

---

# Enriching Human-Robot Interaction through Need-Based Design

**Kathrin Pollmann**

University of Stuttgart, IAT  
Allmandring 35, 70569 Stuttgart  
kathrin.pollmann@iat.uni-stuttgart.de

**Nora Fronemann**

Fraunhofer Institute for Industrial Engineering IAO  
Nobelstr. 12, 70569 Stuttgart  
nora.fronemann@iao.fraunhofer.de

**Abstract**

Addressing psychological user needs is a well-known approach in user experience research to design for positive experiences with technology, thus increasing the probability for user acceptance and long-term use. We propose to apply this approach to social human-robot interaction and describe a research project where we use the need-based design approach to develop interaction strategies for social domestic robots for older adults.

**Author Keywords**

Positive user experience, need-based design, Human-Robot-Interaction.

**ACM Classification Keywords**

Human-centered computing~User centered design

**Introduction**

In the past years, much research has been conducted to improve the technical features and interactivity of robots to make them appear more social. However, their application in real-world scenarios is still limited, and insufficient answers have been provided for how to ensure the acceptance and long-term use of social robots, especially in private spaces such as our homes.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

<b>Psychological User Needs</b>	
<b>Security:</b>	needing structure, the absence of danger and the independence of outer circumstances
<b>Keeping the meaningful:</b>	collecting meaningful things
<b>Self-expression:</b>	developing one's own character and showing it to others.
<b>Relatedness:</b>	feeling close to the ones who are important to someone
<b>Popularity:</b>	being popular and appreciated by others
<b>Competition:</b>	being better than others
<b>Physical health:</b>	supporting one's own well being
<b>Competence:</b>	feeling able to master challenges Includes: autonomy
<b>Influence:</b>	achieving something in my environment and with others
<b>Stimulation:</b>	curiosity and exploring new things.

**Table 1:** Overview of psychological needs presented in the UXellence® Framework [1].

Coming from the field of Human-Computer Interaction, we use a need-based design approach [8] to design technical products that provide a positive user experience (UX). It has been shown that a positive UX can enhance the acceptance and motivation to use a product [1]. Our need-based design approach is based on the human-centered design process [5] and enriches it with a focus on psychological needs, as described in our UXellence® Framework [1]. In the research project NIKA we transfer this approach to the field of Human-Robot Interaction to design acceptable interaction strategies for social robots.

### UXellence® Framework

Our framework to design for a positive UX is based on the approach by Hassenzahl [3, 4]. A positive experience can thus be designed by fulfilling basic psychological human needs. Based on [7, 8], our framework consists of ten needs (see table 1). The UXellence® Framework has been integrated with user research and innovation methods to identify and integrate relevant user needs already in early stages of the design process.

### The NIKA project

The NIKA project focusses on developing interaction strategies for social Human-Robot Interaction (HRI) with older adults. The goal of the project is to employ robots to assist older adults in their home with a robot, so that they can stay independent for a longer time. As older adults are known to be rather hesitant regarding the uptake of new technology, the acceptance of a

<sup>1</sup> <https://www.softbankrobotics.com/emea/en/robots/pepper>

<sup>2</sup> <http://consequentialrobotics.com/miro/>

robot in their private home is an especially sensitive issue. We will therefore adapt a need-based design approach to ensure that the developed interaction strategies meet the users' needs and provide them with an overall positive experience during the interaction with the robot. As it can be expected that users also differ regarding their preferences for the appearance of the robot, we work with three different types of robots (Pepper<sup>1</sup> - humanoid, MiRo<sup>2</sup> - animoid and Neato<sup>3</sup> - abstract) with the goal to design need-oriented interaction strategies for the different types.

Our approach for assessing the user needs is twofold: On the one hand, we assess general characteristics and psychological needs of the user group using qualitative methods such as interviews, contextual inquiries and focus groups. On the other hand, we conduct psychological experiments to examine perceptions of and attitude towards the three types of robots.

### Open Research Questions

- How can we design social robots that also take into account the psychological needs of the users and not only their capabilities and requirements?
- How does the need-based design approach need to be adjusted to be applied in HRI?
- Which aspects of acceptance of social robots can concretely be improved by addressing psychological needs in the interaction design?

<sup>3</sup> <https://www.neatorobotics.com/de/>

- How do the users perceive the different types of robots? Which one is most suitable to address the psychological needs?

### **First steps towards a need-based design in HRI**

As a first step towards identifying the general needs of the user group and potential for the promotion of positive experiences, we conducted experience interviews [2, 9] with older adults. During the interviews, participants were asked to describe a positive experience from their daily lives. These experience reports can be used to extract the relevant underlying needs and to transfer the reported positive moments to the interaction with a technical device [6] - in this case, a robot.

### **Next Steps**

In the upcoming months, we will extend our qualitative user research and are currently preparing the contextual inquiries, focus groups and psychological experiments.

The NIKA project has only started two months ago and we are looking forward to a challenging project with interesting research questions. Since we are only starting with our studies we are interested to exchange thoughts and insights with other researchers. We have brought knowledge in UX and user research and are interested to learn about other approaches to design socially interactive robots.

### **Acknowledgements**

NIKA is a project funded by the German Federal Ministry of Education and Research (BMBF).

### **References**

- [1] Fronemann, N. and Peissner, M. 2014. User Experience Concept Exploration. User Needs as a Source for Innovation. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: fun, fast, foundational. Helsinki, Finland - October 26 - 30, 2014*, V. Roto, Ed. ACM, New York, NY, 727–736. DOI=10.1145/2639189.2641203.
- [2] Fronemann, N., Pollmann, K., Weisener, A., and Peissner, M. 2016. Happily Ever After. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. ACM, New York, NY, 1–6. DOI=10.1145/2971485.2996740.
- [3] Hassenzahl, M. 2003. The thing and I: understanding the relationship between user and product. In *Funology. From usability to enjoyment*, M. A. Blythe, Ed. Kluwer Academic Publishers, Dordrecht, Boston, 31–42.
- [4] Hassenzahl, M. 2008. User experience (UX): towards an experiential perspective on product quality. In *Proceedings of the 20th International Conference of the Association Francophone d'Interaction Homme-Machine. IHM '08*. ACM, New York, NY, USA, 11–15. DOI=10.1145/1512714.1512717.
- [5] ISO/TC 159/SC 4. 2010. *Ergonomics of human-system interaction -- Part 210: Human -centred design for interactive systems.*, ISO 9241-210.
- [6] Pollmann, K., Fronemann, N., Krüger, A. E., and Peissner, M. 2018. PosiTec. How to Adopt a Positive, Need-Based Design Approach. In *Design, User Experience, and Usability: Users, Contexts and Case Studies. 7th International Conference, DUXU 2018, Held as Part of HCI International 2018, Las Vegas, NV, USA, July 15-20, 2018*,

*Proceedings, Part III*, A. Marcus and W. Wang,  
Eds. Lecture Notes in Computer Science 10920.  
Springer International Publishing, Cham.

- [7] Reiss, S. 2004. Multifaceted Nature of Intrinsic Motivation The Theory of 16 Basic Desires. *Review of General Psychology*, Vol. 8, No. 3, 179–193.
- [8] Sheldon, K. M., Kim, Y., Elliot, A. J., and Kasser, T. 2001. What Is Satisfying About Satisfying Events? Testing 10 Candidate Psychological Needs. *Journal of Personality and Social Psychology* 80, 2, 325–339.
- [9] Zeiner, K. M., Laib, M., Schippert, K., and Burmester, M. 2016. Identifying Experience Categories to Design for Positive Experiences with Technology at Work. In *CHI'16. Extended Abstracts*. DOI=10.1145/2851581.2892548.