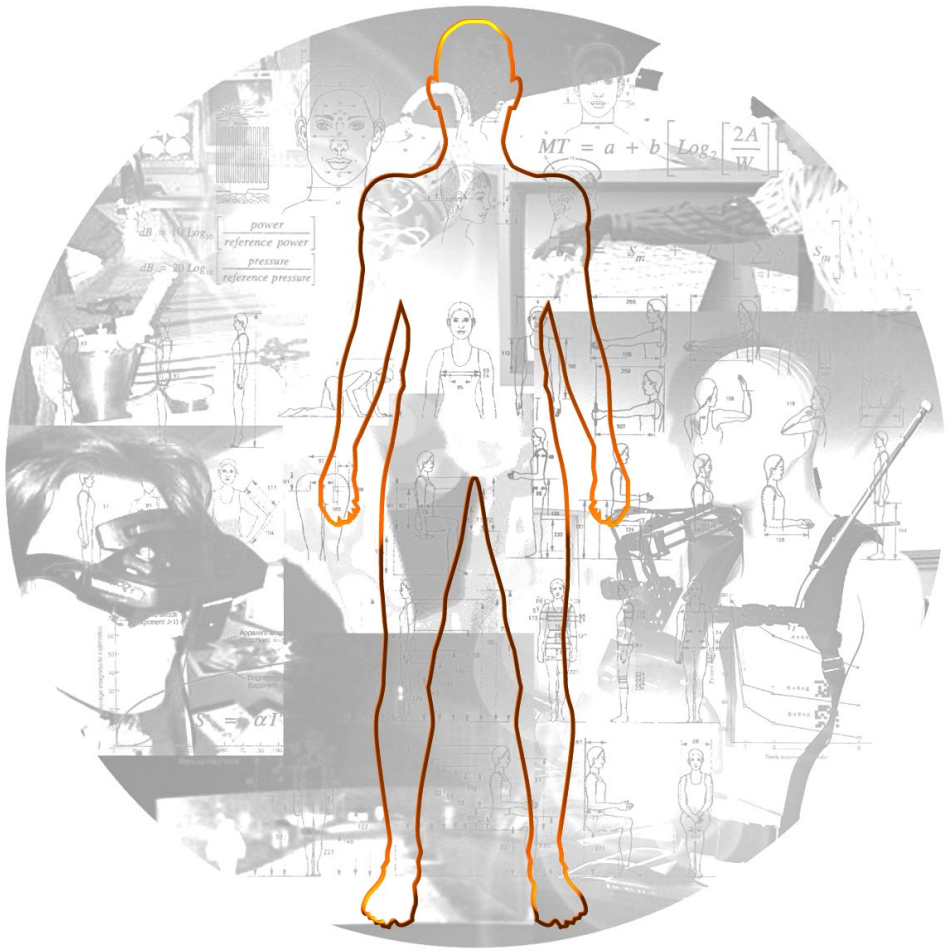
Autonomous Vehicles: the human experience

Prof. Joseph Giacomin

Human Centred Design



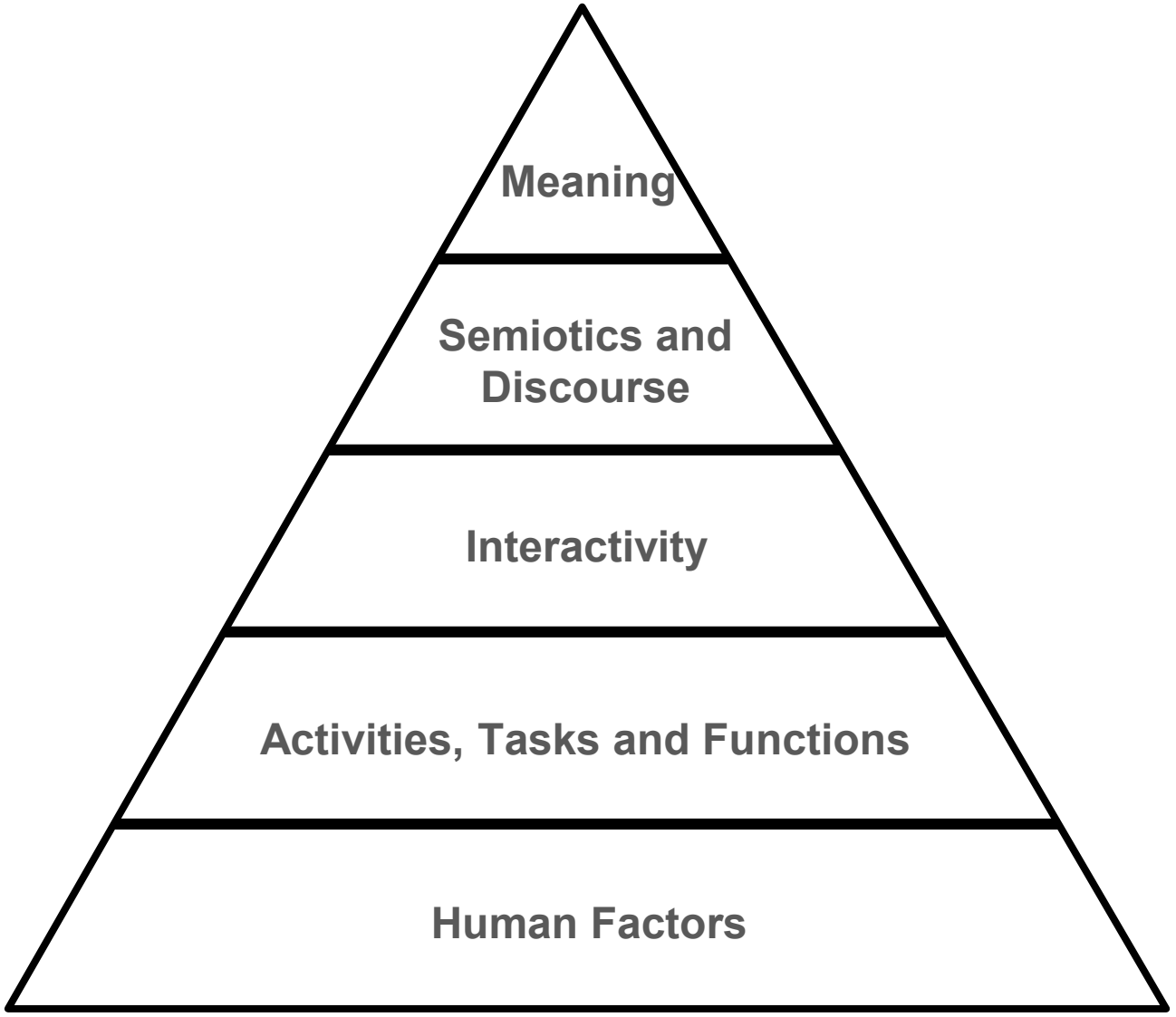
Human Centred Design

Involves techniques which interact, empathise and stimulate the people involved, obtaining an understanding of their needs, desires and experiences which often transcends that which the people themselves actually knew and realised.

It is a form of structured empathy.

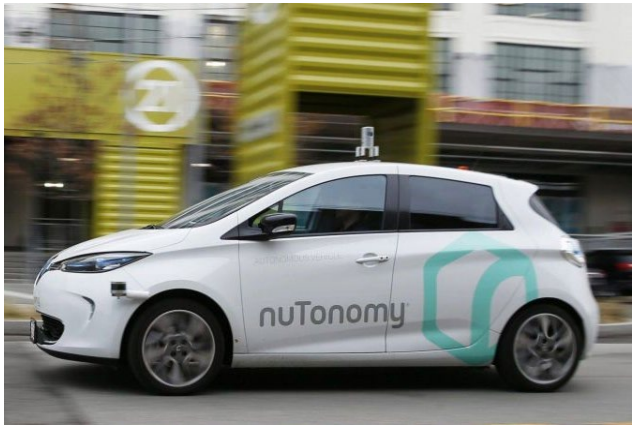
It leads to products, systems and services which are physically, perceptually, cognitively and emotionally intuitive.

The Human Centred Design Pyramid



Giacomin, J. 2014, What is human centred design?, The Design Journal, Vol. 17, No. 4, pp 606-623.

Autonomous Vehicles



The Issue Of Anthropomorphism

Anthropomorphism

The tendency to attribute human characteristics to inanimate objects, animals and others with a view to helping us rationalise their actions.

It is attributing cognitive or emotional states to something based on observation in order to rationalise an entity's behaviour in a given social environment.

This is effectively the use of projective intelligence to rationalise a system's actions.

Duffy, B.R. 2003, Anthropomorphism and the social robot, Robotics And Autonomous Systems, Vol. 42, No.3-4, pp.177-190.

Anthropomorphism

Occurs naturally for even small degrees of similarity...

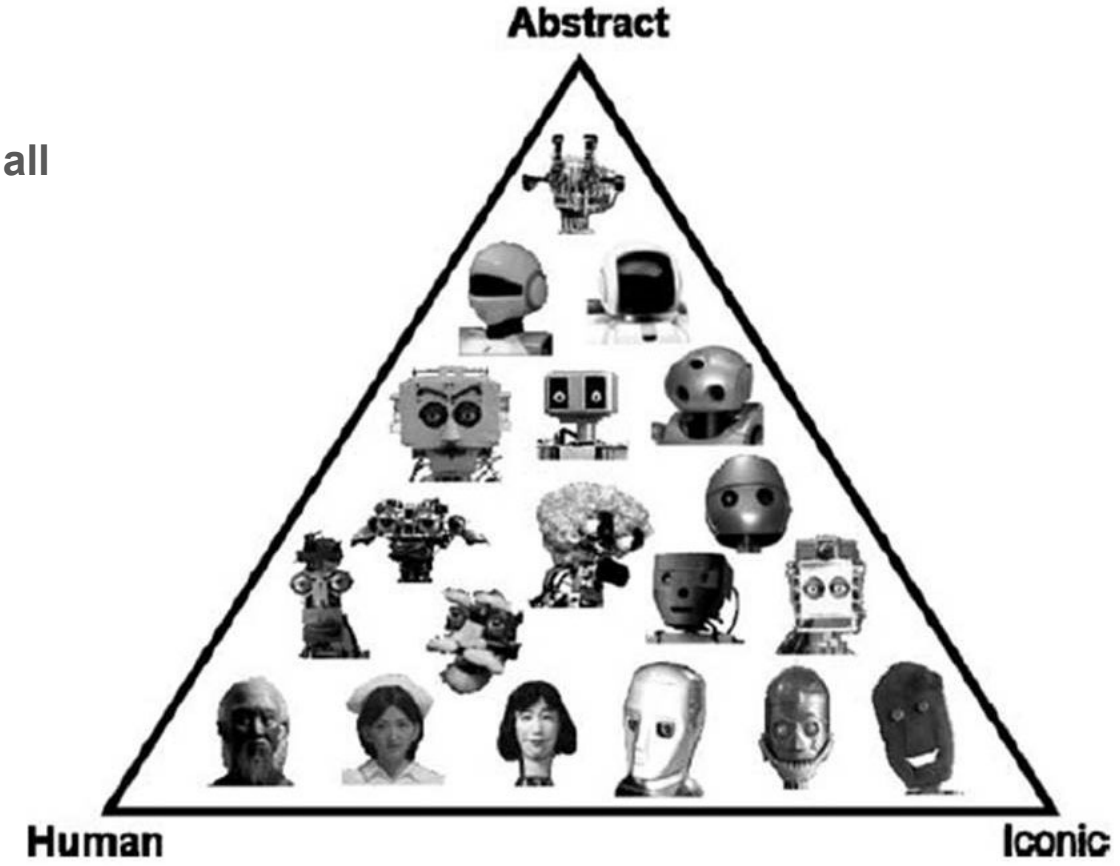
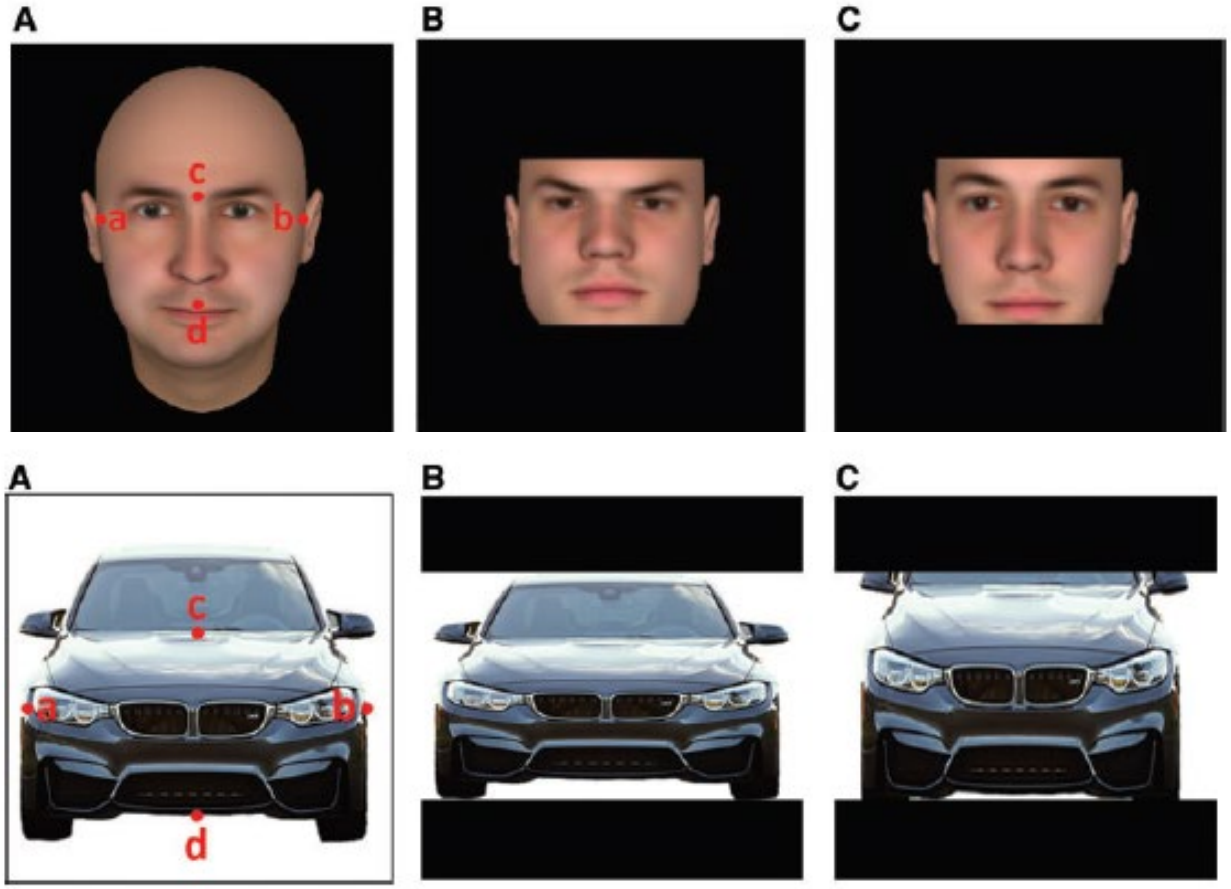


Fig. 1. Anthropomorphism design space for robot heads

Duffy, B.R. 2003, Anthropomorphism and the social robot, Robotics And Autonomous Systems, Vol. 42, No. 3-4, pp.177-190.

Anthropomorphism



Automobile faces have been found to be perceived in mostly the same way as human faces, with a higher face ratio (ratio of face width to face height) being associated with a greater sense of dominance.

Maeng, A. and Aggarwal, P. 2018, Facing dominance: anthropomorphism and the effect of product face ratio on consumer preference, Journal of Consumer Research, Vol. 44, No. 5, pp.1104-1122..

Anthropomorphism

Participants using a driving simulator drove either a normal car, an autonomous vehicle able to control steering and speed, or a comparable autonomous vehicle augmented with additional anthropomorphic features—name, gender, and voice.

Behavioural, physiological and self-report measures revealed that participants trusted that the vehicle would perform more competently as it acquired more anthropomorphic features.

Waytz, A., Heafner, J. and Epley, N., 2014. The Mind In The Machine: Anthropomorphism increases trust in an autonomous vehicle, Journal of Experimental Social Psychology, Vol. 52, pp.113-117.

Anthropomorphism

Employees of a company which develops medicine delivery robots observed hospital staff being friendlier towards robots that had been given human names.

Tolerance for malfunction was higher with anthropomorphic framing.

“Oh, Betsy made a mistake!” vs. “This stupid machine doesn’t work!”.`

Darling, K. 2015, 'Who's Johnny?‘ anthropomorphic framing in human-robot interaction, integration, and policy, Robot Ethics, Vol. 2, March 23rd.

There Is A Choice To Be Made

Non-Thinking Tool

or

Sentient Assistant

Need to decide whether the autonomous vehicle should be thought of, for reasons of affordances and branding, as a tool or instead an agent.

Name

Name

500 college students were asked to rate 400 popular male and female names. The questions were of the type: “Imagine that you are about to meet Samantha. How competent/warm/old do you think she is when you see her name?”

Warm and competent names: Ann, Anna, Caroline, Daniel, David, Elizabeth, Emily, Emma, Evelyn, Felicia, Grace, James, Jennifer, John, Jonathan, Julie, Kathleen, Madeline, Mark, Mary, Matthew, Michael, Michelle, Natalie, Nicholas, Noah, Olivia, Paul, Rachel, Samantha, Sarah, Sophia, Stephen, Susan, Thomas, William.

Warm but less competent names: Hailey, Hannah, Jesse, Kellie, Melody, Mia.

Competent but less warm names: Arnold, Gerard, Herbert, Howard, Lawrence, Norman, Reginald, Stuart.

Names of low warmth and competence: Alvin, Brent, Bryce, Cheyenne, Colby, Crystal, Dana, Darrell, Devon, Dominic, Dominique, Duane, Erin, Larry, Leslie, Lonnie, Malachi, Marcia, Marco, Mercedes, Omar, Regina, Rex, Roy, Tracy, Trenton, Vicki, Whitney.

Newman, L.S., Tan, M., Caldwell, T.L., Duff, K.J. and Winer, E.S. 2018, Name Norms: a guide to casting your next experiment, Personality And Social Psychology Bulletin, Vol. 44, No. 10, pp.1435-1448.

Name

Researchers varied the “social group membership’ of a robot by using first names to indicate whether the robot belonged to a German in-group or a Turkish out-group.

To increase the salience of the group membership, the study participants were also told that the robot had been developed in either Germany or Turkey.

The participants rated the in-group robot more favourably, and also anthropomorphised it more strongly.

Eyssel, F. and Kuchenbrandt, D., 2012. Social categorization of social robots: Anthropomorphism as a function of robot group membership. British Journal of Social Psychology, 51(4), pp.724-731.

Name

Animal names and machine names have historically followed a “general law of name development”.

Descriptive names were usually adopted for the new and unfamiliar to increase acceptance within the community.

As the animals or machines became more familiar, however, the naming usually shifted to commemorative associations then eventually to nearly arbitrary commercial branding.

Once well understood, animals and machines have usually been named based on the social and media benefits of the name.

Meaning

Function

- **the way something works or operates;**
- **the natural purpose of something or the duty of a person.**

Some things need doing, with or without aesthetic or semiotic content.

Giacomin, J. 2017, What is design for meaning?, Journal Of Design, Business & Society, Vol. 3, No. 2, pp.167-190.

Ritual

- **a series of actions or a type of behaviour which is regularly and invariably followed by someone;**

- **a set of fixed actions and sometimes words performed consistently and regularly, especially as part of a ceremony or collectively.**

Some actions are performed for their aesthetic and semiotic content. The motions and actions send messages.

Giacomin, J. 2017, What is design for meaning?, Journal Of Design, Business & Society, Vol. 3, No. 2, pp.167-190.

Myth

- **a traditional story, especially one concerning the early history of a people or explaining a natural or social phenomenon;**

- **an idealised, exaggerated or fictitious conception of a thing or person.**

Some things are pure aesthetic or semiotic content. Motions or actions may not be necessary.

Giacomin, J. 2017, What is design for meaning?, Journal Of Design, Business & Society, Vol. 3, No. 2, pp.167-190.

Traditional Vehicle Meanings

Function – the mail delivery

Ritual – the school run

Myth – the sports experience

Metaphor

Traditional Vehicle Metaphors

Personal transport

Company car

Rental car

Taxi

Newer Vehicle Metaphors

Public shuttles

Mobile office

Mobility service

Entertainment centre

Spectrum Of Metaphors

Utilitarian

Hedonic

Function

Ritual

Myth

Interactions

Metaphor + Persona + Scenario => Customer Journey

Taxi

Jane and Julia

Travelling To Airport

Taxi

Hamad the Retiree

Travelling To GP Surgery

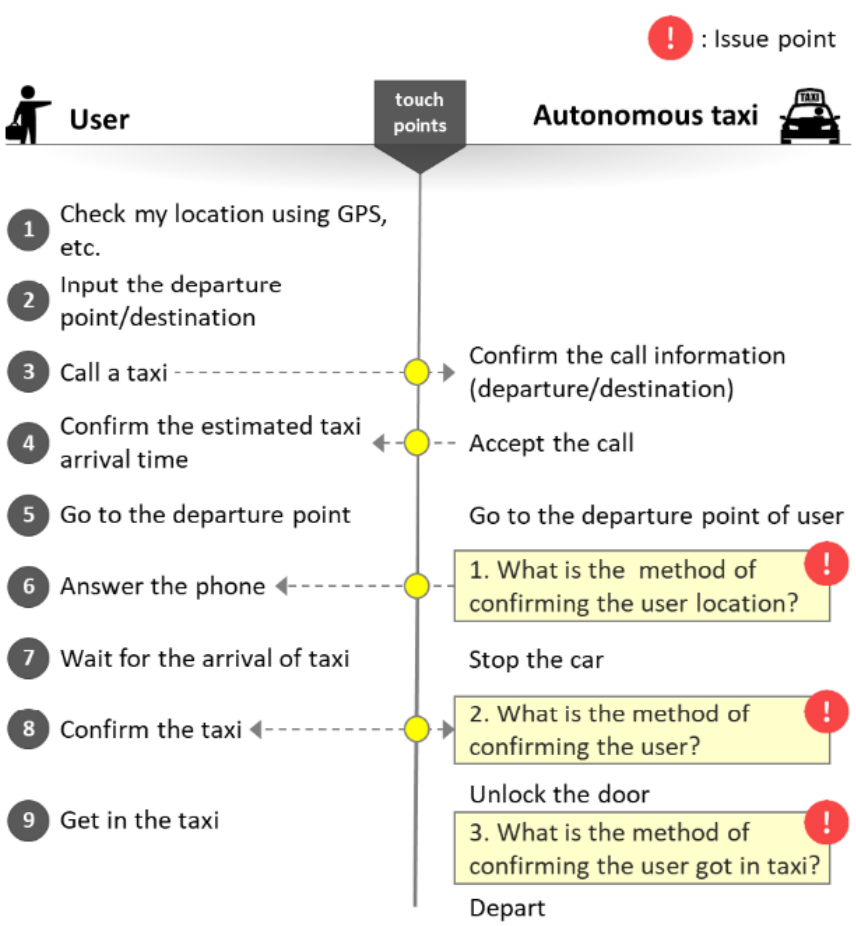
Taxi

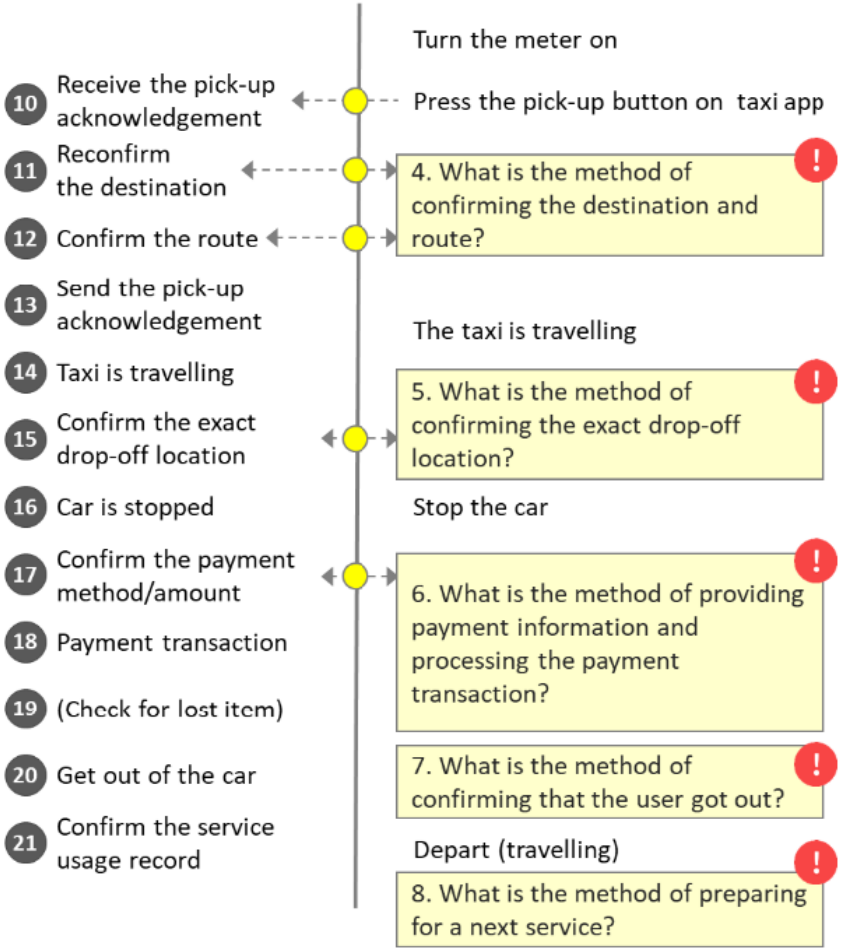
Ben the Musician

Travelling To Concert

Customer Journey

Taxi





Kim, S., Chang, J.J.E., Park, H.H., Song, S.U., Cha, C.B., Kim, J.W. and Kang, N. 2019, Autonomous taxi service design and user experience, International Journal of Human–Computer Interaction, Vol. 36, No. 5, pp.429-448.

Human Factors

Human Factors

More than 100 years of R&D has produced a large body of knowledge in relation to the physical, perceptual, cognitive and emotional characteristics of vehicle operation.

Human Factors laws and data are well embedded within the guidelines and regulatory requirements of the transport sector (manufacturers, operators, insurers and regulators).

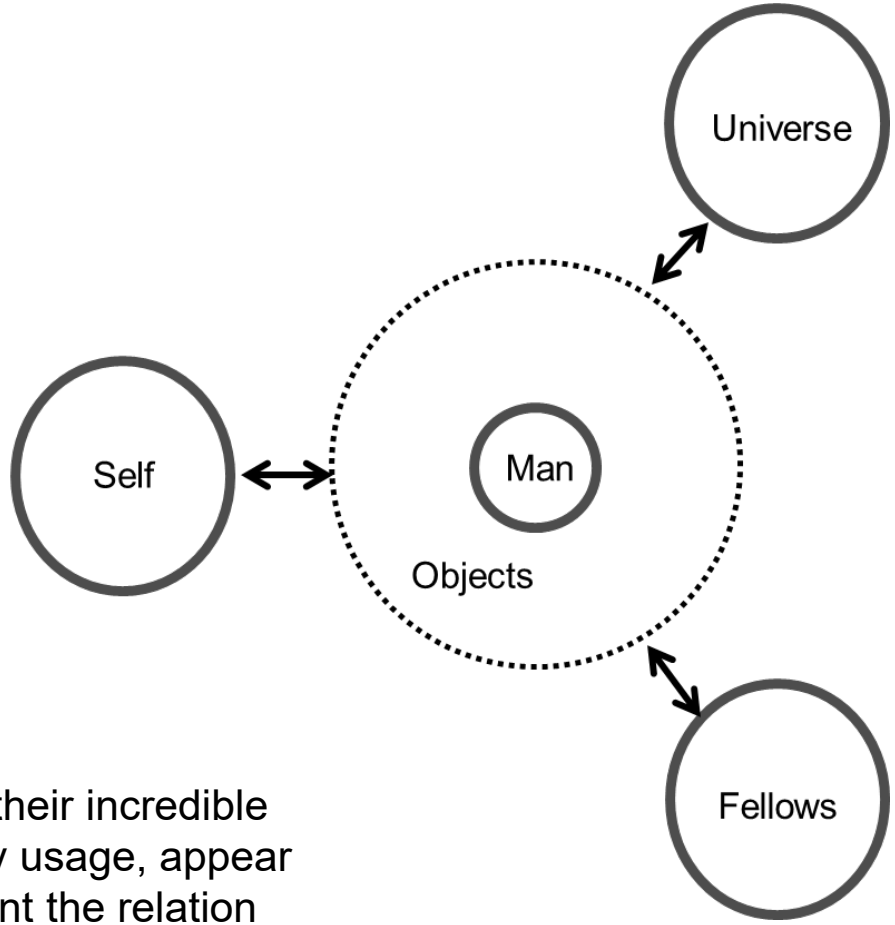
Human Factors

chapter 1 - Introduction to Automotive Ergonomics
chapter 2 - Engineering Anthropometry and Biomechanics
chapter 3 - Occupant Packaging
chapter 4 - Driver Information Acquisition and Processing
chapter 5 - Controls, Displays, and Interior Layouts
chapter 6 - Field of View from Automotive Vehicles
chapter 7 - Automotive Lighting
chapter 8 - Entry and Exit from Automotive Vehicles
chapter 9 - Automotive Exterior Interfaces: Service and Loading/Unloading Tasks
chapter 10 - Automotive Craftsmanship
chapter 11 - Role of Ergonomics Engineers in the Automotive Design Process
chapter 12 - Modeling Driver Vision
chapter 13 - Driver Performance Measurement
chapter 14 - Driver Workload Measurement
chapter 15 - Vehicle Evaluation Methods
chapter 16 - Special Driver and User Populations
chapter 17 - Future Research and New Technology Issues

Bhise, V.D. 2012, Ergonomics In The Automotive Design Process, CRC Press, Boca Raton, Florida, USA..

And The Ethics ?

Ethics



The objects that people use, despite their incredible diversity and sometimes contradictory usage, appear to be signs of a blueprint that represent the relation of man to himself, to his fellows, and to the universe.

Csikszentmihalyi, M. and Rochberg-Halton, E. 1981, The Meaning of Things: domestic symbols and the self, Cambridge University Press, Cambridge, UK

Ethics

There are a large number of ethical theories.

Inspection of even a few of the most popular suggests important differences in perspective and criteria.

A major distinction is that between the “intention” and the “consequence” of an action.

Ethical Egoism	The right action is the one which advances one’s own best interests. The interests of others are only relevant if helpful to promoting one’s own good.
Utilitarianism	The right action is the one which achieves the best balance between happiness and unhappiness, across all of the people who are involved.
Natural Law Theory	The right actions is the one which is consistent with nature, i.e. with its revealed characteristics, purposes and goals.
Virtue Ethics	The right act is the one which produces happiness and flourishing due to increasing natural virtues and progressing towards a natural purpose.
Kantian Ethics	The right action is the one which is performed out of a sense of duty, rather than because of contextual factors such as the effects of the act. Right actions are performed based on good will and duty for duty’s sake.
Social Contract Theory	The right act is the one which is consistent with the implicit or explicit social contract in which self-interested and rational people agree the behaviours which ensure their safety, peace and prosperity.
Feminist Ethics	The right act is the one which corrects how gender operates within our beliefs and practices. It supports personal relationships, considers the emotions involved and emphasises care.

Applied Ethics: the practical application of moral considerations.

Table 1 Ethical issues, hazards and risks

Ethical issue	Ethical hazard	Ethical risk	Mitigation	Comment	Verification/ Validation
Societal	Loss of trust (human robot)	Robot no longer used or is misused, abused	Design to ensure reliability in behaviour	If unexpected behaviour occurs, ensure traceability to help explain what happened	User validation
	Deception (intentional or unintentional)	Confusion, unintended (perhaps delayed) consequences, eventual loss of trust	Avoid deception due to the behaviour and/or appearance of the robot and ensure transparency of robotic nature	–	Software verification; user validation; expert guidance
	Anthropo-morphization	Misinterpretation	Avoid unnecessary anthropomorphization Clarification of intent to simulate human or not, or intended or expected behaviour	See deception (above) Use anthropomorphization only for well-defined, limited and socially-accepted purposes	User validation; expert guidance
	Privacy and confidentiality	Unauthorized access, collection and/or distribution of data, e.g. coming into the public domain or to unauthorized, unwarranted entities	Clarity of function Control of data, justification of data collection and distribution Ensure user awareness of data management and obtain informed consent in appropriate contexts	Privacy by design Data encryption, storage location, adherence to legislation	Software verification
	Lack of respect for cultural diversity and pluralism	Loss of trust in the device, embarrassment, shame, offence	Awareness of cultural norms incorporated into programming	Organizational, professional, regional	Software verification; user validation
	Robot addiction	Loss of human capability, dependency, reduction in willingness to engage with others, isolation	Raise awareness of dependency	A difficult area, particularly in relation to vulnerable people Careful evaluation of potential applications is needed	User validation; expert guidance

BRITISH STANDARD

BS 8611:2016

BS 8611: 2016 Robots and Robotic Devices: guide to the ethical design and application of robots and robotic systems.

Applied Ethics: the practical application of moral considerations.

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Ethical issue	Ethical hazard	Ethical risk	Mitigation	Comment	Verification/ Validation
Commercial/ Financial	Employment issues	Job replacement, job change, unemployment, loss of tax revenue	Appropriate support networks, appropriate taxation, retraining opportunities	Note literature on robot economics	Economic and social assessment
	Equality of access	Propagation of the "digital divide", isolation of minorities, non-compliance with human rights legislation	Inclusive design of robot behaviour to conform with Corporate Social Responsibility, and recognition of characteristics of intended application domain Support networks to minimize risks	–	Legal assessment; software verification
	Learning by robots that have some degree of behavioural autonomy	Robot might develop new or amended action plans, or omit steps in processes, that could have unforeseen consequences for safety and/or quality of outcomes	Designers can enable robots to inform their operators when a new form of behaviour has been developed	Important consideration for human-robot trust	Software verification; user validation
	Informed consent	Unaware operators causing accidents, unwanted consequences, unfair and inequitable responsibilities placed upon consenter, inability to respond to situations	Design contracts to make explicit, in plain language, what the consenter is agreeing to, as far as the robot is concerned, including risks Also, contracts to make plain what personal or private information could be passed on to the network(s) to which the robot is connected	In principle, the actions of sets of robots, especially when networked, is nearly unlimited There are privacy and security issues that might arise as robots working in close co-ordination with humans become more informed about human behaviour	User validation

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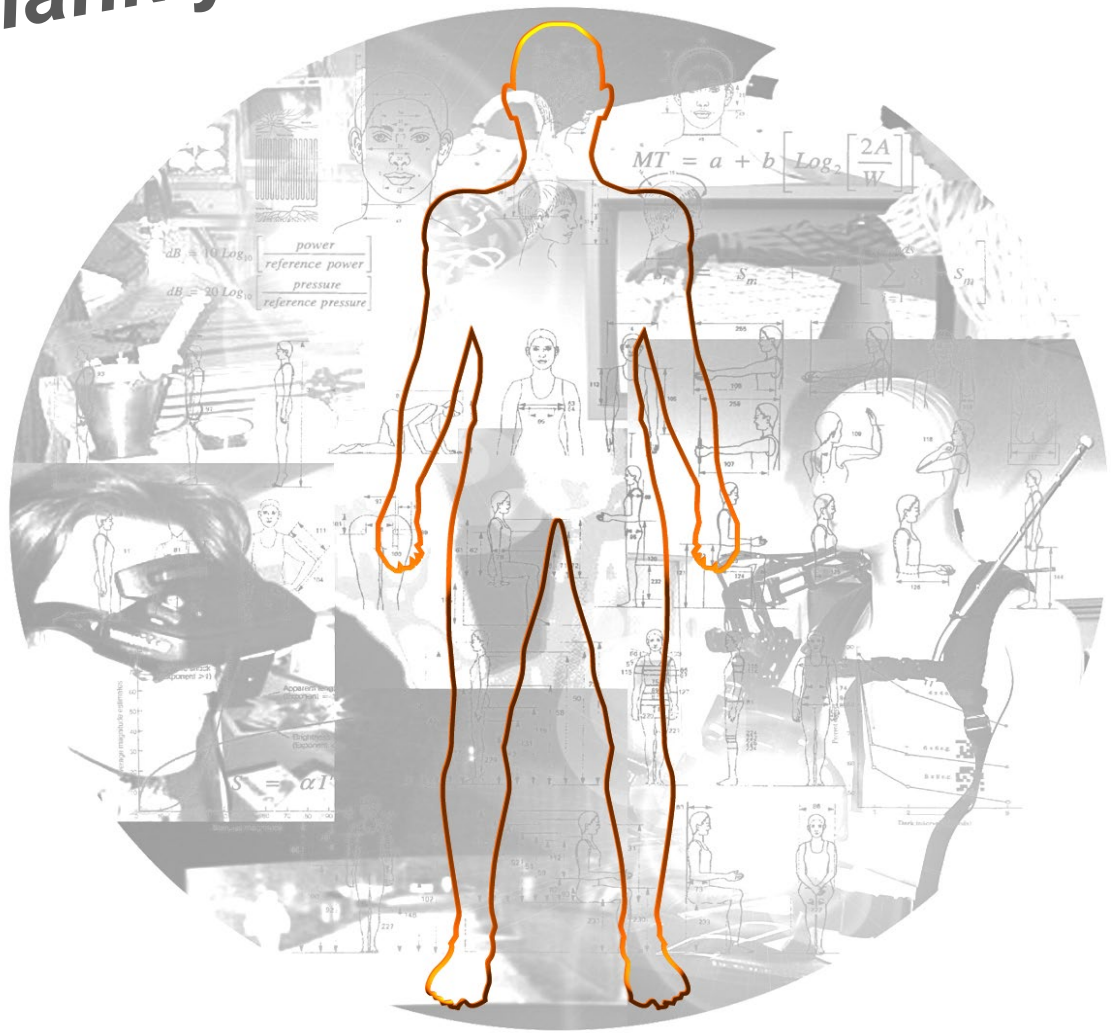
Commercial/ financial	Informed command	User is unaware of extent or legality or social acceptance of the tasks given to the robot, consequences of the tasks might ramify in unexpected ways and extents	As a principle, robots ought to only act on the basis of a properly-constructed command. If the robot cannot construe such a command from the human's communication, it ought to seek further guidance	A generally accepted principle is that "the last person to issue a command is responsible for its outcome". For equity, safety and security, it is necessary to ensure that operators are as informed as possible about the capabilities and limitations of the robots that they utilize[A]	Software verification
Environmental	Environmental awareness (robot and appliances)	Cause concerns about wastage and destruction of the environment Failure to conform to regulations and/or codes of practice designed to protect the environment resulting in harm to the society	Adopt good/best management practice in design (see BS EN ISO 9000 series) and support for recycling and other circular economy activities	Likely to be of steadily-increasing importance	Life cycle compliance tests
	Environmental awareness (operations and applications)	Execution of non-sustainable actions, harm to local situation, reputational harm	Good/best management practice (see BS EN ISO 14000 series) built into contract terms, design of robot sensing to ensure recognition and labelling of physical environment, and, particularly in relation to pick-and-place actions, sources and sinks are known	–	Compliance tests

[A] For examples of "properly-constructed commands", designers and operators can consult NATO's C-BML (Coalition Battle Management Language). See 5.1.12.

BS 8611: 2016 Robots and Robotic Devices: guide to the ethical design and application of robots and robotic systems.

Thank you.


$MT = a + b \left[Log_2 \left[\frac{2A}{W} \right] \right]$
$dB = 10 Log_{10} \left[\frac{power}{reference\ power} \right]$
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