.

Evaluate it

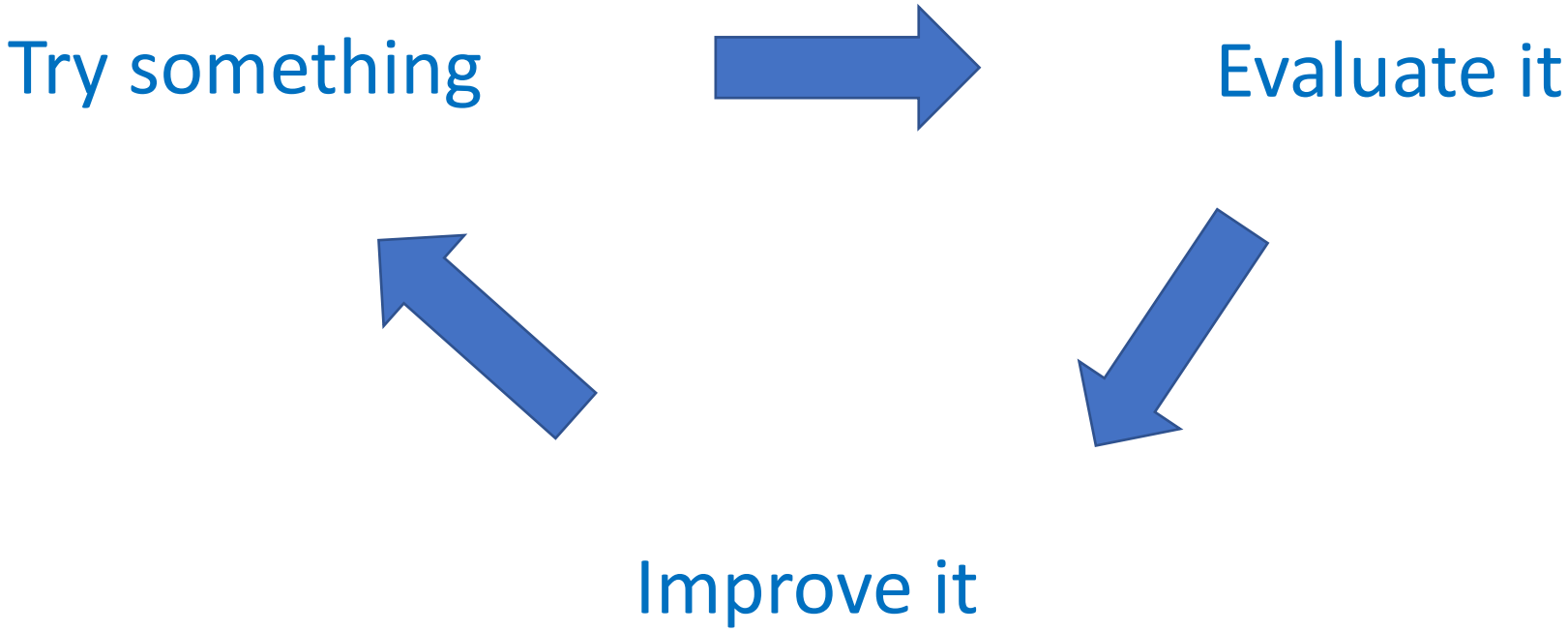


?

Improve it

You are cordially invited to
Robert and Alexandra's
delectable after dinner party.

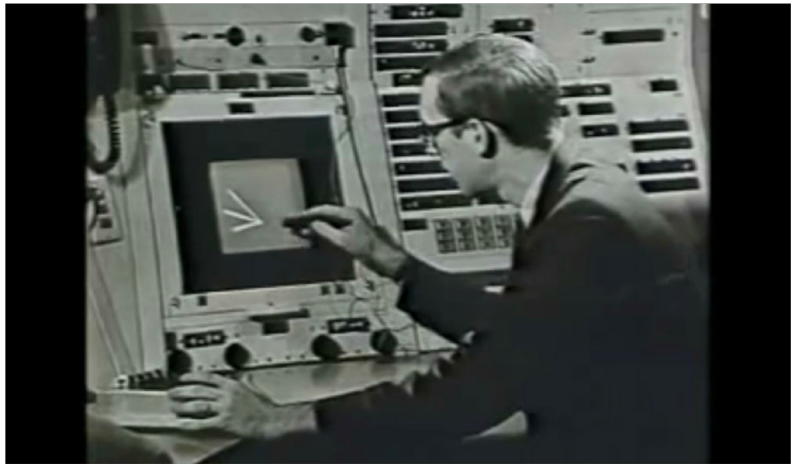
The iterative design process

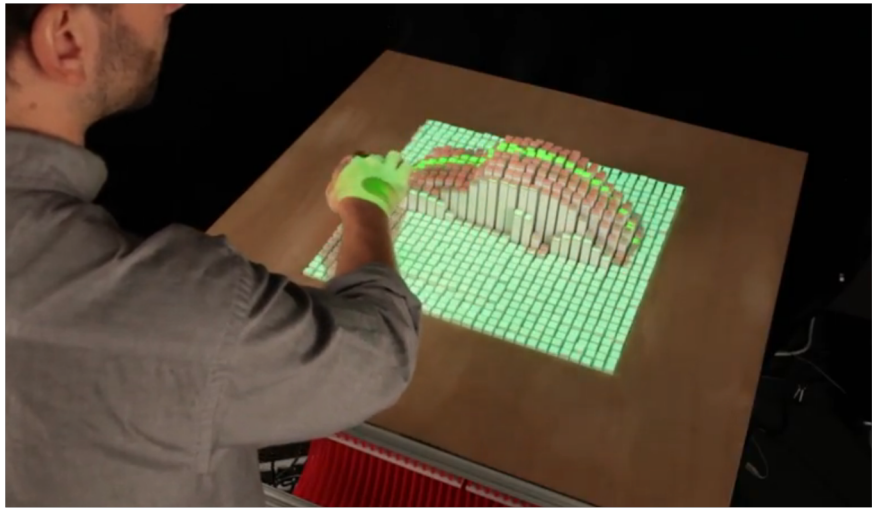


Research topic:

Computational Design

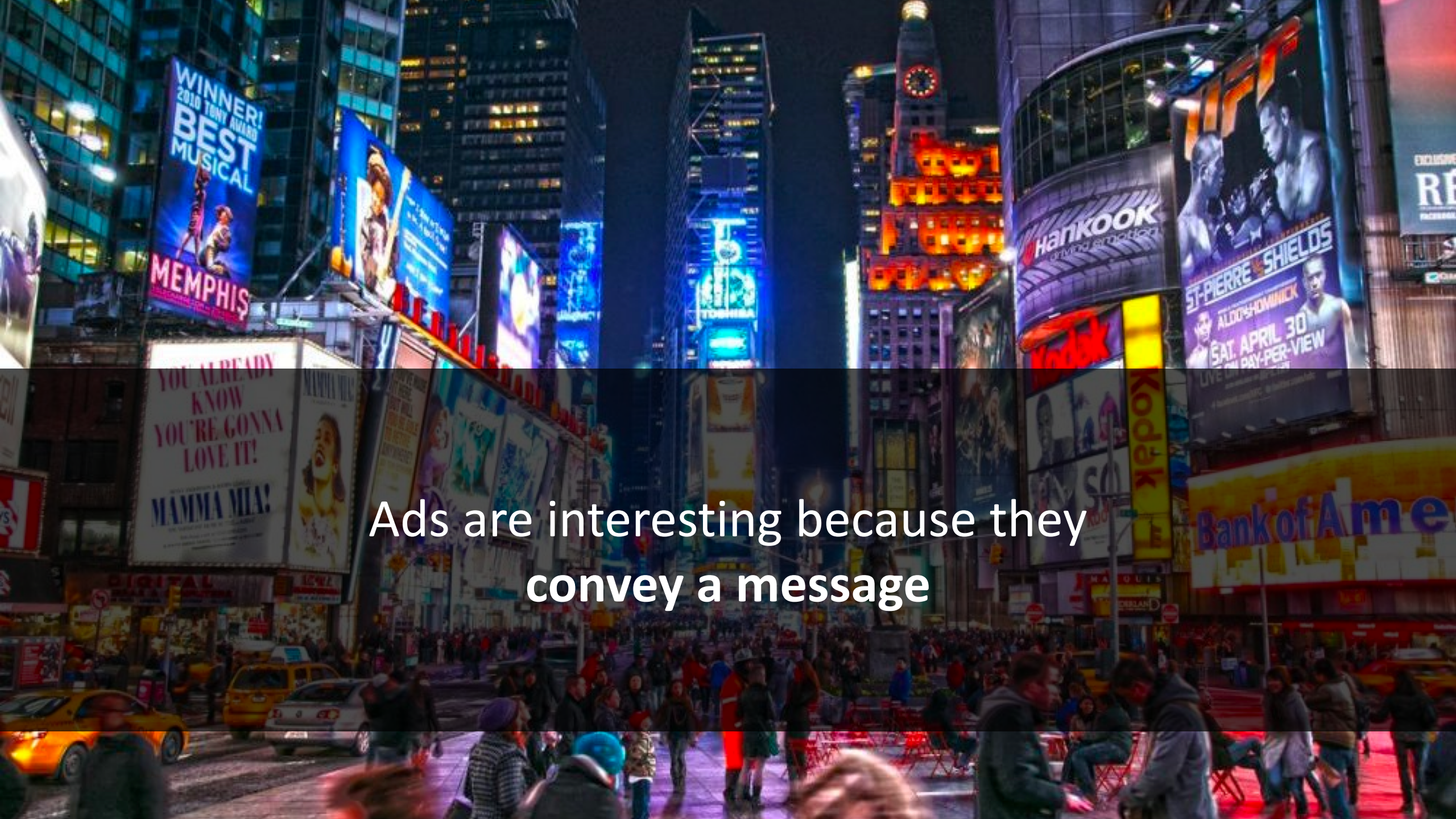
Research projects test ideas





User Interface Design Research:

Crowdsourcing Creative Ads



Ads are interesting because they
convey a message

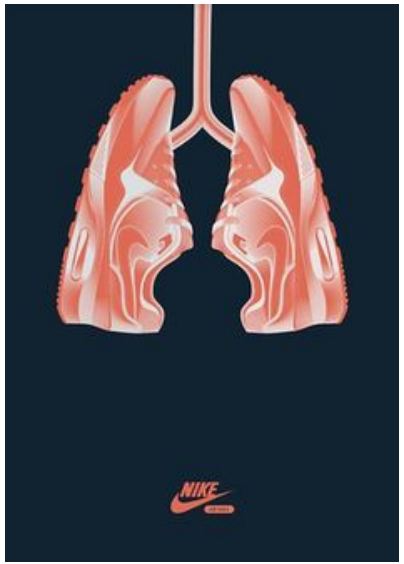
Ads convey a message *implicitly*

Buy RedBull

Google

creative ads

All | Images | Videos | News | Maps | More | Settings | Tools

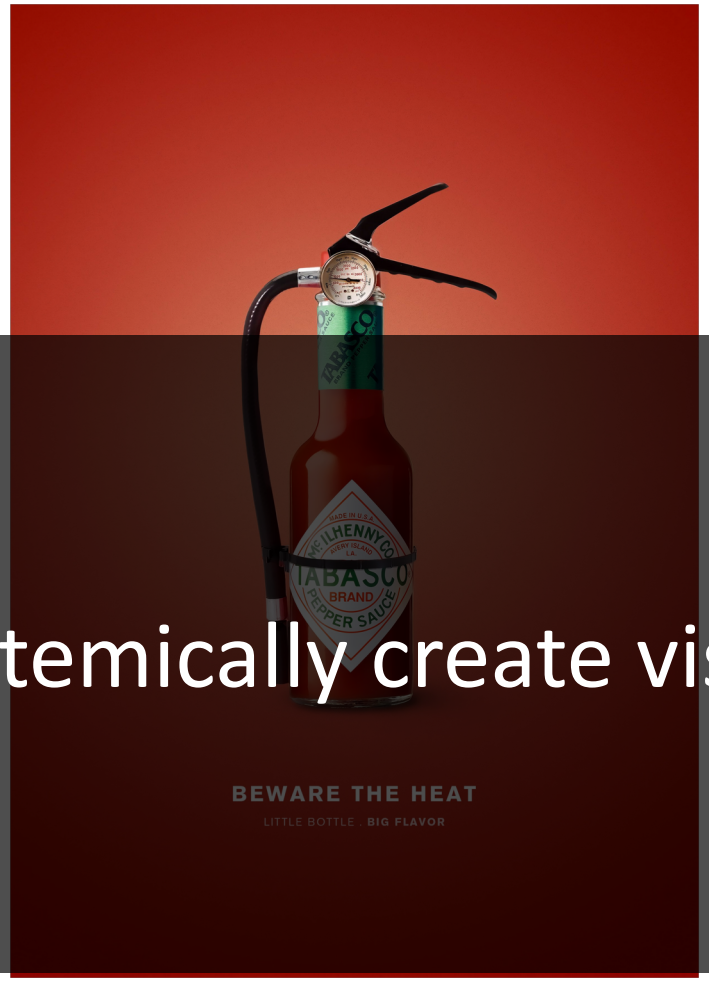


Visual Metaphors

Brazil + Takes Off

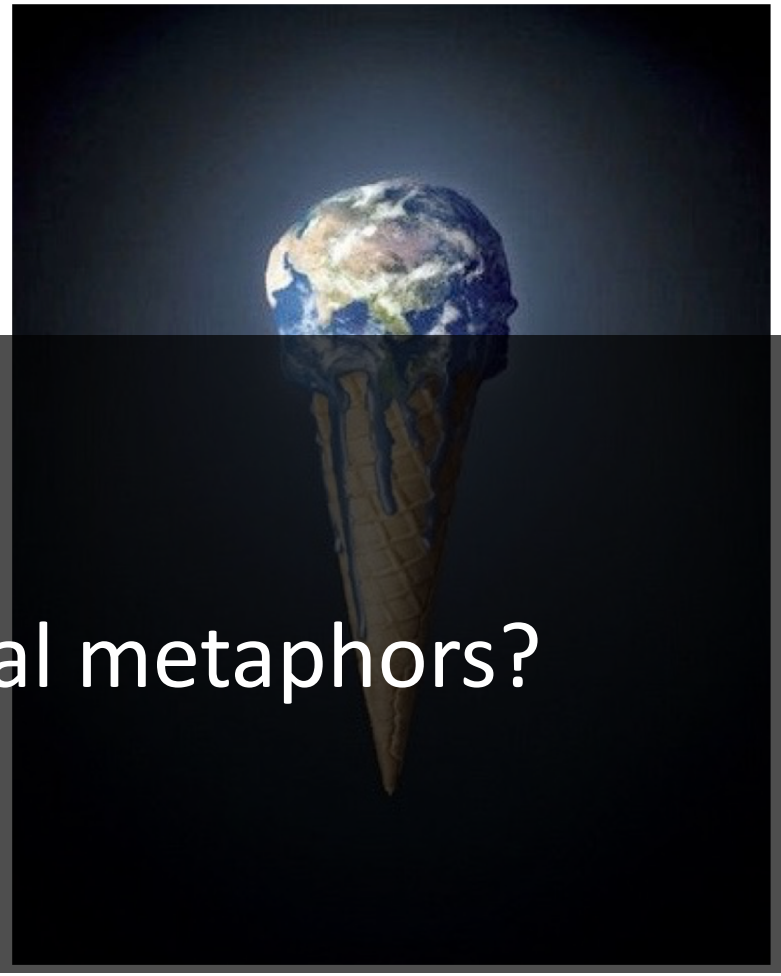
News

Tabasco + Hot



Advertisements

Earth + Melt



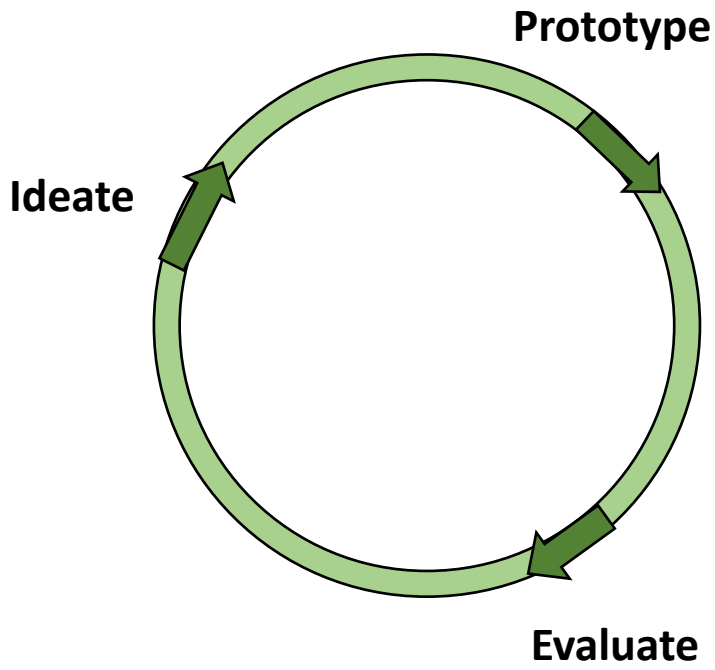
Public Service Announcements

How can we systemically create visual metaphors?

Visual Metaphors are a creative design problem. There is no simple recipe.

Design process:

- **Brainstorm**,
- **Prototype** many ideas,
- **Select** the best ones
- **Iterate** to improve designs



Outline: Crowdsourcing Creative Ads

- Illustration of the VisiBlends Pipeline
- 3 Evaluations:
  - Can we decompose the problem for **decentralized users** to make blends?
  - Can co-located **groups** collaborate to make visual blends?
  - Can we improve **novices**' ability to make Visual Blends?
- Can we decompose other creative tasks?

Visual Metaphors

Brazil + Takes Off

News

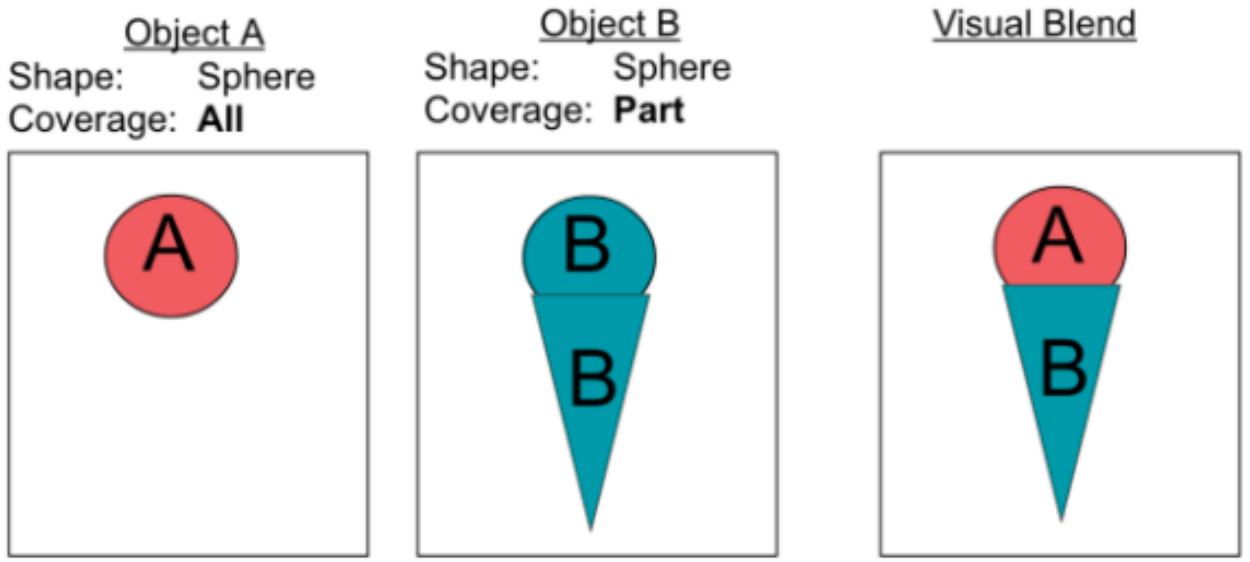
Tabasco + Hot

Advertisements

Earth + Melt

Public Service Announcements

Design Pattern: Single Shape Mapping



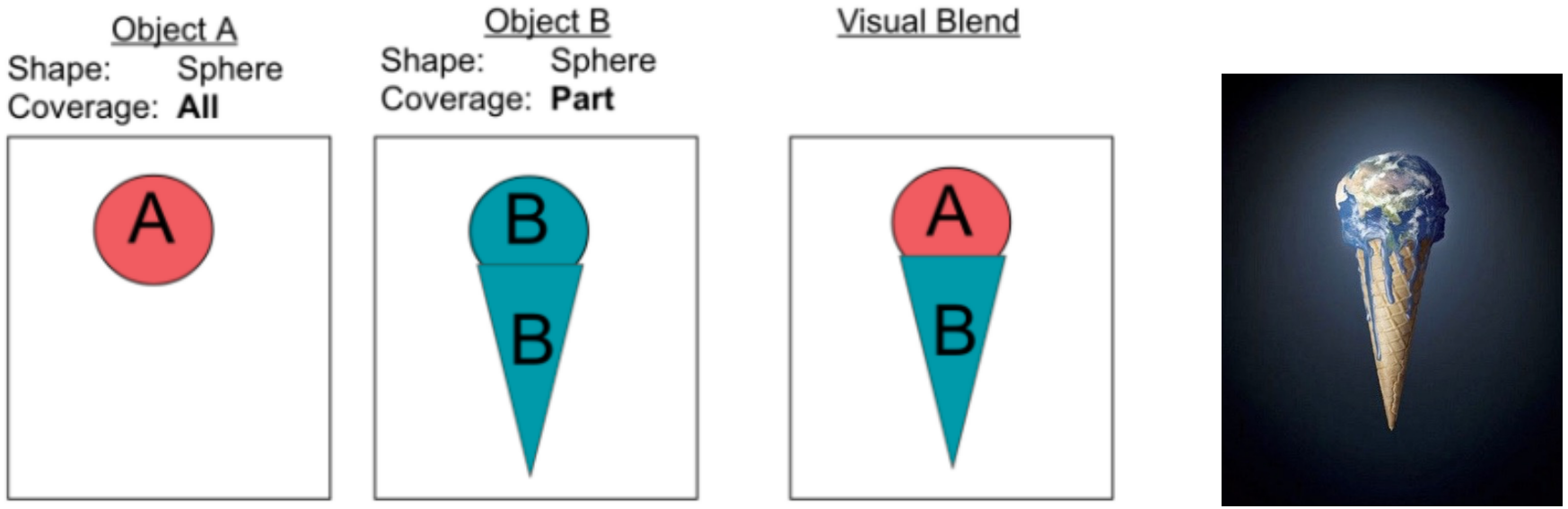
1. Two objects are **integrated** into one object
2. Both objects are individually **identifiable**

Tabasco	Hot	Tabasco + Hot
		

Turn off	Cell phone	Turn off + Cell phone
		

A creative problem is now a search problem:

For two concepts, search for symbols that meet this constraint



1. Two objects are **integrated** into one object
2. Both objects are individually **identifiable**

Starbucks + Summer

Inputs: Two Concepts

Starbucks

Summer

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations	store, frappuccino	

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations	store, frappuccino	
Find images of objects	 	

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations	store, frappuccino	
Find images of objects	 	
Annotate shapes	 	

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations	store, frappuccino	
Find images of objects		
Annotate shapes		
Annotate coverage	*All* of object	*Part* of object

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations		beach, sun, swim

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations		beach, sun, swim
Find images of objects		

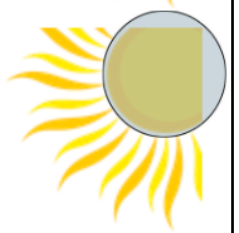
Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations		beach, sun, swim
Find images of objects		 
Annotate shapes		 
Annotate coverage		*Part* of object / *Part* of object

Inputs: Two Concepts

	Starbucks		Summer	
Brainstorm associations	store, frappuccino		beach, sun, swim	
Find images of objects				
Annotate shapes				
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object

Inputs: Two Concepts

	Starbucks		Summer	
Brainstorm associations	store, frappuccino		beach, sun, swim	
Find images of objects				
Annotate shapes				
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object

Inputs: Two Concepts

	Starbucks		Summer	
Brainstorm associations	store, frappuccino		beach, sun, swim	
Find images of objects				
Annotate shapes				
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object
Prototype blend				

Inputs: Two Concepts

	Starbucks		Summer	
Brainstorm associations	store, frappuccino		beach, sun, swim	
Find images of objects				
Annotate shapes				
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object
Prototype blend				
Evaluate prototype				

✓ Two objects are **integrated** into one
✓ Both objects are **identifiable**

Inputs: Two Concepts

	Starbucks		Summer	
Brainstorm associations	store, frappuccino		beach, sun, swim	
Find images of objects				
Annotate shapes				
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object
Prototype blend				
Evaluate prototype	✓ Two objects are **integrated** into one ✓ Both objects are **identifiable**			

Output:
A visual blend

Inputs: Two Concepts

	Starbucks	Summer
Brainstorm associations	store, frappuccino	beach, sun, swim
Find images of objects	 	 
Annotate shapes	 	 
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object
Prototype blend		
Evaluate prototype		

Iterate

Output:
A visual blend

✓ Two objects are **integrated** into one
✓ Both objects are **identifiable**

Inputs: Two Concepts

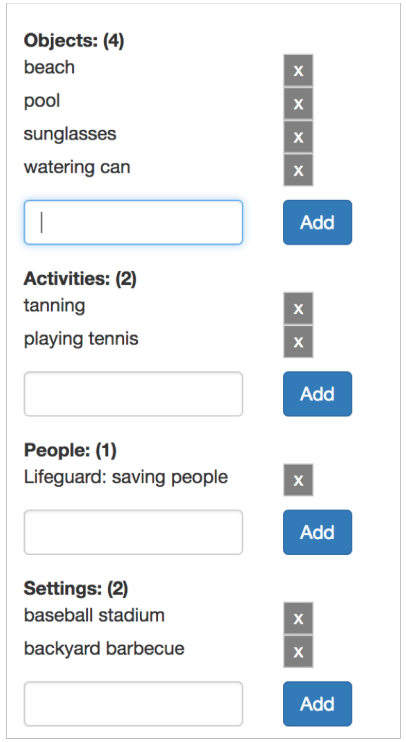
	Starbucks	Summer
Brainstorm associations	store, frappuccino	beach, sun, swim
Find images of objects	 	 
Annotate shapes	 	 
Annotate coverage	*All* of object	*Part* of object	*Part* of object	*Part* of object
Prototype blend				
Evaluate prototype				

Iterate

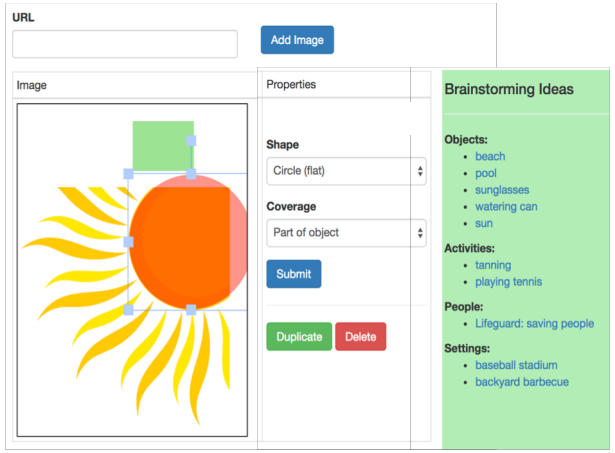
✓ Two objects are **integrated** into one
✓ Both objects are **identifiable**

VisiBlends:
A web interface to collaboratively make blends

A) Brainstorm for **summer**



B) Find and annotate images for **summer**



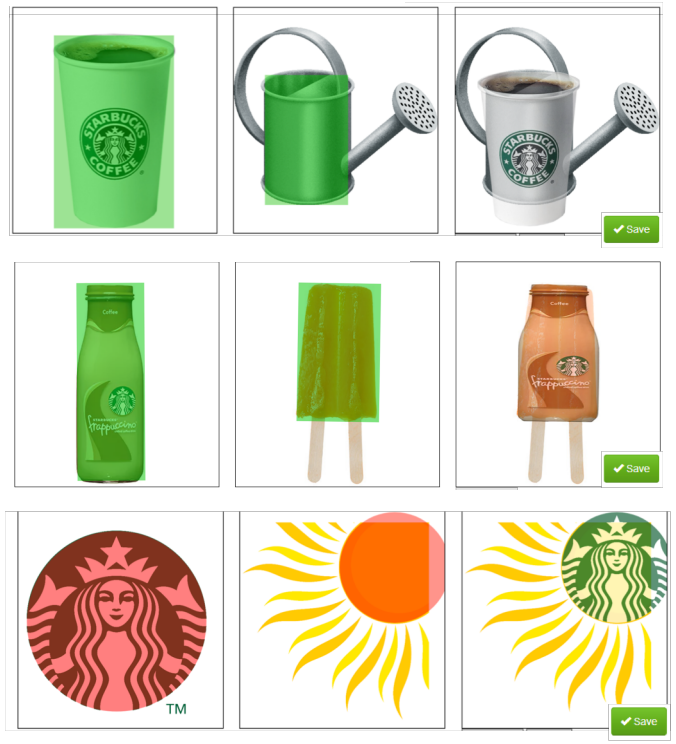
C) Matching algorithm **Starbucks + summer**

```
matches = []
for a in summer_symbols:
  for b in starbucks_symbols:
    a_ratio = a.height / a.width
    b_ratio = b.height / b.width
    ratios = sort(a_ratio, b_ratio)

    if (a.shape == b.shape) and
       (a.coverage  != coverage) and
       (ratios[0] >= 0.5*ratios[1]):
           matches.push([a, b])

return matches
```

D) Automatic blends + human evaluation **Starbucks + summer**



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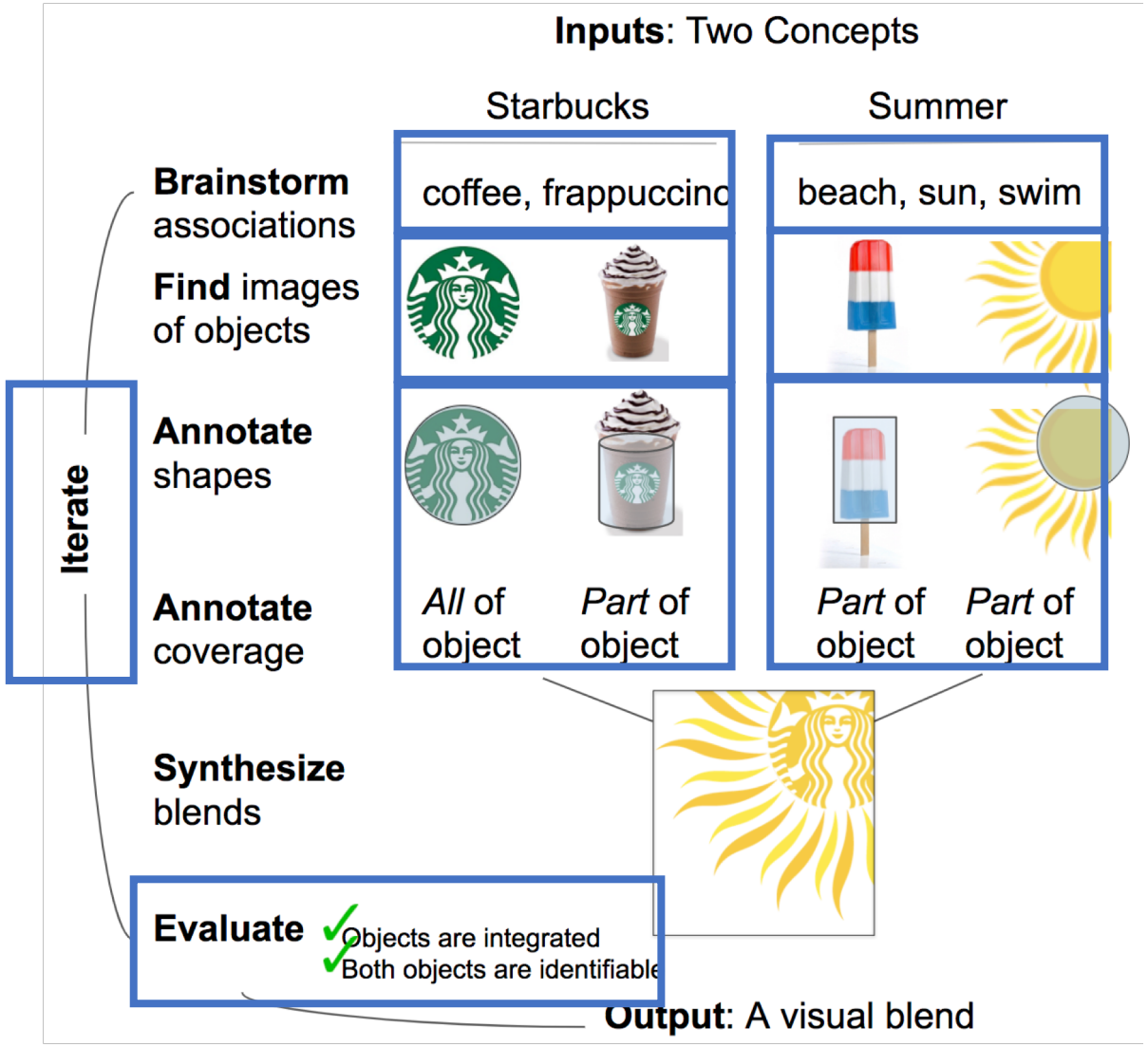
- Can we decompose other creative tasks?

Decompose the pipeline



Five people

Five people

One person

One person

One person

One person

Computer: matching and blending algorithms

One person

One person

Rules for finding images are complex

Objects…

Not scenes

Simple objects…

Not fancy objects

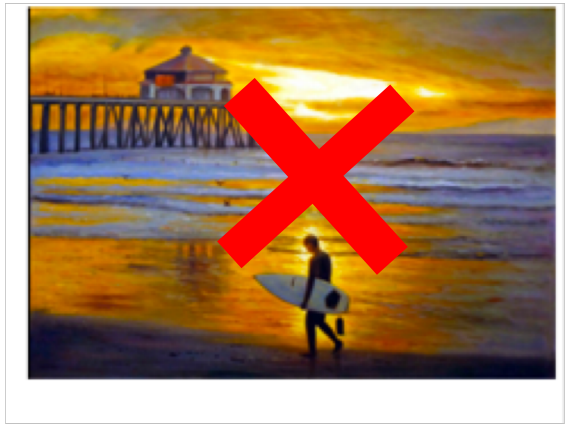
Object with one main shape…

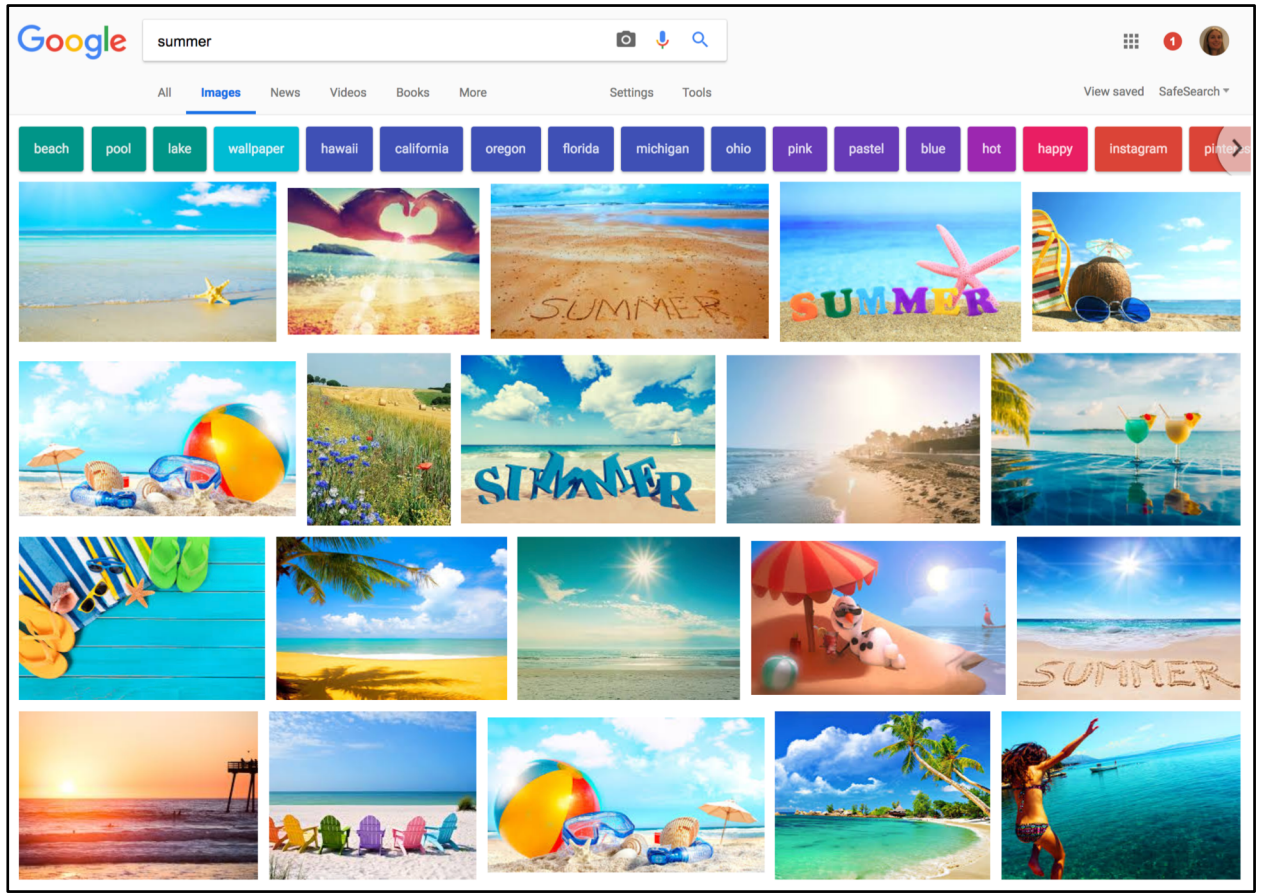
Not objects with multiple main shapes

Objects…

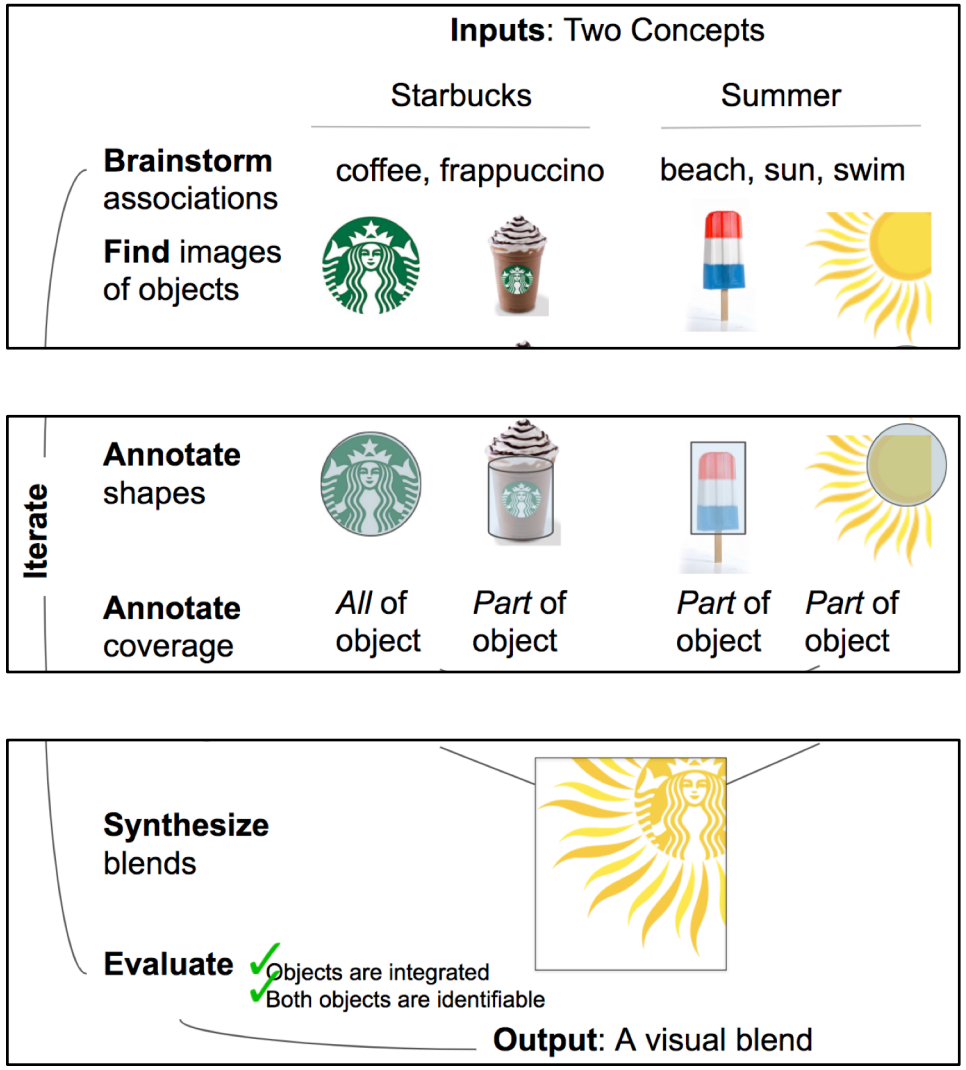
Not people or animals

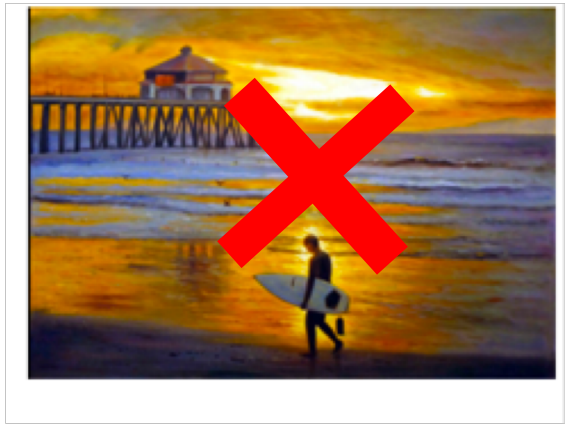
Our first attempt failed.
People weren't finding the right images.

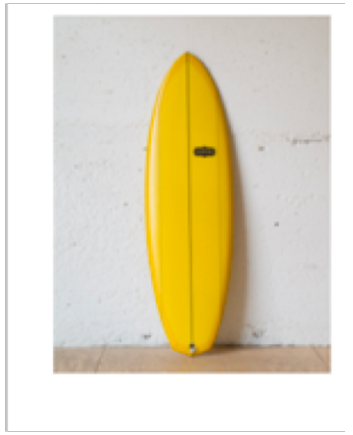




To fix it, we trained people on the pipeline steps *backwards*.







Now they know why they need to pick
Simple, iconic objects with a single main shape.

Because they're seen how it affects the pipeline

Independent people can make blends for random concept pairs.

Bicycle + Fall

McDonald's + Energy

McDonald's + Healthy

NYC + Fashion

11 of 16 pairs found a blend in iteration 1
5 of 16 pairs found a blend in iteration 2

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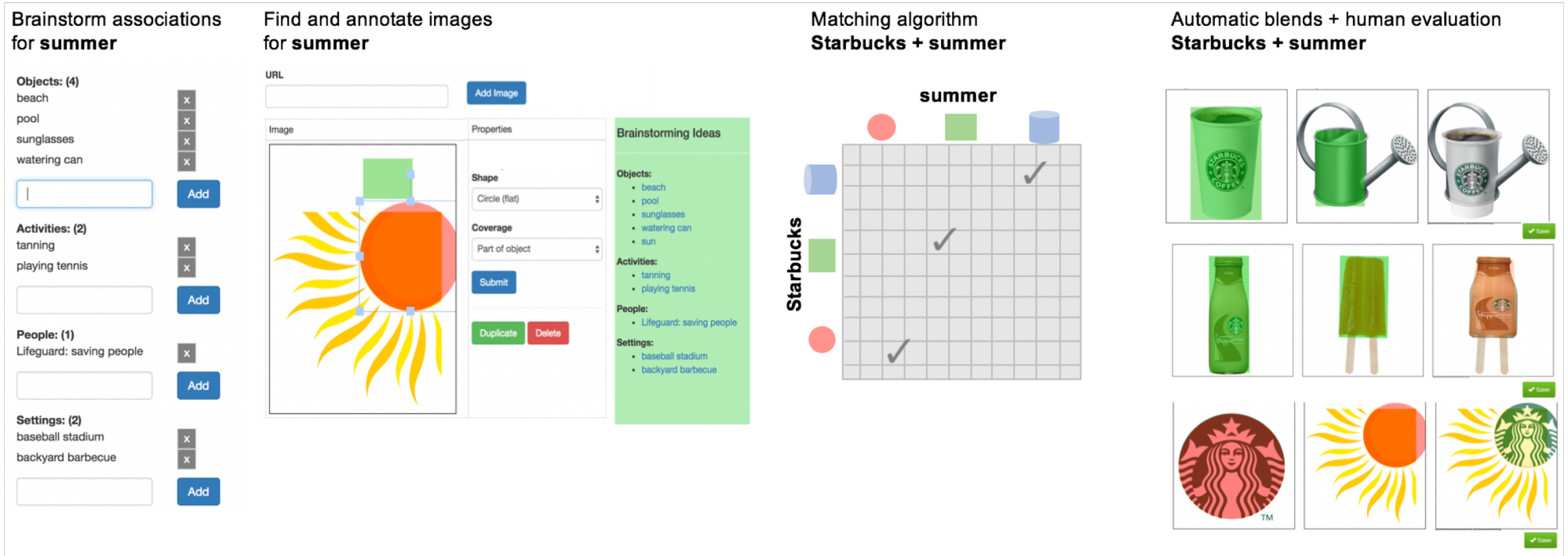
Study 2

- 5 co-located groups of 3 undergrads and/or grad students
- All had their own laptop
- Data is synchronized across users in real time



Study 2: Joe’s Coffee + Night

Ad

“Joe’s Coffee: Open Late”

Study 2: Hand-washing + smart

PSA

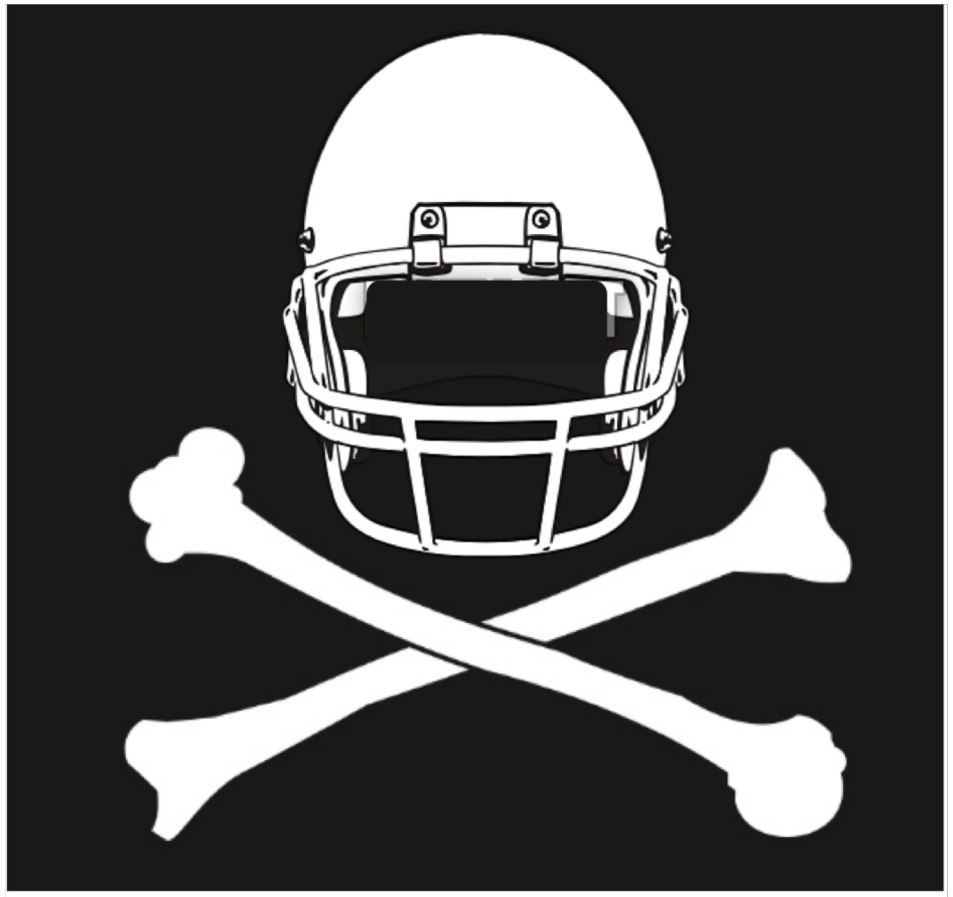
"Wash your hands.
It's the smart move."

Study 2: Women + CS

Ad:

“Panel Discussion:
Women in Computer Science”

Study 2: Football + Dangerous



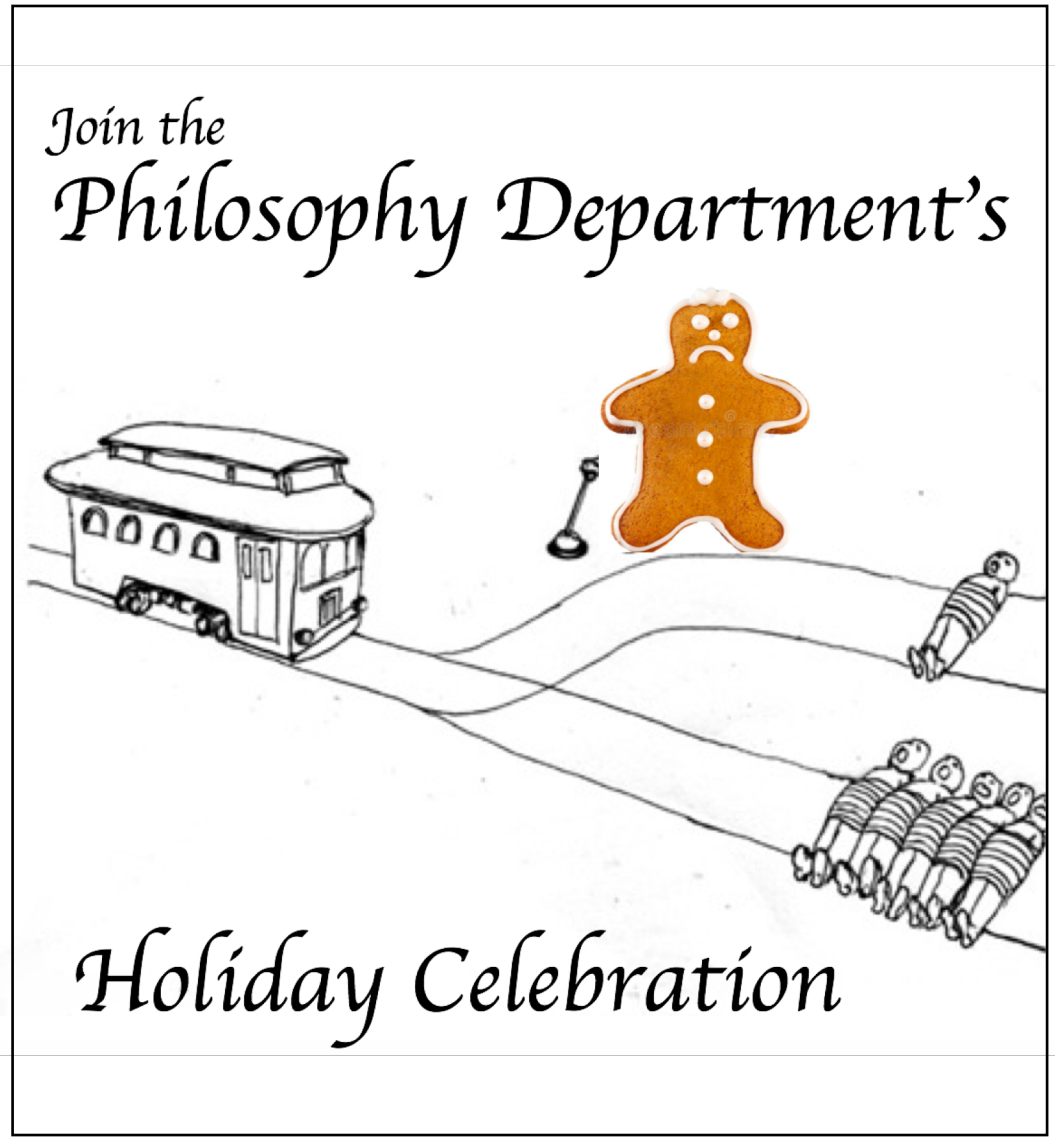
Football Linked to Lasting Brain Damage

DALLAS, Tex. – Reports show and increasing number of retired NFL players who have suffered concussions have developed cognitive issues

News

"Football linked to lasting brain damage."

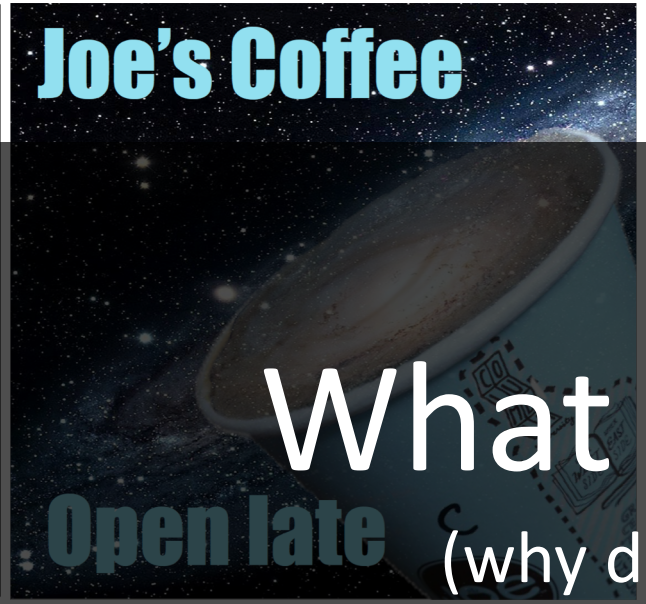
Study 2: Philosophy + Christmas

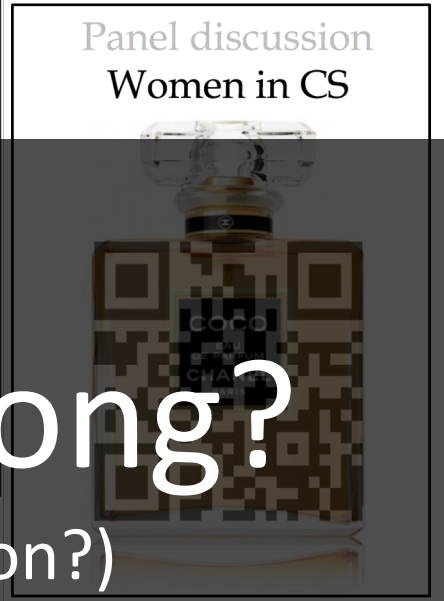


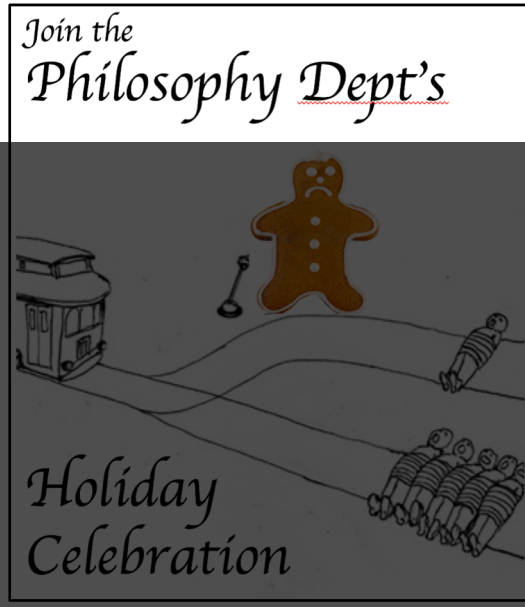
Ad:

"Join the Philosophy Dept's Holiday Celebration"

Groups can collaboratively make blends for their own messages







What goes wrong?

(why do we need iteration?)

Football + Dangerous

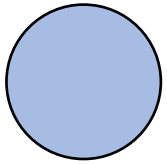
Football

Dangerous

Brainstorm
associations

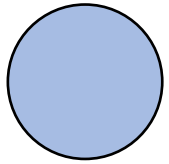
Find Images
of objects

Annotate
shapes



Annotate
shape coverage

Shape covers
All of object



Shape covers
Part of object

Blend

Evaluate

✓ Are both objects identifiable?

✗ Are two objects integrated into one object?

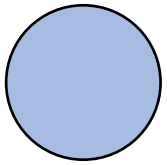
Football

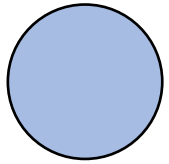
Dangerous

Brainstorm
associations

Find Images
of objects

Annotate
shapes





Annotate
shape coverage

Shape covers
All of object

Shape covers
Part of object

Blend

Evaluate

- ✓ Are both objects identifiable?
- ✓ Are two objects integrated into one object?

NYC + Healthy

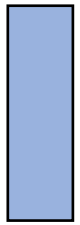
NYC

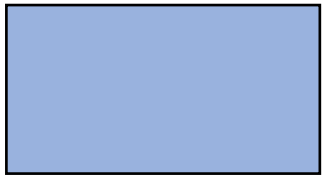
Healthy

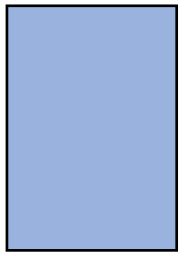
Brainstorm associations

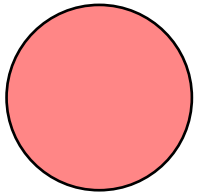
Find Images of objects

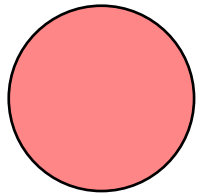
Annotate shapes











Annotate shape coverage

Blend

No shape matches

Evaluate

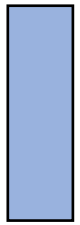
NYC

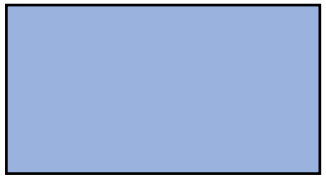
Healthy

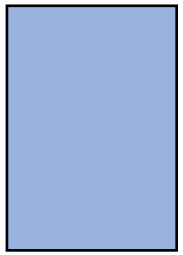
Brainstorm associations

Find Images of objects

Annotate shapes







Annotate shape coverage

Blend

Evaluate

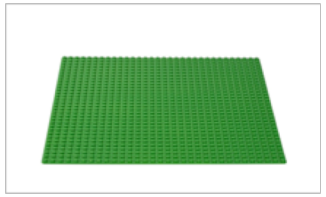
- ✓ Are both objects identifiable?
- ✓ Are two objects integrated into one object?

Lego + Healthy

Lego

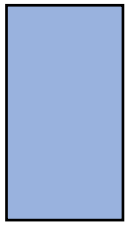
Healthy

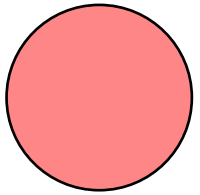
Brainstorm
associations

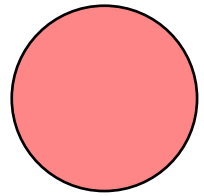


Find Images
of objects

Annotate
shapes







Annotate
shape coverage

Blend

No shape matches

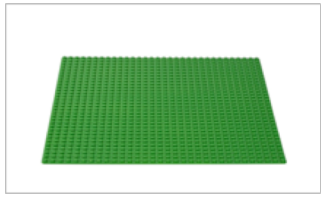
Evaluate

Lego

Healthy

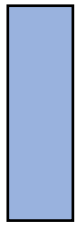
Brainstorm
associations

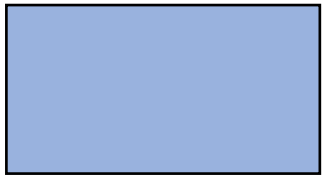
Find Images
of objects

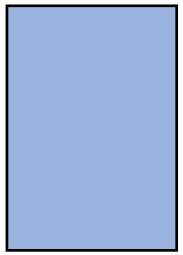


Annotate
shapes

Annotate
shape coverage





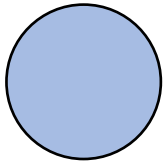
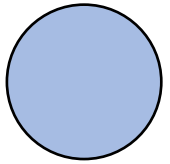


Blend

Evaluate

- ✓ Are both objects identifiable?
- ✓ Are two objects integrated into one object?

Orange + Healthy

	Orange	Healthy
Brainstorm associations		
Find Images of objects		
Annotate shapes		
Annotate shape coverage	Shape covers **Part** of object	Shape covers **All** of object
Blend		

Evaluate

Are both objects identifiable?
Are two objects integrated into one object?

Brainstorm
associations

Find Images
of objects

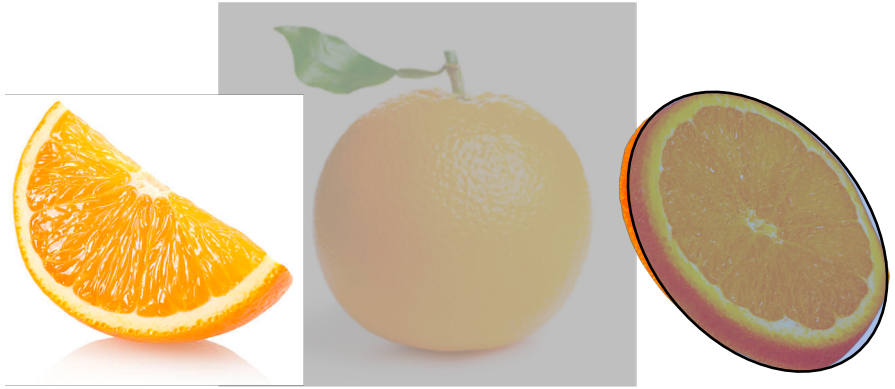
Annotate
shapes

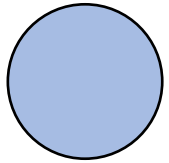
Annotate
shape coverage

Blend

Evaluate

Orange

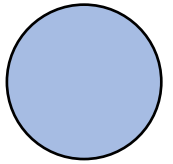




Shape covers
All of object

Healthy

Exercise equipment



Shape covers
Part of object

Brainstorm
associations

Find Images
of objects

Annotate
shapes

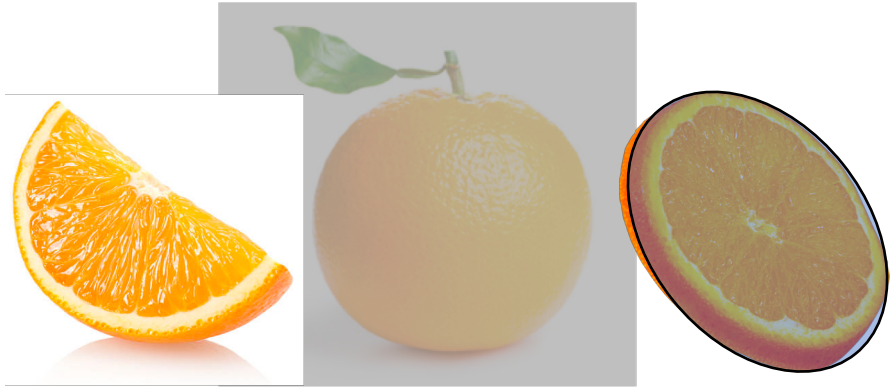
Annotate
shape coverage

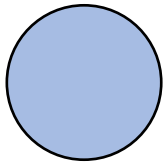
Blend

Evaluate

Are both objects identifiable?
Are two objects integrated into one object?

Orange

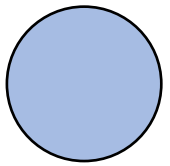




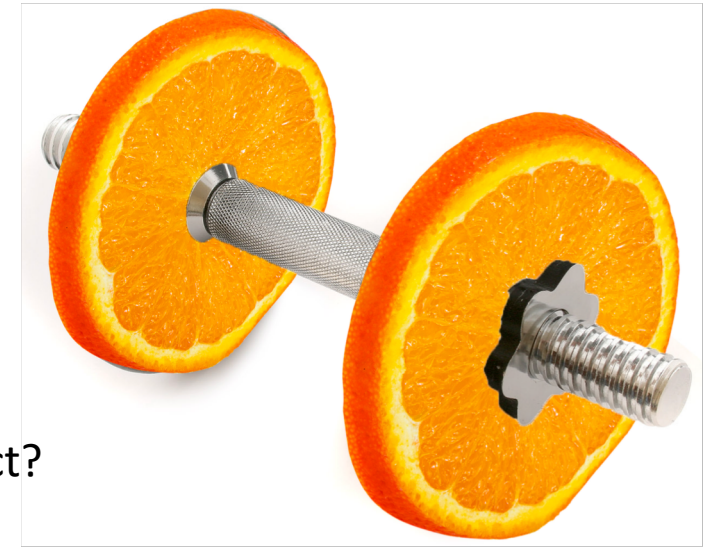
Shape covers
All of object

Healthy

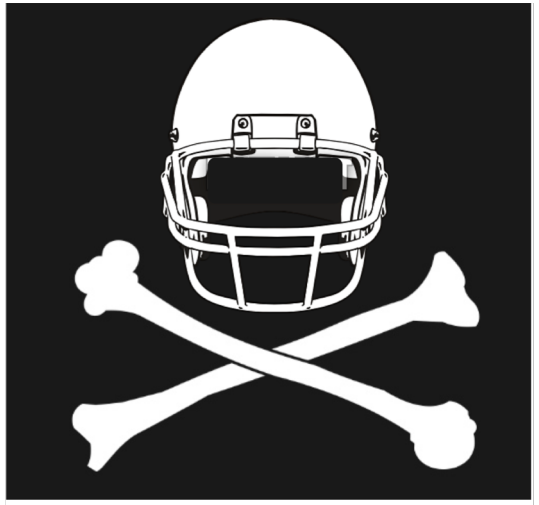
Exercise equipment



Shape covers
Part of object

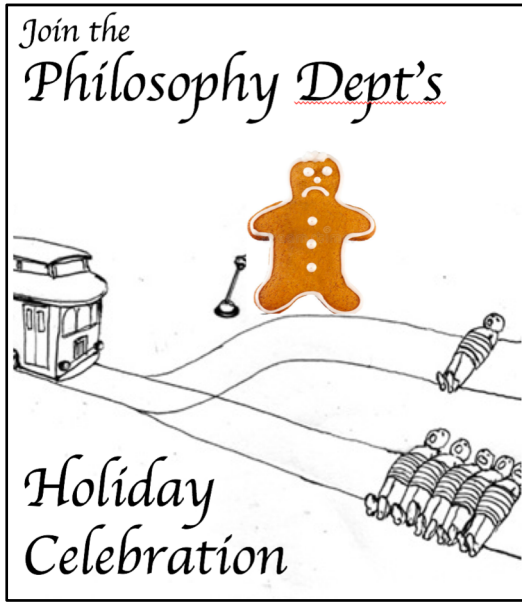


Groups can collaboratively make blends for their own messages



Football Linked to Lasting Brain Damage

DALLAS, Tex. – Reports show and increasing number of retired NFL players who have suffered concussions have developed cognitive issues



When do we need to iterate?

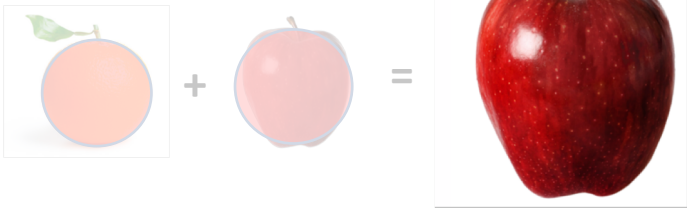
Improve object fit

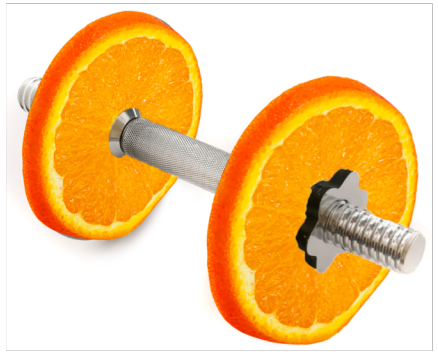
Within same search space, meet other constraints.
Find versions of an object with different
color, style, aspect ratio

No matches

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

Objects are not identifiable





Search in a new subspace
Find symbols with
a different shape

Outline: Crowdsourcing Creative Ads

- Illustration of the VisiBlends Pipeline
- 3 Evaluations:
  - Can we decompose the problem for decentralized users to make blends?
  - Can co-located groups collaborate to make visual blends?
  - Can we improve **novices**' ability to make Visual Blends?
- Can we decompose other creative tasks?

Controlled Study

- 13 undergraduates
- Each made 6 blends
- Control-first condition
  - 3 blends **without** VisiBlends
  - 3 blends with VisiBlends
- System-first condition
  - 3 blends with VisiBlends
  - 3 blends **without** VisiBlends
- How many successful blends could they make?

Blend-making success with and without VisiBlends

Control-first	Without VisiBlends	**With** VisiBlends	
Avg. Number of blends made	**0.56**	**5.56**	(t(18)=4.88, p<0.001)

System-first	**With** VisiBlends	Without VisiBlends	
Avg. Number of blends made	**5.67**	**0.67**	(t(21)=5.84, p<0.001)

Why is this task so hard?

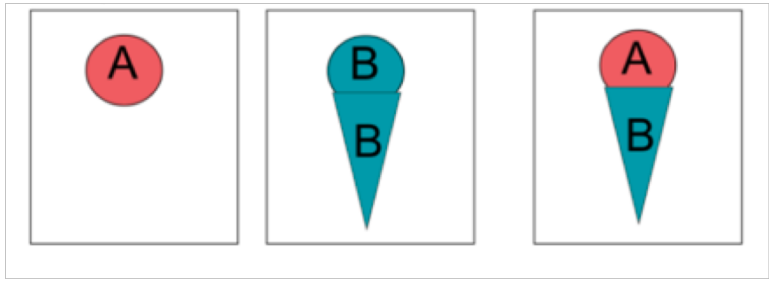
There are a lot of constraints.
Novices without the system focused on
meeting one constraint
at the expense of others.

Usually they, found symbols, and then forced them together.

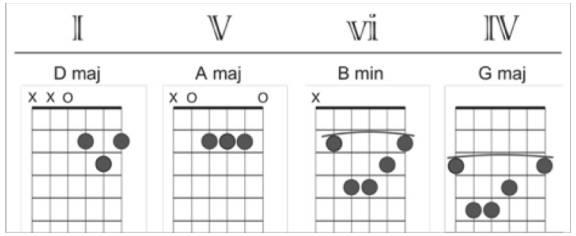
Outline: Crowdsourcing Creative Ads

- Illustration of the VisiBlends Pipeline
- 3 Evaluations:
  - Can we decompose the problem for decentralized users to make blends?
  - Can co-located groups collaborate to make visual blends?
  - Can we improve novices' ability to make Visual Blends?
- Can we decompose other creative tasks?

Design patterns:
Abstract ways that parts fit

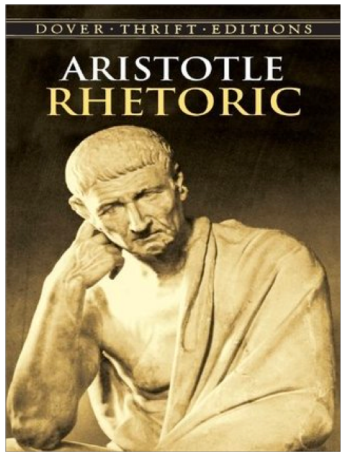


Music

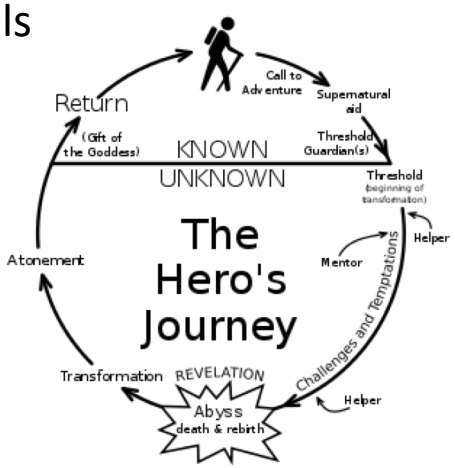


Architecture

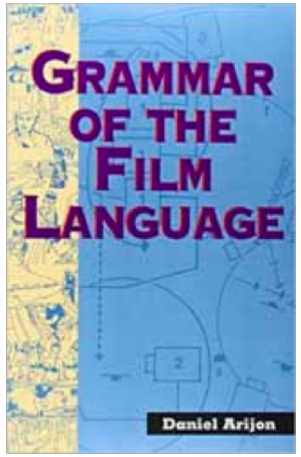
Rhetoric



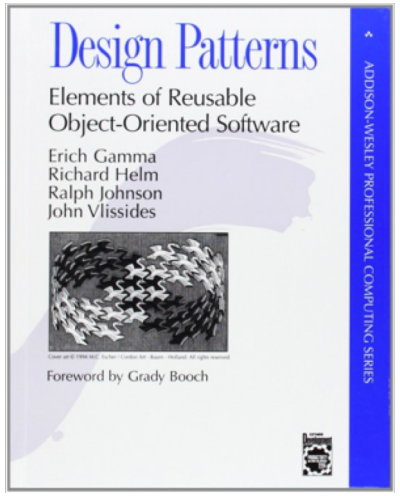
Novels



Cinematography

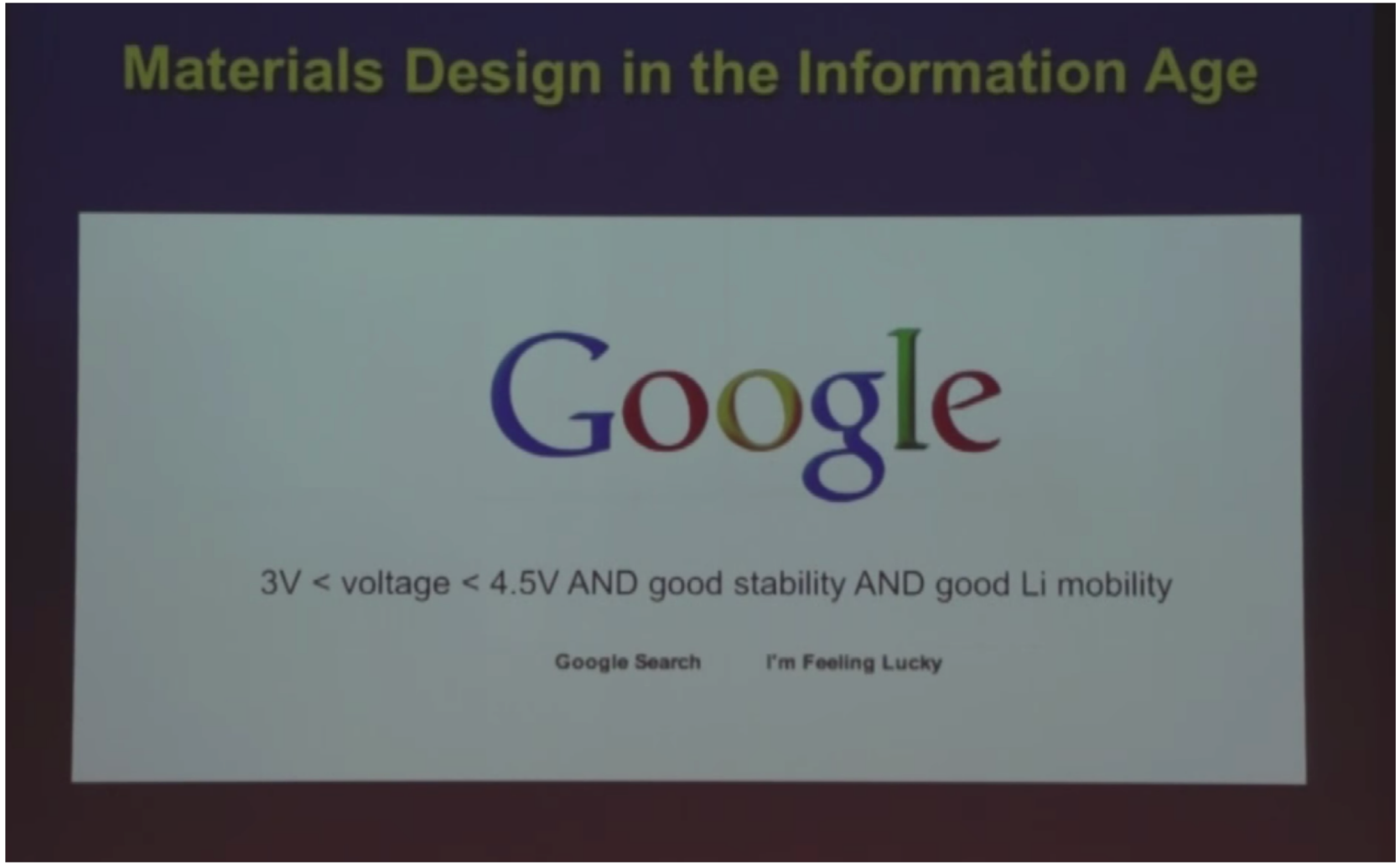


Software



Material Science

Kristin Persson,
Lawrence Berkeley National Laboratory



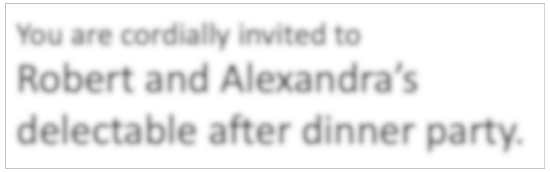
Summary

For design problems,
there is **no linear process** that guarantees a solution.

Try something

You are cordially invited to
Robert and Alexandra's
delectable after dinner party.

Evaluate it

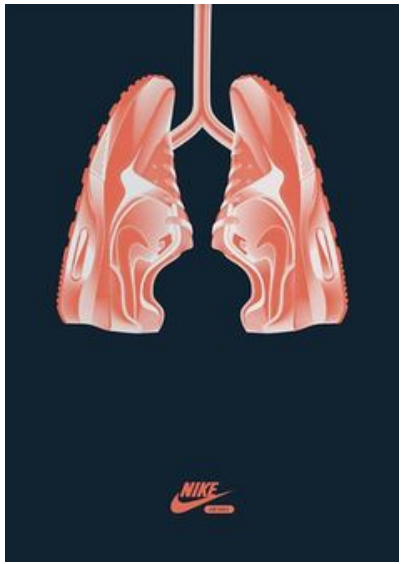


?

Improve it

You are cordially invited to
Robert and Alexandra's
delectable after dinner party.

Advertisements can convey messages visually.

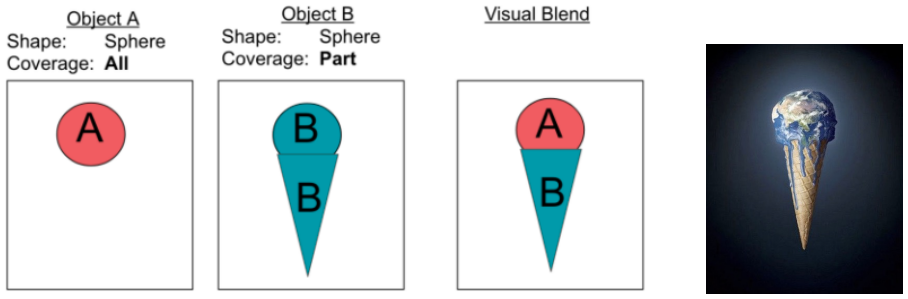


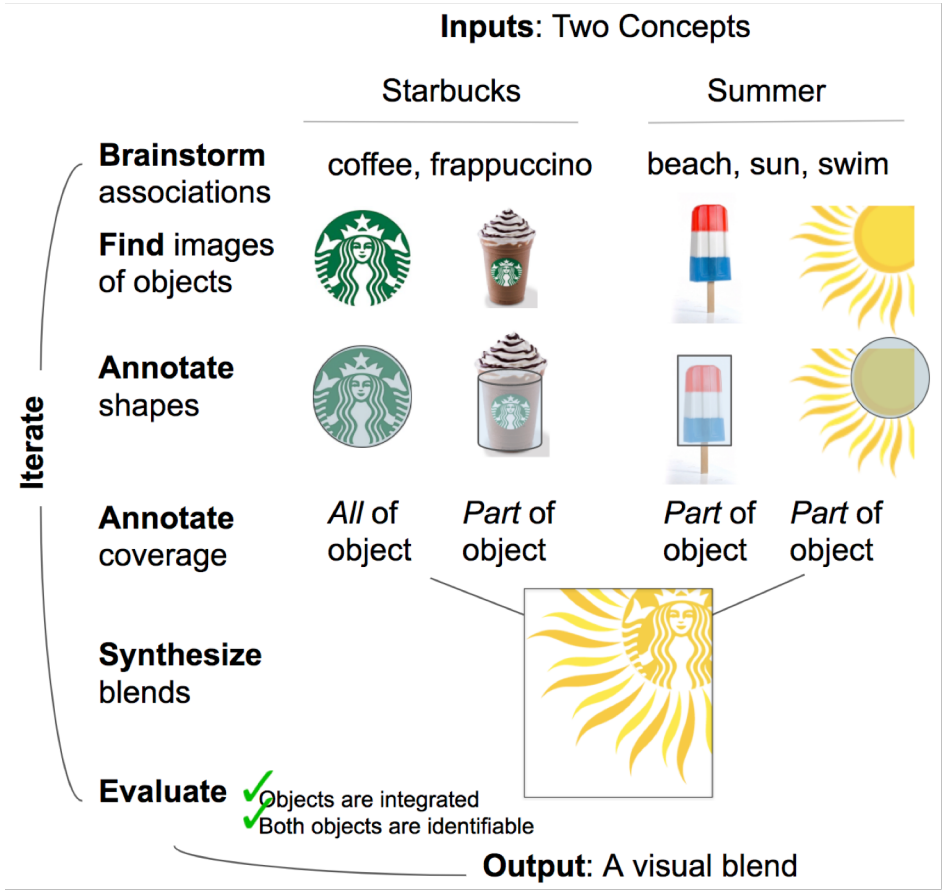
We can decompose design problems

by using an

abstract design pattern

to turn it into a **search problem**.





Independent people can make blends for random concept pairs.

Bicycle + Fall

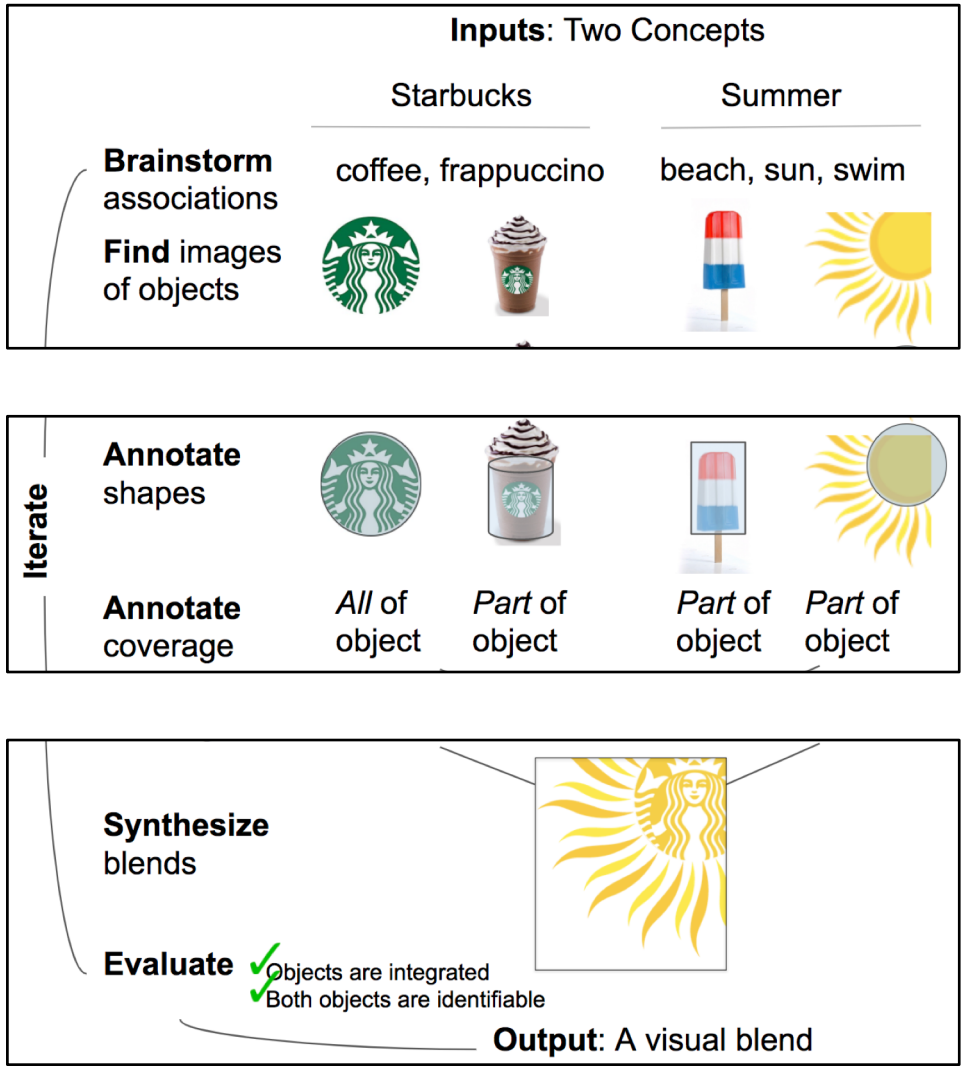
McDonald's + Energy

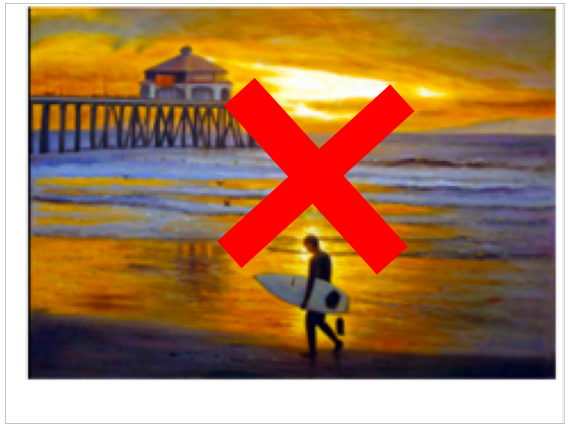
McDonald's + Healthy

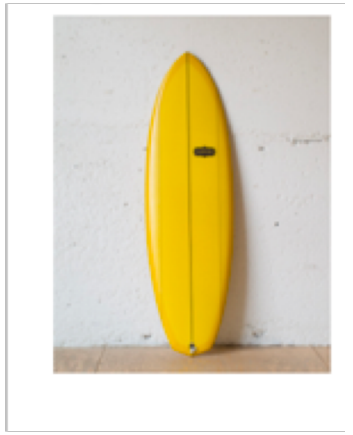
NYC + Fashion

But…

Knowledge of the pipeline is needed to motivate the rules, and fill in gaps.



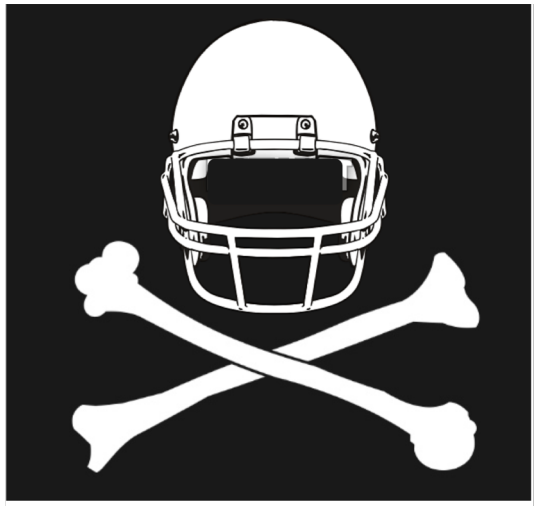




Now they know why they need to pick
Simple, iconic objects with a single main shape.

Because they're seen how it affects the pipeline

Groups can collaboratively make blends for their own messages



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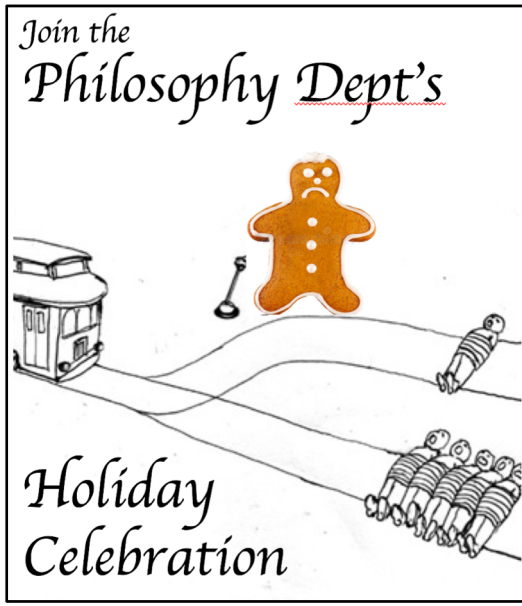


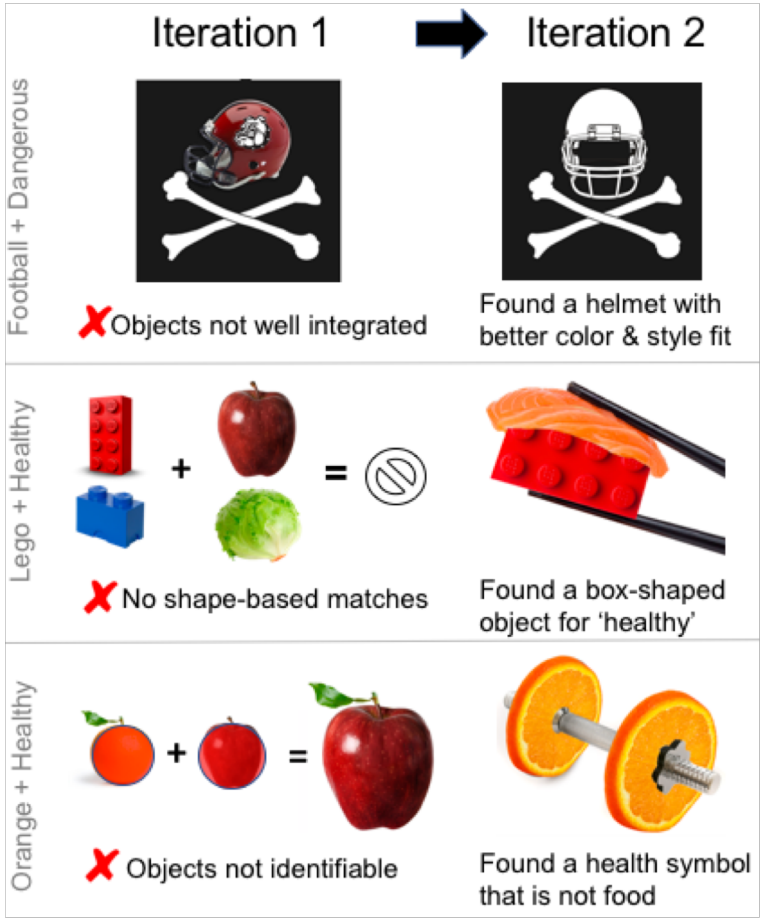
But…

Iteration is necessary to:

Fix small problems like
aesthetic refinement

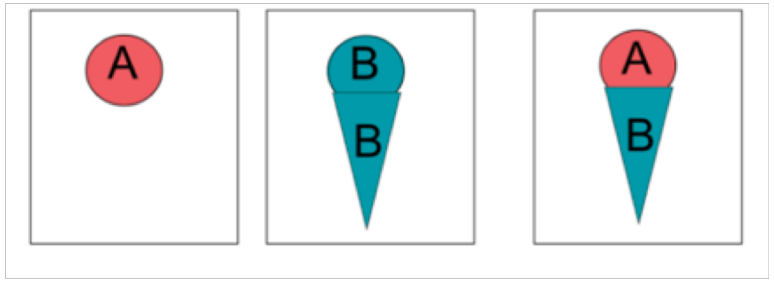
Fix bigger problems by
refining the search for different shapes

Fix failure cases with unforeseen problems by
re-directing the search for different symbols

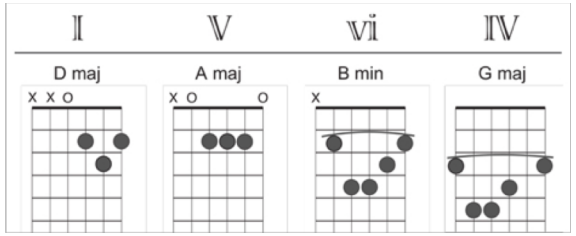


10x improvement in novices' ability to make blends

Design patterns:
Abstract ways that parts fit

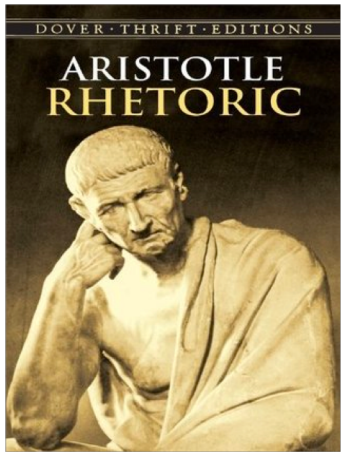


Music

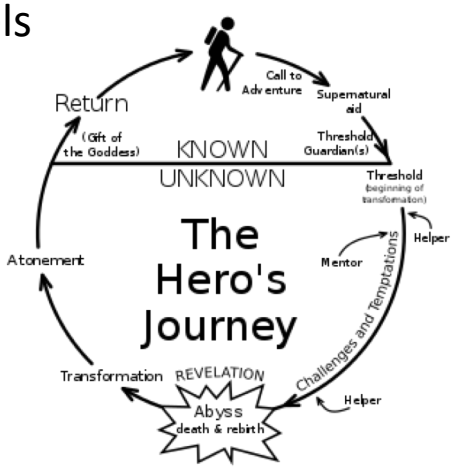


Architecture

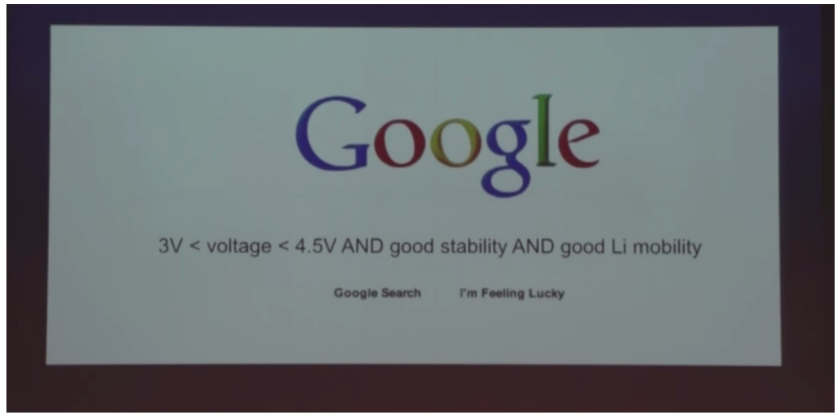
Rhetoric



Novels



Materials Science



Software