Human-Robot Interaction

Module 3: Design

Lecture 2: Design methods, prototyping tools, culture in HRI design, & human-robot symbiosis

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Topics

- Design methods
  - Engineering design process
  - User-centred design process
  - Participatory design
- Prototyping tools
- Culture in HRI
- Human-robot symbiosis

Engineering Design Process

Potential problems:

- Unable to capture the real world in sufficient detail
- Infeasibly large number of design parameters
- Changing, incomplete, interdependent, indeterminate requirements
  - Lack of information about what behaviours are appropriate
  - Lack of understanding of consequences of deploying robots in social contexts

Aim to satisfice rather than optimize

User-centred Design Process

- User-centred design: UCD

- Focus on
  - The people who will use the robot
  - The context in which they will operate

  throughout the design process

- Seek their views on
  - Possible design options
  - Prototypes
  - Final version

  and identify their preferences

User-centred Design Process

Many design decisions have no obvious answers, so

"Test early, test often"

User-centred Design Process

Identify the different types of users, collectively called stakeholders

- Primary users
  - e.g. nurses and patients who interact with a drug-delivery robot
- Secondary users
  - e.g. other medical staff who see the robot in the corridor and who will be affected by its presence
- Tertiary users
  - e.g. people whose job might be changed or replaced by the robot

User-centred Design Process

Involve the stakeholders in the design process

- Needs requirements analysis
- Field studies
- Focus groups
- Interviews
- Surveys
- Testing and evaluation of prototypes and final product

Participatory Design

Involve the stakeholders in the design process

- Throughout the design process
  - including the early phases
  - including the design processes
- Not just to evaluate design decisions

Participatory Design

Involving stakeholders in the design process is challenging

- People have preconceptions about robots
- People have little knowledge of what is required to build them

This leads to unrealistic design ideas

- Designers have little knowledge of day-to-day
  - Lives
  - Experiences
  - Needs

  of stakeholders and their environments

This leads to unrealistic assumptions on which the design is based

Prototyping Tools

Enable rapid, iterative development of robot designs

LEGO Mindstorms	https://www.lego.com
Vex Robotics Design System	https://www.vexrobotics.com/
Arduino microcontroller	https://www.arduino.cc
Raspberry Pi single-board computer	https://www.raspberrypi.org

Very inside-out in approach

Culture in HRI Design

- Culture
  - Beliefs
  - Values
  - Practices
  - Language
  - Traditions
- Effect of culture on
  - Perception of robots
  - Interaction with robots

Contrasting Cultural Norms, Values, Beliefs

Human exceptionalism
is the source of discomfort with social and humanoid robots

(Human exceptionalism is the idea that humans are unique, distinctive beings that have a priority over other beings. Also referred to as anthropcentrism: "the belief that human beings are the central or most important entity in the universe", https://en.wikipedia.org/wiki/Anthropocentrism)

Animist beliefs
might underpin comfort with robots in Japan and Korea

("Animism is the belief that objects, places, and creatures all possess a distinct spiritual essence", https://en.wikipedia.org/wiki/Animism)

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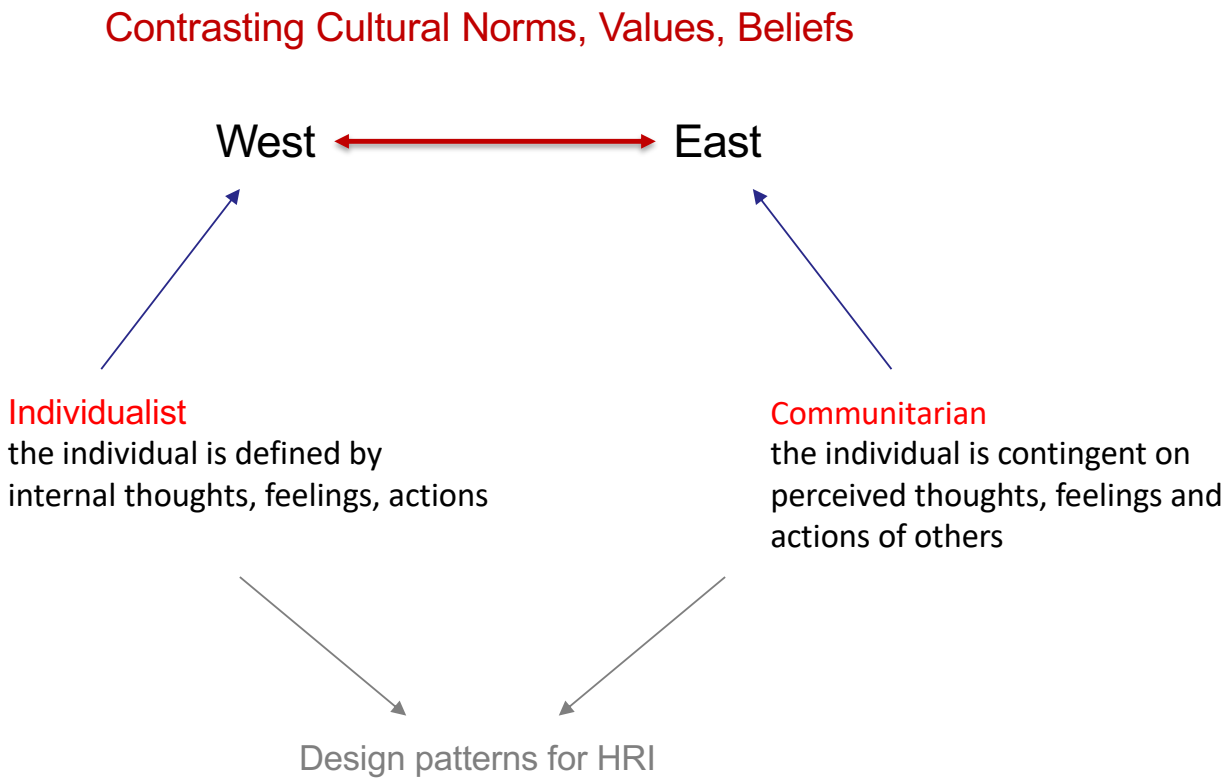

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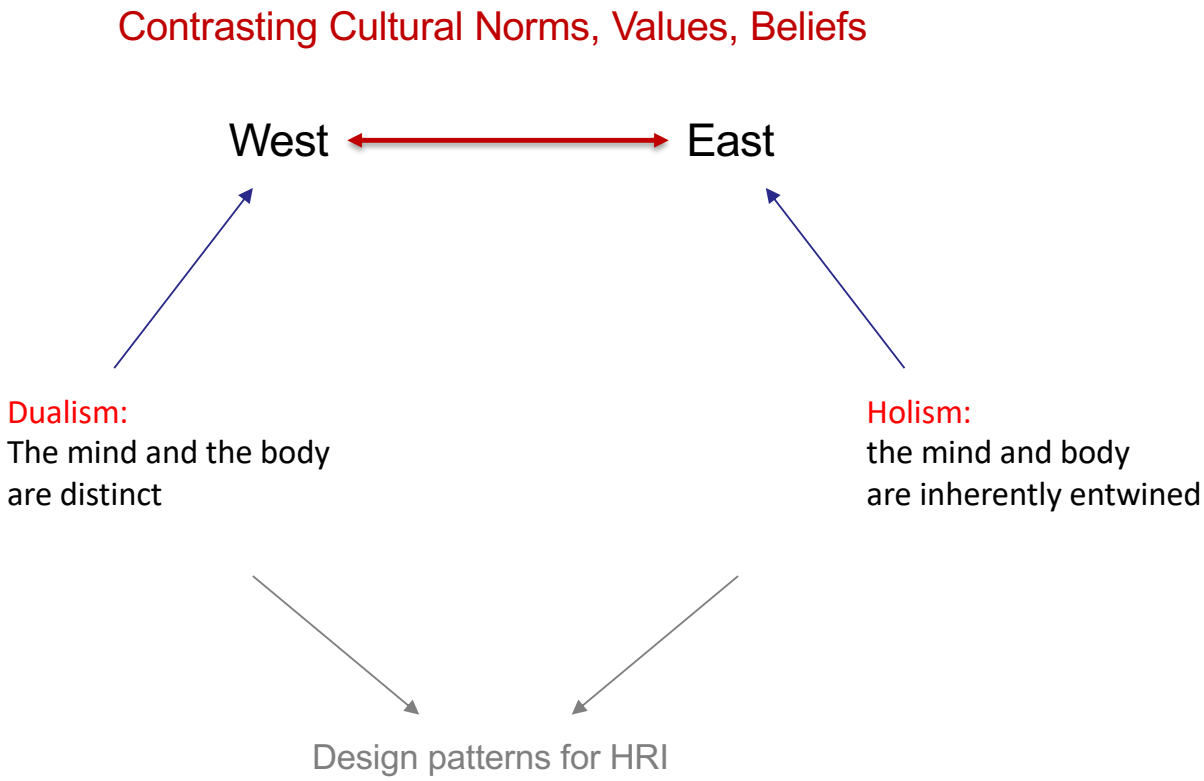

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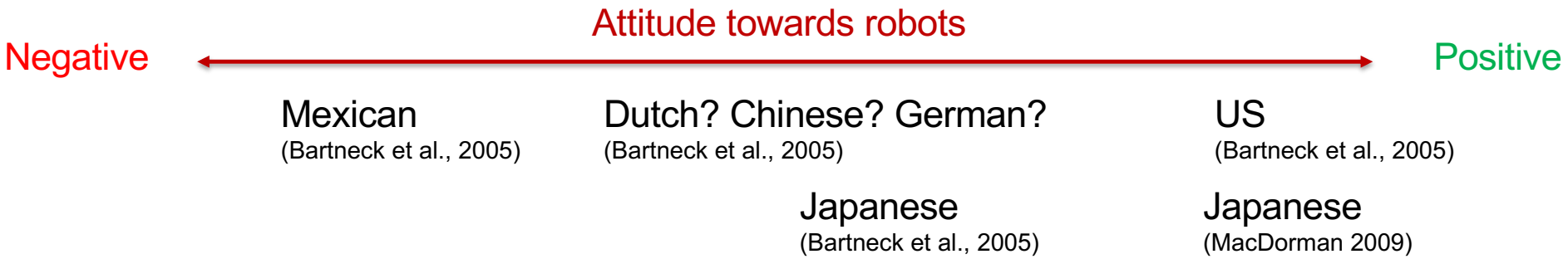

Japan, UK, Sweden, Italy,
South Korea, Brunei, US:
Likabiliity traits depend on country
(Shibata et al., 2009)

Culture in HRI Design

Human team members find robots more persuasive when they use culturally appropriate forms of communication
(Lindblom and Ziemke, 2003)

Mexican
(Bartneck et al., 2005)

Dutch? Chinese? German?
(Bartneck et al., 2005)

US
(Bartneck et al., 2005)

Japanese
(Bartneck et al., 2005)

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(MacDorman 2009)

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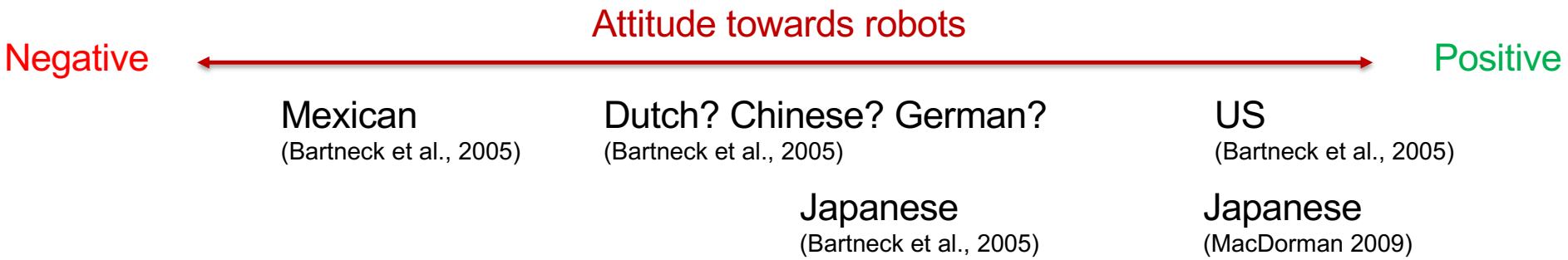
Culture in HRI Design

User expectations of robots and need for robots in the home differ:
Relation-oriented in Korea vs. functionally-oriented in the USA
(Lee et al., 2012)



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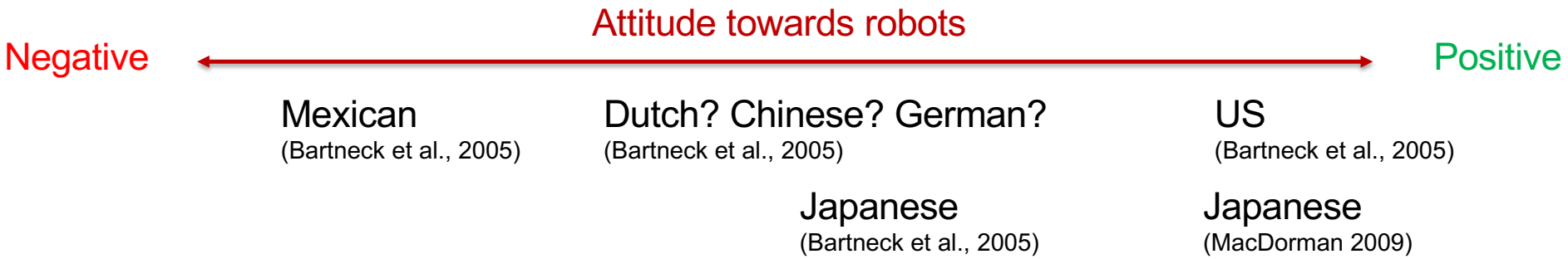
Culture in HRI Design

Caveat: need to read the original papers to fully understand these nuanced findings



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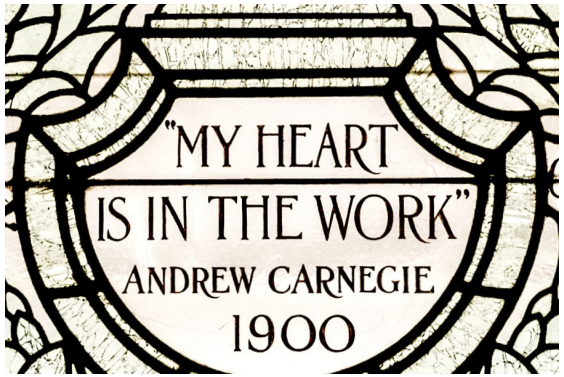
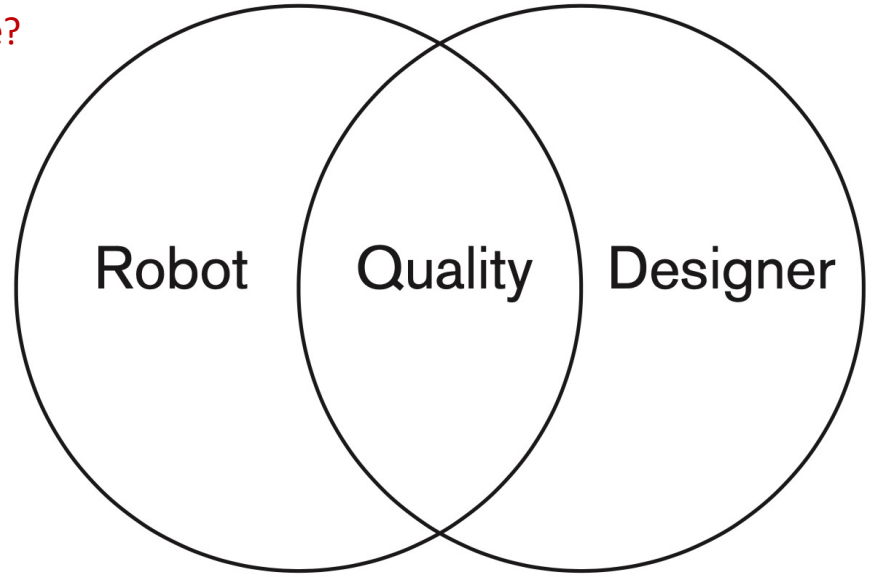
Philosopical, Ethical, and Political Commitments

Appearance:
human or machine?



https://www.cmu.edu/staff-council/what-we-do/index.html

(Bartneck et al., 2020)



Goals & Motivation:

Understand humans?
Develop technology?
Build applications?

Immortality project?

Symbiosis of robot and robot designer?

Surrogate for robot designer?

Impact of the psychological state of the designer
on the quality of the design?

Peace of mind … Flow … In the zone … at one with the work

Reading

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

Chapter 4 – Design, pp. 56-68.