Generative Theories of Interaction

Master Class

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Schedule

Wednesday, 10 July

-- 08:30 **Breakfast**
-- 09:00 **Introductions**
-- 09:15 **Generative Theories of Interaction**
-- 09:45 **Instrumental Interaction**

-- 10:45 **Break**

-- 11:15 **Analysis and Critique**

-- 12:00 **Lunch**

-- 13:00 **Co-Adaptation**
-- 14:00 **Analysis and Critique**
-- 14:30 **Reconstructing Google Slides**

-- 15:30 **Break**

-- 16:00 **Generating Generative Theories**
-- 16:15 **Discussion: Designing Actionable Principles**

-- 17:00 **End**

Learn how to ...

Understand the concept of generative theory

Apply two generative theories of interaction

Transform an existing theory into a generative theory

Generative theories of Interaction

Concepts & Principles

Instrumental Interaction

- Instruments & Substrates
  - Reification
  - Polymorphism
  - Reuse

Co-Adaptation

- Human-computer partnerships
  - Discoverability
  - Expressivity
  - Customizability
  - Appropriability

Types of theory

Descriptive:	*Describe* behavior	Observational study
	Frameworks, taxonomies, models	
	High context, weak claims, low+ external validity	
	Examples: Distributed cognition, boundary objects	
Predictive:	*Predict* behavior	Controlled experiment
	Mathematical relationships	
	Low context, strong claims, good external validity	
	Examples: Fitts law, McCollough effect	
Control:	*Control* behavior	Controlled event
	Mathematical relationships	
	Specific context, strong claims, high external validity	
	Examples: Schedules of reinforcement, shaping	
Generative:	*Generate* behavior	Participatory design
	High context, few claims, untested external validity	
	Examples: Technology probes, interactive thread	

Types of theory

Descriptive: *Describe* behavior — Observational study
Frameworks, taxonomies, models
High context, weak claims, low+ external validity
Examples: Distributed cognition, boundary objects

Predictive: *Predict* behavior — Hypothesis-testing experiment
Mathematical relationships
Low context, strong claims, good external validity
Examples: Fitts law, McCollough effect

Control: *Control* behavior — Stimulus control experiment

Mathematical relationships
Specific context, strong claims, high external validity
Examples: Schedules of reinforcement, shaping

Generative: *Generate* behavior — Participatory design study
High context, few claims, untested external validity
Examples: Technology probes, interactive thread

Who is who?

Generative theory
9:15 – 9:45

Generative theory

Wendy Mackay

ACM Transactions on
Computer-Human Interaction

Generative Theories of Interaction

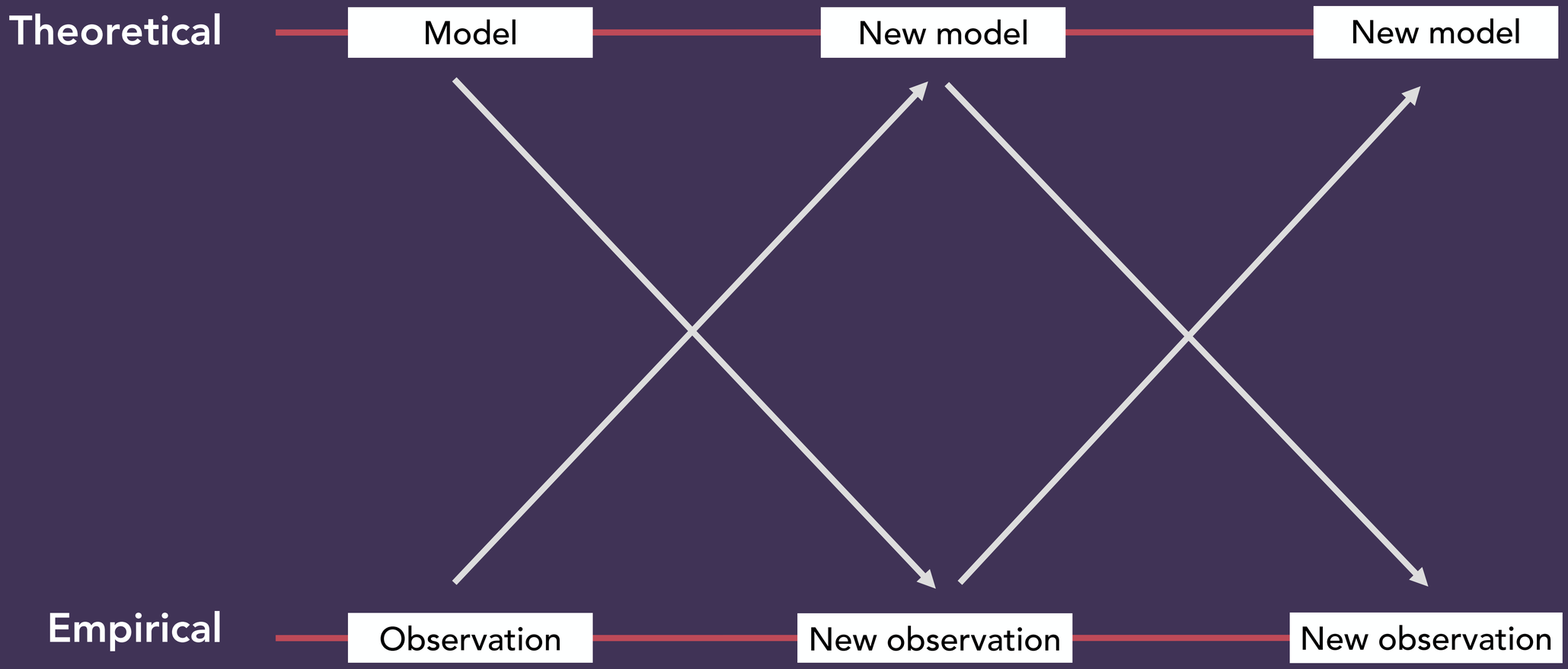
Michel Beaudouin-Lafon
Susanne Bødker
Wendy E. Mackay

Why generative theory?

Natural Science Research

Mackay & Fayard (1997)

Move back-and-forth between theoretical and empirical study of natural (and social) phenomena



Designed artifacts

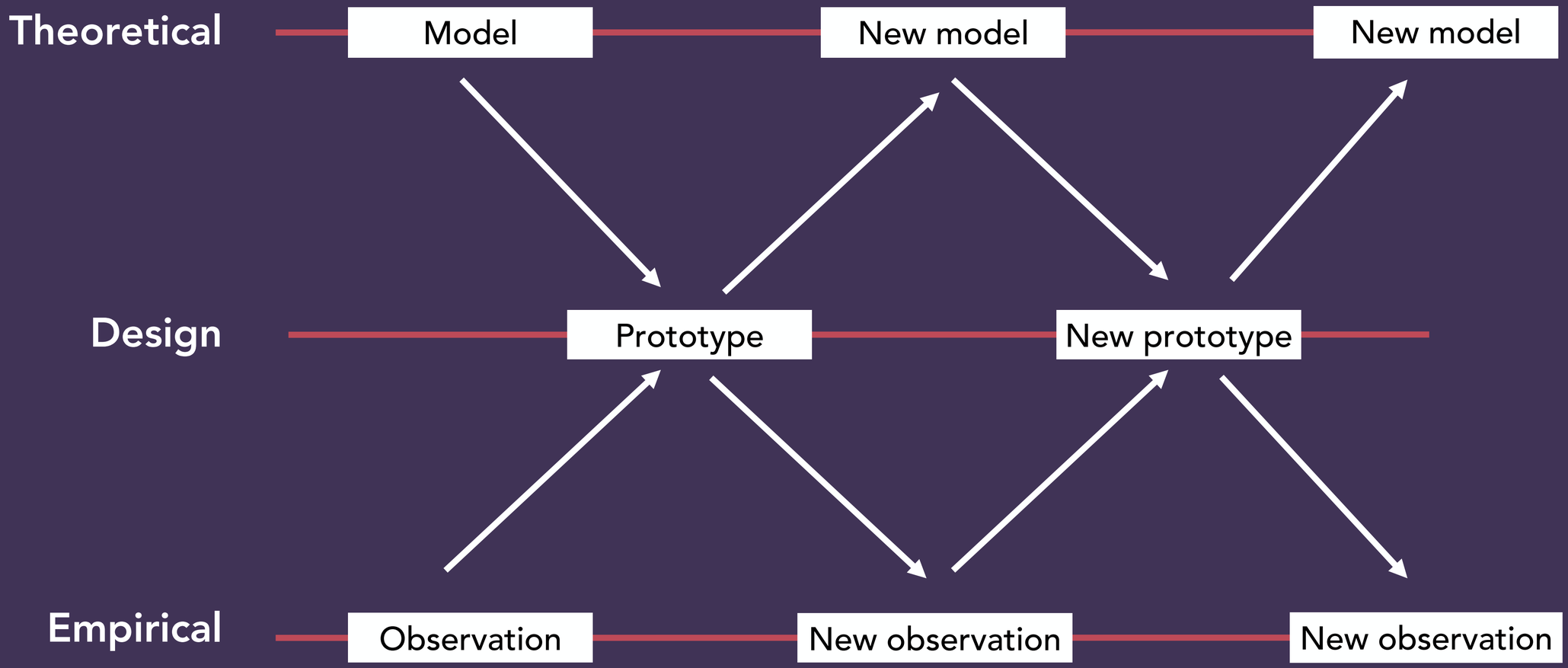
Mackay & Fayard (1997)

… but researchers are not ‘independent observers’
of human-designed artifacts

HCI Research

Mackay & Fayard (1997)

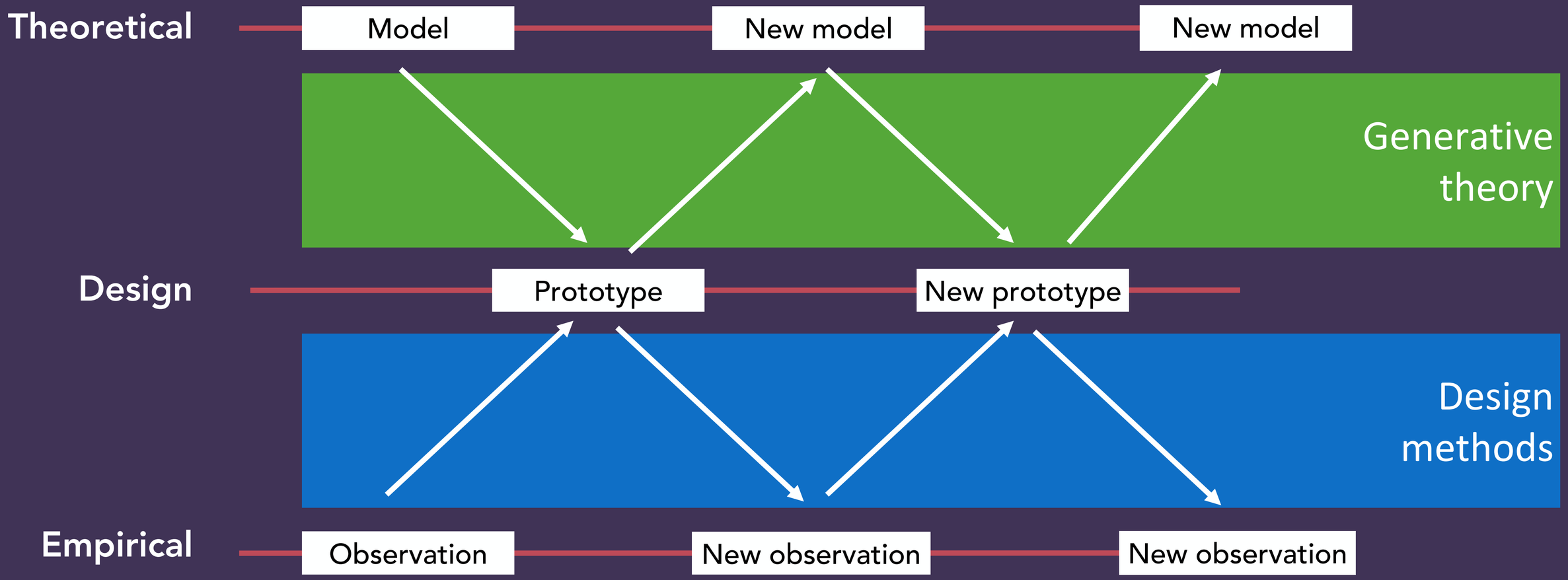
... combines natural and social science with creation and study of human-designed artifacts

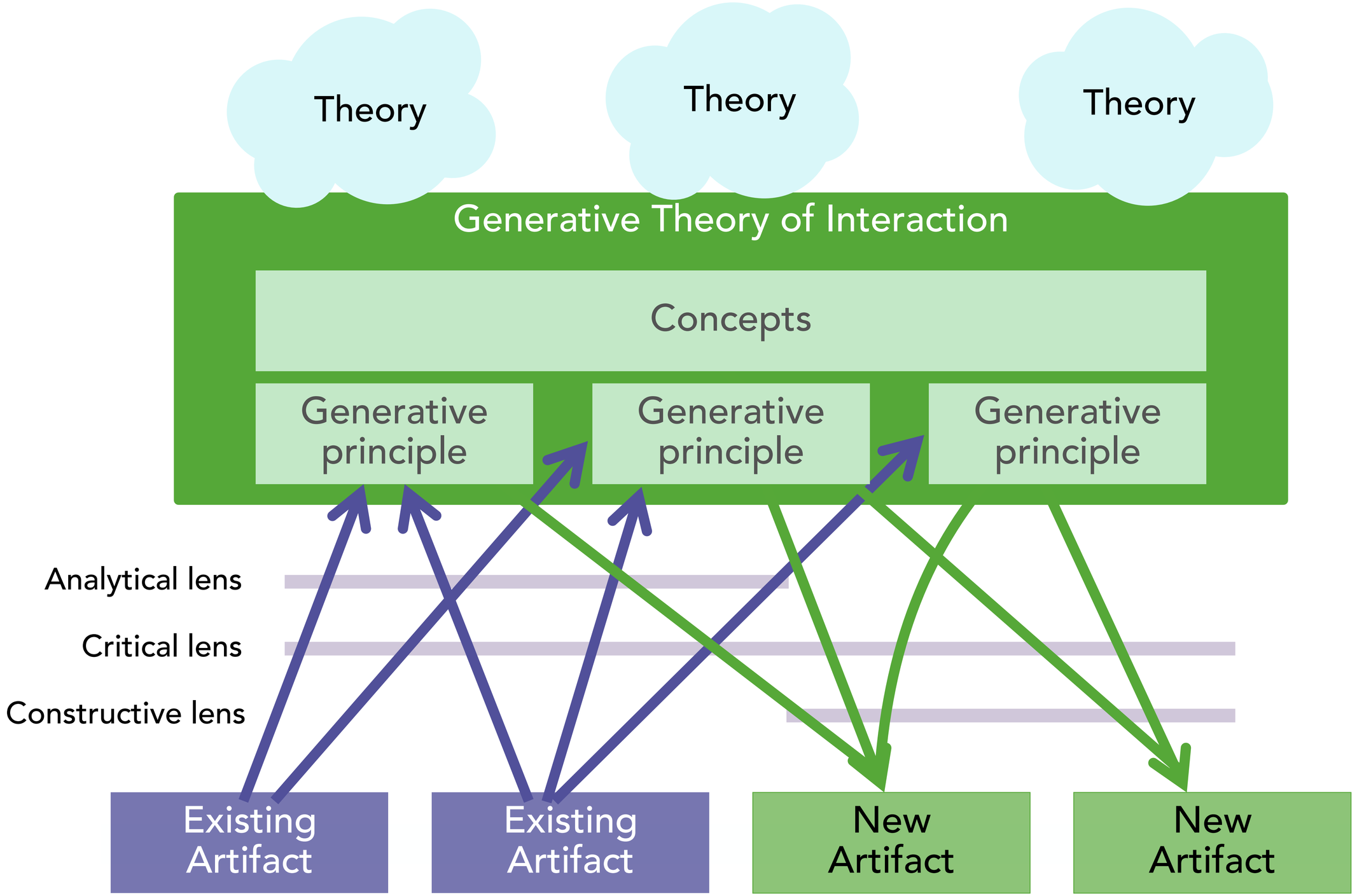


HCI Research

Mackay & Fayard (1997)

Design methods focus on study of artifacts,
Generative theory focuses on creating innovative artifacts




Theory
Theory
Theory
Generative Theory of Interaction
Concepts
Generative principle
Generative principle
Generative principle
Analytical lens
Critical lens
Constructive lens
Existing Artifact
Existing Artifact
New Artifact
New Artifact

Generative Theory	Analytical lens	Critical lens	Constructive lens
Concept	Is the concept applied? If so, how?	Is the concept applied to its fullest extent?	How could the concept improve the system?
Principle	Is the principle applied? If so, how?	Is the principle applied to its fullest extent?	How could the principle improve the system?

Instrumental Interaction
9:45 – 10:45

Break
10:45 – 11:15

Analysis & Critique
11:15 – 12:00

Analysis

Critique

Analysis

Instrumental Interaction

Have any principles from the concept of **instrumental interaction** been applied?

- reification
- polymorphism
- reuse

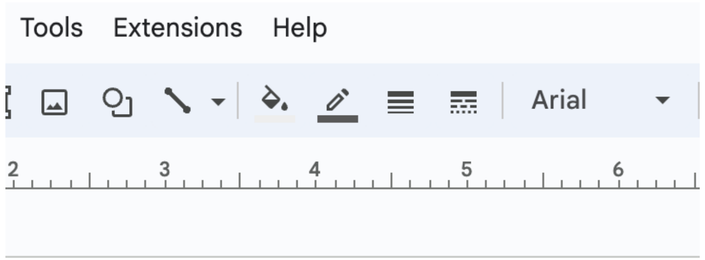
Analysis

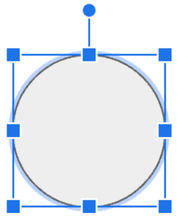
“Fill Color” Command

Current interaction

“Fill Color” Command

Select the circle shape

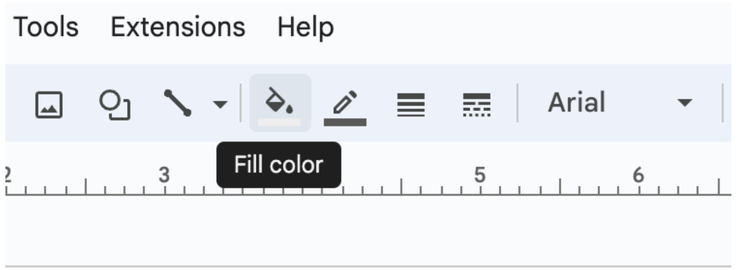


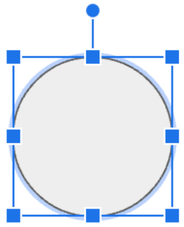


Current interaction

“Fill Color” Command

Click on the “fill color” icon

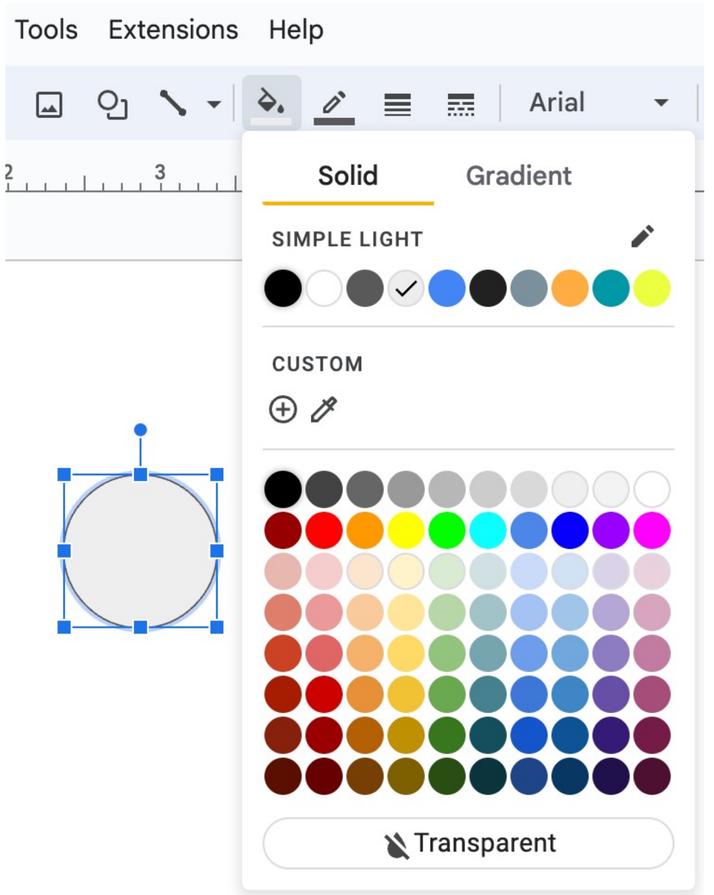




Current interaction

“Fill Color” Command

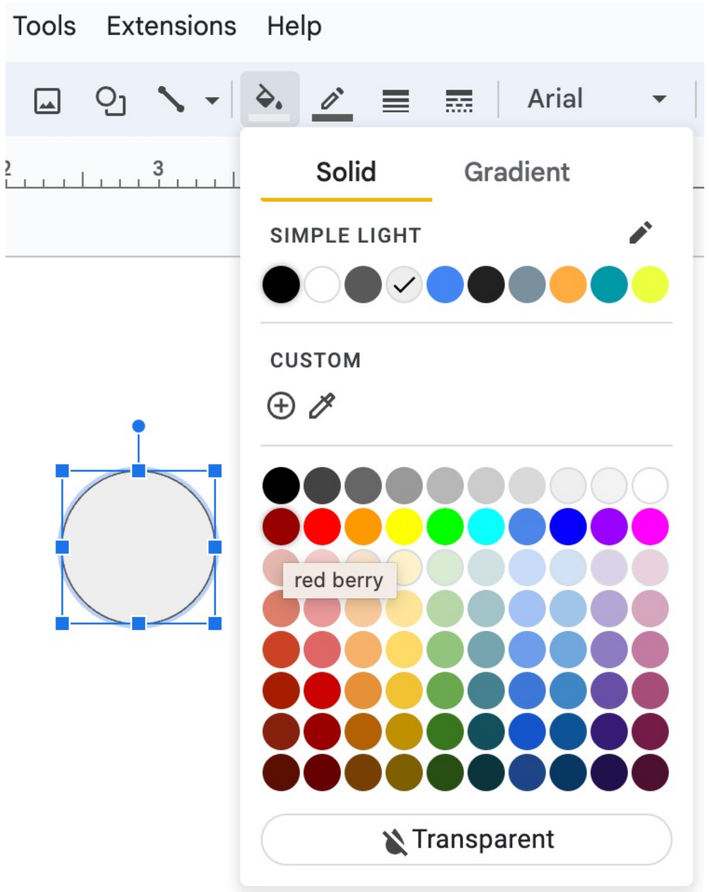
The color palette appears



Current interaction

“Fill Color” Command

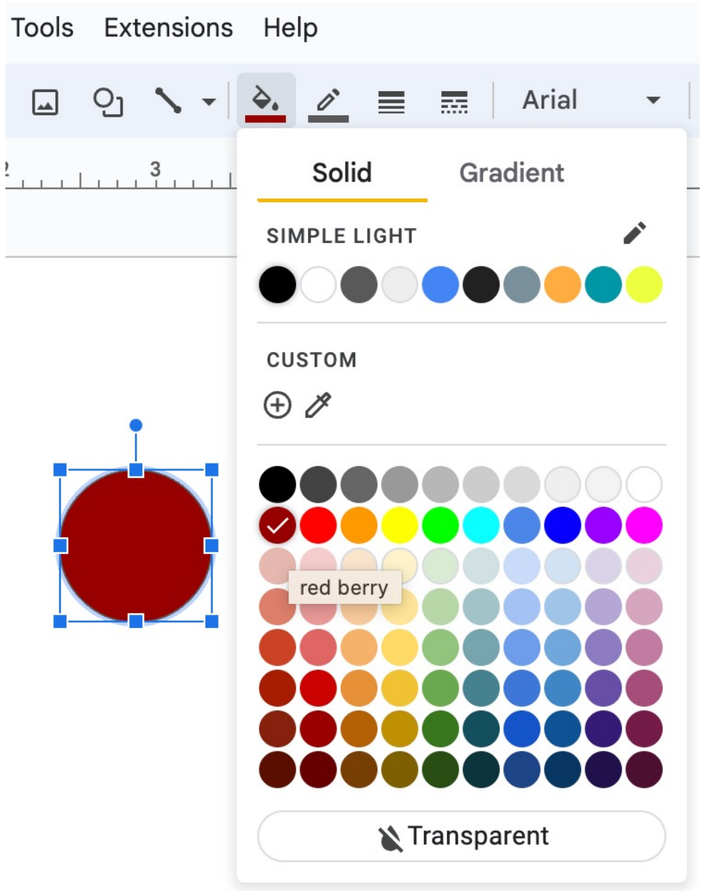
Choose “red berry” from the color palette



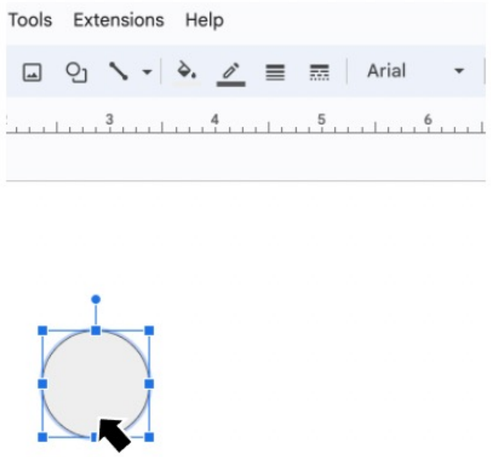
Current interaction

“Fill Color” Command

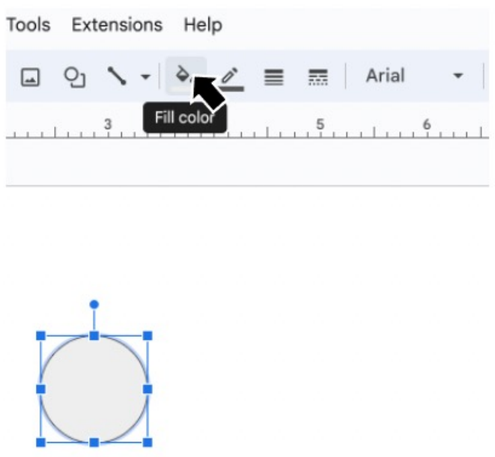
The circle changes color



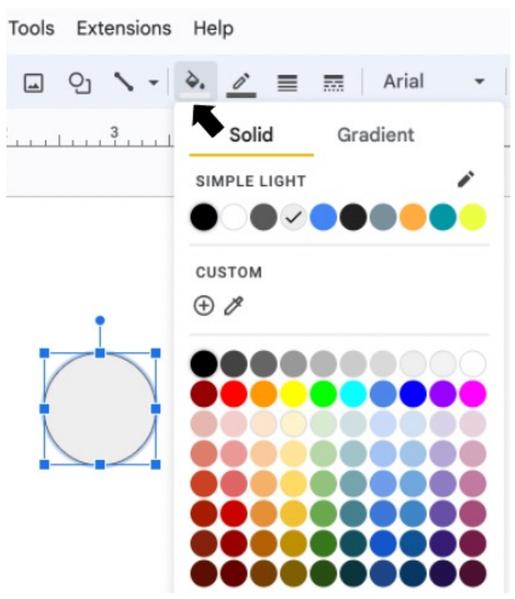
1. Select the circle shape.



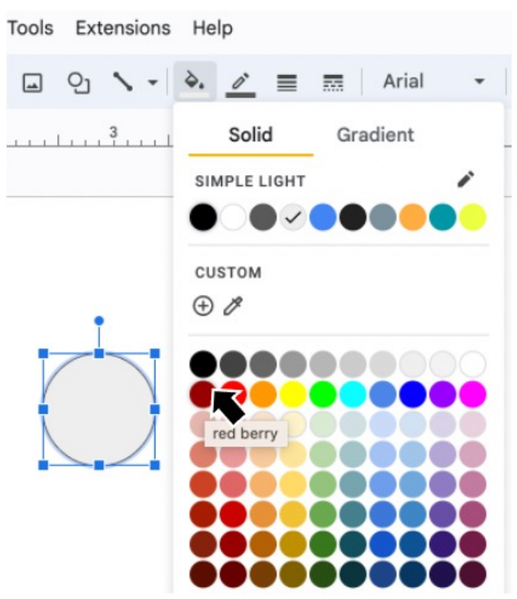
2. Click on the "fill color" icon.



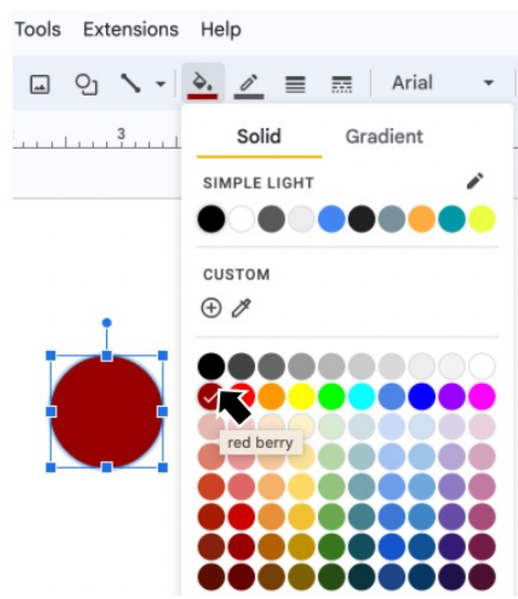
3. The color palette appears.



4. Choose "red berry" from the color palette



5. The circle changes color .



Principles			Actionable Behavior	Example
Reification	*of a*	**command**	transforms a command into a **persistent, interactive instrument**	**Instrument**
	of an	**effect**	transforms effects into **a persistent, interactive substrate** that **contains objects, interprets objects** and **manages relationships among objects.**	**Substrate**
Polymorphism	*of a*	**command**	enables an instrument to affect **different types of objects**	**Multi-object**
	of an	**effect**	enables a substrate to manage **different types of relationships**	**Multi-relationship**
Reuse	*of a*	**command**	applies **previous actions to different objects**	**Macro**
	of an	**effect**	applies **previous effects to different objects**	**Template**

Critique

Instrumental Interaction

If the principles have been applied,
do they improve or hinder the system?

If they have not been applied,
what problems does this cause?

Could applying the principles improve the interface?

Google Slides

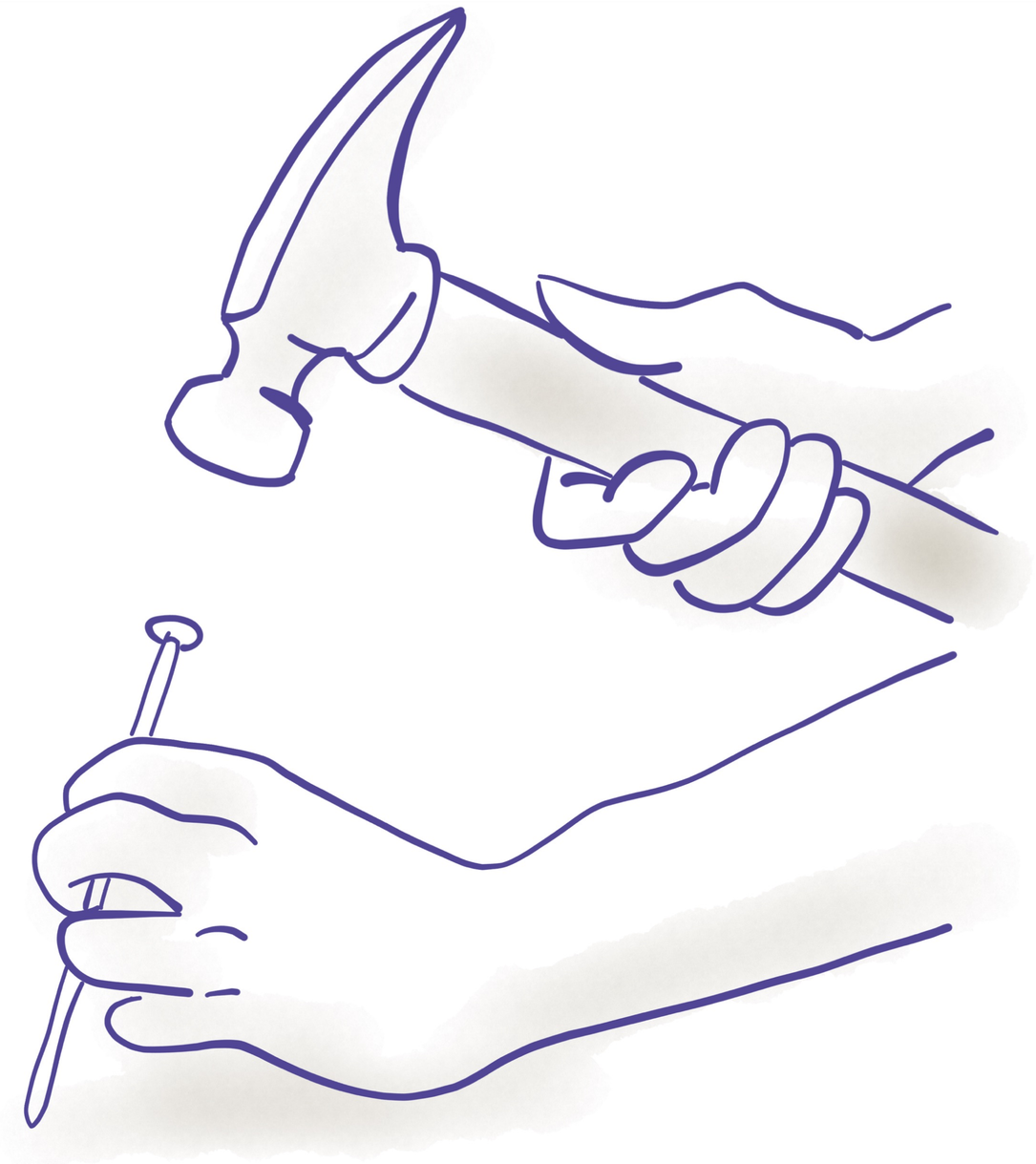
Lunch
12:00 – 13:00

Co-Adaptation
13:00 – 14:00

Generative Theory of Interaction:

Human-Computer Partnerships

Wendy E. Mackay



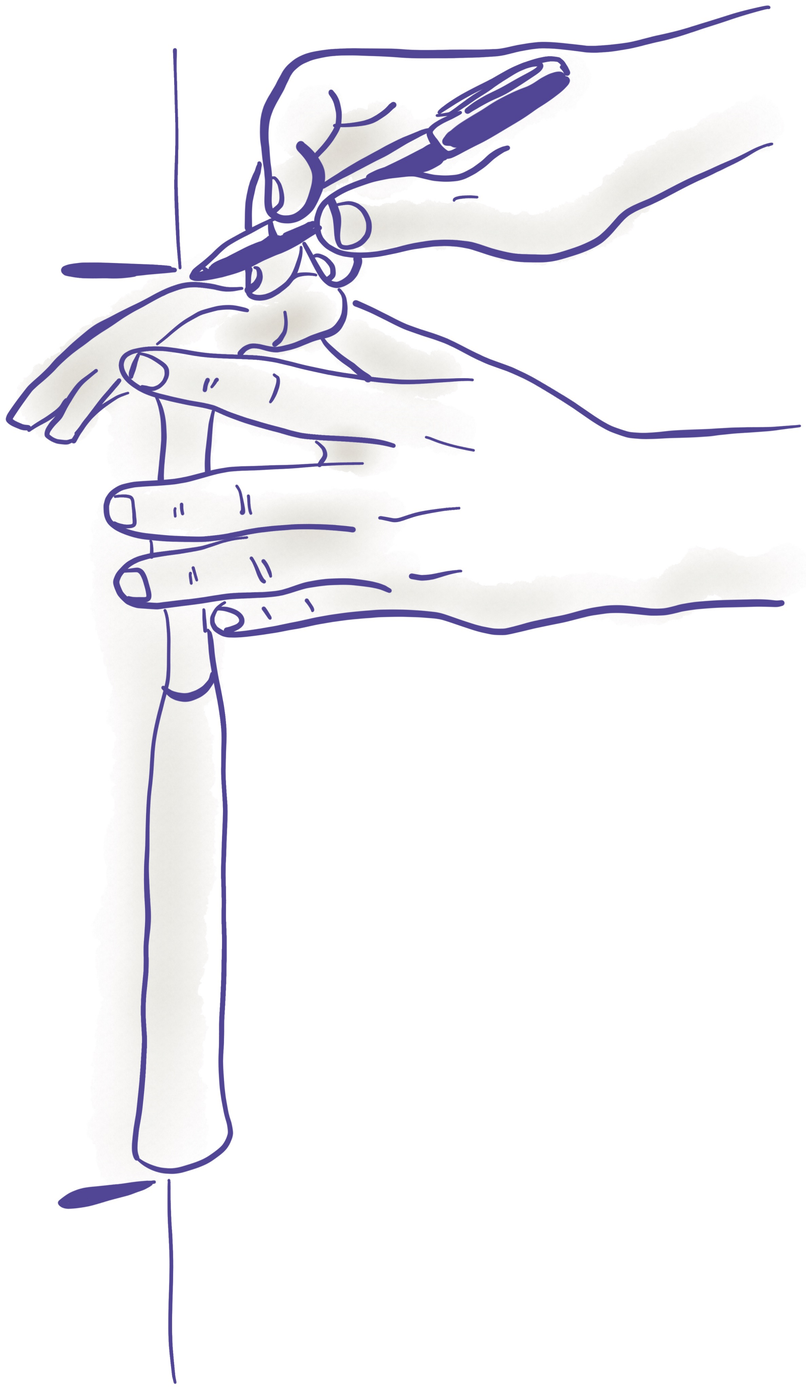
Inspiration: Physical tools

We can use tools as designed

Inspiration: Physical tools

We can also innovate

We use the properties of the object to accomplish the task at hand



Inspiration: Physical tools

We can also innovate

We use the properties of the object to accomplish the task at hand

... or use the properties of a tool to accomplish a different task

Co-Adaptive systems

Focus on the user's interaction with the system over time

We start as novices and learn

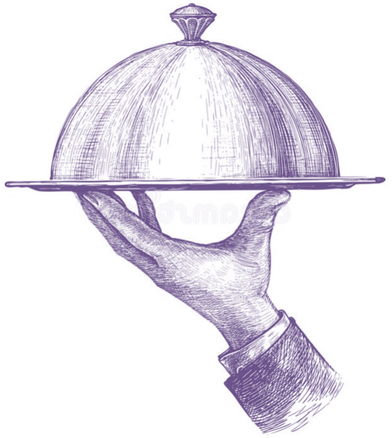
...some can become virtuosos

Human roles vary relative to computers

Human-Computer Interaction

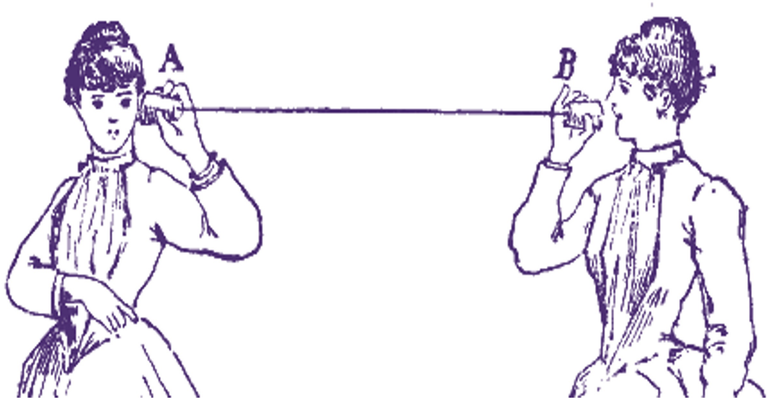
Computer treated as a tool:
User performs tasks

Artificial Intelligence



Computer acts as a servant:
System performs tasks

Mediated Communication



Computer mediates
human communication

Co-Adaptation:

***Adapt to* technology**

We **discover** what technology can do

Co-Adaptation:

***Adapt to* technology**

We **discover** what technology can do

We learn how to control technology to **express** ourselves

Co-Adaptation:

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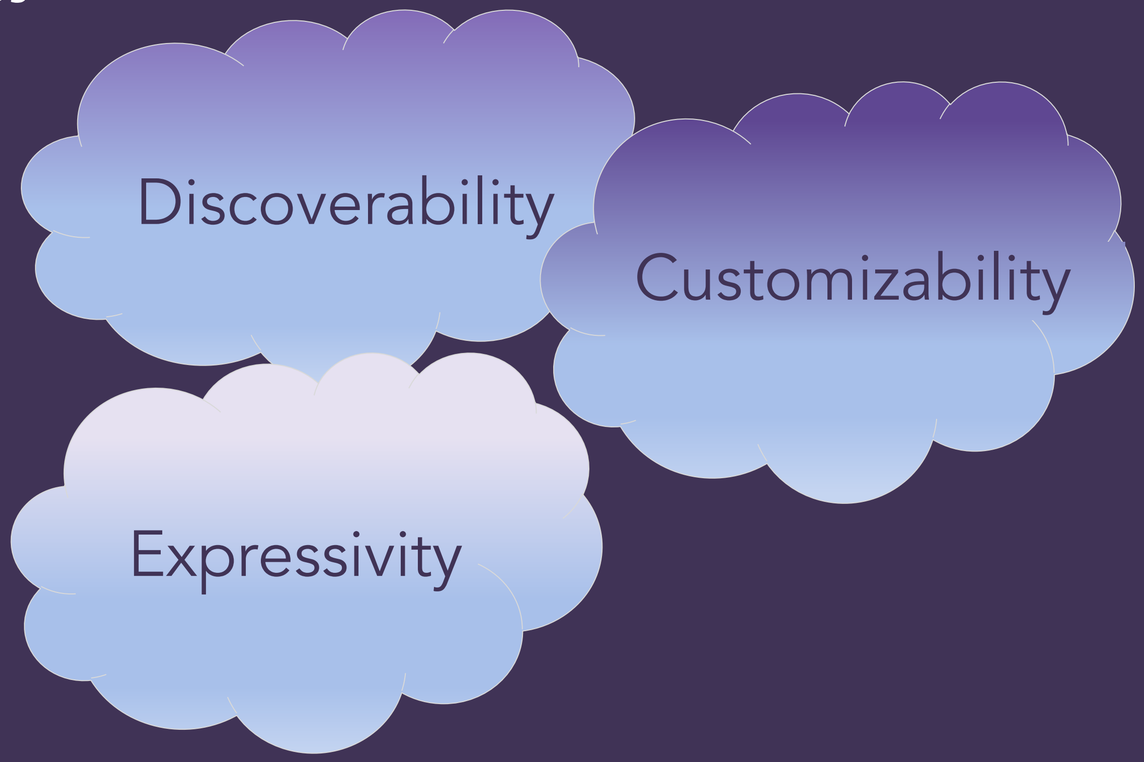


***Adapt* technology**

We **customize** technology to meet personal needs

Co-Adaptation:

Adapt to technology

We **discover** what technology can do

We learn how to control technology to **express** ourselves

Adapt technology

We **customize** technology to meet personal needs

We reinterpret and **appropriate** technology to innovate

Co-Adaptation: Human-computer partnerships

Adapt to technology

We **discover** what technology can do

We learn how to control technology to **express** ourselves

Adapt technology

We **customize** technology to meet personal needs

We reinterpret and **appropriate** technology to innovate

Instruments

Commands become interactive objects

Reification of a command
transforms a command into a persistent, interactive object (instrument)

Polymorphism of a command
enables an instrument to affect different types of objects

Reuse of a command
applies previous commands to other objects

Substrates

Effects become persistent relationships

Reification of an effect
transforms the effects of a command into a persistent, interactive relationship (substrate)

Polymorphism of an effect
enables a substrate to manage different types of relationships

Reuse of an effect
applies previous relationships to other objects

Adapt to...

User learns the technology

Discovery of an action
lets users see possible future actions

Discovery of an effect
lets users see how the system interpreted their behavior

Expressivity of an action
lets users transform deviation from the norm into rich output

Expressivity of an effect
lets users fine-tune effects into reusable objects

Adapt...

User appropriates the technology

Customization of an action
lets users create new instruments or transform properties into families of tools

Customization of an effect
lets users redefine the mapping between actions and effects

Appropriability of a property
lets users reinterpret a property

Appropriability of a relationship
lets users reinterpret relationships among objects

Appropriability of an effect
lets users reinterpret an effect

System learns user patterns

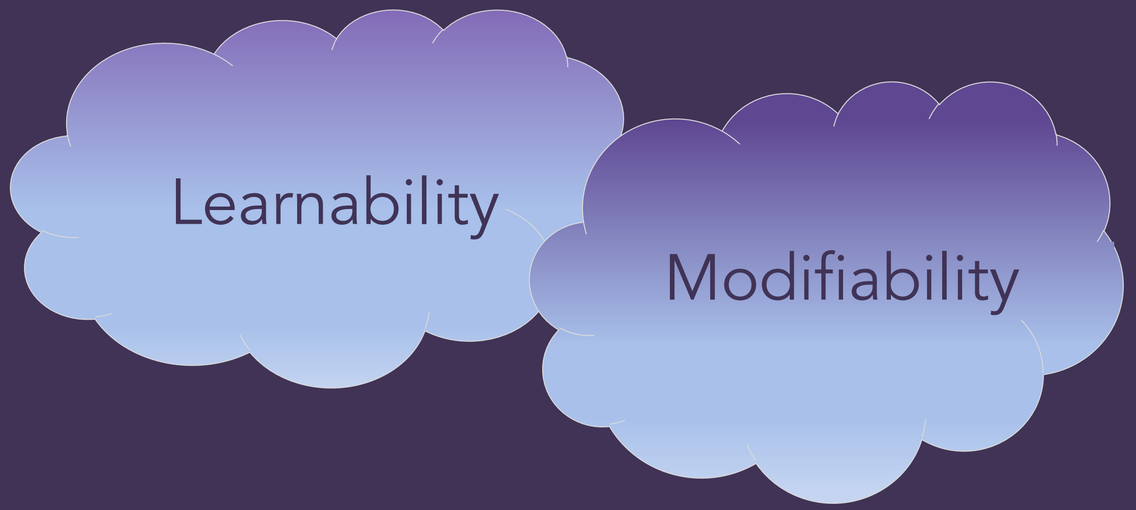
System modifies user behavior

Reciprocal Co-Adaptation: Human-computer partnerships

System *adapts* to the user

What happens if the system can learn from (adapt to) the user?

System **discovers** patterns of user interaction



System *adapts* the user

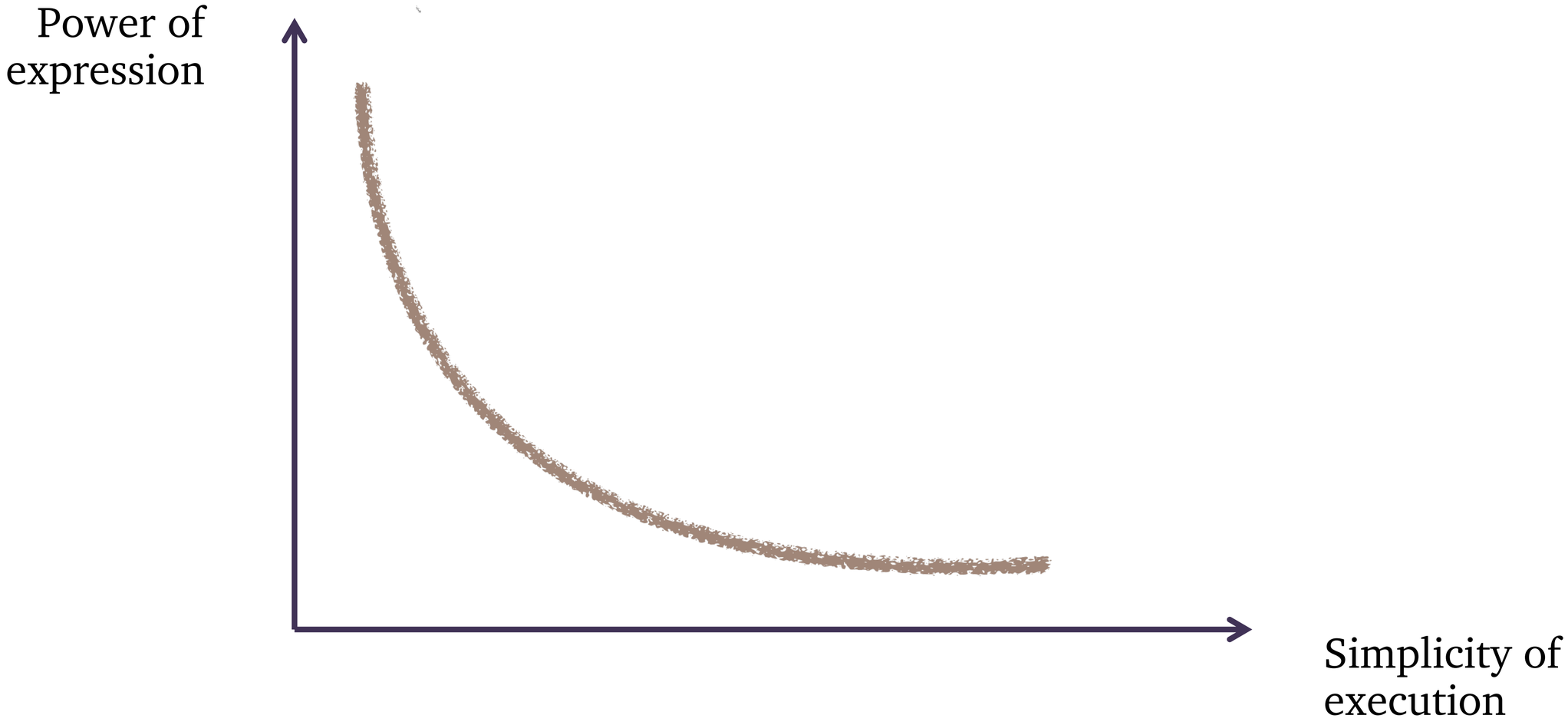
What happens if the system modifies (or adapts) the user's behavior?

System **modifies** the user's behavior over time

Making it simple is complicated!

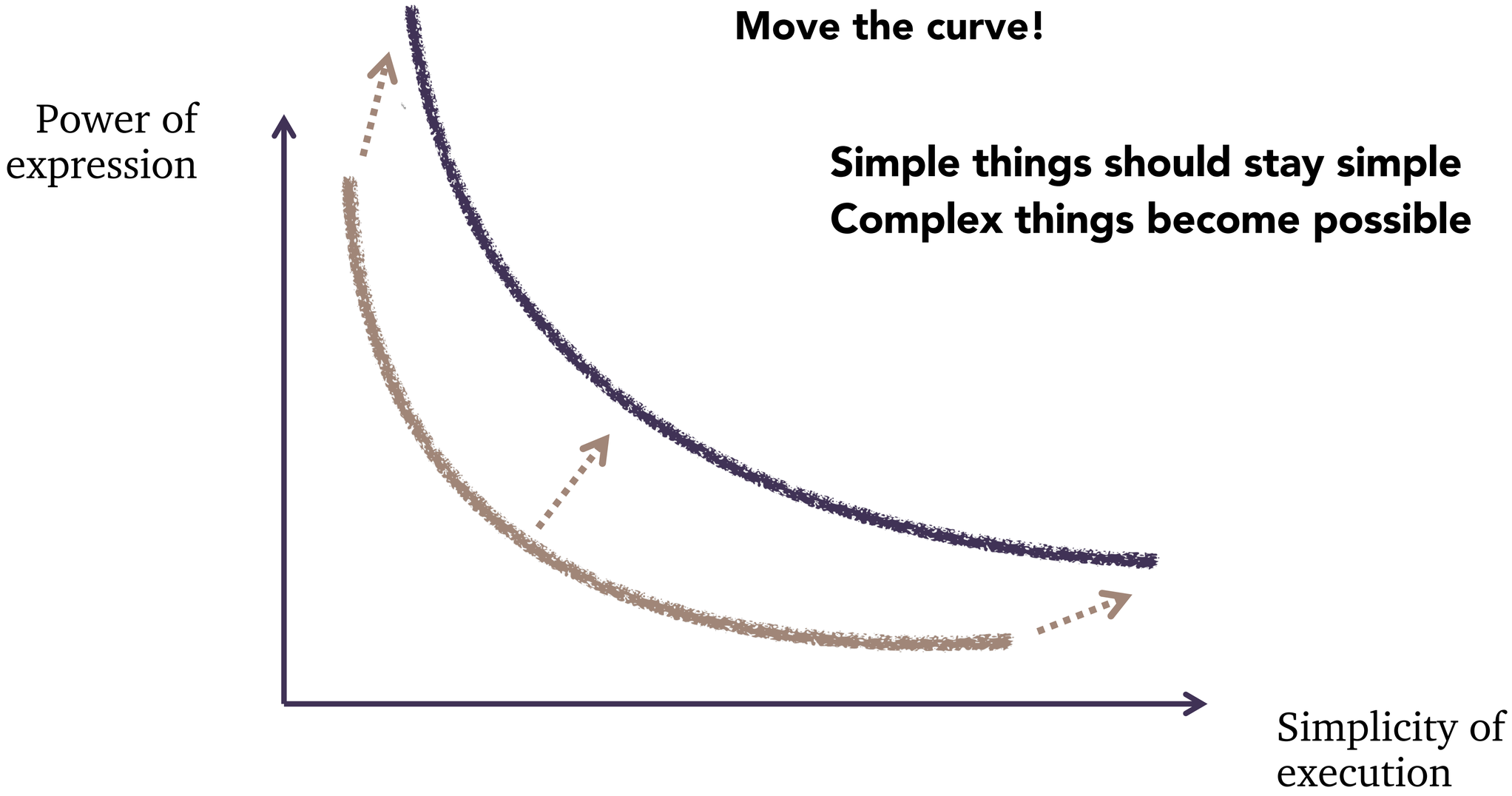
HCI research challenge

Compromise between power and simplicity



HCI research challenge

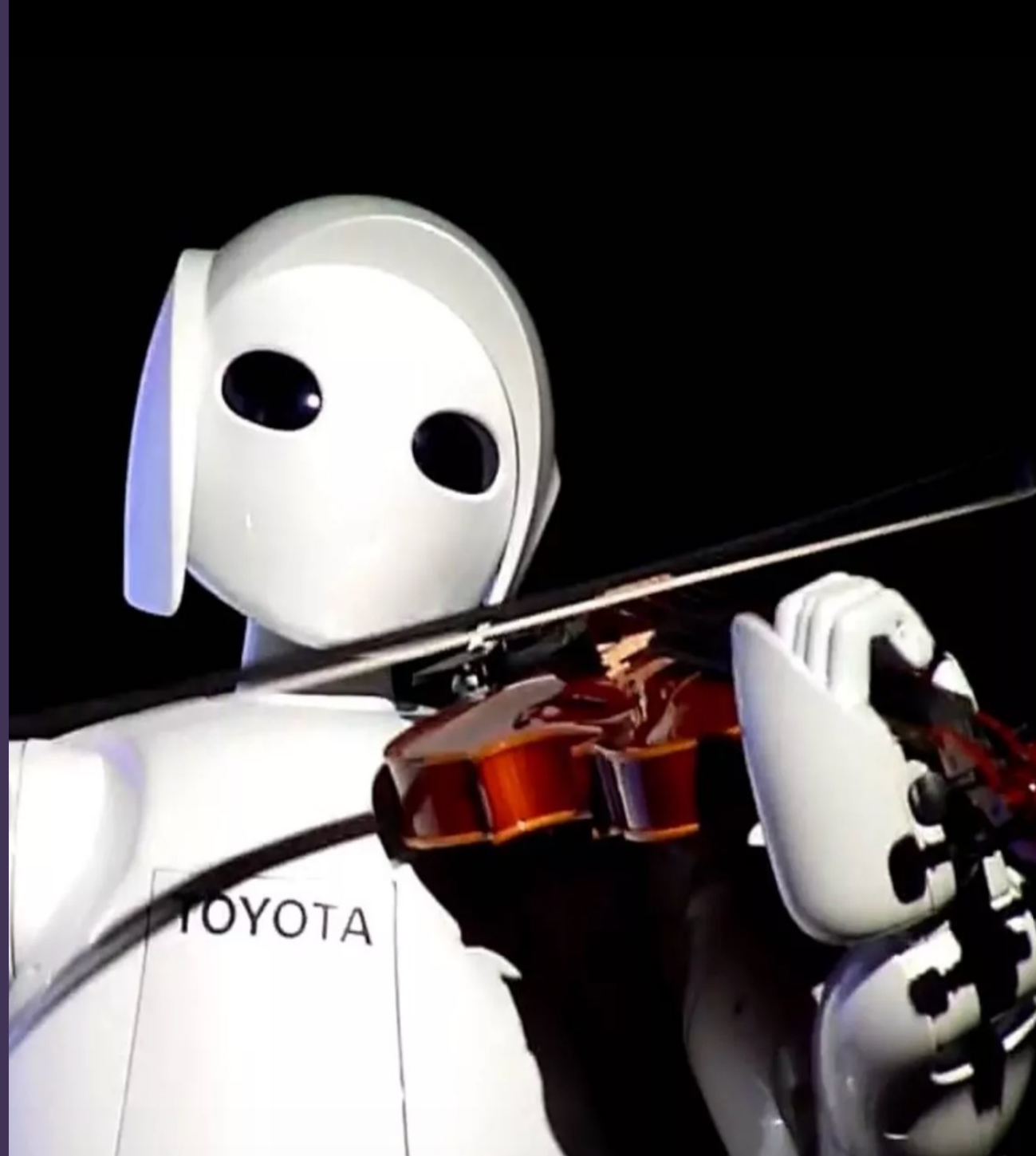
Move the curve!



Simple things should stay simple
Complex things become possible

Human-computer interaction

Artificial intelligence



Human-Computer Partnerships

Combine:
- computer as a tool
- to augment human capabilities

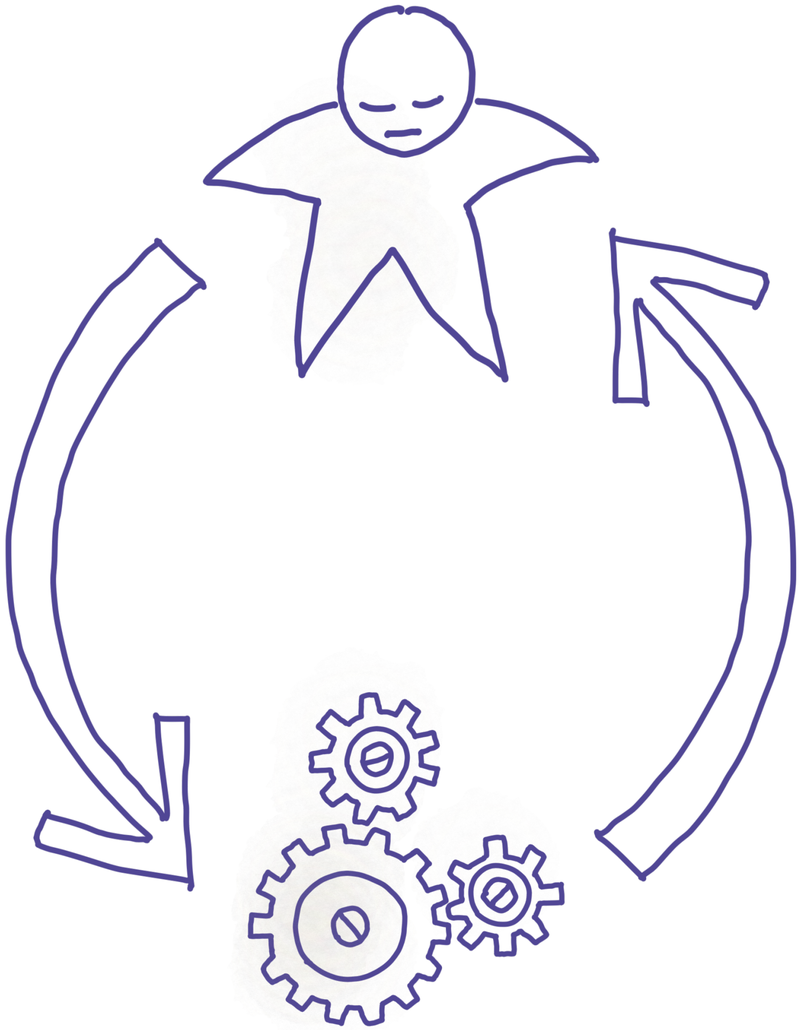
computer as a servant
that takes over certain tasks

But keep the user in control!

Interaction cycle

Always involves both
humans and algorithms

Interaction cycle

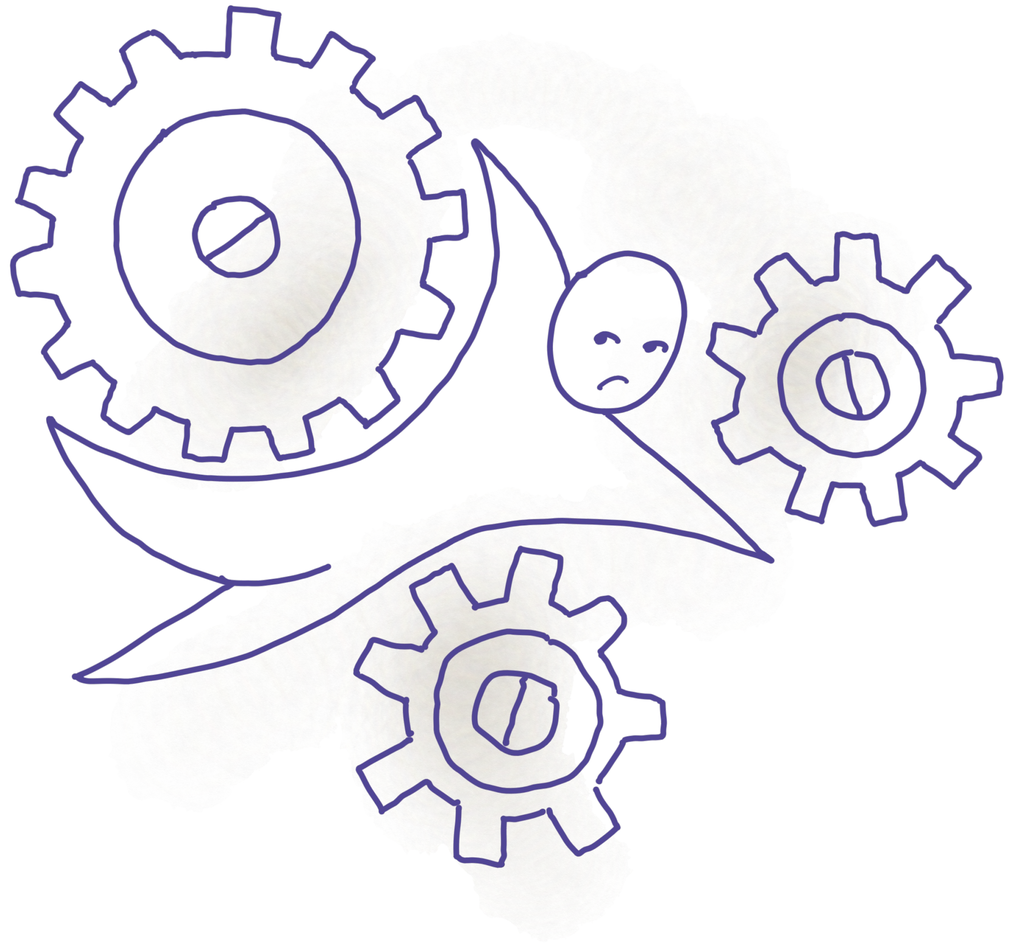


Human-in-the-loop

Research in artificial intelligence measures the algorithm's performance

not its impact on the user

Interaction cycle



A.I. perspective

What is the role of the human?
to provide data
for the algorithm

Humans become components
of the machine

Human-in-the-loop

“Intelligent” agents
change the user’s role

from an **author**...

Human-in-the-loop

"Intelligent" agents
change the user's role

from an **author**...
to an **error corrector**

Human-in-the-loop

Different algorithms
with the same interaction
may produce same user results

The same algorithm with
different interaction may
cause different user results

Human-in-the-loop

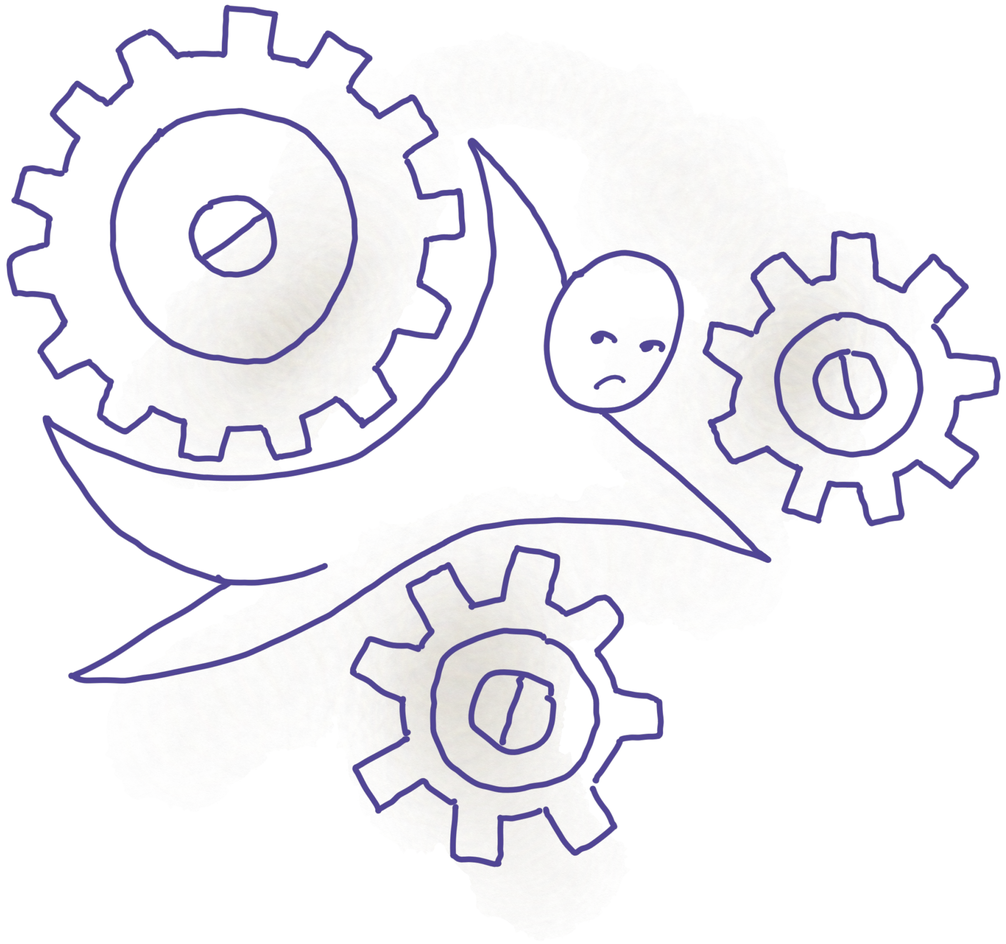
Different algorithms
with the same interaction
may produce same user results

Human-Computer Interaction perspective

What is the role of the human?

Let users benefit from the system

Empower users:
gain skills
control the interaction



Instead of treating people as a source of data

for an algorithm

Consider algorithms as a source of information for the user

Instead of treating people as a source of data

for an algorithm

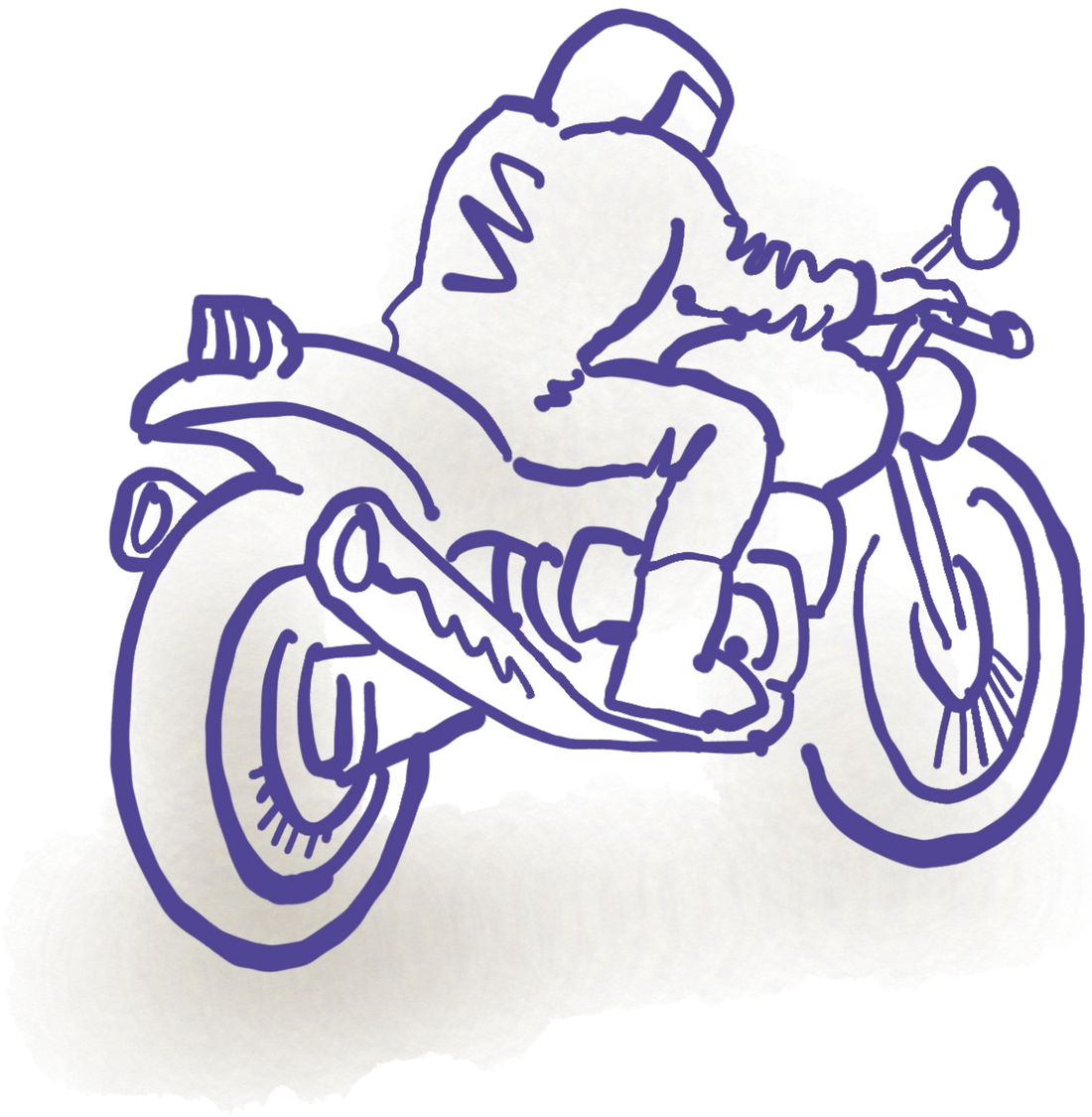
Human-Computer partnerships

Take advantage of the best features of humans and computers

What is a “partnership”?

Take a taxi

Driver in control



What is a “partnership”?

Drive a motorcycle

User in control

What is a “partnership”?

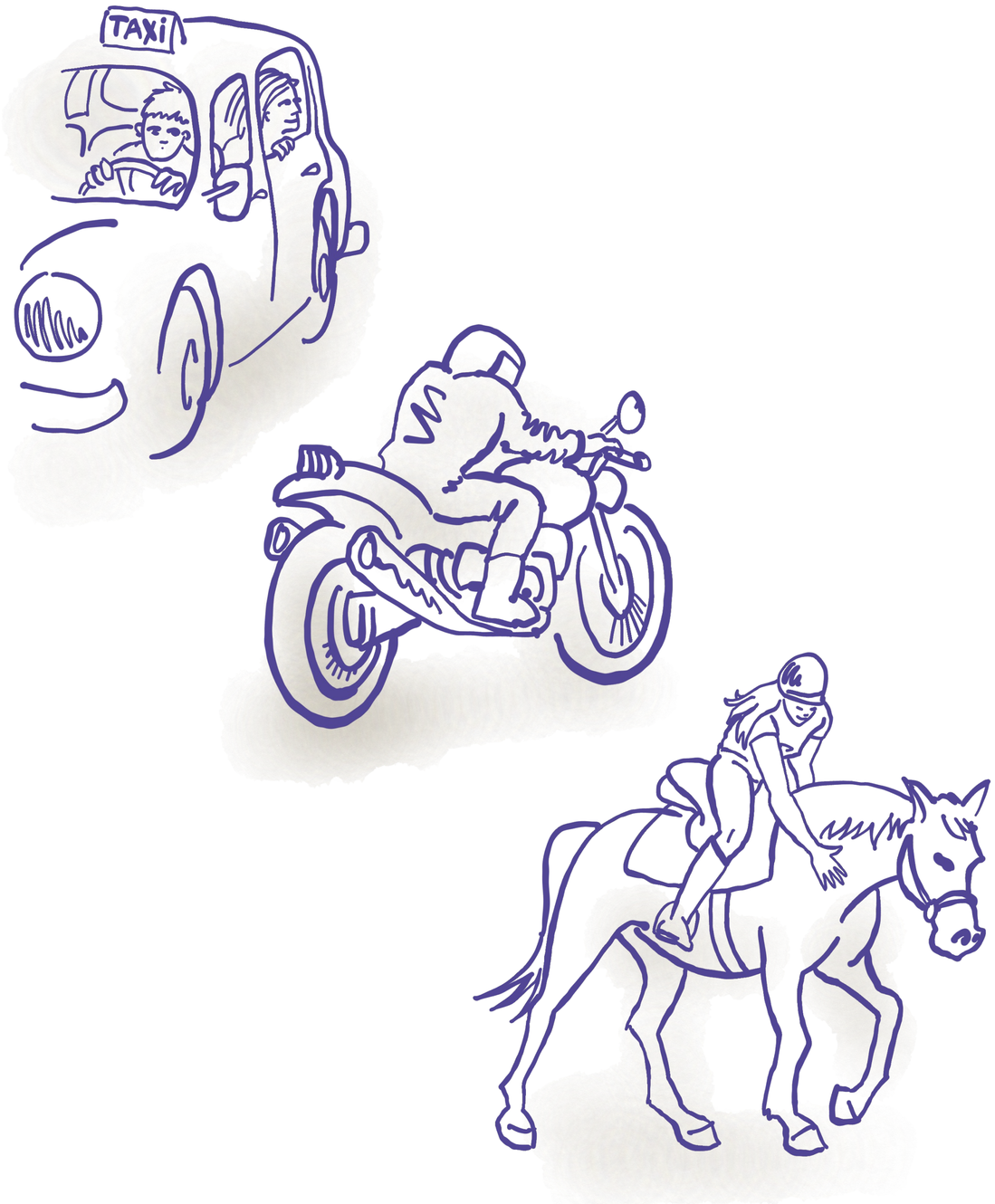
Ride a horse

Shared control

Human-computer partnerships

Combine three types of relationships between the user and the system

How let users control the interaction?



A.I. perspective

Human-in-the-loop

Measure of success:

Does the algorithm perform better?

A.I. perspective

Human-in-the-loop

Measure of success:

Does the algorithm perform better?

HCI perspective

Computer-in-the-loop

Measure of success:

Is the user better off?

Better intelligent algorithms are neither necessary nor sufficient

for creating better intelligent systems

Co-Adaptation: Human-computer partnerships

***Adapt to* technology**

Discovery of an:

action lets users see possible future actions

Feedforward
What can it do next?

Co-Adaptation: Human-computer partnerships

***Adapt to* technology**

Discovery of an:

action lets users see possible future actions

effect lets users see how the system interpreted their behavior

Feedforward
What can it do next?

Feedback
What did it just do?

Co-Adaptation: Human-computer partnerships

***Adapt to* technology**

Expressivity of an:

action lets users transform **input variation** into rich output

effect lets users fine-tune or **tweak** effects into reusable objects

input variation
Transform deviation from the norm into expressive effects

tweaking
Adjust effects into reusable results

Co-Adaptation: Human-computer partnerships

***Adapt* technology**

Customizability of an:

action lets users create new instruments or

transform properties into families of tools

Customization of an **effect** lets users redefine the mapping between actions and effects

Co-Adaptation: Human-computer partnerships

***Adapt* technology**

Appropriability of a **property**
lets users reinterpret a property

Appropriability of a **relationship**
lets users reinterpret
relationships among objects

Appropriability of an **effect**
lets users reinterpret
a result

Co-Adaptation:

Adapt to technology

We **discover** what technology can do

We learn how to control technology to **express** ourselves

Adapt technology

We **customize** technology to meet personal needs

We reinterpret and **appropriate** technology to innovate

How to discover
the system’s capabilities?

Find an unconscious action

that predicts future behavior

Discoverability

From unconscious action to understanding

Unconscious actions
may predict future actions

Detect predictive behavior
to aid the user

Let users learn from unconscious action
then shift to intentional action

GraspSense
Interstices

Apple’s enlarged mouse cursor
ToolTips

Design example
… Octopocus

Pick up a glass ...

what happens next?

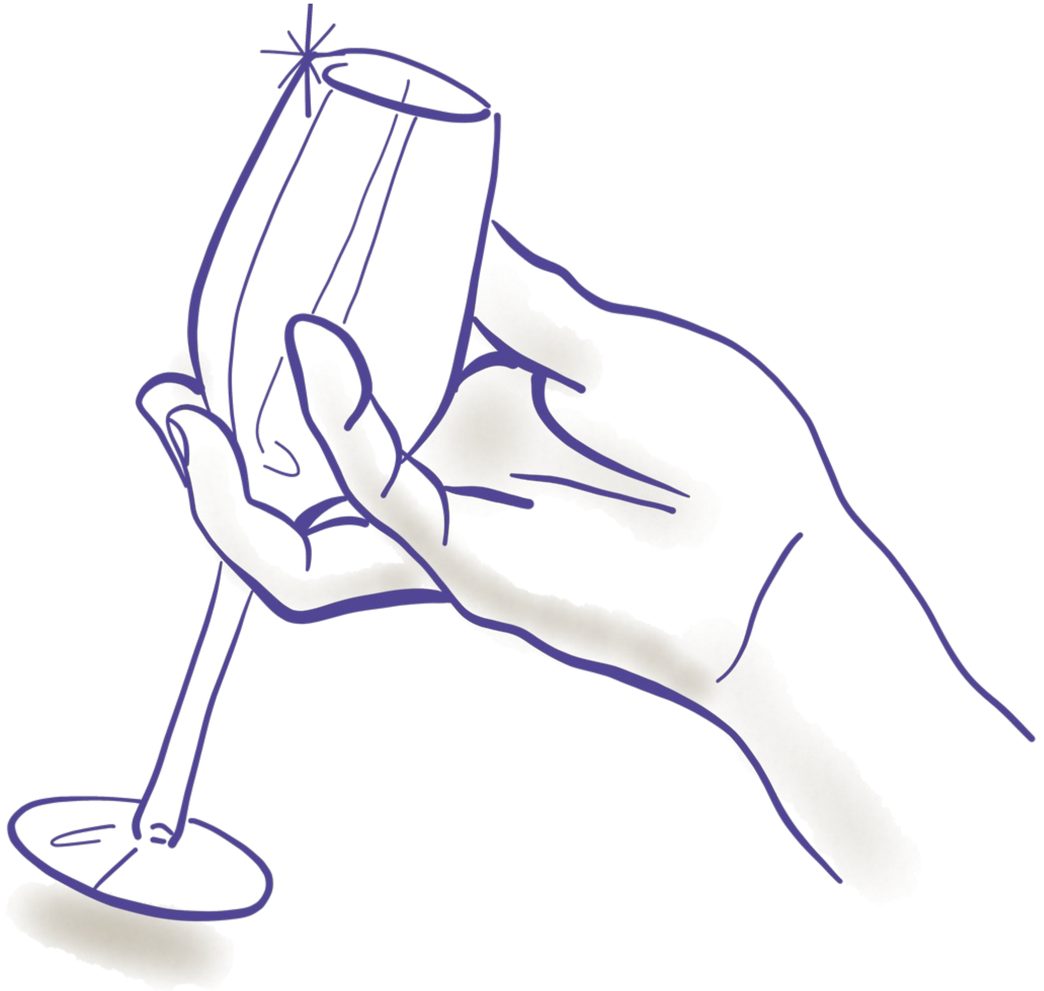
Take a drink

Pick up a glass ...

Take a drink

what happens next?

Put the glass away



Predict gestures

Webb et al. Interstices (CHI'19)

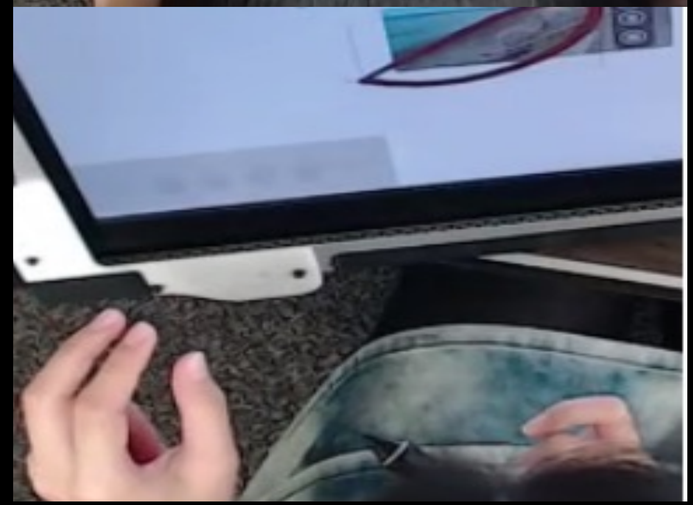
Landscape architects
drawing on a bimanual tablet

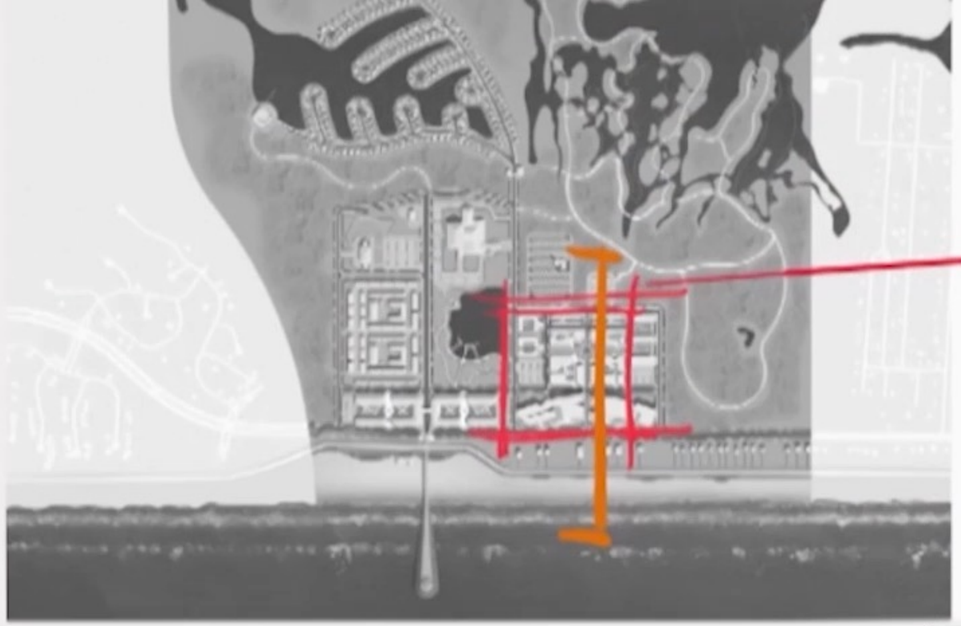
Placement of their hands
unconsciously indicates their next move

Hovering

Away

Rested





Interstice

Find the cursor

Apple mouse cursor

What do you do if you cannot see the mouse cursor on the screen?

Wiggle the mouse ...

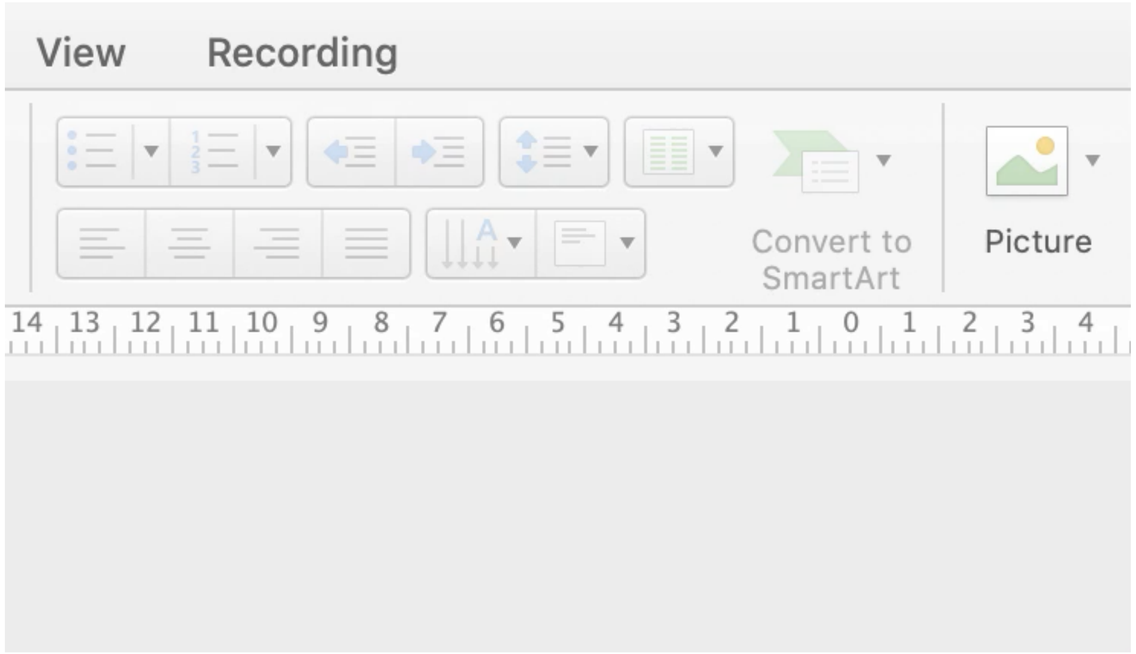
Mouse cursor gets bigger

Transition from an unconscious action

to a conscious action

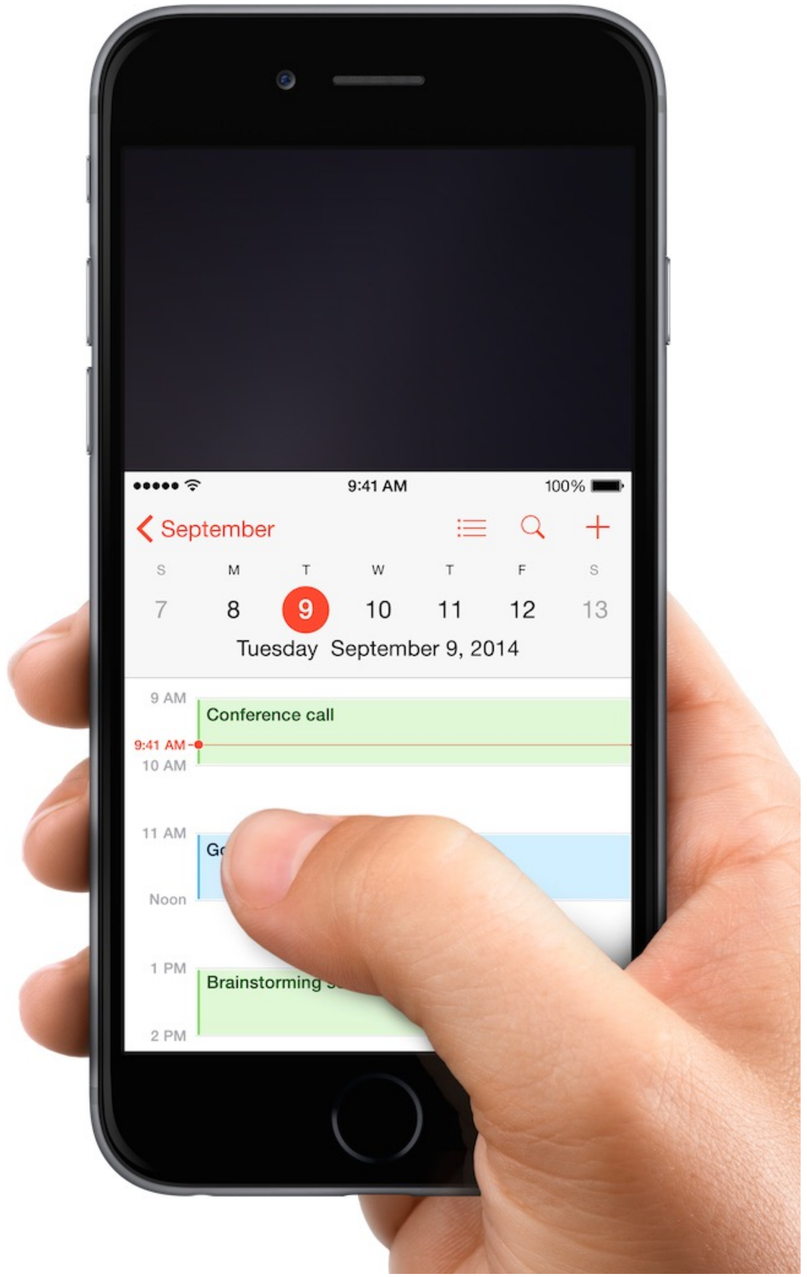
Tooltips

Pause on an interactive element
to display more information about it



Smartphone interaction

why not use gestures to interact with commands?

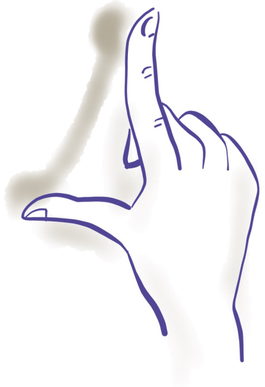


Interact via gestures

Today's smartphones are more powerful
than the computer
that put a man on the moon

Point

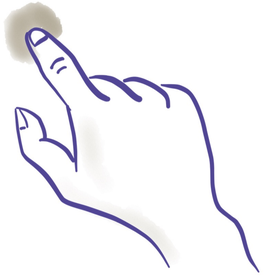
Move



Pinch

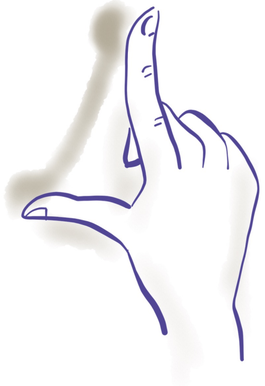
Interact via gestures

The interaction is very simple …
but also very limited



Point

Move



Pinch

Cook

Sculpt

Play violin

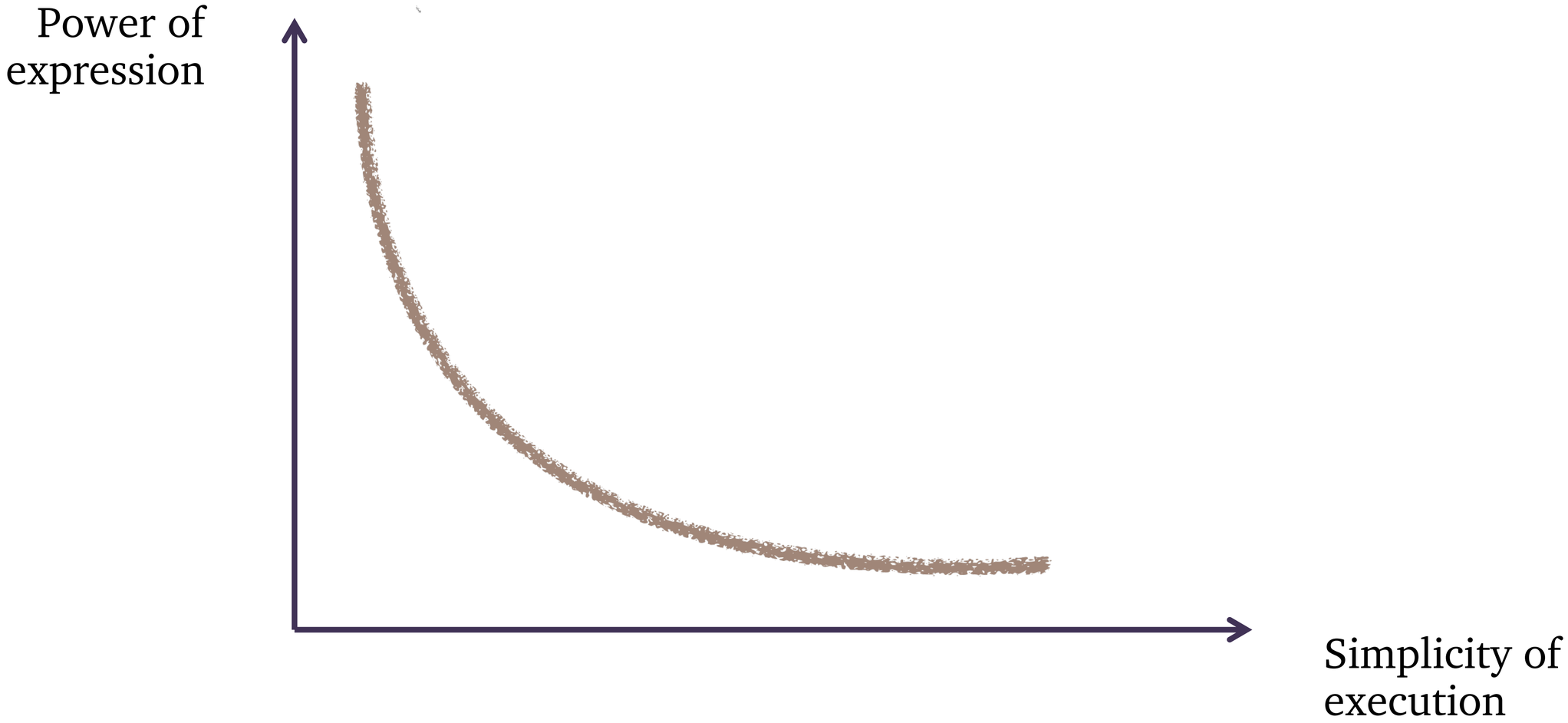
Interact via gestures

The interaction is very simple ...
but also very limited

unlike physical tools

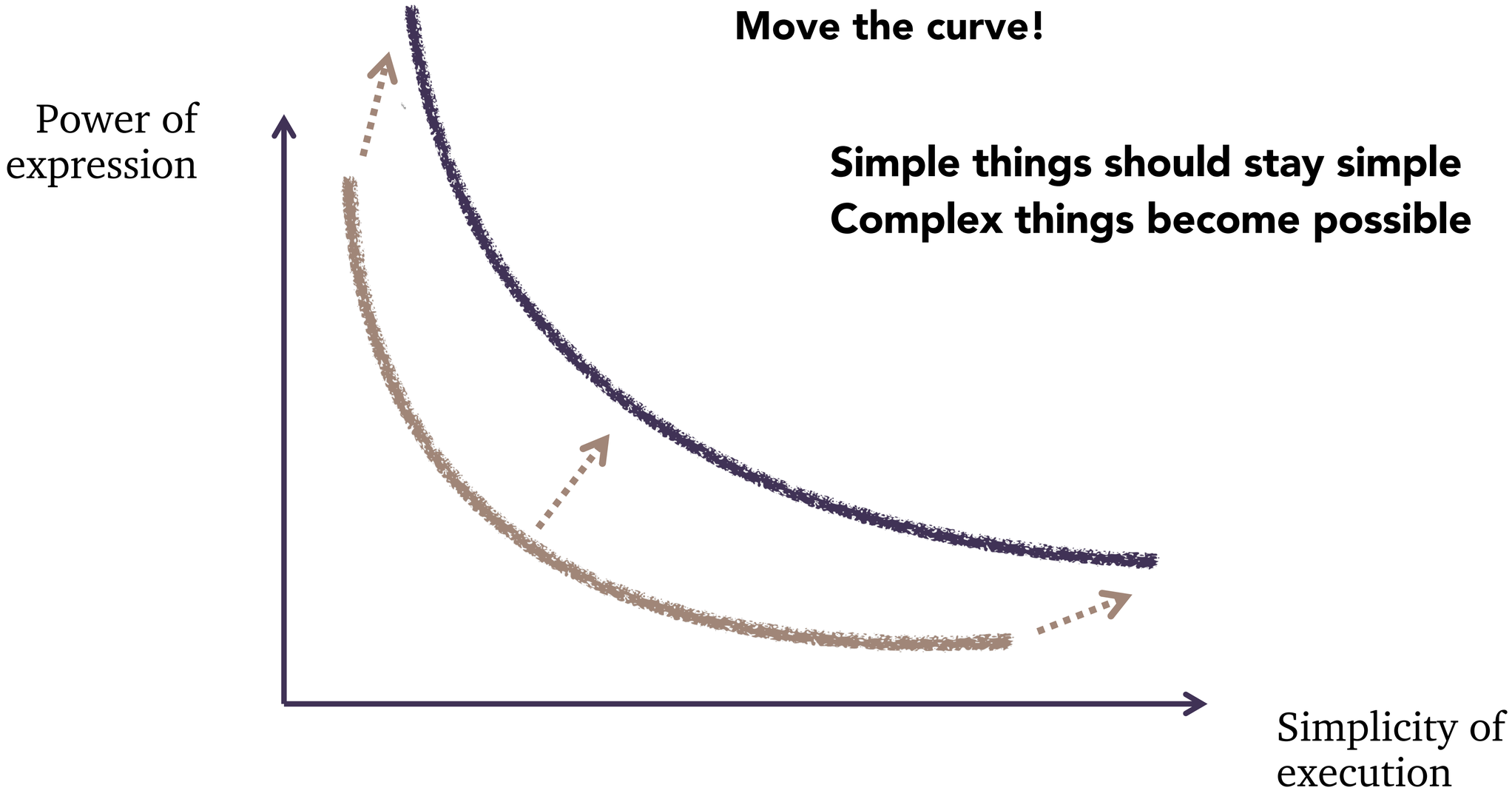
Remember?

Compromise between power and simplicity



Remember?

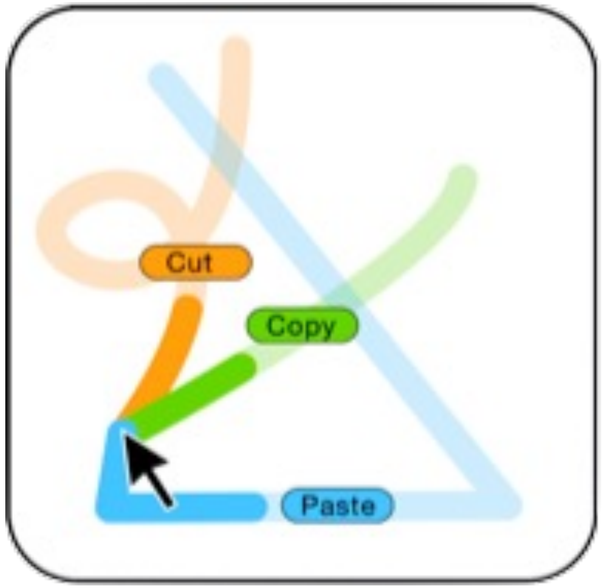
Move the curve!



Simple things should stay simple
Complex things become possible

Making it simple ...

is complicated!



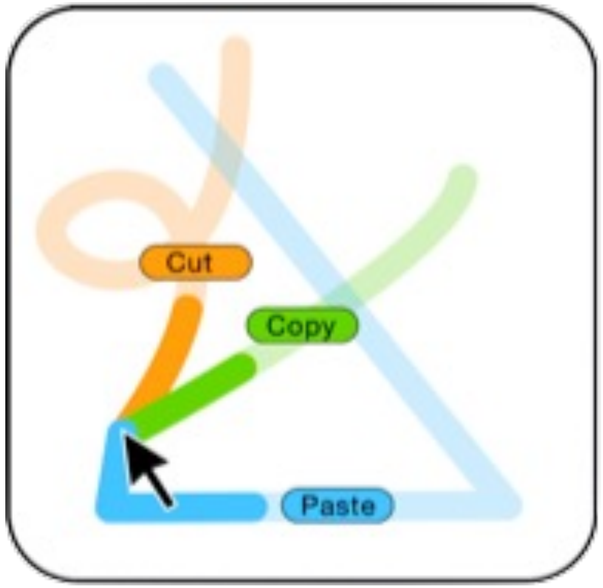
Find gesture commands

Octopocus (Bau & Mackay, UIST'08)

Observe how users use gesture commands

Biggest problem:

> Users have to learn and remember which gesture performs each command



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Experts want to act quickly:

They just execute the command

Find gesture commands

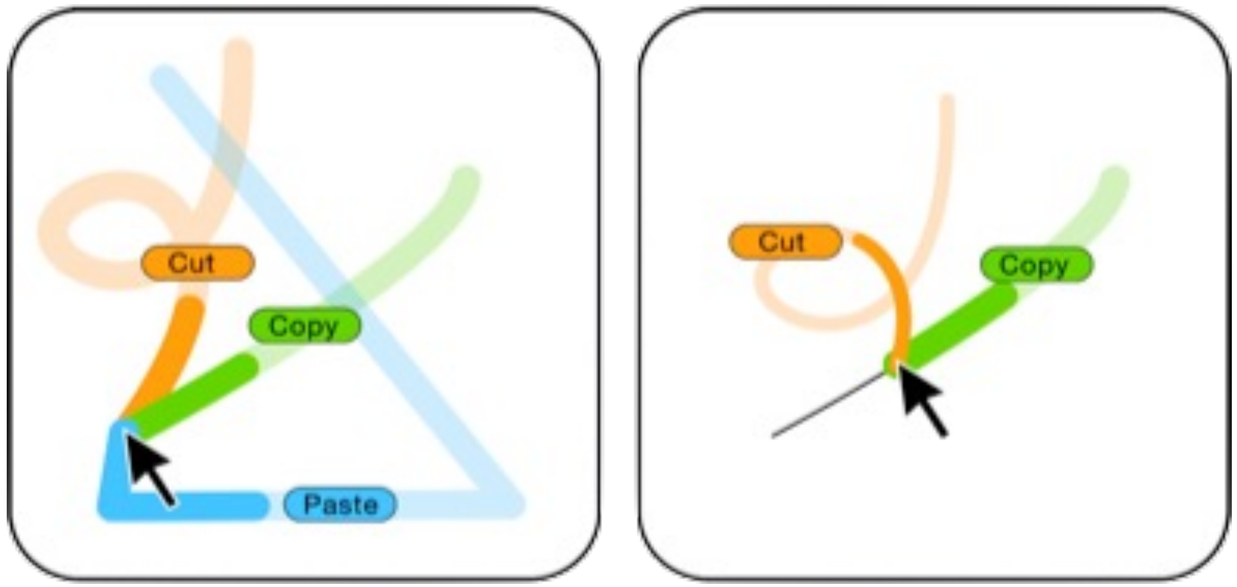
Octopocus (Bau & Mackay, UIST'08)

Experts want to act quickly:
They just execute the command

Novices hestitate when they need help
Dynamic guide appears

Find gesture commands

Octopocus (Bau & Mackay, UIST'08)



Experts want to act quickly:
They just execute the command

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Find gesture commands

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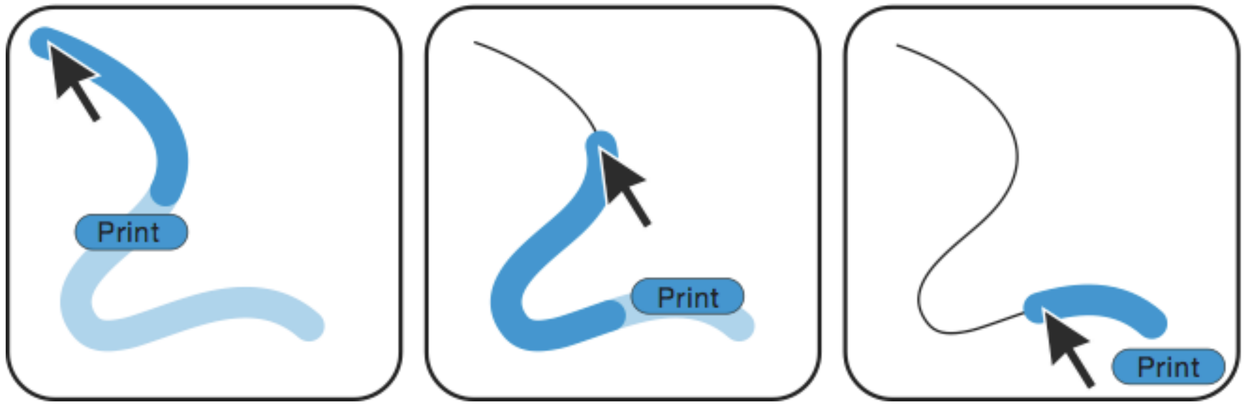
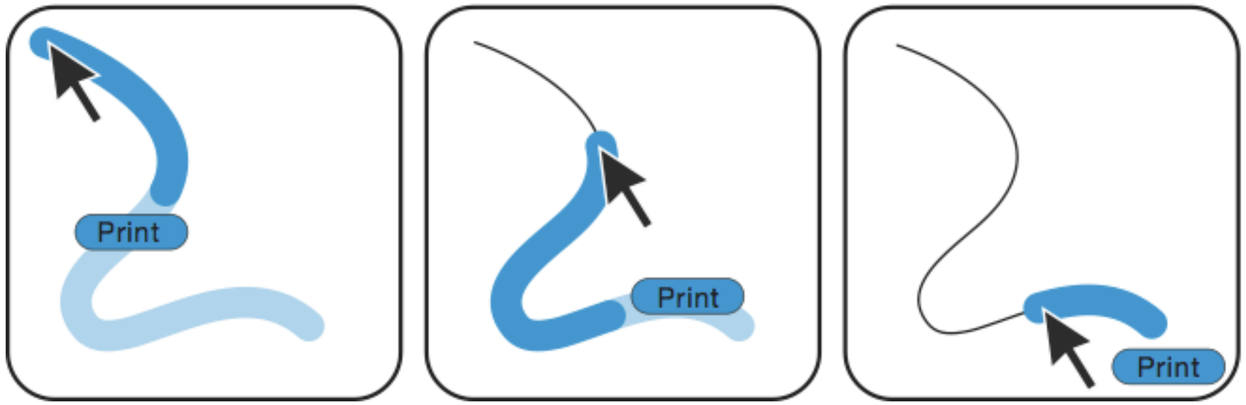


Progressive **feedback**
discover what the system understood



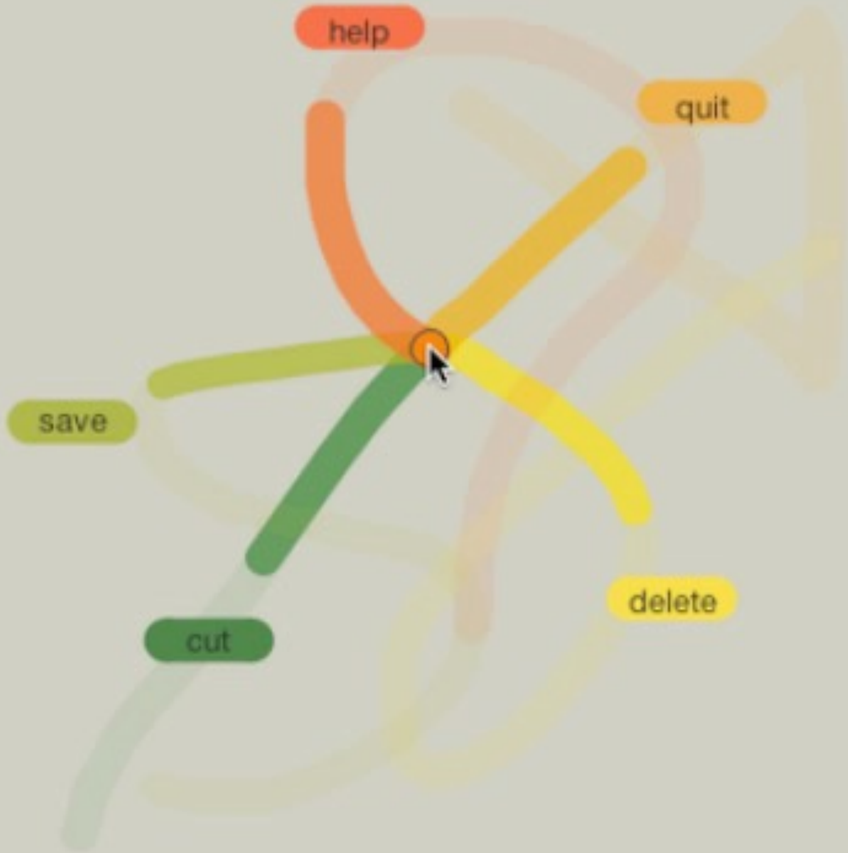
Find gesture commands

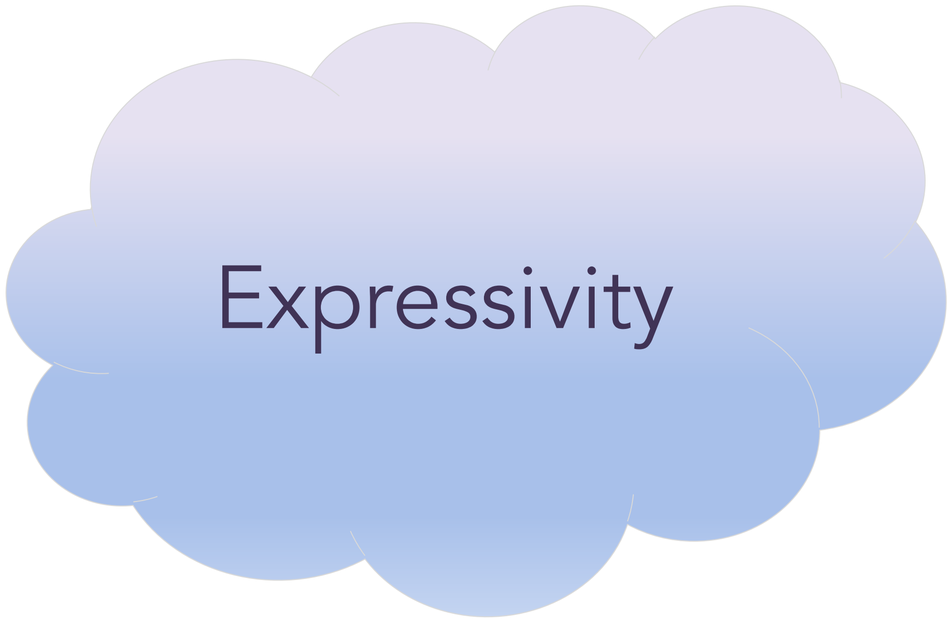
Octopocus (Bau & Mackay, UIST'08)

Progressive **feedback**
discover what the system understood

Progressive **feedforward**
discover what is possible

The width of the path shows
the probability it will be recognized


help
quit
save
delete
cut



How to generate personalized, expressive output?

Expressivity

Instead of treating all input the same

let users **exploit user variation**

Expressivity

Capture variability in the user's input

Interpret music
    choose performance style

Vary drawings
    control the variation

Modify handwriting
    select expressive characteristics

Design example
… Expressive keyboard

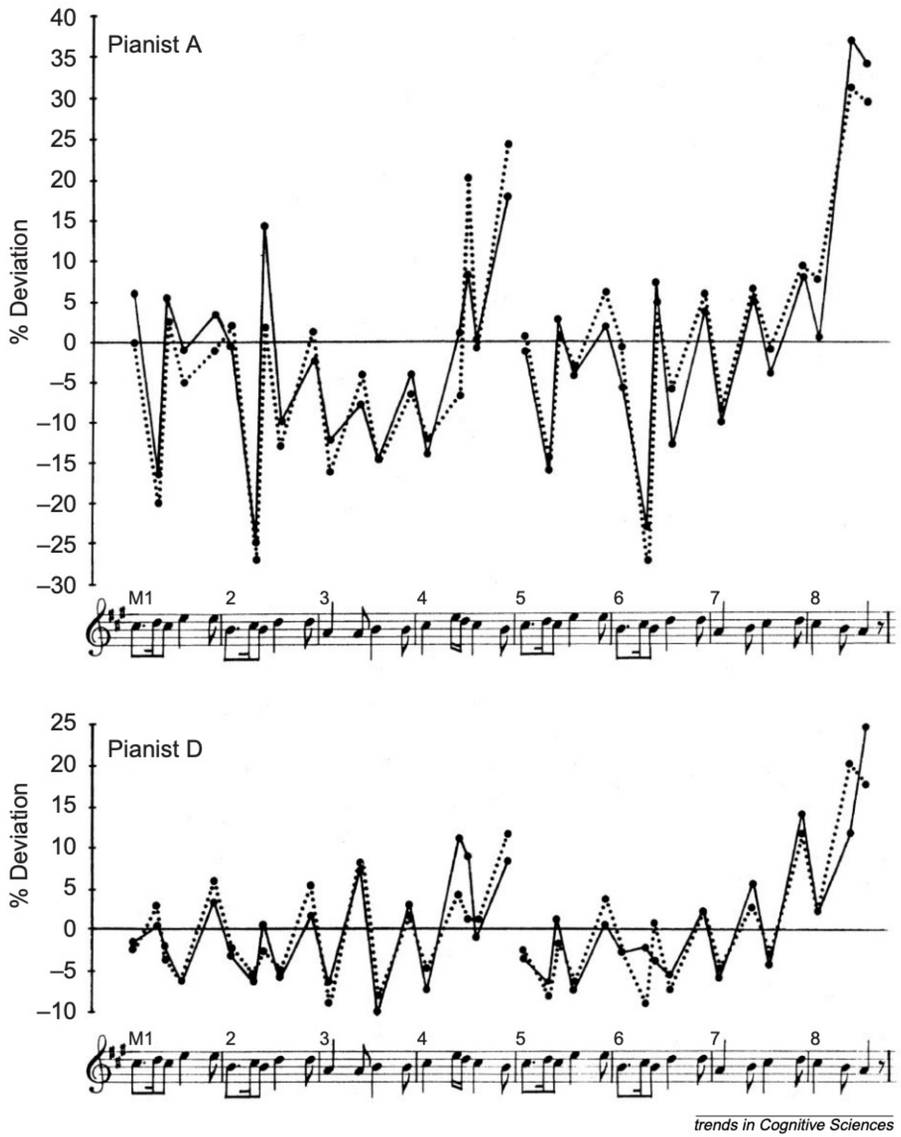


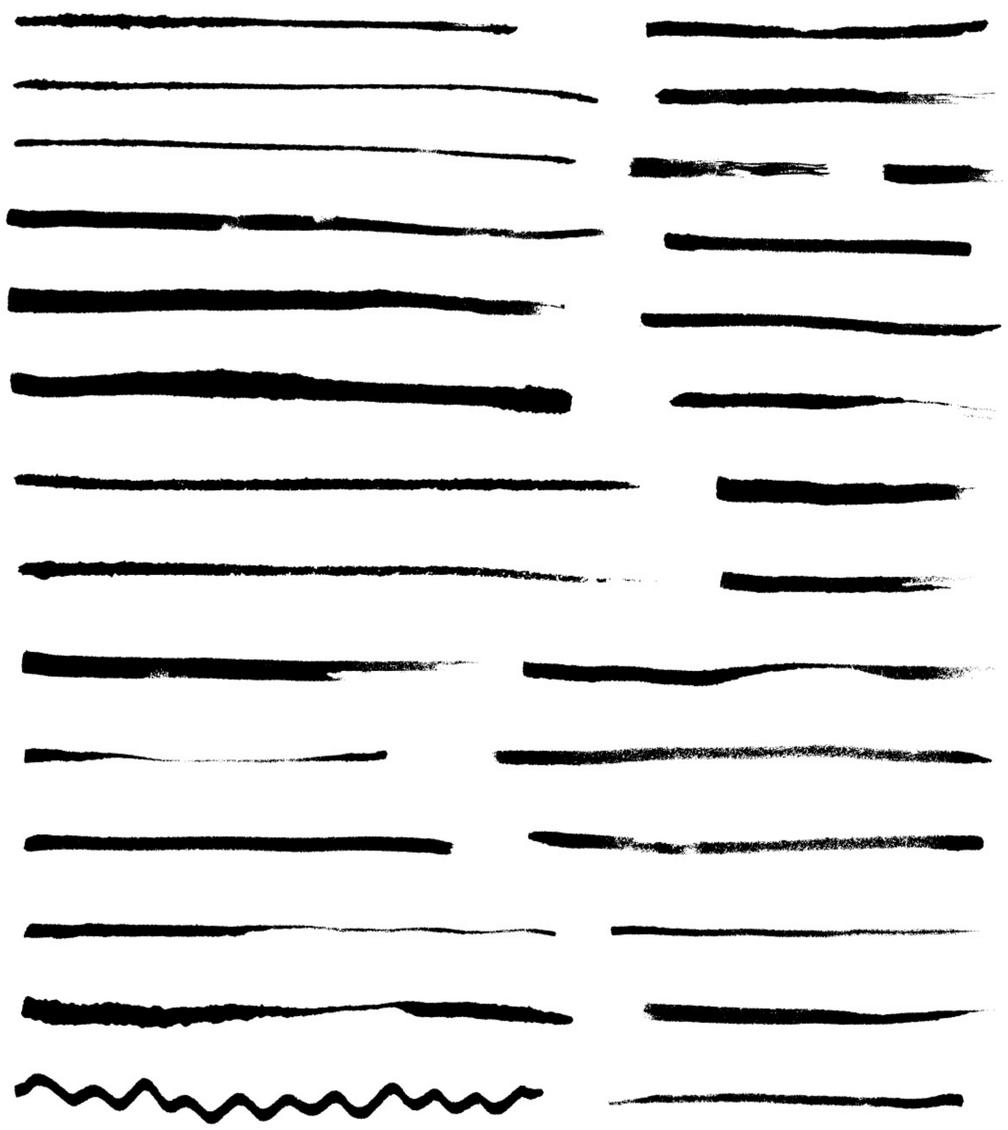
Fig. 2. Consistency in performance. Percentage deviation from mechanical regularity (zero line) in two pianists' performances of the theme in Mozart's Piano Sonata in A Major, K. 331. Solid line: first performance, dotted line: repetition. This shows the reproducibility in expression by a given performer across performances. (Reproduced, with permission, from Ref. 10.)

Interpretations vary

Individual differences in music performance
Sloboda (Trends in Cognitive Science) 2000

Expert musical performance
not just a matter of technical motor skill

also
ability to generate expressively different performances of the same piece of music



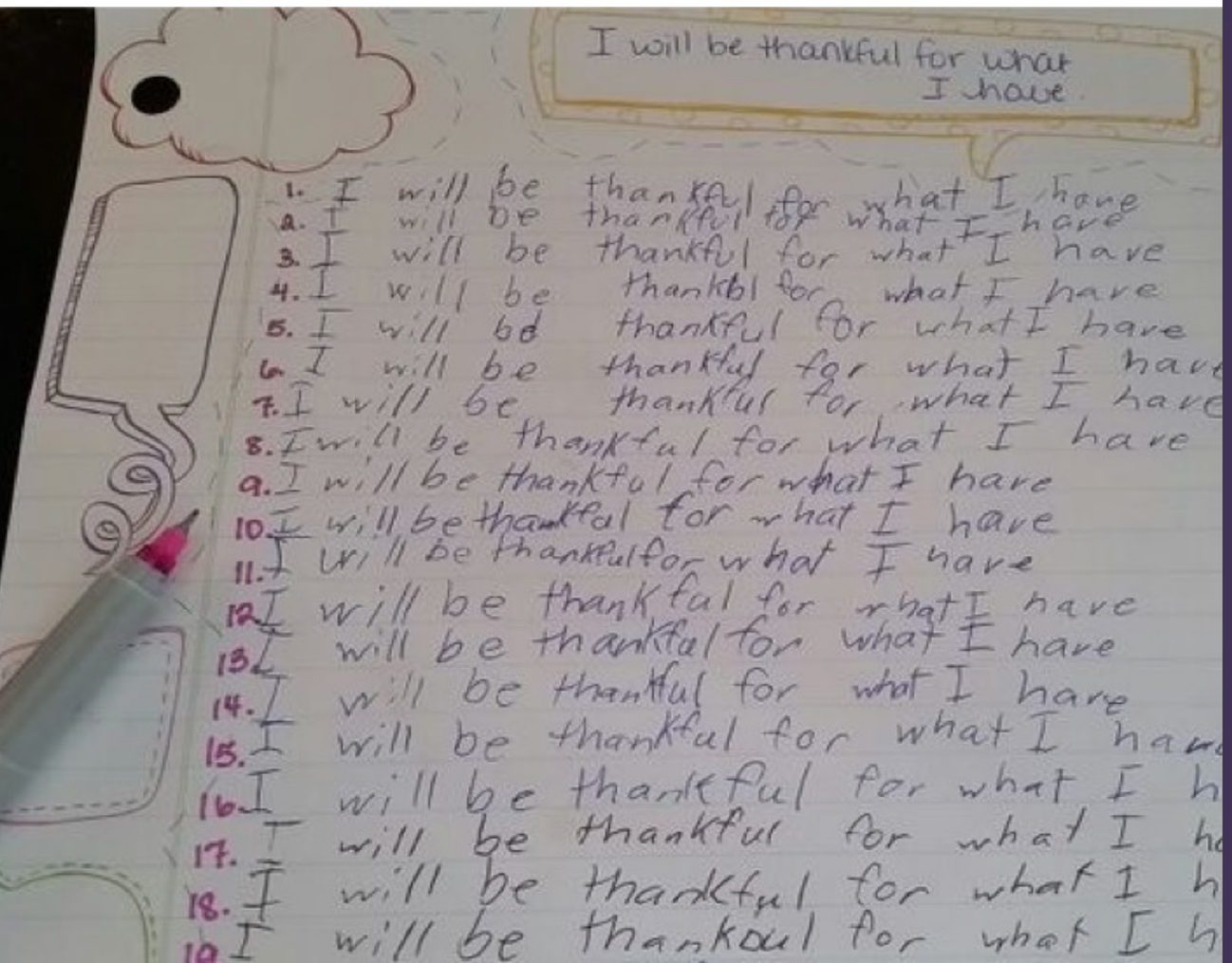
Vary line drawings

Each individual line is different

Variation is partially intentional
and partially random

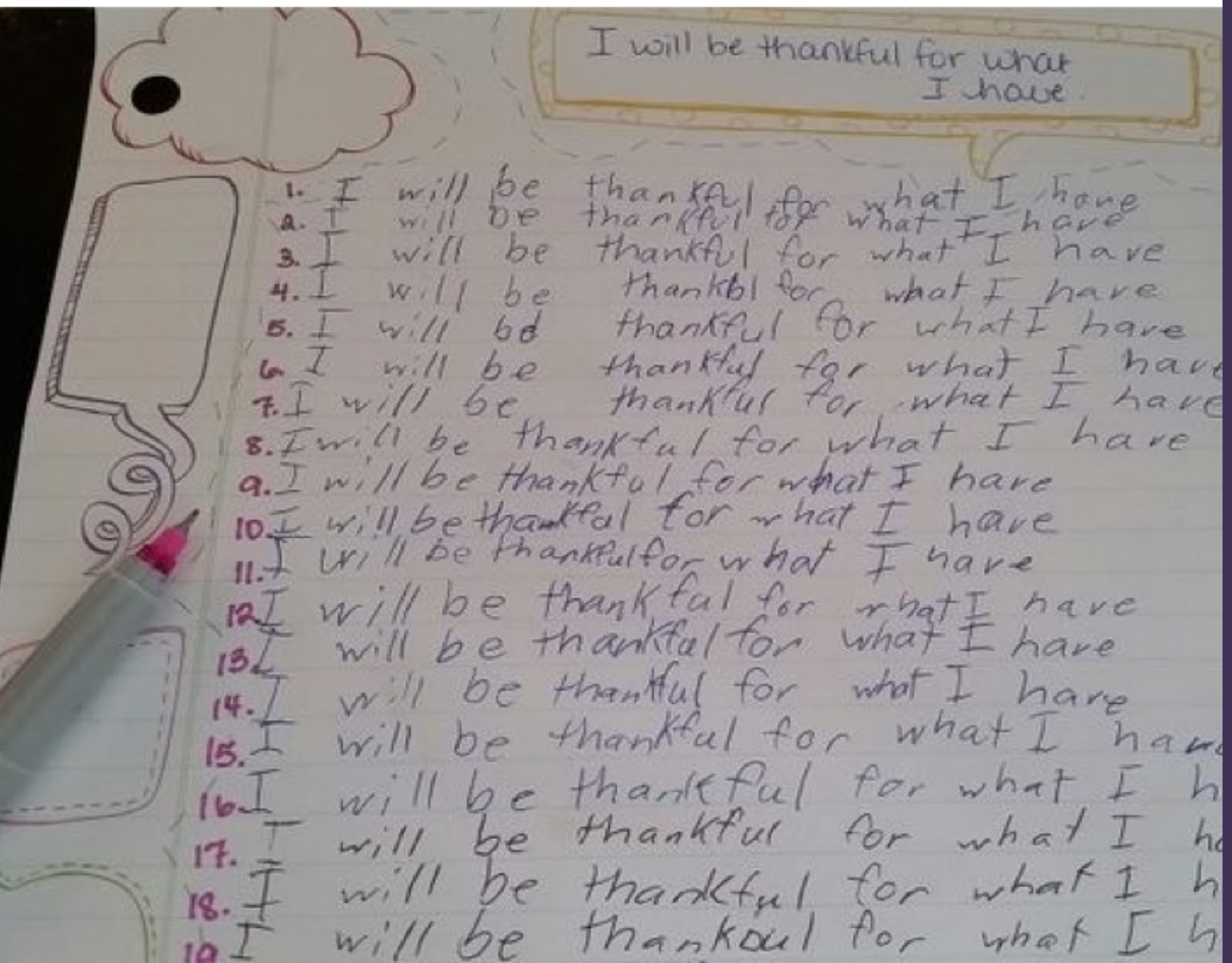
Handwritten text

Very expressive ...



Handwritten text

Very expressive ...



Text messages

Not so much...

How to add a personal touch?

Create rich output

Expressive keyboard (Alvina et al., UIST'16)

How to type quickly:
- Gesture type (Swipe type)
- Slide finger from key to key

System's goal:
- recognize the correct word
- despite huge individual variation

Create rich output

Expressive keyboard (Alvina et al., UIST'16)

How to type quickly:
- Gesture type (Swipe type)
- Slide finger from key to key

System's goal:
- recognize the correct word
- despite huge individual variation

40% faster than regular typing

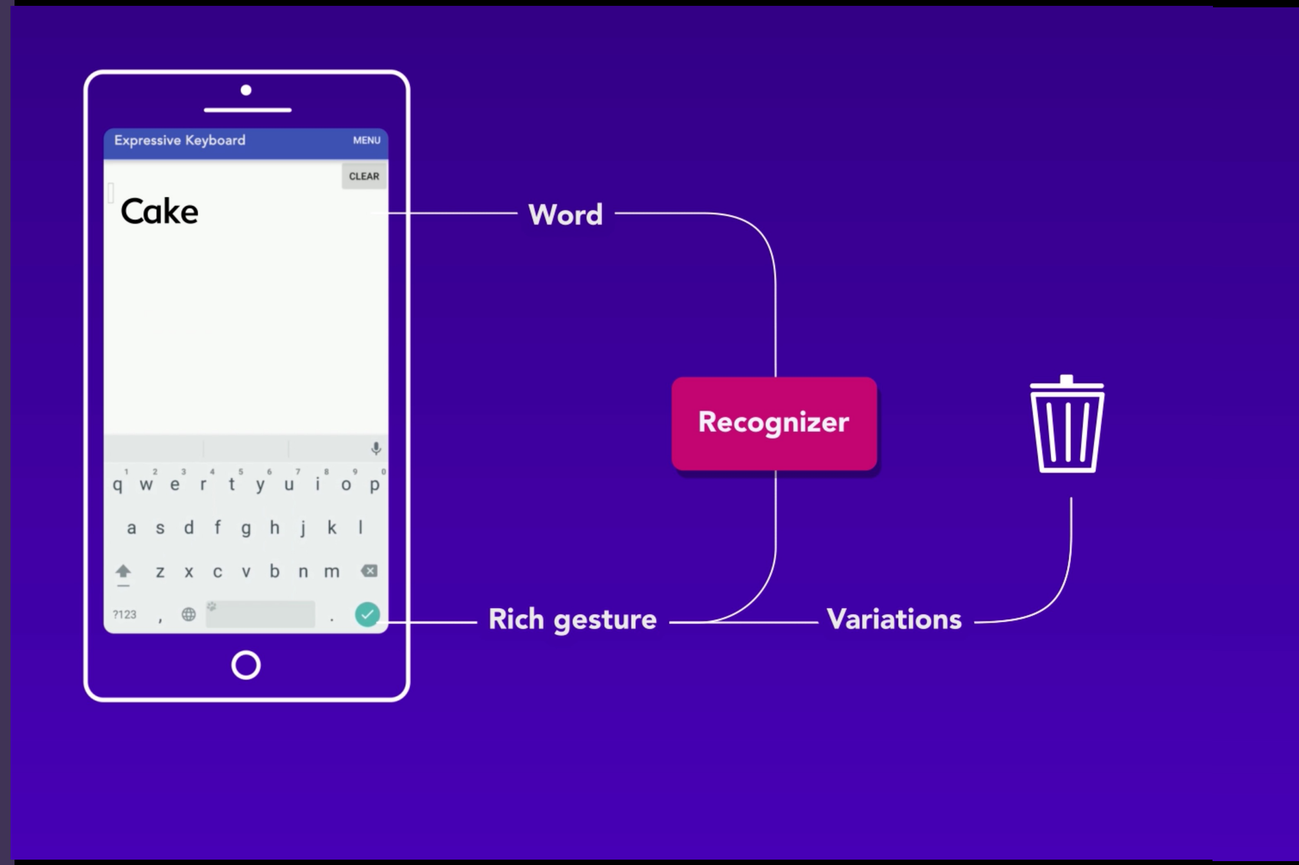
Each successfully inputs the word "great"




Different expertise

Expressive keyboard (Alvina et al., UIST'16)

Machine learning
- Guess or classify the correct word
- Throw away human variation

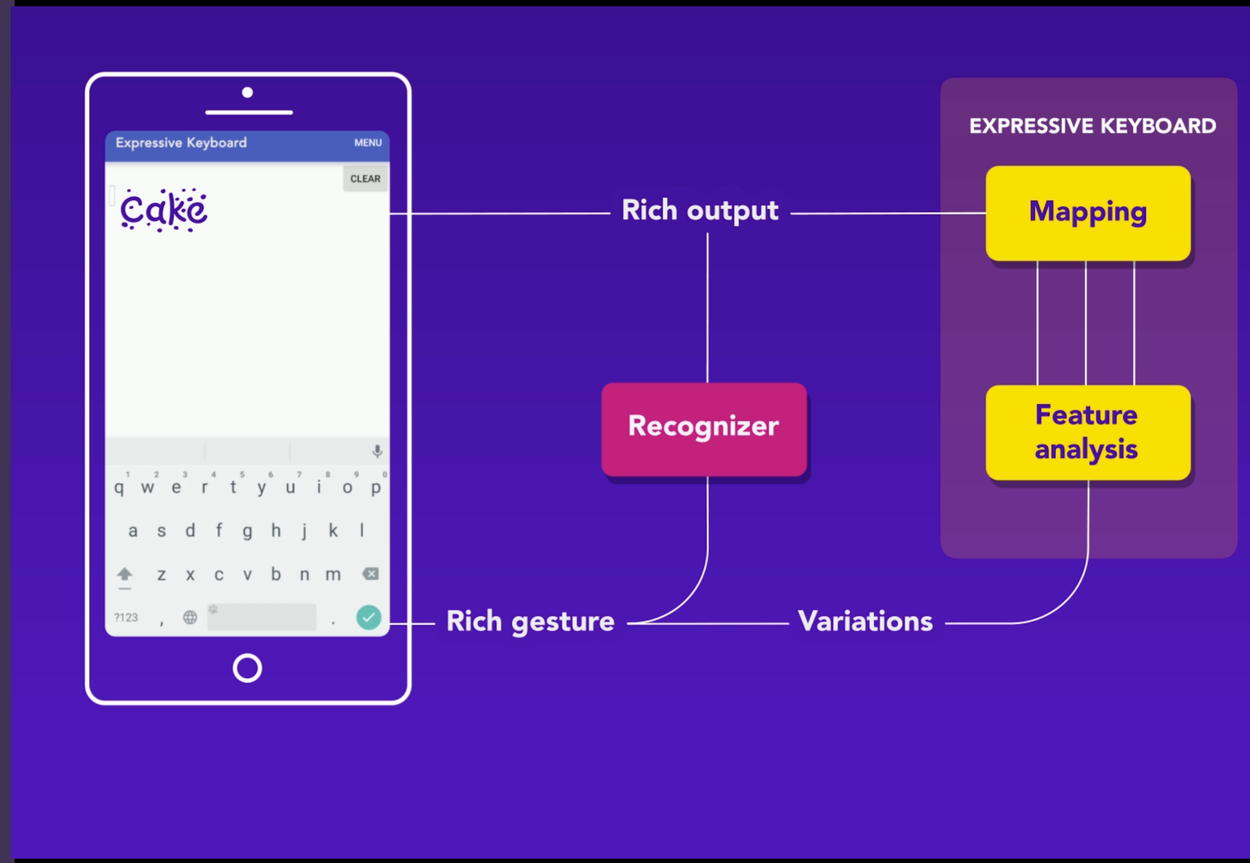


Different expertise

Expressive keyboard (Alvina et al., UIST'16)

Machine learning
- Guess or classify the correct word
- Throw away human variation

Human-centered approach
- Transform human variation into expressive output

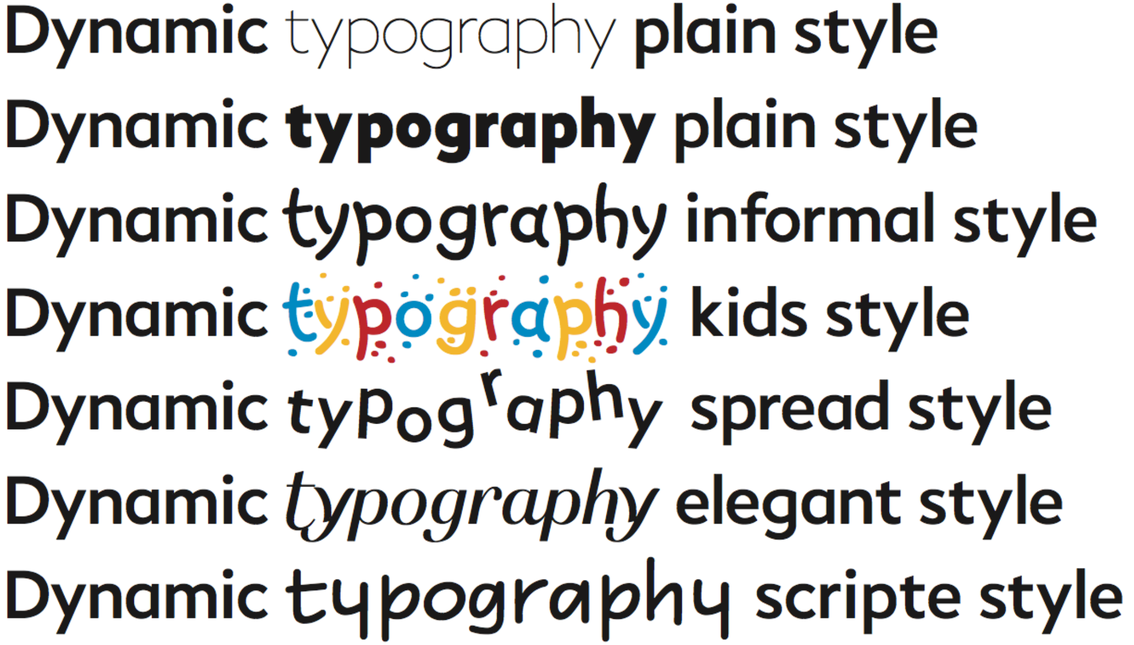


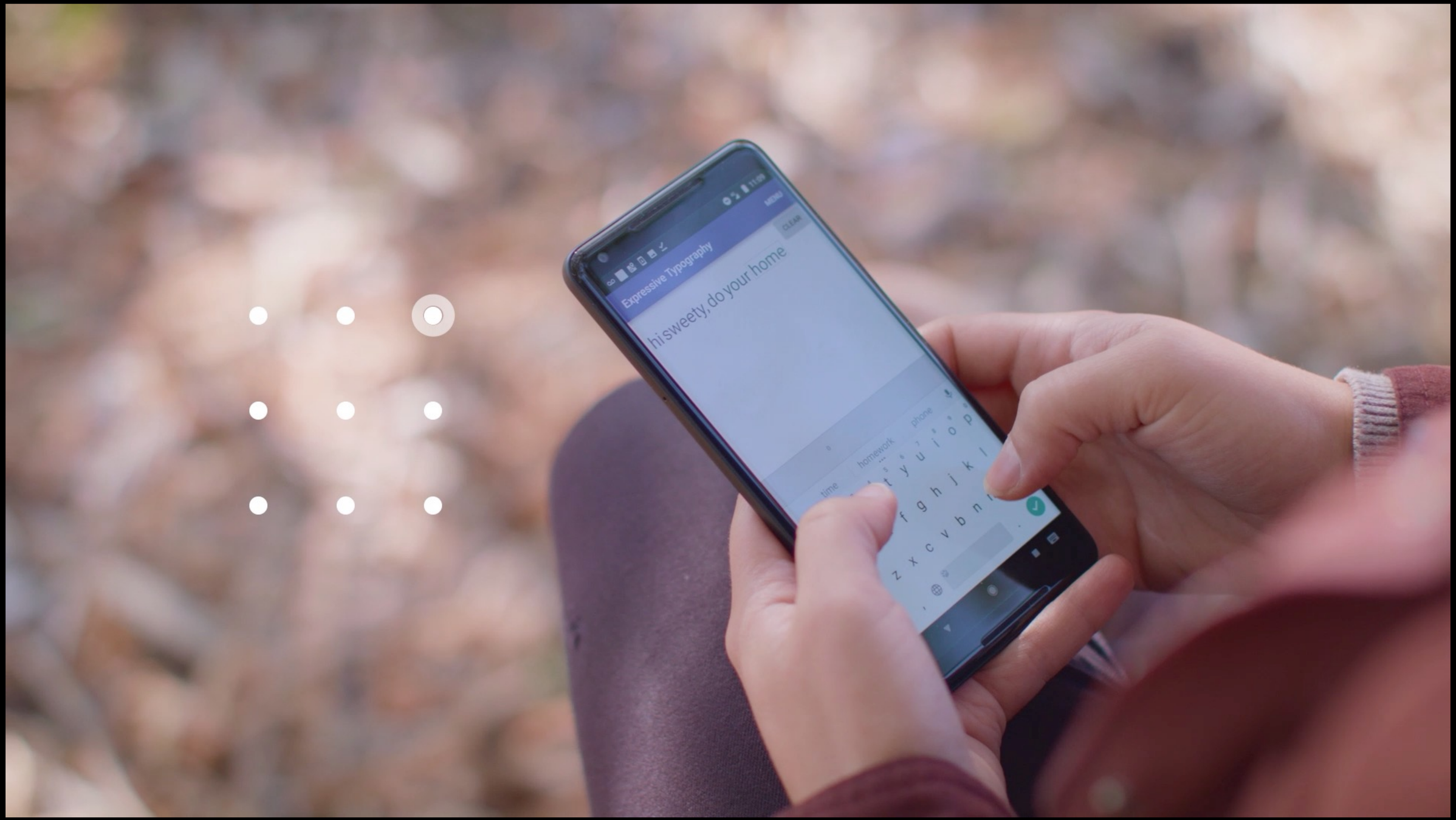
Different expertise

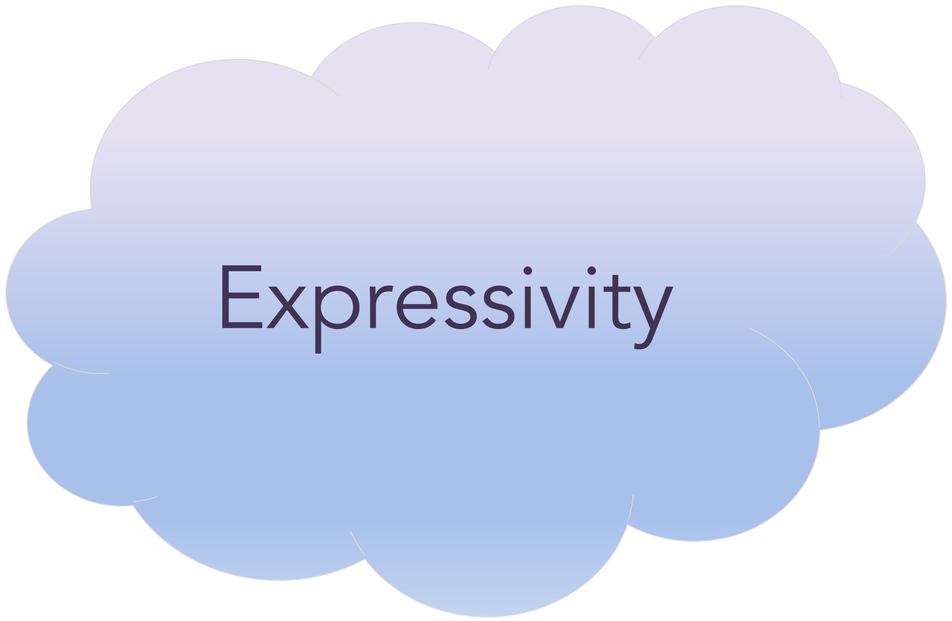
Expressive keyboard (Alvina et al., UIST'16)

How to personalize output while typing ?

Instead of treating human variation
as "noise",
interpret it dynamically




Expressive Typography
hi sweety, do your home



Tweaking

Adjust the output afterwards (post hoc)

Adjust color
    control the hue, change the brightness

Adapt text to fit
    modify the size, space or characteristics

Design example
… StickyLines

Expressivity

Instead of requiring default settings

Let users **tweak the output**

Tweak the master

How to make the text fit?

Different strategies:

1. Rewrite the text:
   remove “much”

2. Reduce the font size
   from 80 to 60 points

3. Compress character
   spacing by 4 points

4. Extend placeholder width

This text is much too long

This text is too long

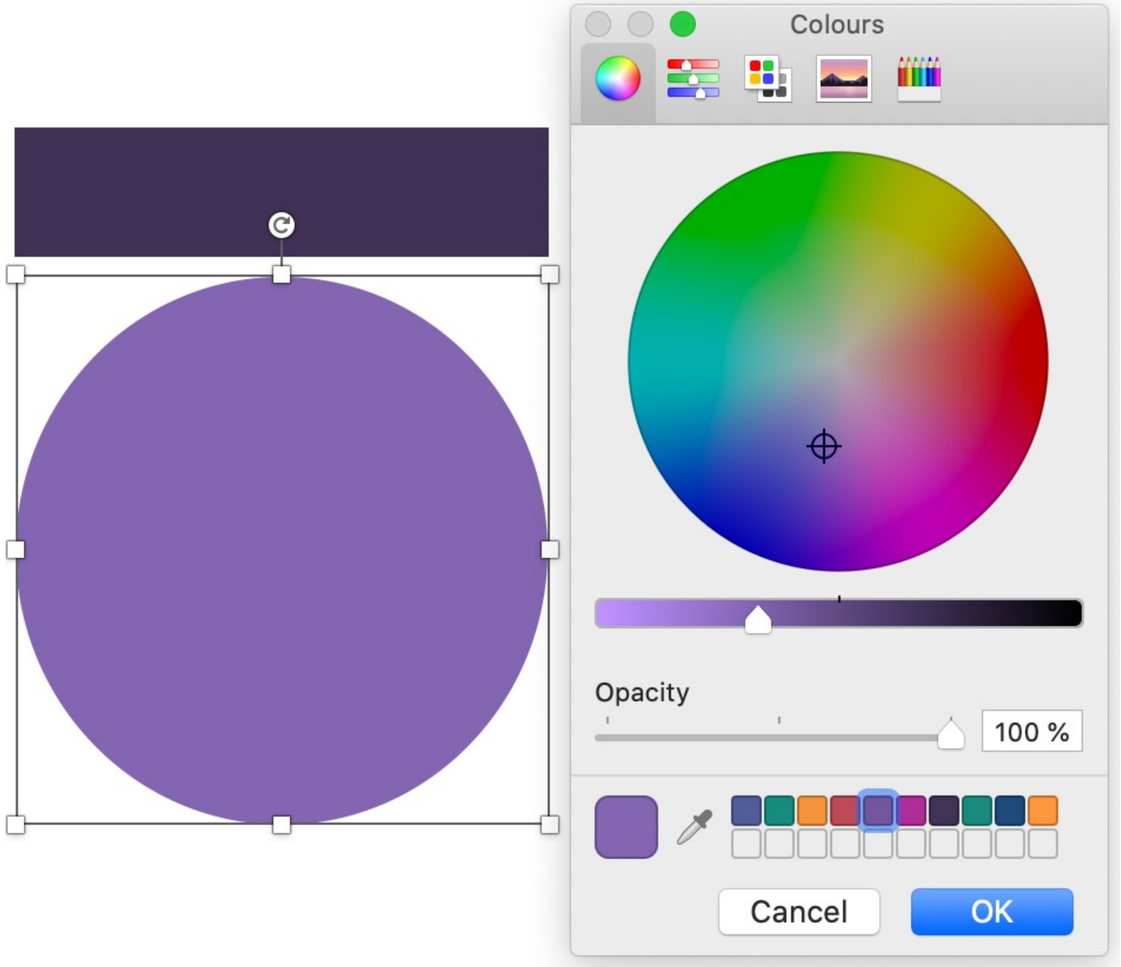
This text is much too long

This text is much too long

This text is much too long

Adjust Color

Start with the basic hue
then adjust the brightness
for a new color

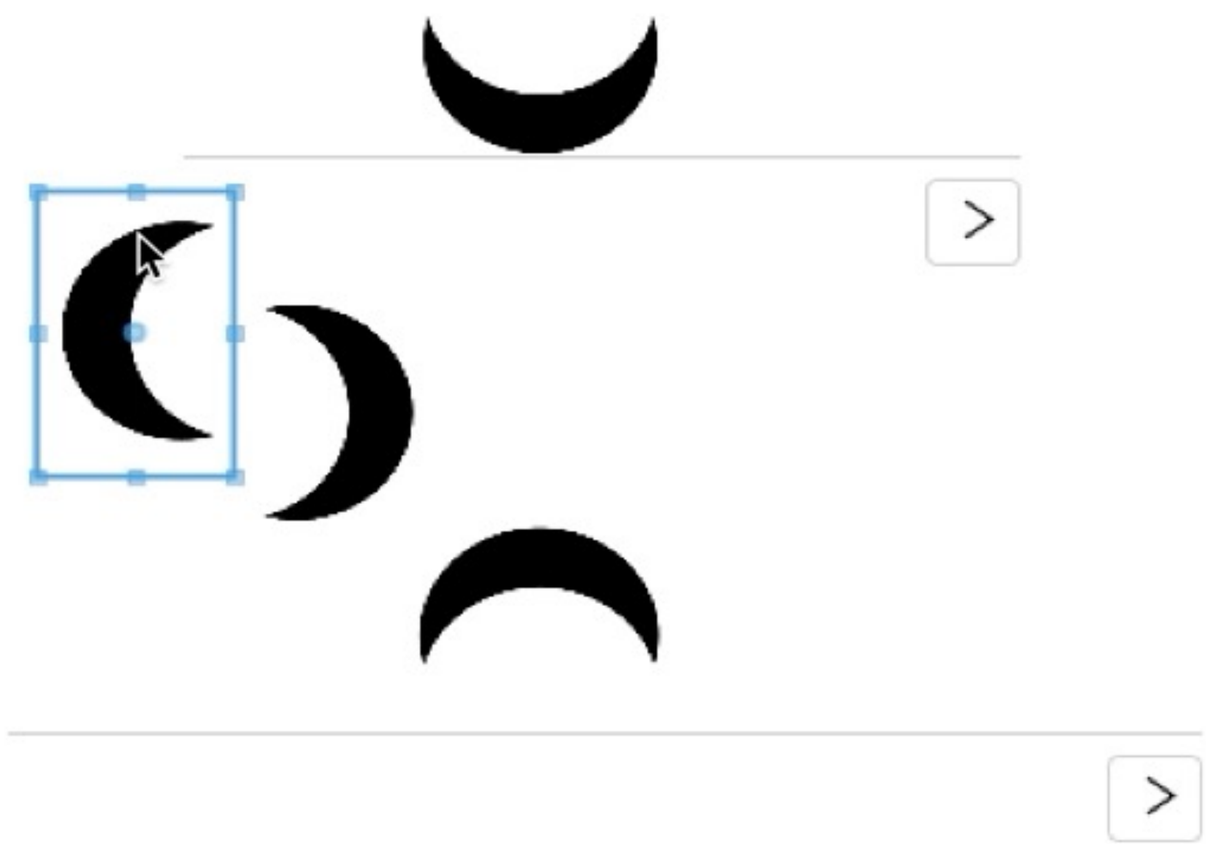


Tweaking

Ciolfi et al. StickyLines (UIST ’16)

What if the user wants to adjust
the default placement?

Tweaking lets users make small changes
that offset the “normal” placement



Let users create their own commands and interaction

Appropriability

Users create personal tools and interaction

Select from a family of tools
    Choose crayons or pencils

“Currying” tools
    Transform tool properties into new tools
        Colored brushes
        Specific times

Map actions to commands

Design example:
    Fieldward

Currying

In Computer Science:

Transform functions with multiple arguments
into a family of functions
each with one argument

Create personal tools

In Instrumental Interaction:

Transform commands with multiple properties
into a family of commands
each with one or several properties

Currying

From a command with multiple properties to a family of single-property commands

Transform general tool for drawing lines into colored crayons and colored pencils

Currying

From a command with multiple properties to a family of single-property commands

Transform general tool for drawing lines into colored crayons and colored pencils

or create personalized brushes

Currying

Transform a timer tool into custom timers

Create individual time warnings
when giving a presentation
printed or hand-drawn

Create custom tools

Currying

Transform a timer tool into custom timers

Create individual time warnings
    when giving a presentation
    printed or hand-drawn

Create custom timers from a timer app

Apple watch timers
    1 minute
    3 minutes
    5 minutes

Create custom tools

Personalze gestures

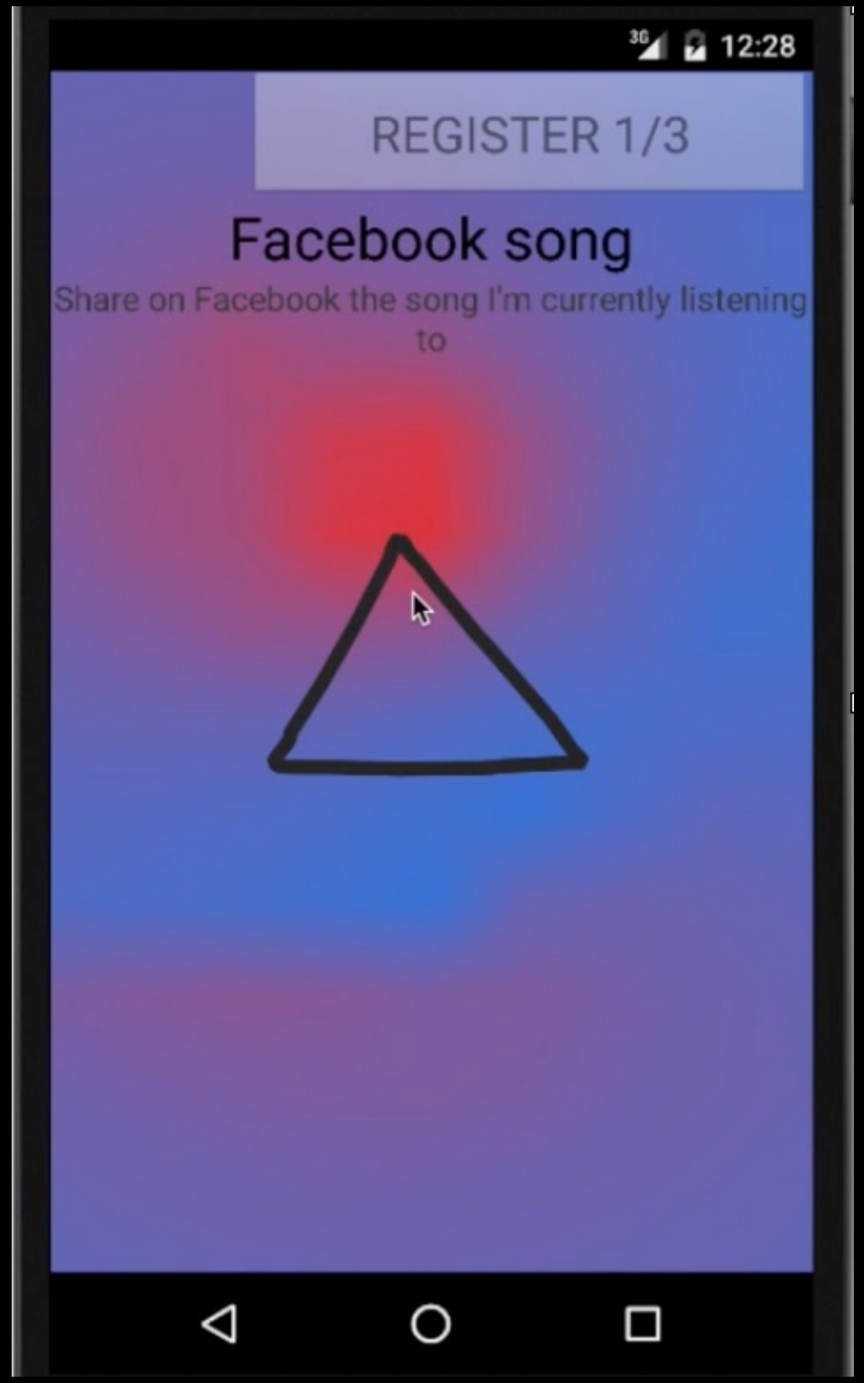
How to create our own gesture commands?

Personalize gestures

Fieldward (Malloch et al., 2017)

User:
gestures must be easy to recall

System:
gestures must be easy to recognize



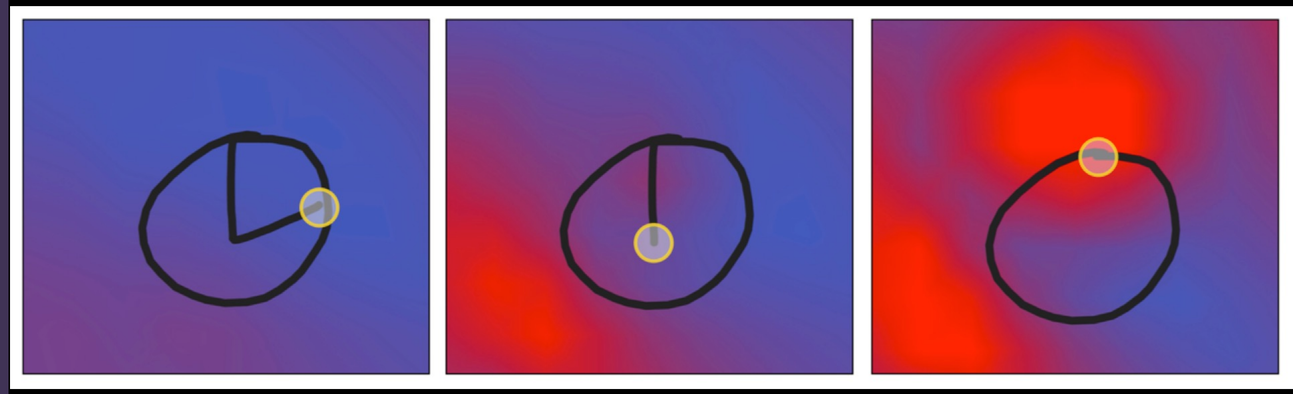
Personalize gestures

Fieldward (Malloch et al., 2017)

Define gestural commands

Dynamically show
what the system understood
and what is possible

Blue = recognizable
Purple = ambiguous
Red = already defined

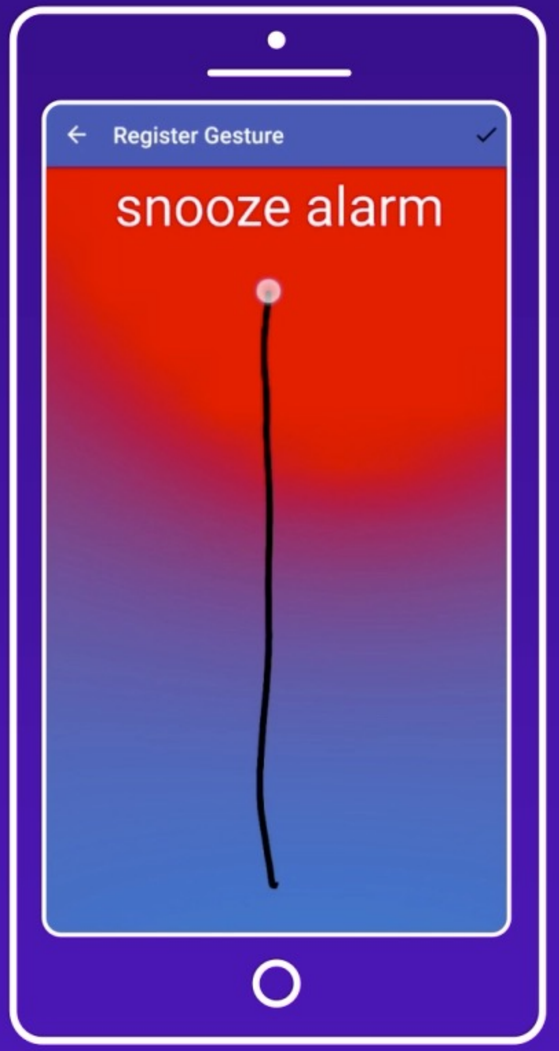


Reveal the underlying model

Fieldward (Malloch et al., 2017)

Fieldward does not only reveal
what gestures can be recognized

Drawing the “same” line
but in different directions
Can produce two different commands



Co-Adaptation:

Adapt to technology

We **discover** what technology can do

We learn how to control technology to **express** ourselves

Adapt technology

We **customize** technology to meet personal needs

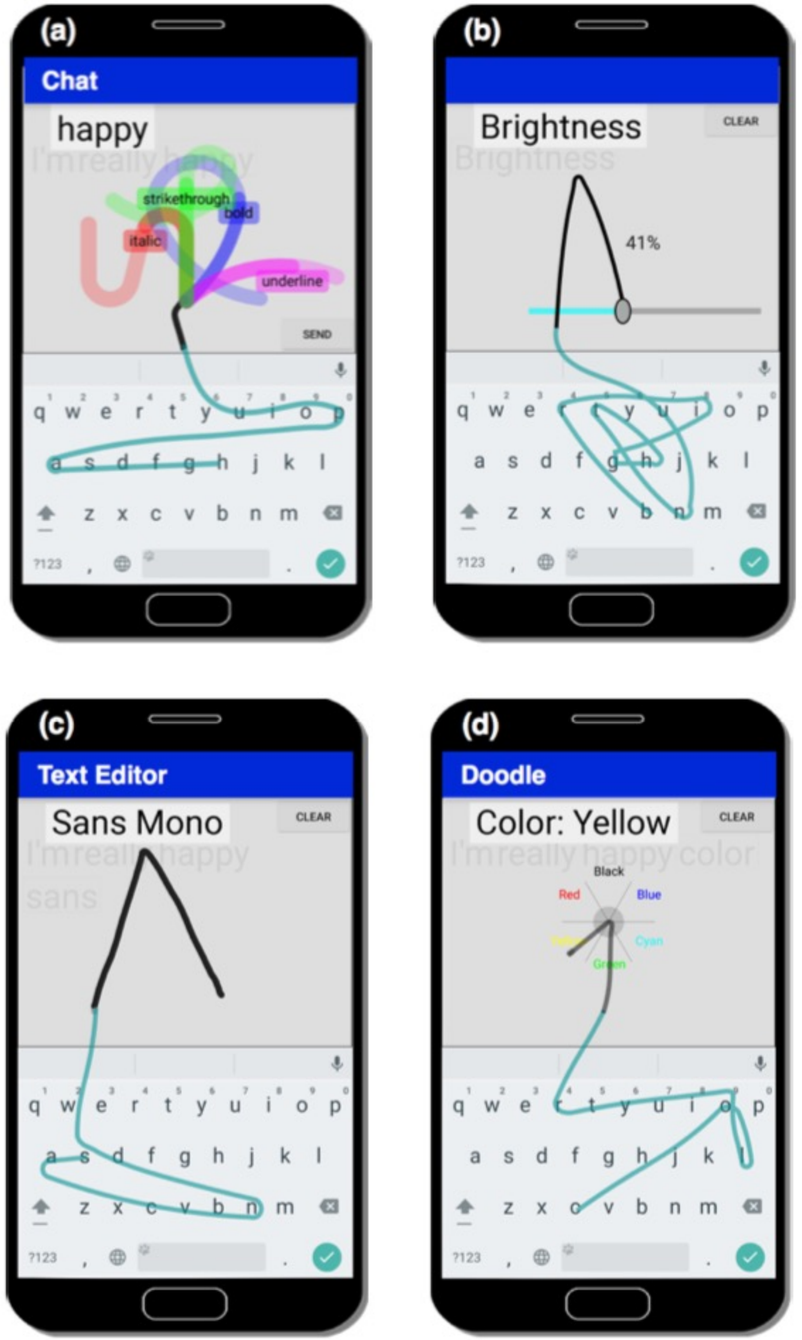
We reinterpret and **appropriate** technology to innovate

Combining principles

CommandBoard (Alvina et al., CHI'17)

Transform the space above the keyboard into an interactive command space

Make it discoverable, expressive and appropriable



Concept: Co-adaptation

Key principles

Discovery

Let users discover what the system did, and what it can do next

Expressivity

Let users express individual variation as personalized output, and reuse the result

Customizability

Let users redefine actions and effects to create new instruments and substrates

Appropriability

Let users re-interpret actions, properties, effects and relationships

Human-computer partnerships

Action focus

How can the user create their own instruments?

Currying

Let users transform object properties
into families of tools

Action focus

How can the user create their own instruments?

Effect focus

How can the user redefine the results of their commands?

Remapping

Let users redefine the mapping
between actions and effects

Appropriability

Let users redefine their input actions
to perform new commands and
reuse the results of those comands

Action focus

How can the user reinterpret their actions

Technical reasoning

Let users reuse properties
for different purposes

Action focus

How can the user reinterpret their actions

Effect focus

How can the user reinterpret the results of their commands?

Redefinition

Let users reinterpret relationships
among objects and substrates

	Action focus	Effect focus
Discoverability	Which commands are available and how can the user invoke them?	What command was performed and how was it interprete?
Expressivity	How does an individual user's input vary over time?	How does the resulting variability differ from the norm?
Customizability	How can users reuse properties for different purposes?	How can users redefine mappings between actions and effects?
Appropriability	How can users redefine how to perform specific commands?	How can users reinterpret relationships among objects and substrates?

Analysis & Critique
14:00 – 14:30

Analysis

Co-Adaptive Systems

Have any principles from the concept of **co-adaptation** been applied?

discoverability
expressivity
customization
appropriation

Critique

Co-Adaptive Systems

If the principles have been applied,
do they improve or hinder the system?

If they have not been applied,
what problems does this cause?

Could applying the principles improve the interface?

Principles			Actionable Behavior	Example
Discovery	*of a*	**command**	lets users see **possible future actions**	**Feedforward**
	of an	**effect**	lets users see how the system **interpreted their behavior**	**Feedback**
Expressivity	*of a*	**command**	lets users transform **input deviation from the norm into rich output**	**Input variation**
	of an	**effect**	lets users **fine-tune effects into reusable objects**	**Tweak**
Customizability	*of a*	**command**	lets users create instruments or **transform properties into families of tools**	**Currying**
	of an	**effect**	lets users redefine the mapping between actions and effects	**Remapping**
Appropriability	*of a*	**command**	lets users **reuse properties for different purposes**	**Technical reasoning**
	of an	**effect**	lets users **reinterpret relationships among objects and substrates**	**Redefinition**

Google Slides

Reconstructing Google Slides
14:30 - 15:30

Instrumental Interaction

Construct

Create a novel instrument and/or substrate that applies each principle

Co-Adaptive Systems

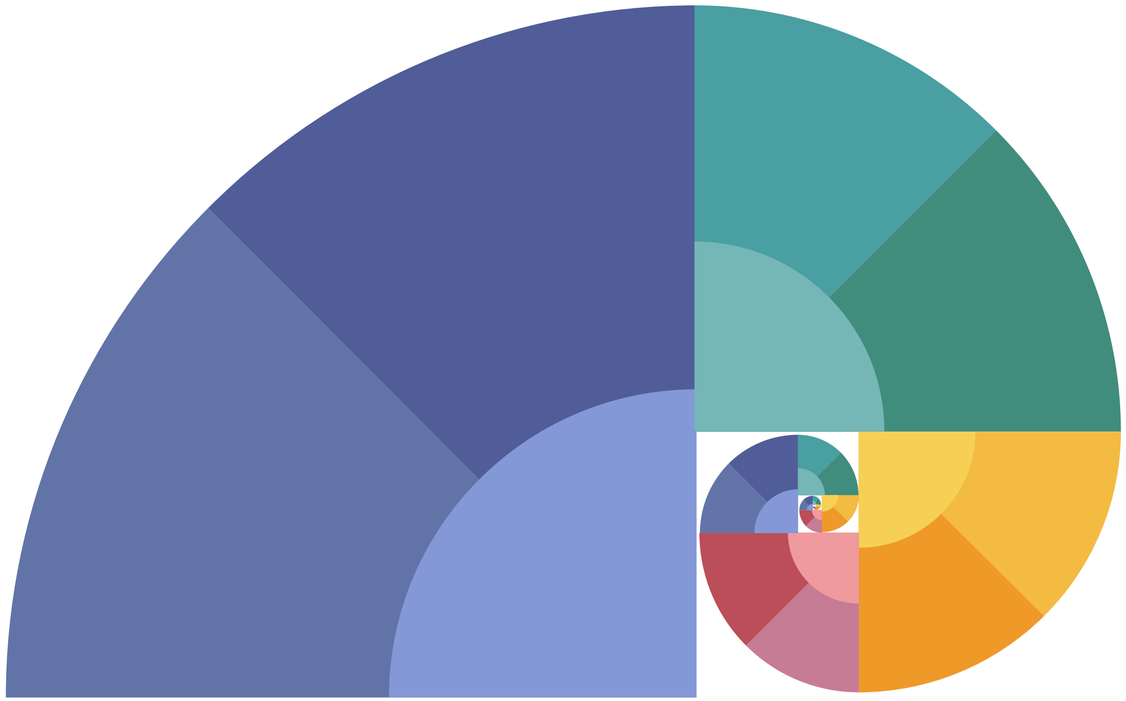
Construct

Enhance your previous tool or substrate
by applying the principles of co-adaptation

Google Slides

Break
15:30 – 16:00

Generating Generative Theory
16:00 – 16:15



Socio-technical principles

How do we incorporate
socio-technical principles
into the design process?

Process for applying
socio-technical principles
that inform the design process

Generative deconstruction

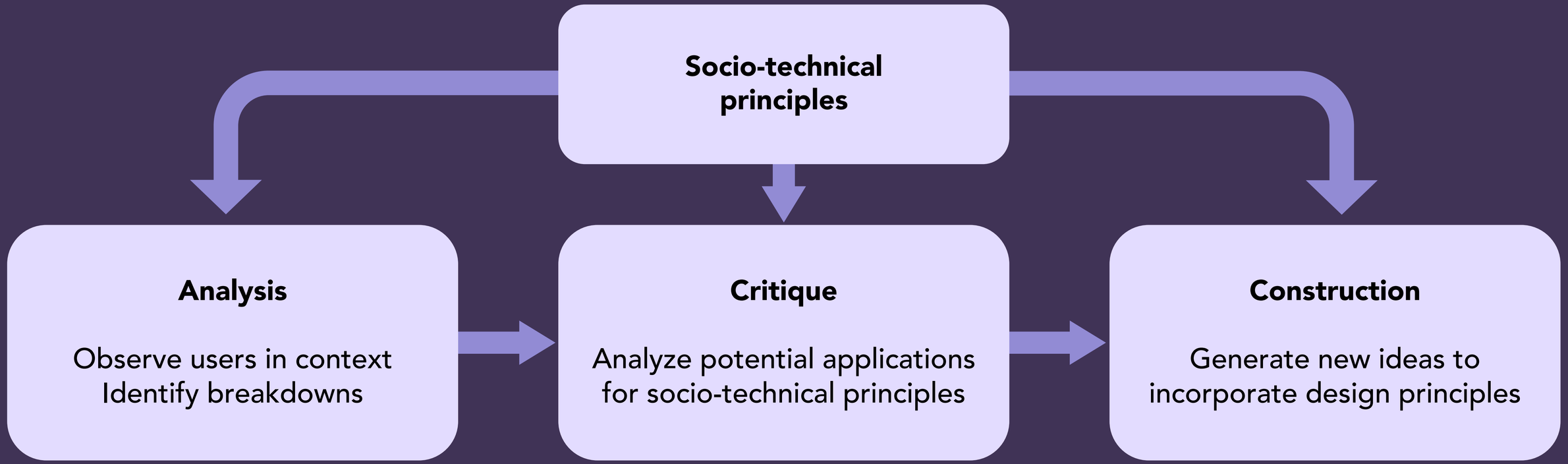
Observe users in order to:
to understand what to design
to evaluate what has been designed

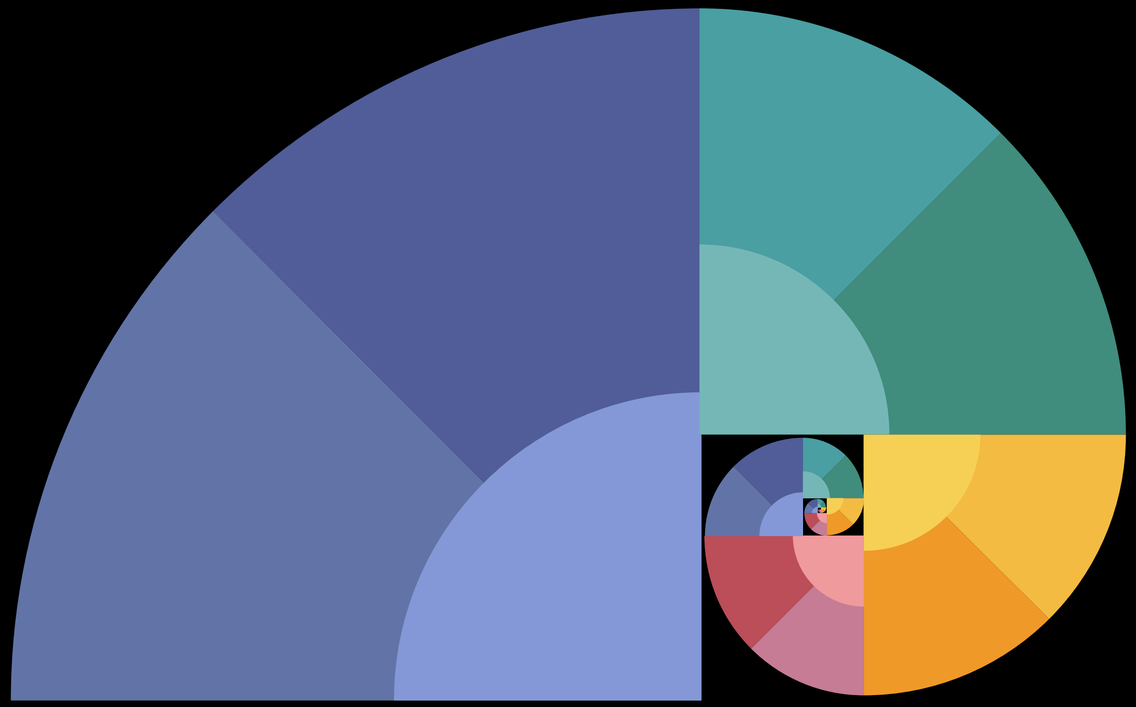
Deconstruct what is going on:
Who is the user?
What is the technology?
What is the user's context?
What is the interaction like?

Reconstruct the design
to design a new technology or
to fix an existing one

Generative deconstruction

Apply socio-technical principles to generate grounded designs





Generative walkthrough

Generative walkthrough

Design walkthrough

Systematic critique
of a design artifact

Generative walkthrough

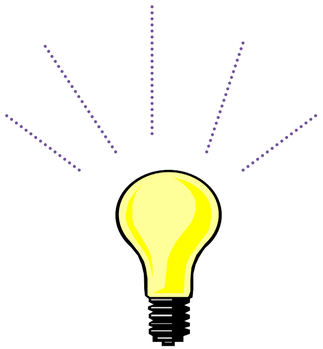
Design walkthrough

Systematic critique
of a design artifact

plus

Targeted brainstorming

Generate new ideas
based on a specific principle



Generative walkthrough

Examine each interaction snippet

Analyze:

Do the principles exist?

Critique:

What works well? What does not?

Construct:

Brainstorm new ways to apply the principle to the current interaction snippet

Socio-technical principles

Situated Action

Rhythms & Routines

Selective Attention

Reciprocal Co-adaptation

Distributed Cognition

Socio-technical principles

Situated Action	Beyond planning
Rhythms & Routines	Identify use patterns
Selective Attention	Consider the periphery
Reciprocal Co-adaptation	Re-interpret use
Distributed Cognition	Reduce cognitive load

Users modify their planned activities in new, unforeseen circumstances

Users establish routines and spatial patterns based circadian and external influences

Users vary their attention and shift between focus and the periphery

Users both learn and customize systems, while systems adapt to their behavior

Users rely on other people and objects “outside the head” to remember or communicate

Socio-technical principles

Social scientists conduct studies of users and provide deep insights

as **socio-technical principles**

that describe how people interact with technology in context

But ...

abstract principles are hard to translate into specific designs

Reflecting on sticky notes

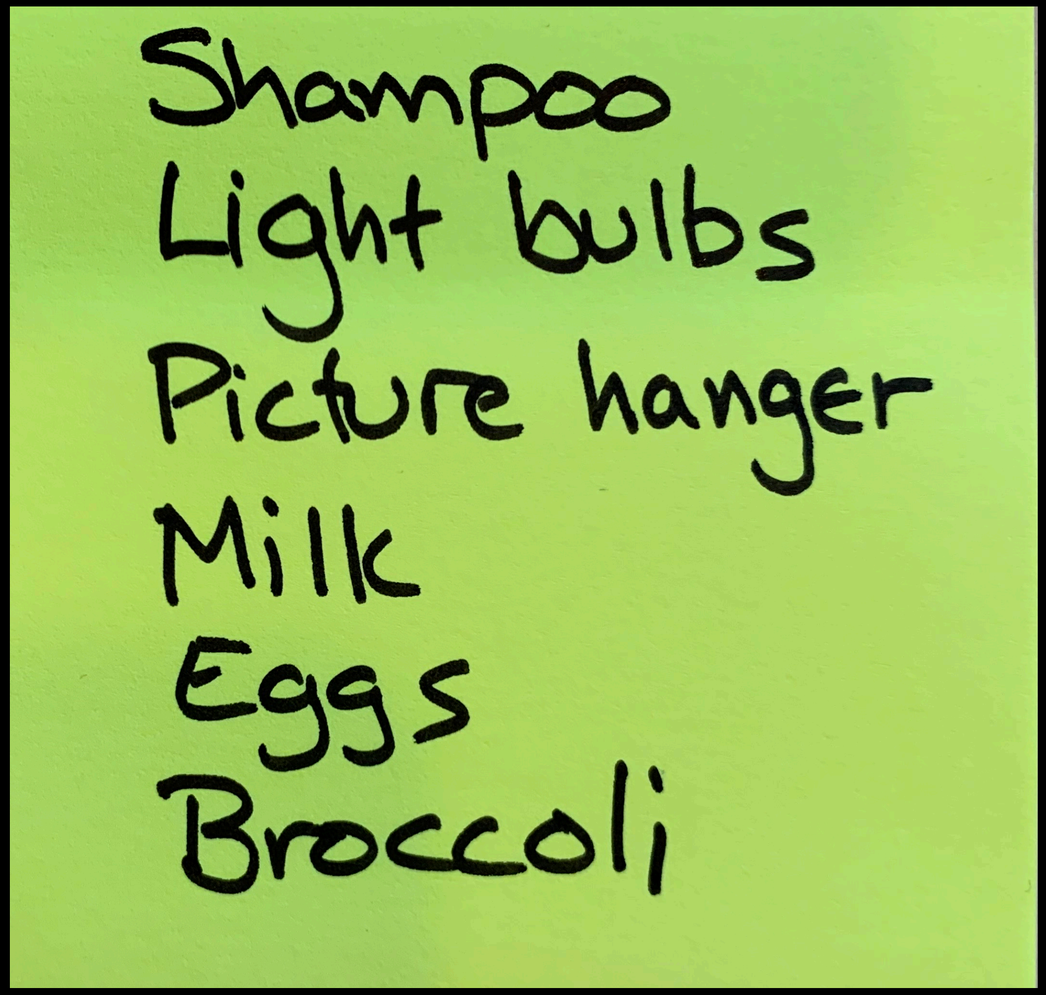
What are sticky notes?

What are they used for?

What are their most important properties?

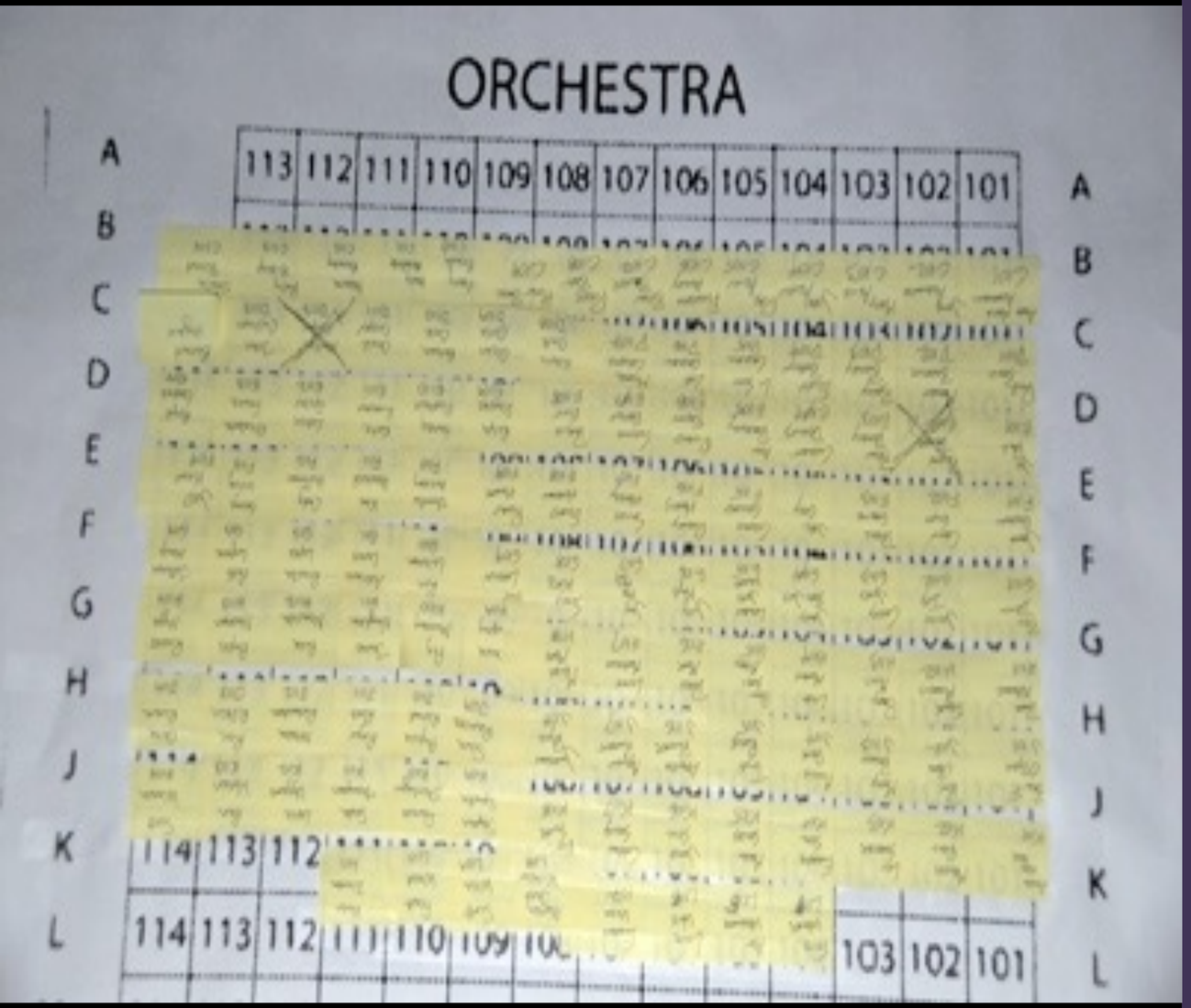
Why do they work?

Have you seen any creative uses of sticky notes?



Reminding

Planning


ORCHESTRA
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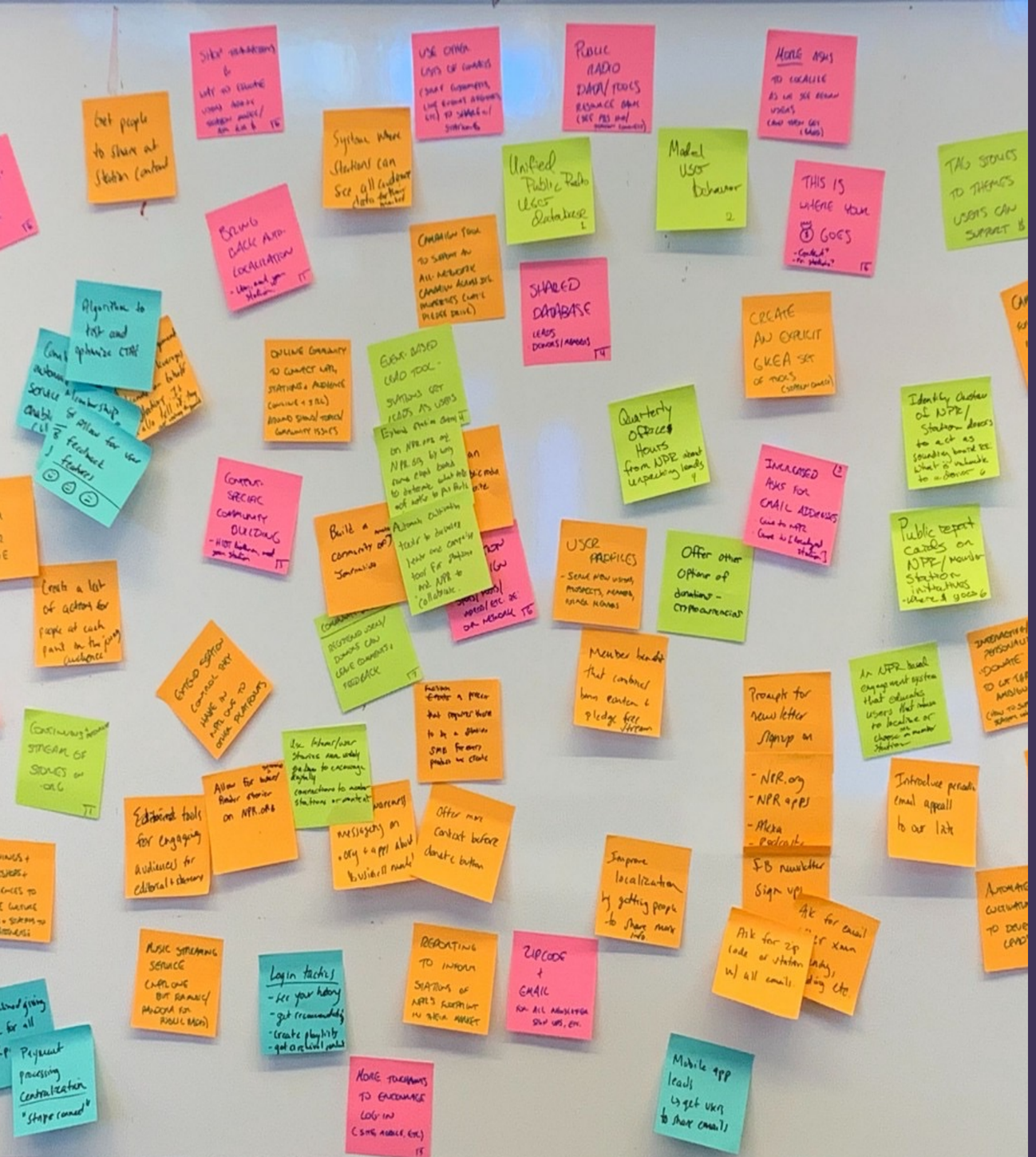
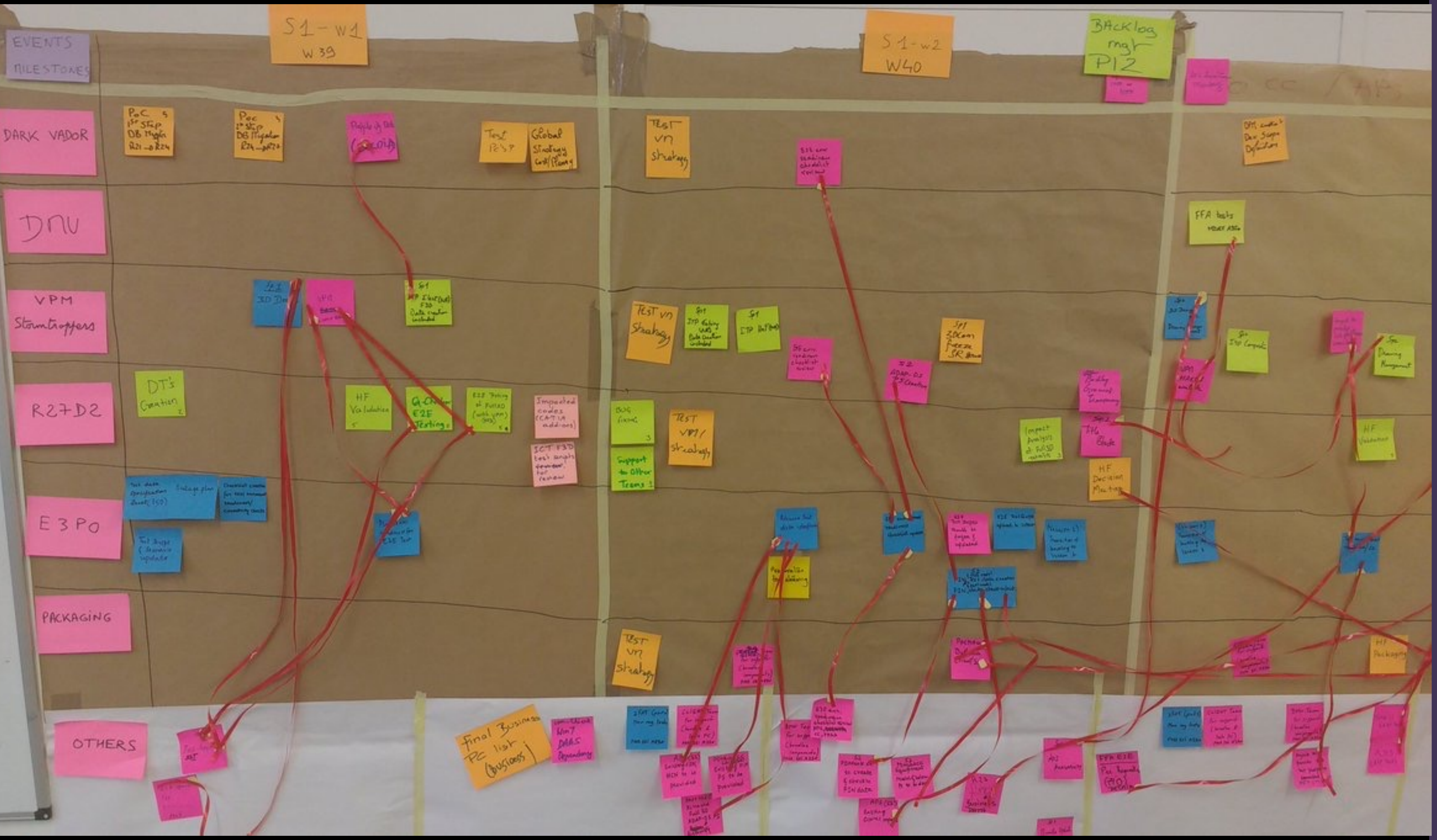
Assigning

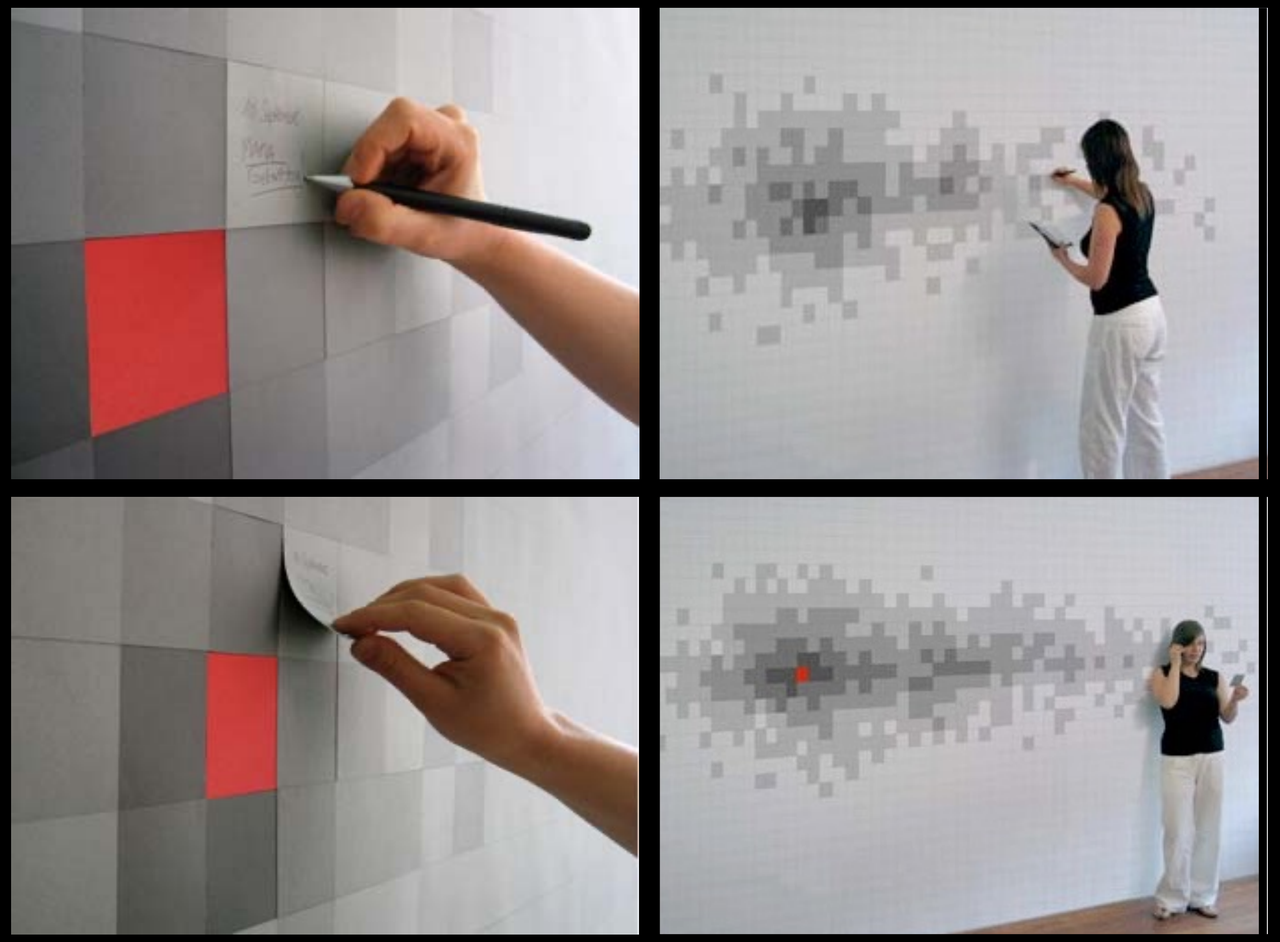
Organizing



Brainstorming


S1 - W1
W39
S1 - W2
W40
EVENTS
MILESTONES
DARK VADOR
VPM
R2D2
E3PO
PACKAGING
OTHERS

Tracking



Wall calendar (!)

Sticky mania

Socio-technical principles

Situated Action

Rhythms & Routines

Selective Attention

Reciprocal Co-adaptation

Distributed Cognition

Lucy Suchman, 1986

Situated Action

Situated Action

Overview

We can plan our activities
but we always act within a real-world context

How can we take context into account?
What about interruptions?
What about breakdowns?

How can we give users flexibility
to adapt their plans
as the context changes?

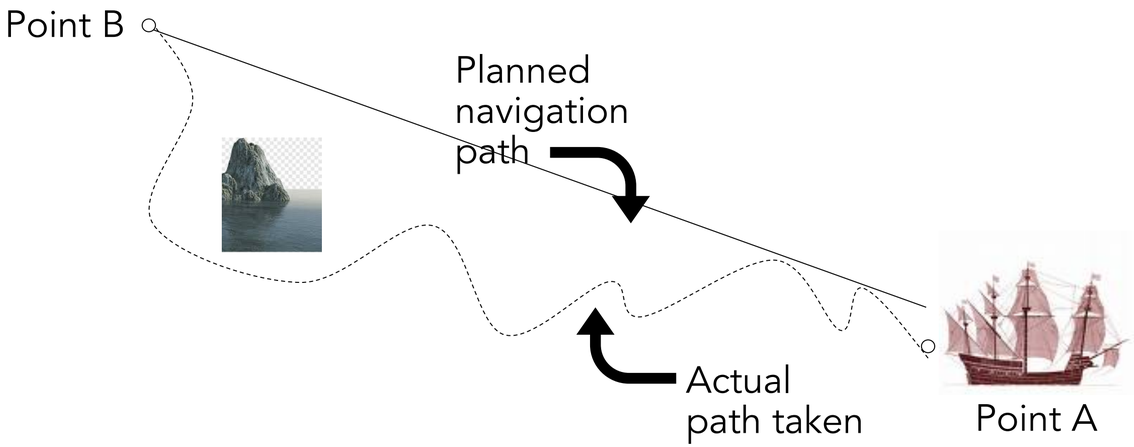
Situated Action

Principles

Emergent action

Identify which actions emerge when the user is in a specific situation

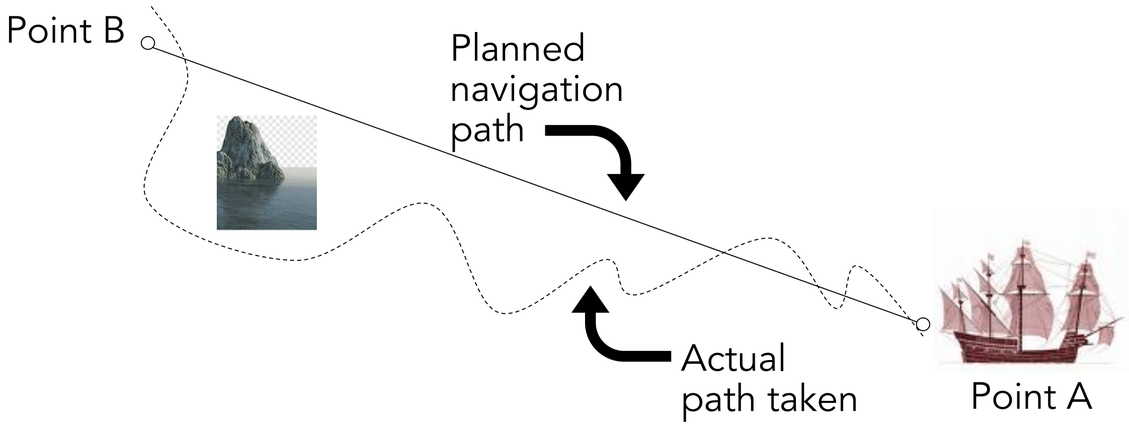
Consider relevant properties of the object or the environment



Situated Action

"The plan consisted of navigating
on a direct course
from point A to point B
including a small detour to avoid a rock.

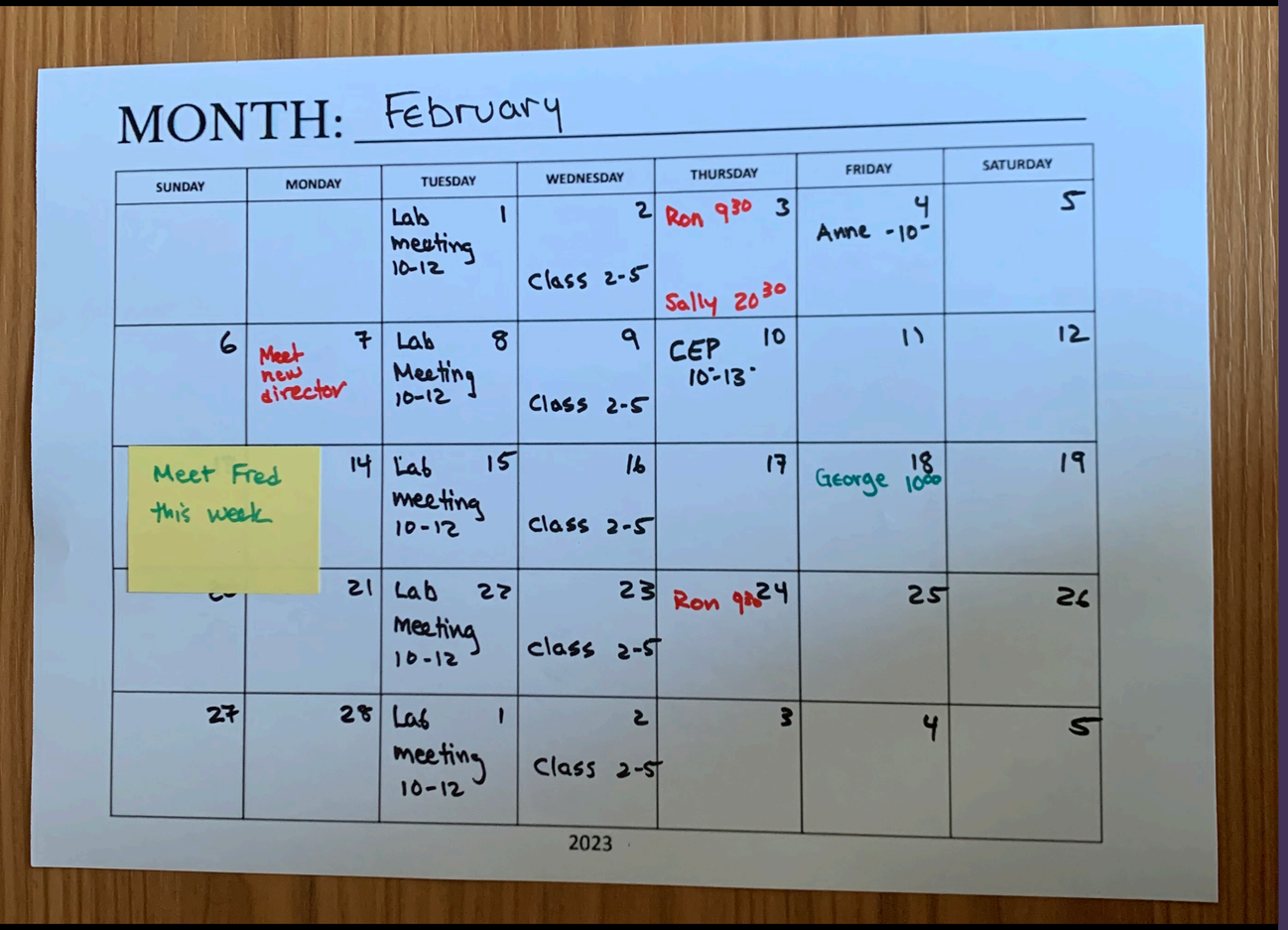
In reality, the course was an intricate
series of adjustments to circumstances
including changing wind,
water currants, drift, and
operator over-compensation."



Emergent action

Planning for change

Paper calendars help plan future events
but ink is hard to change.
How can sticky notes help add flexibility?



Emergent action

Planning for change

Paper calendars help plan future events
but ink is hard to change.
How can sticky notes help add flexibility?

Problem:

Sally wants to meet with Fred next week
but does not yet know when

Solution:

Place a sticky note at the beginning
of the week

Lena Palen & Stinne Aaløkke, 2006

Rhythms & Routines

Rythms & Routines

Overview

People are strongly influenced
by biological rhythms (circadian rhythms)
Waking up and going to sleep
Getting hungry

People also establish regular routines
Going to class or work
Eating at a particular time

How can we help users take advantage
of existing rhythms and routines?

Rythms & Routines

Principles

Temporal rhythms

Identify which biological rhythms influence users behavior

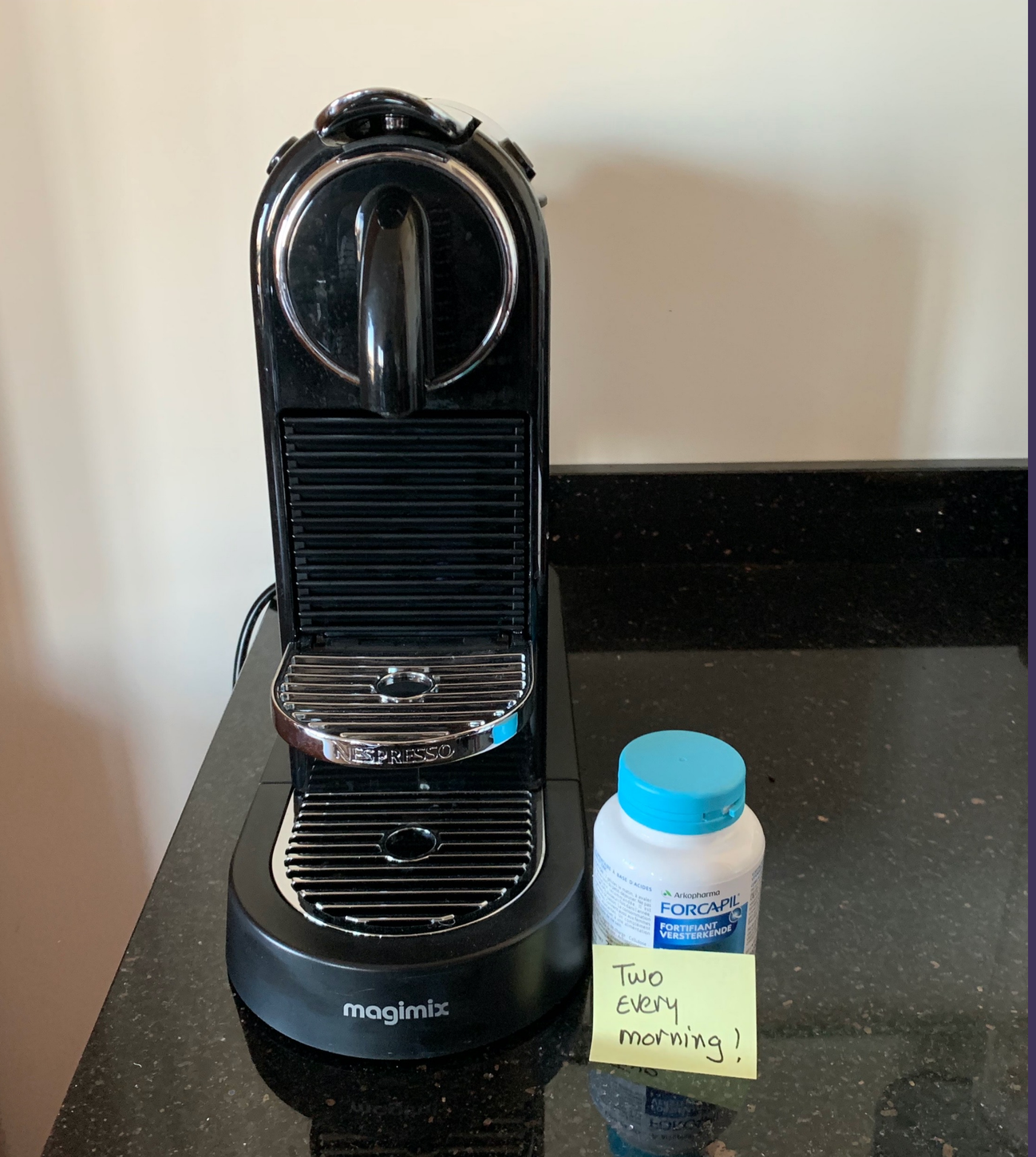
Spatial rhythms

Identify which spatial layouts affect users behavior

Temporal rhythms

Situated reminders

Take advantage of human circadian rhythms to plan for future activity



Temporal rhythms

Situated reminders

Take advantage of human circadian rhythms to plan for future activity

Problem:

Ann needs to take her pills every morning

Solution:

Ann needs coffee to wake up in the morning
She places her pills next to the coffee machine

Spatial routines

Situated reminders

Context is important for remembering

Plan using knowledge of future activity
Place a reminder where you will find it at the appropriate time and place

Spatial routines

Situated reminders

Context is important for remembering

Plan using knowledge of future activity
- Place a reminder where you will find it at the appropriate time and place

Problem:
- Jean wants let his son know that Tara called

Solution:
- Place the message next to his son’s usual seat at the dinner table

Michael Posner, 1988

Selective Attention

Selective Attention

Overview

Human perception involves both
focused and peripheral vision

Example: Vision

Central vision	see **color**, detail
Peripheral vision	see black & white
	see *movement*

Most interactive system designers assume
they have the user's full attention
but users multi-task and live in a complex
world

How can we design to account for the periphery?

Selective Attention

Principles

Peripheral vision

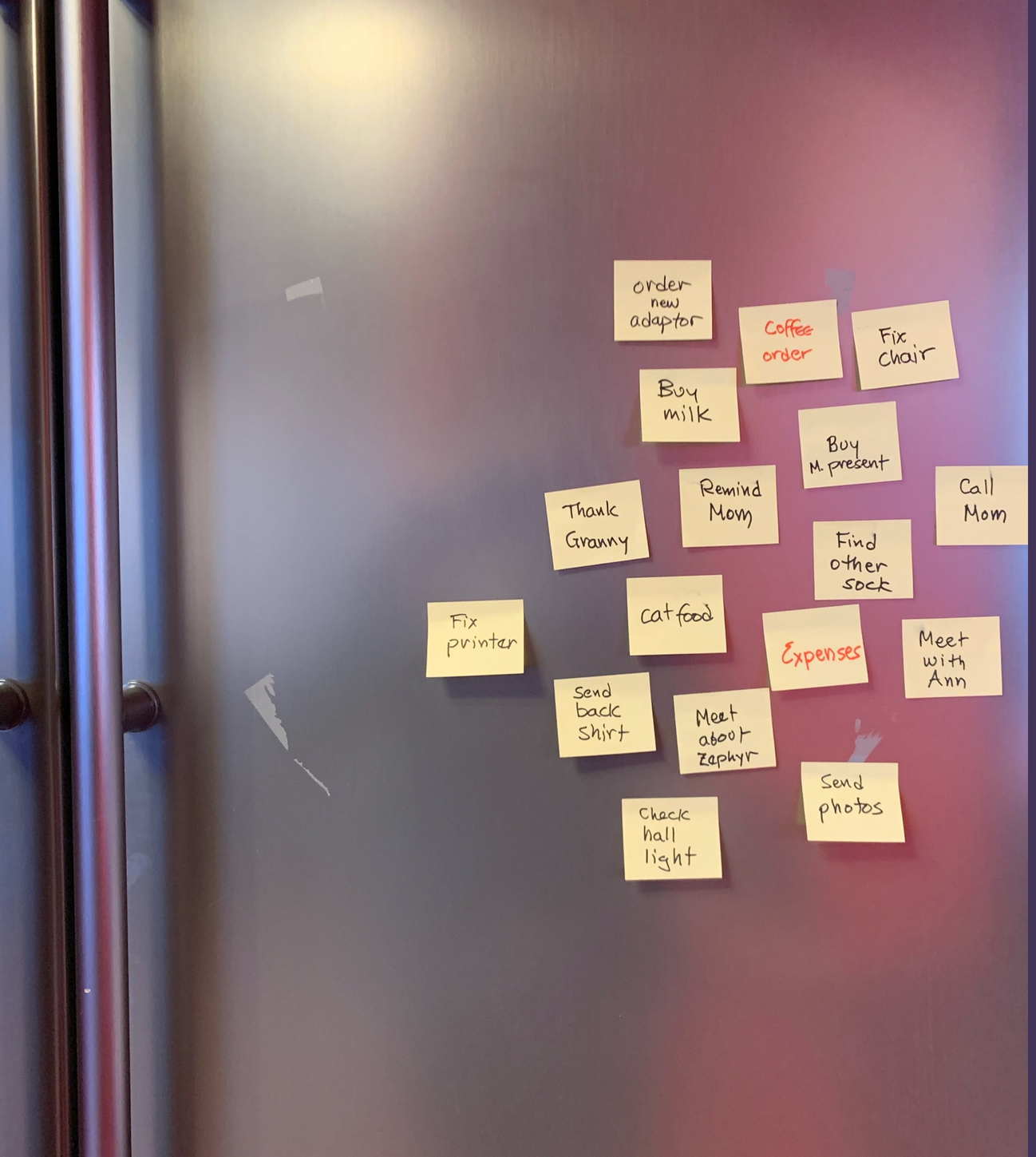
Assume users will be distracted
Let users take advantage of peripheral vision

Selective attention

Peripheral awareness

Where should we place items?

How can we use peripheral vision to track progress, without distracting us?



Selective attention

Peripheral awareness

Where should we place items?

How can we use peripheral vision to track progress, without distracting us?

Problem:

Paul puts his chores on post-it notes on the refrigerator.

Solution:

Paul stops procrastinating when he senses that the refrigerator door is “too yellow”

Ed Hutchins, 1995

Distributed cognition

Distributed Cognition

Overview

Not all cognition is located in the brain
    We take advantage of the physical environment and other people

Physical objects form part of our memory
    if we know where to find it,
    we can forget it

Objects may be shared among people
    but different people may have different interpretations of the same object

Distributed Cognition

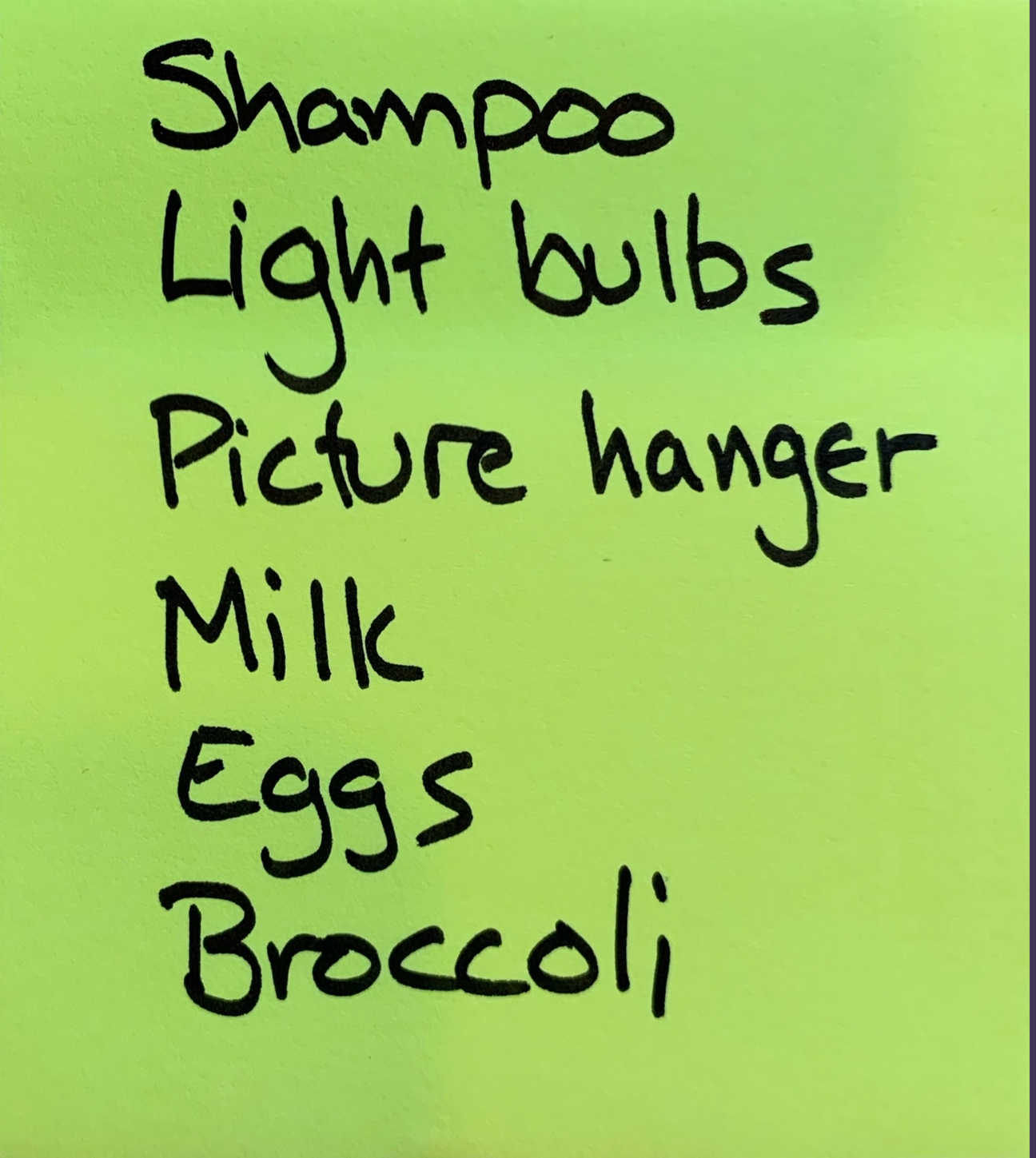
Principles

Memory aid

Writing it down lets us forget
until we need it

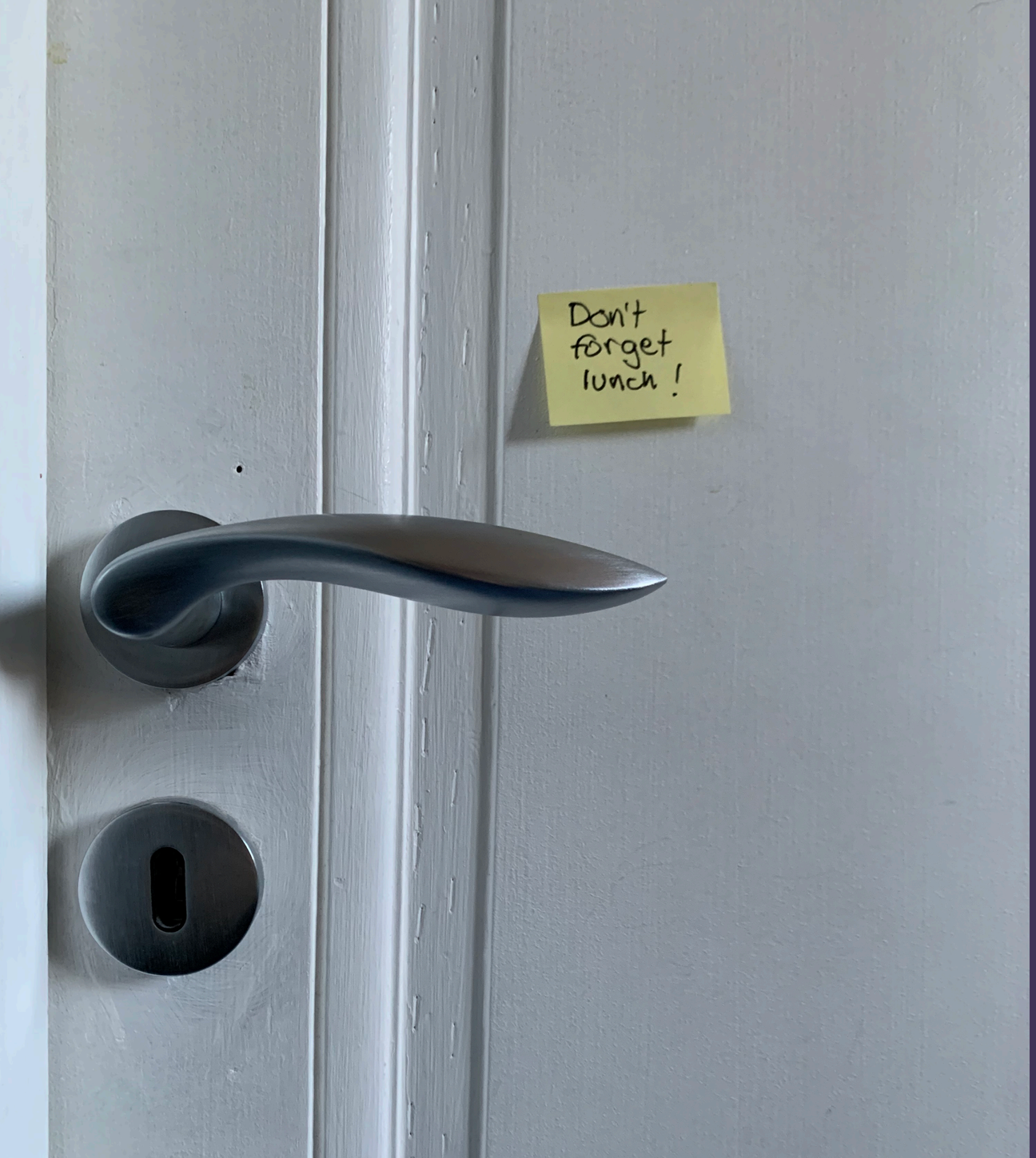
Boundary object

Different people interpret objects differently



Memory aid

We can leave physical objects where we know we will find them when we need them



Memory aid

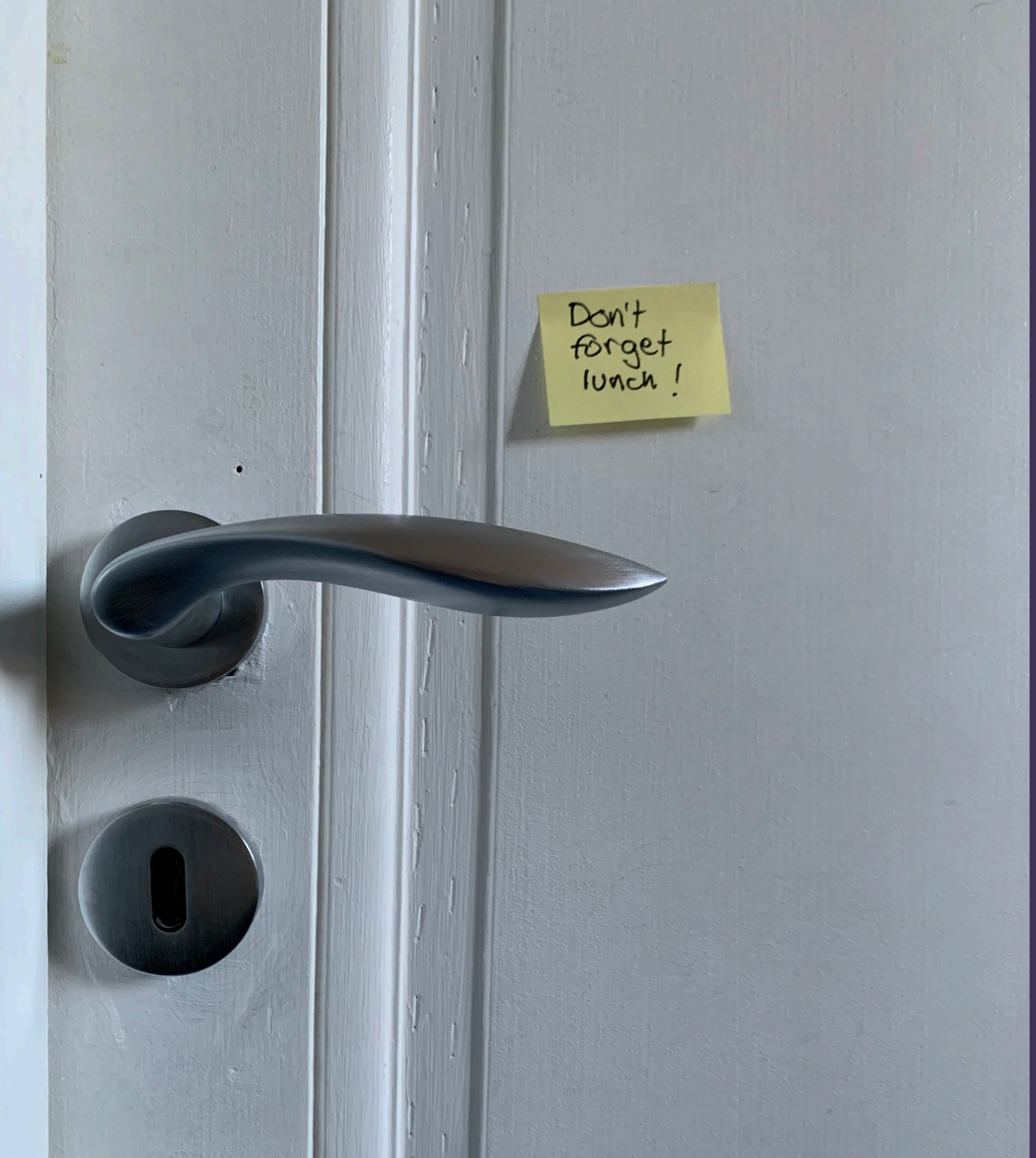
We can leave physical objects where we know we will find them when we need them

Problem:

Bob needs to remember to bring his lunch to work

Solution:

Put a note next to the door handle so he'll see it as he leaves



Memory aid

We can leave physical objects where we know we will find them when we need them

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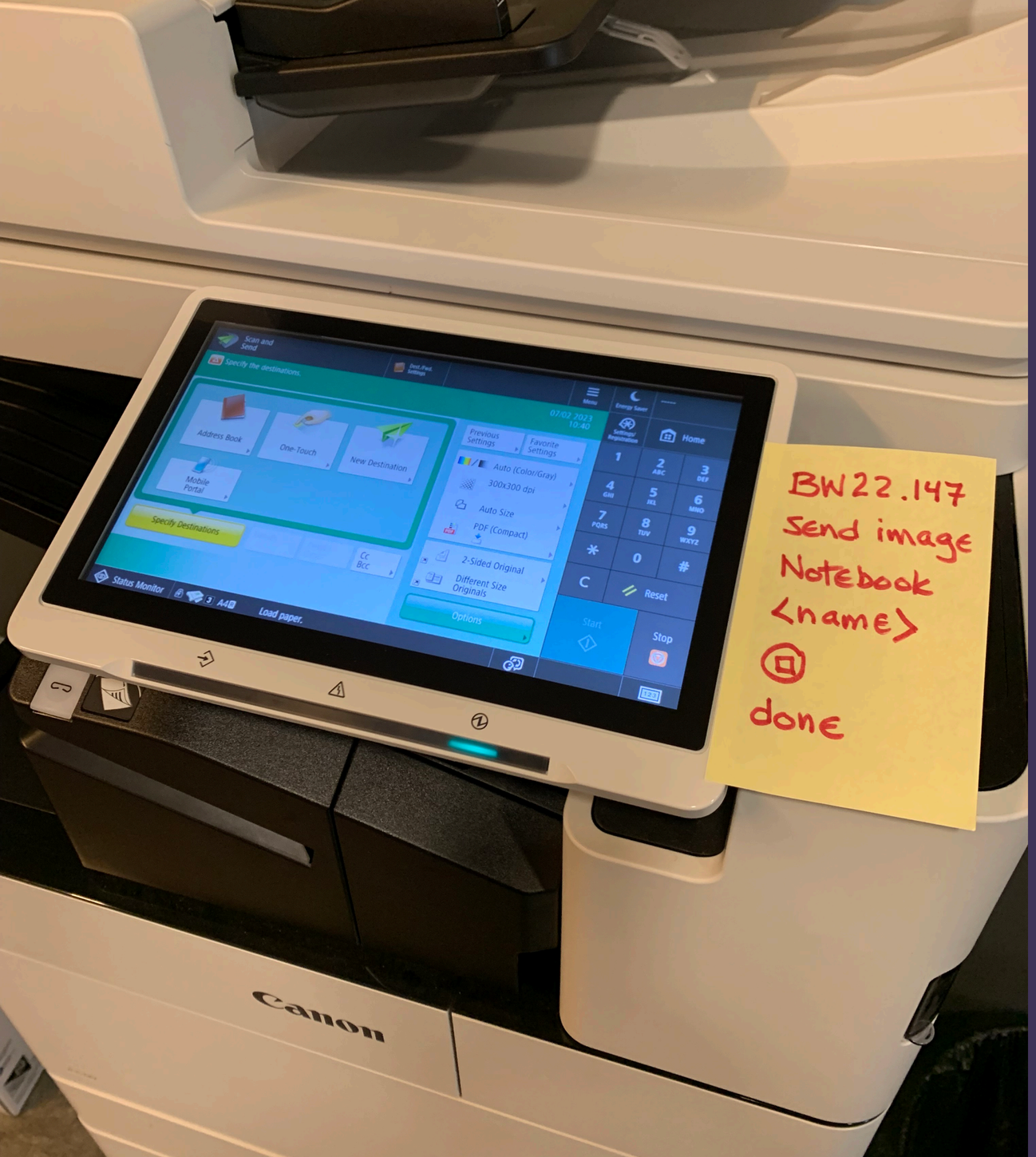
What other principles do you see?

Emergent action
Distributed cognition
Spatial routine
Temporal routine

Boundary object

Different people will interpret the same
message differently,
based on their existing knowlege



Boundary object

Different people will interpret the same message differently,
based on their existing knowlege

Problem:

Leave a message for users to help them send and image from this printer

Solution:

Experts will understand how to use the “BW22.147” code and ignore the later steps

Novices will follow the steps
(but may be confused)

Reciprocal Co-adaptation

Mackay, 2000
Beaudouin-Lafon et al., 2022

Reciprocal Co-adaptation

Overview

Designers assume users will use systems “correctly”

But users also adapt systems to meet personal needs

How can we make interactive systems easier to learn and easier to appropriate?

Appropriation

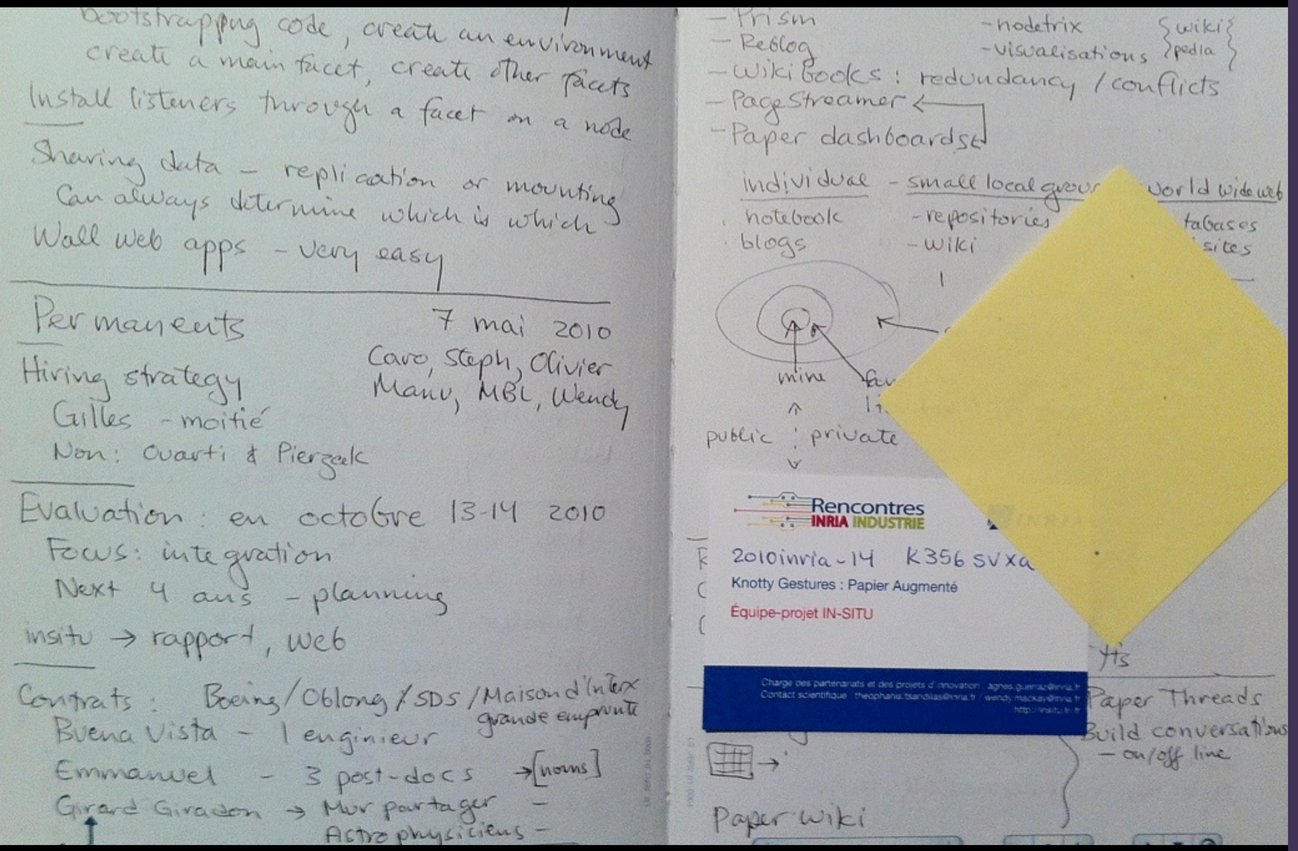
How can we take advantage of existing properties to solve current problems?

Problem:

Sue receives a business card from a colleague and does not want to lose it

Solution:

Take advantage of the glue of the sticky note to attach the business card to the notebook



Appropriation

How can we take advantage of existing properties to solve current problems?

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Socio-technical principles

Situated Action	Beyond planning	Users modify their planned activities in new, unforeseen circumstances
Rhythms & Routines	Identify use patterns	Users establish routines and spatial patterns based circadian and external influences
Selective Attention	Consider the periphery	Users vary attention and shift between focus and the periphery
Reciprocal Co-adaptation	Re-interpret use	Users both learn and customize systems, while systems adapt to their behavior
Distributed Cognition	Reduce cognitive load	Users rely on other people and objects “outside the head” to remember or communicate

Designing Actionable Principles
16:15 – 17:00