UNIVERSITY
OF TRENTO - Italy

Know
dive

World representation and reasoning
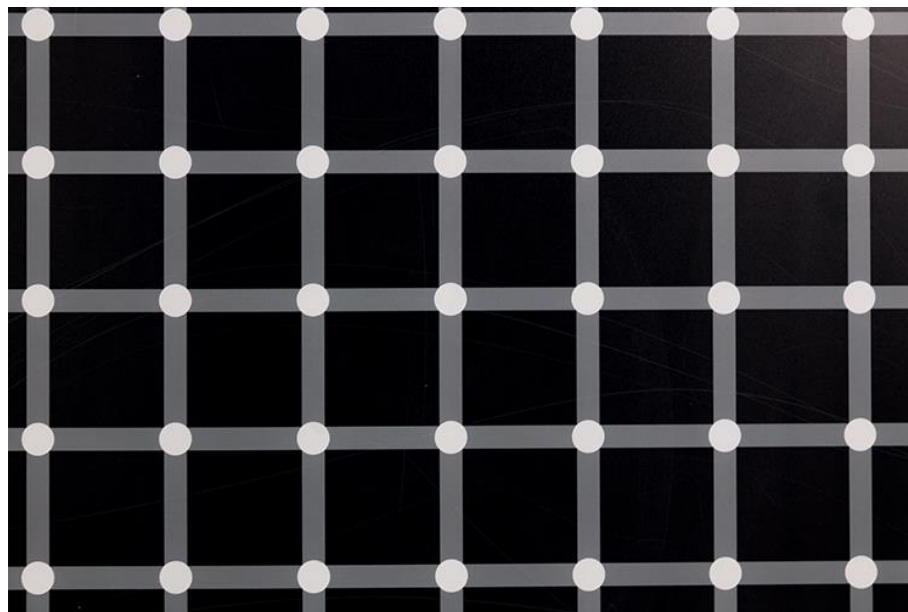# (HP2T)

The World and the Mind

Most (all?) of us think that the world is how we see (perceive) it.

That is, we confuse the world with our mental representation of the world itself.

Is this a correct assumption?

Perception - Optical illusions

The **Herman Grid** is an optical illusion in which a grid of white dots on a black background appears to create dark spots at the points of intersection.

This example demonstrates how our visual perception (and so our senses) can deviate from *objective* (?) reality.

Perception - Optical illusions

Pareidolia is the tendency for perception to impose a meaningful interpretation on a nebulous stimulus, usually visual, so that one sees an object, pattern, or meaning where there is none.

For example, we tend to see faces everywhere, even in the surface of the Moon.

Perception - Optical illusions

Viewers can see either a young woman looking away or an old woman in profile, depending on how they interpret the drawing's lines.

This illusion plays on our **ability to switch between different perspectives**.

Perception – Optical illusions

Viewers can either see a vase in the center or two faces in profile facing each other.

This illusion plays on our **ability to switch between a figure-focused and**

a ground-focused perspective.
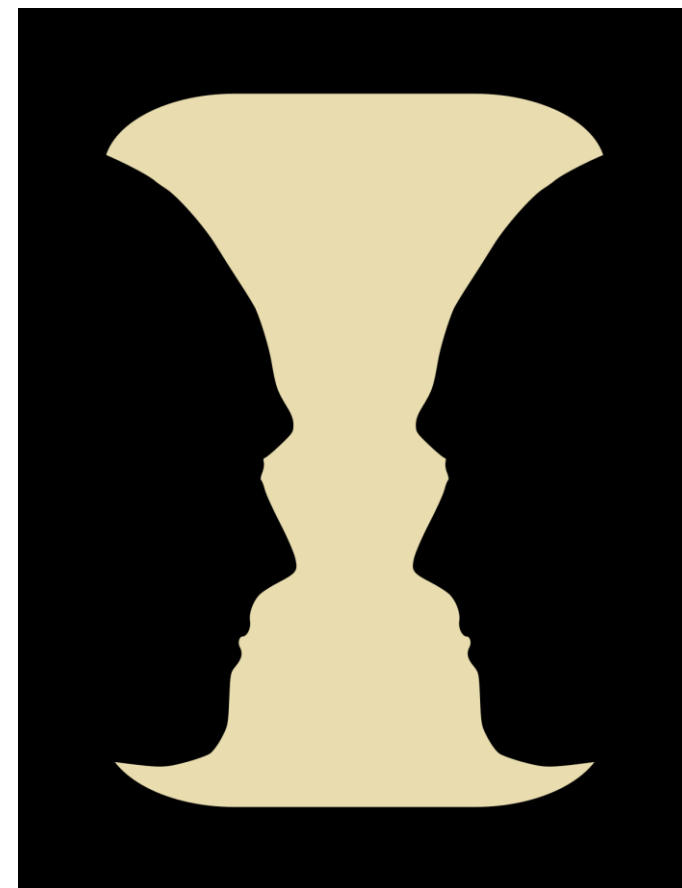
Conceptualization – the ??? accident (ex.)

In two experiments, subjects viewed films of accidents and then answered questions about events occurring in the films.

The question

"About how fast were they going when they <u>smashed</u> into each other?"

elicited higher estimates of speed than questions which used the verbs **collided**, **bumped**, or **hit** in place of **smashed**.

Conceptualization – the car accident (ex. cont.)

On a retest one week later, those subjects who received the verb *smashed* were more likely to say "**yes**" to the question

"Did you see any broken glass?"

… even though broken glass was not present in the film.

Questions asked subsequent to an event often cause a reconstruction in one's memory of that event (*false memories*).

Elizabeth F Loftus and John C Palmer. Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of verbal learning and verbal behavior*, 13(5):585–589, 1974.

Representation – the Asian disease problem (ex.)

People were asked to imagine that

"… the U.S. is preparing for the outbreak
of an unusual Asian disease,
which is expected to kill 600 people."

Two alternative programs to combat the disease were proposed.

Representation – the Asian disease problem (ex. Cont.)

The first group of participants was presented with the following choice. In a group of 600 people,

- ***Program A***: "200 people will be saved";

- ***Program B***: "there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved"

72% of the participants preferred program A, 28%, opted for program B.

<u>Representation</u> – the Asian disease problem (ex. Cont.)

The second group of participants was presented with a different choice. In a group of 600 people,

- ***Program C***: "400 people will die";

- ***Program D***: "there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die"

In this decision frame, 78% preferred program D, with the remaining 2% opting for program C.

Representation – the Asian disease problem (ex. Cont.)

- Programs A and C are *identical,* as are programs B and D.

- The change in the decision frame between the two groups of participants produced a preference reversal.

- When the programs were presented in terms of lives saved, the participants preferred the secure program, A (= C).

- When the programs were presented in terms of expected deaths, participants chose the gamble D (= B).

Daniel Kahneman and Amos Tversky. The psychology of preferences. *Scientific American*, 246(1):160–173, 1982.

Reasoning - Mind Fallacies

A **fallacy** is reasoning that is logically invalid, or that undermines the logical validity of an argument

Fallacies can be classified depending on their **structure** (formal fallacies) or on their **content** (informal fallacies).

A **formal fallacy**, also called a deductive fallacy or logical fallacy, represents a type of reasoning that loses validity due to a flaw in its logical structure. In other words, it is a deductive argument that is invalid.

Informal fallacies, the larger group, may then be subdivided into categories such as improper presumption, faulty generalization, and error in assigning causation and relevance, among others.

Reasoning - Mind Fallacies (example)

Example 1.10 (Cognitive Bias) Cognitive biases are informal fallacies. They represent systematic patterns of deviation from the norm and rationality in the evaluation process. The *Asian disease example* is an instance of cognitive bias.

Example 1.11 (Misconceptions) Misconceptions are informal fallacies. A common misconception is a perspective or data that is often considered to be true but is actually false. Usually, such misunderstandings stem from entrenched traditions (such as gossipy tales), stereotypes, superstitions, fallacies, misinterpretations of science, or the spread of pseudoscience.

Example 1.13 (Paradoxes) Paradoxes are examples of formal fallacies. Paradoxes are situations or statements that seem contradictory or counterintuitive, often challenging our normal thinking and expectations.

Example (Logical misunderstanding): The meaning of *"All men are mortal"*

Reasoning - Mind Fallacies (example)

Example 1.12 (Cognitive Distortion) Cognitive distortions are informal fallacies.

- *overgeneralization,* which draws overly broad conclusions from a single negative event;
- *mental filtering,* which focuses attention only on the negative aspects of a situation;
- *over-labeling,* which assigns negative labels to oneself or others based on mistakes or failures;
- *dichotomous thinking,* which considers only extremes without acknowledging nuance;
- *emotional reasoning* makes one believe that one's feelings reflect objective reality;
- *personalization* leads one to interpret events as being directly related to oneself;
- *Negative prediction* involves predicting the worst without concrete evidence;
- *Catastrophism* makes one imagine the worst as the only possibility, ignoring alternatives,
- *Sample selection* draws general conclusions from a limited set of data or experiences.

Four types of mental activities

- *Perception.* From *reality* (the source of what we perceive) to *percepts* (e.g. *the **images** of a smiling face, the face of an old/young woman*) and *facts* (e.g. *the "**complex" images** of a smiling face in a plug, an old woman looking down and left*) that is, our *mental representations* of reality.

- *Conceptualization.* From percepts to *words*, that is, an **alphabet**, expressing *concepts,* that is, the percepts *named by* words (e.g.,the words: *collided*, *bumped*, *hit*, *smashed*).

- *Representation.* From words to *properties*, *entities, entity types* (*etypes* from now on) … and more … describing facts, that is, *knowledge*, expressed using **sentences** of a *language* constructed, via **formation rules**, using words, (e.g., the sentences: *the plug looks like a smiling face, people living* vs. *people dying*).

- *Reasoning*: From *existing* knowledge to *new* knowledge (e.g., reasoning: *if people get saved it is better to use a safer program, if people die it is better to use a more risky program.*)

These activities co-occur in any complex mental activity

Four types of mental mistakes

- *Perception* **mistakes:** see what is not there and vice versa (e.g. *a face in the moon, the face of an old/young woman*).

- *Conceptualization* **mistakes:** same world, with different words for same percept (e.g., *collided, bumped, hit, smashed*) or same words for two percepts (e.g., *which car*? an *automobile* or a *train car*?).

- *Representation* **mistakes:** partial, biased, wrong memories (*people living* vs. *people dying*).

- *Reasoning* **mistakes:** wishful thinking, derivation of wrong conclusions (e.g., all *fallacies*).

These mistakes co-occur in any complex mental activity

Mistakes or different mental contructions?

- *Perception mistakes or different percepts?*

- *Conceptualization mistakes or different conceptualizations/ concepts?*

- *Representation mistakes or different mental representations?*

- *Reasoning mistakes or different reasoning processes?*

Logic

- *Logic* gives us with a structured framework for *modeling* the world, and our way of thinking, that is *reasoning*, about it.

- *Logic* is crucial for the (minimization of the impact of) *modeling* differences in *perception, conceptualization, representation*.

- *Logic* is crucial for *automation of reasoning*

- *Logic* is a key enabler in Computer Science and Artificial Intelligence!

- *We* will formalize all four mental activities into appropriate world modeling logics, *we* will show how to compose them, *we* will use them for the automation of reasoning in machines.

Key Notions

- World vs. mind.

- Perception, percepts, facts.

- Conceptualization, words expressing concepts, words naming percepts.

- Knowledge, entities, entity types, properties, sentences in a language, formed by composing word via formation rules.

- Reasoning, from knowledge to more knowledge.

- Mistakes vs. different mental constructions.

- Logic

World representation and reasoning
(HP2T)