Human-Robot Interaction

Module 1: The Nature of HRI

Lecture 1: Overview of Human-Robot Interaction

David Vernon
Carnegie Mellon University Africa

www.vernon.eu

Motivation

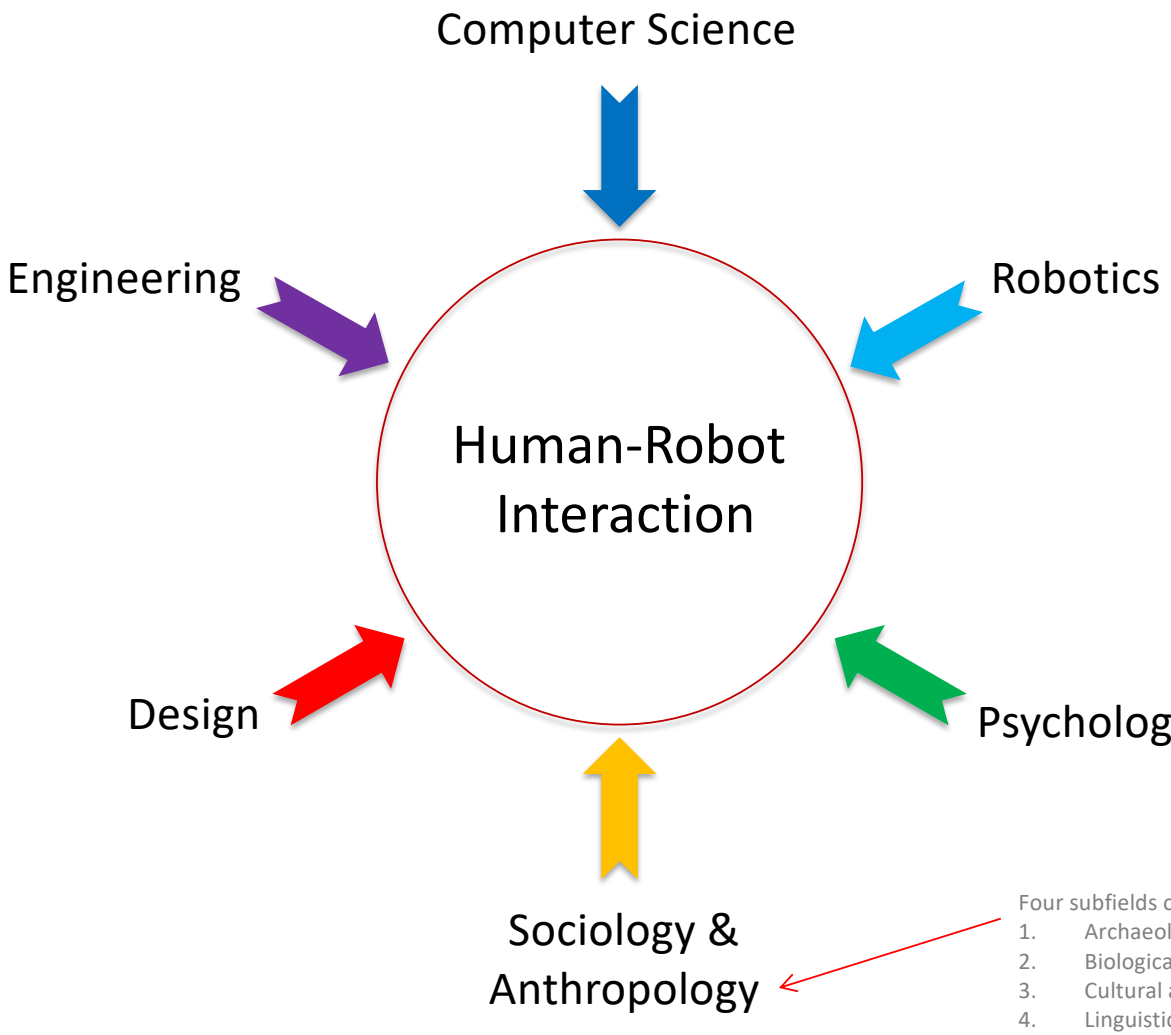
"If you have an engineering background, do you think you can build a robot that interacts with people, working only with other engineers?

We, unfortunately, predict that you will not be able to do so."

- "To design robots that people want to interact with,
  you need a good understanding of human social interaction

- To reach such understanding,
  you need insight from people trained in the social sciences and humanities."

(Bartneck et al. 2020)



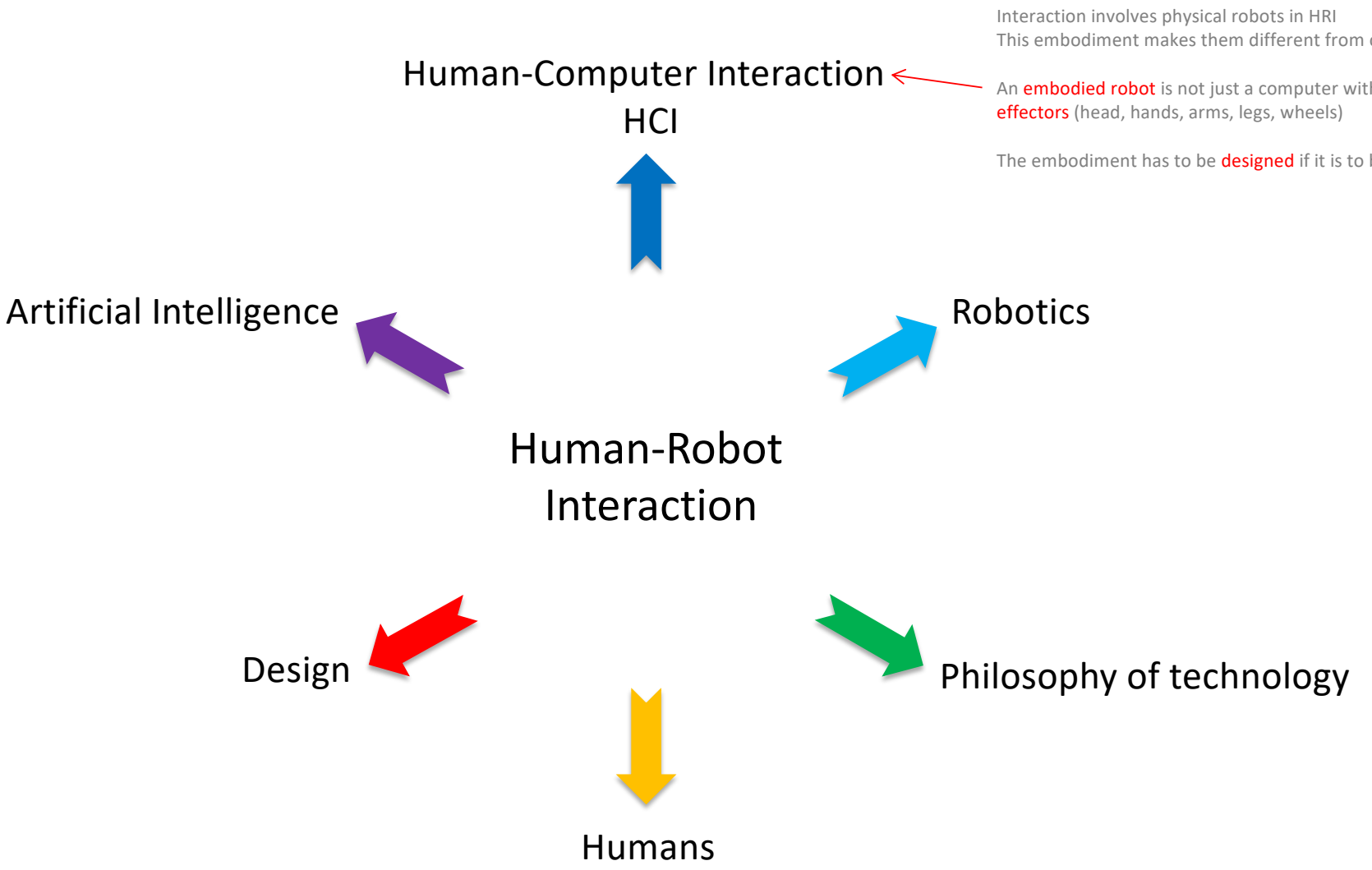
Four subfields of anthropology
1. Archaeology
2. Biological anthropology
3. Cultural anthropology
4. Linguistic anthropology

Robotics vs. HRI

Robotics is concerned with the ways in which robots navigate and manipulate the physical world

HRI is concerned with the ways in which robots interact with people in the social world

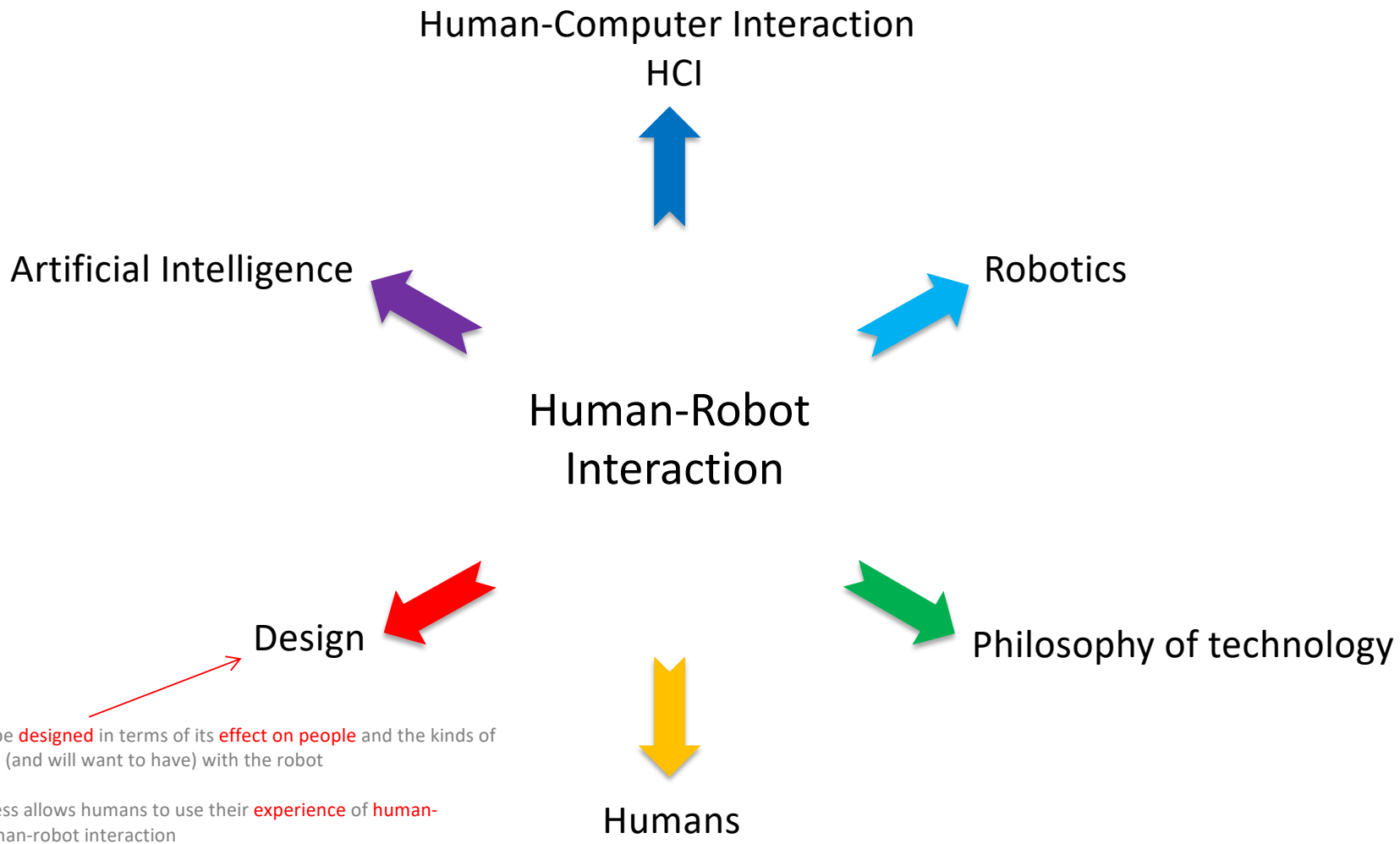
The robot must know and obey social rules and norms



Interaction involves physical robots in HRI
This embodiment makes them different from other technologies

An embodied robot is not just a computer with actuators and effectors (head, hands, arms, legs, wheels)

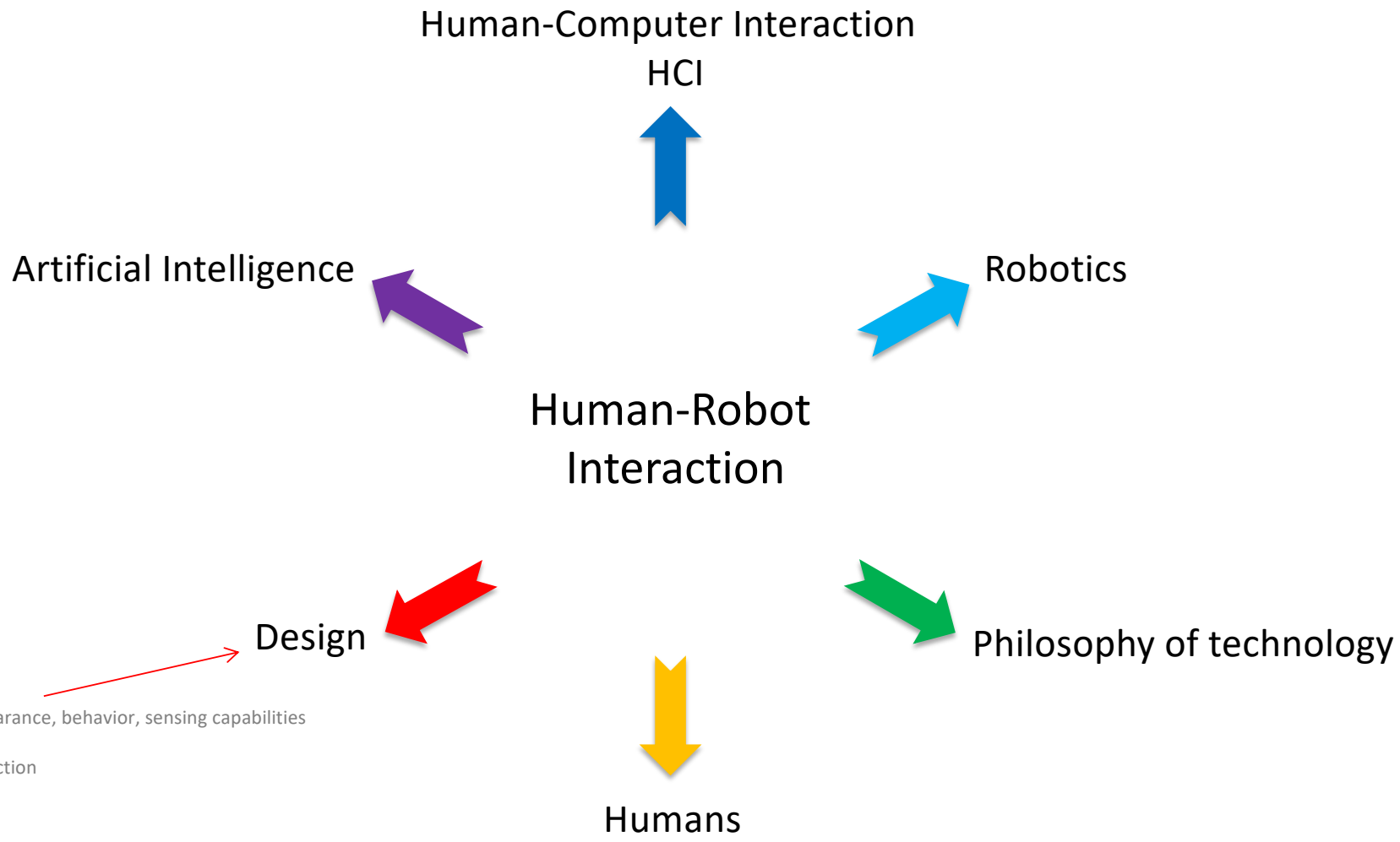
The embodiment has to be designed if it is to be effective.



The embodiment has to be designed in terms of its effect on people and the kinds of interaction they can have (and will want to have) with the robot

The robot's human-likeness allows humans to use their experience of human-human interaction in human-robot interaction

This can lead to frustration if the robot does not live up to the user's expectations



Design challenges: robot appearance, behavior, sensing capabilities

These inspire and guide interaction

Humanoid Robots

Humanoids

Consumer

Entertainment

Pepper

Pepper is a friendly humanoid designed to be a companion in the home and help customers at retail stores. It talks, gesticulates, and seems determined to make everyone smile.

CREATOR
SoftBank Robotics
(originally created by Aldebaran Robotics, acquired by SoftBank in 2015)

COUNTRY
Japan

YEAR
2014

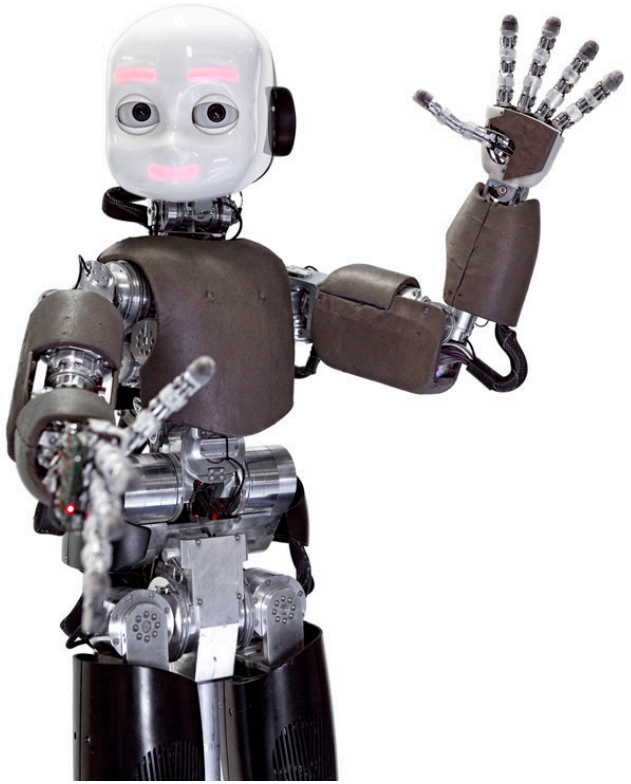
TYPE
Humanoids, Consumer, Entertainment

Source: https://robots.ieee.org/robots/pepper/

Humanoid Robots

Humanoids

Research



iCub

iCub is a child-size humanoid robot capable of crawling, grasping objects, and interacting with people. It's designed as an open source platform for research in robotics, AI, and cognitive science.

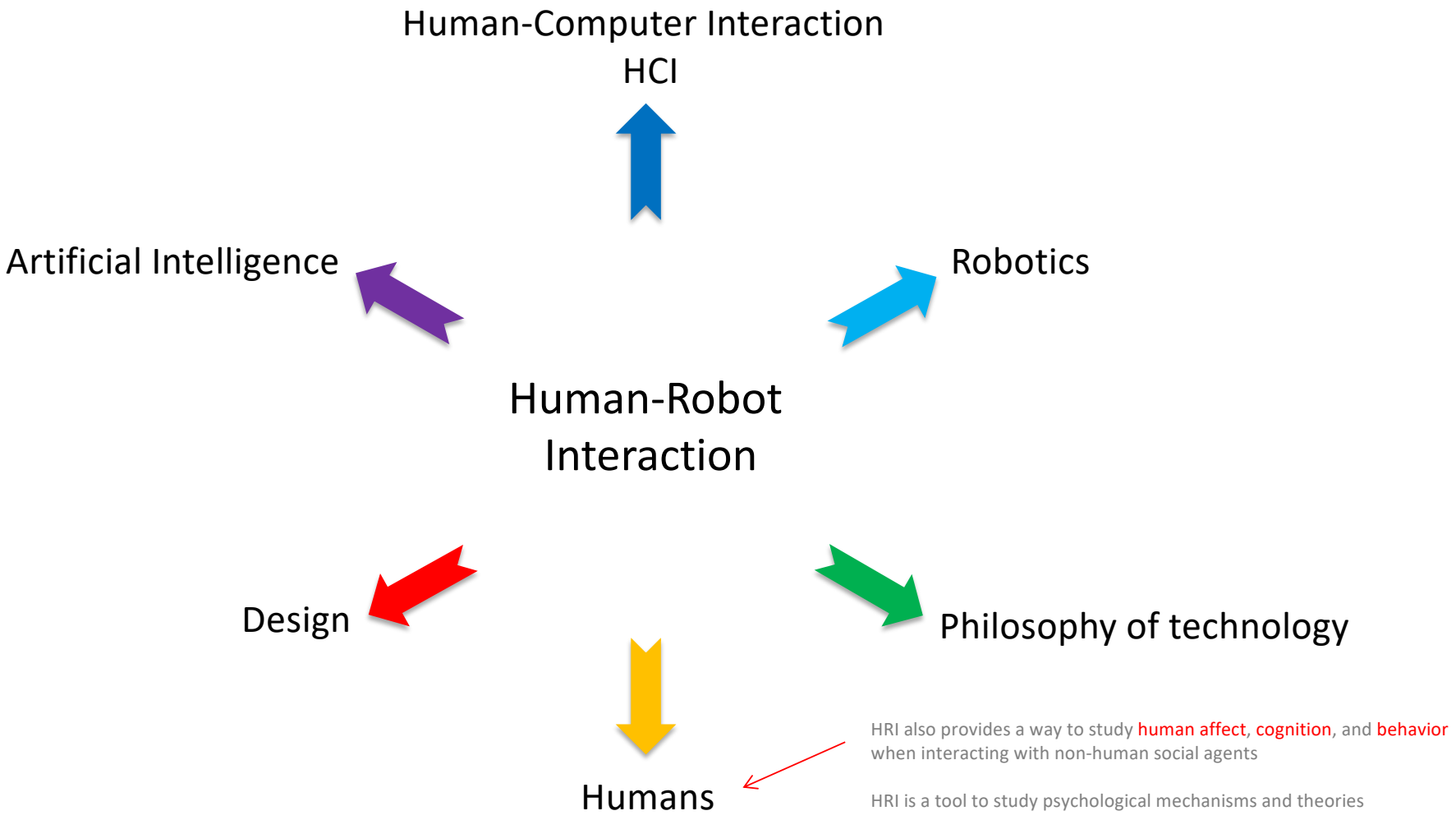
CREATOR
RoboCub Consortium and IIT

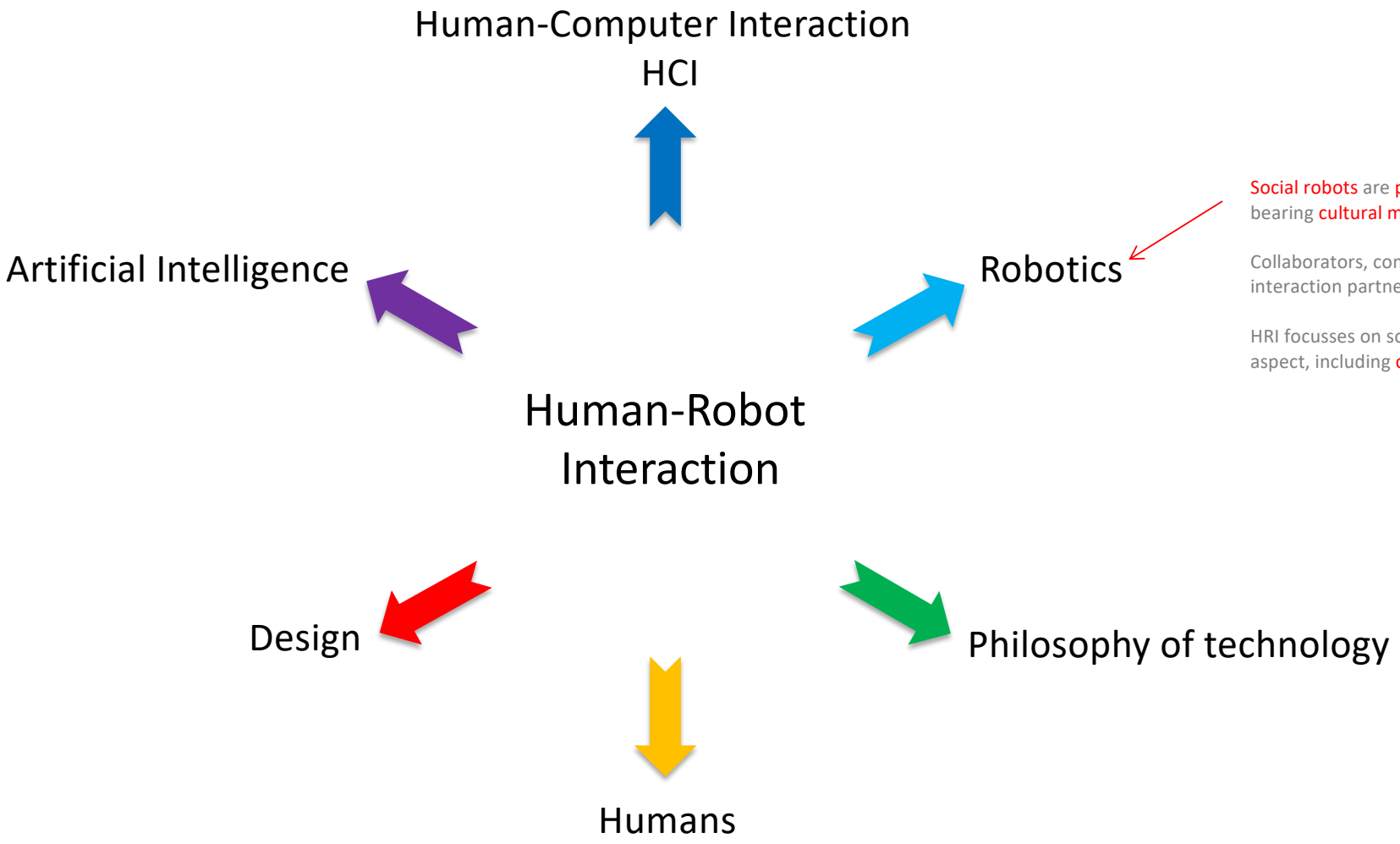
COUNTRY
Italy

YEAR
2004

TYPE
Humanoids, Research

Source: https://robots.ieee.org/robots/icub/


Human-Computer Interaction
HCI
Artificial Intelligence
Robotics
Human-Robot Interaction
Design
Philosophy of technology
Humans
HRI also provides a way to study human affect, cognition, and behavior when interacting with non-human social agents
HRI is a tool to study psychological mechanisms and theories



Social robots are perceived as social actors bearing cultural meaning

Collaborators, companions, guides, tutors, social interaction partners of all types ...

HRI focusses on societal and organizational aspect, including cultural sense-making

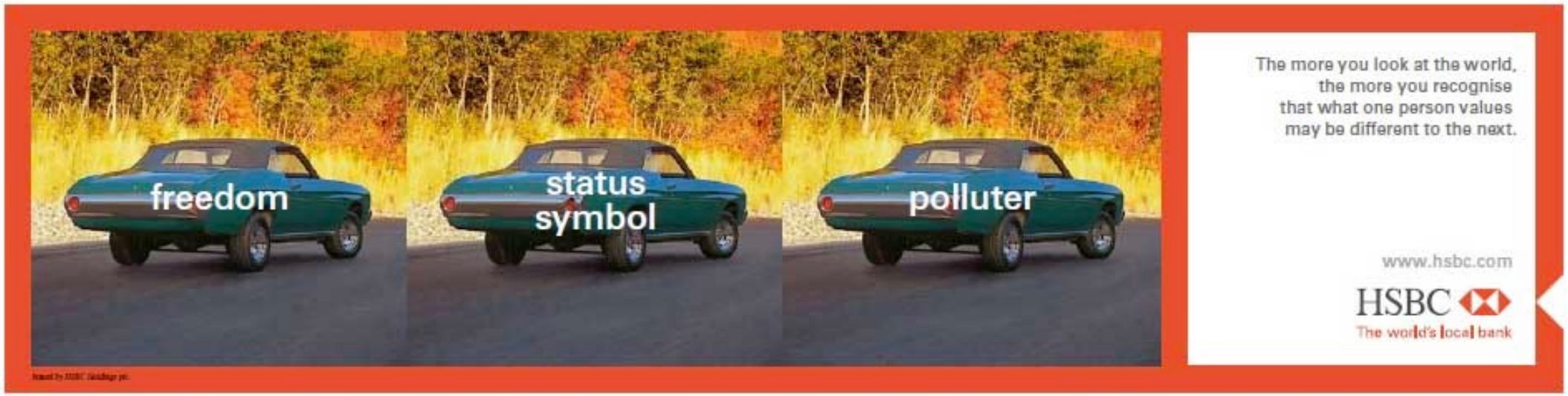
Aside: Cultural Norms

Different cultures perceive different meaning in same thing

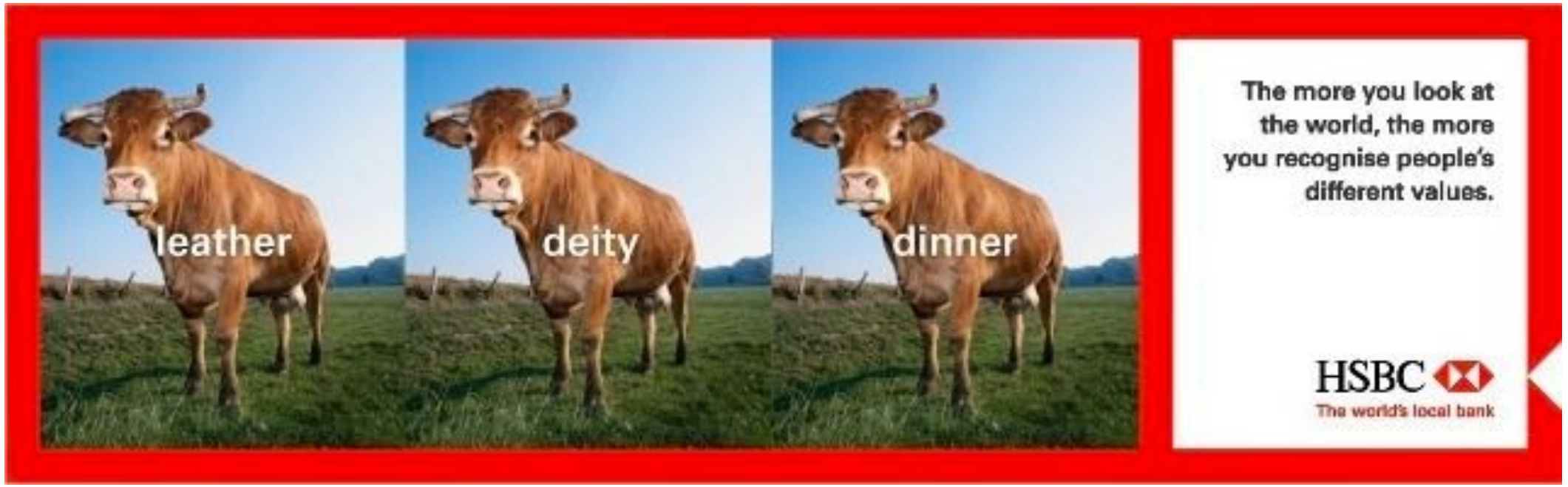
The following are a series of advertisements from HSBC that make the point

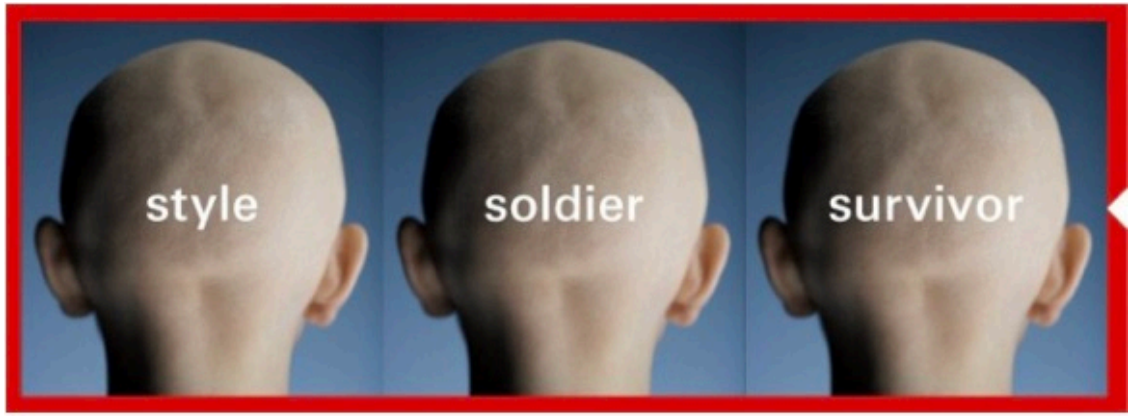
ecology
equality
independence
The more you look at the world,
the more you recognise
people's different values.
www.hsbc.com
HSBC
The world's local bank
Issued by HSBC Holdings plc.

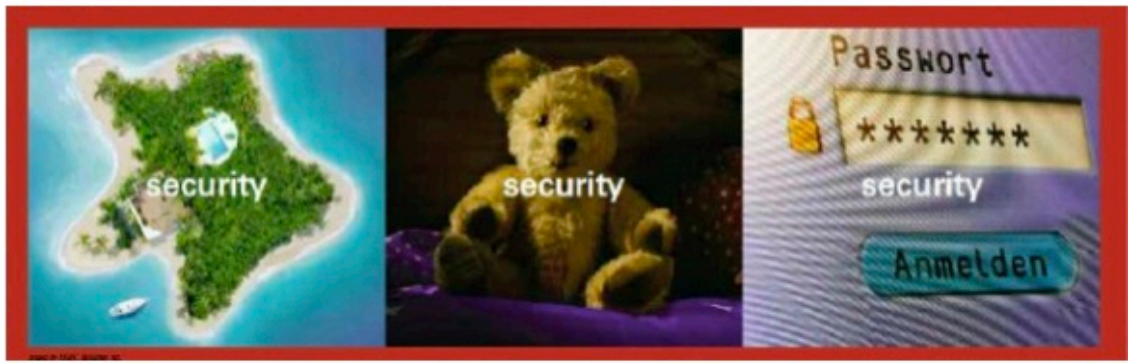
drought
d.i.y.
torture
The more you look at the world
the more you recognise how
people value things differently.
HSBC
The world's local bank


freedom
status symbol
polluter
The more you look at the world, the more you recognise that what one person values may be different to the next.
www.hsbc.com
HSBC
The world's local bank

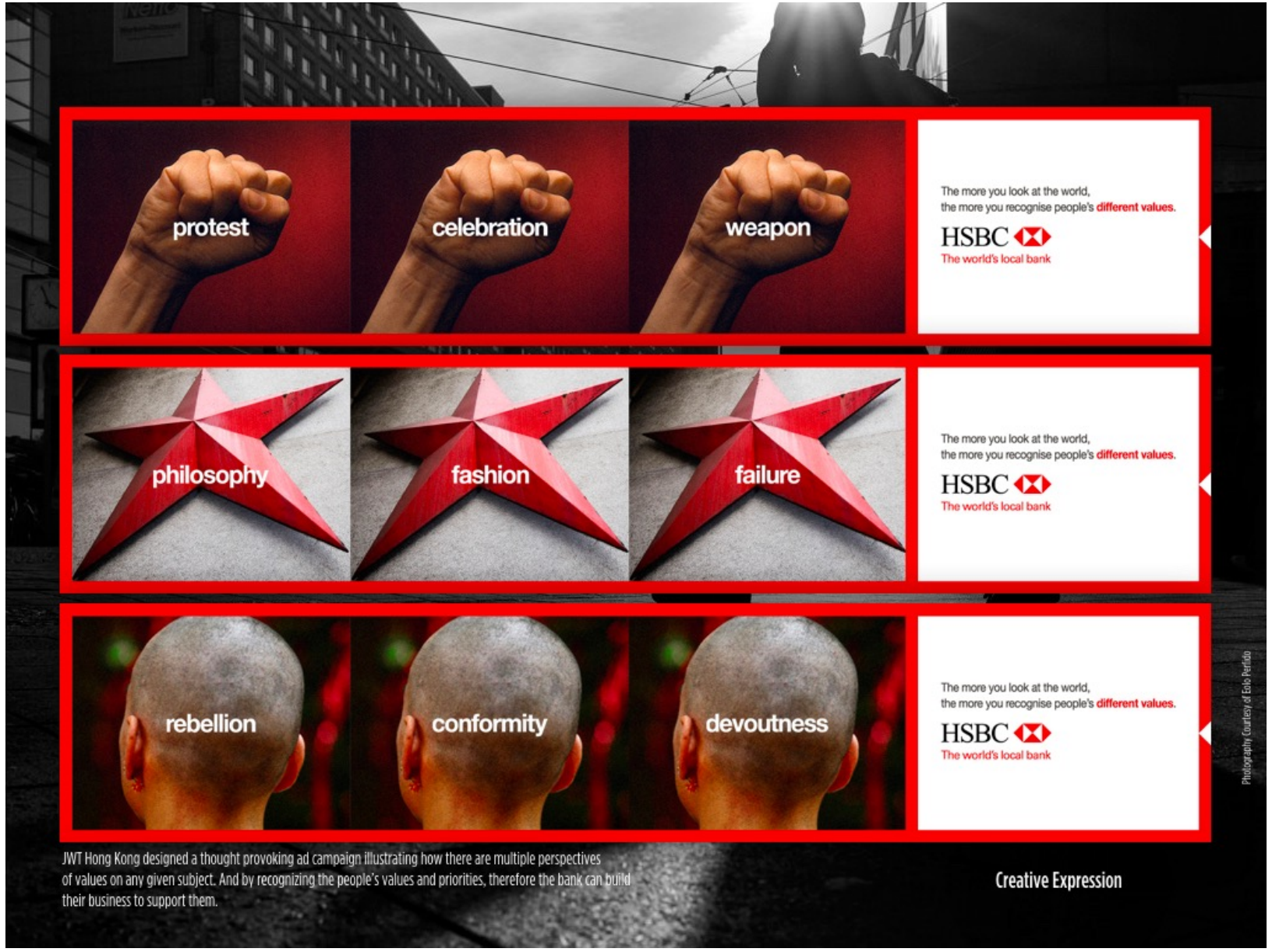
decor
souvenir
place
of prayer
The more you look at the world,
the more you recognise how
people value things differently.
www.hsbc.com
HSBC
The world's local bank


leather
deity
dinner
The more you look at the world, the more you recognise people's different values.
HSBC
The world's local bank


style
soldier
survivor


security
security
Passwort
****
security
Anmelden

fate
fear
fairy tale


protest
celebration
weapon
The more you look at the world,
the more you recognise people's different values.
HSBC
The world's local bank
philosophy
fashion
failure
The more you look at the world,
the more you recognise people's different values.
HSBC
The world's local bank
rebellion
conformity
devoutness
The more you look at the world,
the more you recognise people's different values.
HSBC
The world's local bank
Photography Courtesy of Eslo Perido
JWT Hong Kong designed a thought provoking ad campaign illustrating how there are multiple perspectives of values on any given subject. And by recognizing the people's values and priorities, therefore the bank can build their business to support them.
Creative Expression

leader
follower
follower
leader

We see no problem in different points of view.
Only potential.

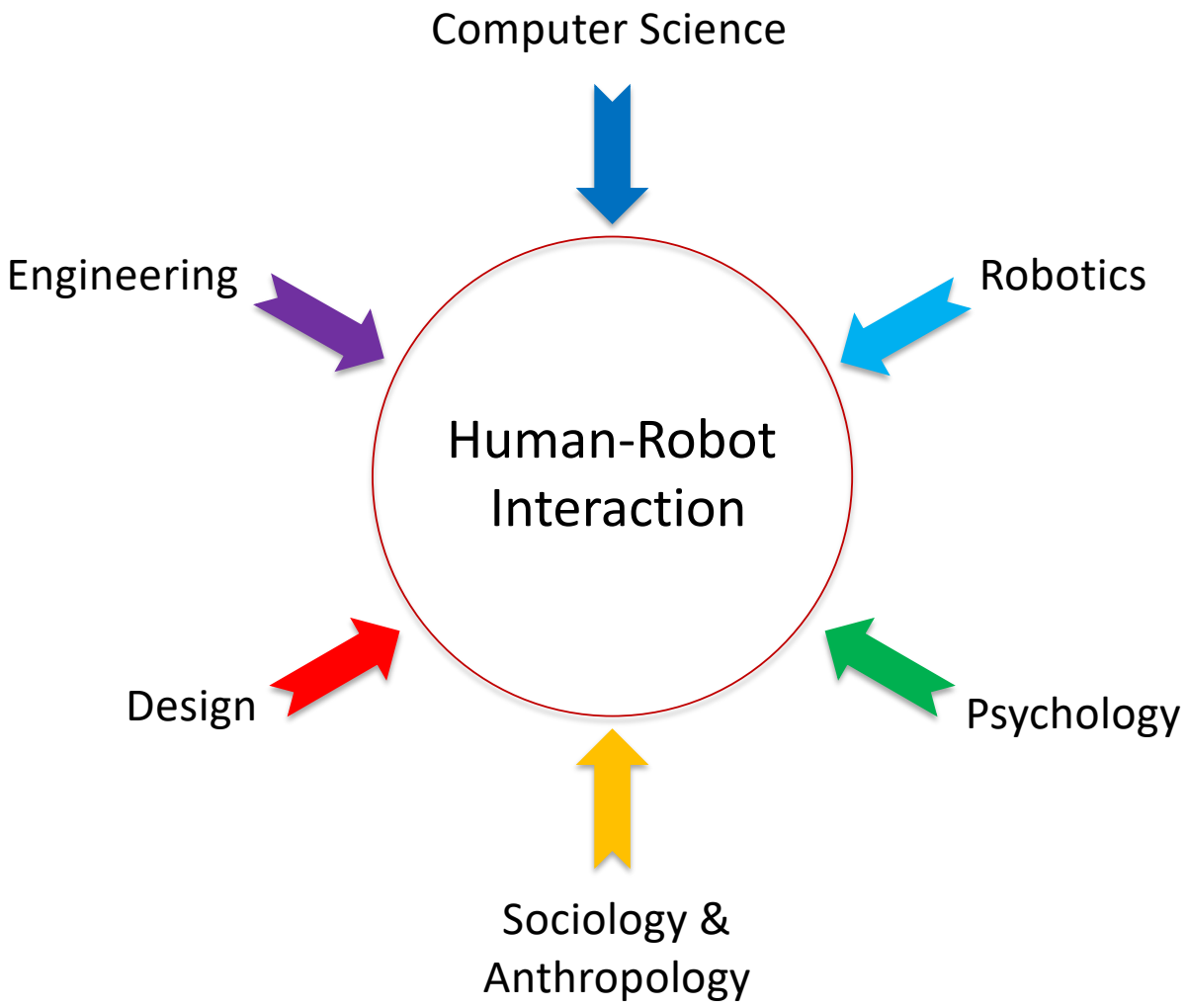
yourpointofview.com

HSBC
The world's local bank

tasty
nasty
nasty
tasty
Everyone looks at the world
from a different point of view.
yourpointofview.com
HSBC
The world's local bank

wise
old
old
wise

Barriers between Disciplines



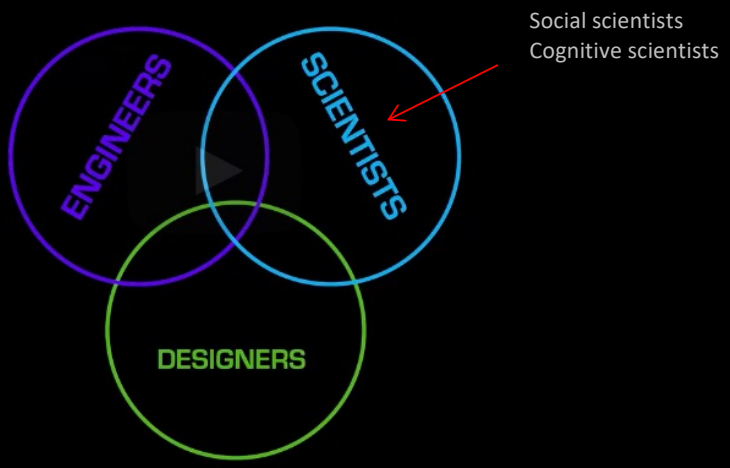
Barriers between Disciplines

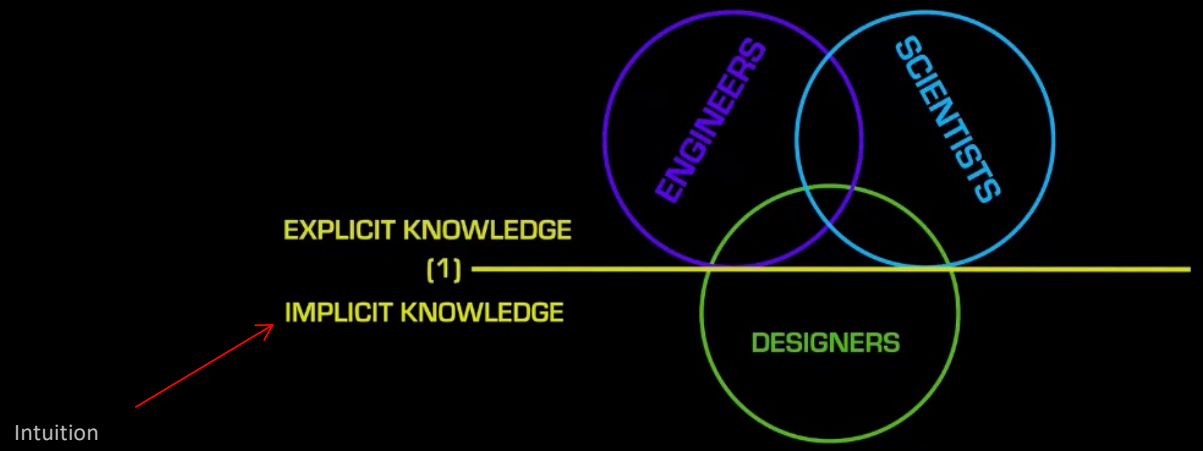
Disciplines differ from each other in terms of

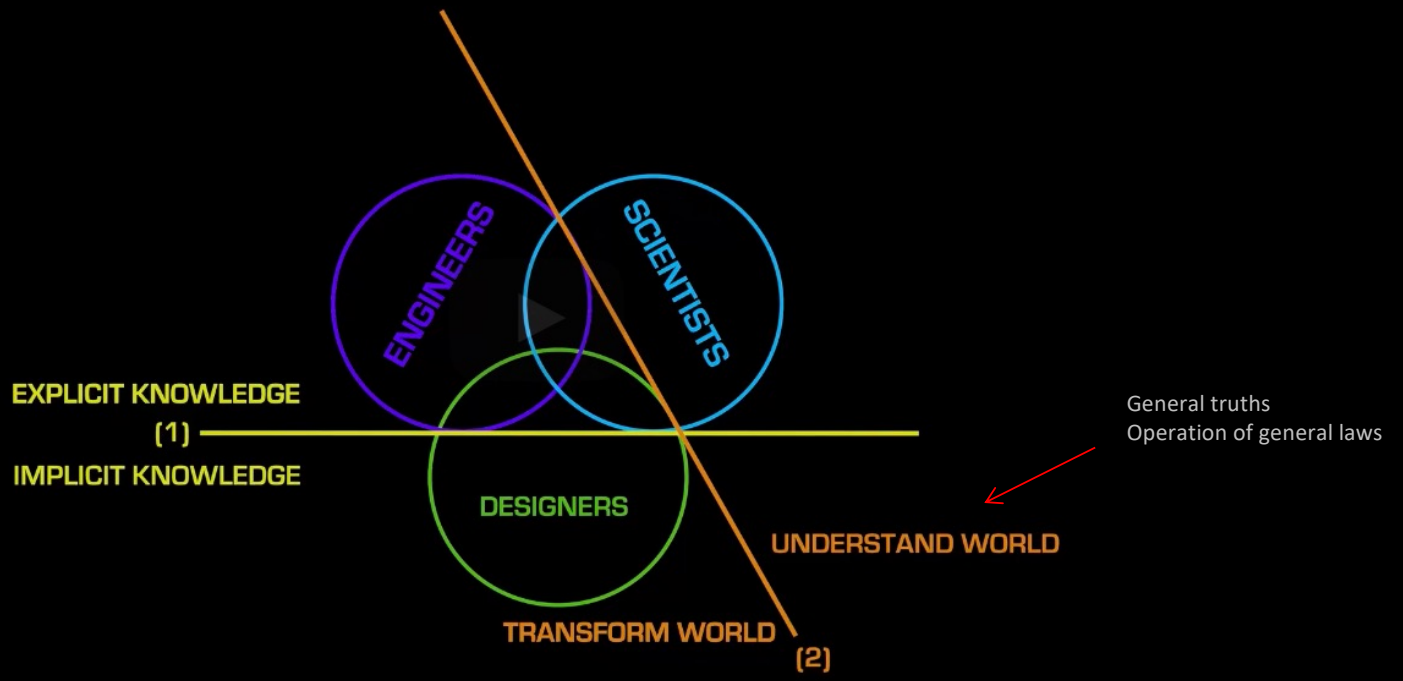
- Shared beliefs
- Values
- Models
- Exemplars

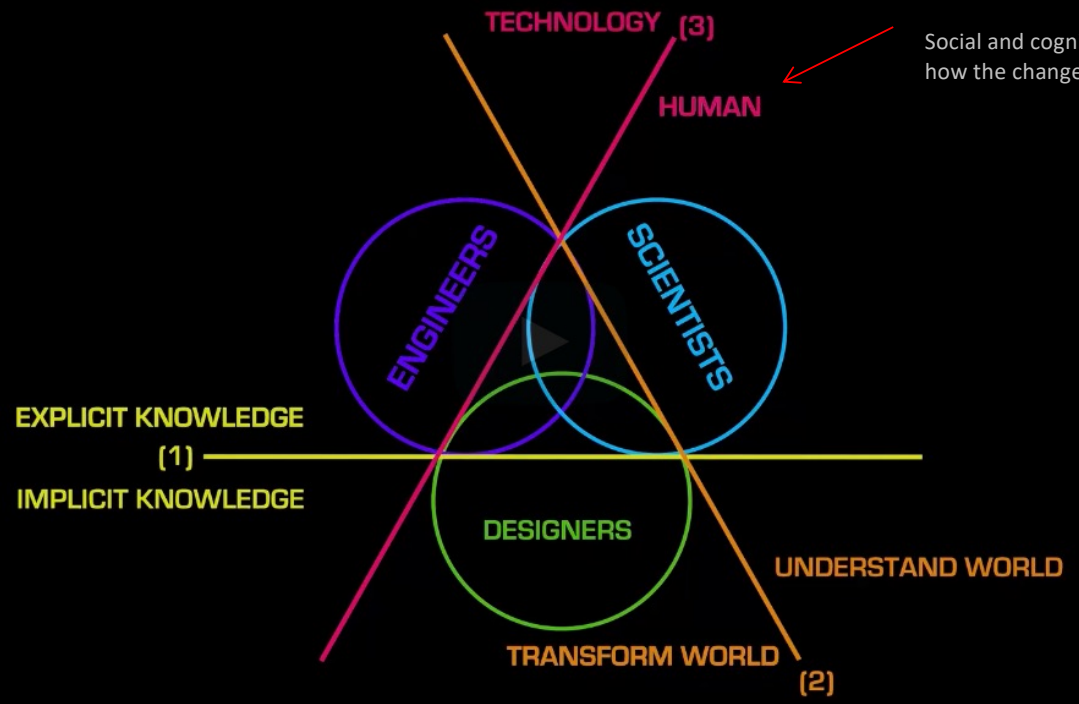
These form a paradigm that guides a community of theorists and practitioners

Researchers within a paradigm share beliefs, values, and exemplars


ENGINEERS
SCIENTISTS
DESIGNERS
Social scientists
Cognitive scientists

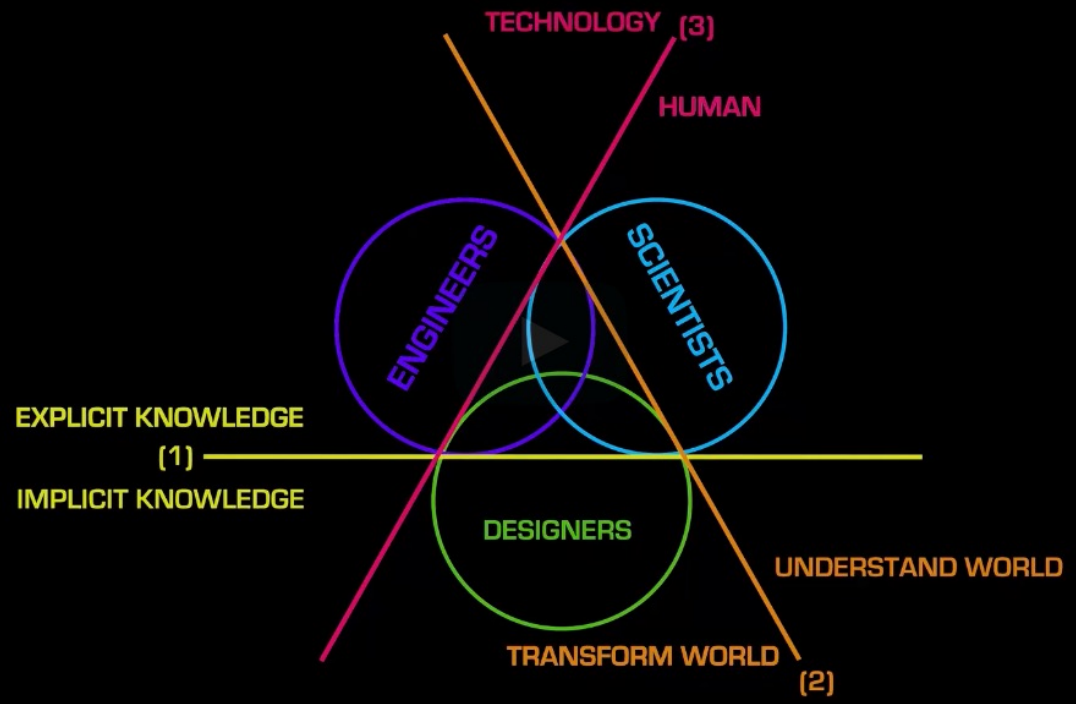

ENGINEERS
SCIENTISTS
DESIGNERS
EXPLICIT KNOWLEDGE
(1)
IMPLICIT KNOWLEDGE
Intuition


ENGINEERS
SCIENTISTS
EXPLICIT KNOWLEDGE
(1)
IMPLICIT KNOWLEDGE
DESIGNERS
UNDERSTAND WORLD
TRANSFORM WORLD
(2)
General truths
Operation of general laws



Designers: human values to guide requirements and solutions

Social and cognitive scientists: perception, cognition, actions, behaviors and how the change in different contexts



"We often do not know what we do not know"

Hence the value of collaborating with domain experts from different disciplines

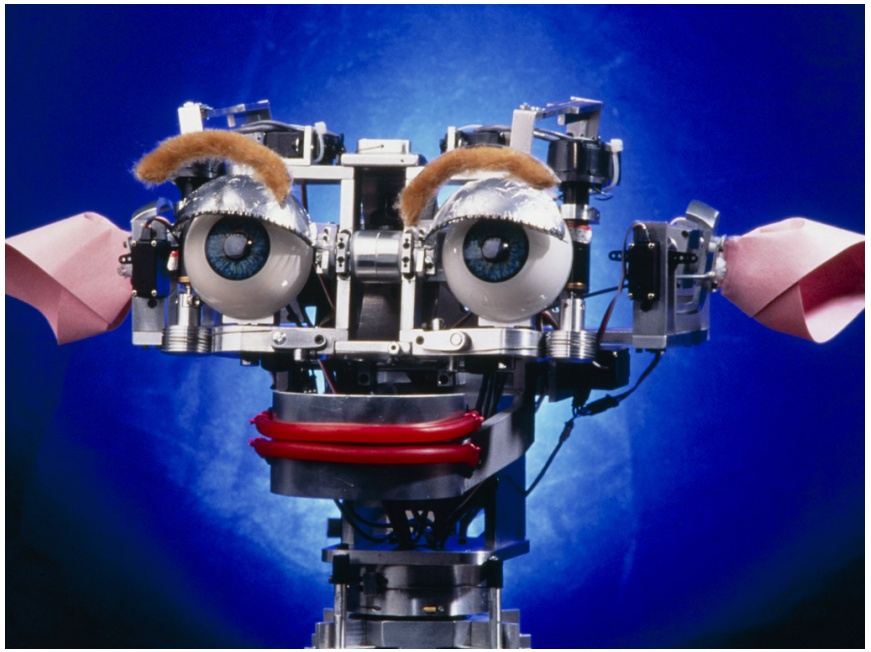
Social Robots

Robots that evoke humanlike character traits

- Exploit multiple, fast reactive behaviors to give a sense of social presence
- Give at least an appearance of intelligence
- Also known as behavior-based robots

Social Robots

Humanoids Research



Kismet

Kismet was one of the first robots able to demonstrate social and emotional interactions with humans. It had a cartoonish face, spoke with a squeaky baby voice, and could always make people smile.

CREATOR
MIT

COUNTRY
United States

YEAR
1998

TYPE
Research, Humanoids

Surprisingly effective at presenting a social presence
(the control software contained a small selection of social drives)

Took advantage of human psychology, e.g., the baby schema, a predisposition of humans to treat things with big eyes and exaggerated features in a social manner, despite their lack of fully-functional social skills

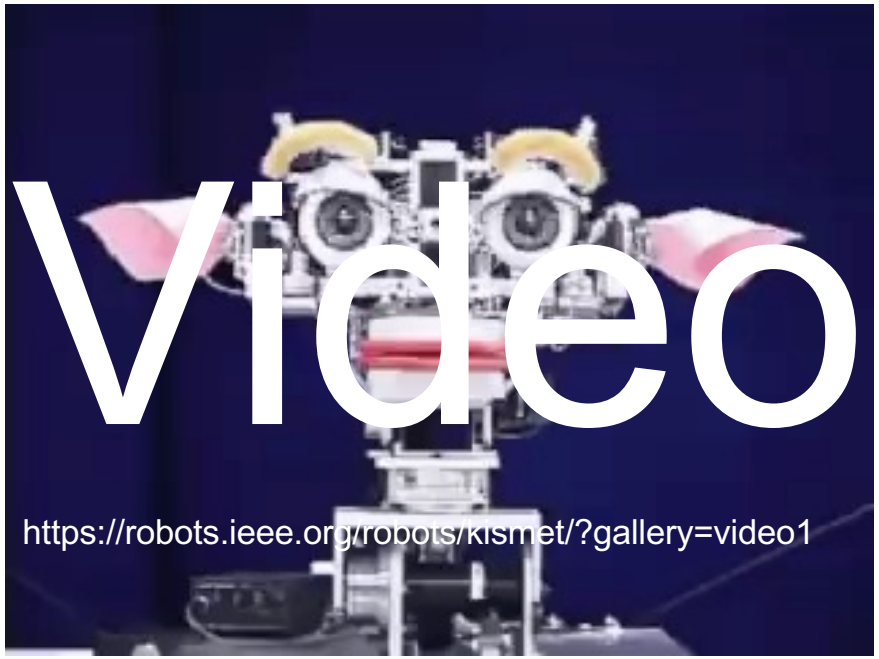
Humans tend to anthropomorphize

Source: https://robots.ieee.org/robots/kismet/

Social Robots

Humanoids

Research



Kismet

Kismet was one of the first robots able to demonstrate social and emotional interactions with humans. It had a cartoonish face, spoke with a squeaky baby voice, and could always make people smile.

CREATOR
MIT

COUNTRY
United States

YEAR
1998

TYPE
Research, Humanoids

Source: https://robots.ieee.org/robots/kismet/

Social Robots

Humanoids

Research

Education

One of the most influential robots in the study of social robotics

Nao

Nao is a small humanoid robot designed to interact with people. It's packed with sensors (and character) and it can walk, dance, speak, and recognize faces and objects. Now in its sixth generation, it is used in research, education, and healthcare all over the world.

CREATOR
SoftBank Robotics
(originally created by Aldebaran Robotics, acquired by SoftBank in 2015)

COUNTRY
France

YEAR
2008

TYPE
Humanoids, Research, Education

Source: https://robots.ieee.org/robots/nao/

Video

https://robots.ieee.org/robots/nao/?gallery=video1

Social Robots

Humanoids

Research

Education

A social robot does not need to appear humanlike

Keepon

Keepon is a social robot that interacts with people and dances when music is playing. It's used to engage with children in autism research. A toy version, My Keepon, is designed for general audiences.

CREATOR
BeatBots

COUNTRY
United States

YEAR
2003

TYPE
Consumer

Source: https://robots.ieee.org/robots/keepon/

Video

https://robots.ieee.org/robots/keepon/?gallery=video1

Source: https://robots.ieee.org/robots/keepon/

Social Robots

Medical

Requires almost no technical skill to operate: has been used by psychologists, anthropologists, health researchers to study psychological and physiological effects on people

Paro

Paro is a robotic baby harp seal designed as a therapeutic tool for use in hospitals and nursing homes. The robot is programmed to cry for attention and respond to its name. It includes an off switch.

CREATOR
AIST

COUNTRY
Japan

YEAR
2004

TYPE
Medical

Source: https://robots.ieee.org/robots/keepon/

Video

https://robots.ieee.org/robots/paro/?gallery=video1

Source: https://robots.ieee.org/robots/paro/

Types of Robot

Entertainment

Consumer

Aibo

Aibo is a friendly robotic dog whose personality and behavior evolves over time. It can recognize its owner's face, detect smiles and words of praise, and learn new tricks. And of course, it loves to be petted.

CREATOR
Sony

COUNTRY
Japan

YEAR
2018

TYPE
Consumer, Entertainment

Source: https://robots.ieee.org/robots/aibo2018/

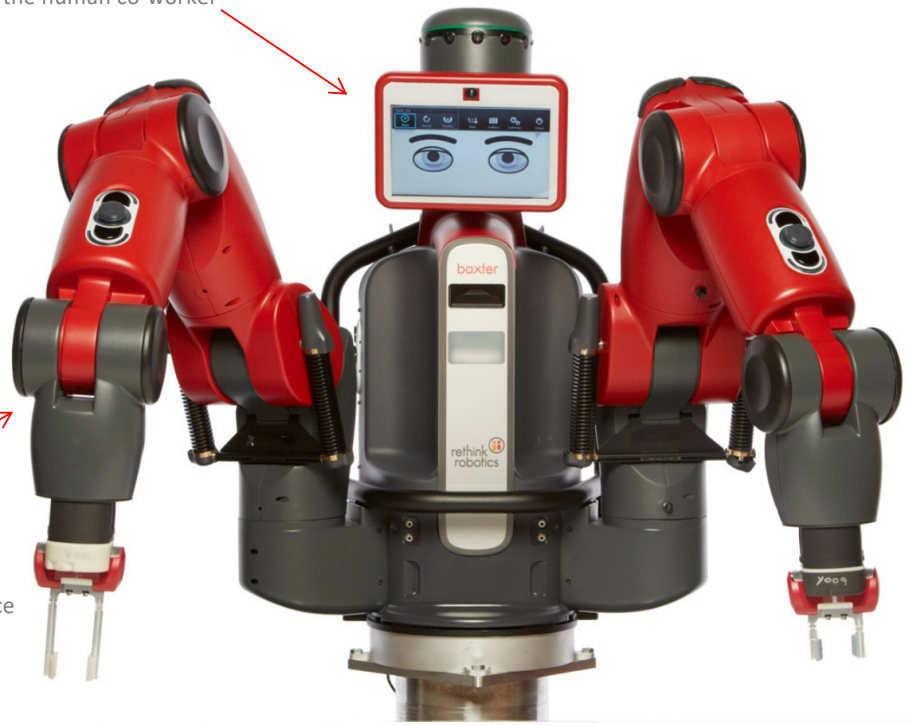
Video

https://www.youtube.com/watch?v=5ifwGc-0mAY

Social Robots

Industrial

Industrial robot and a platform for HRI
Its eye fixations communicate a sense of attention to the human co-worker



Actively-compliant arms:
They move in response to an externally applied force

Sometimes referred to as a co-bot:
a robot that is safe to work with in close proximity

Baxter

Baxter is a versatile manufacturing robot. Its cameras and force-sensing actuators let it adapt to changes in the environment, and a user can program a new task simply by moving its arms around.

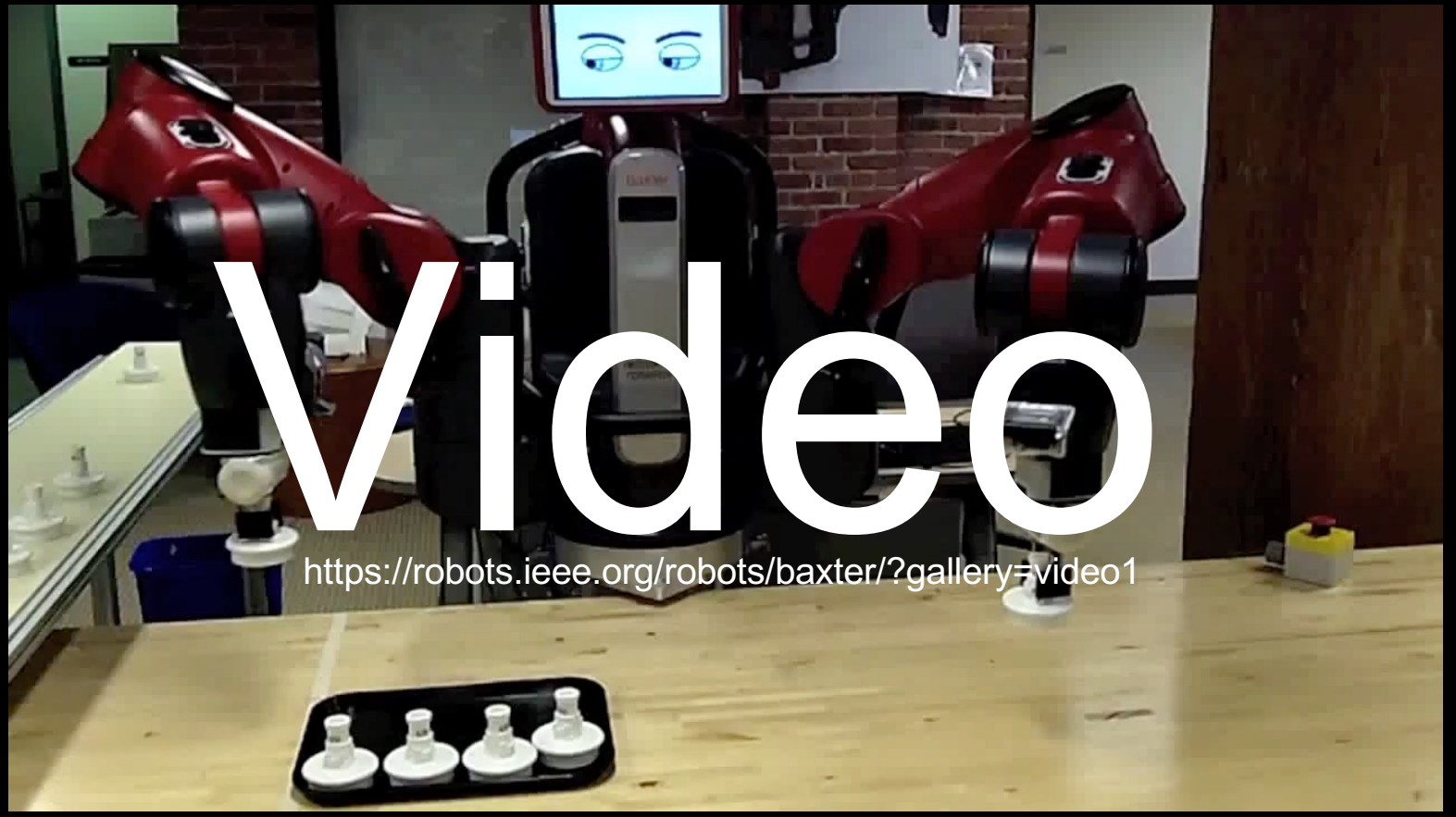
CREATOR
Rethink Robotics

COUNTRY
United States

YEAR
2012

TYPE
Industrial

Source: https://robots.ieee.org/robots/baxter/



Source: https://robots.ieee.org/robots/baxter/

Social Robots

Robots that evoke humanlike character traits

- Exploit multiple, fast reactive behaviors to give a sense of social presence
- Give at least an appearance of intelligence
- Also known as behavior-based robots

HRI

Emphasizes the social interactions between humans and robots

- Dyads (two interacting partners)
- Groups
- Institutions
- Societies

HRI

- Technological advancements that are the result of joint interdisciplinary efforts can have important societal and ethical impact

  For example, consider gender bias in robots

  See Simon, M. (2018, Oct. 3). It's Time to Talk about Robot Gender Stereotypes. Wired. https://www.wired.com/story/robot-gender-stereotypes/

- Doing human-centred research will lead to the development of robots that are
  - Widely accepted
  - Serve humans for the greater good

Reading

Bartneck, C., Belpaeme, T., Eyssel, F., Kanda, T., Keijsers, M., Sabanovic, S. (2020). Human-Robot Interaction - An Introduction, Cambridge University Press.

Chapter 1 – Introduction, pp. 1-2

Chapter 2 – What is Human-Robot Interaction? pp. 6-17