ADVANCED DESIGN OF INTERACTIVE SYSTEMS

15 JANUARY 2026

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LECTURES & TOPICS

1 Introduction

Introduction of Goals and Topic

Exercise: DOIS Quiz & Choose groups

Homework: Story Interviews

2 Understanding Humans

Understand underlying cognitive effects:

Alignment, Theory of Mind, Mental Models

Exercise: Concept Development

Homework: Initial Design

3 Agency and Control in HAI

Explainability, Ironies of Automation

How to design for Error, Feedback and Control?

Exercise: Build Prototype

Homework: Storyboard

4 Iterating on Design

Socio-Technical Systems in AI

Exercise: Prototype + Generative Walkthrough

Homework: Revise Concept

5 Evaluating intelligent Systems

Overview of evaluation methods

Exercise: Revise Prototype

Homework: Evaluation protocol

6 Reflection on HAI

Social, legal, sustainability impact of AI

Discuss the role of designers for HAI interaction

Exercise: Poster, Presentation

COURSE PROJECT

Create a novel, principled design that:

- provides innovative interaction
- reflects the real-world needs of users
- takes advantage of generative design
- **Uses AI to improve user skills**

Improve users skills

- Focus on the user interaction with the system
  - Does it perform actions for the user?
  - Does it help the user improve their skills?

- Consider the effects on the user over time

COURSE PROJECT

Tasks

- Identify key issues for AI users: What do they need?
- Build on methods from the intro course & create your own methods
- Create a novel, principled design that takes advantage of generative design principles
- Create a final video prototype

HOMEWORK

INTERVIEWS AND METHOD QUIZ

Interviews

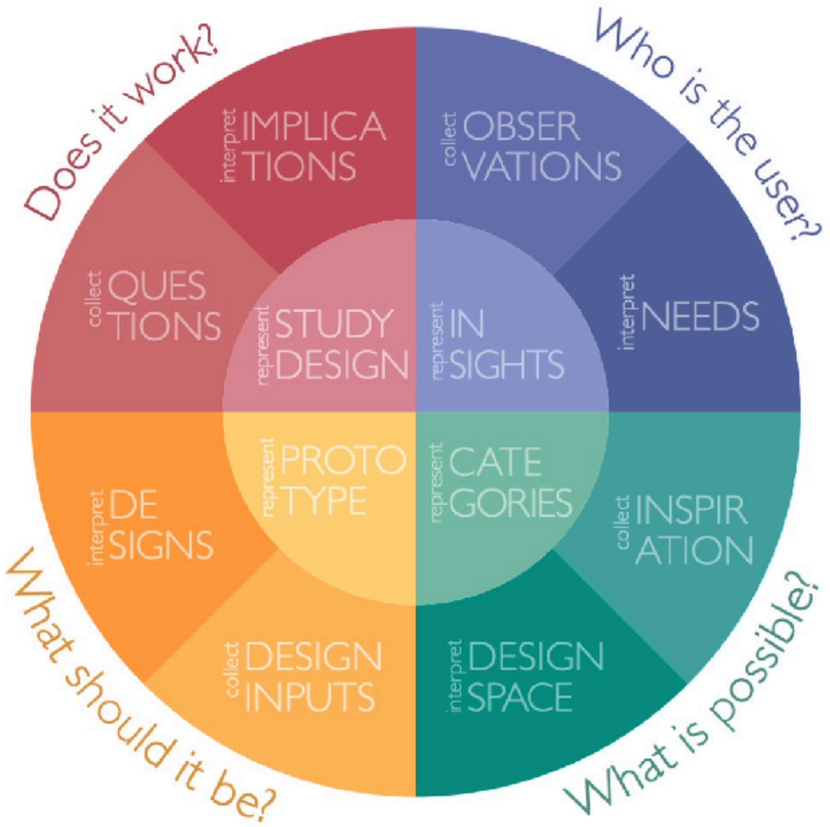
- Conduct at least two story interviews with target users
- Transcribe interviews and number each answer
- Describe 3 main issues/needs and add answer number(s)

HOMEWORK

INTERVIEWS AND METHOD QUIZ

Method Quiz

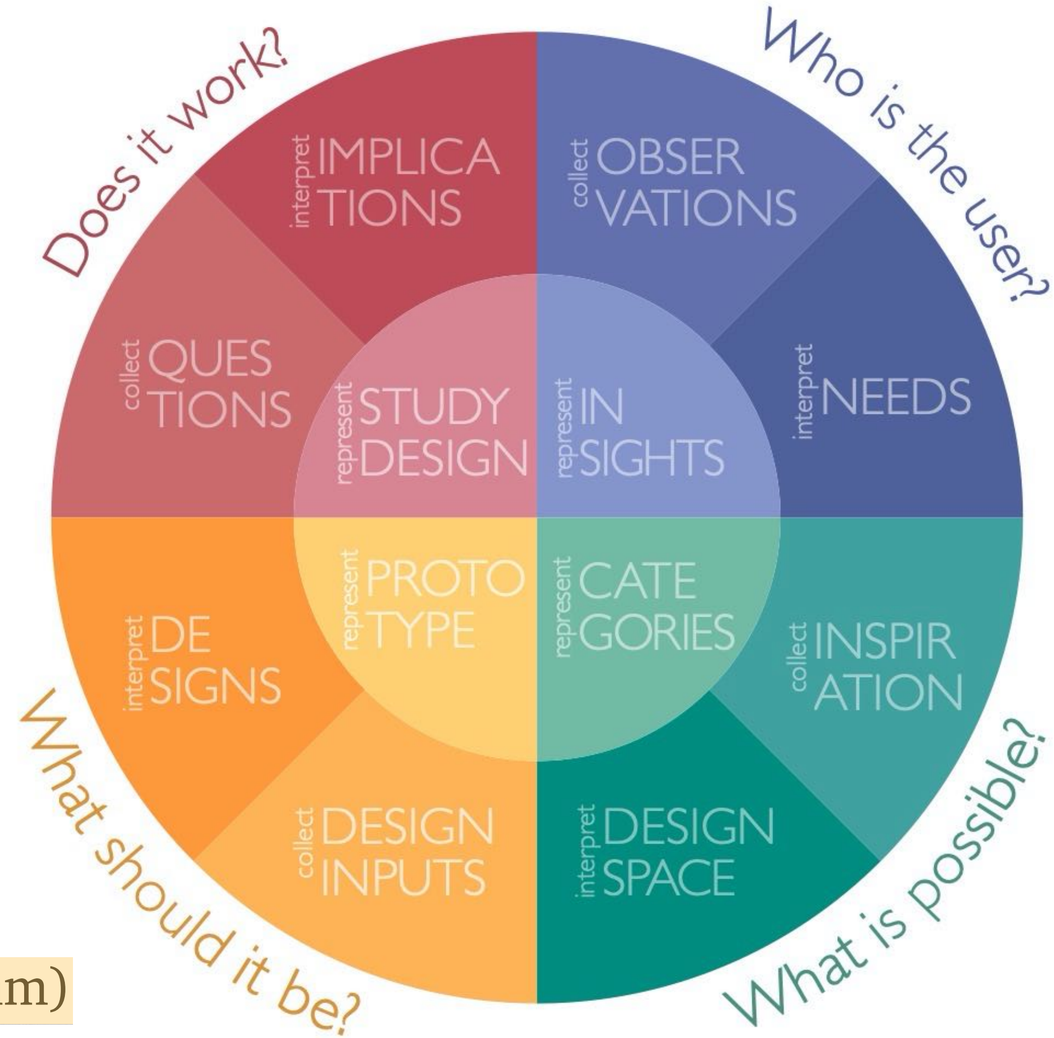
- Match specific design activities to locations on the Methods poster



Methods game

Where do they fit?

- Brainstorming
- Breakdown Analysis
- Current Scenario
- Design Alternatives
- Design Concept
- Design Dimensions
- Design Space
- Design Walkthrough
- Experiment
- Extreme Character
- Future Scenario
- Idea Archive
- Improvements
- Interaction Snippets
- Interaction Table
- Mockups
- Peer Interview
- Peer Introspection
- Persona
- Questionnaires
- Research Questions
- Story Interview
- Storyboard
- User Profile
- Video Brainstorming
- Video Prototype
- Visual Abstract (design diagram)

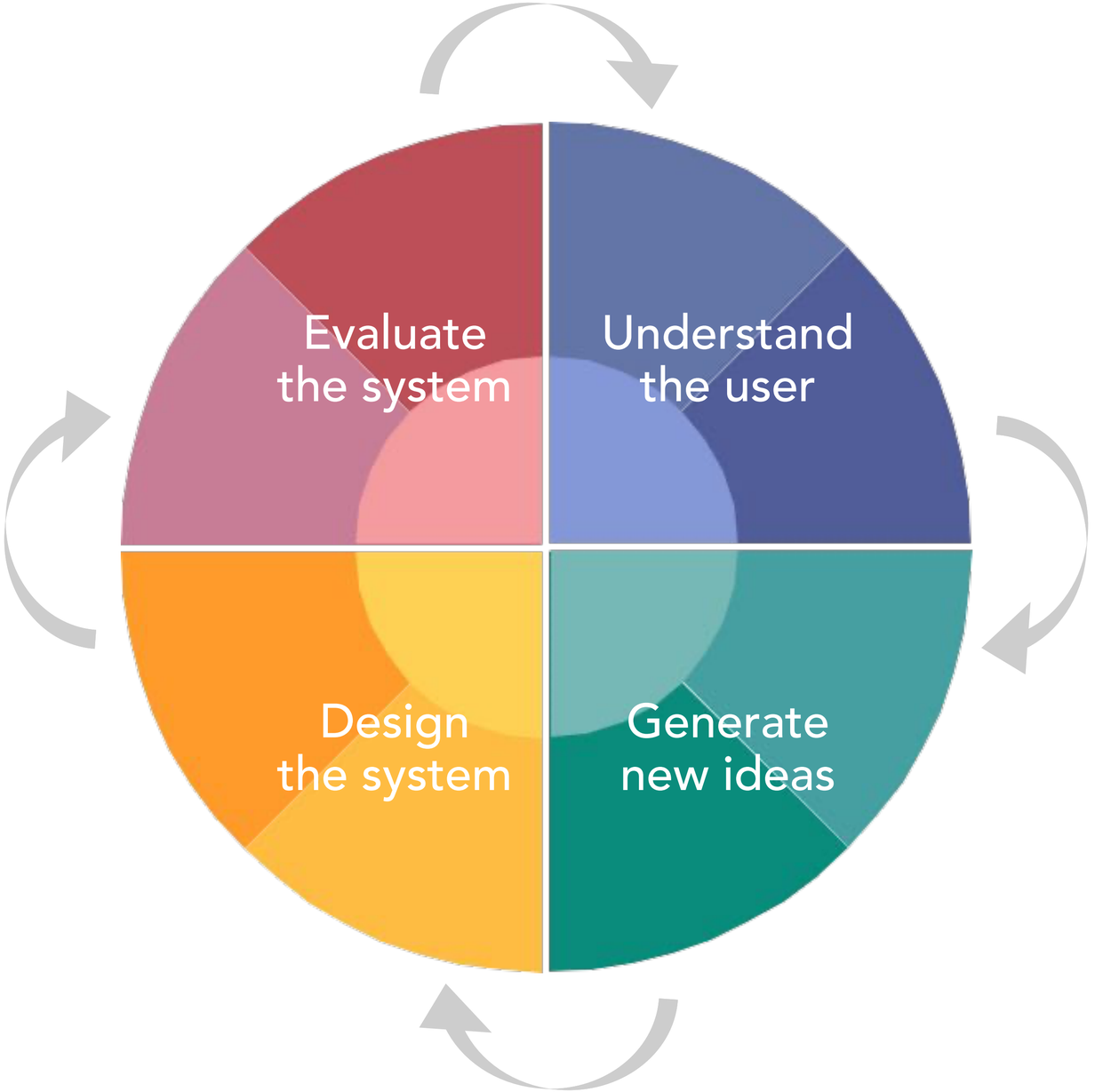


RECAP

Iterative design

Every design phase contributes to every other phase:

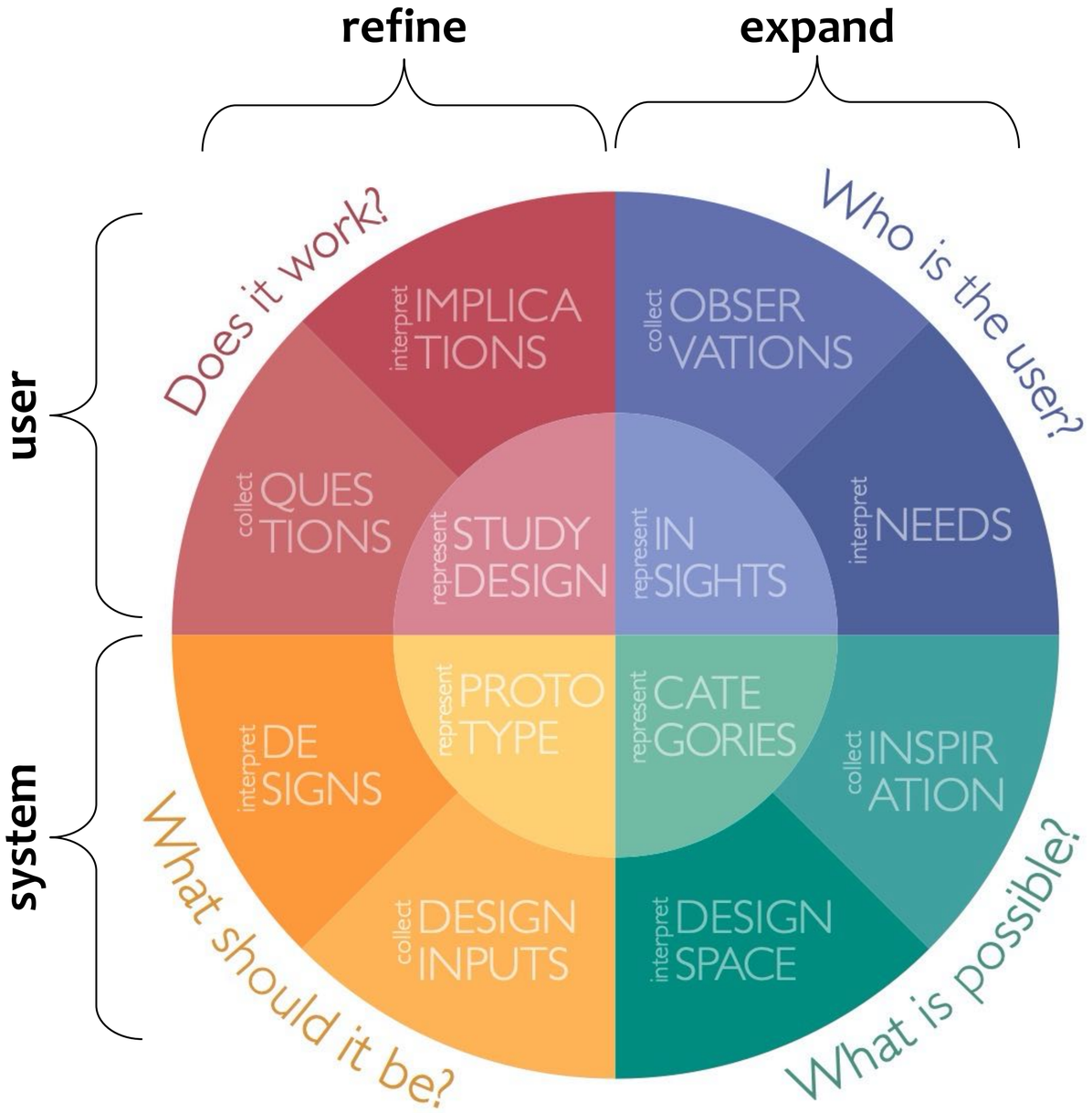
Jump from any phase to any other phase as needed



RECAP

Generative design

Consider the trade-offs across methods



UNDERSTANDING HUMANS

Mental Models

Grounding

Theory of Mind

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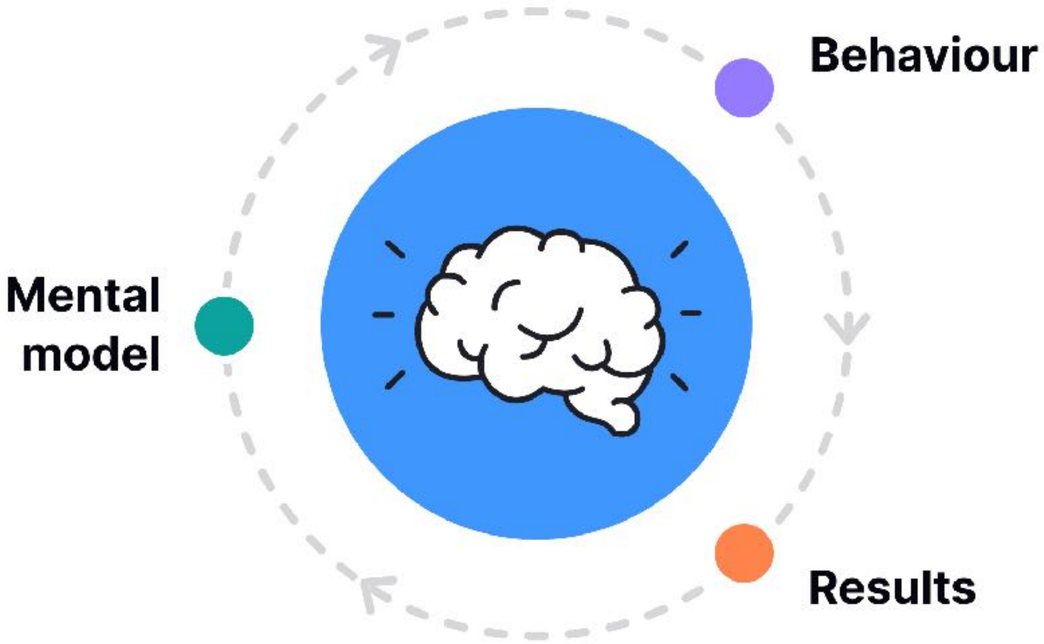
MENTAL MODELS



“In design, mental models refer to the representations or frameworks that individuals construct in their minds to understand and interpret how a system, product, or interface works.”

https://app.uxcel.com/glossary/mental-models

Mental Models. Adapted from Gentner, D., & Stevens, A.L. (Eds.). (1983). Mental Models (1st ed.). Psychology Press. Image adapted by The Center for Implementation, 2024.

CRITIQUING MENTAL MODELS ___

‘In HCI research, the notion of **"mental models"** has come to be a very general catch phrase for **anything having to do with end users’ knowledge** of an application (van der Veer, 1990).

There is a feeling that **if we could "capture" mental models, then we could build good interfaces** [...]

Many are much less convinced of the alleged benefits of mental models and of our ability to use them for reasoning or other complex cognition.”

Nardi, B. A., & Zarmer, C. L. (1993). Beyond models and metaphors: Visual formalisms in user interface design. Journal of Visual Languages & Computing, 4(1), 5-33.

Definition by

Jakob Nielson

'A mental model is **what the user believes** about the system at hand.'

UNDERSTANDING MENTAL MODELS

- is **based on belief, not facts**: it's a model of what users know (or think they know) about a system
- Is base of users' predictions about the system (ideally users' thinking is closely related to reality)
- allows users to plan their future actions

Jakob Nielsen. Mental Models on October 17, 2010

DESIGNING FOR MENTAL MODELS ___

‘Goal for designers to make the user interface communicate the **system's basic nature** well enough that users form reasonably accurate (and thus useful) mental models.’

- Common usability dilemma: a gap between designers' and users' mental models
- ‘Individual users each have their own mental model —> different users might construct different mental models of the same user interface.

Jakob Nielsen. Mental Models on October 17, 2010

DESIGNING WITH CONCEPTUAL MODELS

The model the designers wants the user to have

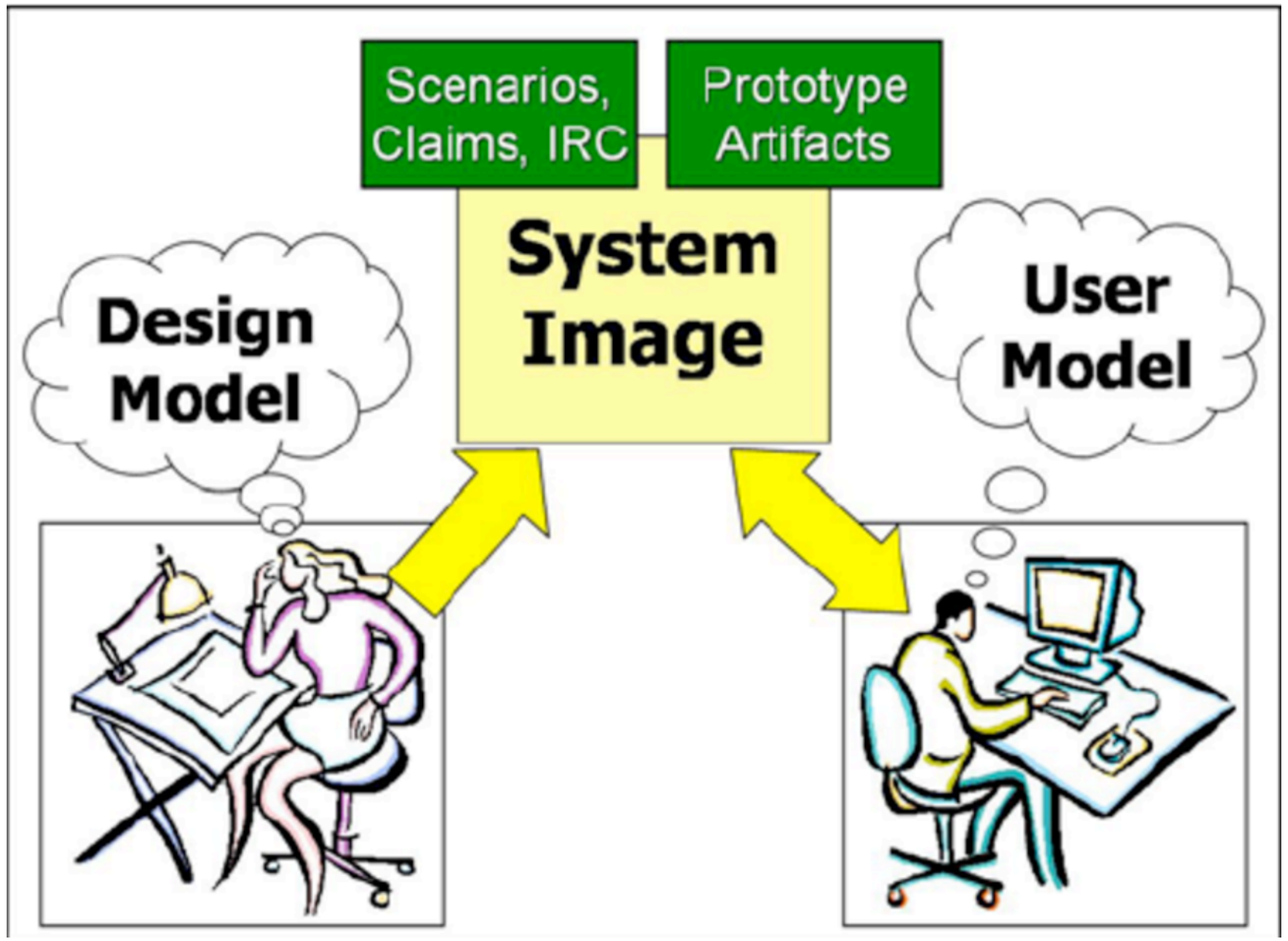
"A **conceptual model** is a high-level description of how a system is organized and operates."

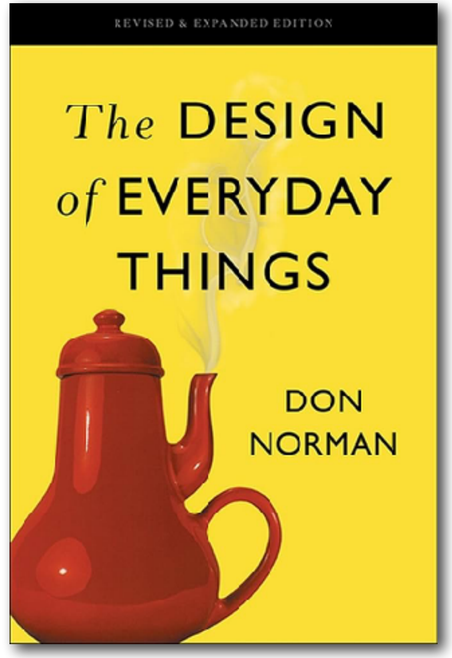
- is deliberately designed
- allows users to understand and operate the UI
- draws on prior knowledge/experience of the user
- communicated through the UI and interaction design

Johnson, J., & Henderson, A. (2002). Conceptual models: begin by designing what to design. interactions, 9(1),-32.

William Hudson. Mental Models, Metaphor and Design (2003).UK UPA and HCI2003

DESIGNING FOR MENTAL MODELS ___

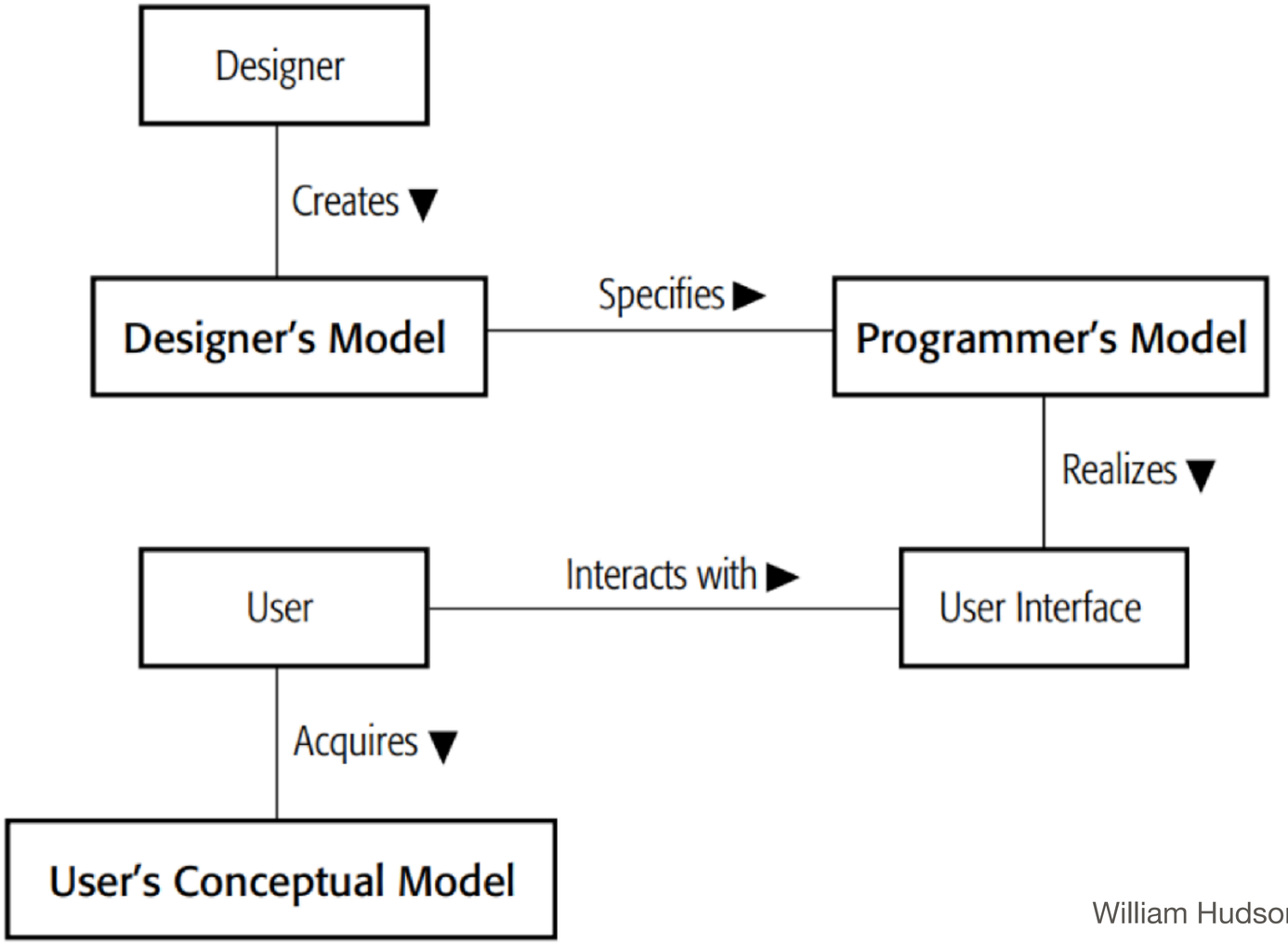


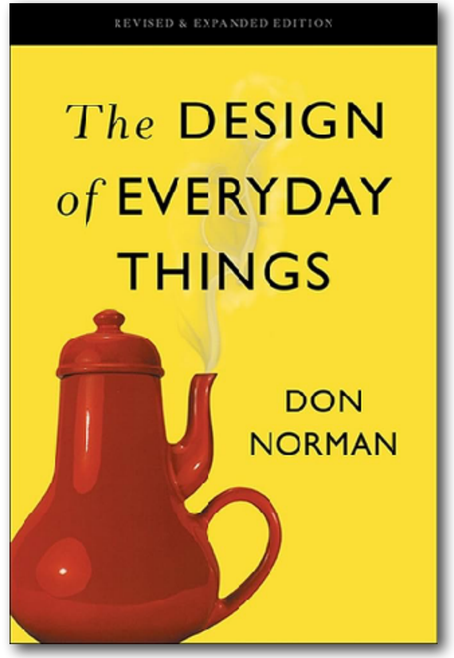


Based on “Designer Model, User Model, and System Image:

Lee et al. Image is everything: advancing HCI knowledge and interface design using the system image (2005).Proceedings of the 43rd annual Southeast regional conference

DESIGNING FOR MENTAL MODELS ___





Based on "Designer Model, User Model, and System Image:

William Hudson. Mental Models, Metaphor and Design (2003).UK UPA and HCI2003

EXERCISE

REFINE PERSONAS AND USERS

Discuss:

- Exchange insights based on your interviews
  - What are their key characteristics?
  - What surprised you?
- What are the users' most important needs? What is their mental model?
  - What are the key problems to solve?
  - What are the design opportunities?
  - Where does the user's mental model differ from the designer's intention?
- What did you learn about the user's mental model of the process?
  - How do they address the task without AI?
  - What steps are involved that are not present in the AI process?
  - What impact does it have? Should we integrate it?
  - How do they address identified problems without AI? Can we learn something?
- Adapt your personas' characteristics, ensure they are real, based on your data

RECAP

DOIS

Identify user's key conceptual objects

What digital objects do users want to manipulate?

Example:

- **Powerpoint or Keynote**
  - Presentations
  - Individual slides
  - Graphical objects
  - Text
  - Images

CONCEPTUAL OBJECT

RECAP

DOIS

What does the user care about?

Music apps include: songs, artists, playlists

Properties:

Songs include: duration, tempo
performer(s), style

Representations:

Songs appear as: name, album cover

Functions:

Songs can be: played, deleted, added

Interactions:

Songs can be: clicked, dragged

CONCEPTUAL OBJECT

EXERCISE

OBJECTS OF INTEREST___

Identify:

- List common “objects of interests” form your interviews

- Select 2-3 central objects and outline functions that apply to the object
  Incl. functions that apply to the object
  Incl. functions that users aimed to apply based on your insights (current limitations)

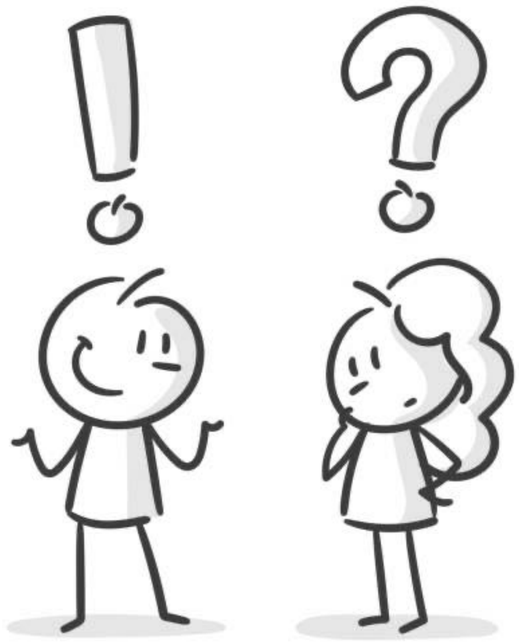
UNDERSTANDING HUMANS

Mental Models

Grounding

Theory of Mind

UNDERSTANDING GROUNDING___



Conversational Grounding

‘Grounding’ refers to the ability to create a shared base of knowledge, beliefs, or assumptions surrounding a goal striven toward

Distinguishes:

1. Purpose
2. Medium

Clark (1991): Perspectives on socially shared cognition, APA

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

GROUNDING

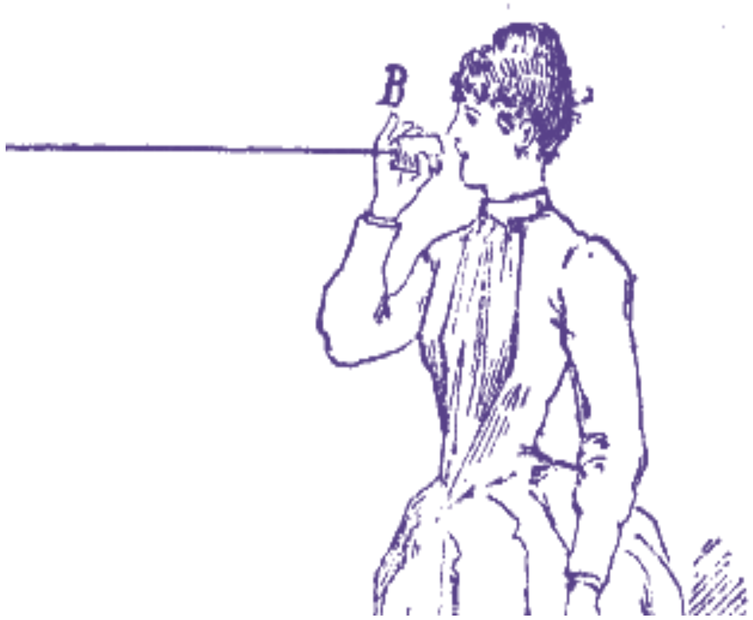
Main aspects

1. Expressing one’s objectives

Clark (1991): Perspectives on socially shared cognition, APA

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

GROUNDING



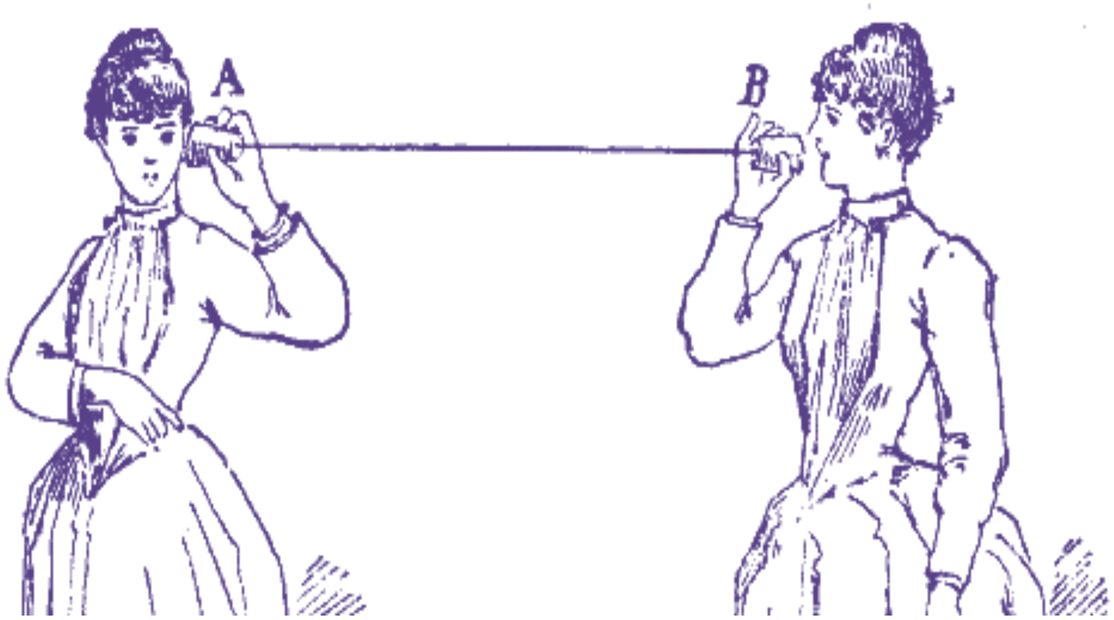
Main aspects

1. Expressing one’s objectives
2. Selecting an effective medium

Clark (1991): Perspectives on socially shared cognition, APA

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

GROUNDING



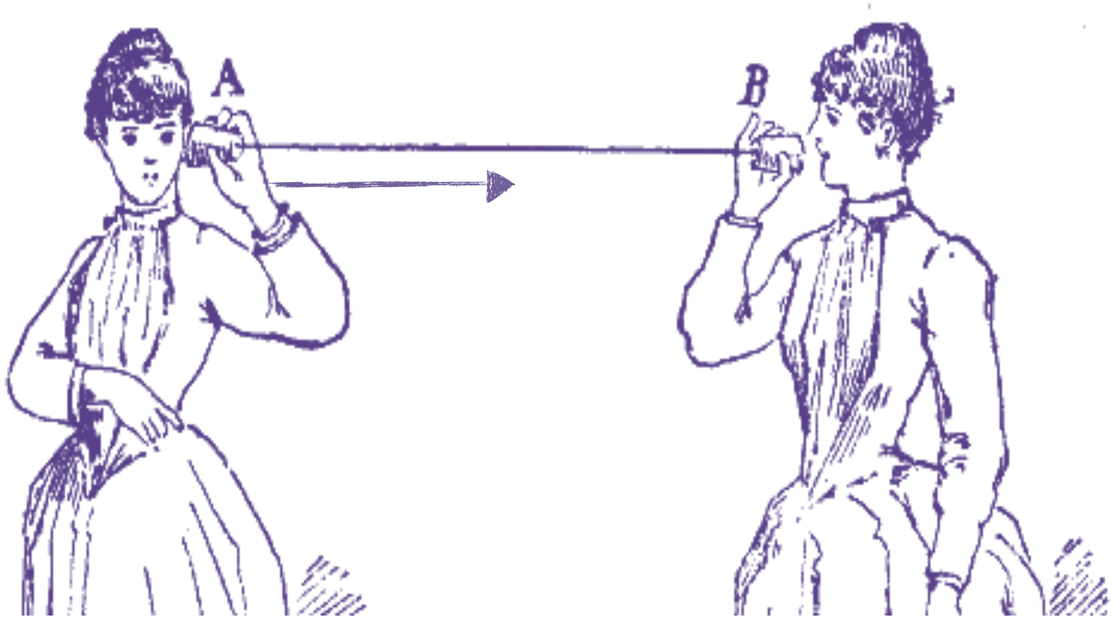
Main aspects

1. Expressing one’s objectives
2. Selecting an effective medium
3. Evaluating the effort of the communicative action

Clark (1991): Perspectives on socially shared cognition, APA

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

GROUNDING



Main aspects

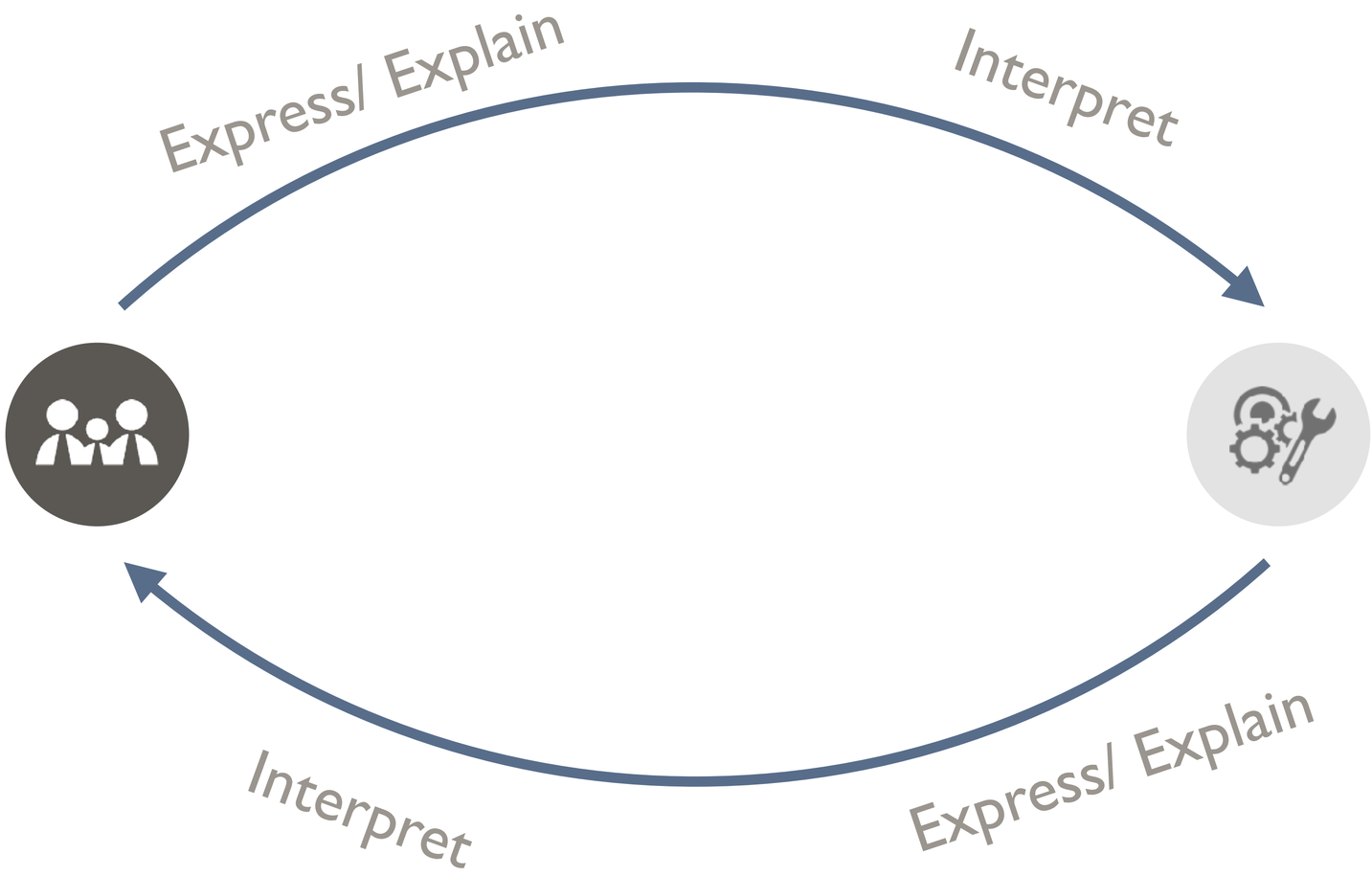
1. Expressing one’s objectives
2. Selecting an effective medium
3. Evaluating the effort of the communicative action
4. Being able to confirm receipt of the intended message

Clark (1991): Perspectives on socially shared cognition, APA

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

COLLABORATION

HUMAN-AI INTERACTION



COLLABORATION

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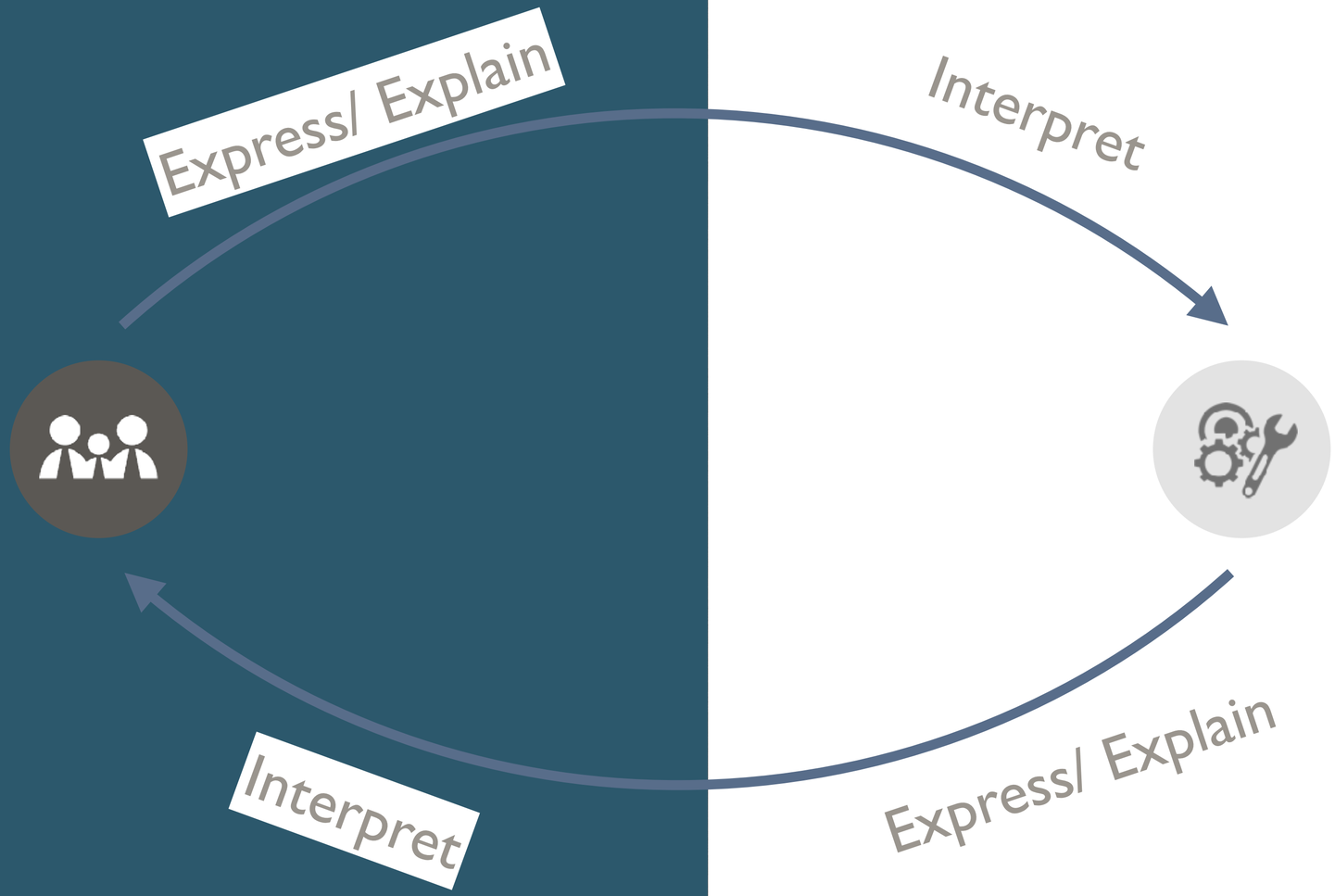

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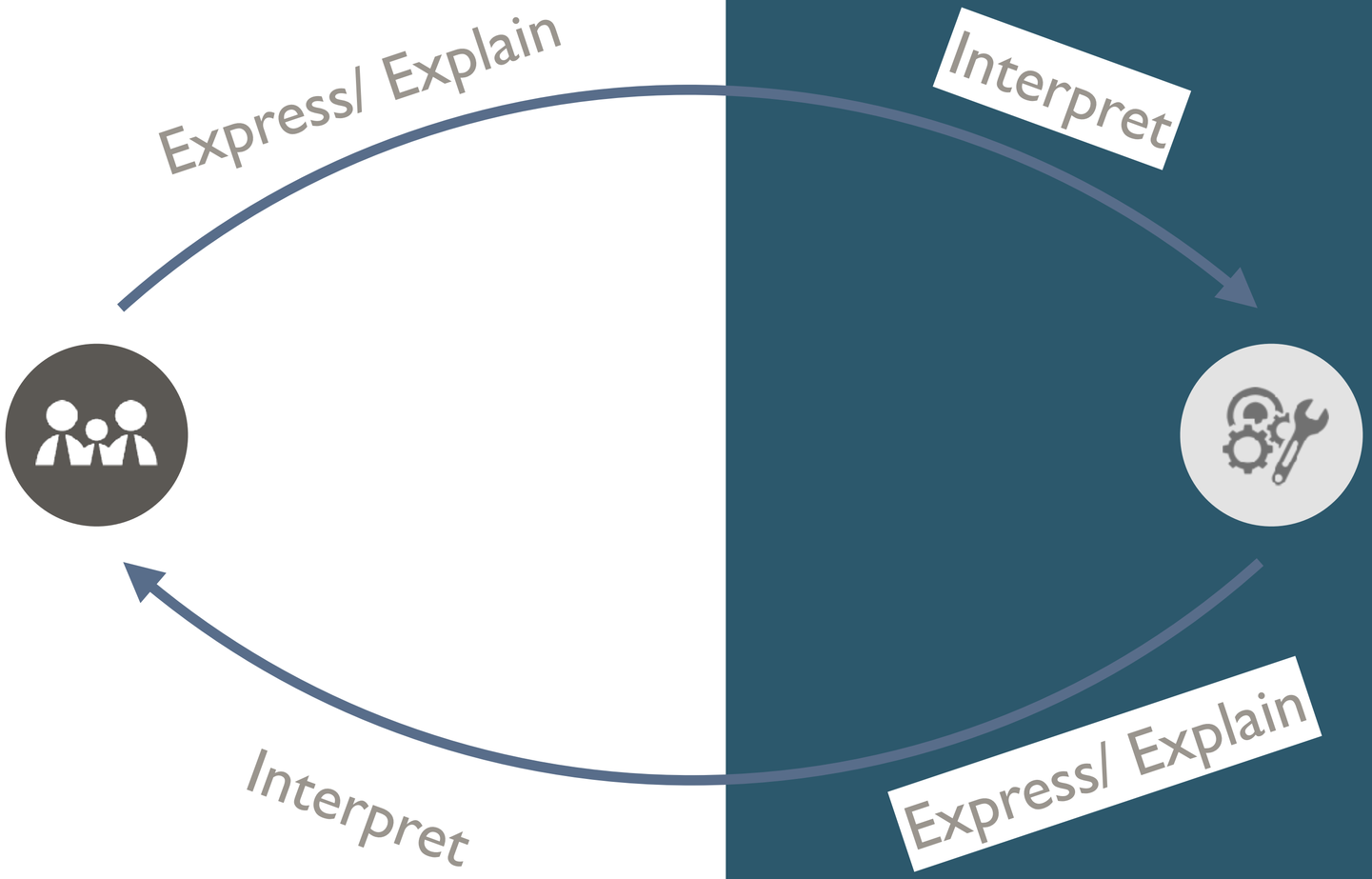


EXERCISE

OBJECTS OF INTEREST COMMUNICATION ___

Discuss:

- How are your objects of interest communicated?
- What medium do users use when interacting with the AI versus not?
- How do they optimize their communication? E.g. References, Associations?
- What feedback clues do they need or lack?

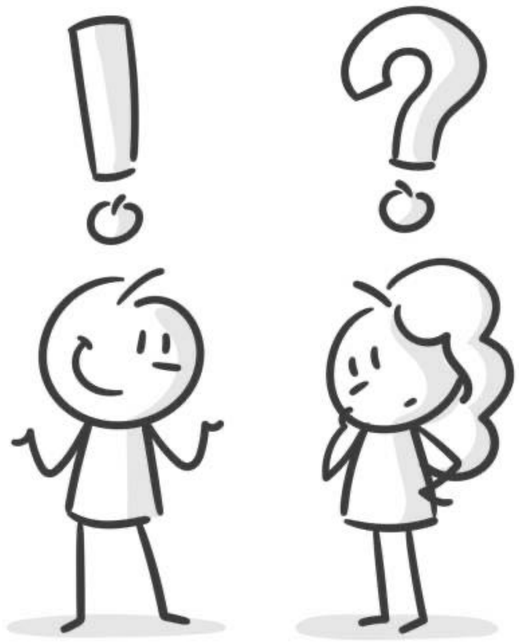
UNDERSTANDING HUMANS

Mental Models

Grounding

Theory of Mind

UNDERSTANDING THEORY OF MIND



Theory of Mind

Theory of Mind refers to the ability to attribute mental states to oneself and others, understanding that others have beliefs, desires, intentions, and perspectives that are different from one’s own.

It is crucial for successful collaboration!

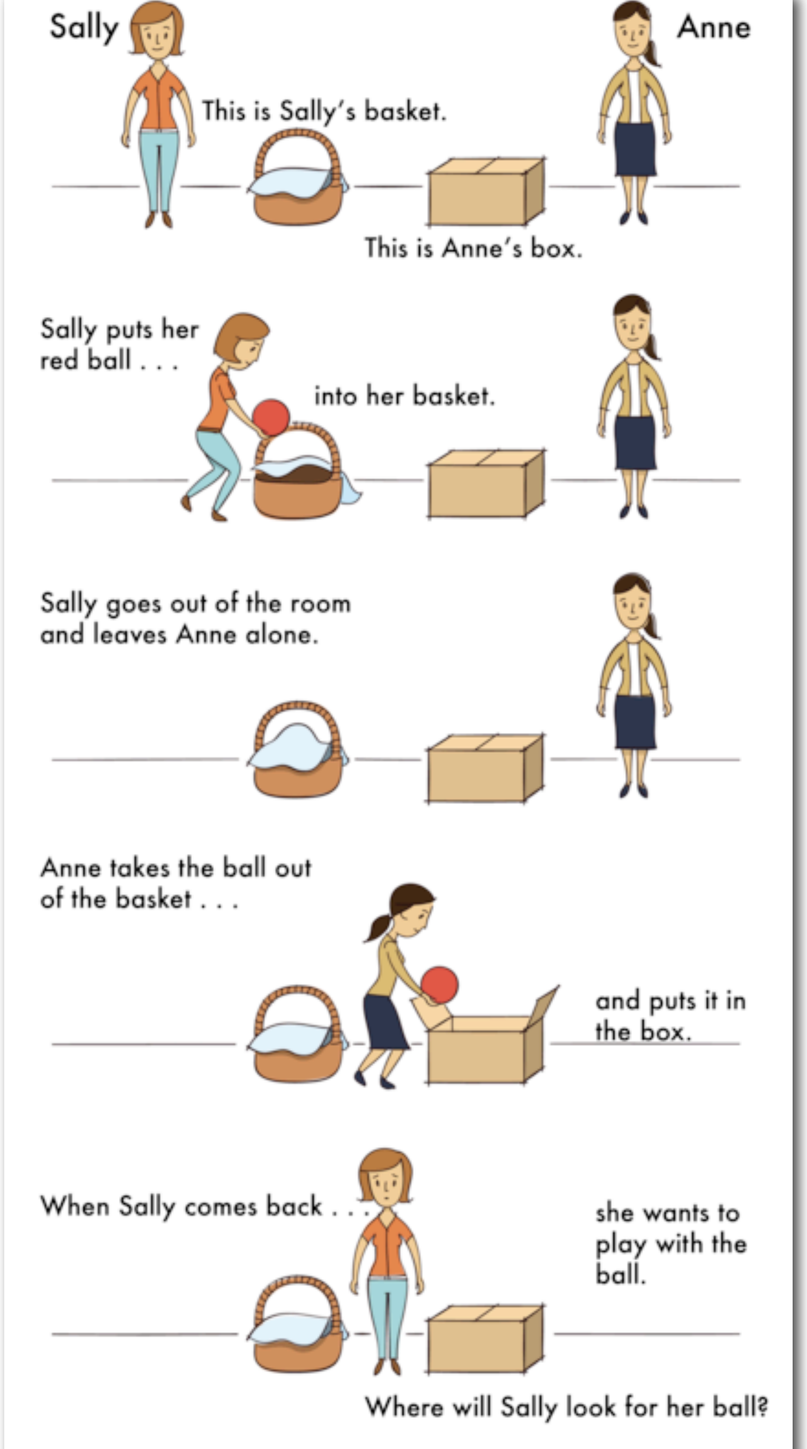
Engel et al. (2014): Reading the mind in the eyes or reading between the lines? PloS one

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

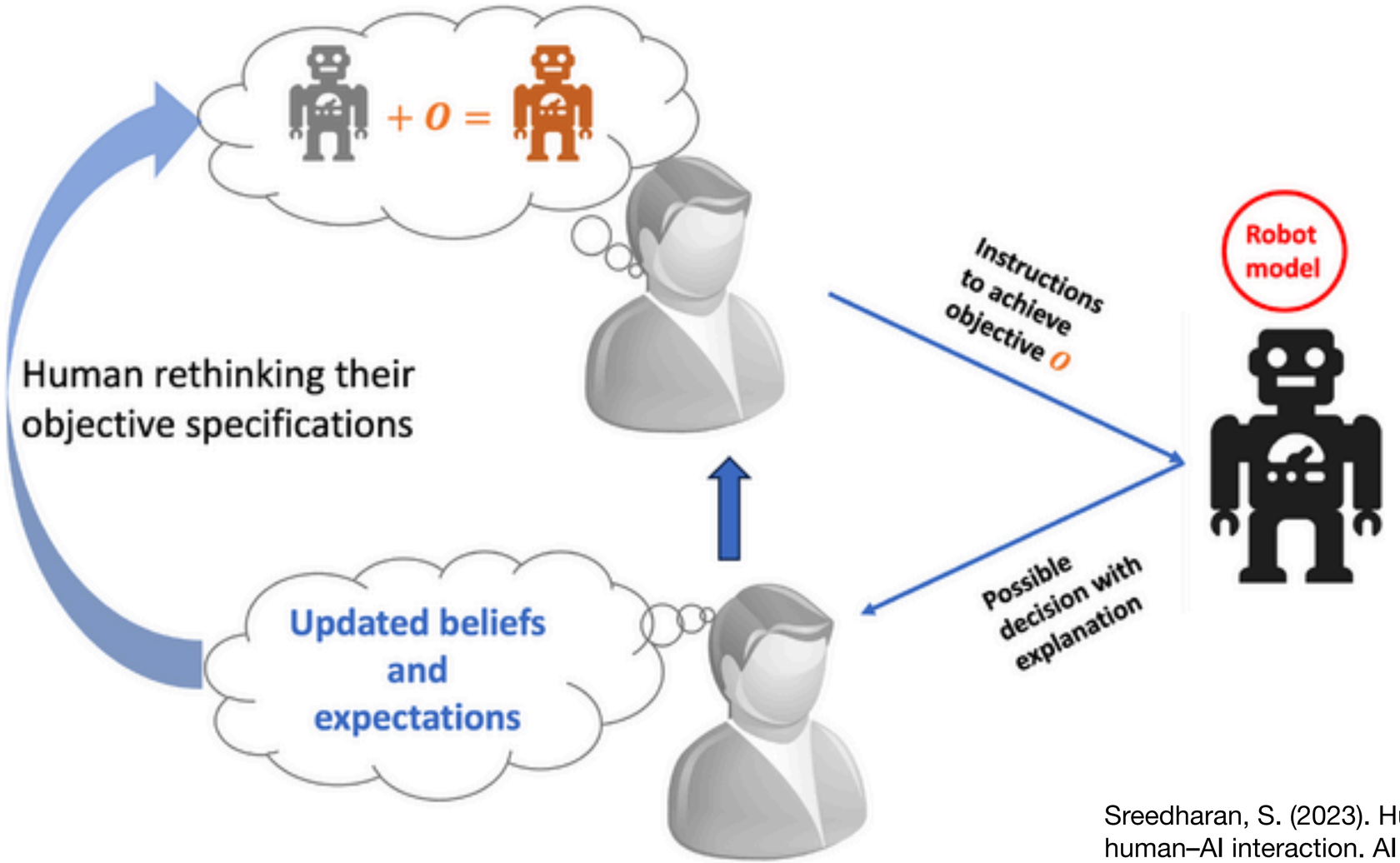
UNDERSTANDING THEORY OF MIND ___

SALLY-ANNE TEST

- Several studies indicate that children around four or five years of age are able to pass this false-belief task (Baron-Cohen et al., 1985; Gopnik & Astington, 1988; Nelson et al., 2008; Sung & Hsu, 2014)



UNDERSTANDING
THEORY OF MIND ___



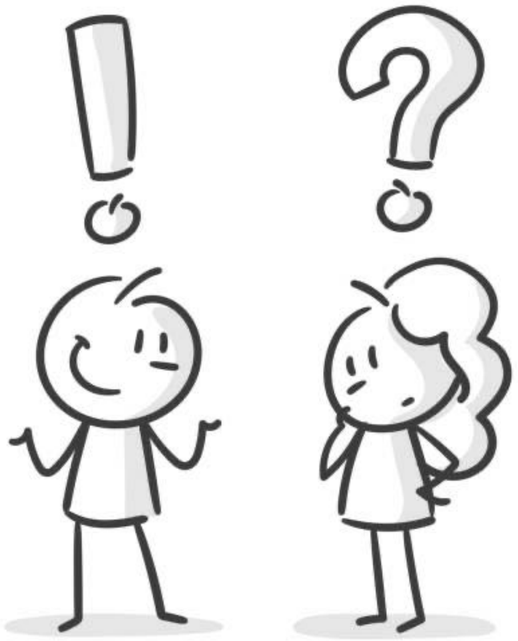
- Feedback
- Explanations

Sreedharan, S. (2023). Human-aware AI—A foundational framework for human–AI interaction. AI Magazine, 44(4), 460-466.

THEORY OF MIND

Main aspects

1. Interpreting one’s own mental states
2. Interpreting others’ mental states
3. Predicting subsequent behavior.



Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

COLLABORATION

HUMAN-AI INTERACTION

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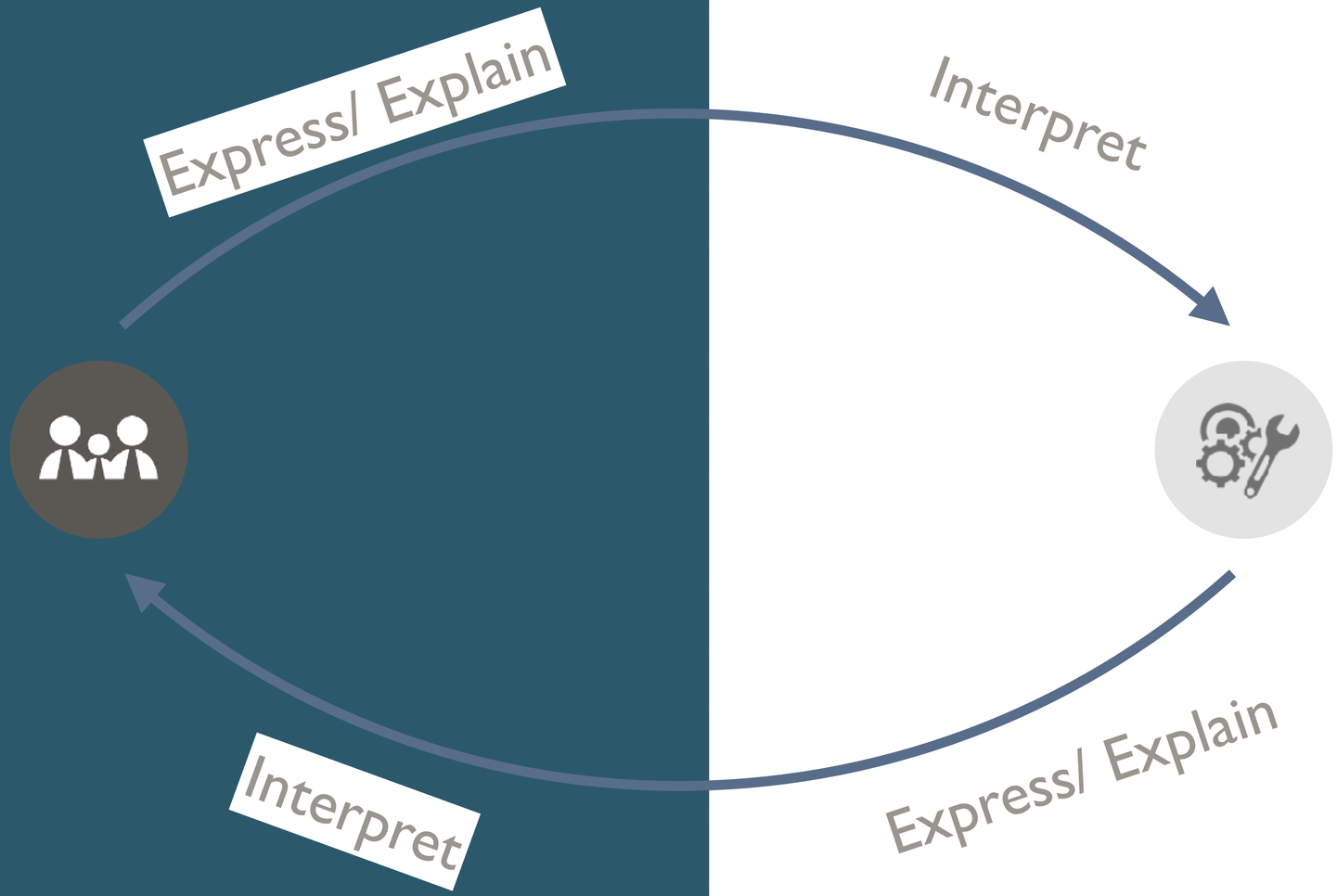

COLLABORATION

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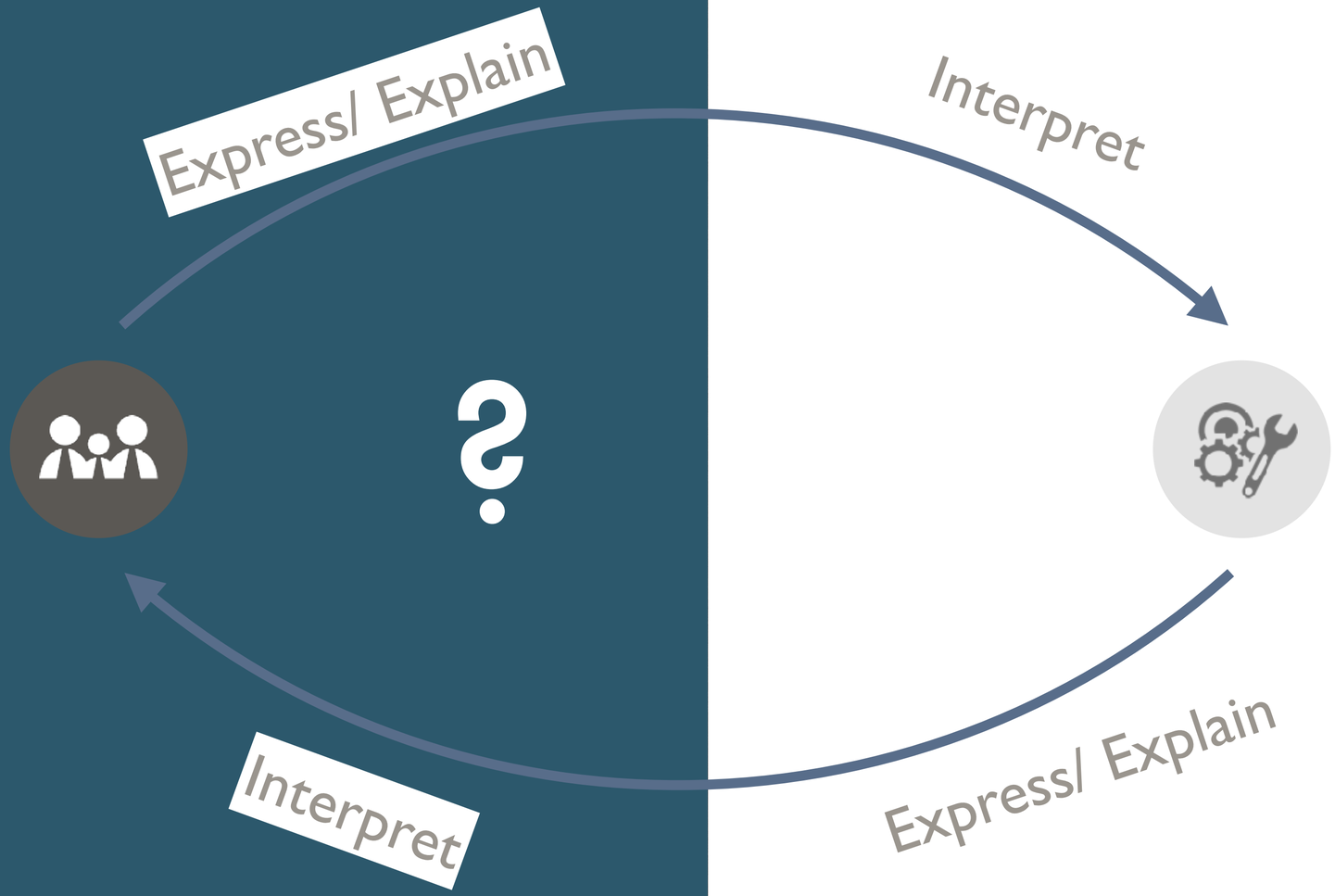

COLLABORATION

HUMAN-AI INTERACTION

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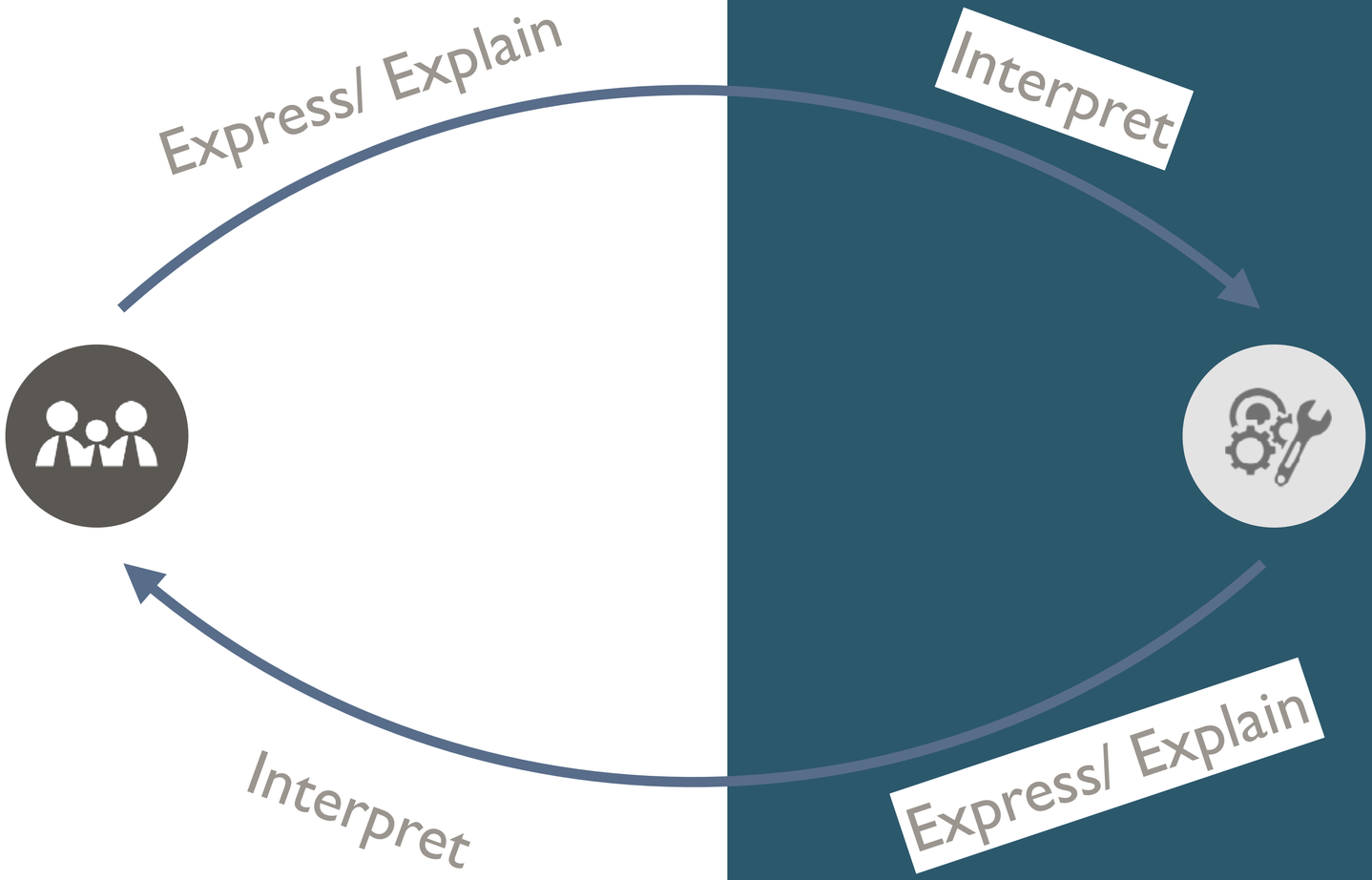


THEORY OF MIND

Main aspects

1. Interpreting one’s own mental states
2. Interpreting others’ mental states, and
3. Predicting subsequent behavior.

1. Allows a system with every interaction to updates this understanding, to extend its knowledge..
2. AI attempts to identify the users strategy through co-adaptation and history
3. Infers the next suitable behavior/ choices — Constantly learning and communicating the rationale for the suggestion

Koch and Oulasvirta (2018); Group Cognition and Collaborative AI. Springer Book

EXERCISE

UNDERSTANDING THE USER

Discuss:

- How can you break down the user needs to help the system understand?
- What information can you extract from your object of interest, and what additional aspects do you need?
- What response/ feedback does the user expect? Can you think about other information that would be interesting to the user?

DESIGN PROJECT_

COURSE PROJECT

User-centered Design

- Good interaction design requires taking the user's perspective
  - Who is the user?
  - What do they want to do?
  - What is the current context?

- You cannot "design the user experience"
- But….you can control some of the user's experience

EXERCISE

THINK ABOUT INTERACTION

For every object of interest:

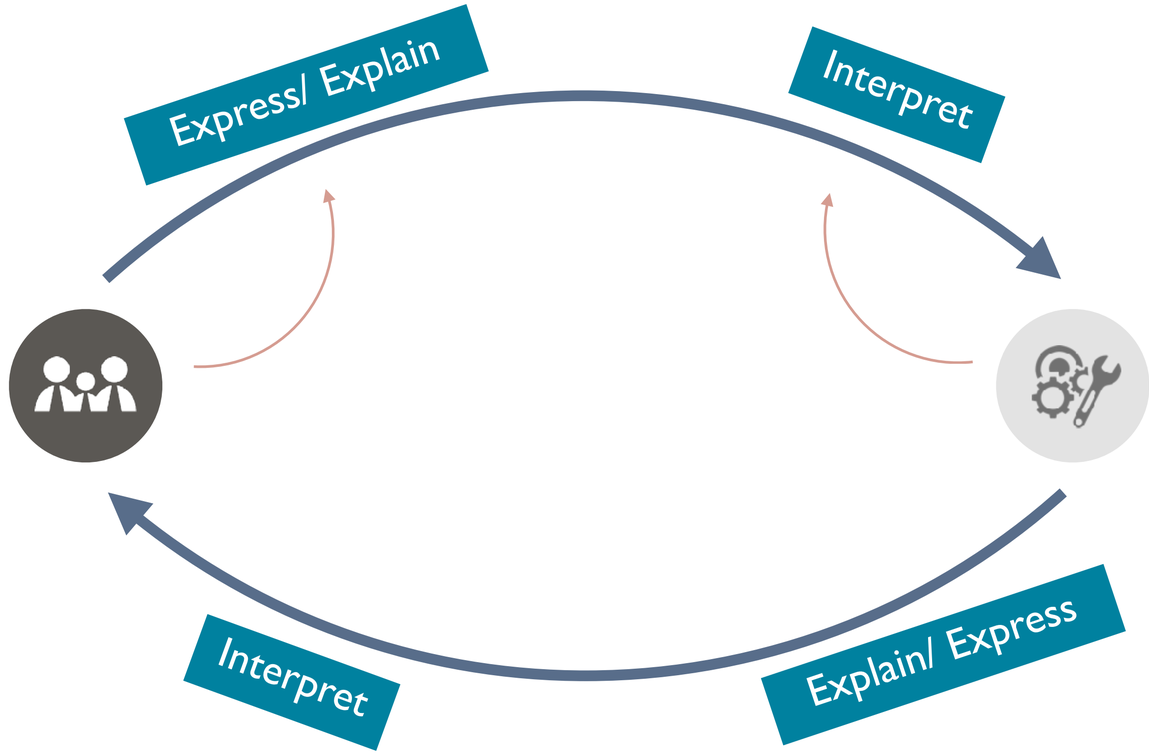
- Act out an interaction between two users:
  - One describes the use of your object of interest (based on your interviews) in your use case and asks for help, insights,…
  - One aims to help: asks questions/ feedback
- Two remaining team members: write notes about the interaction (one for the user/ one for the helper)
- Switch roles

EXERCISE

THINK ABOUT INTERACTION

Based on your notes outline:

- Means of expression by the user
  - Gestures, sketches, description, text, use of objects
- Means of feedback by the second user
  - What would a system need to know?
  - What systems could provide?



EXERCISE

GENERATE IDEAS

You choose:

- Solo + Team
- Sketch or describe or act
- Video or manual

Don’t discuss — just do it! :)

EXERCISE + HOMEWORK

INITIAL DESIGN CONCEPTS ___

Discuss (and agree):

- Choose one object of interests
- Note down the precise, specific interaction problem
- Summarise ideas in a design concept
- Describe
  - functions the user applies to the object
  - How a system could understand them
  - What are current limitations of AI systems in this regard?

ADVANCED DESIGN OF INTERACTIVE SYSTEMS

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