Agency in Human-Machine Networks; Impacts on Trust and Behaviour

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• Agency forms part of the HUMANE typology
  – Describes the capabilities of the human and machine actors
• Agency: a much debated topic in the literature
  – Several theoretical models of human agency
  – However, debate on whether machines can exhibit agency
    – Platforms, software components/agents, devices and infrastructure, sensors, robots, ...
• We have revisited definitions to be useful for the purposes of analysing, understanding and designing HMNs
  – Needs to be *practical* and useful for HMN designers
What is agency?

• According to Structuration Theory (ST):
  – “the capability to make a difference” (Giddens 1984)

• According to Actor Network Theory (ANT):
  – “[no] difference in kind between people on the one hand, and objects on the other” (Law, 1992)

• According to Social Cognitive Theory (SCT):
  – “agency refers to acts done intentionally” (Bandura 2001)

• Thus, we have a conflict…
  – Intentionality implies agency is exclusive to humans
  – This is a sticking point for some regarding actor-network theory

Intentionality – Bandura (2001) cont.

- Intentionality encompasses the ability to choose to behave in a certain way
  - in particular with a future course of action in mind.
- Related to forethought
  - setting goals, which affects behaviour in order to achieve desired outcomes and avoid undesired ones.
- Linked to motivation
  - guides the chosen actions and anticipations of future events, which “provides direction, coherence, and meaning to one’s life” (Bandura 2001)

So, what about the machines?

• Compared to humans, machines do not...
  – have self-generated intention or motivation
  – experience trust or reliance, nor behave altruistically or irrationally of their own volition

• However, there is a need to refer to ‘machine agency’
  – active participants in increasingly significant roles
  – influencing other agents and the outcomes of the HMN itself

• Some have argued similarly in other contexts and include machine agency in one way or another, e.g.,
  – Actor-Network Theory (Law 1992)
  – Double Dance of Agency (Rose and Jones 2005)
  – Increasing complexity of machine algorithms (Hildebrandt, 2015)

A practical definition

“The capacity to perform activities in a particular environment in line with a set of goals/objectives that influence and shape the extent and nature of their participation” (Engen et al., 2016)

– Whether human or machine
– Environment being the HMN

Three factors that can be used to quantify agency:

1. the activities the agent can perform (quantity, freedom vs restriction)
2. the nature of the activities (open vs closed, predictability, emergence)
3. the ability to interact with other agents (exert influence)
4. perceived agency for machines

Machine agency

• In practical terms, our definition of machine agency reflects the degree to which machine agents may
  a) perform activities of a personal and creative nature (e.g., supporting health care by personalising motivation strategies),
  b) influence other agents in the HMN (thus, “make a difference”),
  c) enable human agents to exercise proxy agency, and
  d) the extent to which they are perceived as having agency by human agents (anthropomorphism).
Examples of human agency

Many activities, open nature, much interaction

Few activities, closed nature, no interaction
Characterising HMNs – agency

• Informs analysis of implications for the design of the HMN, e.g.,
  – Trust, user adoption, participation, motivation, collaboration, etc.
  – Robustness, failover, interoperability, integrity, security, etc.

• Particularly useful for HMNs that have different states

• eVACUATE – a complex network
  – Emergency decision support for crowd management
  – 2 states
    – Normal operation (monitoring)
    – Crisis → evacuation
AGENCY, TRUST AND BEHAVIOUR
Definition of trust

“the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (Mayer et al., 1995, p.712)

- In short: willingness to expose oneself to vulnerability.
- Involves risk assessment to decide whether to make oneself vulnerable (Shin, 2010).

Agency and trust

- Trust is important for technology acceptance (Mayer et al., 1995) and intentions to explore technology (Thatcher et al., 2011).
- Machines perform more complex and autonomous tasks → increasing the agency
  - Opportunities for innovation (Følstad et al., 2017).
  - However, implications for trust relationships.
    - Are humans becoming more reliant or even dependent on the machines?
    - Necessary to control agency for ethical reasons? How to manage accountability & responsibility?
  - Trust is increasingly important to develop and maintain.

Model of key influences on behaviour in HMNs

- Trust model of 7 key inter-related constructs affecting the behaviour of people in HMNs
  - Expanding model of Thatcher et al. (2011) into the wider ecosystem (risk, regulation and agency)
(Computer) self-efficacy

- Related to human agency, and affected by machine agency.
- Positively correlated with the behaviour in the HMN, but negatively correlated with perceived risk.
• Positively correlated with human agency.
• Mediates the effects of human agency on the behaviour in the HMN.
• Negatively affected by perceived risk.
• Perceived risk and machine agency negatively correlated with changes in regulation.
• Regulation affects human agency.
Use of the model

1. Informing implication analysis, e.g.,
   – What if we are able to reduce perceived risk?
     – We can expect an increase in trust.
     – In turn, increase in trust influences the behaviour of people in the HMN.
   – Strategies for reducing perceived risk, e.g.,
     – Increase regulatory control.
     – Encourage users' belief in their own abilities in the HMN (self-efficacy).

2. Understanding behaviour in a network
   – Identifying and addressing key influences on behaviour.
   – E.g., people stopping to use the HMN due to a break-down in trust.
     – How to re-build trust → implication analysis (above).
CONCLUSIONS AND FURTHER WORK
Conclusions and further work

• Established practical definitions of human and machine agency
• Proposed a model describing the key influences on the behaviour of people in HMNs
  – Extending the work of Thatcher et al. (2011) → wider ecosystem
  – Increase our understanding of the interplay between agency and trust, and other key constructs such as social norms and self-efficacy
• Model to be evaluated
  – First via an expert group (familiar with trust, H2M interactions and technology)
  – Then via a quantitative survey (extending instruments from previous research) → factor analysis to validate hypotheses
Thank you!

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