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Privacy-Aware and Acceptable Video-Based Technologies and Services for Active and Assisted Living

Perceptions of personal privacy in different users regarding health monitoring technologies

ESR1 Caterina Maidhof

Stockholm University

19.04.2023

Research Progress

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Universitat d'Alacant
Universidad de Alicante
Project Coordinator

RWTH AACHEN UNIVERSITY

Stockholm University

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

TU WIEN

ESR 1. Caterina Maidhof – Overview of the Presentation

1. **Goal and Relevance of the project** 🎯
2. (Short) Literature Recap 🔄
3. Open Questions addressed in the project ❓❓❓
4. Past Research ✔️
5. Research Progress ➡️
6. The Future 🔮
7. Publications 📚

Perceptions of personal privacy in different users regarding health monitoring technologies

- **Goal**

  - context-specific ***privacy needs*** and ***privacy preferences*** and ***trade-offs*** of potential users of different video-based AAL- and lifelogging technologies.
  - elaborate understanding of privacy as an influencing factor of video-based AAL ***technology acceptance***

- **Relevance**

  - informed, effective, and well ***targeted communication strategies*** for each user group of potential users
  - ***Inform technical designers*** about the privacy needs outlined that needs to be considered for matching the technological functioning accordingly

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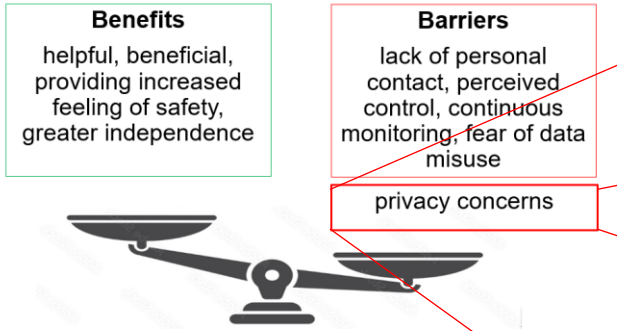
- Cognate-based approach in social science:
  - classified as behaviour, predisposition of the individual to behave (Smith et al., 2011)
  - considered as state of mind or assertion of control
    (Alpert, 2003; Westin, 1967; Goodwin, 1991; Milne, 2000)

- **WHY?** Privacy satisfies basic human needs (i.e., contemplation, autonomy, rejuvenation, confiding and creativity)

- **HOW?** The optimum level op privacy is reached through boundary regulation processes (i.e., behavioural mechanisms, paraverbal/verbal expressions and movements, cultural norms and customs)
  Altman, 1975, 1976; Pedersen, 1979, 1997, 1999; Smith et al., 2011; Uysal, et al., 2010



Privacy Concerns

misuse of data access

misuse of personal information

continuous surveillance

invasion of personal space

obtrusiveness

being naked and vulnerable

Beringer et al., 2011; Demiris et al., 2004; Kirchbuchner et al., 2015; Peek et al., 2014; Yusif et al., 2016; van Heek et al., 2018; Arning & Ziefle, 2015; Mulvenna et al., 2017; Berridge et al., 2019

Benefits

helpful, beneficial, providing increased feeling of safety, greater independence

Barriers

lack of personal contact, perceived control, technical issues, false alarms, feeling of incapacitation

privacy concerns

Beringer et al., 2011; Demiris et al., 2004; Kirchbuchner et al., 2015; Peek et al., 2014; Yusif et al., 2016; van Heek et al., 2018; Arning & Ziefle, 2015; Mulvenna et al., 2017; Berridge et al., 2019

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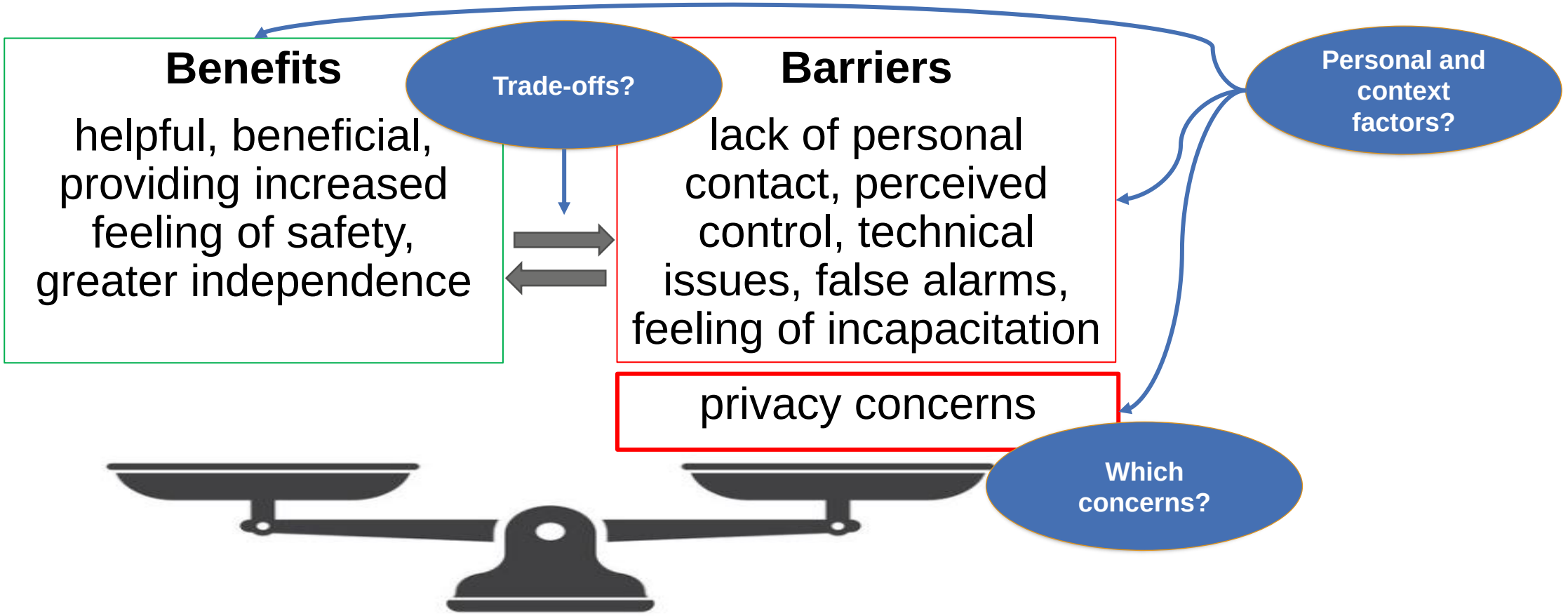

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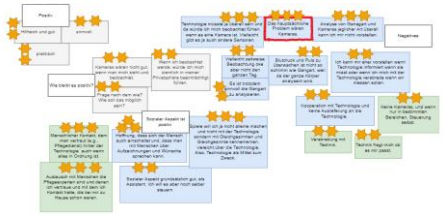
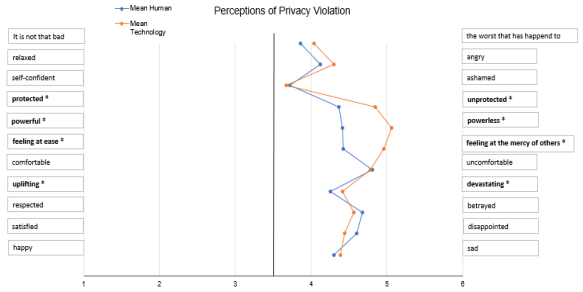
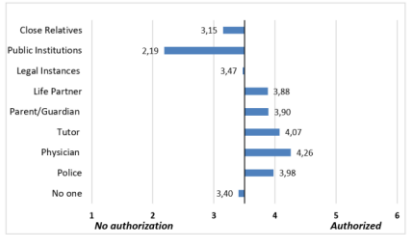
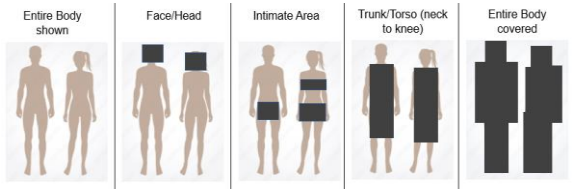
ESR 1 Caterina Maidhof – Past Research

- Creation of mental maps of living with AAL (Maidhof et al., 2022)
  - Privacy themes emerged: Handling of Data, Handling technology, Sensitive Activities
- Scoping Review: Privacy and Acceptance of video-based AAL (Mujirishvili et al., 2023)
- Affective perceptions of privacy Invasion by human vs. technology and related concerns (Offerman, Maidhof & Ziefle, 2023)
  - Invasion by technology perceived significantly more unprotected, powerless, at mercy of others, devastating
  - Main concerns: data misuse, more people seeing data, unpleasant
- Privacy Invasion by various stakeholders (Maidhof et al., 2023)
  - Privacy invasion is least critical for physicians and most critical for public institutions
- Comfortableness of being filmed and Nudity Visualization Preferences (Maidhof & Hashemifard et al., 2022)
  - Intimate activities such as toileting, washing oneself, changing clothes are most uncomfortable to be filmed – even when needing care
  - Nudity and visualization of skin have a negative influence on technology acceptance









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Questions

- In which **context** should privacy and acceptance be measured?
  - Privacy is dependent on the **activity**
  - Specific assessment of household, social and intimate activities
- What **personal characteristics** might have a relevant influence on the evaluations?
  - Privacy is dependent on **user diversity**
  - Demographics and Personality (i.e., self-awareness, autonomous functioning)

Empirical Methods

1. Qualitative pre-study to understand which activities of daily living, benefits, barriers and conditions are most relevant for video-based AAL monitoring
2. Conceptualization of **quantitative online questionnaire**

Start

Characteristics of Participants

- **Demographics** (age, gender, education, living situation)
- **Health** (chronic illness) **& Care** (need for care, care experience)
- **Personality** (BFI, self-awareness, Fenigstein, 2009) **& General Technical Understanding** (adapted from Beier, 1999, 2003)
- **General Privacy Understanding** (adapted from Burgoon, 1982)

- **Privacy need for 25 activities of daily living**

Video based AAL and Monitoring of Activities of Daily Living

Detailed Information about AAL and video based sensors

General Care Scenario: Living alone with video based AAL at home as an 80 year old person that needs care

- **General Acceptance of AAL**

Specific Scenario: Household Activity	***Specific Scenario:*** Social Activity	***Specific Scenario:*** Intimate Activity
Acceptance	Acceptance	Acceptance
Benefits / Barriers	Benefits / Barriers	Benefits / Barriers
Technological Preferences	Technological Preferences	Technological Preferences

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ESR 1 Caterina Maidhof – Sample Description

Convenience sampling in summer 2022

Demographics

- **Age:** range: 17-81 (M=37.02; SD=16.32)
- **Gender:** 66.7% females, 33.3% males
- **Education:** 65.7% university degree, 27.7% A-level
- **Nationality:** N=102 German; N=44 Bulgarian

Health & Care

- 24.1% **chronic illness** (asthma, migraine, endometriosis, high blood pressure, diabetes)
- 6.4% **needing care** in daily life
- 40.6% **have cared** for another person (either professionally or informally)

ESR 1 Caterina Maidhof – Research Progress

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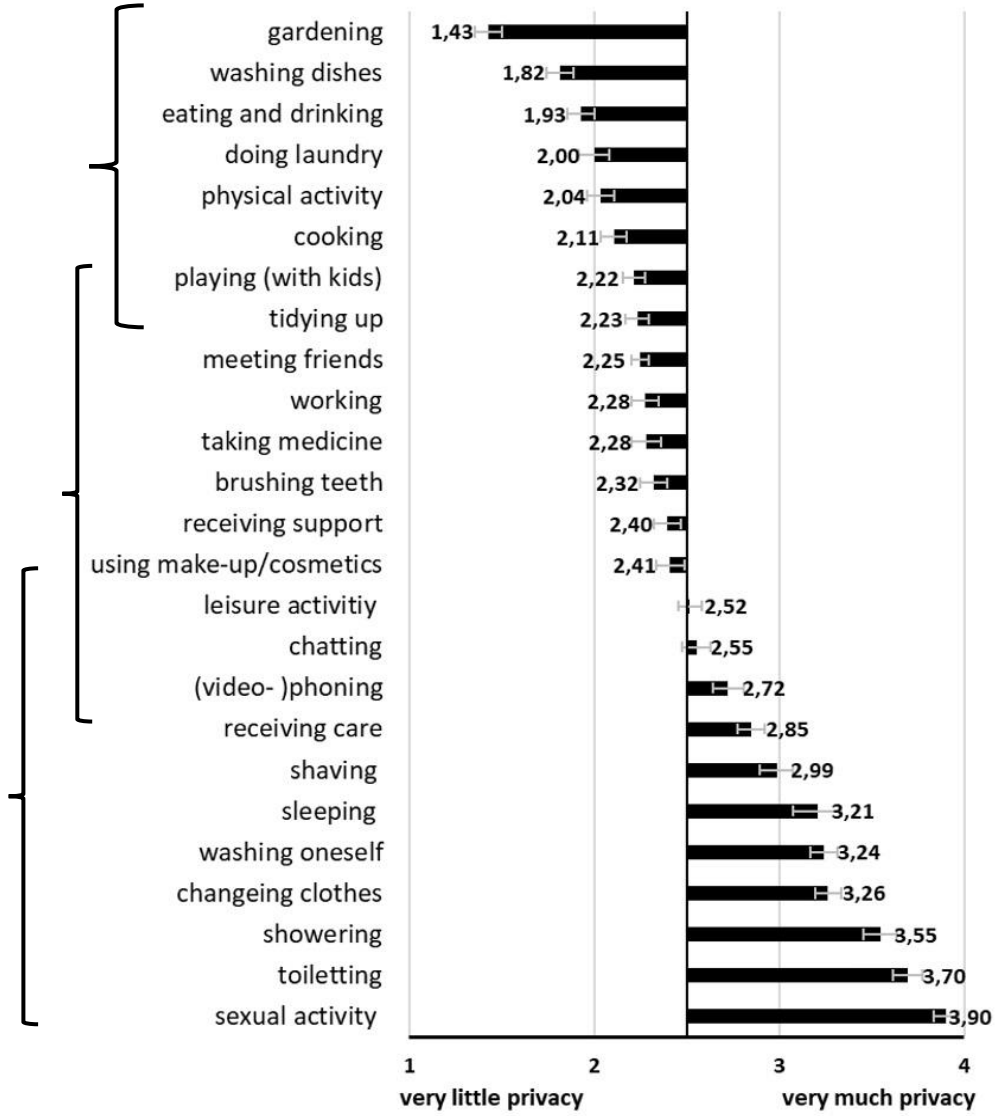
ESR 1 Caterina Maidhof – Privacy Need

Household Activities

Social Activities/
Care Activities

Intimate Activities



- 4 –point scale 1= very little privacy 4=very much privacy
- Mean values adjunct to bars. Error bars show standard error

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ESR 1 Caterina Maidhof – Privacy Need – Exploring individual differences (N=196)

- Explored data for individual differences regarding:
  - Age
  - Gender
  - Health Status
  - Academic Degree
  - Living Situation and Location

No differences found

We can assume that privacy needs are stronger and deeper than these individual differences

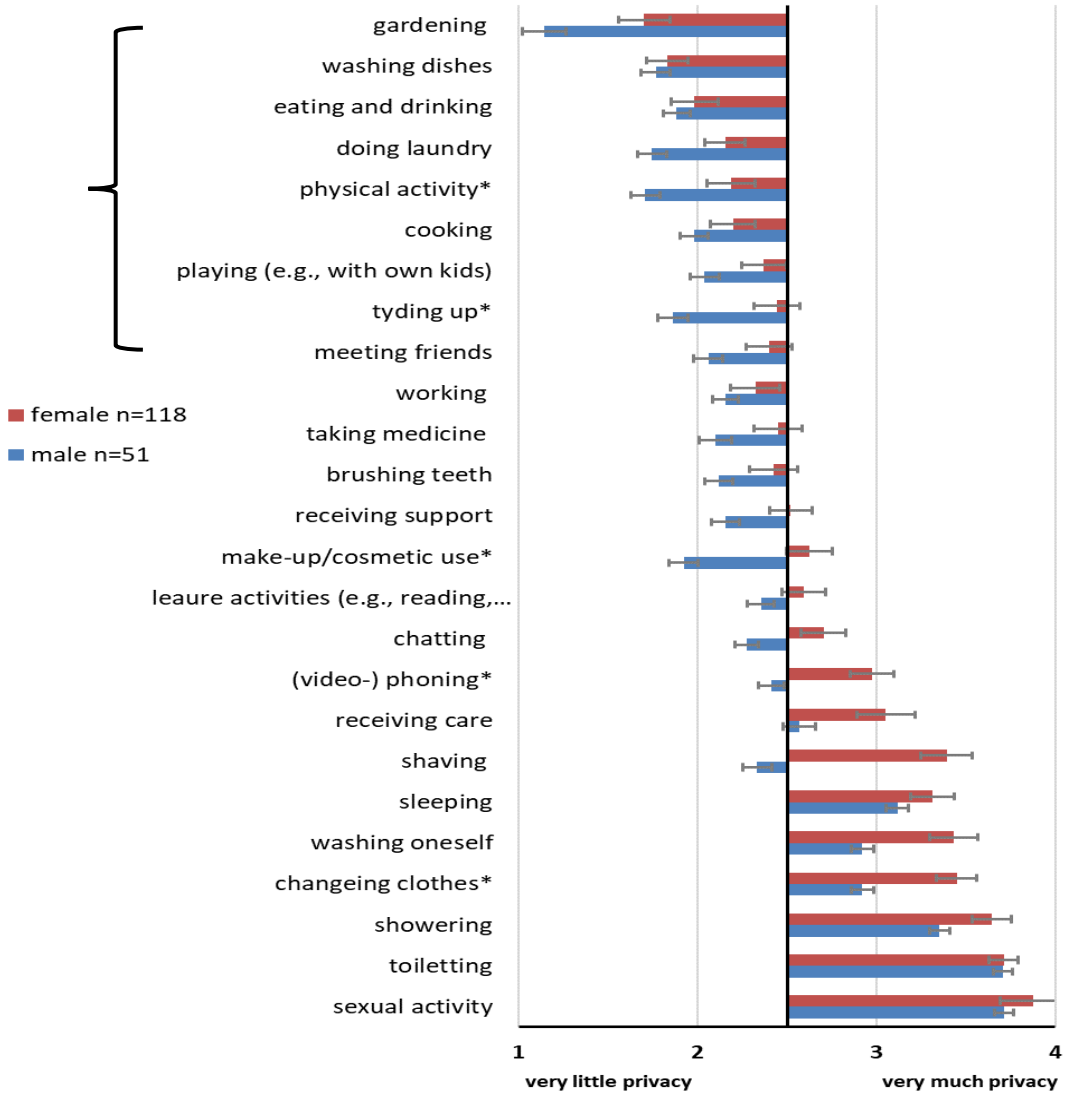
Independent samples t-tests with α= 0.002 (after Bonferroni correction)

ESR 1 Caterina Maidhof – Privacy Need – Gender differences

Household Activities

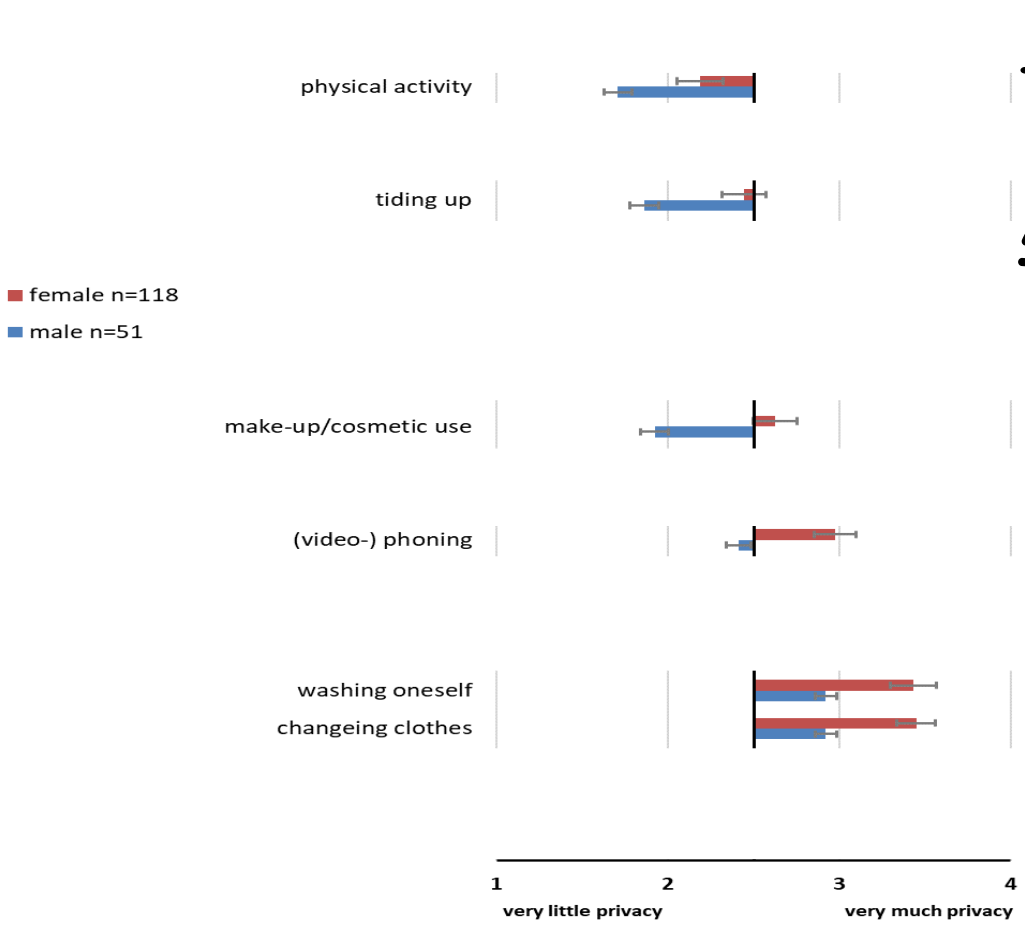
Social Activities/
Care Activities

Intimate Activities



ESR 1 Caterina Maidhof – Gender Differences

- Significant differences between male and female participants for specific activities
- Overall women seem to have a differentiated perception of privacy need for several Activities of daily living
- Article currently in preparation: Maidhof et al. What about gender roles in privacy perception and acceptance of video-based AAL?



Male: M=1.71, SD=0.944;
Female: M=2.19, SD=0.886
T(167) =-3.172 , p< .002

Male: M=1.86 , SD=0.917;
Female: M=2.44,SD=0.911
T(167) =-3.778, p< .000

Male: M=1.92, SD=0.913;
Female: M=2.63, SD=0.865
T(167) = -4.785, p< .000

Male: M=2.41, SD=0.876;
Female: M=2.97 , SD=0.789
T(86.715) = -3.948, p<.000

Male: M= 2.92, SD=0.796;
Female: M=3.43 , SD=0.698
T(74,001) =-3.439 , p<.001

Male: M=2.92, SD=0.796;
Female: M=3.45 , SD=0.674
T(167) =-3.172 , p<.000

ESR 1 Caterina Maidhof – Research **Progress**

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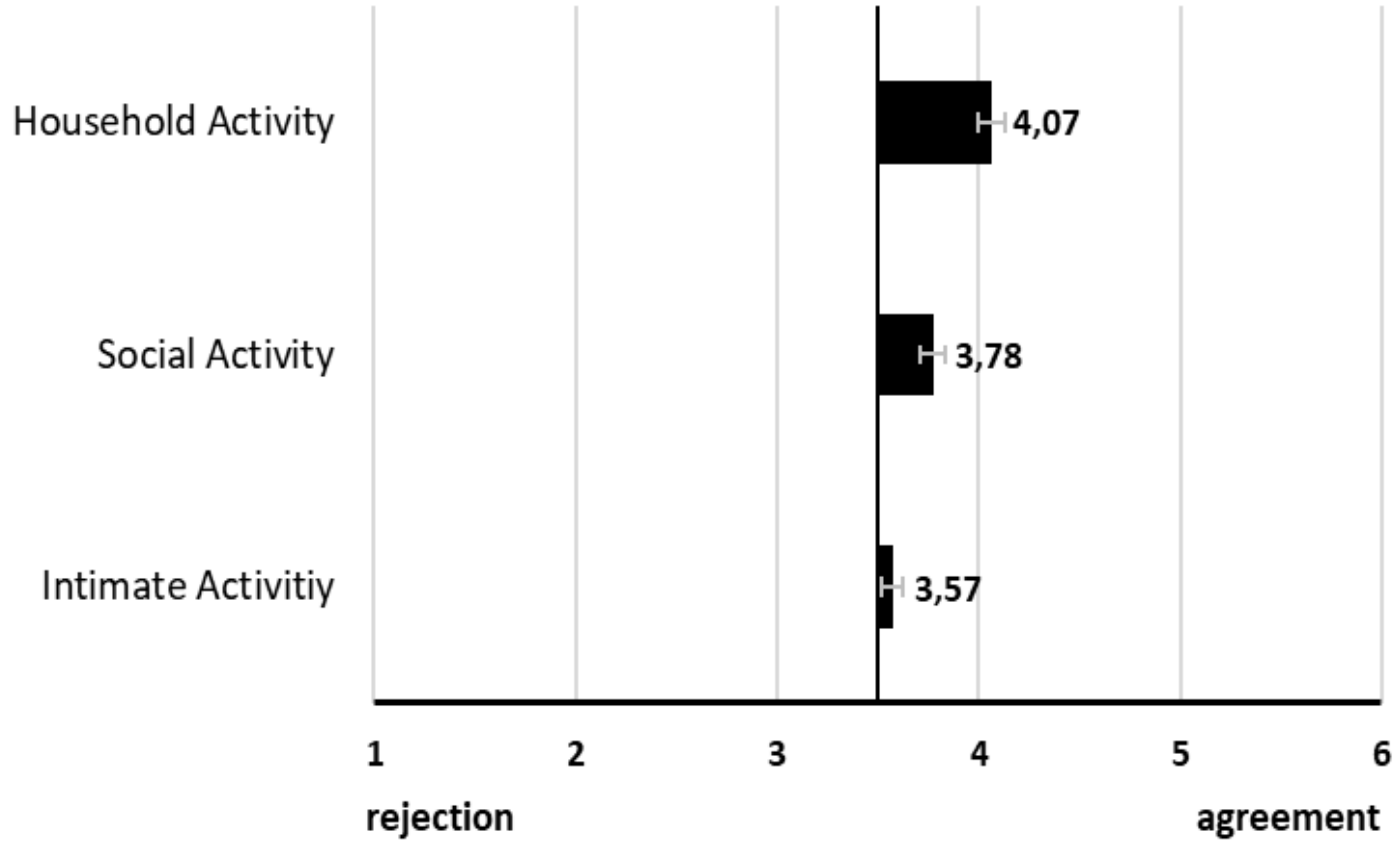
ESR 1 Caterina Maidhof – Acceptance – differences between activities



- Household activities have the highest agreement
- intimate activities have the lowest agreement
  - F(1.9, 284)=25.794, p <.000

Characteristics of Participants

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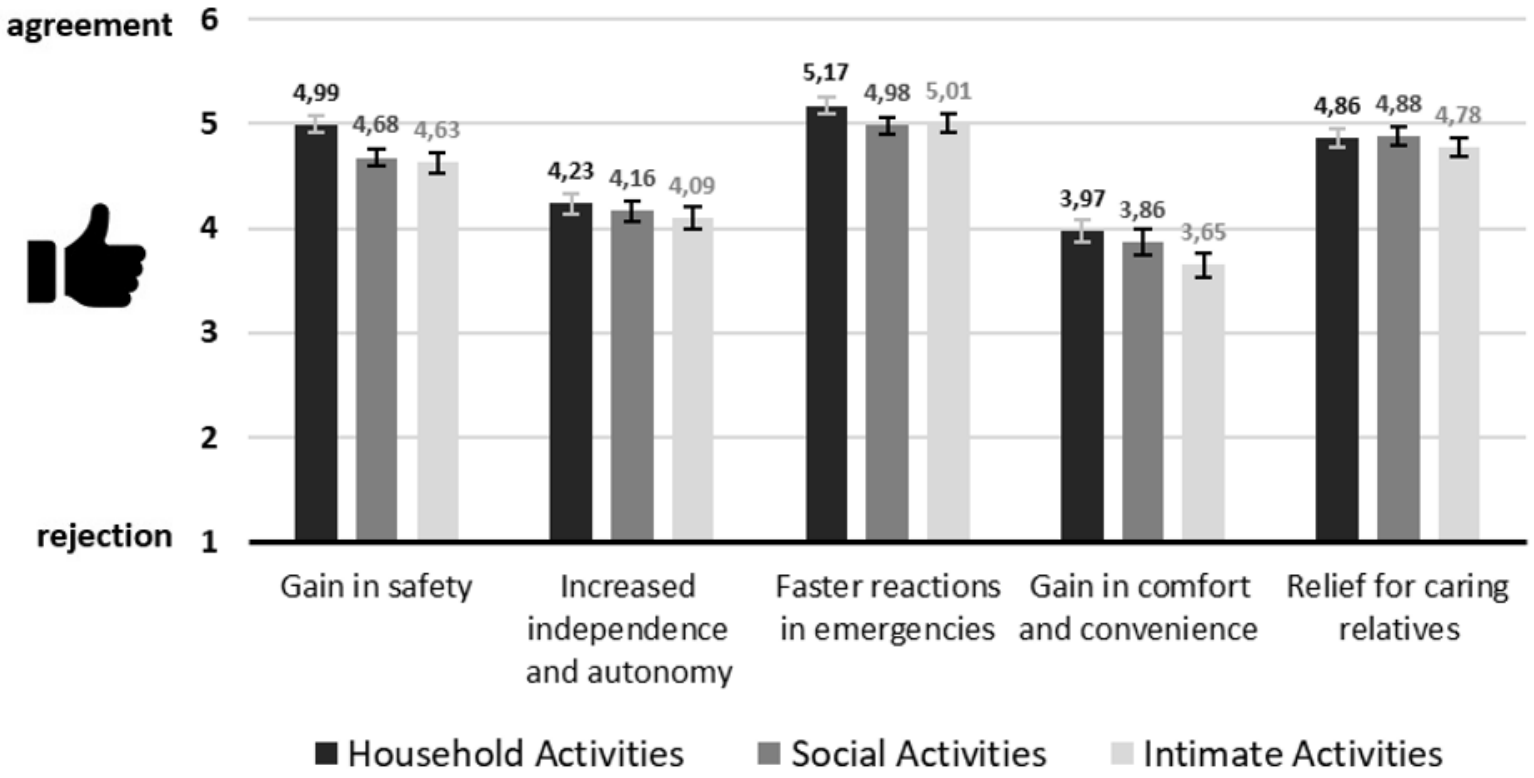
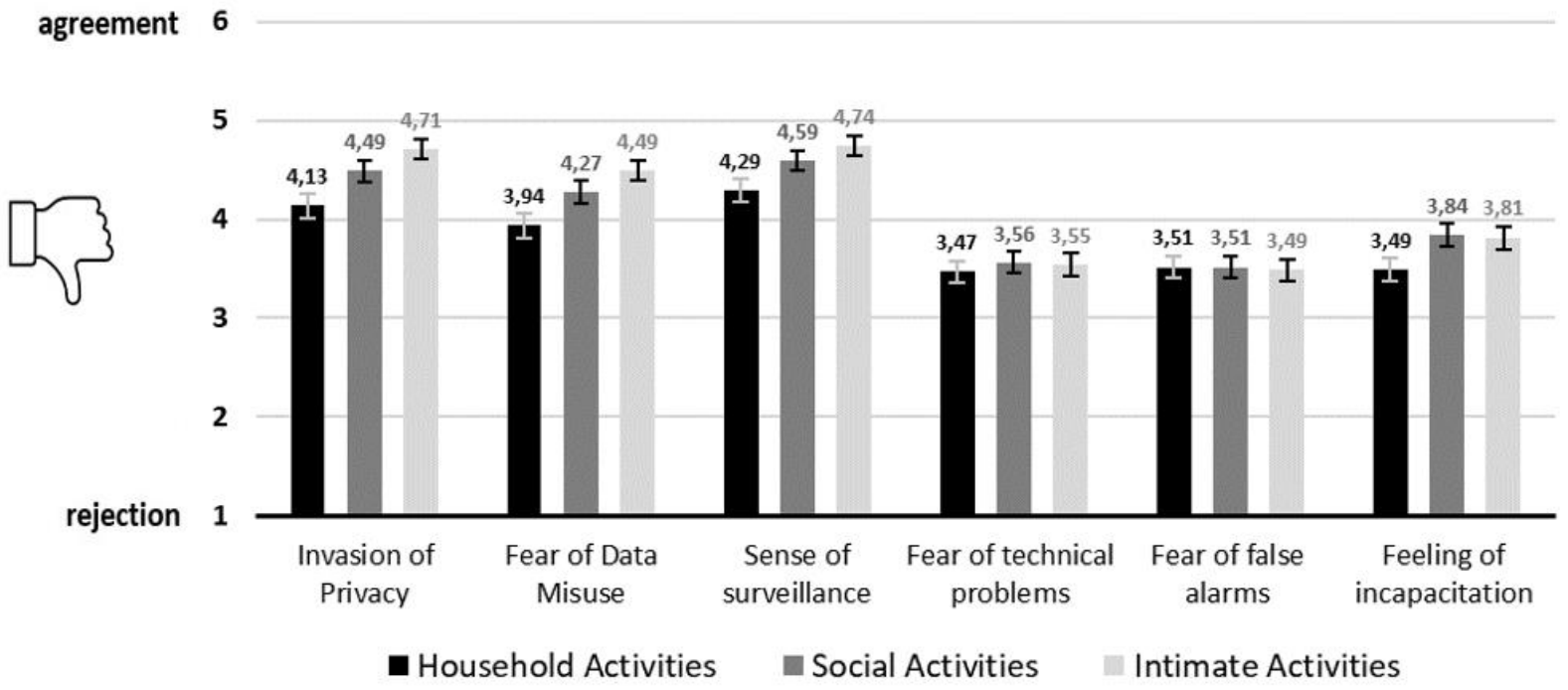
ESR 1 Caterina Maidhof – Benefits



- Faster Reactions highest rated benefit for all activities
- significant effect of activity type for:
  - Gain in safety:
    - F(2,276)=11.765, p< .000
  - Faster reactions:
    - F(1.9, 258,3)=4.39, p<.016
  - Gain in comfort and convenience:
    - F(2,276)=5.798, p<.003

ESR 1 Caterina Maidhof – Barriers



- Privacy Barriers are the highest rated barriers
- significant effect of activity type for:
  - Invasion of privacy:
    - F(1.7, 270.7)=16.620, p<.000
  - Fear of data misuse:
    - F(1.9, 263.7)=14.314, p<.000
  - Sense of surveillance:
    - F(1.9, 260.4)=11.492, p<.000
  - Feeling of incapacitation
    - F(2,278)=6.888, p<.001

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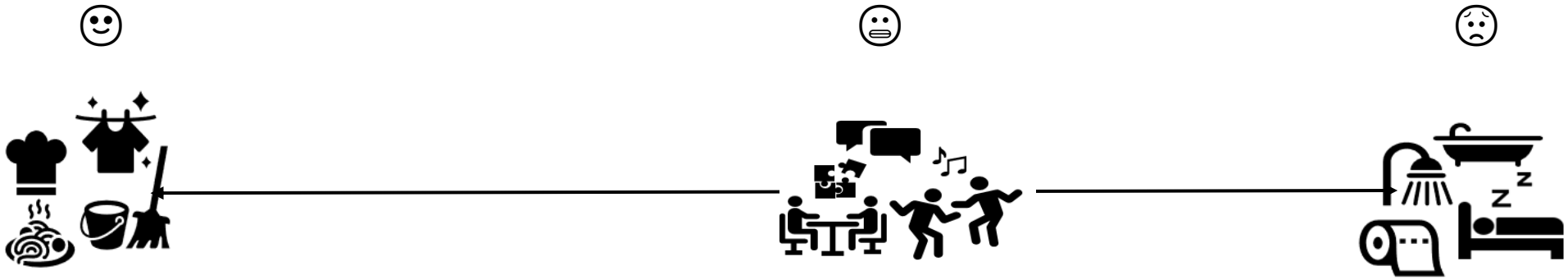
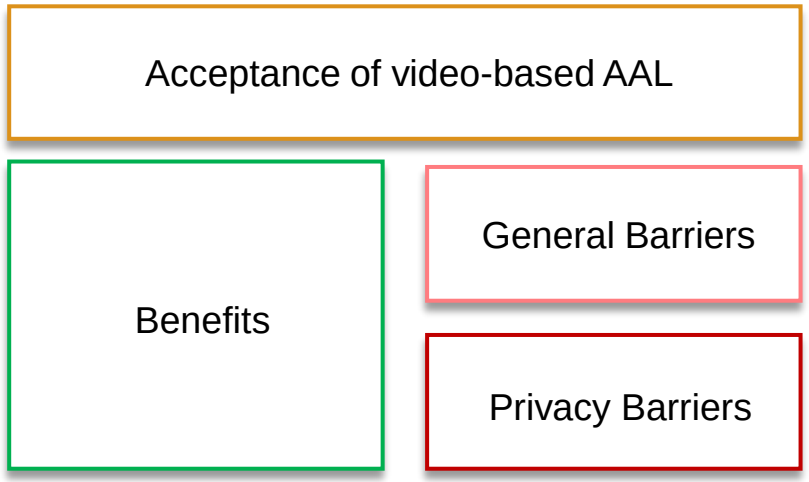
ESR 1 Caterina Maidhof – Differences between Activities



Two-step cluster analysis to identify segments/groups of participants according to their similarities in their evaluation patterns (Hair, 2011).

Based on constructs:



Cluster 1

- Mean Age: 34.24
- Medium/High ratings of Private-Self Consciousness
- Medium/High ratings of Public-Self Consciousness
- Medium/High General Privacy Perception

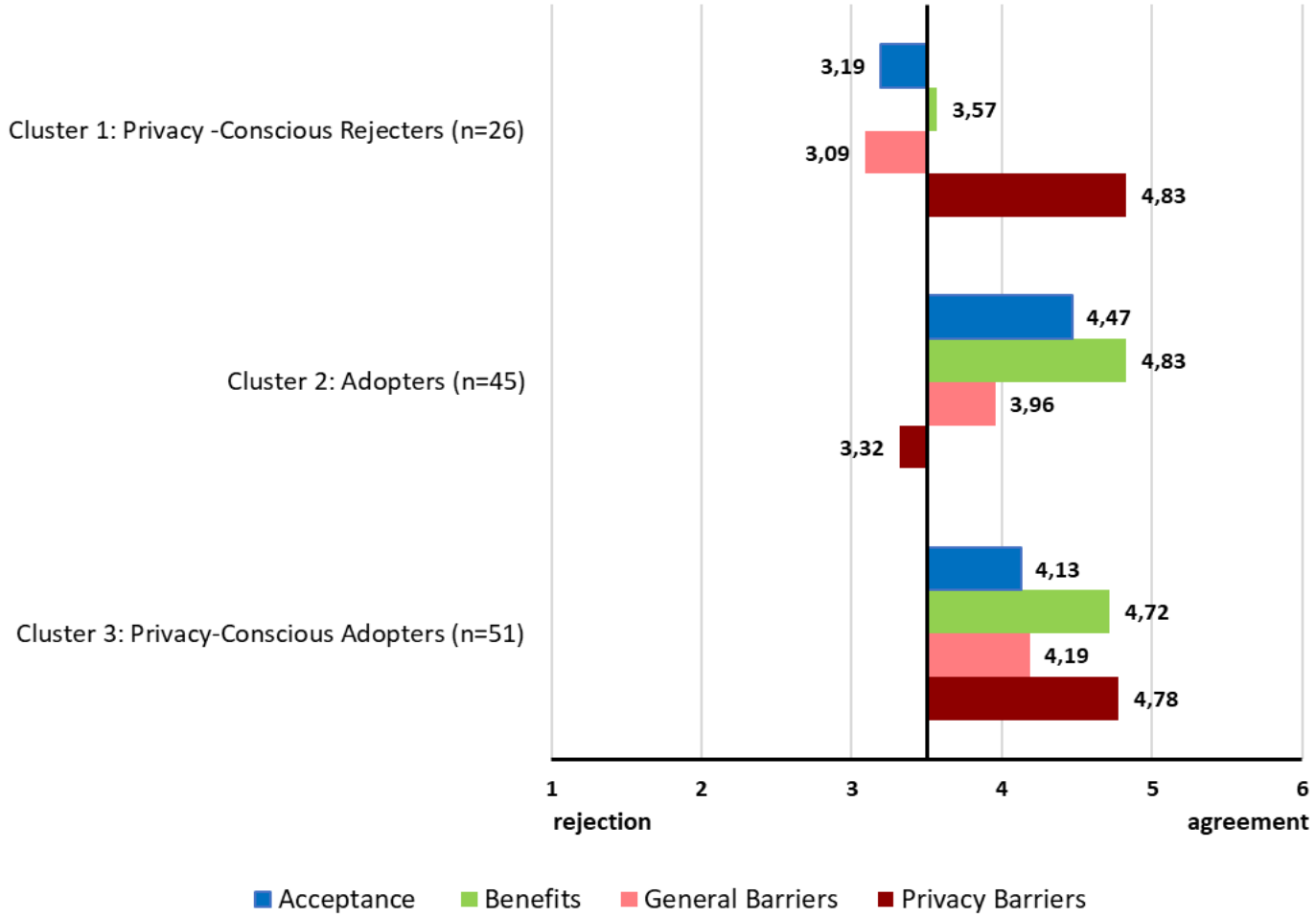
Cluster 2

- Mean Age: 45.00
- Lower ratings of Private-Self Consciousness
- Lower ratings of Public-Self Consciousness
- Lower General Privacy Perception

Cluster 3

- Mean Age: 33.71
- Highest ratings of Private-Self Consciousness
- Highest ratings of Public-Self Consciousness
- Highest General Privacy Perception

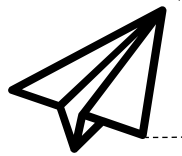
ESR 1 Caterina Maidhof – Research **Progress**



Cluster 1: Privacy-Conscious Rejecters

Cluster 2: Adopters

Cluster 3: Privacy-Conscious Adopters



Elaboration likelihood model of persuasion
(Petty & Cacioppo, 1986; Petty, Barden & Wheeler, 2009)

Central Route of Persuasion

- Facts and logical arguments
- Audience is capable and motivated to be attentive to and think about the issue-relevant information

Peripheral Route of Persuasion

- Superficial information, simple associations
- Audience gives little thought about issue-relevant information and relies on mental shortcuts and heuristics

Cluster 1: Privacy-Conscious Rejecters

- Lowest intention to use video-based AAL
- Highest perception of privacy barriers
- Medium/high ratings of privacy perception and medium/high self-consciousness

Cluster 2: Adopters

- Highest intention to use video-based AAL
- High perception of benefits
- Significantly older than two other clusters
- Lowest rating of self-consciousness and privacy perception

Cluster 3: Privacy-Conscious Adopters

- High intention to use video-based AAL
- High ratings of privacy barriers
- Highest evaluations of self-consciousness and privacy perception

Central route of communication

Based on technological evidence and logical arguments

Highlighting technical privacy preservation techniques (e.g., Climent-Pérez et al., 2020; Ravi et al., 2021)

Highlight legal basis and GDPR regulations applicable for AAL (e.g., He, 2022)

"The elaboration likelihood model of persuasion" (Petty & Cacioppo, 1986; Petty, Barden & Wheeler, 2009)

Privacy-Conscious Rejecters

- Lowest intention to use video-based AAL
- Highest perception of privacy barriers
- Medium ratings of privacy perception and medium self-consciousness

Adopters

- Highest intention to use video-based AAL
- High perception of benefits
- Significantly older than two other clusters
- Lowest rating of self-consciousness and privacy perception

Privacy-Conscious Adopters

- High intention to use video-based AAL
- High ratings of benefits and privacy barriers
- Highest evaluations of self-consciousness and privacy perception

Highlighting technic
Highlight

l., 2020; Ravi et al., 2021)
e.g., He, 2022)

Peripheral route of communication
Suitable testimonial
Focus on evoking emotions and positive associations

"The elaboration likelihood model of persuasion" (Petty & Cacioppo, 1986; Petty, Barden & Wheeler, 2009)

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Own Research

- Understand **trade-offs of privacy preferences** for accepting video-based AAL
- Meta-studies of **influencing variables** (e.g., gender, age, personality) on privacy preferences and acceptance of video-based AAL

Research Collaboration

- combine **trust**, **privacy**, and **perceptions of AI** in one study
  - scenario-based approach with experimental design
  - different types of technologies (non-AI vs. AI; camera types)
- with visuAAL colleagues **Sophia** and **Alex**

Secondment

- **2nd** secondment at Austrian Institute of Technology (**AIT**)
  - Planned start in September 2023
  - Planned contribution to Beaucoup-project.eu
    - creating solutions to improve how older adults explore and interact with cultural heritage, inside and outside museums and monuments.

ViBRANT Workshop

- **EICS 2023:** 15th international ACM SIGCHI conference devoted to engineering interactive computing systems and their user interfaces, addressing one or more software quality factors, such as usability, user experience, reliability, security, etc.

Call for Papers

the latest advancements in video-based AAL including their practical, real-life applications and methodological approaches to identifying the potentials and risks associated with using visual devices in healthcare settings.

- Submission deadline: **29.05.2023** for exteneded abstracts or original work
  - Planned workshop date 28.07.2023 in Swansea, UK
- With visuAAL colleagues **Irene** and **Wiktor**

ESR1 Caterina Maidhof – Publications

Journal | **Conference/Book Proceeding**

2022

Maidhof, C., Ziefle, M., & Offermann, J. (2022). Exploring Privacy: Mental Models of Potential Users of AAL Technology. In ***ICT4AWE 2022*** (pp. 93-104).
DOI: 10.5220/001104620000318

Maidhof, C., Hashemifard, K., Offermann, J., Ziefle, M., & Florez-Revuelta, F. (2022, June). Underneath Your Clothes: A Social and Technological Perspective on Nudity in The Context of AAL Technology. In ***Proceedings of the 15th International Conference on PErvasive Technologies Related to Assistive Environments*** (pp. 439-445). DOI:10.1145/3529190.3534733

2023

Offermann, J., Wilkowska, W., **Maidhof, C.,** & Ziefle, M. (2023). Shapes of You? Investigating the Acceptance of Video-Based AAL Technologies Applying Different Visualization Modes. ***Sensors***, *23*(3), 1143. DOI: 10.3390/s23031143

accepted

Maidhof, C., Offermann, J., & Ziefle, M. (2023). Living on Video: Insights on the User Perspective of Video-based AAL Technology.
In ***ICT4AWE* 2023**.

Maidhof, C., Ziefle, M., & Offermann, J. (2023). Don't you worry 'bout a Thing? Identification and Quantification of Relevant Privacy Parameters within the Acceptance of AAL Technology. **Springer Book of ICT4AWE 2022**

Offermann, J., **Maidhof, C.**, & Ziefle; M. (2023). Visual Ambient Assisted Living technologies for different daily activities: Users' requirements and data handling preferences. **HCI International 2023 Conference**.

Mujirishvili, T., **Maidhof, C.,** Flórez-Revuelta, F., Ziefle, M., Richart-Martínez, M., & Cabrero-García, J. (2023) Acceptance and Privacy Perceptions Toward Video-based Active and Assisted Living technologies: Scoping Review. **J Medical Internet Research.**

submitted/under review

Wilkowska, W., Otten, S., **Maidhof, C**., & Ziefle, M. Trust conditions and privacy perceptions in the use of accepted ambient technologies for health-related purposes. *(submitted to **Journal of Human-Computer Interaction**)*

Offermann, J., **Maidhof, C.,** & Ziefle; M. "Somebody is Watching Me? Analyzing Privacy Preferences in Using Visual AAL Technology Considering Human-, Technology-, and Context- Related Factors *(submitted to **Frontiers in Public Health**)*

Maidhof, C., Offermann, J., & Ziefle, M. Eyes on Privacy: Acceptance of video-based AAL impacted by activities being filmed. (*submitted to **Frontiers in Public Health**)*

Thank you!

Caterina Maidhof

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