visuAAL

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

TU Wien

29.11.2023

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. **Aim and objectives of the PhD** 
2. State of the Art – (short) literature recap 
3. Advancing the State of the Art: Open Questions addressed in the project 
4. Progress to date - Research 
5. Publications 
6. The Future (& Now) – Timeline and Career ambitions 
7. Feedback about VisuAAL 

Perceptions of personal privacy in different users regarding health monitoring technologies

- **Goal**

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

ESR 1. Caterina Maidhof - Goal and Relevance of the Project

Perceptions of personal privacy in different users regarding health monitoring technologies

- **Goal**

  - context-specific ***privacy needs*** and ***privacy preferences and concerns*** and ***trade-offs*** of potential users of different video-based AAL 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 of 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 related aspects

data access

personal information

surveillance

personal space

appearance

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

Privacy Concerns

Privacy related aspects

unauthorized data access

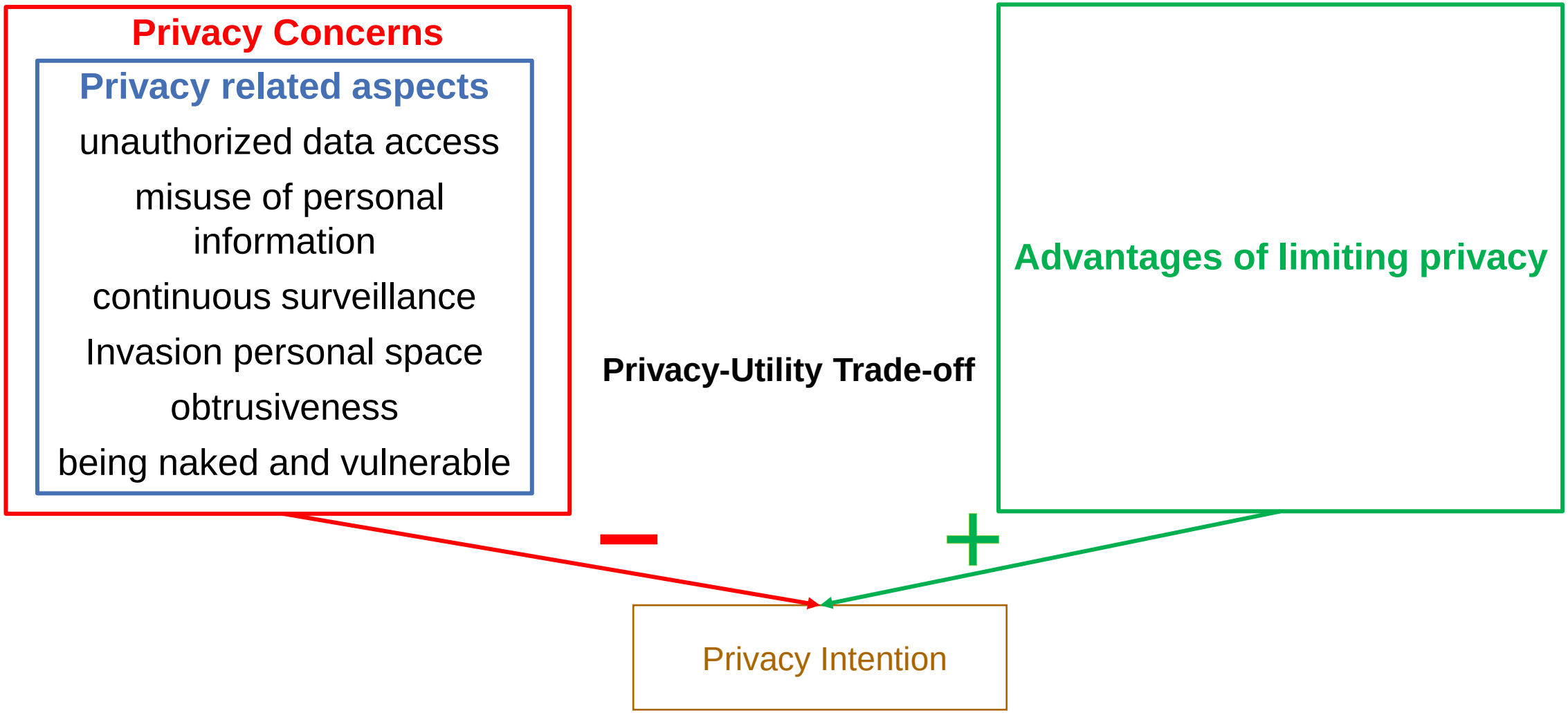
misuse of personal information

continuous surveillance

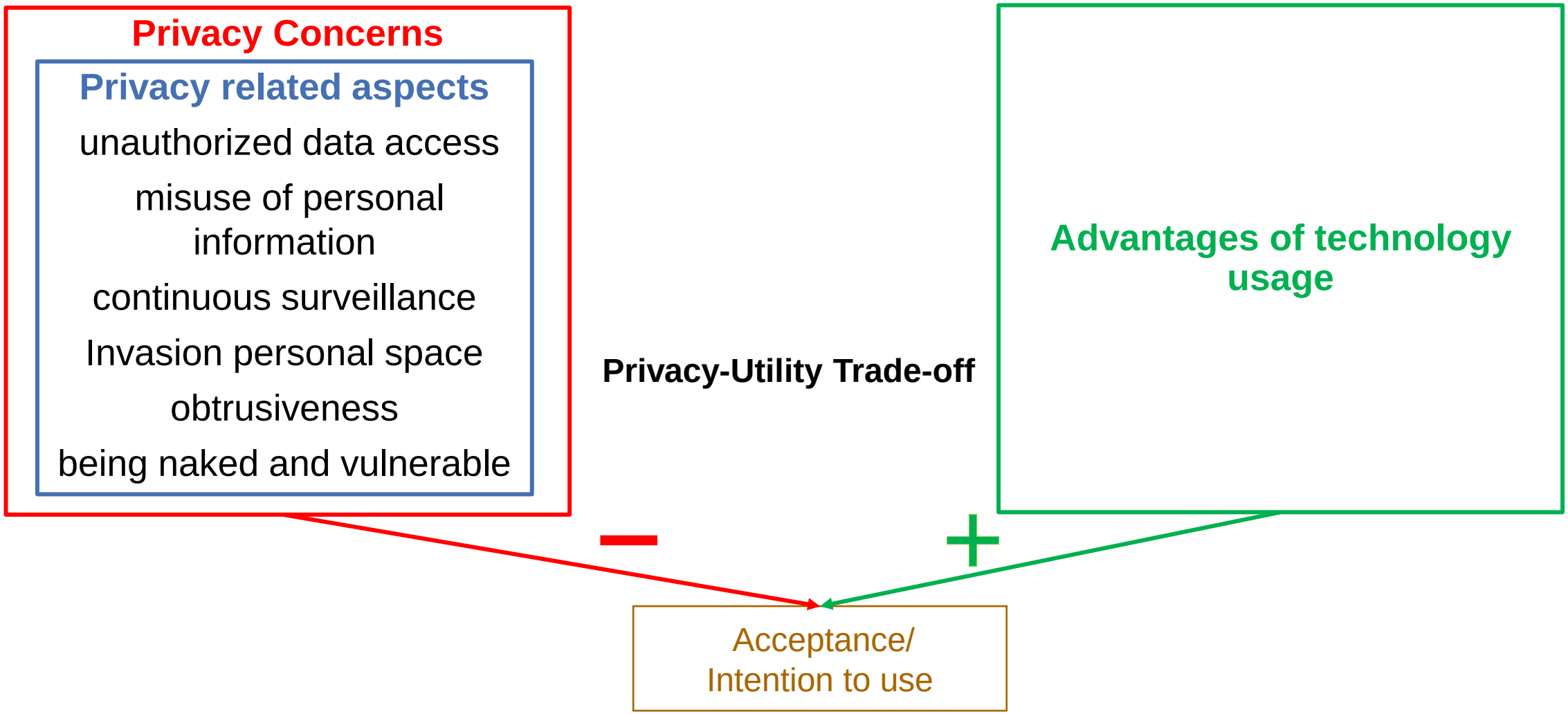
Invasion personal space

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; Smith et al., 2011; Dinev & Hart, 2006; Gerber, Gerber, Volkamer, 2018



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; Smith et al., 2011; Dinev & Hart, 2006; Gerber, Gerber, Volkamer, 2018; Lee et al., 2015; Krasnova et al., 2012; Trepte et al., 2017



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; Smith et al., 2011; Dinev & Hart, 2006; Gerber, Gerber, Volkamer, 2018; e.g., Li et al., 2016; Schomakers et al., 2020; Offermann, et al., 2019; Ermakova et al., 2014; Schomakers et al., 2021, 2022

ESR 1. Caterina Maidhof - Privacy and Trade-offs in Acceptance of AAL

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

Barriers

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

Benefits

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

privacy

versus

Barriers

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

Benefits

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

privacy

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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ESR 1. Caterina Maidhof - Open Questions addressed

What is privacy in video-based AAL? What are concerns of privacy?

Are privacy aspects influenceable?

To what extent is the perception of privacy related to the perception and acceptance of video-based AAL?

How are privacy aspects traded-off?

Understanding Privacy	**Influences on privacy perceptions**	**Modelling Privacy**	**Privacy decisions**
Within the context of video-based AAL and as a barrier and concern	Contextual factors and personal factors	Connections and relationships among relevant variables including acceptance	Trade-offs of privacy related factors in relation to each other

Qualitative (i.e., interviews, content analysis)	Theoretical modelling (i.e., structural equation modelling)	Applied testing (i.e., conjoint analysis)
Quantitative (i.e., questionnaire, descriptive and inferential statistical analysis)		

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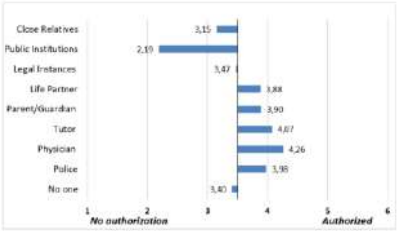
ESR 1. Caterina Maidhof - Past Research – Understanding Privacy

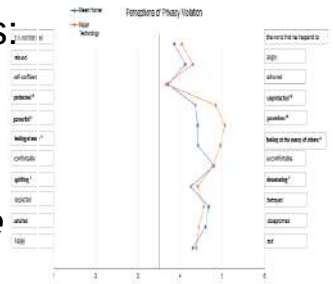
Understanding Privacy → Influences on privacy perceptions → Modelling Privacy → Privacy decisions

Creation of mental maps of living with AAL: Privacy themes emerged: ***Handling of Data, Handling technology, Sensitive Activities, Privacy Invasion***
(Maidhof et al., 2022)

Privacy Invasion by various stakeholders: Privacy invasion is ***least critical for physicians*** and ***most critical for public institutions***
(Maidhof et al., 2023b)



Affective perceptions of privacy invasion by human vs. technology and related concerns: Invasion by technology perceived significantly more unprotected, powerless, at mercy of others, devastating
Main concerns: ***data misuse, more people seeing data, unpleasant***
(Offerman, Maidhof & Ziefle, 2023c)



Comfortableness of being filmed and Nudity Visualization Preferences: 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
(Maidhof & Hashemifard et al., 2022)

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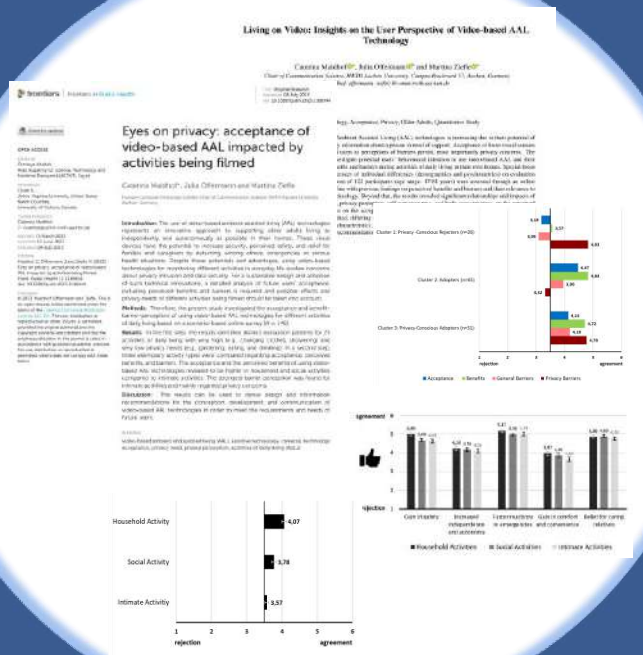
ESR 1. Caterina Maidhof - Past Research – Influences

Understanding Privacy

Influences on privacy perceptions

Modelling Privacy

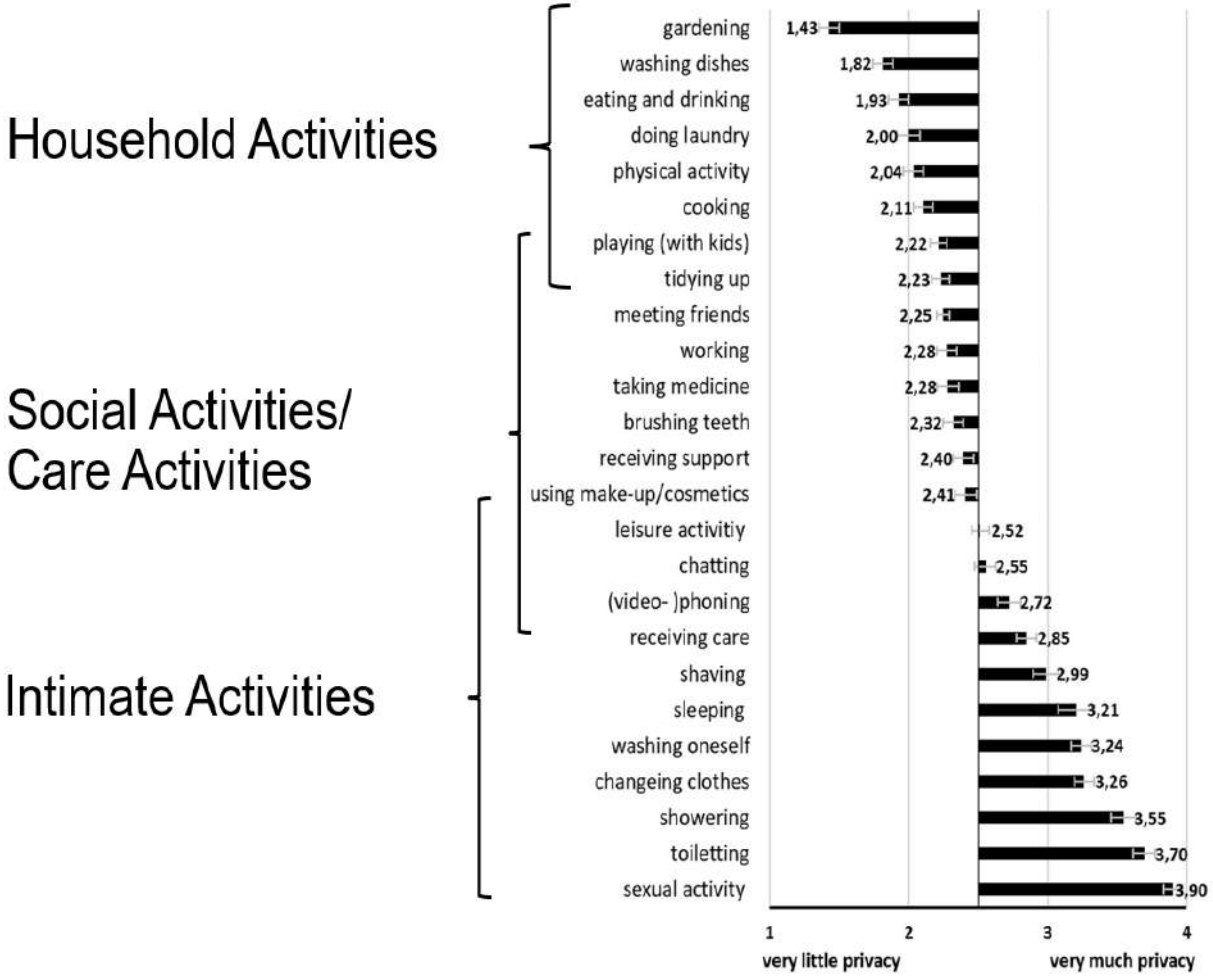
Privacy decisions



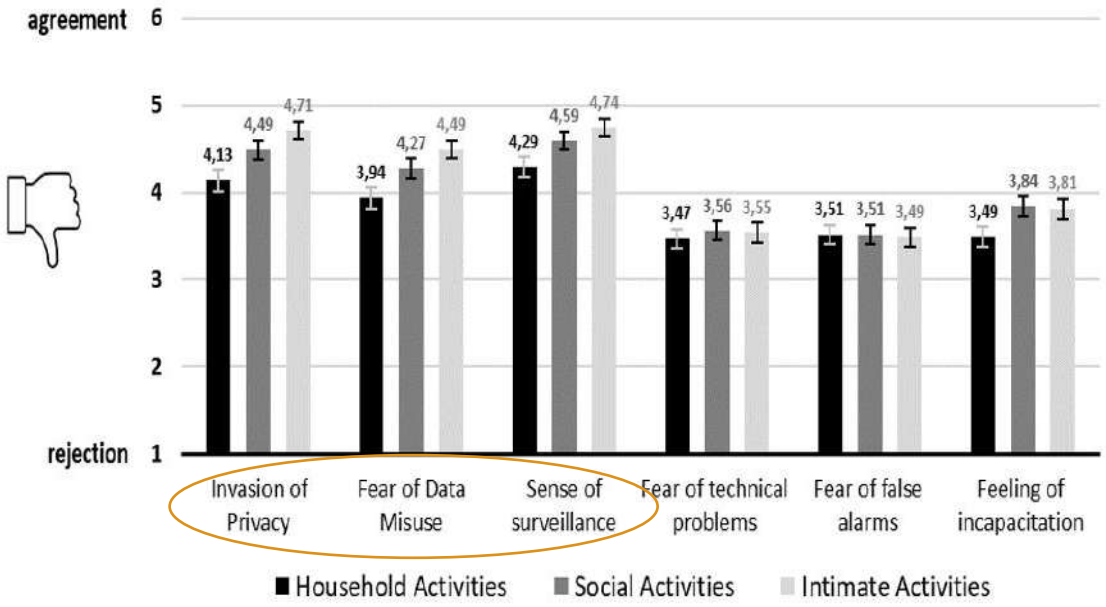
Maidhof et al., 2023a
Maidhof et al., 2023d

ESR 1. Caterina Maidhof - Past Research – Contextual influences N=146

Privacy Need



Barriers of video-based AAL



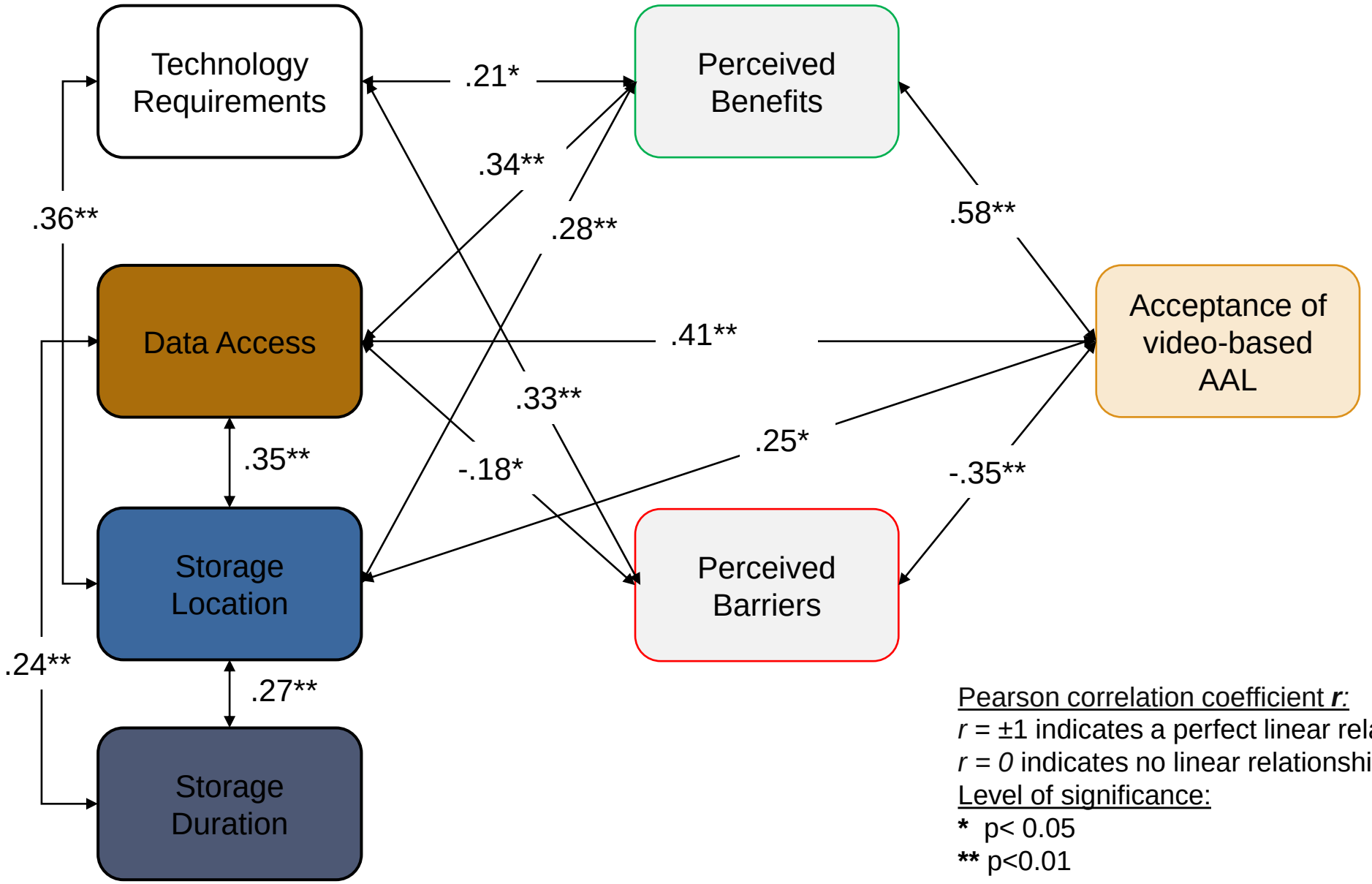
Maidhof et al., 2023a

ESR 1. Caterina Maidhof - Research Progress – Modelling Privacy

Theoretical Challenge:
Despite similar psychological origins (utility trade-off) technology acceptance and privacy have largely been researched separately from each other.
→Investigating and clarifying the relationships between privacy related aspects and acceptance evaluations for video-based AAL is not clear yet.

To what extent is the perception of privacy including data handling preferences (requirements, access, storage) related to the perception and acceptance of video-based AAL including evaluation of benefits and barriers of usage?

ESR 1. Caterina Maidhof – Research Progress – Correlations with Acceptance



Pearson correlation coefficient ***r:***

r = ±1 indicates a perfect linear relationship

r = 0 indicates no linear relationship

Level of significance:

***** p< 0.05

****** p<0.01

ESR 1. Caterina Maidhof - Research Progress – Modelling Privacy

Understanding privacy

Influences on privacy perceptions

Modelling Privacy

Privacy decisions

Aggregate-data across all questionnaires to include other variables such as personal characteristics

→proposition of a conceptual model through structural equation modelling

ESR 1. Caterina Maidhof - Research Progress – Privacy Decisions

Practical Challenge:
Privacy related aspects and their relationships have only been studied in isolation.
→Understanding privacy related factors in conjunction and relation to each other and gain insights which of these privacy related factors become relevant as part of a simulation of deciding the optimal video-based AAL set-up.

Which privacy-related aspect is most decisive for the composition of video-based AAL (when care is optional compared to when there is a severe care need)?

What contributes positively or negatively to the decisions?

ESR 1. Caterina Maidhof - Research Progress – Conjoint Measurement

Attributes | **Levels**

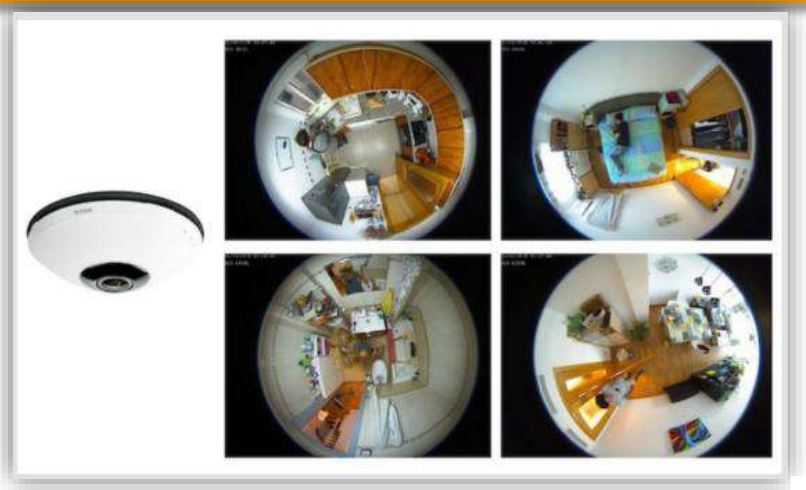
Conjoint-Measurement assesses how consumers/participants make trade-off decisions when considering products or services with **multiple attributes** which have **several levels**.

→It helps to understand what people like about different parts of a product or service – this could be some features, or functions. E.g., phone

→The main goal is to figure out which combination of these things matters the most when people are deciding or to determine the "utility" or the perceived value or preference that individuals assign to different attributes of a product or service and how the various levels contribute to the decision.

ESR 1. Caterina Maidhof - Research Progress – Conjoint Measurement

Attributes	Levels



Ravi et al., (2023) ODIN

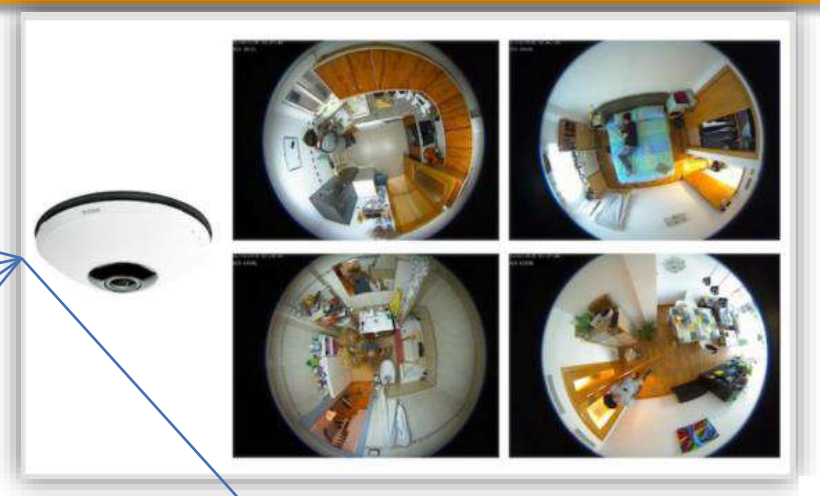
Conjoint-Measurement assesses how consumers/participants make trade-off decisions when considering products or services with **multiple attributes** which have **several levels**.

ESR 1. Caterina Maidhof - Research Progress – Conjoint Measurement

Attributes

Levels

- Data Access
- Storage Duration
- Storage Location
- Visualisation
- Type of Activity



Ravi et al., (2023) ODIN

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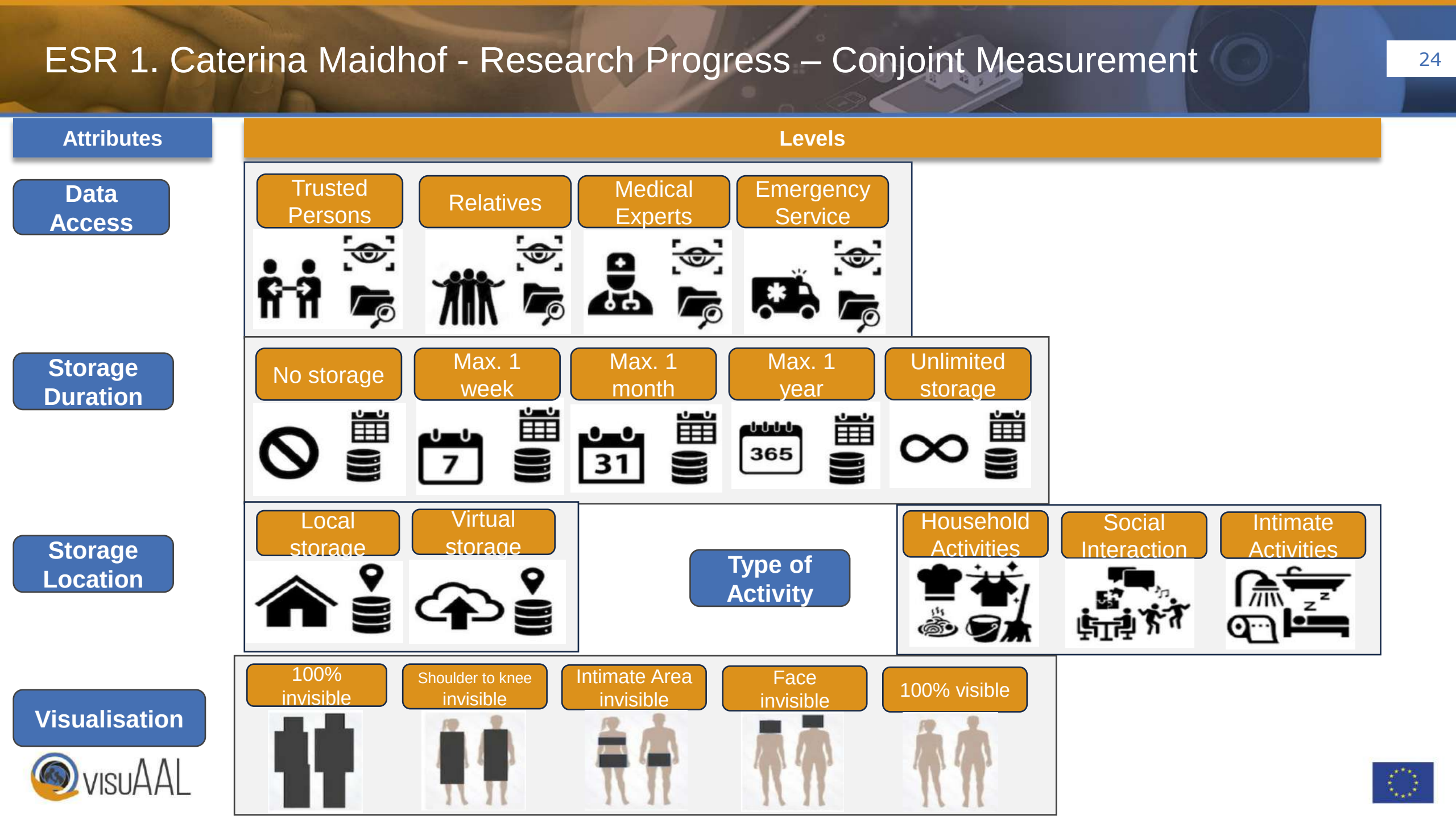
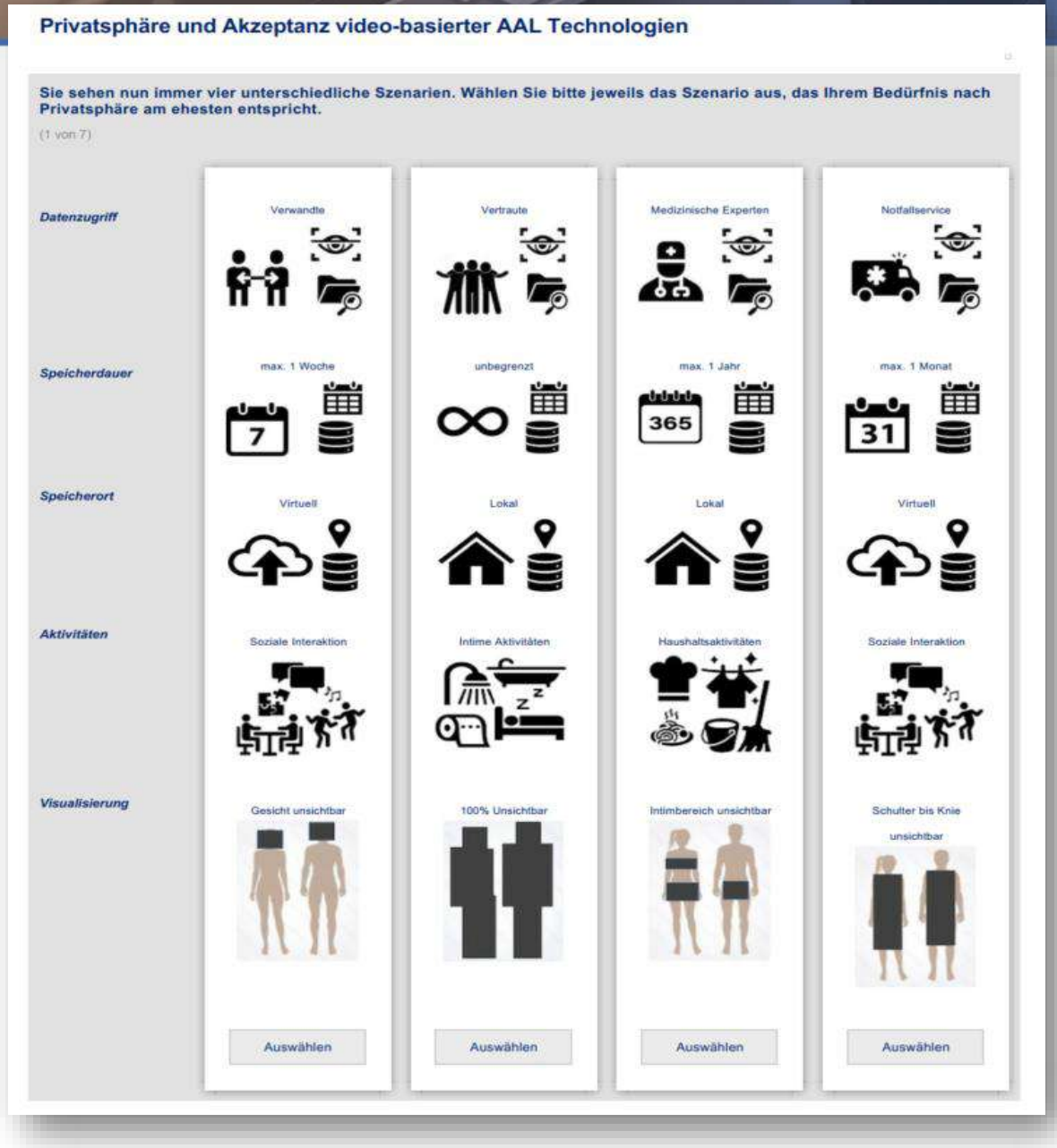
ESR 1. Caterina Maidhof - Research Progress – Conjoint Measurement

Attributes	Levels
Data Access	Trusted Persons; Relatives; Medical Experts; Emergency Service
Storage Duration	No storage; Max. 1 week; Max. 1 month; Max. 1 year; Unlimited storage
Storage Location	Local storage; Virtual storage
Type of Activity	Household Activities; Social Interaction; Intimate Activities
Visualisation	100% invisible; Shoulder to knee invisible; Intimate Area invisible; Face invisible; 100% visible



ESR 1. Caterina Maidhof - Research Progress – Conjoint - Questionnaire



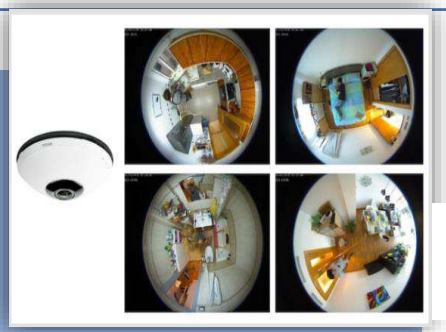
Respondents are presented with **hypothetical scenarios** featuring varied **attribute combinations** and their choices or ratings are analyzed (Hierarchical Bayes Estimation based on a Monte Carlo Markov Chain Algorithm)

Start

Video based AAL and Monitoring of Activities of Daily Living

Detailed Information about AAL and video based sensors
Explanation of the conjoint attributes and their levels:

Data Access | **Storage Duration** | **Storage Location** | **Activity Type** | **Visual-isation**



Ravi et al., (2023) ODIN

Scenario: 1

being ***75 years old*** and having a ***mild care need*** where support is rather optional

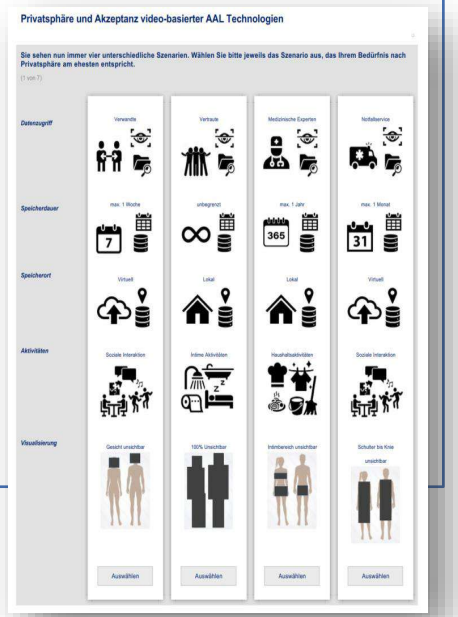
7 x choice tasks with 4 options each

Scenario: 2

being ***80 years old*** and having a ***severe care need*** where support is really needed

7 x choice tasks with 4 options each

e.g. Choice task



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ESR 1. Caterina Maidhof - Research Progress – Sample Description (N=238)

Convenience sampling in summer - autumn 2023

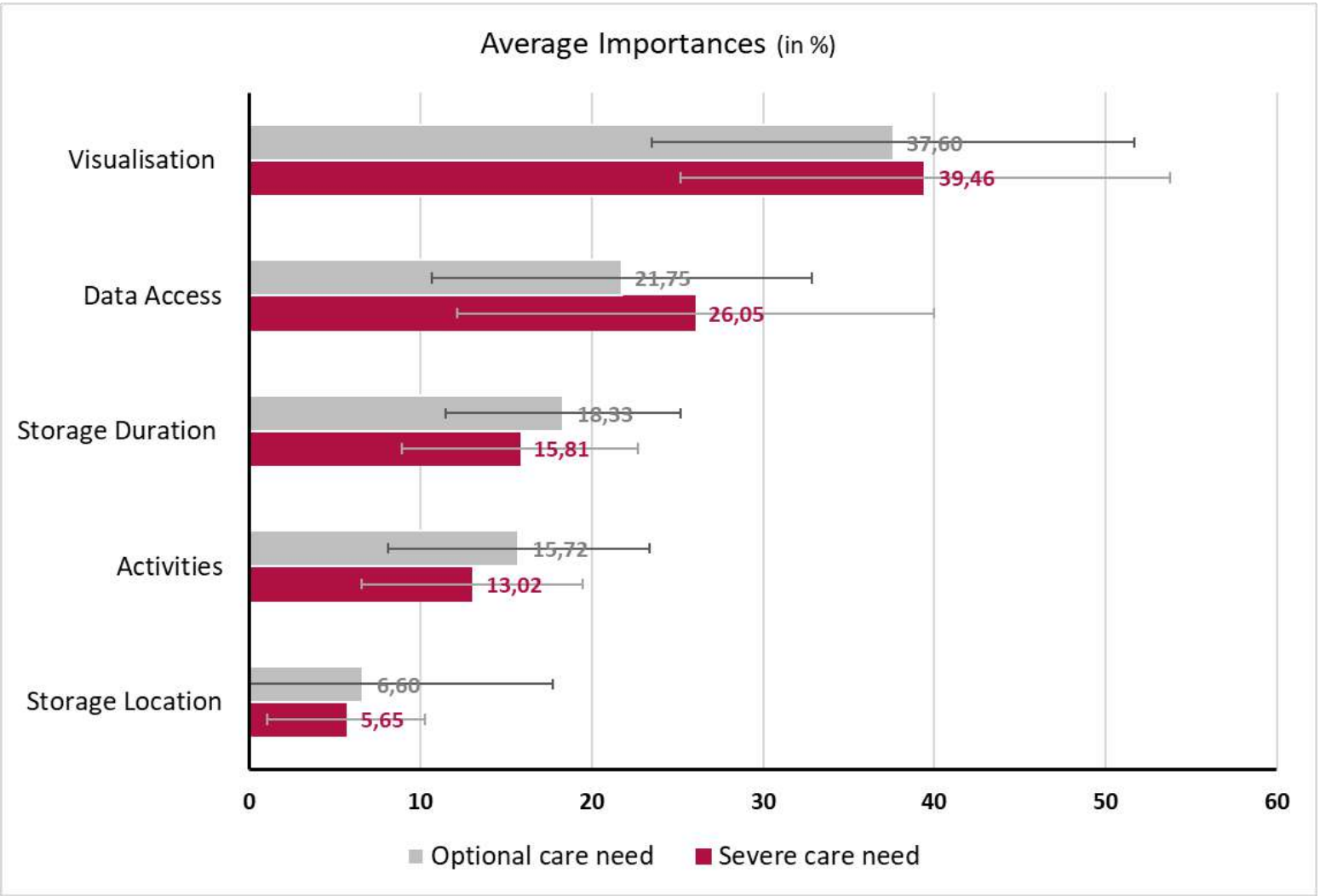
Demographics

- **Age:** range: 18 - 88 (M=35.58; SD=17.2)
- **Gender:** 55.9% females, 42.9% males, 1.3% no specification
- **Education:** 50% university degree, 31.1% A-level

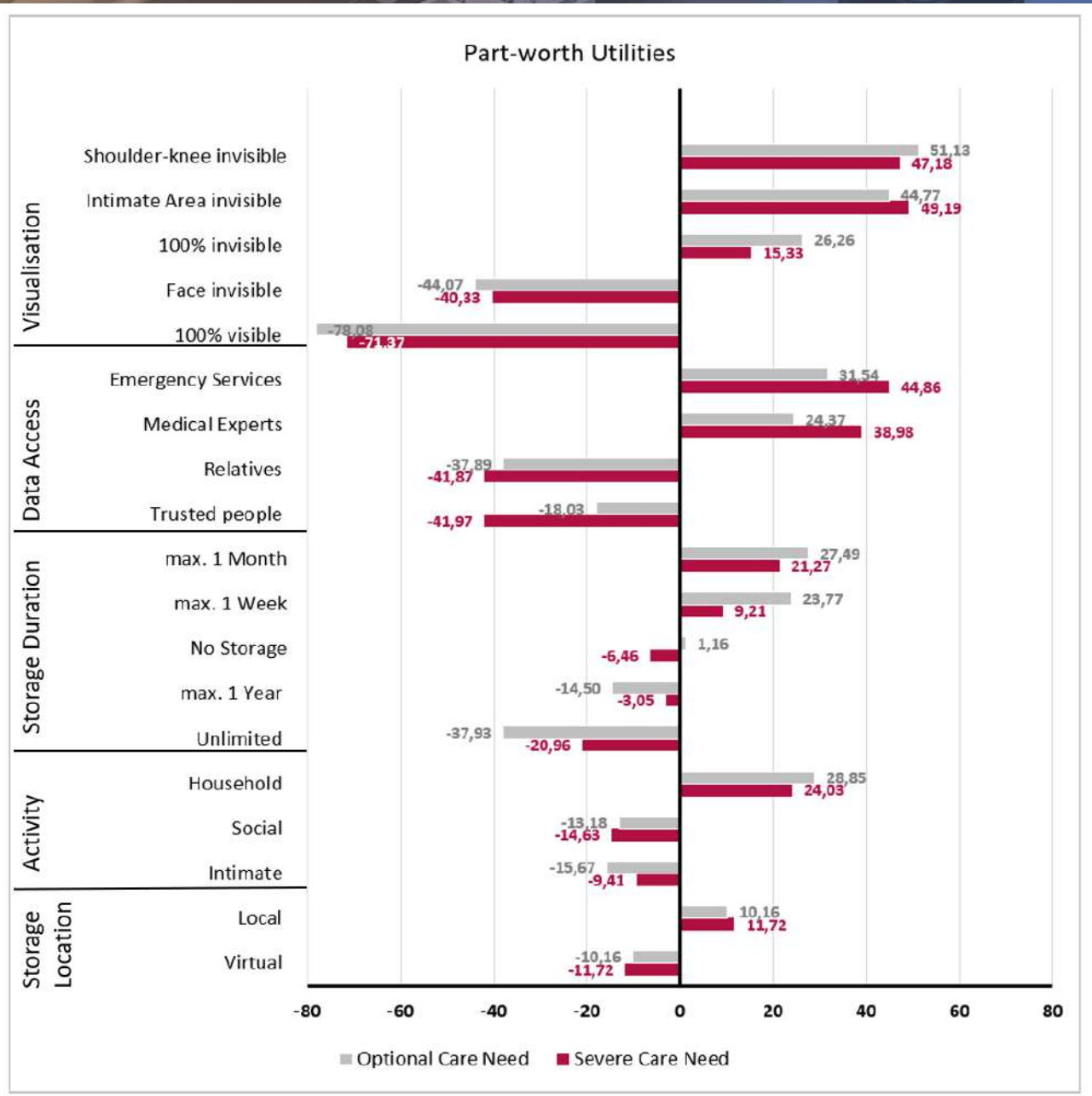
Health & Care

- 16.8% **chronic illness** (asthma, migraine, endometriosis, high blood pressure, diabetes)
- 2.5% **needing care** in daily life
- 39.9% **have cared** for another person (either professionally or informally)

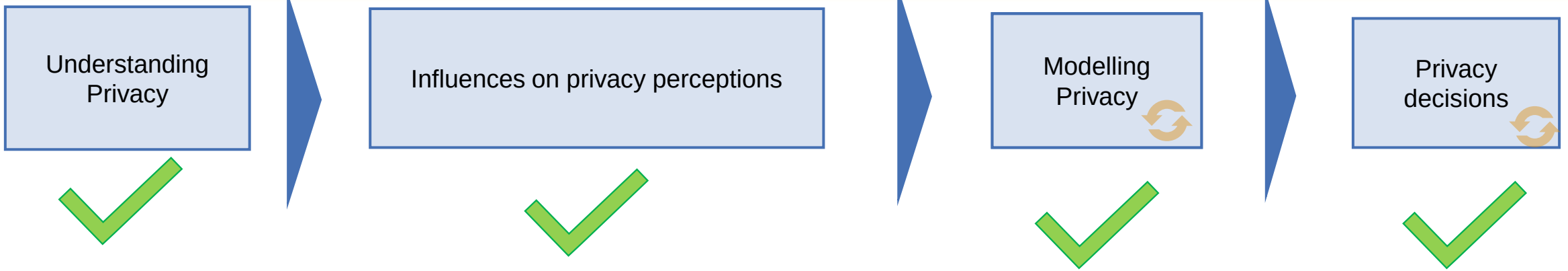
ESR 1. Caterina Maidhof - Research Progress - Most important Privacy Attribute



ESR 1. Caterina Maidhof - Research Progress – Positive and Negative Contributions



ESR 1. Caterina Maidhof - Research Progress



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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
		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**
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	**Maidhof, C.,** Offermann, J., & Ziefle, M. (2023). Living on Video: Insights on the User Perspective of Video-based AAL Technology. In ***ICT4AWE* 2023**.
		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.**
	Wilkowska, W., Otten, S., **Maidhof, C**., & Ziefle, M. Trust conditions and privacy perceptions in the use of accepted ambient technologies for health-related purposes. ***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. ***Universal Access in the Inform. Society***.
		Maidhof, C., Offermann, J., & Ziefle, M. Eyes on Privacy: Acceptance of video-based AAL impacted by activities being filmed. ***Frontiers in Public Health****, 11,* 1186944. DOI: 10.3389/fpubh.2023.1186944
Planned	**Maidhof, C**., Offermann, J. & Ziefle, M.(2024) Trading-off privacy related factors in the use of video-based AAL: A conjoint-study***. Journal*** (to be defined)	**Maidhof, C**., Offermann, J. & Ziefle, M.(2024) Gender differences in privacy-related factors for video-based AAL***. Journal*** (to be defined)
		Maidhof, C., Ziefle, M.& Sackl, A. (2024). Exploring conditions for well-being and safe spaces during a digitally enhanced remote museum visit for older adults. ***Conference*** (to be defined)

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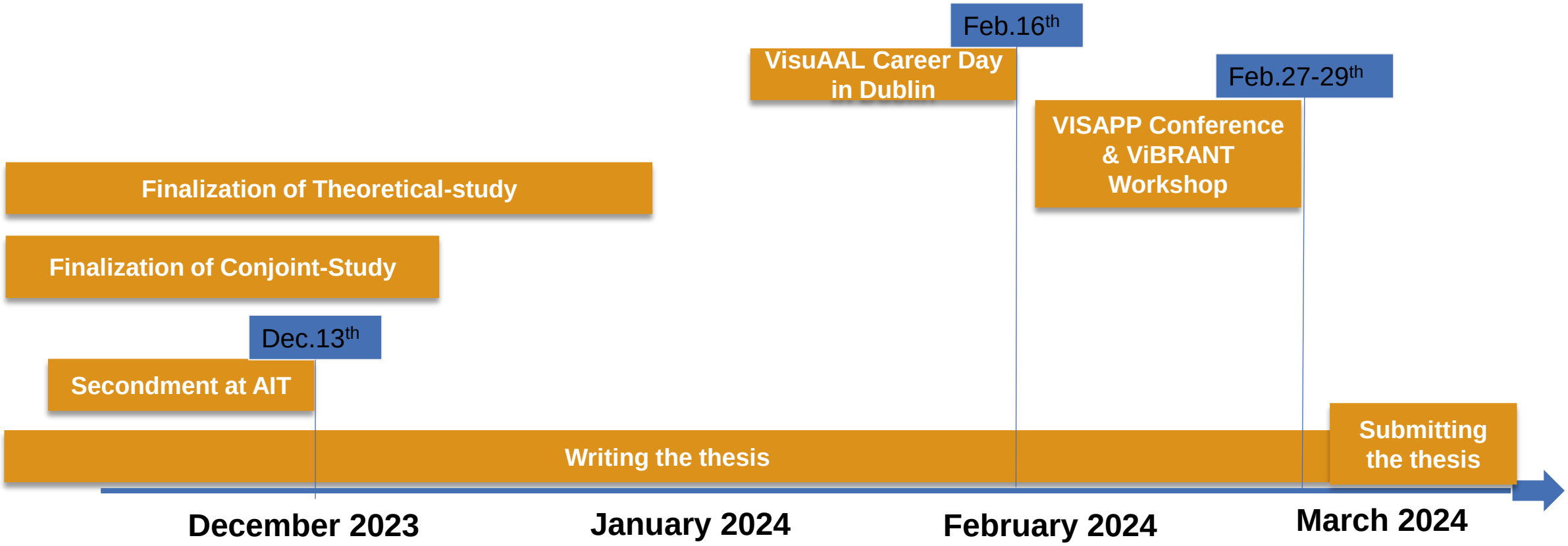
ESR 1. Caterina Maidhof - The Future – Research Timeline



ESR 1. Caterina Maidhof - The Future - Career Ambitions

Academic environment

Non- Academic environment

Work in human-computer interaction
Applied settings
Assistive technology

Multi & Interdisciplinary environment

Business insights
(acquiring projects and funding)

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ESR 1. Caterina Maidhof – Feedback on VisuAAL

Helpful, open-minded and curiosity-driven environment

Good communication across disciplines

Informative and very well-organized training schools

Understanding my identity as an ESR

Understanding dissemination and communication of the own research

Thank you!

Caterina Maidhof

RWTH Aachen University

maidhof@comm.rwth-aachen.de