



The central person in the network i.e., questionnaire respondent

Nodes: The entities within the network

The group member connected to Ego

The robot that interacts with the individuals (under the same session ID)



Edges: The relationships between Ego and the Alteri

EGOCENTRIC ROBOTS IN A HUMAN-CENTRIC WORLD? EXPLORING GROUP-ROBOT-INTERACTION IN PUBLIC SPACES

The project received approval from the Research Ethics Committee of TH Köln (application no. THK-2023-0004)

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Abstract - The deployment of social robots in real-world scenarios is increasing, supporting humans in various contexts. However, they still struggle to grasp social dynamics, especially in public spaces, sometimes resulting in violations of social norms, such as interrupting human conversations. This behavior, originating from a limited processing of social norms, might be perceived as robot-centered. Understanding social dynamics, particularly in group-robot-interactions (GRI), underscores the need for further research and development in human-robot-interaction (HRI). Enhancing the interaction abilities of social robots, especially in GRIs, can improve their effectiveness in real-world applications on a micro-level, as group interactions lead to increased motivation and comfort. In this study, we assessed the influence of the interaction condition (dyadic vs. triadic) on the perceived extraversion (ext.) of social robots in public spaces. The research involved 40 HRIs, including 24 dyadic (i.e., one human and one robot) interactions and 16 triadic interactions, which involve at least three entities, including the robot.

MOTIVATION AND RELATED WORK

- **Growing use of social robots** designed to engage and foster social connections with humans within **public spaces**.
- **Challenge of Acceptance:** Incomplete acceptance due to limited understanding of human behavior and social norms.
- **Importance of Social Norms:** Ensures robust and safe autonomous operation.
- **Group-Robot Interactions (GRI):** Previous research has mainly focused on dyadic interactions. However, GRI present distinct challenges due to social intricacies.
- **Social Norms in GRI:** Higher demands for acknowledging social norms in group settings.
- **Egocentrism in Robots?** Social robots might exhibit egocentric behavior due to lack of social understanding.

WHAT IS EGO-NETWORK ANALYSIS?

Ego-Network Analysis (ENA) is a method from the empirical social sciences used to understand and analyze the structure of social relationships surrounding a central individual (Ego). ENA was developed to gather extensive data on topics such as voting behavior.



HOW WE USED ENA

Our research design recognizes the realities of field experiments and uses ENA to capture the relationship dynamics in GRI without requiring each group member to complete a questionnaire. Our methodology involves egos (i.e., questionnaire participants) conducting extensive self-observation and using ENA to assess GRI.

Questionnaire
Network measure to determine dyadic vs. GRI

Name generators

- Extraversion Dimension from BFI (Ego)
- Extraversion Dimension from BFI (Robot)
- Extraversion Dimension from BFI (Alteri)
- Demographics, including technical affinity (Ego)
- Self-Efficacy in HRI
- Satisfaction with the system (Ego)

*Items in both - dyadic and GRI - questionnaires
*Items specifically for group interactions

interaction partner = study respondent (ego)

respondent = any group member (ego), the others = alteri

Apart from me there were [please select 1-6] person(s) present.

[fictitious name] was rather quiet.

I have the necessary skills to talk to the robot.

DESCRIPTIVES

Item	Dyadic (n = 24)	GRI (n = 16)	Total (N = 40)
Gender (ego) (f/m/d)	9/15/-	7/7/1 (1 unrep.)	16/22/1 (1 unrep.)
Age (ego)	29.09 (11.94), (2 unrep.)	26 (3.89), (1 unrep.)	27.84 (9.56), (3 unrep.)
Use of intelligent personal assistants (ego) (M)	3.46	3.19	3.35
Use of generative AI (ego) (M)	3.63	4.07	3.79
Attitudes towards AI (ego) (% M (SD))	69.88 (30.29)	76.75 (24.33)	72.63 (27.93)
System satisfaction scale (ego) (M(SD))	3.99 (.72)	3.78 (.75)	3.90 (.73)
Extraversion of ego (M(SD))	3.18 (.68)	3.22 (.83)	3.20 (.73)
Extraversion of the robot (M(SD))	3.16 (.68)	3.22 (.83)	3.20 (.73)
Ext. of the Alteri (M(SD))	-	289 (1.09), (2 unrep.)	-

Research needed: Enhancing understanding of social dynamics in unpredictable environments for example in turn-taking to improve conversational systems for GRI.

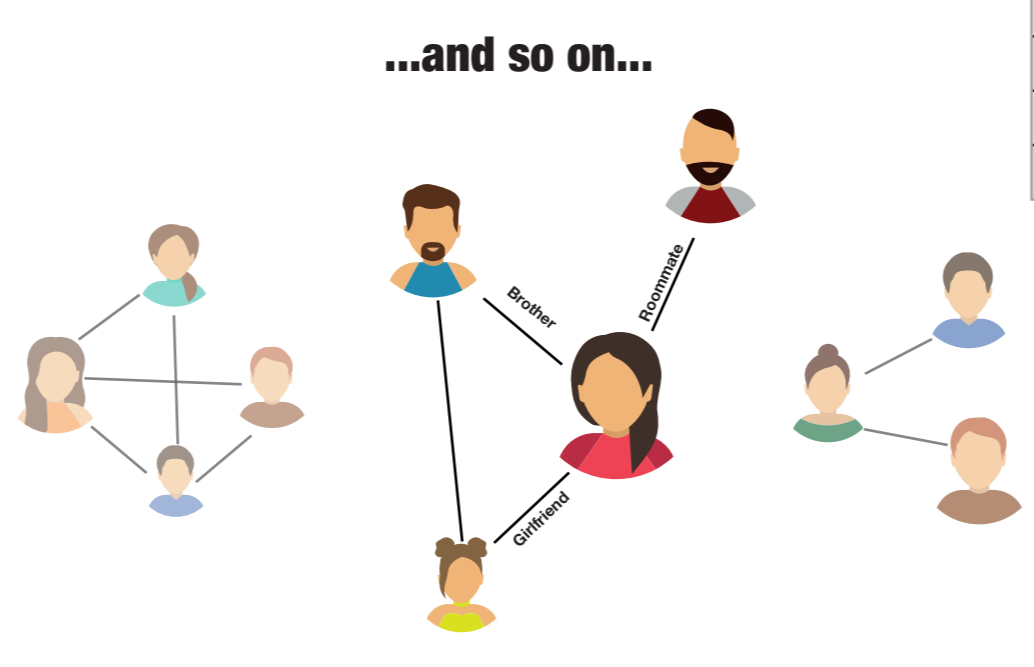
- Study at the cafeteria of TH Köln
- 13 days in Jan. and Feb., 2024
- Involving a Furhat robot placed on a stand with a screen to display transcripted dialogues.
- The robot was connected to a self-developed AI-powered dialogue system GPT 3.5 was used to refine training datasets.
- Llama-2 was integrated as a secondary resource for requests beyond the knowledge base's scope.

Assessed interaction context (dyadic vs. GRI) on perceived extraversion of social robots.

Field Experiment: 40 interactions (24 dyadic, 16 GRI).

Ego-Network Analysis (ENA): Used to assess GRI by evaluating interactions and group dynamics.

Goal: Improve understanding of social dynamics and impact of group structures on H/GRI as effective GRI can enhance dyadic HRI by increasing engagement and comfort.



PERCEPTIONS OF SELF-EXTRAVERSION AND ROBOT'S EXTRAVERSION ACROSS CONTEXTS

Context	Self-extraversion		Robot's extraversion	
	Mean ± SD	N	Mean ± SD	N
GRI (N of Items 12)	3.22 ± .83	16	2.84 ± .61	16
Dyadic (N of Items 12)	3.19 ± .68	24	3.16 ± .53	24

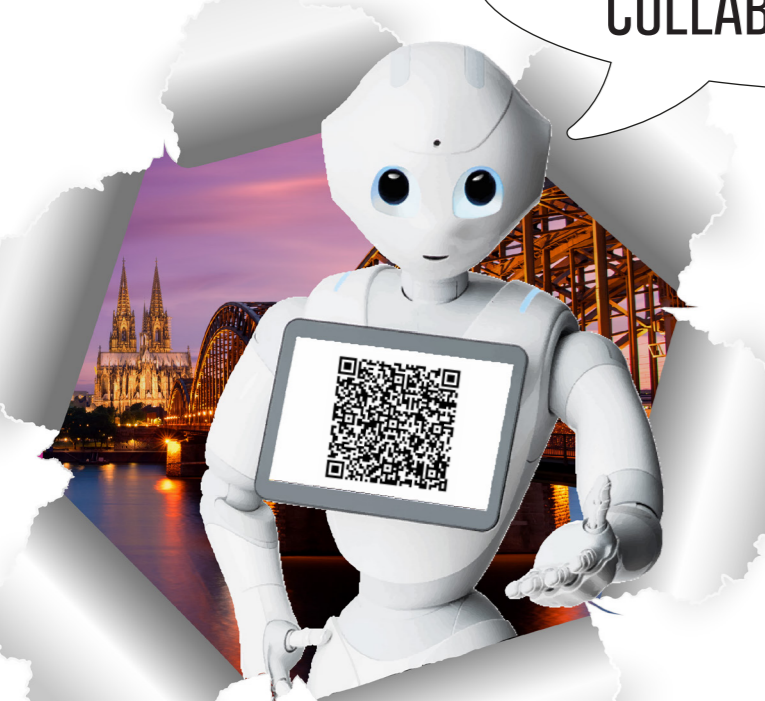
t(38) = -.152, p = .88 for self-extraversion
t(38) = -1.764, p = .086 for robot's extraversion

TAKEAWAY: USING ENA IN GRI-RESEARCH? YES! BUT...

ENA Benefits: Method enabled us to assess GRIs using a single node (ego), reducing the need for data collection from each group member. This streamlined the questionnaire process and minimized participant requirements.

ENA Limitations: We faced a limitation that is also recognized in social sciences: The extended survey length for the ego (i.e., [number of items] * [number of group members] = total number of items). This could impact response rates, leading us to exclude certain aspects to manage this issue.

MERGING MINDS & MACHINES:
COLLABORATE WITH US!



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