Z. Arb. Wiss. (2023) :78–91
https://doi.org/10.1007/s41449-022-00339-1

WISSENSCHAFTLICHE BEITRÄGE

Fulfilling social needs through anthropomorphic technology? A reflection on existing research and empirical insights of an interview study

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Accepted: 20 June 2022 / Published online: 30 November 2022
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Abstract

As interactive technologies, such as chatbots or voice assistants, increasingly become social counterparts and resemble human interaction partners in many ways, the question arises whether they are also able to address users' social needs. This paper explores whether interaction with technology can address social needs and what role technology anthropomorphism plays in this. While previous research shows somewhat contradictory results potentially related to challenges of applied assessment methods of anthropomorphism and social needs, we complement this by means of a qualitative interview study ($n = 8$). Our study findings support a potential of anthropomorphic technology to address users' social needs but also highlight differences between the quality of human-technology and interpersonal interaction. In addition, our findings hint at a social desirability bias, since people see social need fulfillment through technology as silly or inappropriate. Design and societal implications are discussed.

Practical Relevance: This article explores the potential of technology to address users' social needs and discusses practical implications for marketing and design, e.g., how technologies should be designed in order to affect users' social needs and which contexts of application might be suitable. Moreover, the article also reflects on societal implications resulting from a potential effect of interaction with technology on users' social needs.

Keywords Anthropomorphism · Social needs · Human-computer interaction · Human-technology interaction · Human-technology relationship

Erfüllung sozialer Bedürfnisse durch anthropomorphe Technologien? Eine Reflexion bisheriger Forschung und empirische Einsichten einer Interview-Studie.

Zusammenfassung

Da interaktive Technologien wie Chatbots oder Sprachassistenten zunehmend zu sozialen Gegenübern werden und menschlichen Interaktionspartnern in vielerlei Hinsicht ähneln, stellt sich die Frage, inwiefern diese auch soziale Nutzerbedürfnisse ansprechen können. Der Artikel geht dieser Frage nach und fokussiert die Rolle des Anthropomorphismus von Technologie diesbezüglich. Während bisherige Forschung teilweise widersprüchliche Ergebnisse aufweist, die mit Herausforderungen angewandter Messmethoden von Anthropomorphismus und sozialen Bedürfnissen zusammenhängen könnten, ergänzen wir diese anhand einer qualitativen Interview-Studie ($n = 8$). Ergebnisse unserer Studie unterstützen das Potenzial anthropomorpher Technologien, soziale Nutzerbedürfnisse anzusprechen, und unterstreichen gleichzeitig Unterschiede in der Qualität der Mensch-Technik- und zwischenmenschlichen Interaktion. Darüber hinaus deuten Ergebnisse auf eine Verzerrung durch Effekte sozialer Erwünschtheit hin, zumal Individuen die Erfüllung sozialer Bedürfnisse durch Technologien als lächerlich oder unangemessen zu betrachten scheinen. Gestaltungs- und gesellschaftliche Implikationen werden diskutiert.

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Praktische Relevanz: Der Artikel erforscht das Potenzial von Technologien, soziale Nutzerbedürfnisse anzusprechen und diskutiert Implikationen für Marketing und Produktgestaltung, z. B., wie Technologien gestaltet sein sollten, um soziale Nutzerbedürfnisse anzusprechen bzw. welche Anwendungskontexte sich anbieten. Ebenso reflektiert der Artikel gesellschaftliche Implikationen, die sich aus dem potenziellen Effekt der Interaktion mit Technik auf soziale Nutzerbedürfnisse ergeben.

Schlüsselwörter Anthropomorphismus · Soziale Bedürfnisse · Mensch-Computer-Interaktion · Mensch-Technik-Interaktion · Mensch-Technik-Beziehung

1 Introduction

Nowadays, we increasingly interact with technologies that we perceive as social counterparts. Examples are chatbots, smart home solutions, or even autonomous robots. These technologies are no longer perceived as simple tools, but become other (Ihde 1990). Accordingly, the embodied relationship with technology as a tool becomes one of alterity (Hassenzahl et al. 2021) and our interactions with such technologies are often similar to interactions with other humans. According to the "computers are social actors" (CASA) paradigm (Nass et al. 1994), individuals apply social rules from interpersonal interaction to interaction with non-human agents (Nass and Moon 2000; Reeves and Nass 1996), especially if the technology shows humanlike characteristics (e.g., a computer that features a form of dialogue similar to human conversation). Moreover, individuals oftentimes attribute humanlike characteristics, emotions, and motives to these technologies, also known as the phenomenon of anthropomorphism (Epley et al. 2007). For example, it has been shown that people tend to judge a computer's performance more favorably than it actually is (Nass et al. 1994), presumably because they do not want to hurt the computer's "feelings" when entering their judgment into the computer interface. Furthermore, studies have shown that individuals can even perceive a sort of social connectedness to technologies (Christoforakos et al. 2021; Kang and Kim 2020) or see them as attachment objects that spend relief and comfort when feeling lonely (Diefenbach and Borrmann 2019). Thus, while human-technology relationships obviously resemble interpersonal relationships in several ways, research also needs to clarify the boundaries of this perspective and reveal central differences regarding the nature of the relationship. In this regard, for example, the question arises whether technology actually has the potential of addressing users' social needs in a similar way as a human counterpart.

Single study results imply a possible "social saturation" through interaction with technologies or products when they come with humanlike qualities. Mourey et al. (2017), for example, could show that after interacting with anthropomorphic (vs. non-anthropomorphic) products, socially excluded participants exaggerated their number of social connections less and their anticipated need to engage with close others as well as their willingness to perform prosocial behavior were reduced (Mourey et al. 2017). Similarly, Krämer et al. (2018) found that participants with a high need to belong reported a lower willingness to engage in social activities after the interaction with an agent that showed socially responsive behavior.

Still, other studies that have investigated the potential of technology to address individual needs to interact with others have not found an according effect. Namely the willingness to socialize with other humans was not affected by previous interaction with anthropomorphic technology (e.g., Christoforakos and Diefenbach 2022; Christoforakos et al. 2021). In line with this, in a short survey ($n = 37$) that we conducted, 97% of the participants (completely) disagreed with the statement "After the interaction with a technical voice assistant (e.g., Alexa) I have the feeling that my desire to interact with other humans is satisfied.", and 76% of the participants (completely) disagreed with the statement "After the interaction with my smartphone I have the feeling that my desire to interact with other humans is satisfied.".

Naturally, the comparison of study results is challenging due to the different manipulations of technology anthropomorphism as well as the different means of assessment of central variables. However, based on the equivocal character of previous findings, further research is needed to broaden the view on this interrelation and better understand the potential of technology to fulfill humans' social needs and therefore possibly influence their desire to interact with other human counterparts.

In this paper, we aim to explore whether the interaction with technology can address users' social needs, and understand a possible role of technology anthropomorphism in this regard. The next sections (Sects. 2 and 3) reflect on previous work focusing on the potential of anthropomorphic technology or products to address users' social needs. We specifically reflect on methodological as well as conceptual challenges, which can affect the insights on the interrelation in question. After this (Sect. 4), we present an empirical qualitative study to further complement previous research on the relationship between the interaction with anthropomorphic technology and users' social needs. This is followed by a general discussion (Sect. 5) where we re-

flect on our study results in the light of relevant previous work and derive future research directions.

2 Anthropomorphic technology's potential to address individuals' social needs

According to evolutionary and developmental theories, humans naturally seek close connections to other humans (Baumeister and Leary 1995; Maslow 1943). Furthermore, the social production function theory implies that apart from their physical integrity, humans consider their social well-being to be a universal goal in life (Ormel et al. 1999). When social needs remain unsatisfied, individuals are consequently motivated to seek alternative ways to fulfill such, which DeWall and Baumeister (2006) coined the social reconnection hypothesis. This stands in line with previous findings implying that feeling currently lonely or chronically disconnected from others can go along with the attribution of anthropomorphic qualities to non-human objects and entities (e.g., religious agents, pets, imaginary creatures; Epley et al. 2007, 2008; Niemyjska and Drat-Ruszczak 2013).

To date, a few studies have attempted to investigate whether the interaction with technology or products in general actually bears the potential of addressing users' social needs. As already noted in the introduction section, Mourey et al. (2017), for example, showed that when individuals interacted with anthropomorphic consumer products, their social needs could be partly satisfied, and experimentally induced effects of social exclusion were mitigated. Specifically, after interacting with anthropomorphic (vs. non-anthropomorphic) products, socially excluded participants exaggerated their number of social connections less and their anticipated need to engage with close others as well as their willingness to perform prosocial behavior were reduced (Mourey et al. 2017). In a study by Krämer et al. (2018), when participants interacted with a virtual agent with socially responsive (vs. not socially responsive) nonverbal behavior, there was no main effect of socially responsive behavior on individuals' connectedness with the agent or their experience of rapport, namely the short time liking and responsiveness of the agent. Yet, participants with a high need to belong reported a lower willingness to engage in social activities after the interaction with the agent only when the respective agent showed socially responsive behavior (Krämer et al. 2018).

Other studies that have aimed at investigating the effect of technology on social needs have not found a social saturation effect. For example, in their study, Christoforakos and Diefenbach (2022) have explored whether anthropomorphic products have the potential to fulfill social needs and how individually perceived anthropomorphism correlates to social needs. The authors conducted two consecutive experimental studies in which participants were socially excluded (vs. not socially excluded) and interacted with an anthropomorphic (vs. non-anthropomorphic) smartphone. Anthropomorphism was manipulated more implicitly in the first study (by anthropomorphic vs. non-anthropomorphic questions about one's own smartphone) and more explicitly (by anthropomorphic vs. non-anthropomorphic design cues) in the second study. In both studies, no incidence of a social saturation effect emerged, given that participants' willingness to socialize with other humans were not lower (i.e., better fulfilled) after interacting with an anthropomorphic (vs. non-anthropomorphic) smartphone. Yet, results of their first study showed an overall positive correlation between the willingness to socialize and perceived anthropomorphism. Thus, a higher willingness to interact with other individuals came along with a higher perceived anthropomorphism in one's own smartphone. Furthermore, results of their second study highlighted that this relationship was especially pronounced for individuals with a high tendency to anthropomorphize, given that the product supports a humanlike perception through its appearance and design cues. Therefore, although such results do not support a social saturation through the interaction with anthropomorphic products, they imply a general interrelation between social needs and anthropomorphism and stress individual and contextual strengthening factors (Christoforakos and Diefenbach 2022).

In another study where participants regularly interacted with a conversational chatbot over a period of two weeks, Christoforakos et al. (2021) found, that interaction duration and intensity positively predicted social connectedness to the chatbot. Furthermore, perceiving the chatbot as anthropomorphic, mediated the interrelation of interaction intensity and social connectedness to the chatbot. Similarly, the perceived social presence of the chatbot mediated the relationship between interaction duration as well as interaction intensity and social connectedness to the chatbot. Yet, contrary to the social saturation hypothesis, the authors could not find a negative correlation between users' social connectedness felt to the technology and their desire to socialize with other humans (Christoforakos et al. 2021).

In sum, there seems to exist some sort of relationship between individuals' social needs and the interaction with technology or products in general, especially when they are perceived to be humanlike.

Still, research on whether anthropomorphic technology has the potential of addressing social needs must be extended to understand the interrelation and causal mechanisms. Overall, empirical findings need to be reflected on a conceptual as well as methodological level to understand possible challenges of research regarding the effect of interaction with anthropomorphic technology on social needs.

3 Methodological and conceptual challenges in exploring the effect of interaction with anthropomorphic technology on social needs

It appears that interaction with technology could come with a certain potential of fostering social experiences, especially when anthropomorphism comes into play. Yet, it might be challenging to capture this relationship in a valid manner by applying common methods of measurement, both regarding the perception of anthropomorphism and social needs as well as general research paradigms.

3.1 Assessment of anthropomorphism

From a methodological perspective, the applied measurement of anthropomorphism can naturally influence study results. In their studies, Mourey et al. (2017) as well as Krämer et al. (2018) focused on the manipulations of anthropomorphism to investigate the interrelation with social needs and did not measure perceived anthropomorphism. While both studies support an effect of the interaction with an anthropomorphic technology on users' social needs, analyses within the main studies did not explicitly consider a measurement of perceived anthropomorphism. Thus, the role of the individual perception of anthropomorphism for the found interrelation as well as potential alternative explanations for the effect on users' social needs remain unclear.

In contrast, the above discussed studies by Christoforakos et al. (2021) as well as Christoforakos and Diefenbach (2022), which could not detect a so-called saturation effect of the interaction with anthropomorphic technology on users' social needs assessed perceived anthropomorphism by explicit measures. Namely, the authors applied the Anthropomorphism Subscale of the Godspeed Questionnaire including five items (e.g., "machinelike"/"humanlike") to be assessed on five-point semantic differential scales (Christoforakos et al. 2021). In the other study, Christoforakos and Diefenbach (2022) assessed anthropomorphism by a self-constructed single item, that is, "To what extent does your smartphone make a humanlike impression?" on a five-point Likert scale (1 = "not humanlike at all"; 5 = "very humanlike"). Yet, as also supported by a study by Kim and Sundar (2012), applying such explicit measures might have caused psychological reactance within participants, leading to a possibly invalid measurement of perceived anthropomorphism and in turn potentially influencing the study outcome. Namely, in their study, Kim and Sundar (2012) found that most participants who were exposed to an anthropomorphic version of a website (a website with a guiding humanlike character) reported a lower degree of perceived humanlikeness than those exposed to the non-anthropomorphic version of the website (no humanlike character) (Kim and Sundar 2012). Therefore, the authors argue that participants who were exposed to the anthropomorphic version of the website intentionally denied treating the website in a human way, particularly when personifying the website with simple labeling. This is further supported by their insights showing that participants who denied treating the website in human terms when exposed to the character tended more to attribute personal characters to the website compared to those not exposed to the character (Kim and Sundar 2012). The authors conclude that anthropomorphism is rather mindless, i.e., a non-conscious tendency to treat computers as human beings than mindful, i.e., a conscious tendency to treat computers as human beings. Thus, explicit measurement of anthropomorphism to assess the perception of participants might impair the validity of insights. In general, this makes the assessment of anthropomorphism a challenging research objective as it appears difficult to measure it appropriately without probably influencing the measurement itself.

3.2 Assessment of social needs

In addition, from a methodological perspective, when exploring the potential of interaction with anthropomorphic technology to fulfill social needs, the measures applied to assess individuals' social needs can also naturally influence study insights. For example, Krämer et al. (2018) as well as Christoforakos et al. (2021) and Christoforakos and Diefenbach (2022) applied (an adapted version of) the scale to measure willingness to socialize, developed and validated by Krämer et al. (2018) as well as behavioral measures, that imply a certain degree of willingness to socialize (Christoforakos and Diefenbach 2022; Krämer et al. 2018). The scale was developed to measure the willingness to engage in social activities, including items clustering on the factors "desire" (e.g., "Now I feel like texting my friends") and "plan" (e.g., "I am going to text my friends today"). As also discussed by Christoforakos and Diefenbach (2022) ratings of specific items, such as "Now I would like to meet my friends.", or "I am going to meet my family today." are prone to be affected by contextual factors, such as the physical distance to one's family and friends or other plans, which may overwrite potential effects of an experimental manipulation.

Mourey et al. (2017) further focused on more indirect measures of need for social connection, for example, estimated number of Facebook friends or planned prosocial behavior. In this case, the authors based their interpretation solely on the behavioral intentions to socialize, which assumably influence the estimation of Facebook friends or prosocial behavior. Moreover, result interpretation based on

the study designs and measures applied in the studies presented above (Krämer et al. 2018; Mourey et al. 2017) relies on the assumption that a sort of social need satisfaction is causal.

On a more conceptual level, even if a measure to assess the satisfaction of social needs, such as the General Belongingness Scale (e.g., "I feel like an outsider"; Malone et al. 2012), were applied, it is questionable to what extent the short-term interaction with an (anthropomorphic) technology could actually affect users' social needs. According to Baumeister and Leary (1995), the need to belong represents a central human need and is defined as the "need to form and maintain at least a minimum quantity of interpersonal relationships". Therefore, it is unlikely that an effect of the interaction with anthropomorphic technology on social needs can be observed in a cross-sectional study design.

Moreover, the social reconnection hypothesis posits that the experience of social exclusion (i.e., a primary threat to belongingness needs) motivates individuals to seek out new sources of social acceptance (Maner et al. 2007). Furthermore, study results show that when one's need for social belonging is threatened, people are faster at recognizing smiling faces in a crowd and focusing on positive, social faces as opposed to unhappy faces or positive, nonsocial images (DeWall et al. 2009). Thus, in many instances, threats to individuals' needs increase motivation to restore those needs directly. In accordance, to investigate the possible social saturation effect through interaction with anthropomorphic technology, social exclusion needs to be induced. Although most of the above presented studies exploring this interrelation include an according manipulation of social exclusion, especially in online settings it is difficult to ensure that participants are actually alone while participating at the study. Even in experimental settings, the simple presence of a researcher could counteract the effect of social exclusion. Therefore, even after experimentally inducing social exclusion, the need for social interaction might not be as salient as necessary to detect the assumed effect of anthropomorphic technology on social needs.

Finally, it appears worthwhile to reflect on the nature of the social needs construct that is in focus. First studies imply a possible effect on social needs in general (e.g., Mourey et al. 2017) by showing that there is less willingness to engage in social behavior after an interaction with an anthropomorphic product or technology. Still, it is not specified whether this observed effect is actually based on the satisfaction of a specific need. The fact that other studies have not found a so-called saturation effect on the willingness to interact with others through the interaction with an anthropomorphic technology, as well as previous research implying a positive relationship between loneliness and perception of anthropomorphism (e.g., Epley et al. 2008; Niemyjska & Drat-Ruszczak 2013) could speak for the potential of anthropomorphic technology to act as a social snack rather than saturate the need for interpersonal interaction.

In sum, the discussed limitations support the general complexity of the relationship between anthropomorphic technology and social needs. Moreover, the discussed methodological and conceptual challenges highlight that current research needs to be complemented by alternative approaches to foster deeper insight on whether the interaction with technology has the potential to address social needs and relevant underlying psychological mechanisms.

4 Empirical study

To complement previous experimental research on the potential of anthropomorphic technology to address users' social needs, and broaden the view on this interrelation, we conducted a qualitative interview study. In our interview study we aimed to explore whether technology has the potential to address users' social needs and what role anthropomorphism plays in this interrelation. Based on the above presented varying results regarding the interrelation of interest, we followed an explorative approach, to foster an unbiased investigation of our research question and capture a comprehensive image of what is truly at the heart of individuals' experience when interacting with technology. In addition, the above-presented methodological and conceptual challenges regarding our research objective speak for the application of alternative methods to traditional experimental research paradigms, in order to gain broader insights regarding our research question.

4.1 Methods

For our qualitative study we followed the approach of psychological phenomenology according to Moustakas (1994). A phenomenological study in general describes the meaning for several individuals of their lived experiences of a concept or phenomenon (Creswell 2007). In this, the focus lays on what all participants have in common regarding this experience. By means of a phenomenological study, individual experiences regarding a phenomenon can be reduced to a universally applicable essence. The hermeneutical phenomenology (van Manen 1990) as one type of phenomenology refers to "interpreting the 'texts' of life" (Creswell 2007) and thus reflects on essential themes of a phenomenon of interest in order for the researcher to write a description of it as well as make an interpretation regarding the meaning of certain lived experiences. Psychological phenomenology (Moustakas 1994) is mainly focused on descriptions of participants rather than interpretations of the

researcher. Thus, the approach is characterized by the concept of bracketing, where researchers try to leave aside their own experiences in order to foster a fresh perspective with regards to the phenomenon in question.

As our research focuses on understanding the potential of technology to address individuals' social needs, the phenomenological approach allows deep insight into the experience of a number of individuals regarding their interaction with technology and the possible effect on their social needs. Furthermore, by applying the approach of psychological phenomenology by Moustakas (1994) the participants' experience can be focused by leaving aside as much as possible the researcher's perspective on the interrelation in question, which could for example be influenced by previous literature in this regard. At the same time, reflecting on existing literature regarding the effect of anthropomorphic technology on users' social needs prior to the study supports a basic understanding of relevant existing broader assumptions, which is necessary to conduct phenomenological research (Creswell 2007).

4.1.1 Participants

Eight participants (50% female, 50% male) between twenty-five and sixty-one years ($M = 36.88$; $SD = 12.24$) were interviewed. Daily interaction with interactive technology was the only precondition for participation. As a thank you for participation, interviewees received a twenty Euro Amazon coupon. The sample size was chosen based on our study's emphasis on in-depth understanding of experiences and according recommendations for phenomenological and interpretive research (e.g., Polkinghorne 1989; Thompson 1997). Participants had diverse academic backgrounds. Table 1 shows a detailed sample description.

4.1.2 Procedure

The interview study was introduced as a study on innovative technology in everyday life. Each participant was given a pseudonym and was assured of anonymity and confidentiality. During the interviews, participants could choose to talk about any products in the domain of technology/consumer electronics they found relevant to answer the questions. Most participants mentioned several products and later picked one which they focused on. These products, for example, included smartphones, smart washing machines, or even vacuum cleaners. The interview started with a short introduction for the participants to get acquainted with the topic. Participants were asked to describe personal interactions with technologies that resemble interactions with other humans as well as general effects of any technology on personal social needs.

After this introductory part, the main part of the interview focused on three overreaching, guiding questions, i.e., participants were asked to reflect on (1) similarities and differences in interaction with technology vs. humans with regard to users' social needs, (2) technology characteristics that could be relevant for an effect of interaction with technology on users' social needs and finally, (3) third party reactions to human-technology interaction resembling interpersonal interaction.

4.1.3 Data analysis

Our methodology followed the approach of a phenomenological analysis, revealing general themes as well as participants' experiences regarding a research subject. Specifically, for each guiding question, we conducted multiple steps, as suggested by Creswell (2007) and originally based on the phenomenological analysis by Moustakas (1994). First, transcriptions of the raw data were analyzed for significant statements, meaning "sentences or quotes that provide an understanding of how the participants experienced the phenomenon" (Creswell 2007), so-called level A statements. These statements were paraphrased and then organized into clusters of meaning (level B), which represented reoccurring issues within all participants' interviews. To be meaningful, issues must not necessarily be present in all participants' narrations. Even experiences from only a single participant can be theoretically important, and generality is not a primary concern of phenomenology (Creswell 2007). Finally, the clusters of meaning were organized into

Table 1 Sample description of empirical study
Tab. 1 Stichprobenbeschreibung der empirischen Studie

Participant	Gender	Age	Occupational Status	(Field of) Occupation	Housing situation
P1	Female	61	Employed	Computer Science, Executive Position	Living with others
P2	Female	25	Student	Art/Culture, Marketing/PR	Living with others
P3	Female	48	Employed	Art Consulting	Living with others
P4	Male	27	Employed	IT Project-Management	Living alone
P5	Male	39	Employed	Online Marketing & IT	Living alone
P6	Female	31	Employed	Research Assistant	Living with others
P7	Male	35	Employed	Engineer	Living with others
P8	Male	29	Employed	Asset Management	Living with others

Table 2 Findings on similarities and differences in interaction with technology vs. humans with regard to users' social needs (guiding question 1)
Tab. 2 Befunde zu Ähnlichkeiten und Unterschieden in der Interaktion mit Technologien bzw. Menschen in Bezug auf soziale Bedürfnisse der Nutzer (Leitfrage 1)

Themes (level C)	Clusters of meaning (level B)	Mentions (in participants)	Exemplary Statements (level A)
Description of interaction content with technology/ human counterpart	Exchange of orders/instructions and answers with technology	6	"Because the way it is right now, a question is simply followed by a predefined answer." [P4]
	No emotional/content feedback/support from technology	4	"I don't feel loved by the technology surrounding me. [Technology cannot] show me the way or be there for me." [P2]
	No haptic interaction with technology	4	"What we cannot do (with technologies), is touch each other or so, meaning that the haptic component is definitely missing and that is not good on the long run." [P3]
	Emotional/content feedback/support from humans	3	"[A human can] show me the way and be there for me." [P2]
	No common history/leisure activities with technology	2	"With this thing one cannot (..), watch a DVD or go out for a beer." [P5]
	More unpredictability in interaction with humans	2	"With a human this is naturally different. I get everything back, maybe not the way I imagined it, but I give and receive something. And that's what is actually interesting, that it is not one hundred percent predictable (…)." [P7]
	No own will of technology in interaction	1	"Yes, it naturally doesn't have an own will." [P7]
	No judgement/observation through technology	1	"I would say when I am surrounded by technology, I am not being judged or seen." [P2]
	Similar interaction with technology and humans through modality of speech	1	"(…) that you can speak with a machine like you would with a human." [P1]
	Simple coexistence with technology	1	"(…) It's more like another person is in the room, who is looking in another direction and is occupied with something else." [P6]
Personal feelings regarding/ evaluation of interaction with technology/ human counterpart	No satisfaction of social needs with technology	4	"I don't feel fulfillment or social satisfaction afterwards (…)." [P2]
	Counteraction of temporary boredom/loneliness/frustration with technology	3	"[My smartphone] can counteract temporary boredom, it can counteract temporary loneliness". [P2]
	More superficial/distant interaction with technology	3	"I think that you maintain a polite distance to technology." [P2]
	No social responsibilities with technology	2	"When I speak with a robot, I am not limited or self-conscious regarding social norms. I can just have a go at it without being worried about how that makes him feel." [P6]
	More control over interaction with technology	2	"Yes, so it is still a thing that is operated by electricity and if I don't feel like it, I can pull the plug." [P4]
	Possible satisfaction of social needs through technology in future	2	"In theory yes [technology might be able to satisfy social needs] but I think that some time needs to pass for this to be achieved." [P4]
	Less need for social interaction after interaction with technology	2	"I think that if a technology spoke with me intensely and I talked about my day and how I was doing, I would actually have the feeling: I have conversed enough." [P4]
	Entertainment/education through interaction with technology	2	"And what he maybe can do, that would rather frustrate me with other humans, is that he actually educates me a little. (…). He educates me to be aware of my stuff lying around." [P5]
	Different quality of satisfaction or peace after interaction with technology	2	"I feel empty and exhausted [after the interaction with technology]." [P2]
	Interaction is more personal/ intense with humans	1	"With humans everything is more personal." [P2]
	Affirmation through interaction with technology	1	"[Technology gives me] affirmation I would say. For example, my smart home would never insult me." [P4]
	Technology as a relationship partner	1	"[With my smartphone] it's just like in a relationship. When the partner is not there anymore, a part is missing." [P8]

larger information units that represented general themes (level C). This process is not a rigorous and unidirectional one. It rather consists of analytic circles, where new insights and reflection processes may lead to revisions of data organization (Creswell 2007). The themes and clusters of meaning were discussed and developed jointly by the first and second author.

4.2 Findings

The study findings are structured along the three guiding questions of the main interview part as described with regard to the study procedure (Sect. 4.1.2). Note that whenever participants' statements were relevant for a specific guiding question, they were considered in the data analyses, even if mentioned with regard to another guiding question. Moreover, it is possible that one participant might have made statements belonging to the same cluster multiple times within the interview. In this case, these statements were not counted multiple times.

4.2.1 Interaction with technology vs. humans with regard to users' social needs

Participants' statements regarding their relationship qualities to technology and respectively other humans formed two general themes (level C), namely, *description of interaction content with technology/human counterpart* and *personal feelings regarding/evaluation of interaction with technology/human* counterpart. The related clusters of meanings (level B) and corresponding exemplary statements are listed in Table 2.

In sum, regarding the first theme of descriptions of interaction content with technology/human counterpart, participants most frequently elaborated on how interaction with technology is an exchange of orders or instructions and according answers in return. One participant for example explained: *"Because the way it is right now, a question is simply followed by a predefined answer."*. In line with this, participants often mentioned how there is feedback or support from the technology missing on an emotional or informative as well as haptic level. In an exemplary statement, one participant said: *"(...) Communication means, that you can exchange feelings, information, and I think, that especially on the emotional level an object actually doesn't give you anything in return."*.

Referring to the second theme of personal feelings or evaluations regarding interaction with technology vs. a human counterpart, participants mostly explained that they did not feel a satisfaction of social needs with technology. Moreover, they frequently mentioned that an interaction with technology could counteract temporary boredom, loneliness, or frustration. In this regard, one participant for example explained *"(...) not every psychological aspect can be addressed through technology but a big part, at least sympathy, meaning 'not feeling alone' can be addressed through technology, I think."*. In the same frequency participants stated that they perceived interaction with technology to be more superficial or distant compared to interpersonal interaction.

4.2.2 Technology characteristics relevant for its effect on users' social needs

Participants' statements regarding characteristics of technology that might influence the extent to which it can affect users' social needs formed two general themes (level C), namely, *Technology characteristics resembling characteristics of (interaction with) humans/animals* and *other technology characteristics. The related clusters of meanings* (level B) and corresponding exemplary statements are listed in Table 3.

Regarding technology characteristics resembling characteristics of (interaction with) humans or animals, participants most frequently mentioned technology intelligence as well as (im)perfection or (un)predictability as a potential factor. In this regard participants for example explained: *"For example, Alexa, who speaks with me doesn't give me anything, she is simply too dumb."* or *"I think it's mainly because it's not perfect. It's cuter when it drives around in confusion than when it's one hundred percent effective in driving along its paths without me noticing."*. In the same frequency participants mentioned a general technology humanlikeness to be possibly relevant for technology to affect users' social needs. Amongst others they explained *"(...) I would say that technology needs to have humanlike characteristics to socially satisfy."*. Less frequently they mentioned technology interaction with users (through speech), as well as visual design cues suggesting humanlikeness as relevant to foster an effect on users' social needs. Moreover, in the same frequency participants mentioned how a combination of various humanlike characteristics would be necessary in this regard (e.g., *"I think appearance as well as empathy play a role, it has to be an interplay (...)")*. Regarding other technology characteristics, participants most frequently named a sort of modern, aesthetic, or appealing design as potentially influential, as well as less a certain timeframe of possession or frequency of use of a certain technology.

4.2.3 Third party reactions to human-technology interaction resembling interpersonal interaction

Participants' statements concerning reactions of third parties regarding an interaction with technology that resembled interpersonal interaction formed two general themes

Table 3 Findings on technology characteristics that could be relevant for an effect of interaction with technology on users' social needs (guiding question 2)
Tab. 3 Befunde zu Eigenschaften von Technologien, die für den Effekt der Interaktion mit Technologien auf soziale Bedürfnisse der Nutzer relevant sein könnten (Leifrage 2)

Themes (level C)	Clusters of meaning (level B)	Mentions (in participants)	Exemplary Statements (level A)
Technology characteristics resembling characteristics of (interaction with) humans/animals	Technology intelligence can play a role	4	"For example, Alexa, who speaks with me doesn't give me anything, she is simply too dumb." [P2]
	General technology humanlikeness can play a role	4	"(...) I would say that technology needs to have humanlike characteristics to socially satisfy." [P4]
	Imperfection/unpredictability in interaction/behavior can play a role	4	"I think it's mainly because it's not perfect. It's cuter when it drives around in confusion than when it's one hundred percent effective in driving along its paths without me noticing." [P5]
	Interacting (through speech) with the user can play a role	3	"I think it's about the way of interaction, the input options, such as voice assistants, who are designed to simulate this [humanlike way of interaction]." [P6]
	Visual design suggesting humanlikeness can play a role	3	"What probably evokes a completely different feeling is, when it has human characteristics on the outside." [P4]
	Combination of various humanlike characteristics necessary	3	"I think appearance as well as empathy play a role, it has to be an interplay (...)." [P6]
	Animallike design can play a role	2	"I can imagine that the doglike design helps in comparison to something totally abstract or more edgy." [P5]
	Reaction to user expressions/emotions can play a role	2	"Also giving feedback [could play a role]. Yes, for example I was thinking of colors. When one is unhappy or angry it could go towards red and success, for example, I would rather associate with green." [P7]
	Humanlike movement/posture of technology can play a role	2	"[The technology] should be moving in a humanlike manner and not just be a box of technology with no humanlikeness other than the voice." [P1]
	Modality of movement can play a role	1	"He moves and I just get this feeling [of a social interaction]." [P6]
	Modality of voice can play a role	1	"The voice [plays a role], that's probably the humanlikeness [of the technology]." [P1]
	Perception of goal motivation of technology can play a role	1	"It's that he does things and I attribute underlying goals." [P6]
Other technology characteristics	Modern/aesthetic/appealing design can play a role	5	"If it had a super modern and smooth design and were actually almost chic like an accessory in my home and in addition spoke and interacted with me, I would develop an emotional relationship to such [technology]." [P2]
	Timeframe of possession/frequency of use can play a role	2	"[Something that] you have owned for a long time and that has some sort of history [can affect social needs]." [P7]
	Perceived development effort of technology can play a role	1	"For example, a mechanic watch. When I imagine that it has hundreds of components and the precision and performance that that was invested." [P7]
	Technology adaptability to user can play a role	1	"I mean for someone who is aggressive [the technology] has to be aggressive as well." [P8]
	Expectation management regarding abilities of technology can play a role	1	"(...) Alexa was promoted as something that represents a friend at home and answers to questions etc. and I think that it is just not developed appropriately." [P2]
	Hedonic character of product can play a role	1	"Things that I use often, that are pleasant and less of working tools." [P6]

(level C), namely, *Rather negative reactions* as well as *Rather neutral or positive reactions*. In this, participants considered their own reactions as well as reactions of others. The related clusters of meaning (level B) and corresponding exemplary statements are listed in Table 4.

Regarding rather negative reactions participants most frequently mentioned reactions where the third party in question was irritated or showed lack of understanding. An example in this regard was: *"Because of the functionality of speaking to Siri, I have often received incredulous looks."*. Less frequently participants mentioned situations where the third party was annoyed or uncomfortable, such as: *"My boyfriend, with whom I lived together back then, was somehow a little annoyed."*.

Table 4 Findings on third party reactions to human-technology interaction resembling interpersonal interaction (guiding question 3)
Tab. 4 Befunde zu Reaktionen Dritter auf Mensch-Technik Interaktionen, die zwischenmenschlichen Interaktionen ähneln (Leitfrage 3)

Themes (level C)	Clusters of meaning (level B)	Mentions (in participants)	Exemplary Statements (level A)
Rather negative reactions	Third party is irritated/shows lack of understanding	5	"Because of the functionality of speaking to Siri, I have often received incredulous looks." [P4]
	Third party is annoyed/ uncomfortable	3	"My boyfriend, with whom I lived together back then, was somehow a little annoyed." [P2]
	Third party finds interaction ridiculous	2	"My husband sometimes says 'poor Harry' [to our car] but I find this a bit ridiculous." [P6]
	Third party has the feeling of another (strange human) entity in the room	1	"(...) and we actually didn't really fancy the idea and it was somehow as if there was another person in the room who did not belong." [P8]
Rather neutral/ positive reactions	Third party approves/does not disapprove of interaction	3	"Nobody has really disliked the interaction because I don't overstretch it." [P4]
	Third party is interested/enthusiastic	2	"I also have friends who are technophile, and they ask: How does this work? How can you manage this?" [P4]
	Third party gets involved in interaction	2	"(...) he would instead simply join the interaction." [P6]
	Third party pays attention/is surprised	2	"When you interact this way [with the technology, others'] attention is definitely steered." [P1]
	Third party encourages interaction	1	"When we meet up for a beer, he asks if I can make [the robot] drive around." [P5]
	Third party is accustomed to interaction	1	"Well, I am quite used to this interaction because I have one [e.g., Siri] myself." [P5]

With regard to rather neutral/positive reactions, participants most frequently mentioned situations where the third party approved or at least did not disapprove the interaction with the technology that resembled an interpersonal one. In this regard, on participant explained: *"Nobody has really disliked the interaction because I don't overstretch it."* Less frequently participants described situations where the third party was interested in or enthusiastic about the interaction (e.g., *"I also have friends who are technophile, and they ask: How does this work? How can you manage this?"*), or where the third party got involved in the interaction with the technology. In the same frequency participants described situations where the third party was surprised, or their attention was steered.

4.3 Discussion

Within our empirical study, we aimed at exploring whether technology has the potential to address users' social needs as well as the role of technology anthropomorphism in this interrelation. In this, we conducted interviews, where we mainly focused on comparisons of human-technology interaction that resembles an interpersonal one and actual interpersonal interaction, technology characteristics that could play a role regarding a potential effect of technology on users' social needs, and finally, reactions of third parties to interactions with technology that resemble interpersonal interactions.

While participants statements refer to different technologies and corresponding modalities of interaction, overall results show many differences in the perceived quality of interaction with technology that resembles interpersonal interaction and actual interpersonal interaction. The first and second most prominently found clusters of meaning included exchange of orders/instructions and answers with technology, no emotional/content feedback/support from technology, no haptic interaction with technology and no satisfaction of social needs with technology. These findings highlight that even though interactions with technology might oftentimes resemble interpersonal interaction, a central perceived difference concerns the dull character of interaction with technology and the accordingly missing reactions to the user on a content, emotional and physical level. This could be a possible reason for the found absence of satisfaction of users' social needs, even though modalities of interaction with technology can be quite similar to those known from interpersonal interaction.

Moreover, regarding technology characteristics that can play a role in addressing users' social needs, the first and second most frequently named clusters of meaning involved technology intelligence, imperfection/unpredictability in technology interaction/behavior, general technology humanlikeness, interacting (through speech) with the user, visual design suggesting humanlikeness, combination of various humanlike characteristics as well as modern/aesthetic/ appealing design and timeframe of possession/frequency of use. It appears, that apart from an attractive design

and the user involvement, e.g., through long possession or frequent use, known to generally influence product or brand engagement (e.g., Majeed et al. 2022), the rest of the mentioned clusters of meaning mainly concerned characteristics resembling humans and/or interaction with them. Such results stand in line with previous findings supporting the role of anthropomorphism for the effect of interaction with technology on users' social needs (e.g., Krämer et al. 2018; Mourey et al. 2017). Within these characteristics it seems that technology intelligence, its imperfection or unpredictability as well as its general humanlikeness are perceived to be most crucial for an effect on users' social needs. It is noticeable that these qualities are rather abstract in comparison to interaction through speech or visual design resembling a human. This finding could speak for the complexity of the relationship between interaction with technology and users' social needs. Additionally, it might underline the challenge for technology users to exactly grasp and verbalize what is really crucial for technology to even rudimentarily address social needs of users. Moreover, it could also explain why study participants often mentioned not having felt a social satisfaction through interaction with technology as those qualities are yet very difficult to implement in technology that we use in our everyday lives, such as voice assistants.

Finally, when asked about reactions of third parties regarding an interaction with technology that resembles an interpersonal one, the first and second most frequently mentioned clusters of meaning were third party is irritated/shows lack of understanding but also third party approves/does not disapprove of interaction. While these results imply that this type of interaction with technology is still novel and often subject of misunderstanding, under certain circumstances it is also accepted, and people come to terms with it. As one participant stated, "I have mostly heard someone say for example: Alexa, how long does the rice take to cook?, and the whole room needed that answer so it made sense.". This statement could for example imply, that when this type of interaction with technology is explainable, i.e., has obvious benefits for the user(s), the interaction could be evaluated positively. Such an interpretation stands in line with the relevance of explainability of innovative, complex technology to foster its acceptance (e.g., Smith-Renner et al. 2020).

4.4 Limitations

Our empirical study comes with certain limitations on a methodological and conceptual level. First, with regard to the methodology, as it is the case with most phenomenological studies, our results are based on a rather small sample size. Moreover, when asked about technologies with which participants interacted in a manner that resembled interpersonal interaction, each participant naturally considered different technologies. Accordingly, they also named different ways of interaction with these technologies that subjectively resembled interpersonal interaction. Thus, participants' reports each refer to a different basis of discussion, which should be considered regarding the generalizability of results. Although both aspects might restrict generalizability of result interpretation from a methodological perspective, we purposely decided to prioritize few but in-depth descriptions of relevant experiences by the participants including individually chosen technologies. Moreover, we have no reason to assume the revealed findings to be entirely specific to the present sample.

Second, as particularly outstanding experiences are very memorable (cf. Chandralal and Valenzuela 2013), it is possible that participants mentioned particularly positive or negative experiences and thus reports might have involved fewer neutral experiences regarding interaction with technology. In future studies the consideration of additional research methods, such as experience sampling (Zuzanek 2000), could foster a more detailed representation of relevant experiences.

Finally, on a more conceptual level, the qualitative approach might have allowed detailed illustrations of participants' experiences and fostered a broader understanding in this regard. Still, participants might have been inhibited about explaining whether and how interaction with technology addresses their social needs as they might have felt self-conscious about the topic's social acceptability. Although technologies increasingly slip into the role of social counterparts, actual satisfaction of social needs through the use of technology might still be frowned upon. Participants' statements such as *"When I talk to the robot, all my brain actually thinks is that it is just ridiculous what I am doing."* support the possibility of such perceptions. Moreover, admitting technologies could even partially satisfy needs in a similar manner to other humans, could cause technology to appear as a threat to humans. Thus, even if participants perceived an effect on their own social needs through the use of technology, they might have rationalized this perception and not shared such or stated otherwise. This conceptual limitation underlines the complexity of the interrelation of interest as a research objective. It furthermore highlights why the assessment of relevant variables, such as satisfaction of social needs, represents a central challenge.

5 General discussion

As technologies increasingly represent our social counterparts and our interaction with them oftentimes resembles interpersonal interaction in many ways, the question arises whether technology also has the potential of addressing

users' social needs in a similar way as a human counterpart. Based on previous findings, technology seems to affect users' social needs in some way, especially when technology anthropomorphism comes into play (e.g., Krämer et al. 2018; Mourey et al. 2017). Yet, research in this regard shows varying findings and comes with certain methodological and conceptual challenges.

Our qualitative study results support a certain interrelation of interaction with technology and users' social needs but also highlight central differences between the quality of human-technology interaction and interpersonal interaction in this regard. For example, based on the clusters of meaning mentioned by participants, our findings imply that interaction with technology, which resembles interpersonal interaction, might help to counteract temporary negative user states, such as boredom, loneliness, or frustration. Thus, our results offer support for previous studies implying a certain connection between loneliness and anthropomorphism (e.g., Epley et al. 2007, 2008; Niemyjska and Drat-Ruszczak 2013). Moreover, our results could imply that found effects of interaction with anthropomorphic technologies on users' social needs within cross-sectional studies (e.g., Krämer et al. 2018; Mourey et al. 2017) are based on a counteraction of users' temporary negative states, such as felt loneliness.

Yet, findings also speak for an absence of satisfaction of users' social needs, possibly due to the described exchange of orders and answers in human-technology interaction and the missing feedback from the technology on a content, emotional and physical level, amongst others. These results stand in line with previous findings which do not imply an effect of interaction with technology on users' social needs (e.g., Christoforakos and Diefenbach 2022). Additionally, our findings could offer potential explanations for this missing effect through found differences in the quality of human-technology interaction vs. interpersonal interaction.

Moreover, our results imply a role of technology anthropomorphism regarding the interrelation of interaction with technology and users' social needs and support previous study findings (e.g., Epley et al. 2007, 2008). Specifically, mostly mentioned clusters of meaning regarding relevant technology characteristics for a potential effect on users' social needs concerned characteristics resembling human or animal behavior or interaction. Results also extend existing insights as to relevant combinations of humanlike characteristics for an according effect as well as other technology characteristics, such as modern and aesthetic design, that might play a role. The frequently named necessity of a combination of humanlike technology characteristics (e.g., visual design combined with the expression of empathy) to address users' social needs could also serve as a possible explanation for the missing effect of anthropomorphic technology on users' social needs within a few previous studies that only manipulated technology appearance (e.g., Christoforakos and Diefenbach 2022).

Finally, as discussed above, results show that when asked about third-party reactions to an interaction with technology that resembles interpersonal interaction, most frequent mentions concerned rather negative reactions. Thus, the interrelation of interest within the present paper might be one of questionable social acceptance. Such an issue could also offer an explanation for previous study findings, that did not show an interrelation between interaction with technology and users' social needs. Additionally, this further supports the complexity of this phenomenon as a research objective.

Further studies in this regard following different methodological approaches are needed to look closer into the relation of interaction with anthropomorphic technology and social needs. Future quantitative research could benefit from considering insights of our qualitative study and framing variables and items accordingly. For example, it could be beneficial to manipulate anthropomorphism by combining different technology characteristics or assessing social needs on a level of loneliness rather than complete social saturation. In this, the complexity of the interrelation of interest in this paper along with the respective challenges of assessment of central variables should be considered.

6 Conclusion

Current research offers varying insights on whether and to what extent technology can actually address users' social needs. Challenges in the assessment of technology anthropomorphism as well as social needs could be just one example of possible reasons for this current state of research.

The interview study presented in this paper partially stands in line with existing research but also extends such and offers first insights into possible reasons for previous study results. Namely, results imply that interaction with anthropomorphic technology could have the potential of—at least temporarily—addressing aspects of users' social needs. Yet, findings also underline technology's limits in this regard by highlighting crucial perceived differences to human interaction and implying that an actual satisfaction of social needs might not be possible through the interaction with technology.

Taken together, on a societal level, the picture that emerges from conserving previous literature as well as our empirical study could be considered a rather optimistic one. Namely, it appears that human interaction is rather unique in ways that technology to this moment cannot imitate to perfection, even if the interaction with such resembles the interpersonal one in many ways. For example, based on our results it seems that even by means of humanlike

interaction, technology cannot offer emotional feedback or support and possibly due to this reason, amongst others, cannot offer satisfaction of social needs. Thus, technology does not appear as a substitute of other humans when it comes to social interaction and its consequences. According to our results, it could rather represent a practical solution to dampen negative effects of temporary user states, such as loneliness.

From a practical perspective it might therefore be advisable to focus on specifics of each entity instead of aiming for interchangeability. Whereas humans appear unique in giving emotional and physical feedback to their human counterparts, technology might be easily applicable to temporarily address boredom, frustration, or loneliness of their users. Technology might even be the ideal interaction partner in such situations, as according to Dörrenbächer et al. (2020) it could come with superpowers of being endlessly patient and non-judgmental. Such characteristics might be especially preferred when a user simply wants to be entertained in order not to feel lonely or bored, as also reflected in our findings, supporting that users feel no social responsibility when interacting with technology. In line with these reflections, fostering an ideal synergy of humans and technology by focusing on specificities of both might be a promising overall strategy for a desirable societal development where humans and technology do not compete but rather benefit from each other.

Funding Open Access funding enabled and organized by Projekt DEAL.

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