

DESIGN OF INTERACTIVE SYSTEMS

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WELCOME

DESIGN OF INTERACTIVE SYSTEMS + TER

Lectures

Tuesday 13:45 - 17:15

Room D101

TER

Friday 13:30 - 17:00

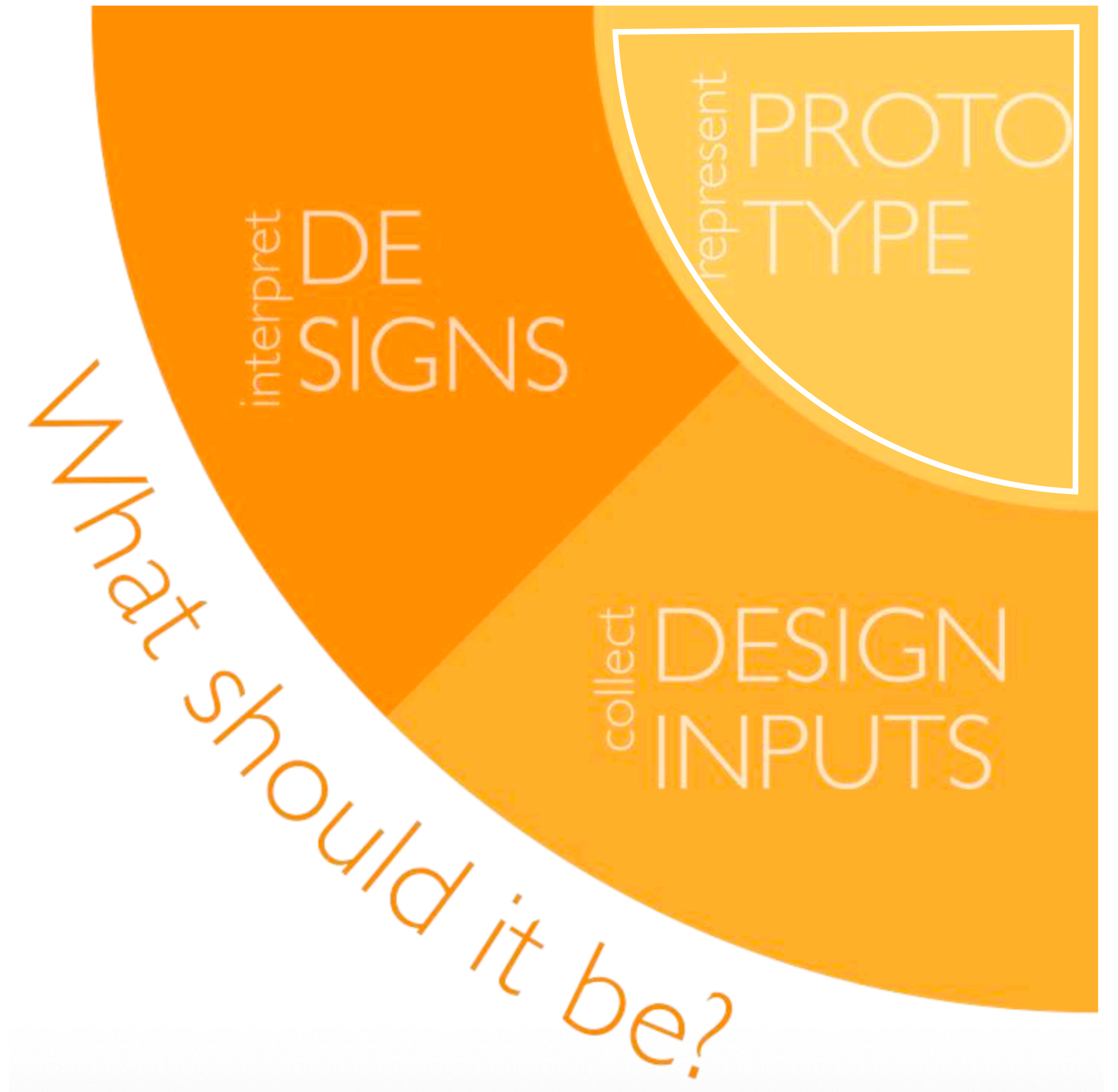
Room E212

LECTURES 7

OVERVIEW

Category	Activity	Duration (min)	Start	End
Homework	Check Video Prototype	5	13:45	13:50
Lecture	Evaluating Designs	20	13:50	14:10
Exercise	Questions	5	14:10	14:15
Homework	Questionnaires	5	14:15	14:20
Lecture	Quantitative Studies	20	14:20	14:40
Homework	Experiment Design	5	14:40	14:45
BREAK		15	14:45	15:00
Lecture	Qualitative Studies	10	15:00	15:10
Exercise	2 x Design Walkthrough	50	15:10	16:00
Lecture	Design Improvements	10	16:00	16:10
Homework	Improvements	5	16:10	16:15
Lecture	Redesign Systems	15	16:15	16:30
Lecture	Representing Design	30	16:30	17:00

REPRESENTING PROTOTYPES



DESIGN REPRESENTING DESIGN

Designing Prototypes	System	Action	Story
Collect	Design brief Design requirements	GATHER GENERATE	Persona Current scenario
Represent	Functional specification Paper prototype Tutorial video Wizard of Oz (tasks) Functional prototype	WRITE SKETCH SHOOT SIMULATE CODE	Future scenario Storyboard Video prototype (story) Wizard of Oz (scenario) Fixed-path prototype
Interpret	Interaction table Design diagram	DESCRIBE SKETCH	Concept description Flow diagram

REVIEW HOMEWORK

EXERCISE/HOMEWORK

VIDEO PROTOTYPE

Transfer the title cards from your storyboard to iPad Video Clipper

Make paper prototypes and mock-ups

Use dark pen, transparencies, sticky notes, colored paper ... be creative!

Shoot a 3-5 minute video

One story with all three personas

Include at least 8 interaction snippets

Get approval before you shoot!

This is not a “how-to” video

Reveal how your system works by showing how personas use it in a realistic context

Upload final prototype to your Group Space!

GENERATIVE DESIGN

Discovery

— Who is the user?

Inspiration

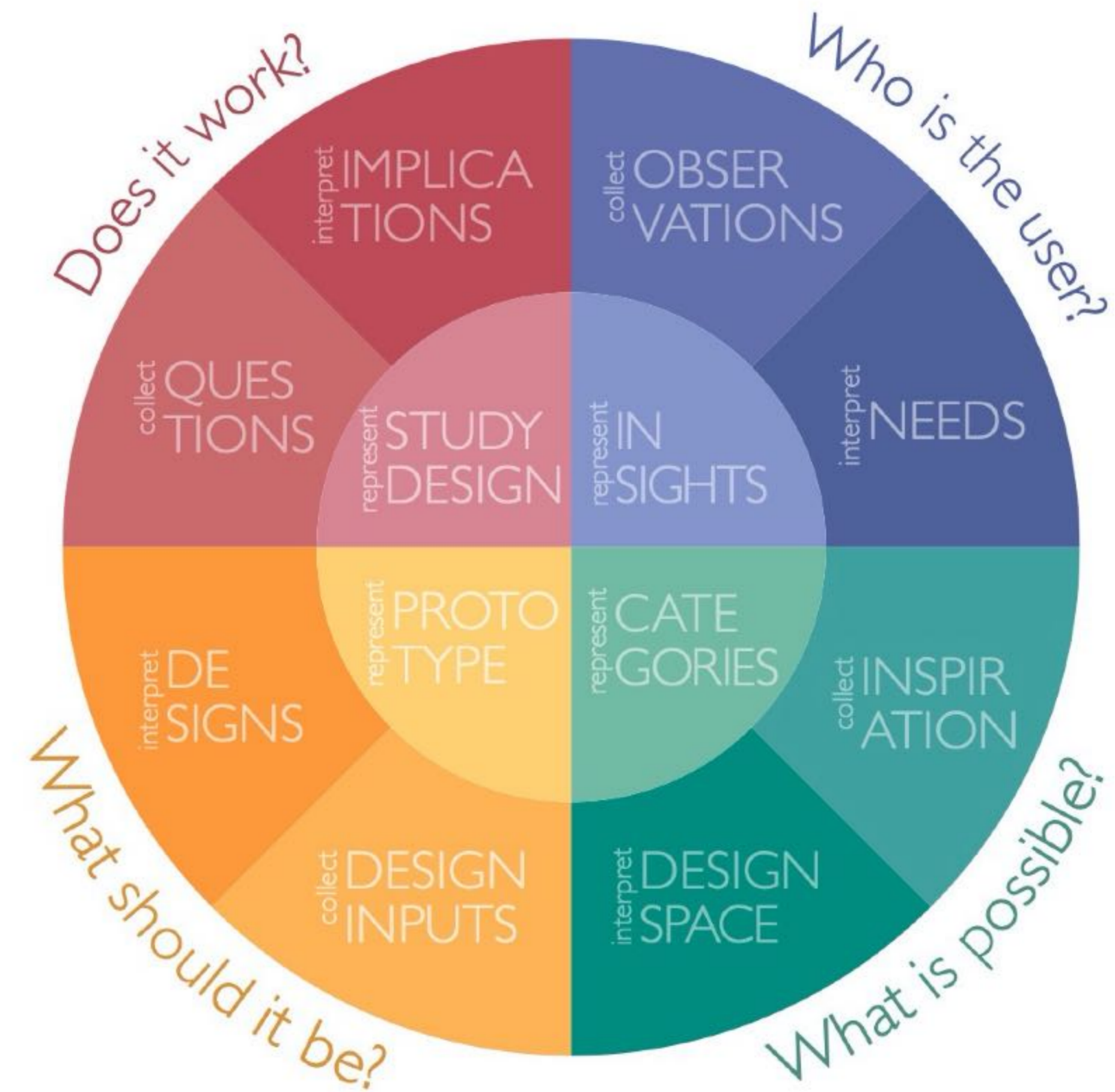
— What is possible?

Design

— What should it be?

Evaluation

— Does it work?



EVALUATING DESIGN



HCI RESEARCH VS. UX DESIGN

HCI RESEARCH

Academic discipline

Envision novel interactive systems

Interactive video, tangible computing

Ubiquitous computing, augmented reality,

Virtual reality

Propose, demonstrate and test new
interaction techniques

Develop new abstractions and theories of
interaction

Develop new methods for understanding users

UX DESIGN

Product development

Understand user needs for a future product

Generate design ideas

Collaborate with developers on product design

Test effectiveness of a product design

Communicate product designs to stakeholders
both internal and external

EVALUATION GOALS

HCI Research

Emphasis on generalizing results

Does the proposed design
offer novel ideas?

Are the research results rigorous and
generalizable beyond the current study?

Is the new method rigorous and
demonstrably useful to others

Do the theories provide new insights?

UX Design

Emphasis on obtaining specific results

Does the proposed design
“work” for the product’s target users?

Are the testing results
adequate for assessing the product’s quality?

Are the design methods rapid and productive
for advancing the design?

(Theory is not a goal of UX design)

Always consider the goal of the study

Marketing

Focus groups AB testing

UX design

Usability studies Surveys
Heuristic evaluation Speed dating
Design walkthroughs Field studies

HCI Research

Controlled experiment Structured observation
Technology probes Interactive thread
Generative walkthroughs

EVALUATION
METHODS

Who are the stakeholders?

Design team members

- Designers
- Developers

Product team members

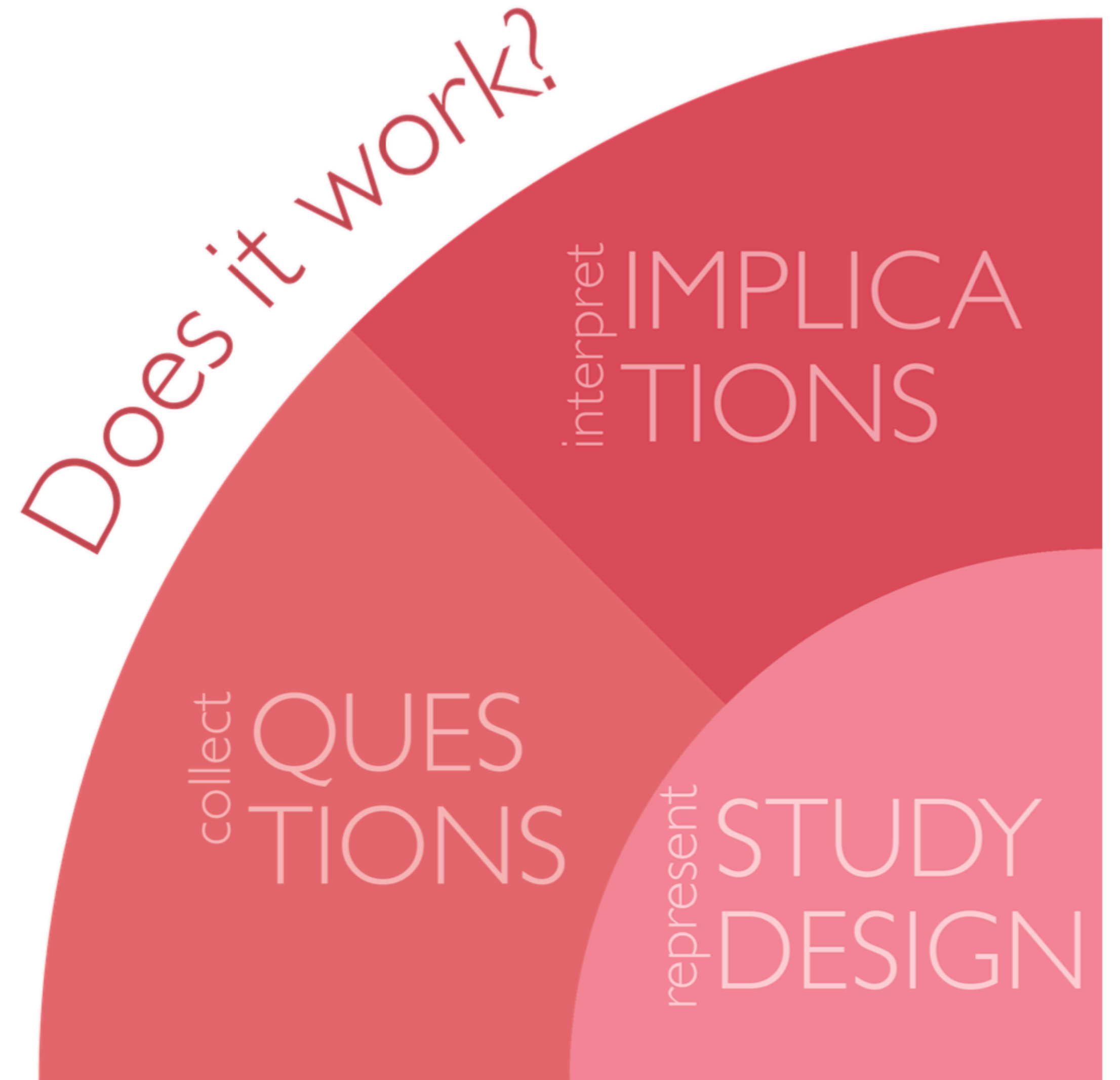
- Marketing
- Finance
- Management

Clients

- End users
- Customers

**COMMUNICATE
DESIGNS**

EVALUATING DESIGN

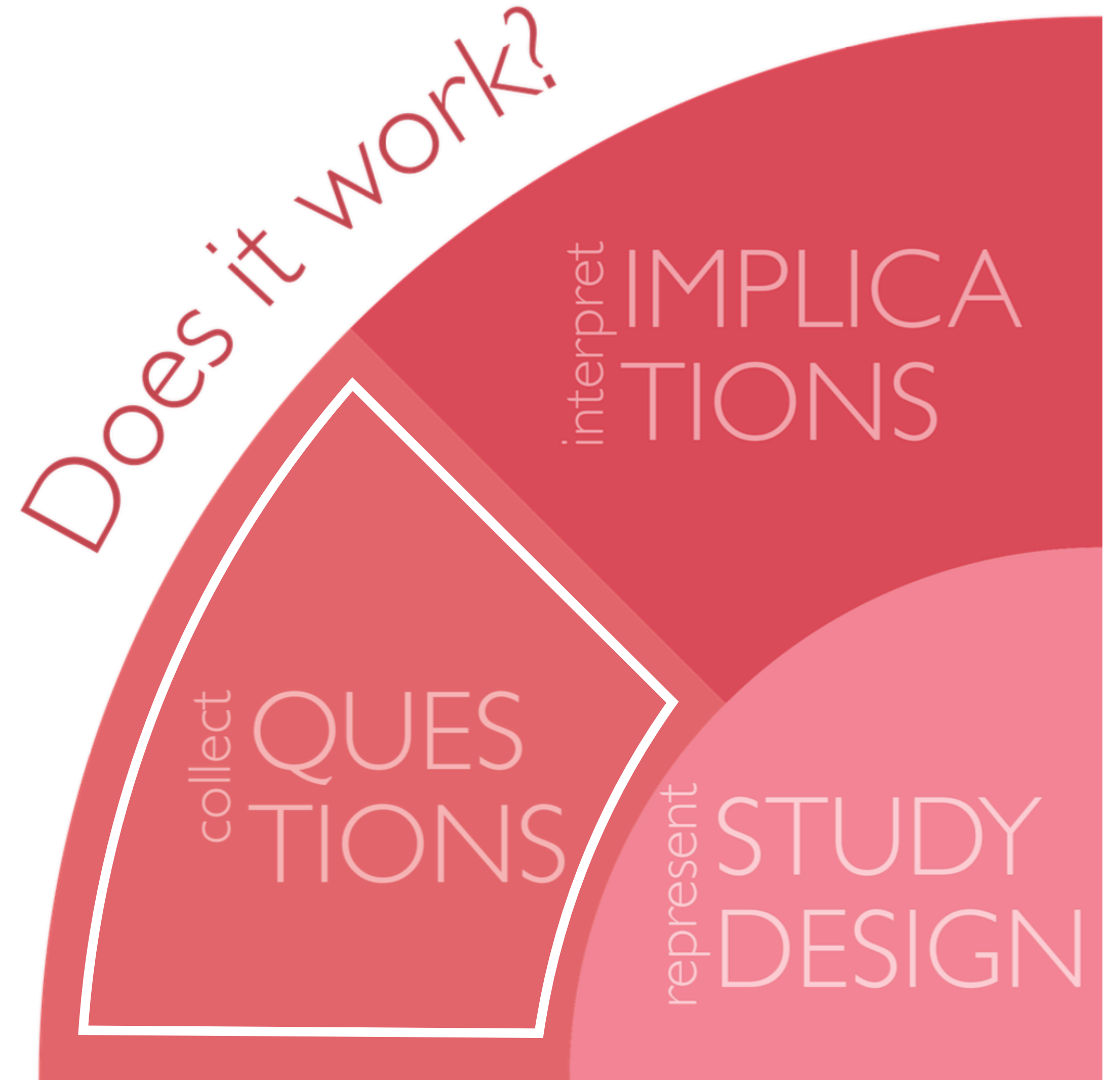


EVALUATION

FINDING PROBLEMS

Finding Problems	System	Action	Story
Collect	Research questions Study questions	DEFINE	User contexts User activities
Represent	Questionnaire User study Controlled experiment Field study	ASK CONDUCT	Interview Design walkthrough Structured observation Diary study
Interpret	Descriptive statistics Inferential statistics Design requirements	ANALYZE	Thematic analysis Mind Map Design implications

COLLECTING ANSWERS



METHODS

Questionnaire

Story questionnaire

Marketing survey

**COMMUNICATE
DESIGNS**

COLLECTING ANSWERS

How do users react to the new system?

Descriptions

Can the user successfully perform specified tasks?

Data

Does the user perform specified tasks more efficiently or with fewer errors?

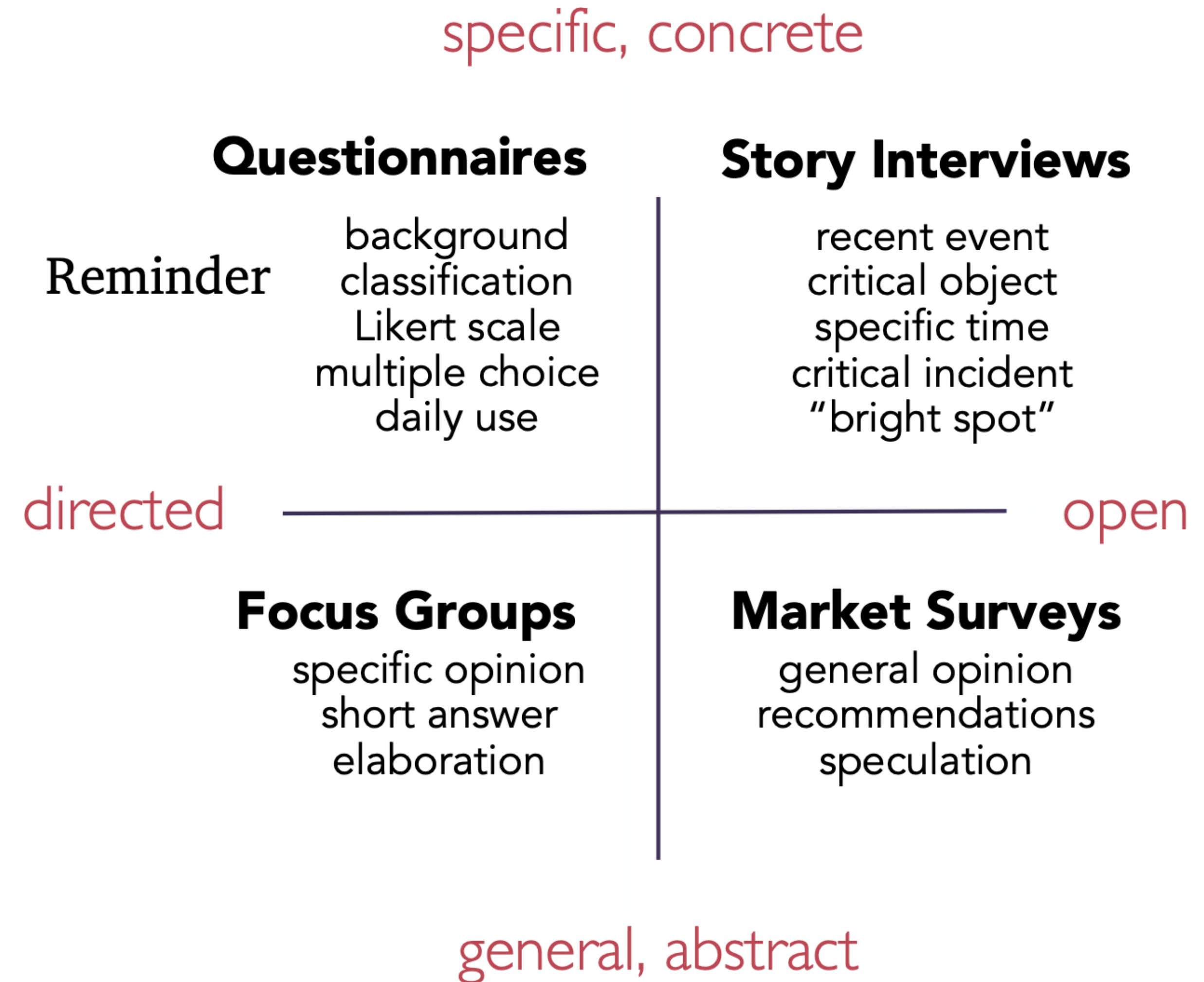
Explanations

Does the user understand how the system works?

Stories

How do users interact with the system in a real-world context?

ASKING QUESTIONS



INTERVIEW VS. QUESTIONNAIRE

INTERVIEW VS. QUESTIONNAIRE

Same question types — Different goals and analysis

INTERVIEW

TRADE-OFFS

Advantages

- get in-context information
- get real-world stories
- can probe for more information

Disadvantages

- fewer participants
- interview time
- analysis time

QUESTIONNAIRE

TRADE-OFFS

Advantages

- large number of participants
- quick to create
- quick to analyze

Disadvantages

- less useful information
- hard to get stories
- cannot probe for more information

QUESTIONNAIRE

GOAL

Obtain data from many users

External validity problem:

Questions may not mean what you think they mean

Solution

Always **pilot test** questions with target users

QUESTIONNAIRE

GOAL

Obtain data from many users

What information are you seeking?

Ask only what is necessary

Frame the questions correctly

Consider audience size

15 - 50 - 1000 users ... more?

Consider questionnaire deployment

Usually a survey web app:

Survey Monkey, Google Forms

Choose data analysis approach

Ensure the data is useful and analyzable

Survey apps include (limited) statistics

QUESTION TYPES

Why do you need this information?

Background

Age, profession, years in the job

General information

How many years have you used this system?

Directed questions

How many messages did you receive yesterday?

Open questions

Describe how you use electronic mail

QUESTION TYPES

Ranking

Rank the usefulness of each email feature:
(1 is most useful)

- ___ Blind copy to myself
- ___ Automatic copy to a distribution list
- ___ Automatic delete
- ___ Automatic file to a topic folder

QUESTION TYPES

Fill-in the blank

What system do you use for each type of communication?

Synchronous	Mixed	Asynchronous
Zoom	Slack	Email

QUESTION TYPES

Radio button

Choose only one answer

I move some messages to project folders

Never	Rarely	Often	Always
☒			

QUESTION TYPES

Multiple Choice

Accept multiple answers

I use the following video conferencing systems (check all that apply):

Zoom	Microsoft Teams	Jitsi	BB Collaborate	Other
☐	☐	☐	☐	☐

QUESTION TYPES

Scalar (Likert Scale)

Use “Neutral positive” statements

I can easily manage my social media.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
-2	-1	0	1	2

QUESTION TYPES

Semantic differential

Compare opposites

Types: evaluation, potency, activity

Rate your social media experience

<i>good</i>	☐	☐	☐	☐	☐	<i>bad</i>
<i>effective</i>	☐	☐	☐	☐	☐	<i>weak</i>
<i>active</i>	☐	☐	☐	☐	☐	<i>passive</i>

QUESTION PRINCIPLES

How to ask

Use **parallel structure** for sentences

Example: Verb first, then noun

Use **neutral positive** statements

Example: "The system is easy to use."

Keep a **consistent order** for values

Example: from positive to negative

QUESTION PRINCIPLES

How to ask

Avoid asking “obvious” questions

Ask the same question in two different ways
to see if you get the same result

Careful! Zero can mean two things
Either: neutral, middle response
or: “I do not know”

Consider adding a degree of confidence

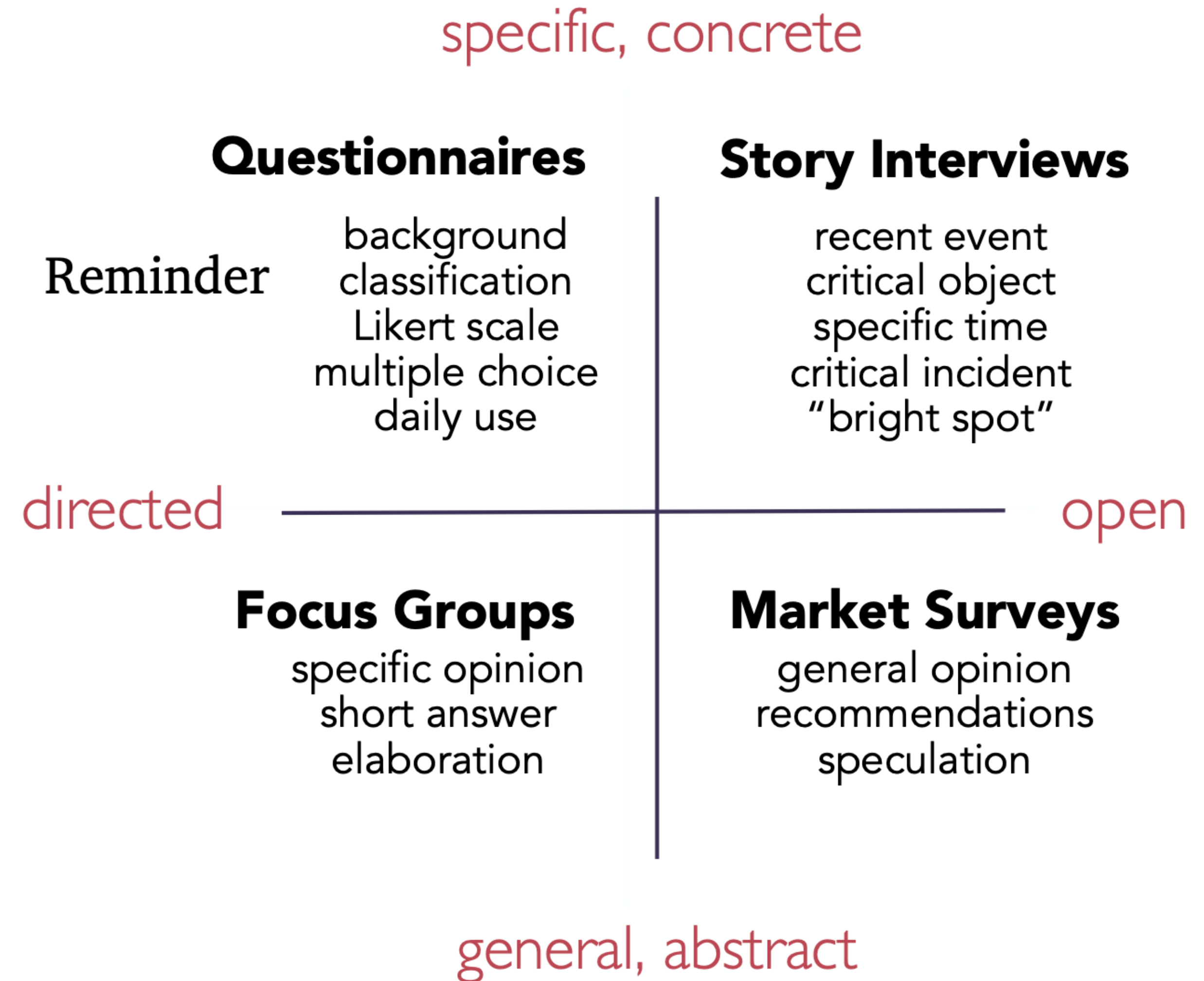
QUESTION PRINCIPLES

How to ask

Directed, specific questions
are easiest to code
belong at the beginning
but ... provide the fewest interesting results

Open, general questions
are difficult to code and analyze
but ... may provide interesting responses
also risk stereotypical responses

CHOOSE APPROPRIATE QUESTIONS



EXERCISE QUESTIONS —

Create a question to find out more about users

HOMEWORK
QUESTIONNAIRE —

Collaborate on a questionnaire
Up to 8 questions

Distribute it to users and
Bring the results next class

Questionnaire

Discover Users Worksheet

ACTIVITY Develop a set of fixed-response questions that elicit facts to inform the design.

Question type	
Question	
Question type	
Question	
Question type	
Question	
Question type	
Question	
Question type	

STORY QUESTIONNAIRE

Topic: problems with customizations done by others

Sam uses a chat app for teams at work (such as Slack, Flockdock or HipChat). Sam's colleagues had a running inside joke about a Japanese woman that used to work with them a long time ago. Quinn, one of Sam's colleagues, customized this app so that every time somebody writes the word "Japan" in a message, an animated GIF of a sexy asian girl appears in the conversation. One day, the company started a project for a Japanese client, so the word Japan started appearing more often in the app along with the animated GIF. Sam felt this was not only annoying but sexist, so he entered the app's customization options and deleted Quinn's customization.

Tell us your story *

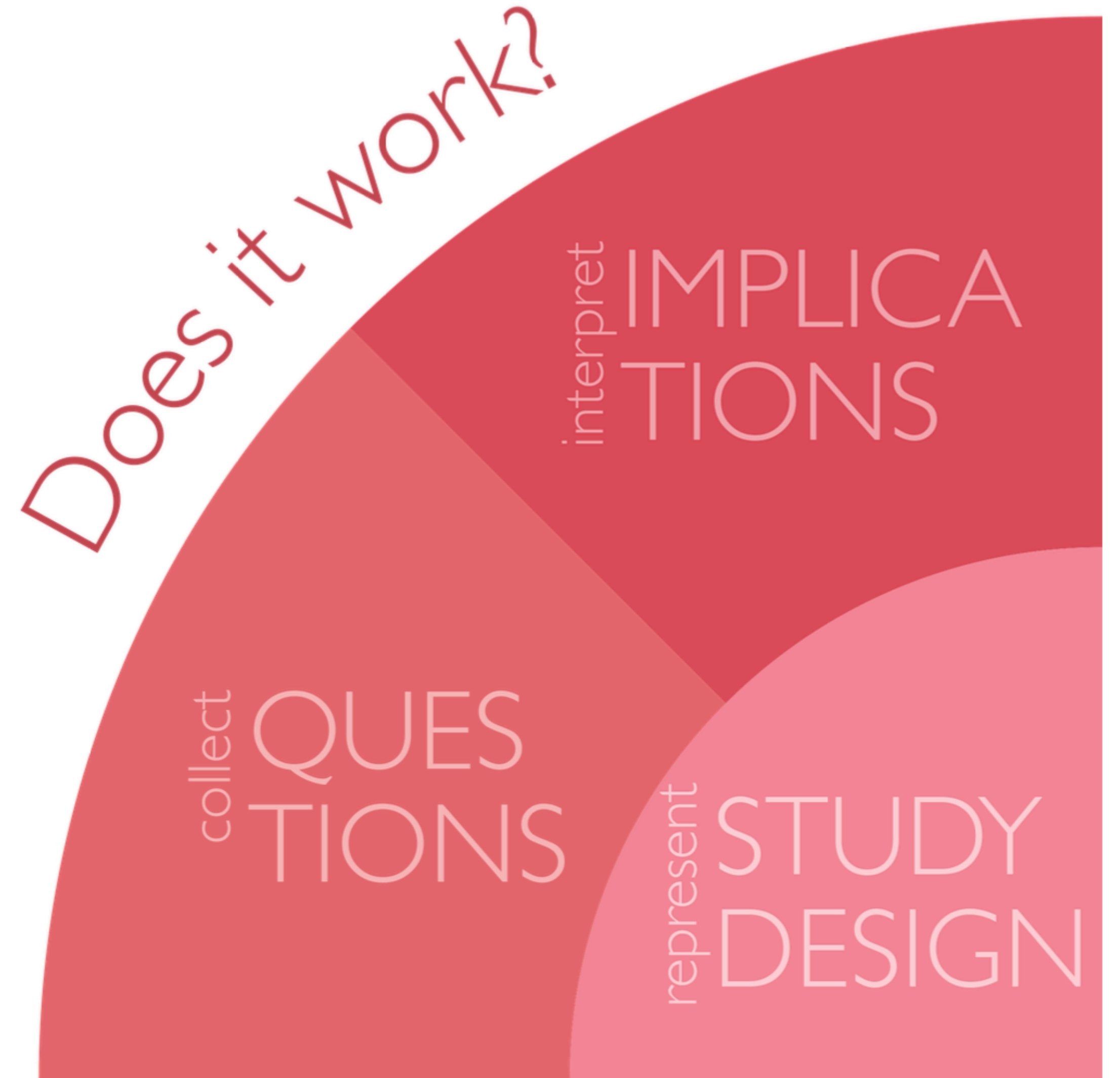
Look at Sam's story above, and tell me the first story of your own experience that comes to mind. If it doesn't remind you of anything, try to remember a story on the same general topic and tell me that. Try to be as specific as possible, mentioning the apps you were using, the emoji/stickers or other features you used (or tried to), your relationship with the person you were chatting with, etc.

A friend who is obsessed with privacy makes his conversations on Facebook messenger so that they delete in 24 hours. Sometimes I send him links/pictures/content that I want to revisit, but everything gets deleted on my side as well, including the messages that I send. I get where he is coming from, but I find the chatlog convenient, and it's not like we discussed anything illegal.

Any other comments?

Let us know anything else you want to share about your story and how you felt. For example, if your story is about a problem: how frustrating was it? Did it happen more than once? If you found a workaround: are you proud of it?

REPRESENTING STUDIES



Quantitative Studies

Qualitative Studies

**RUNNING
STUDIES**

QUANTITATIVE STUDIES

GOAL

Gather performance data

How does the user perform specified tasks with the new system?

Requires:

- Defining tasks

- Choosing which factors to vary

- Choosing what to measure

- Analyzing the results

HCI Researchers:

- Must be rigorous!

UX Designers:

- Must be “good enough”

EXPERIMENT DESIGN

PROCEDURE

Compare design alternatives

Specify design question

Choose several alternatives

Choose independent & dependent variables

Specify null hypothesis

Make a prediction

Set up test conditions to compare

Use at least three real users

Analyze results:

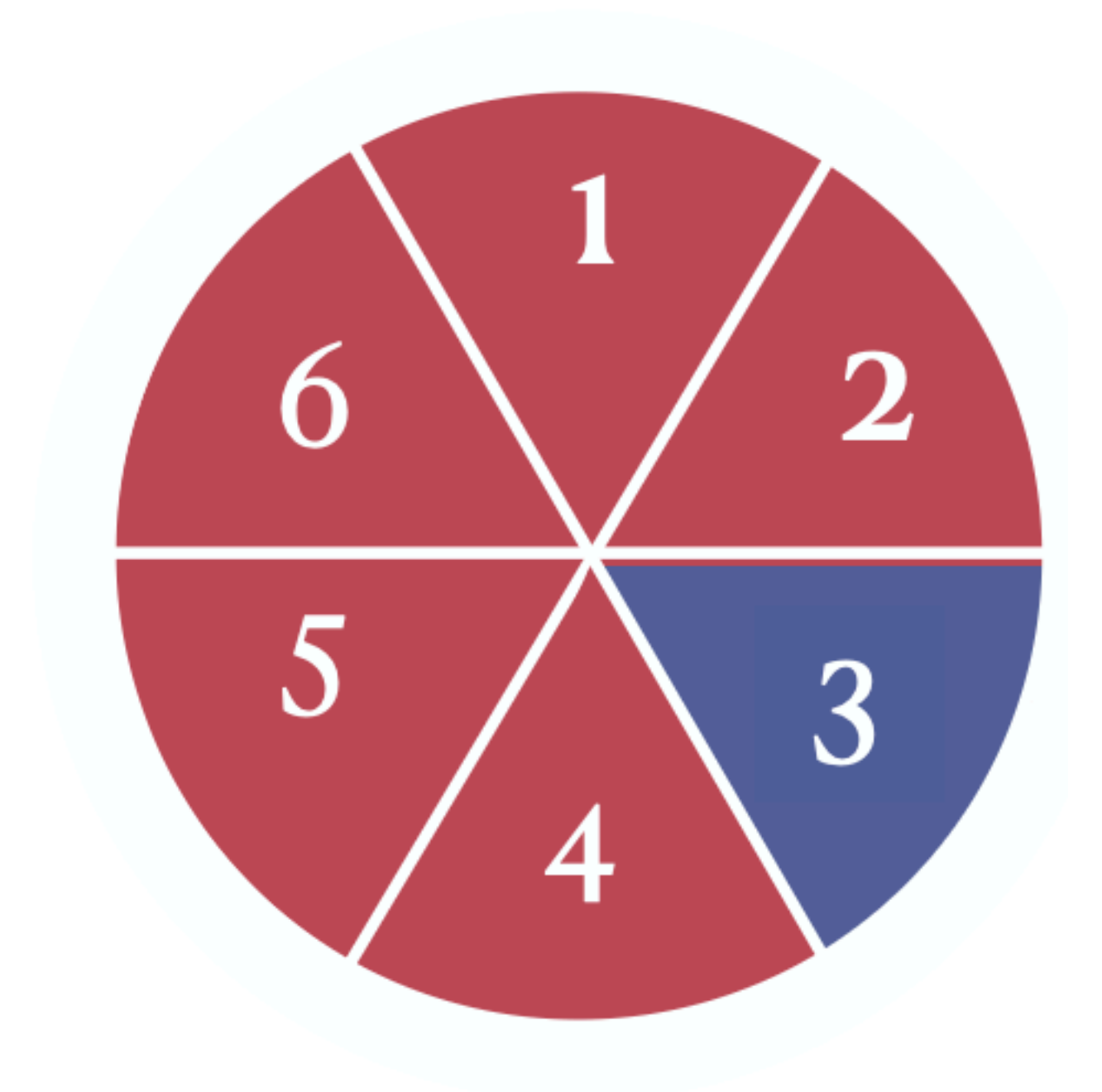
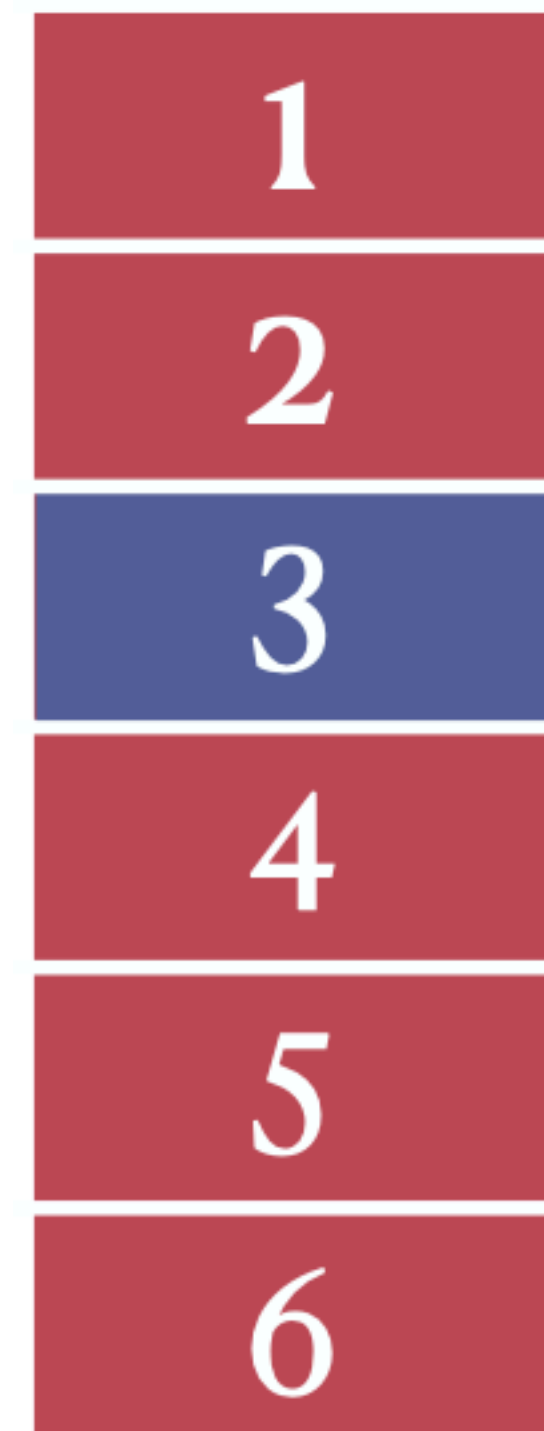
are alternatives significantly different?

State the null hypothesis (H_0)

"There is no difference in performance between users in terms of time or error when selecting an item from a linear or a circular menu regardless of: type of menu, number of menu items, or user's previous experience."

EXPERIMENT DESIGN

Compare a linear menu to circular menu



TYPES OF VARIABLES

Independent variables = Factors
chosen *independently* by experimenter

Dependent variables = Measures
depends on the user's behavior

VARIABLES

TYPES OF VARIABLES

Factors

Factors we want to vary or control
Conditions are the combinations of
independent variables

Factors:	Values:
Type of menu:	linear, circular
Number of items:	3, 6, 9, 12, 15
Expertise:	expert, novice, intermittent

$[2 \times 5 \times 3] = 30$ unique conditions

**INDEPENDENT
VARIABLES**

TYPES OF VARIABLES

Measures

Dependent variables **depend** on user's behavior

Measures measure user's behavior

Reliable statistical tests need enough
measures per condition

Rule of thumb:

- ~12 "small-n" statistics (student's t)

- ~30 normally distributed tests (Z)

**DEPENDENT
VARIABLES**

TYPES OF VARIABLES

Measures

Dependent variables might include:

- Time to select an item

- Number of errors

- What else?

**DEPENDENT
VARIABLES**

OPERATIONALIZE

Create tasks for users to perform

Trickiest part of the experimental design

When done well, it seems obvious

Simplify the task as much as possible:

eliminate bias and external factors,
without making it unrealistic

OPERATIONALIZE

Example

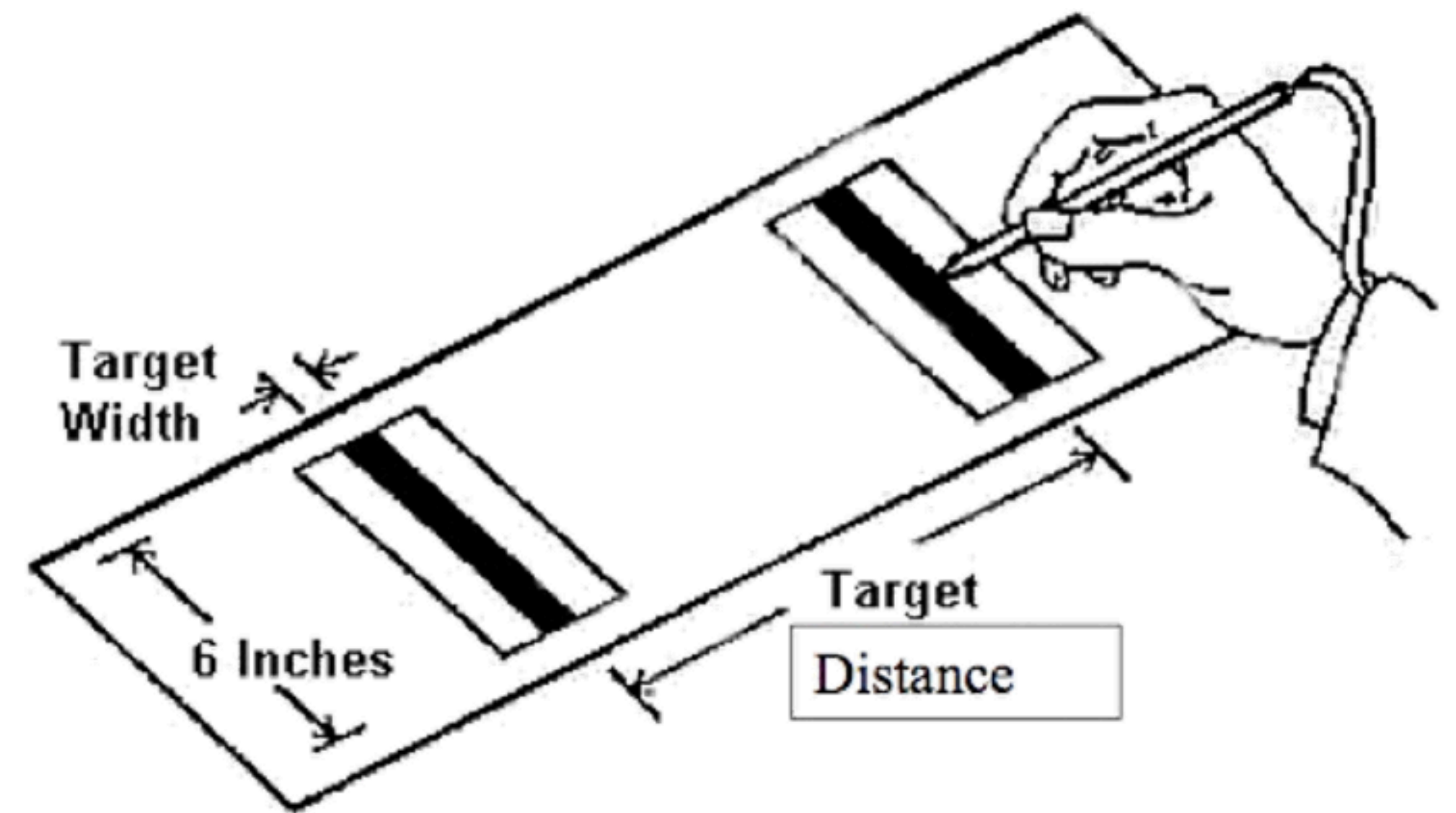
Fitts' pointing task

only one dimension

(target = vertical band)

reciprocal pointing task

(back and forth between 2 targets)



Define the menu selection task

Ensure that conditions are similar as possible

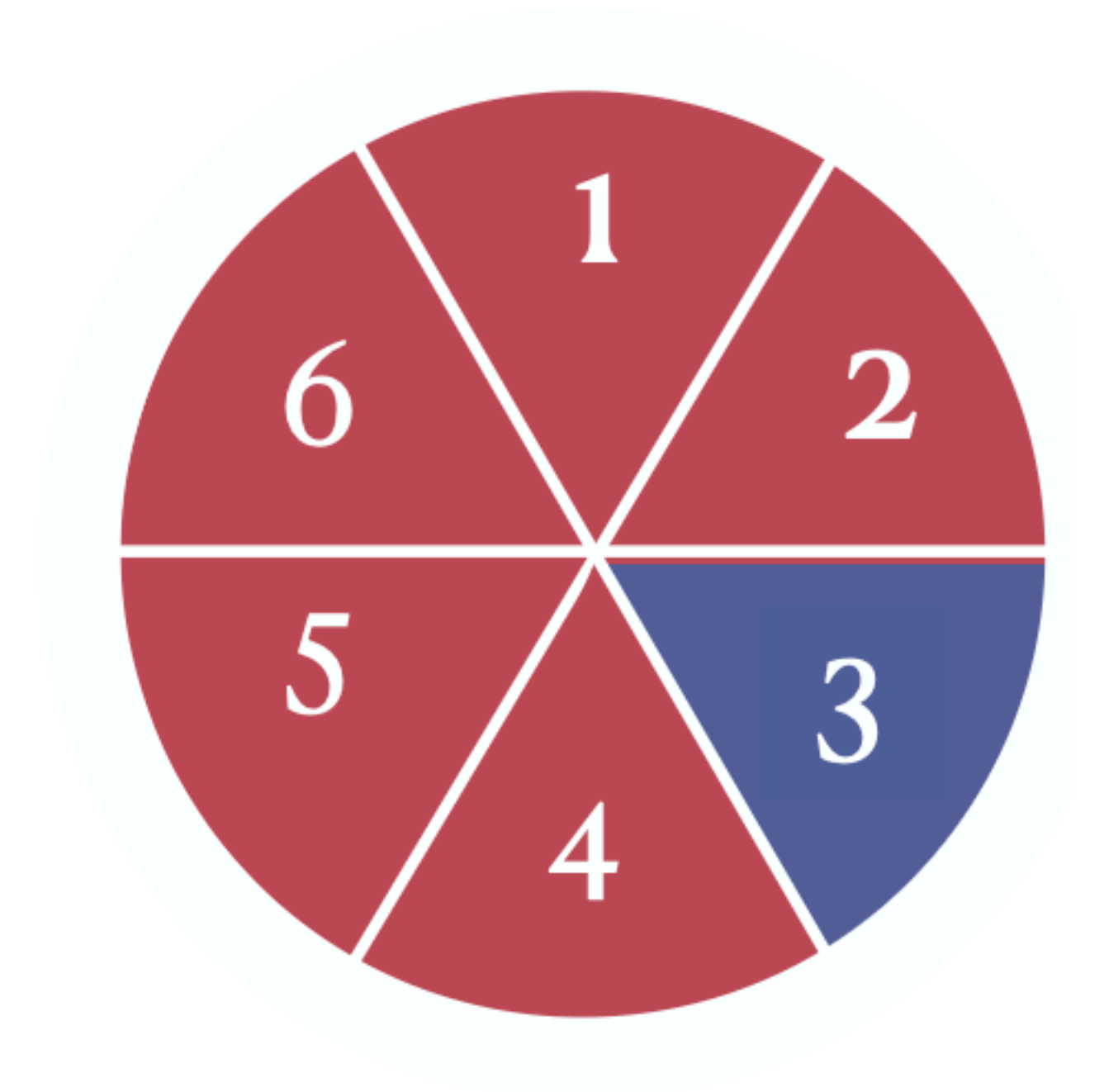
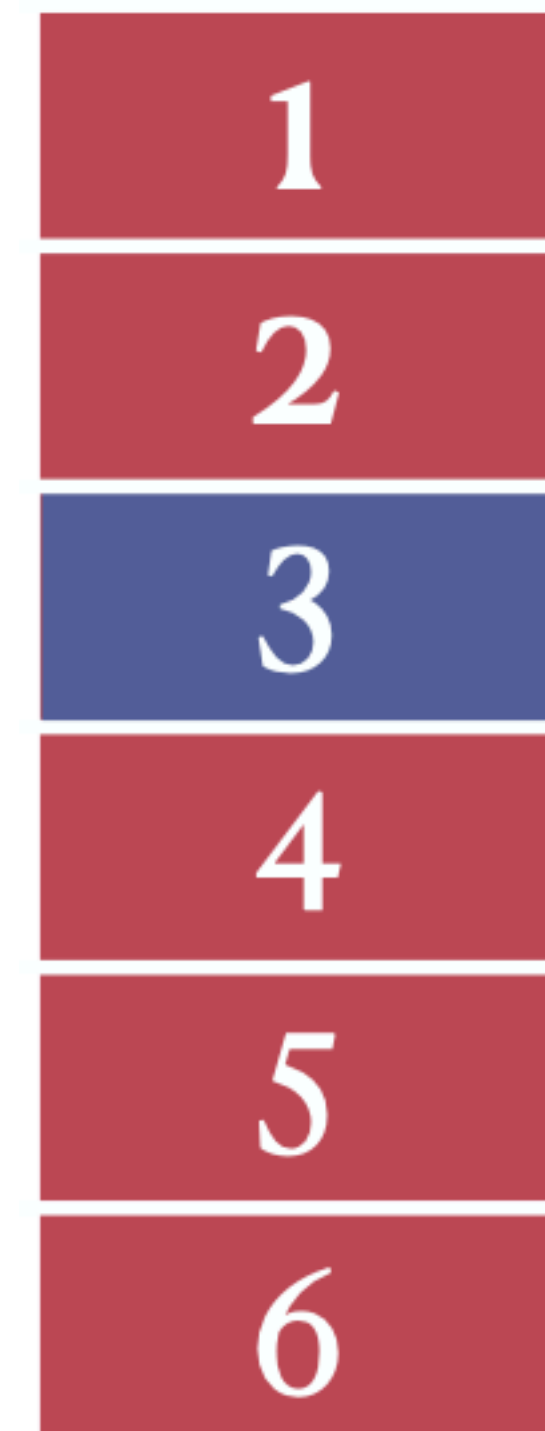
- Same labels for the menu items

- Same location of the menu on the screen
(centered)

- Same highlight for selected item
(highlighted to avoid searching for it)

OPERATIONALIZE

Compare a linear menu to circular menu



Control factors that might bias the results:

- All subjects receive the same instructions

- All subjects perform same tasks
under the same conditions

- All instructions are simple and clear

- Informal contact kept to a minimum

Double blind experiment:

- Neither the experimenter nor the subject
know which group gets which treatment

Can our experiment be double blind?

**RUN THE
EXPERIMENT**

Obtain informed consent from participants
Ensure they understand the consequences
of participating in the experiment

Keep participants anonymous

Give each participant a unique number
Assign conditions based on participant #s

Gather experimental data

Check that data is both reliable and valid
Preserve raw data
Minimize data treatment

**INFORMED
CONSENT**

Record predictions before checking results!

Null hypothesis example:

“Circular and linear menus are equal in performance under all conditions.”

Prediction example:

“I think that circular menus will be faster than linear menus, regardless of user experience and menu items.”

Other possible predictions:

“More than 16 items will lower circular menu performance.”

**PREDICTION
VS.
HYPOTHESIS**

COLLECT DATA

Human- and Machine readable logs

Example:

Start S1 E C-L 3-12-15-9-6 Wed 23 Nov 2023 15:45:54

Condition S1 E C 3 Wed 23 Nov 2023 15:46:35

subjet expertise type size item hit/miss tps(ms)

Trial S1 E C 3 2 Hit 1254

Trial S1 E C 3 1 Miss 885

End S1 E C-L 3-12-15-9-6 Wed 23 Nov 2023 16:23:55

PLAN AN EXPERIMENT

Choose best interaction technique

Identify key independent variables (factors)

Identify key dependent variables (measures)

Operationalize behavior

Define test conditions

Run the experiment

Analyze the data: are they significant?

HOMEWORK
EXPERIMENT _____

Choose a single interaction snippet Identify
at least two additional alternative forms of interaction

- Specify:
- Independent variables
 - Dependent variables
 - Null Hypothesis
 - Prediction

Experiment

Evaluate Systems Worksheet

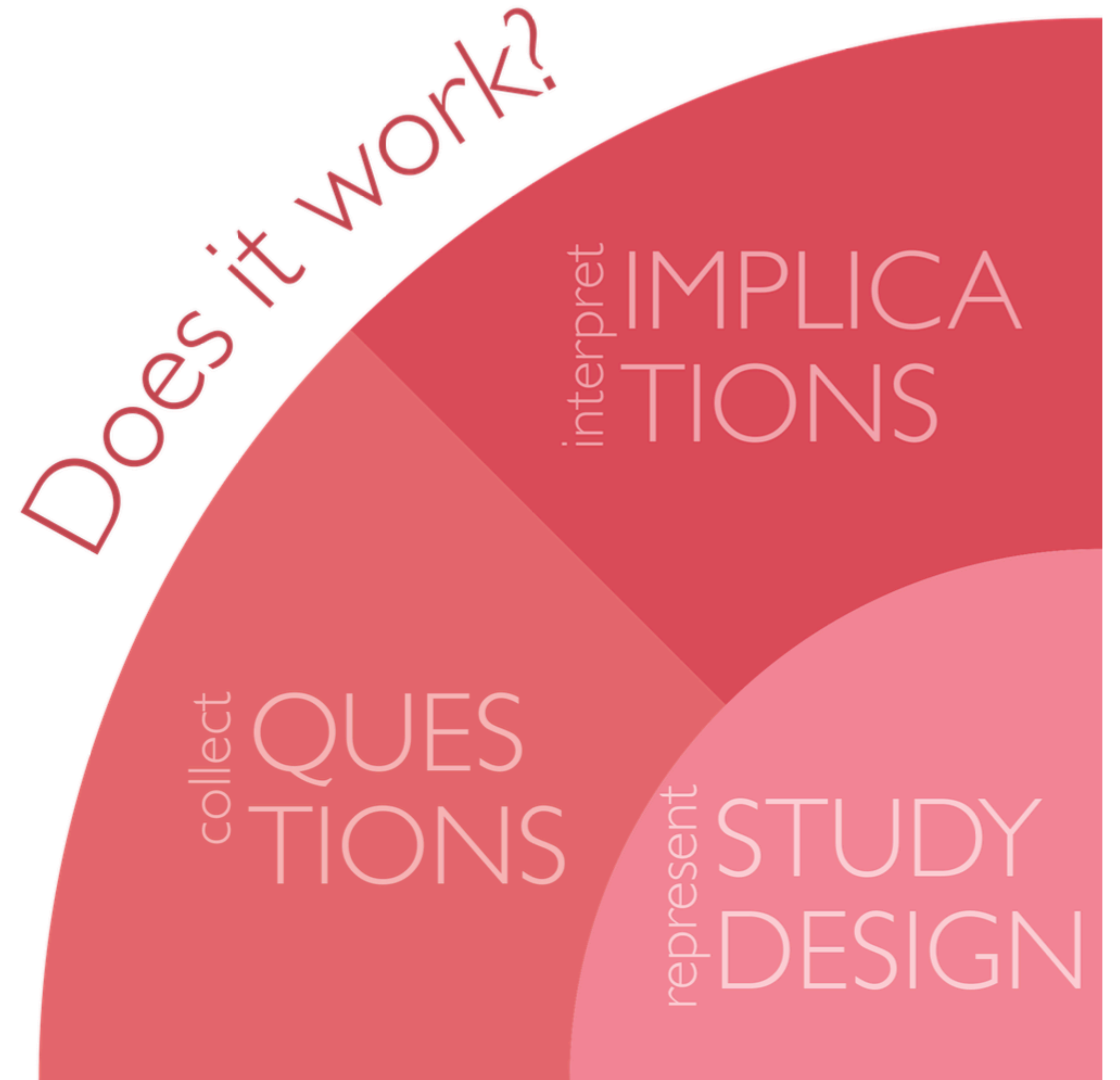
ACTIVITY

Ask users to perform specific tasks according to comparable factors and measure which is better.

Specify three interaction techniques to compare					
1.		2.		3.	
Describe the advantages of each					
1.		2.		3.	
Describe the disadvantages of each					
1.		2.		3.	
Specify factors (independent variables). Include "interaction techniques"					
Specify measures (dependent variables) of user behavior					

BREAK

REPRESENTING STUDIES



Quantitative Studies

Qualitative Studies

**RUNNING
STUDIES**

DESIGN WALKTHROUGH

Step-by-step evaluation

Goal: identify as many problems as possible
at each step

Similar to brainstorming:

- Identify maximum number of problems

BUT also differs from brainstorming:

- Do not defer judgement

DESIGN WALKTHROUGH

Structured Walkthroughs (Yourdon, 1979)

Goal: Find bugs in code

Technique: Systematic step-by-step analysis
of a document by a small group

Principles: Line-by-line analysis
Constructive criticism
Limited time

DESIGN WALKTHROUGH

Apply to any sequential design artifact

Appropriate for many types of material

Originally for programmers and code

Also works well for any sequential artifact:

Text documents:

articles, manuals, specifications, reports

Design resources:

future scenarios, storyboards,

paper prototypes, video prototypes

DESIGN WALKTHROUGH

Find the most problems. Don't solve them!

Comments

Focus on material, not author

Constructive not destructive

Specific, not general

Problems then questions then suggestions

Examples:

"The text is too small to read"

"The user can't see where to change the setting"

"That task takes four steps"

Authors:

Accept feedback, avoid discussing solutions

DESIGN WALKTHROUGH

Authors

Do **not** be defensive!

(Accept feedback and move on)

Do **not** justify your decisions!

(Avoid extra discussion)

Do **not** discuss solutions!

(Do this later, with the design team)

DESIGN WALKTHROUGH

Evaluators

Identify problems

but be constructive

Focus on the material presented

not the author

Include issues related to:

Design

Prototype

Video

Story

etc.

DESIGN WALKTHROUGH

Real-world design walkthroughs

Group composition

- peers (not bosses!)
- small 4-8 works well
- diverse include diverse perspectives

Adopt specific roles:

- technical Is there an error or problem?
- user Is it hard to do?
- manager Is this function necessary?

Apply design rules, principles or perspectives:

- Theory Instrumental Interaction
- Heuristics (Norman, Shneiderman)

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Evaluators

#5

#6

Design walkthrough

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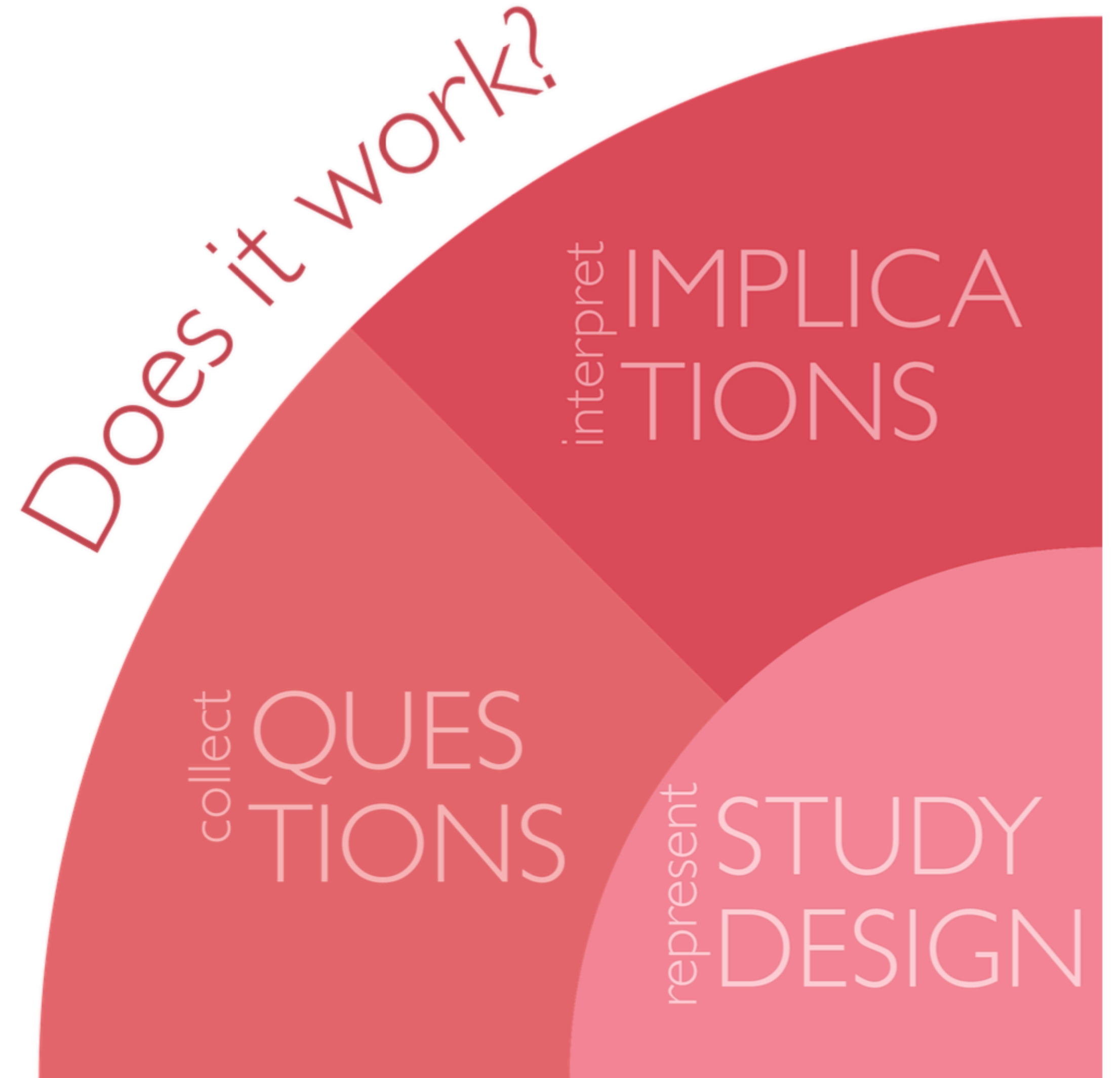
Evaluators

#6

#1

Design walkthrough

INTERPRETING RESULTS



Make your design better!

Users experience technology in the real world

Never assume everything will be 'perfect'

Consider:

- Technical breakdowns

 - The wireless connection is down

- Situation breakdowns

 - User is distracted crossing the street

- Extreme breakdowns

 - User cannot physically control the interface

IMPROVEMENTS

Make your design better!

Consider the results of your
design walkthrough

Reassess your design concept

Can you create a simpler, more powerful
concept?

Explore breakdowns

Identify at least three possible breakdowns

How do they affect the design of your
system?

How can you address them?

IMPROVEMENTS

HOMEWORK IMPROVEMENTS_____

Reread the design walkthrough results

Assess your concept:

How can you improve it?

Identify 3 new breakdowns

Suggest possible solutions

Modify your design with the revised concept

Include at least 3 new interaction snippets

Show how to address breakdowns



HOMEWORK OVERVIEW

Questionnaire

Complete your team's questionnaire with up to 8 questions

Distribute it to users and
Bring the results next class

Experiment

Choose an interaction snippet
Identify at least two additional alternative forms of interaction

Specify:
Independent variables
Dependent variables
Null Hypothesis
Prediction

Improvements

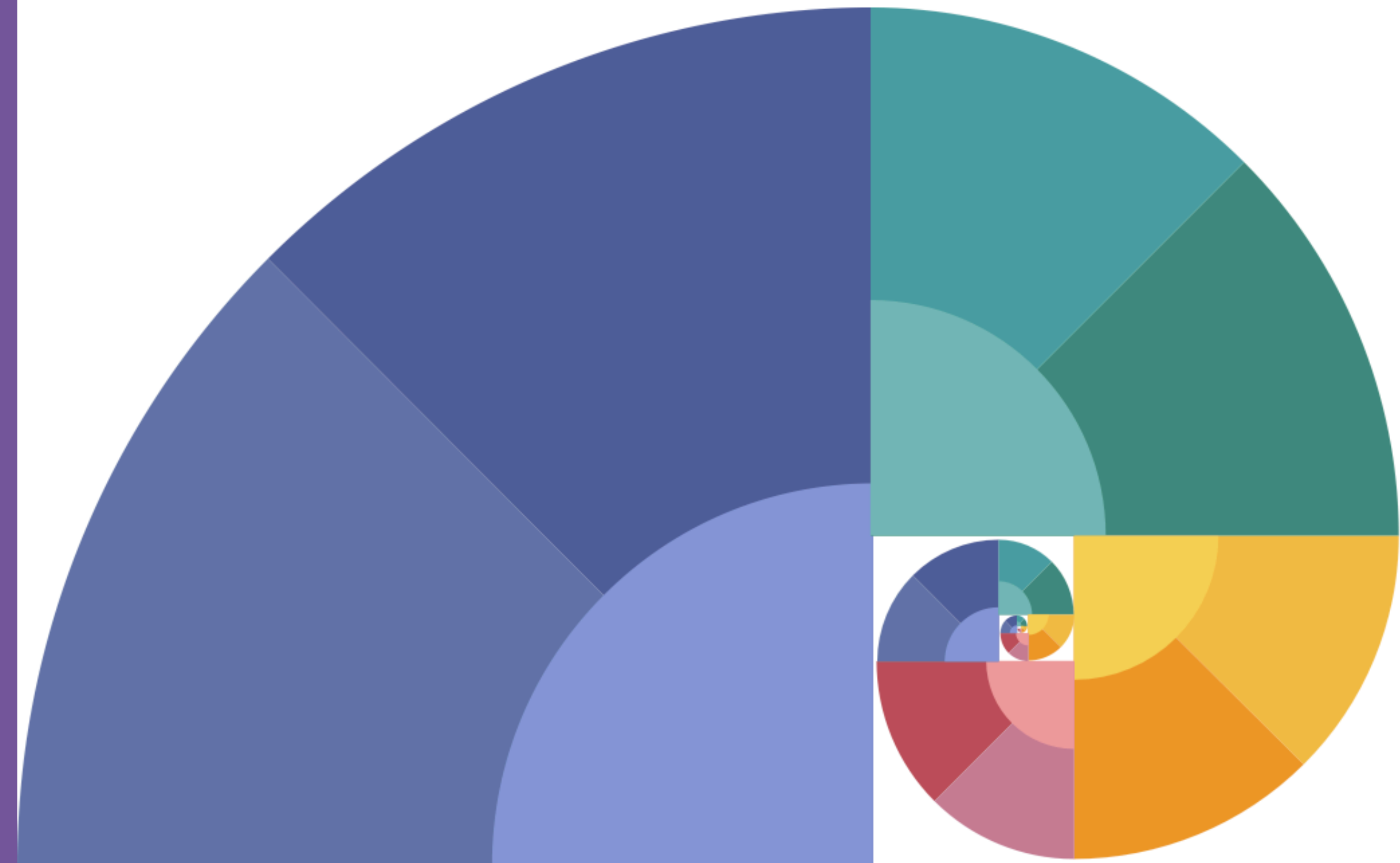
Reread the design walkthrough results

Reassess your concept:
Identify 3 new breakdowns

Modify your design with the revised concept

Include at least 3 new interaction snippets

REDESIGN



GENERATIVE DESIGN —

Discovery

— Who is the user?

Inspiration

— What is possible?

Design

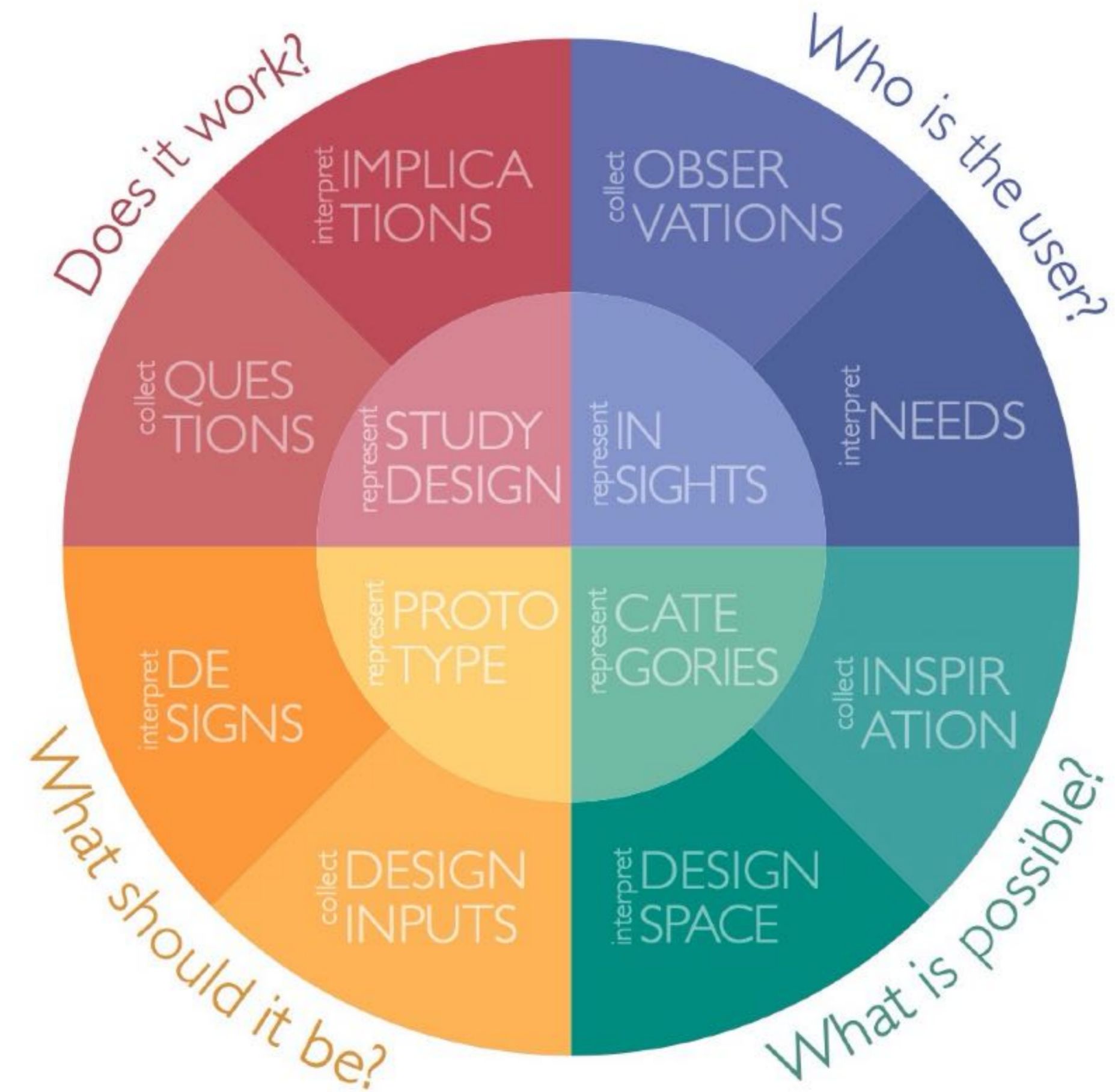
— What should it be?

Evaluation

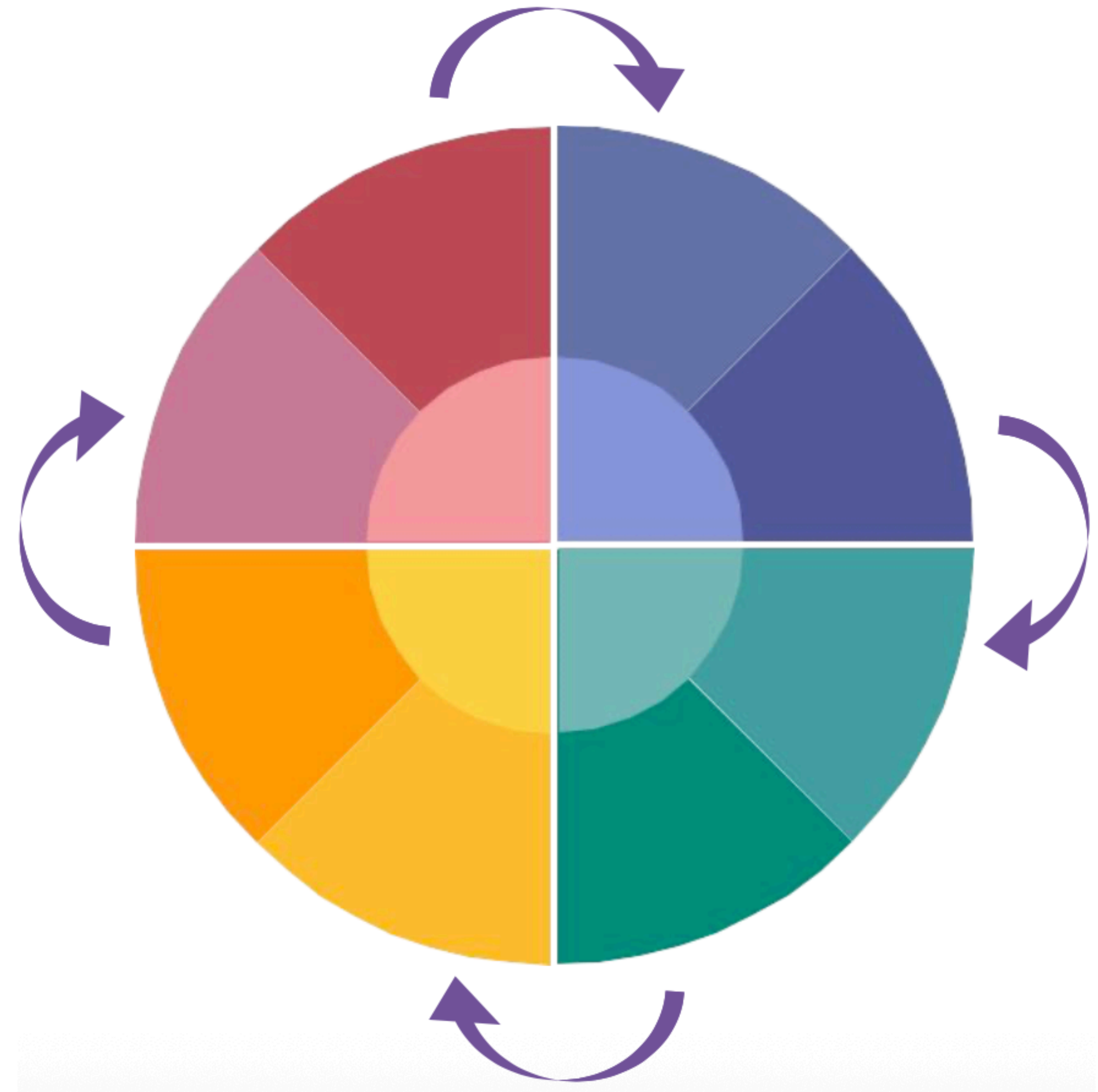
— Does it work?

Redesign

— Make it better!



REDESIGNING SYSTEMS



REDESIGNING SYSTEMS

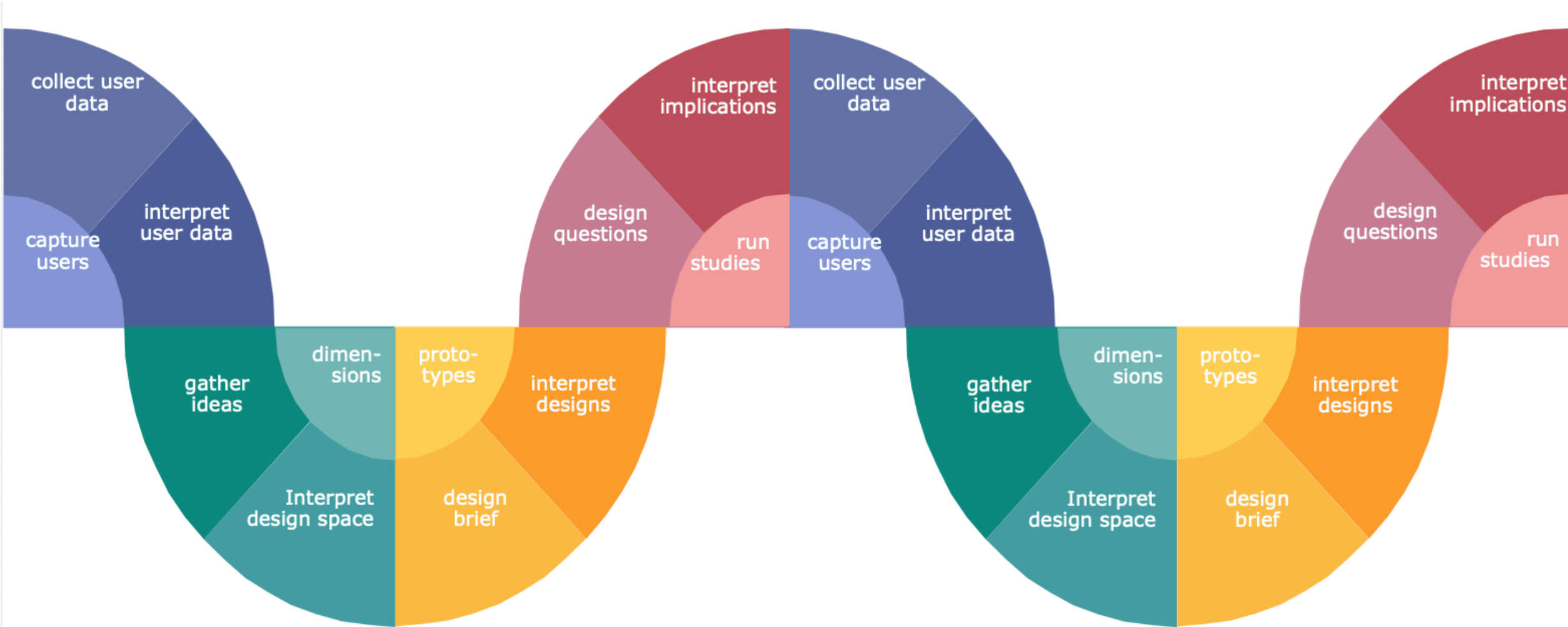
Within an iterative design process
redesign is more important
than initial design

Do not simply
"do it again!"
Reflect on your designs
consider context



DESIGNING ARTIFACTS

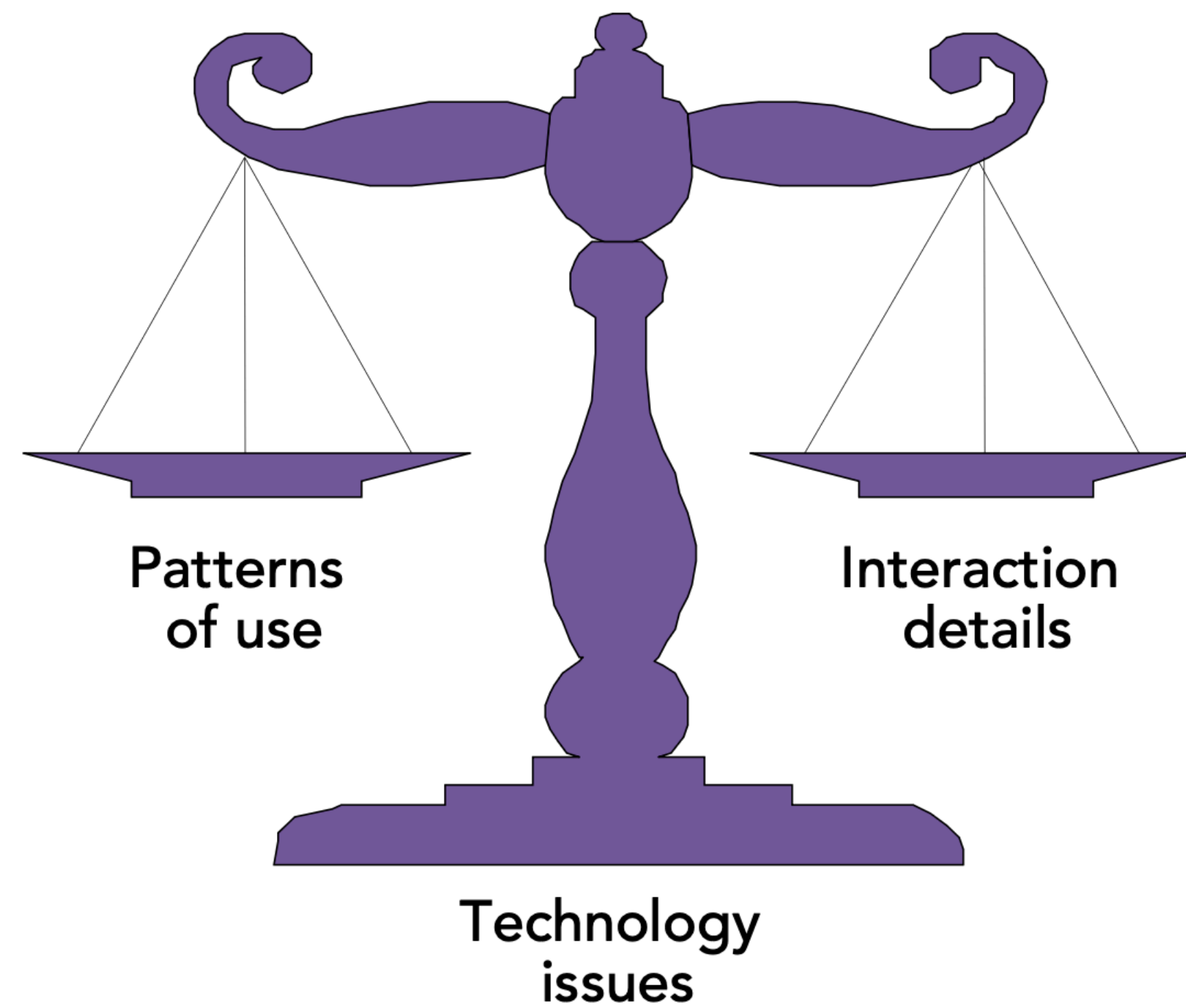
serve as resources for (re)design



“ALL DESIGN
IS REDESIGN”

Bruno Latour

Consider Trade-offs



**FIND A
BALANCE**



REVISED CONCEPT

Make it better!

Refine your design concept:

more interactive easier to manipulate
more powerful more functionality

Then ...

Update the scenario and storyboard

Shoot an **improved** video prototype

**REVISED
CONCEPT**

Make it better!

Reassess your **users**

what new situations or
problems do they have?

Reassess your **ideas**

how will you handle breakdowns?

Reassess your **design space**

can you push the limits or find new gaps?

Reassess your **system**

can you make it simpler or more powerful
... or both?

REVISED
CONCEPT

TECHNICAL BREAKDOWNS

Do not assume technology is perfect!

Ligne	Destination	Attente (min)
CE :RDSACLAY	ID :86	
Noyau :2.12	SU :1.75	
BIV :hernet-3G	Desc :*12.0.17	
nG :Aucun	medium	

INTELLIGENT SYSTEMS

Intelligent systems are not “intelligent”

Consider the impact on the user

How does the user interact with the AI?

Does it “deskill” the user over time?

Consider errors

What happens when the AI is not correct?

Is the user aware of AI errors?

Can the user correct the errors easily?

INTELLIGENT SYSTEMS

Avoid “AI magic”

Do not assume the system fully understands
user needs
or solves problems perfectly
Design for real-world interaction and errors

Remember:

If the system does it automatically
You are no longer the designer



DESIGN DIAGRAM

“Diagrams are pictorial, yet abstract representations of information.

Maps, line graphs, bar charts, engineering blueprints, and architects' sketches are all examples of diagrams, whereas photographs and video are not”.

Anderson (1997)

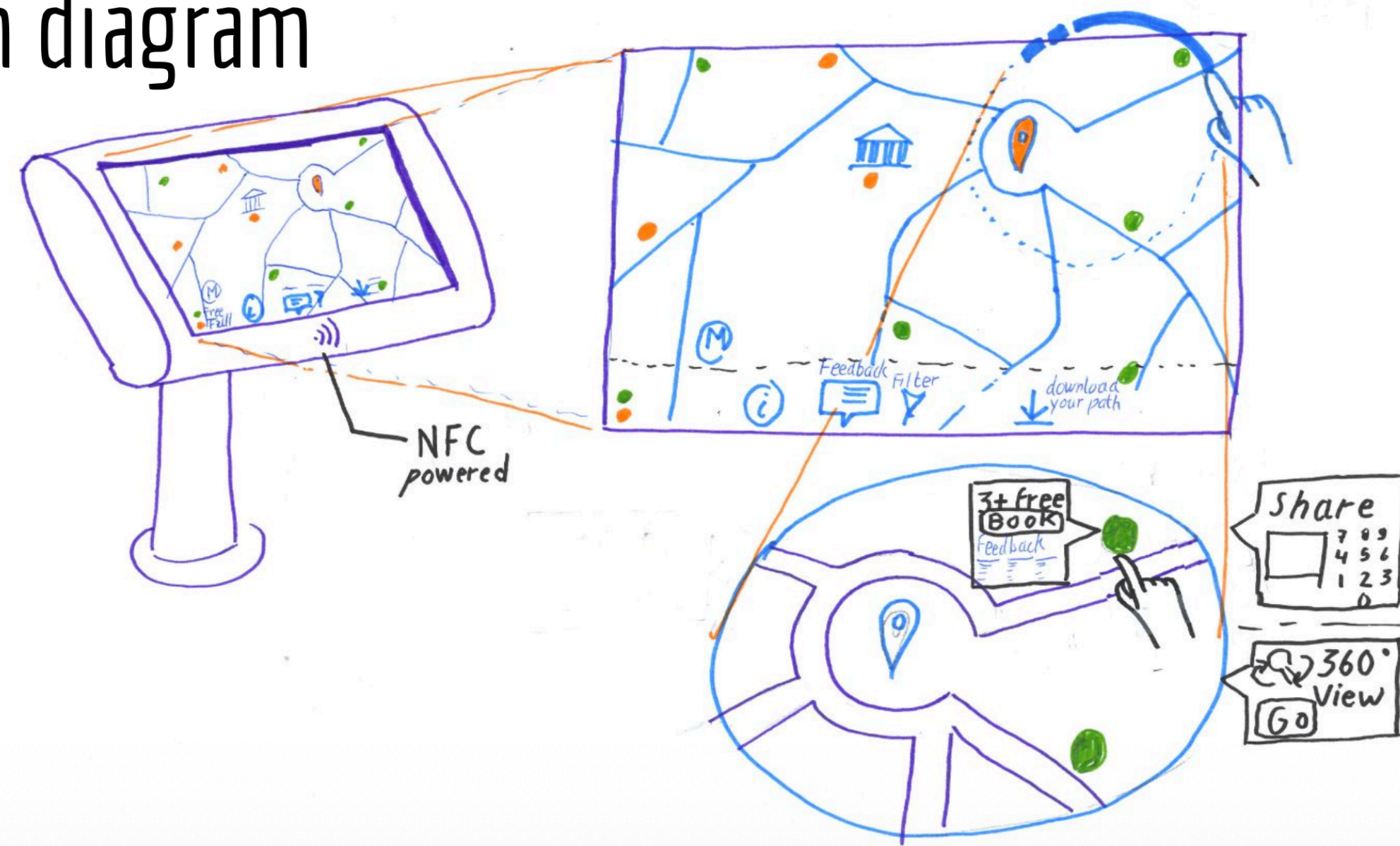
DESIGN DIAGRAM

Capture the essence of your design concept with a diagram

Examples:

- exploded diagram with key functions
- process diagram with arrows

Design diagram



DESIGN DIAGRAM

Advice

Choose a frame structure

Choose a point of view

Create sub-frames

Define relationship among elements

Pre-process photographs

**DESIGN
DIAGRAM**

Antoine et al. (CHI 2021): Interaction Illustration Taxonomy: Classification of Styles and Techniques for Visually Representing Interaction Scenarios (<https://dl.acm.org/doi/abs/10.1145/3411764.3445586>)

Advice

Define the interactive space

Highlight interactive elements

Represent frame dynamics

Highlight user actions

Illustrate non-visual feedback

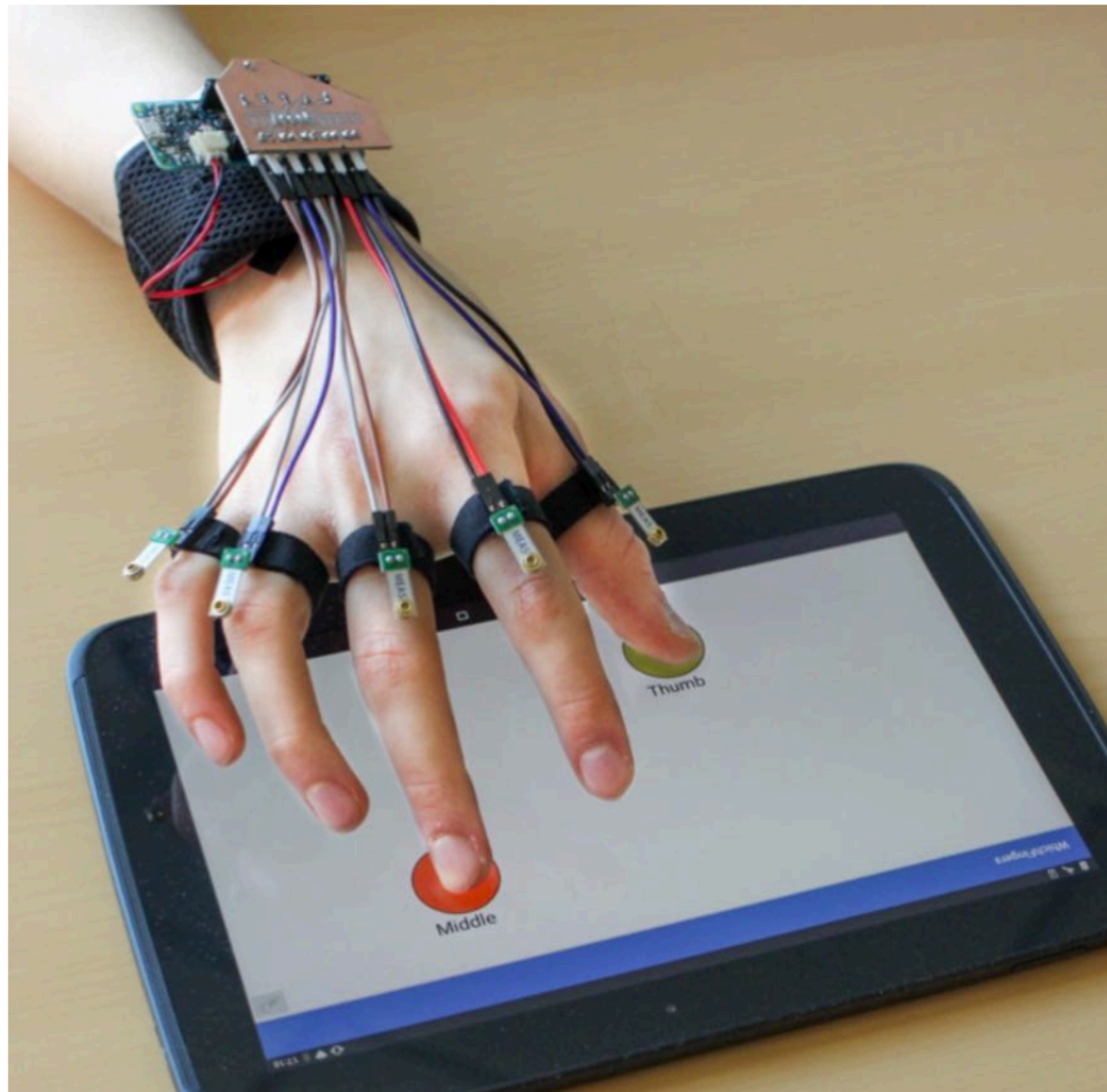
**DESIGN
DIAGRAM**

Antoine et al. (CHI 2021): Interaction Illustration Taxonomy: Classification of Styles and Techniques for Visually Representing Interaction Scenarios (<https://dl.acm.org/doi/abs/10.1145/3411764.3445586>)

EXAMPLES

Prototype photo

Show a user interacting with a prototype

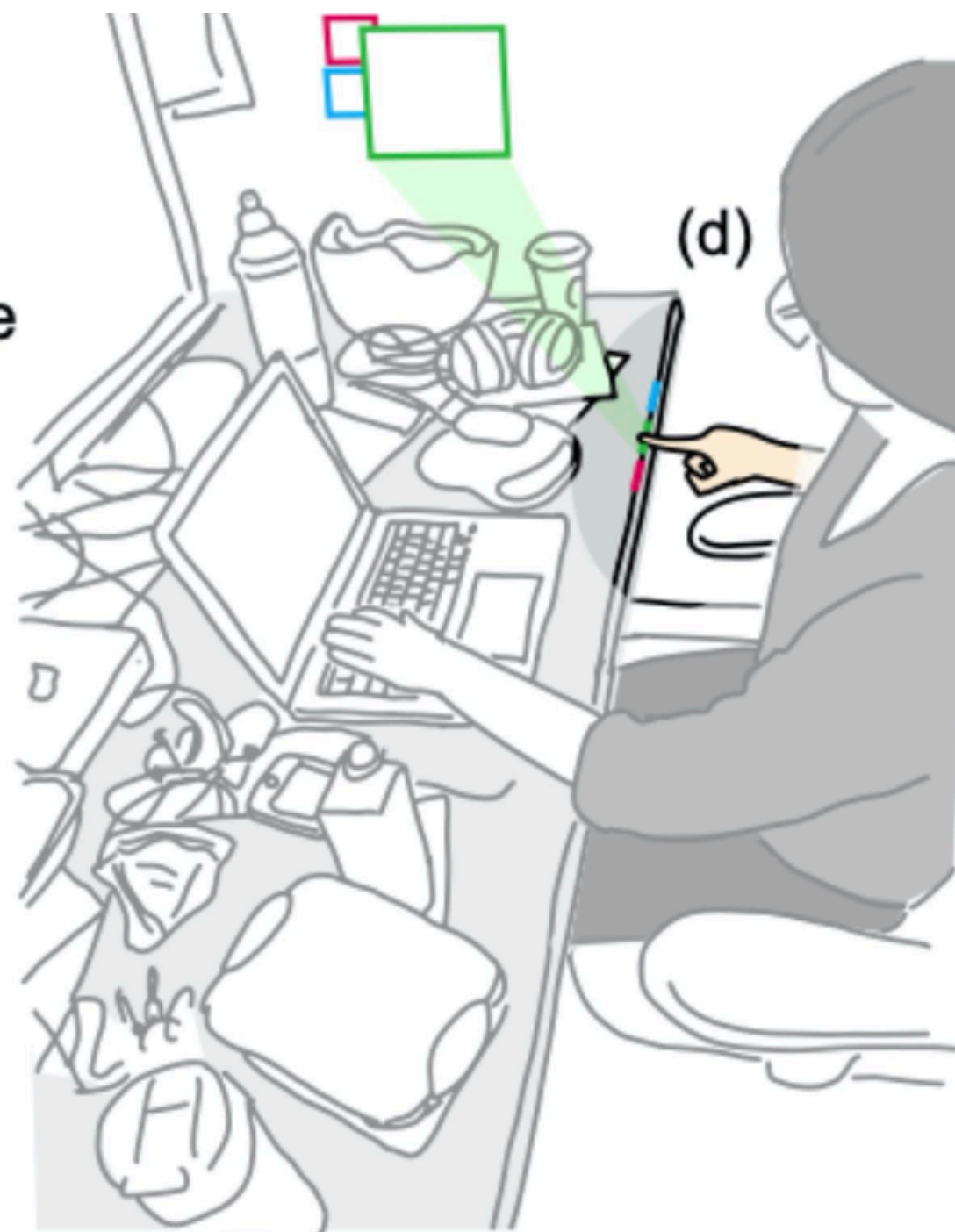
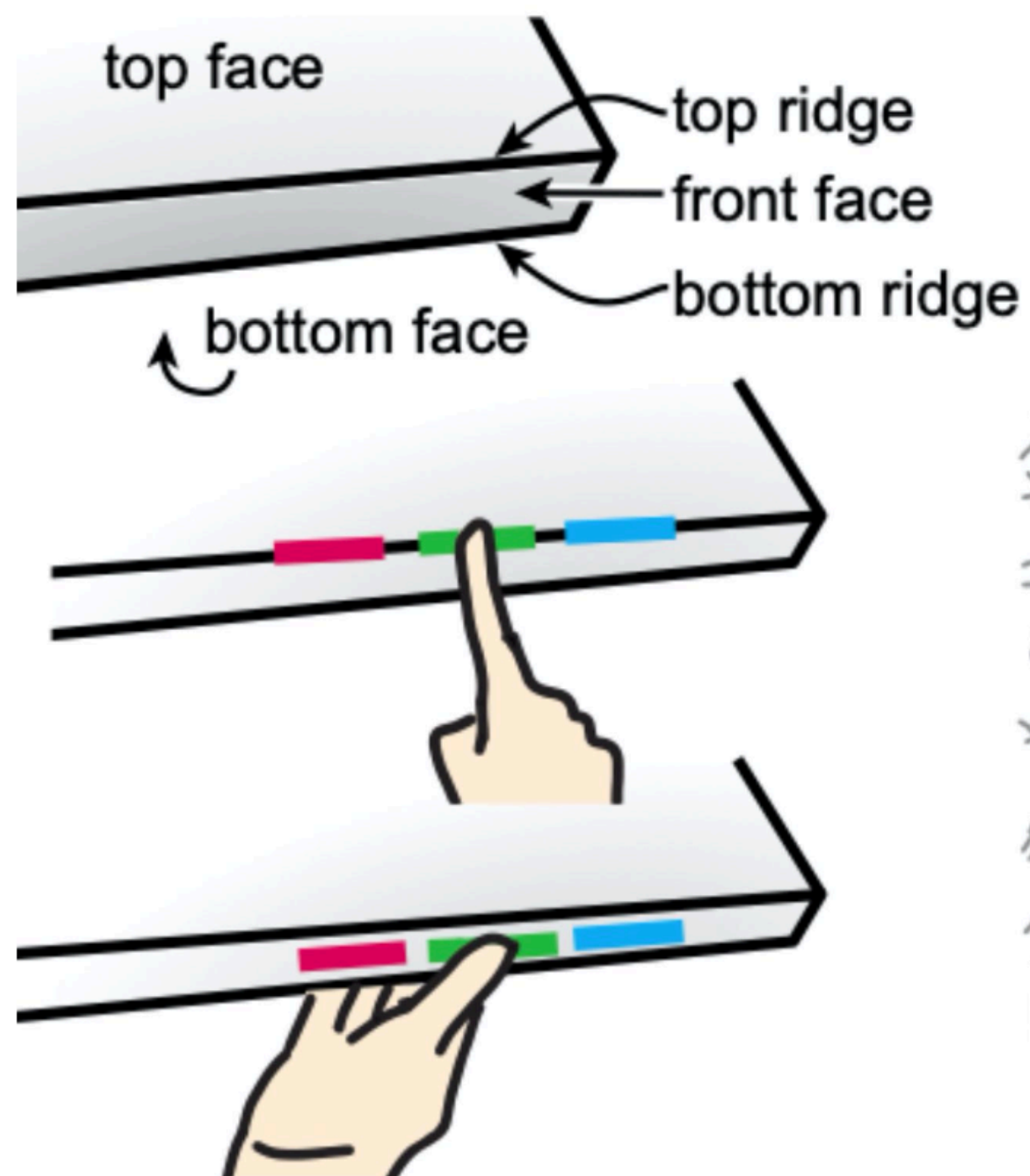


DESIGN
DIAGRAM

EXAMPLES

Photo sketch

Draw a silhouette (user or hand)
to show interaction with the prototype

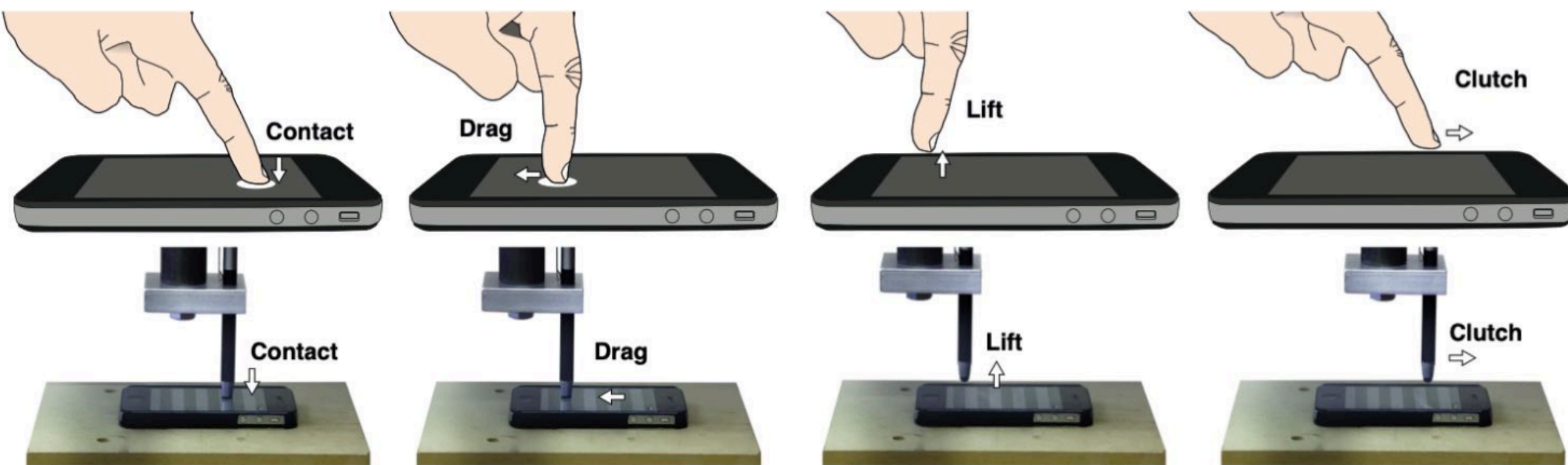


DESIGN DIAGRAM

EXAMPLES

Process diagram

Show each step of the process



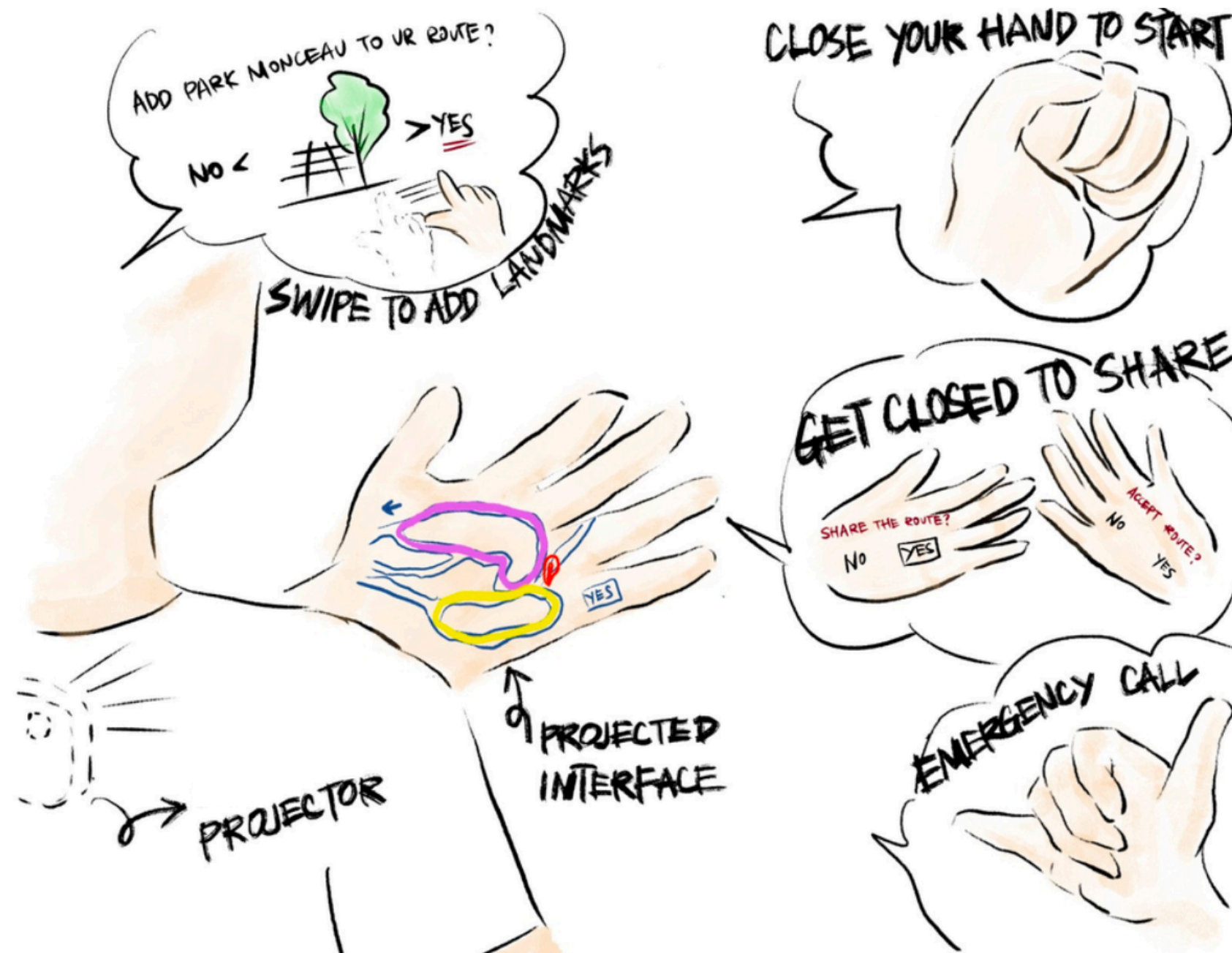
DESIGN DIAGRAM

EXAMPLES

Process diagram

Show each step of the process

Design Diagram

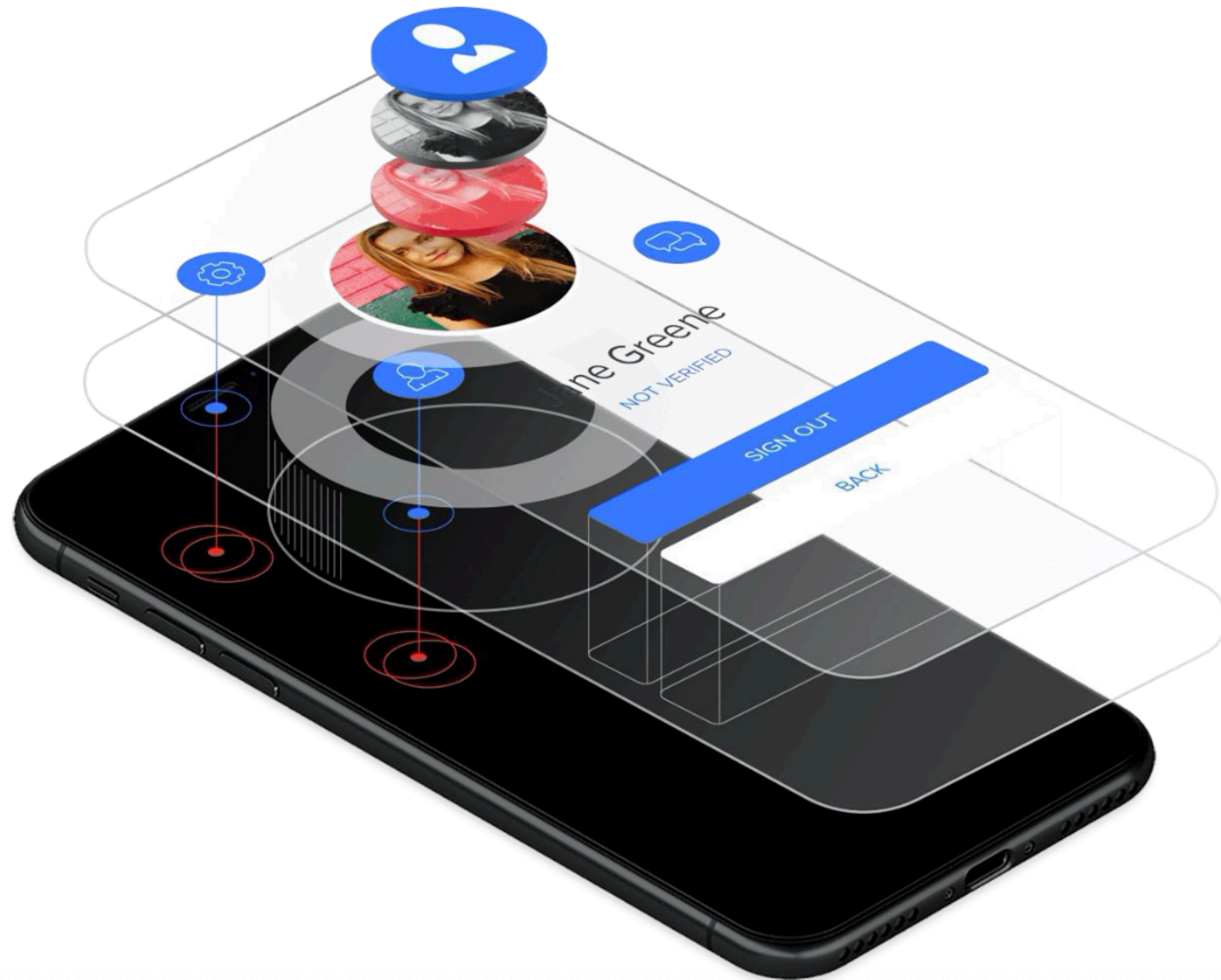


DESIGN DIAGRAM

EXAMPLES

Exploded diagram

Show how the parts fit together, layer by layer

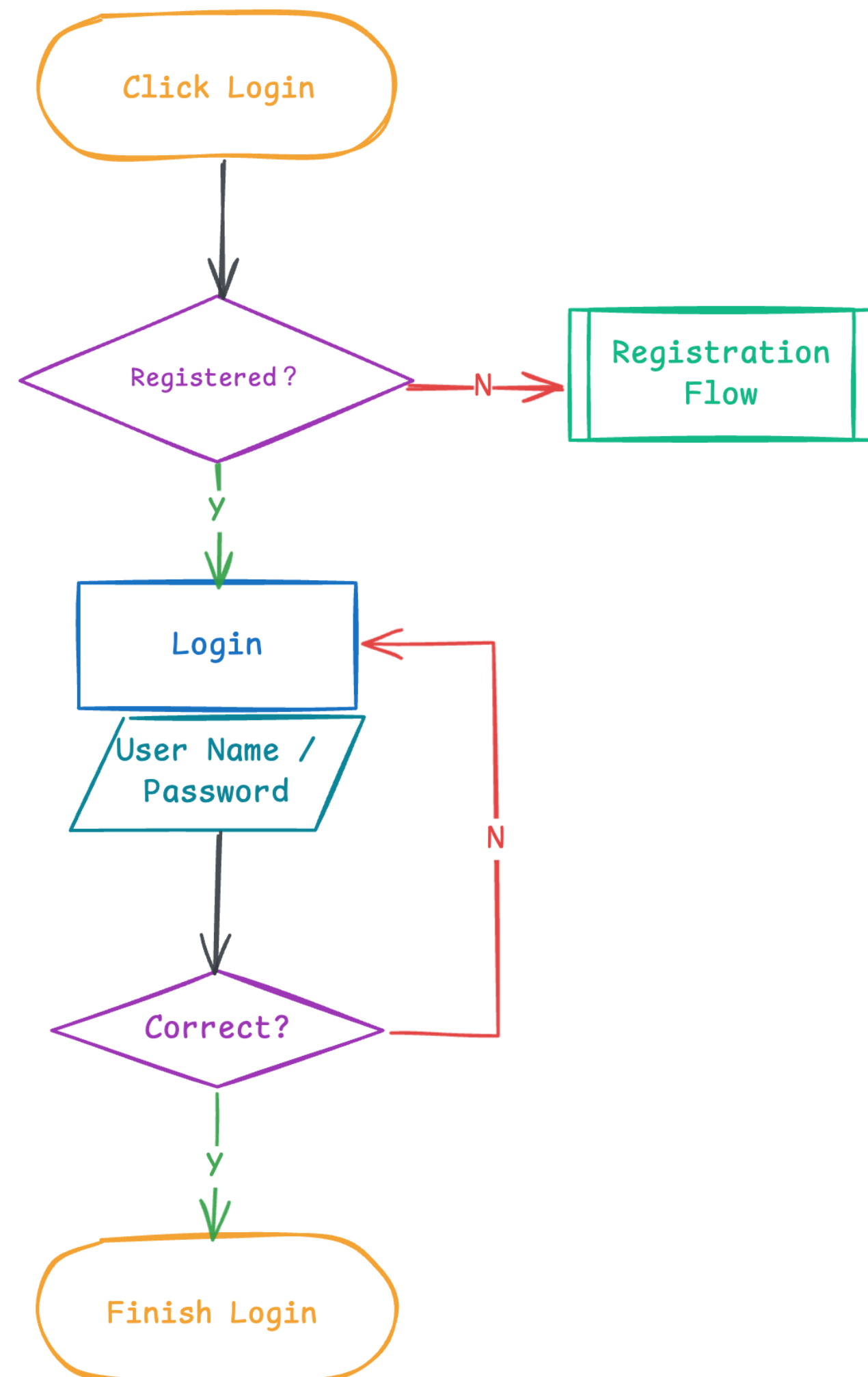


DESIGN DIAGRAM

EXAMPLES

Flow chart

Show each
step of user's
decision process

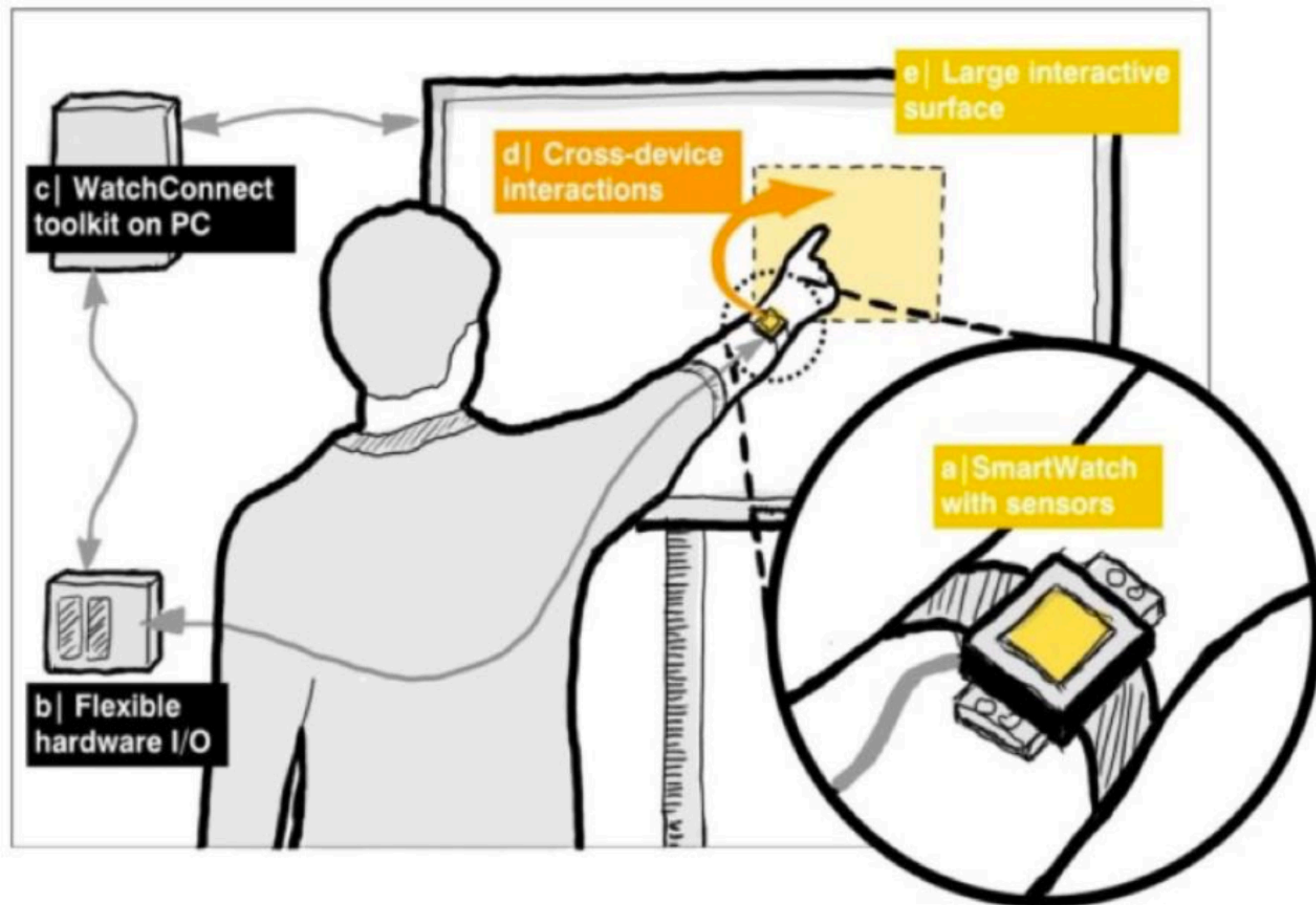


DESIGN DIAGRAM

EXAMPLES

Focus plus context

Highlight key interactions within a use context

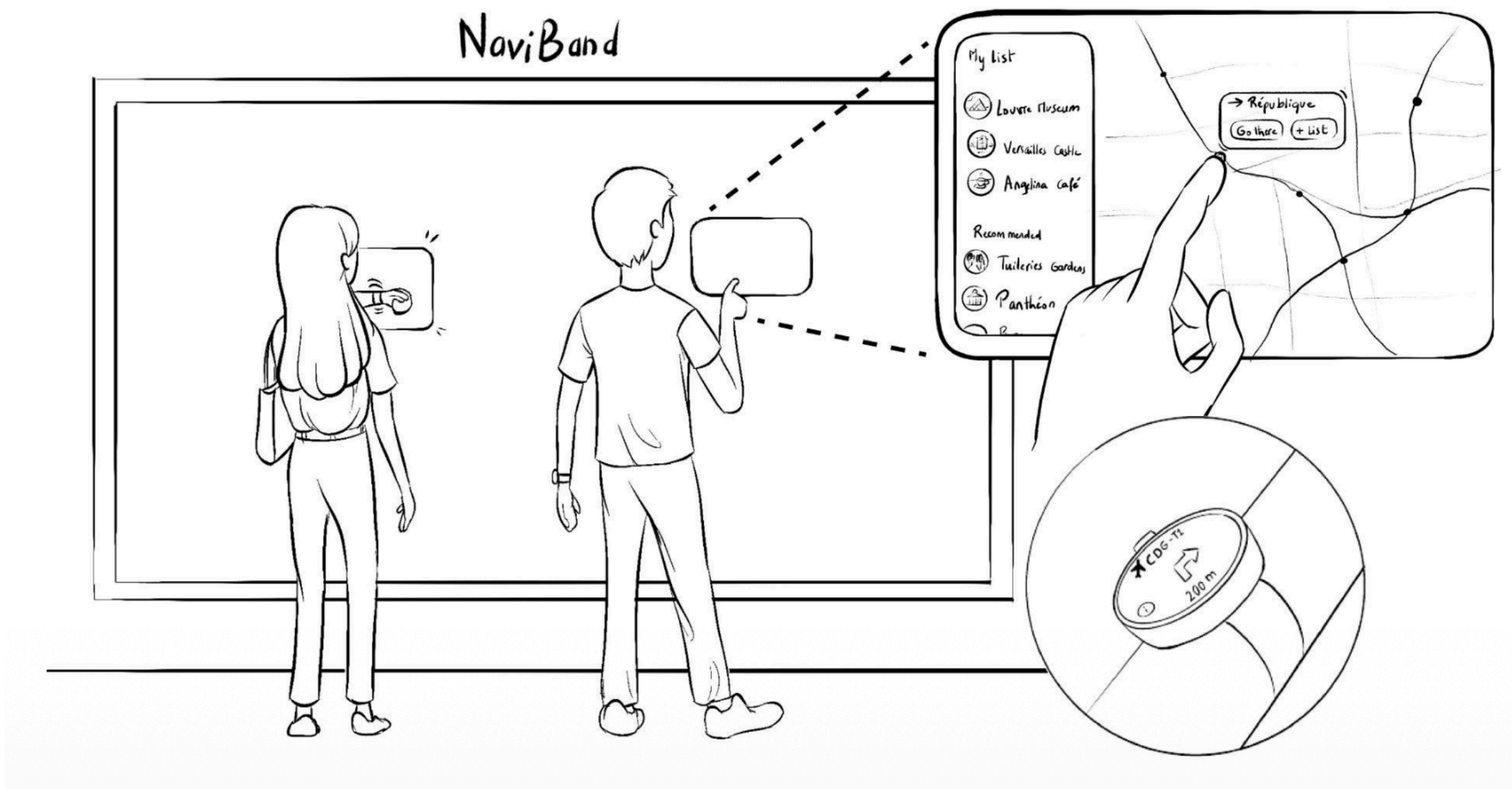


DESIGN
DIAGRAM

EXAMPLES

Focus plus context

Highlight key interactions within a use context



DESIGN
DIAGRAM

EXAMPLES

Visual abstract

Summarize the key elements of the interaction for a research paper

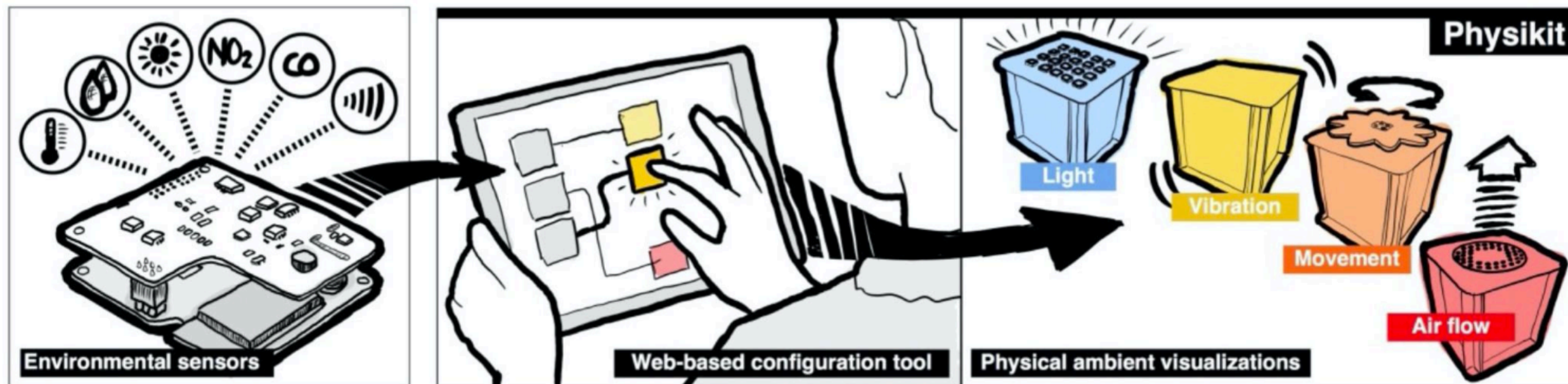


Figure 1. Physikit consist of four physical ambient visualizations (right), and a web-based configuration tool (center) to map the sensed data to the cubes to visualize sensor data, such as the SmartCitizen [8] sensor kit (left).

DESIGN
DIAGRAM

