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Technology as a Social Companion? An Exploration of Individual and Product-Related Factors of Anthropomorphism

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Abstract

From chatbots that simulate human conversation to cleaning robots with anthropomorphic appearance, humanlike designed technologies become increasingly present in our society. A growing strand of research focuses on psychological factors and motivations influencing anthropomorphism, that is, the attribution of human characteristics to non-human agents and objects. For example, studies have shown that feeling lonely can come along with attributing anthropomorphic qualities to objects; others imply that anthropomorphism might influence individuals' social needs in return. Such an interrelation could have great societal impact, if, for example, interacting with humanlike technology would reduce the need for interpersonal interaction. Yet, the interrelation between anthropomorphism and social needs has not been studied systematically and individual as well as situational preconditions of anthropomorphism have not been specified. The present research investigates the interrelation between anthropomorphism and social needs on the example of interacting with a smartphone and highlights possible preconditions by means of two experimental studies using a 2 × 2-between-subjects-design, varying social exclusion and anthropomorphism. Our first study (N = 159) showed an overall positive correlation between the willingness to socialize and perceived anthropomorphism. Our second study (N = 236) highlighted that this relationship is especially pronounced for individuals with a high tendency to anthropomorphize, given that the product supports a humanlike perception through its appearance and design cues. In sum, results support an interrelation between social needs and anthropomorphism but also stress individual and contextual strengthening factors. Limitations, theoretical, and practical implications are discussed.

Keywords

anthropomorphism, interactive technologies, social needs, need to belong, willingness to socialize

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Every day, we spend a remarkable amount of time interacting with smart technologies. The smartphone represents the most evident example (Statista, 2021). Accordingly, such technologies come with the potential to have a significant impact on their users, for example, by affecting their well-being (e.g., Diefenbach and Borrmann, 2019; Elhai et al., 2017; Herrero et al., 2019) and social capital (e.g., Bian & Leung, 2014). In parallel, interactive technologies become increasingly humanlike by means of visual cues and interaction design. For example, chatbots or voice assistants such as Amazon's Alexa and Apple's Siri reflect elements of human interaction on different levels. This ranges from holding a name to the design of interaction and responsiveness, sometimes even revealing a kind of personality in dialogue. As according to literature, depending on humanlike design, interactions with such technologies can adopt a social character (cf. Nass et al., 1994; Reeves & Nass, 1996), these interactions might have a particularly direct and lasting effect on their users, addressing, for example, their social needs.

Moreover, in line with previous research, one possible factor influencing whether or to what extent users anthropomorphize non-human agents or objects appear to be their social needs. Namely, "the need and desire to establish social connections with other humans" (Epley et al., 2007, p. 866) represents one of the psychological factors defining when and why humans anthropomorphize. To date, establishing social connections has always been a fundamental strategy of humans to survive (Baumeister & Leary, 1995; Maslow, 1943). Yet, increasingly tight schedules as well as the extensive occupation with technologies are nowadays continuously hampering frequent face-to-face human interactions. Therefore, it is imaginable that humans might, partly unconsciously, be seeking alternative resources, such as interactions with humanlike products to fulfill their social needs. In line with this idea, research has shown that feeling lonely or chronically disconnected from others can come along with attributing anthropomorphic qualities to objects and entities (e.g., religious agents, pets, and imaginary creatures; Epley, et al., 2008; Epley, Waytz, et al., 2008; Niemyjska & Drat-Ruszczak, 2013). However, the findings of single studies have scarcely been integrated. Systematic research on the interrelations of social needs and perceived anthropomorphism as well as preconditions and internal factors that might play a role within this relationship is still lacking. To address this research gap, the present studies investigated whether anthropomorphic products have the potential to fulfill social needs and how individually perceived anthropomorphism correlates to social needs. Besides deeper insights into the user experience, the potential of interactive products to fulfill social needs also bears relevance on a broader level, from individual well-being up to societal changes of social interaction. On the one hand, a potential fulfillment of social needs by technologies or products in general could foster a positive overall experience for individuals and positively influence their well-being. On the other hand, it is questionable whether it is beneficial for individuals' social needs to be addressed through usage of technologies or products as this could possibly come with a drop of social interaction between individuals.

We conducted two consecutive experimental studies. Within the first one, we focused on an implicit manipulation of anthropomorphism and its effect on social needs on an intentional and behavioral level. In our second study, we implemented a more explicit manipulation of anthropomorphism based on design cues and considered further person variables such as individual tendencies to anthropomorphize. In the following sections, we summarize relevant literature regarding anthropomorphism and social needs, derive our research questions and hypotheses, present two experimental studies, and discuss theoretical as well as practical implications of our findings.

Theoretical Background and Research Hypothesis

Anthropomorphism

According to Epley et al. (2007), anthropomorphism describes the act of attributing human characteristics, motivations, emotions, and intentions to non-human agents, ranging from animals

over spiritual entities to any kind of object. In early years, anthropomorphism was considered an embodied and evolutionary aspect of human judgment that is invariant to situations and similar throughout all individuals' psychological process (Guthrie, 1993; see also Mitchell et al., 1997). In recent years, as anthropomorphic products have increasingly gained attention, there has been more research as to when and why individuals "see human" in non-human agents. The SEEK (Sociality, Effectance, and Elicited Agent Knowledge) model by Epley et al. (2007), for example, considers three relevant components of anthropomorphism. It predicts that humans are more likely to anthropomorphize when "anthropocentric knowledge is accessible and applicable, when motivated to be effective social agents, and when lacking a sense of social connection to other humans" (Epley et al., 2007, p. 1).

Furthermore, research has increasingly focused on consequences of anthropomorphism for essential components of the user experience such as trust or psychological ownership. Study results, for example, point at a positive relationship between anthropomorphic design cues, for example, humanlike appearance or voice, of robots (Hancock et al., 2011; van Pinxteren et al., 2019) as well as agents, in general, and trust in these (e.g., de Visser et al., 2017; de Visser et al., 2016; Pak et al., 2012). In a similar manner, Delgosha and Hajiheydari (2021) found that anthropomorphism positively moderates the relationship between perceived control and psychological ownership of a robot, implying that when human-likeness of a robot is high, the effect of controllability and predictability in predicting psychological ownership is strengthened.

Moreover, apart from the "when" and "why" of anthropomorphism as well as its effects, within the last decade, there has been increasing research as to "who" sees human. In this regard, Waytz et al. (2010) have developed a measure of stable individual differences in anthropomorphism, the Individual Differences in Anthropomorphism Questionnaire (IDAQ). They propose that these individual tendencies further predict to what extent moral care, concern, responsibility, and trust is attributed to the agent in question as well as how far the agent socially influences the self (Waytz et al., 2010).

Anthropomorphism and Social Needs

As also acknowledged in the SEEK model (Epley et al., 2007), people's tendency to anthropomorphize might be traced back to the fundamental need for sociality, acknowledged in almost every prominent need theory (e.g., Maslow, 1943). Moreover, 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. Studies have accordingly shown that individuals threatened in their need for social belonging are faster in recognizing smiling faces in a crowd and generally focus on positive social faces rather than unhappy faces or positive non-social images (DeWall et al., 2009). It thus seems likely that social needs could be a driver to search for social cues in non-living objects and attribute humanlike characteristics.

Regarding the potential connection between social needs and anthropomorphism, prior research has shown that feeling chronically disconnected from others or currently lonely often goes along with the attribution of anthropomorphic qualities to objects and entities (e.g., religious agents, pets, and imaginary creatures; Epley et al., 2007; Epley, Waytz, et al., 2008; Niemyjska & Drat-Ruszczak, 2013). Bartz et al. (2016) replicated the association between loneliness and anthropomorphism, also showing that reminding people of a close, supportive relationship reduced their tendency to anthropomorphize. Furthermore, in their review of six studies with a total of 1314 participants, Kwok et al. (2018) conclude that anxious attachment and anthropomorphic tendencies are positively and moderately related. However, the authors also criticize the overall

methodological quality of the included studies and call for better quality research on the topic (Kwok et al., 2018). More recently, Kang & Kim (2020) have found that anthropomorphism increases the sense of connectedness between user and technology. According to their findings the increased sense of connectedness in turn evokes more positive user responses toward the technology. In line with these findings, previous study results (e.g., Jia et al., 2012; Kim & Sundar, 2012) support that anthropomorphic design cues, for example, humanlike agents on technology interfaces, can lead users to perceive the interaction with the technology to be more social and interpersonal.

In sum, only a few studies go beyond the mere identification of a relationship between anthropomorphism and constructs related to social needs, and further investigate whether the interaction with anthropomorphic products bears the potential of satisfying social needs. Mourey et al. (2017), for example, could show 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). Within another 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).

Research Questions and Hypotheses

Combining the implications of Mourey et al. (2017) and Krämer et al. (2018), we aimed at expanding those insights by a systematic comparison of anthropomorphic vs. non-anthropomorphic products and measuring social needs on an intentional as well as behavioral level.

Our research questions specifically focused on whether anthropomorphic products have the potential to fulfill social needs and how individually perceived anthropomorphism correlates to social needs. Based on the theoretical approaches and previous findings summarized above, we assumed that social exclusion would have an enhancing effect on social needs, whereas interaction with an anthropomorphic technology would dampen such. In addition, we assumed that the interrelation between interacting with anthropomorphic technologies and reporting lower social needs would be particularly pronounced among individuals who have been socially excluded. We explored these general hypotheses via different operationalizations in two consecutive studies. Furthermore, the interrelation of individual perceptions of anthropomorphism and social needs as well as the role of individual differences in anthropomorphism in this relationship were studied on an exploratory level.

Studies

We conducted two studies focusing on the same research questions with different operationalizations. While the first study focused on implicit anthropomorphism, the second study manipulated anthropomorphism more explicitly and additionally explored further variables within the individual.

Study 1

We applied a 2 × 2-between-subjects-design with social exclusion (yes, no) and anthropomorphism (yes, no) as independent variables. Similar to manipulations used by Mourey et al. (2017) and Pickett et al. (2004), social exclusion was induced by asking participants to describe a time they felt socially excluded within a group. Within the condition of no social exclusion individuals were asked to describe their kitchen (e.g., furniture, colors, floor, and windows). Implicit anthropomorphism was manipulated with regard to the participant's personal smartphones. We chose the object of a smartphone as it is paramount in people's everyday lives and provides an opportunity to anthropomorphize (e.g., Wang, 2017). Following Mourey et al. (2017), participants were asked to imagine their personal smartphones and answer questions, formulated in an anthropomorphic vs. non-anthropomorphic manner. Specifically, there was a set of 10 items pertaining to the design, sound, functionality, connectivity, user interface, camera, applications, battery life, alarm, and security of their phone. For each item, there were two versions, one anthropomorphic, person-oriented version, and one non-anthropomorphic, product-oriented version. The items in the anthropomorphic condition used "lifelike, agentic paraphrasing" (Mourey et al., 2017, p. 4) such as "How well would you say does your smartphone work?". On the contrary, items in the non-anthropomorphic condition were formulated in a more neutral manner, for example, "How would you rate the functionality of your smartphone?". All items were to be rated on a five-point Likert scale (1 = "very bad"; 5 = "very good"). To ensure that the questions in the anthropomorphic condition were perceived as more person-oriented and the questions in the non-anthropomorphic condition as more product-oriented, we conducted a separate pre-test among 63 individuals (M = 30.4 years, SD = 13.1 years, 61.90% women). The participants were confronted with both versions of each item and had to choose which one was more product- and which more person-oriented. The forced choice-categorization task showed that in 89.00% of the comparisons, individuals categorized the anthropomorphic item as the person-oriented one and the non-anthropomorphic item as the product-oriented one. We deemed this as an acceptable result to use this set of pre-tested anthropomorphic and non-anthropomorphic items as a manipulation of implicit anthropomorphism in our main study.

Methods

Our first study was realized via an online questionnaire. The study was announced as an experiment on innovative technologies in everyday life. The link was distributed via a study panel consisting of individuals interested in participating in psychological research with diverse professional and socio-economic backgrounds. In addition, the link was distributed via university-related social media groups. The only inclusion criterion was owning and regularly using a smartphone. As an incentive for participation, gift coupons ranging from 10 to 50 Euros were raffled among all participants after the study. Alternatively, students could register for course credit.

Participants

159 participants between 18 to 75 years (M = 26.18 years, SD = 9.56 years; 73.00% women, 1.26% diverse) took part in the study. 61.64% of the participants were users of Android, 37.74% of iOS and only 0.63% of other smartphone software.

Procedure

First, the purpose and duration of the study as well as incentives and data privacy terms were provided, and participants' informed consent was obtained. Afterward, demographic data (sex,

age) and used smartphone software were surveyed. Participants were randomly assigned to one of the four experimental conditions. Depending on the condition, participants received the instruction to describe an event of social exclusion versus their kitchen (no social exclusion). After a measure of mood (as further specified in the next section), depending on the experimental condition, participants were confronted with the anthropomorphic or non-anthropomorphic set of items to describe their smartphone. This was followed by a creative sentence-completion game that we used to assess the behavioral intention to socialize, and several measures as further specified below.

Measures

Behavioral Intention to Socialize. In terms of validity, we aimed at measuring intention to socialize on a behavioral level, as far as possible within the online setting of our study. In order to assess this behavioral act of socializing, we chose a non-competitive virtual game of creative sentence-completion, which we programmed ourselves. Within the game participants were asked to fill out parts of a given sentence, which then was (presumably) completed by another player or the computer. The game itself was not relevant for our measure. We only focused on participants' stated preference for playing the game by themselves or with another participant. Their preference was assessed on a six-point scale (1 = "rather by myself"; 6 = "rather with another participant"). High ratings, that is, a preference for playing the game together with another participant, represented a high behavioral intention to socialize. Participants who stated their preference for playing with another player (i.e., ratings between 4 and 6) were then shown which of the two players within the game represented themselves and which one represented the alleged other participant. Participants who stated their preference for playing by themselves (i.e., ratings between 1 and 3) were shown the same screen, except that the "second player" was labeled "computer." The interactive sentence-completing lasted for two rounds and participants could view the final generated sentences. Thus, while both scenarios resulted in the same programmed game, the stated preference for playing by oneself or with another participant served as a proxy for participants' actual desire to socialize, representing a concrete behavioral act.

Willingness to Socialize. Apart from the behavioral act of socializing, measured by our self-programmed game, we measured participants' willingness to socialize by means of the translated 13-item-scale, developed and validated by 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"). Participants rated the items in a randomized manner on a five-point Likert scale (1 = "does not apply at all"; 5 = "applies fully"). The translated items showed an internal consistency of α = .86, implying a good reliability (Fisseni, 2004; Taber, 2018). Each participant's score on the scale represented an average of their scores on both factors, ranging from 1 to 5.

Mood. Participants' current mood was assessed by a single item, that is, "How is your current mood?", on a five-point Likert scale (1 = "very bad"; 5 = ""very good") based on the measure applied by Mourey at al. (2017). This measure was included to control whether social exclusion (vs. no social exclusion) had an effect on participants' mood, which in turn could influence the dependent variables behavioral intention and willingness to socialize.

Perceived Anthropomorphism. Participants' individually perceived anthropomorphism regarding their own smartphone was assessed 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"). We preferred this measure for the explicit measurement of subjectively perceived anthropomorphism to other established measures (e.g., Bartneck et al., 2009) which are primarily validated for the context of robots and include items, for example, referring to movement of the agent, which are unsuitable for the smartphone as a stimulus.

Demographical Data. Participant's age was assessed by means of an open question. Gender was assessed through a single choice question with three answer options (i.e., male, female, and diverse). Used smartphone software was assessed by a single choice question with three answer options (i.e., iOS (iPhone), Android, and Other).

Hypotheses

Based on the general hypotheses formulated above, we hypothesized the following hypotheses for the particular study and its manipulation:

H1: Individuals who have been socially excluded will show a higher

a) behavioral intention to socialize
b) willingness to socialize

than individuals who have not been socially excluded.

H2: Individuals who have been asked anthropomorphic questions regarding their own smartphone will show a lower

a) behavioral intention to socialize
b) willingness to socialize

than individuals who have been asked non-anthropomorphic ones.

H3a: The interrelation between been asked anthropomorphic questions regarding one's own smartphone and reporting a lower

a) behavioral intention to socialize
b) willingness to socialize

will be particularly pronounced among individuals who have been socially excluded.

Results

Our descriptive analyses showed that across all conditions the mean behavioral intention to socialize was $M = 3.25$ (SD = 2.01), the mean willingness to socialize was $M = 2.99$ (SD = 0.80) and the mean perceived anthropomorphism was $M = 1.75$ ($SD = 0.95$). Furthermore, the mean mood was $M = 3.50$ (SD = 0.83). Overall, it is apparent that the perceived anthropomorphism regarding participants' own smartphones was relatively low in all conditions. More detailed descriptive data regarding the four conditions are presented in Table 1.

Furthermore, two one-way ANOVAs with experimental condition as independent and age, respectively mood, as dependent variables showed that the experimental condition neither affected

Table 1. Mean (M) and Standard Deviation (SD) of Relevant Variables within the Experimental Conditions of Study 1 (N=159).

	Social exclusion				No social exclusion			
	Anthropomorphic smartphone (n = 41)		Non-anthropomorphic smartphone (n = 29)		Anthropomorphic smartphone (n = 39)		Non-anthropomorphic smartphone (n = 50)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Behavioral intention to socialize	3.34	1.98	3.14	2.07	3.46	1.92	3.06	2.09
Willingness to socialize	2.90	0.88	2.75	0.89	3.13	0.77	3.10	0.66
Desire	2.88	0.91	2.77	0.90	3.07	0.99	3.11	0.91
Plan	2.91	1.05	2.74	1.07	3.18	0.90	3.10	0.64
Mood	3.34	0.82	3.66	0.86	3.54	0.76	3.52	0.86
Perceived anthropomorphism	3.34	1.98	1.83	0.97	1.51	0.72	1.86	1.13

age ($F(1,158) = 1.37$, $p = .253$, $\eta^2_p = .03$) nor mood ($F(1, 235) = 0.88$, $p = .453$, $\eta^2_p = .02$). Thus, there were no systematic differences regarding these variables to be further considered.

To control for potential effects of social exclusion on mood, a *t*-test for independent samples showed no significant differences ($t(157) = -0.43$, $p = .669$) regarding participants' average mood between the conditions of social exclusion ($M = 3.47$, $SD = 0.85$) and no social exclusion ($M = 3.53$, $SD = 0.81$).

Hypotheses Testing: Effects of Social Exclusion and Implicit Anthropomorphism

Two-way ANOVAs with social exclusion and implicit anthropomorphism as between-subject factors showed no main effect of social exclusion on behavioral intention to socialize ($F(1, 155) = 0.01$, $p = .938$, $\eta^2_p = .00$) but a main effect on willingness to socialize ($F(1, 155) = 4.98$, $p = .027$, $\eta^2_p = .03$). Yet, as contrary to our hypothesis, mean willingness to socialize was lower for the condition of social exclusion ($M = 2.84$, $SD = 0.87$) than no social exclusion ($M = 3.12$, $SD = 0.77$). Thus, H1a and H1b could not be supported.

Furthermore, no main effect of implicit anthropomorphism, neither on behavioral intention to socialize ($F(1, 155) = 0.95$, $p = .332$, $\eta^2_p = .01$), nor on willingness to socialize ($F(1, 155) = 0.35$, $p = .554$, $\eta^2_p = .00$.), was found. Thus, H2a and H2b were not supported.

No interaction effect of social exclusion and anthropomorphism, neither on behavioral intention to socialize ($F(1, 155) = 0.09$, $p = .762$, $\eta^2_p = .00$), nor on willingness to socialize ($F(1, 155) = 0.23$, $p = .629$, $\eta^2_p = .00$), was found, lending no support for H3a and H3b.

Exploratory Analyses: Interrelation of Willingness to Socialize and Perceived Anthropomorphism

Though we could not find effects of the experimental manipulation of anthropomorphism, our exploratory analyses revealed the individually perceived anthropomorphism as interrelated to social needs. Specifically, correlational analyses across the whole study sample showed a significant positive relationship between participants' willingness to socialize and their perceived anthropomorphism (r (159) = .26, p = .001). These results imply that a higher willingness to socialize goes along with a stronger perceived anthropomorphism in one's own smartphone. All intercorrelations of the relevant variables are illustrated in Table 2.

Discussion

In this study, we investigated the effect of an implicit manipulation of anthropomorphism on social needs. For the manipulation of implicit anthropomorphism, we asked participants questions about their smartphones in an anthropomorphic (vs. non-anthropomorphic) way. Social needs were measured by behavioral intention and willingness to socialize. Furthermore, we included a

Table 2. Mean (M), Standard Deviation (SD), and Pearson Correlation of Relevant Variables within Study 1 (N = 159).

Variable	*M*	*SD*	1	2	3
1. Behavioral intention to socialize	3.25	2.01			
2. Willingness to socialize	2.99	0.80	.13		
3. Perceived anthropomorphism	1.75	0.95	.02	.26*	

*$p < .05$.

manipulation of social exclusion as experimental factor, assuming that social exclusion would further activate the need to socialize and thus strengthen the relationship between anthropomorphism and social needs. Contrary to our expectations, none of the expected main or interaction effects of implicit anthropomorphism and social exclusion on behavioral intention and willingness to socialize emerged.

One reason for the missing effects of the experimental manipulations could be specific challenges of operationalization. We adopted a manipulation of social exclusion (e.g., DeWall et al., 2009; Mourey et al., 2017) which induced seeking for other sources of social belonging according to various studies (e.g., Lakin et al., 2008; Maner et al., 2007; Riva et al., 2014). Yet, within our study, some reported situations of social exclusion were rather untypical or abstract (e.g., "breakfast with colleagues"), which might not have activated a need for social interaction, possibly explaining the missing effect of social exclusion.

Our chosen manipulation of implicit anthropomorphism had previously been successfully applied by Mourey et al. (2017). Slight connotation differences in the translation might have caused the less effective manipulation in our study. Moreover, our pre-test presented both types of questions (anthropomorphic vs. non-anthropomorphic) in direct comparison. As the manipulation was realized as between-subjects factor in the main study, participants were only confronted with one type of question. Thus, the differences between the two sets of questions might not have been severe enough to affect the applied measures. In accordance with the above-elucidated challenges in operationalization, the found main effect of social exclusion on willingness to socialize, which was contrary to our hypothesis, was not interpreted further.

Yet, further analyses across the whole sample showed a positive relationship between willingness to socialize and perceived anthropomorphism, implying that the more people want to socialize with others, the more they perceive their smartphones as humanlike. This finding can be interpreted in line with the assumption of anthropomorphic products as a substitute to saturate users' social needs (cf., Mourey et al., 2017). Although our results do not support an according saturation effect, they imply a general association between anthropomorphism and social needs.

While the reported correlation between perceived anthropomorphism and willingness to socialize does not imply causality, previous research supports the general idea of willingness to socialize as a motive that enhances perceived anthropomorphism. For example, Bartz et al. (2016) found that reminding people of close relationships can reduce their tendency to anthropomorphize, offering support for possible causal effects of social needs on anthropomorphism. Thus, in our study, participants with a high willingness to socialize might have focused on social aspects of the smartphone and therefore perceived it as more anthropomorphic than individuals with lower willingness to socialize. These results underline the importance of individual perceptions and differences in anthropomorphism, which is also supported by the results of Krämer et al. (2018), showing that a lower willingness to engage in social activities after interacting with a socially responsive agent was only found for participants with a high need to belong.

Study 2

Based on the results implying the importance of perception and thus individual differences in anthropomorphism regarding the relationship of anthropomorphism and social needs, we decided to further focus on individual differences in anthropomorphism within our second study. With regard to the intended manipulation of anthropomorphism, which was not reflected in participants' perception within the first study, as well as our limitations regarding the missing product for interaction, we decided to use a more explicit manipulation of anthropomorphism. Furthermore, we chose to implement the manipulation of social exclusion applied in Study 1 as it was confirmed by various previous studies (e.g., DeWall et al., 2009; Mourey et al., 2017; Pickett et al., 2004). To

Figure 1. Anthropomorphic vs. Non-Anthropomorphic Smartphone Designs Applied for the Manipulation of Explicit Anthropomorphism within Study 2.

support internal validity, we wanted to avoid varying more variables than necessary compared to Study 1. In parallel to Study 1, we studied the effect of social exclusion and anthropomorphism on behavioral intention and willingness to socialize, further considering possible interrelations with individual differences in anthropomorphism.

We applied a 2 × 2-between-subjects-design with social exclusion (yes, no) and explicit anthropomorphism (yes, no) as independent variables. Whereas social exclusion was manipulated the same way as in Study 1, anthropomorphism was induced in a more explicit manner. Two different smartphone images were designed. For the anthropomorphic version, a design similar to Apple's iPhone was altered so that the design and placement of the menu-button in combination with the microphone and front camera resembled a human face. The non-anthropomorphic version did not include these cues and simply resembled an Apple iPhone. Both designs are illustrated in Figure 1.

We conducted a separate pre-test with 115 individuals (M_{Age} = 35.77 years, SD = 16.02 years; 68.70% women). To ensure that differences in anthropomorphism were even perceived in indirect comparison, participants were confronted with one of the two smartphones (anthropomorphic, non-anthropomorphic) and asked to state their impression on a seven-point Likert scale ("This smartphone makes a humanlike impression."; 1 = "does not apply at all"; 7 = "applies fully"). The conducted *t*-test for independent samples showed that average ratings of the anthropomorphic (M = 3.24, SD = 1.80) did differ significantly ($t(113) = 3.37$, $p < .001$) from the non-anthropomorphic one

(M = 2.19, SD = 1.53), as the anthropomorphic smartphone was rated significantly more humanlike than the non-anthropomorphic one. Thus, we were positive that the more explicit manipulation of anthropomorphism would be perceived accordingly in our main study.

Methods

Our second study was also realized via online questionnaire. The study was announced as an experiment on innovative technologies in everyday life.

Participants

A total of 236 smartphone users between the age of 17 and 71 (M_{Age} = 30.37 years; SD = 11.17 years; 60.17% women) took part in the study. 57.20% of the participants were users of an Android, 41.10% of iOS and only 1.70% of other smartphone software. The recruitment of the participants as well as the presented incentives and study purpose were identical to Study 1.

Procedure

The procedure of this study was also parallel to Study 1. This time, after participants were instructed to describe an event of social exclusion versus their kitchen (no social exclusion), depending on their study condition as well as the measure of mood, they were confronted with the anthropomorphic or non-anthropomorphic smartphone design depending on the experimental condition. To make sure that individuals perceived the smartphone in detail, they were asked to estimate the height and width of it. To do so, they were given three options of the smartphone's measures (height 13 cm, width 6 cm; height 14 cm, width 7 cm; height 15 cm, width 8 cm). Then, the creative sentence-completion game and the above-described measures followed, this time including a measure for individual differences in anthropomorphism.

Measures

Behavioral Intention to Socialize and Willingness to Socialize. Both behavioral intention and willingness to socialize were measured with the same measures used in the first study. Within this study, the translated items of the willingness to socialize scale showed an internal consistency of α = .85, indicating a good reliability (Fisseni, 2004; Taber, 2018).

Mood and Demographical Data. Mood and demographical data were measured with the same measures used in the first study.

Individual Differences in Anthropomorphism. Based on the results of Waytz et al. (2010), there seem to be stable individual differences in anthropomorphism. Therefore, they should be considered when investigating the relationship between product anthropomorphism and social needs. In line with this, our first study's results highlight the relevance of the subjective perception anthropomorphism and support the importance of individual differences in anthropomorphism. These differences were assessed by the 15-item IDAQ, which was generated and validated by Waytz et al. (2010). Items (e.g., "To what extent does the average robot have consciousness?") were assessed in a randomized manner on a seven-point Likert scale (1 = "does not apply at all"; 5 = "applies fully"). The items were translated to German and showed an internal consistency of α = .86, indicating a good reliability (Fisseni, 2004; Taber, 2018).

Perceived Anthropomorphism. To measure perceived anthropomorphism, participants were asked to rate the following statement "This smartphone makes a humanlike impression" on a five-point Likert scale (1 = "does not apply at all"; 5 = "applies fully").

Hypotheses

Based on our general hypotheses, we assumed the following for the particular study and its manipulation:

H1: Individuals who have been socially excluded will show a higher

a) behavioral intention to socialize
b) willingness to socialize

than individuals who have not been socially excluded.

H2: Individuals who have interacted with the anthropomorphic smartphone will show a lower

a) behavioral intention to socialize
b) willingness to socialize

than individuals who have interacted with the non-anthropomorphic smartphone.

H3: The interrelation between interacting with the anthropomorphic smartphone and reporting a lower

a) behavioral intention to socialize
b) willingness to socialize

will be particularly pronounced among individuals who have been socially excluded.

Results

Our descriptive analyses showed that across all conditions the mean behavioral intention to socialize was $M = 3.34$ (SD = 1.98), the mean willingness to socialize was $M = 3.01$ ($SD = 0.80$), the mean IDAQ was $M = 3.22$ (SD = 0.96), and the mean perceived anthropomorphism was $M = 1.77$ ($SD = 1.01$). Furthermore, the mean mood was $M = 3.69$ ($SD = 0.85$). More detailed descriptive data regarding the four conditions are presented in Table 3.

It was further tested whether there were significant differences regarding the average age, mood, and IDAQ within the four conditions. Three one-way ANOVAs with experimental condition as independent and age, mood, respectively IDAQ as dependent variables showed no effect of experimental condition on age ($F(1, 235) = 0.75$, $p = .526$, $\eta^2_p = .01$), mood ($F(1, 235) = 0.43$, $p = .735$, $\eta^2_p = .01$), or IDAQ ($F(1, 235) = 0.27$, $p = .847$, $\eta^2_p = .00$). Thus, there were no systematic differences regarding the variables above to be further considered.

In addition, it was examined whether average perceived anthropomorphism varied significantly between the anthropomorphic vs. non-anthropomorphic smartphone condition. In accordance with our manipulation, the conducted *t*-tests for independent samples showed significant differences ($t(234) = -4.42$, $p < .01$) regarding the average perceived anthropomorphism between

Table 3. Mean (M) and Standard Deviation (SD) of Relevant Variables within the Experimental Conditions of Study 2 (N = 236).

	Social exclusion				No social exclusion			
	Anthropomorphic smartphone (*n* = 59)		Non-anthropomorphic smartphone (*n* = 50)		Anthropomorphic smartphone (*n* = 64)		Non-anthropomorphic smartphone (*n* = 63)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Behavioral intention to socialize	3.64	2.03	3.28	1.94	3.23	1.98	3.21	1.96
Willingness to socialize	2.91	0.82	3.03	0.72	3.05	0.85	3.04	0.81
Desire	2.92	0.82	3.13	0.77	3.00	0.94	3.03	0.93
Plan	2.89	1.08	2.81	0.84	3.05	0.80	3.07	0.79
Mood	3.64	0.85	3.74	0.99	3.77	0.73	3.62	0.87
Perceived Anthropomorphism	1.97	1.10	1.48	0.71	2.11	1.26	1.48	0.67
IDAQ	3.15	0.09	3.31	1.01	3.19	1.00	3.24	0.95

Note. IDAQ = Value on Individual Differences in Anthropomorphism Questionnaire.

the anthropomorphic (M = 2.04, SD = 1.18) vs. non-anthropomorphic (M = 1.48, SD = 0.68) smartphone condition.

Similar to the previous study, to control for potential mediating effects of mood, a t-test for independent samples showed no significant differences ($t(234) = -0.43$, $p = .965$) regarding participants' average mood between the conditions of social exclusion ($M = 3.69$, $SD = 0.91$) and no social exclusion (M = 3.69, SD = 0.80).

Hypotheses Testing: Effects of Social Exclusion and Explicit Anthropomorphism

Two-way ANOVAs with social exclusion and explicit anthropomorphism as between-subject factors showed no main effect of social exclusion, neither on behavioral intention to socialize ($F(1, 234) = 0.87$, $p = .352$, $\eta^2_p = .04$), nor on willingness to socialize ($F(1, 234) = 0.51$, $p = .476$, $\eta^2_p = .004$). Thus, H1a and H1b could not be supported.

Furthermore, no main effect of explicit anthropomorphism, neither on behavioral intention to socialize ($F(1, 234) = 0.57$, $p = .450$, $\eta^2_p = .02$), nor on willingness to socialize ($F(1, 234) = 0.24$, $p = .622$, $\eta^2_p = .001$) was found. Neither H2a nor H2b were supported.

No interaction effect of social exclusion and explicit anthropomorphism, neither on behavioral intention to socialize ($F(1, 234) = 0.42$, $p = .517$, $\eta^2_p = .02$), nor on willingness to socialize ($F(1, 234) = 0.39$, $p = .533$, $\eta^2_p = .002$) was found, yielding no support for H3a and H3b.

Exploratory Analyses: Interrelation of Willingness to Socialize and Perceived Anthropomorphism considering IDAQ

Although again no effects of the experimental manipulation of anthropomorphism were found, correlational analyses across this study's sample showed a significant positive relationship between participants' willingness to socialize and their perceived anthropomorphism ($r(236) = .15$, $p = .022$). These results imply that a higher willingness to socialize goes along with a stronger perception of anthropomorphism in smartphone design. The overall correlations of relevant variables are reported in Table 4.

To explore potential effects of individual differences in anthropomorphism, we separated participants with particularly high and low individual tendency to anthropomorphize, measured with the IDAQ, and studied the pattern of results within the two subgroups. Specifically, a median split separating individuals with a high (IDAQ $\geq$ 3.2) vs. low (IDAQ < 3.2) individual tendency to anthropomorphize revealed differences between the two groups with regard to the interrelation of perceived anthropomorphism and willingness to socialize. Among individuals with a high tendency to anthropomorphize (IDAQ $\geq$ 3.2), willingness to socialize and perceived anthropomorphism were significantly correlated ($r(117) = .28$, $p = .003$) while there was no correlation

Table 4. Mean (M), Standard Deviation (SD), and Pearson Correlation of Relevant Variables within Study 2 (N = 236).

Variable	*M*	*SD*	1	2	3	4	5
1. Willingness to socialize	3.01	0.80					
2. Perceived anthropomorphism	1.77	1.01	.15*				
3. Mood	3.69	0.85	.12	0.51			
4. Behavioral intention to socialize	3.34	1.98	.15*	-.08	.09		
5. IDAQ	3.22	0.96	.24**	.05	.03	.14*	

Note. IDAQ = Value on Individual Differences in Anthropomorphism Questionnaire. * $p < .05$. ** $p < .01$.

among individuals with low tendency to anthropomorphize ($r(119) = .02$, $p = .863$). Furthermore, the correlation values differed significantly ($z = 2.04$, $p < .05$). Hence, it seems that perceiving a smartphone as humanlike with rising social needs could be based on a general individual tendency to anthropomorphize non-living objects (here: IDAQ ≥ 3.2).

Based on this finding, suggesting that a particular level of IDAQ might be supportive to effects between anthropomorphism and social needs, we performed further analyses among individuals with a high tendency to anthropomorphize (IDAQ ≥ 3.2). We additionally considered the experimental manipulation of explicit anthropomorphism, that is, comparing conditions where the smartphone offered anthropomorphic design cues to where it did not. Among individuals with a high tendency to anthropomorphize (IDAQ ≥ 3.2), the correlation between perceived anthropomorphism and willingness to socialize was stronger and only significant in the anthropomorphic smartphone condition ($r(58) = .41$, $p = .001$), but not in the non-anthropomorphic smartphone condition ($r(59) = .10$, $p = .410$). For participants with a low tendency to anthropomorphize (IDAQ < 3.2), the correlation between perceived anthropomorphism and willingness to socialize was neither significant in the anthropomorphic smartphone condition ($r(65) = -.03$, $p = .786$), nor in the non-anthropomorphic smartphone condition ($r(54) = .08$, $p = .553$). All descriptive data and correlations considering participants with high vs. low IDAQ values are illustrated in Table 5 and Table 6. This pattern of correlation could suggest that individual factors (here: an individual tendency to anthropomorphize) and design factors (here: a smartphone offering humanlike design cues) may both play a role for the general relationship between social needs and anthropomorphism. Yet, these specific results should be interpreted with caution as the significant correlations within the participants with a high tendency to anthropomorphize in the anthropomorphic smartphone condition vs. non-anthropomorphic smartphone condition did not differ significantly ($z = 1.77$, $p > .05$).

Discussion

Within our second study, we investigated the relationship between social needs, operationalized by behavioral intention and willingness to socialize, and technology anthropomorphism, by confronting individuals with an anthropomorphic vs. non-anthropomorphic smartphone, after social exclusion vs. no social exclusion. Apart from applying a more explicit manipulation of anthropomorphism by presenting products with anthropomorphic design cues, we also focused on a possible effect of individual differences in anthropomorphism, as our first study highlighted an importance of individually perceived anthropomorphism. Our results showed no main effects of social exclusion or explicit anthropomorphism on behavioral intention and willingness to socialize. Yet, we found a positive correlation between willingness to socialize and perceived anthropomorphism for the overall sample as well as specifically under the preconditions of a certain individual tendency to anthropomorphize (IDAQ ≥ 3.2) and the confrontation with a smartphone with anthropomorphic design cues.

In parallel to Study 1, we did not observe main effects of social exclusion or anthropomorphism on behavioral intention and willingness to socialize. As elucidated above, the manipulation of social exclusion could only be controlled to a certain extent due to the online character of the study. Although our explicit manipulation of anthropomorphism showed effective as it yielded in a more or less humanlike impression of the smartphone in our pre-test, the same manipulation did not directly affect behavioral intention and willingness to socialize in our main study. Hence, the missing main effect of anthropomorphism in our main study might also root in the specific measures of behavioral intention and willingness to socialize. In fact, previous studies showing an effect between anthropomorphism and social needs (e.g., Mourey et al., 2017) have often used more indirect measures of need for social connection, for example, estimated number of

Table 5. Mean (M), Standard Deviation (SD), and Pearson Correlation of Willingness to Socialize and Perceived Anthropomorphism within Participants of Study 2 with a Low IDAQ Value (< 3.2).

	All participants (n = 119)			
	M	*SD*	1	2
1. Willingness to socialize	2.86	0.81		
2. Perceived anthropomorphism	2.45	0.49	.16	
	Anthropomorphic smartphone (n = 65)			
	M	*SD*	1	2
1. Willingness to socialize	2.89	0.83		
2. Perceived anthropomorphism	3.13	2.46	−.03	
	Non-anthropomorphic smartphone (n = 54)			
	M	*SD*	1	2
1. Willingness to socialize	2.83	0.79		
2. Perceived anthropomorphism	2.45	0.79	.08	

Note. IDAQ = Value on Individual Differences in Anthropomorphism Questionnaire.

Table 6. Mean (M), Standard Deviation (SD), and Pearson Correlation of Willingness to Socialize and Perceived Anthropomorphism within Participants of Study 2 with a High IDAQ Value (≥ 3.2).

	All participants (n = 117)			
	M	*SD*	1	2
1. Willingness to socialize	3.16	0.78		
2. Perceived anthropomorphism	4.00	0.62	.28**	
	Anthropomorphic smartphone (n = 58)			
	M	*SD*	1	2
1. Willingness to socialize	3.10	0.85		
2. Perceived anthropomorphism	3.98	0.60	.41**	
	Non-anthropomorphic smartphone (n = 59)			
	M	*SD*	1	2
1. Willingness to socialize	3.22	0.71		
2. Perceived anthropomorphism	4.03	0.65	.11	

Note. IDAQ = Value on Individual Differences in Anthropomorphism Questionnaire. * p < .05. **p < .01.

Facebook-friends, estimated social connection with friends and family in the future, or planned prosocial behavior. We implemented more direct variables focusing on the short time and behavioral intentions regarding the interaction with others (here: behavioral intention to socialize) as

well as friends and family (here: willingness to socialize). Ratings of specific items such as "Now I would like to meet my friends." or "I am going to meet my family today." might have been affected by contextual factors, such as the physical distance to one's family and friends or other plans, which may have overwritten potential effects of the experimental manipulation. Additionally, the limited interaction with the anthropomorphic vs. non-anthropomorphic smartphones might not have been sufficient to induce an observable effect.

As an additional factor to Study 1, Study 2 also considered individual differences in anthropomorphism. In line with our exploratory results, the consideration of IDAQ values provided a more differentiated perspective on the association between anthropomorphism and social needs. More specifically, when considering IDAQ values (high vs. low) and the confrontation with anthropomorphic vs. non-anthropomorphic design cues within a smartphone, a significant correlation occurred only among individuals with a high tendency to anthropomorphize (IDAQ $\geq$ 3.2), showing that the higher their willingness to socialize was, the more anthropomorphic they individually perceived a smartphone. Moreover, an additional more fine-grained analysis showed that this correlation was only present within the anthropomorphic smartphone condition, operationalized by anthropomorphic placement and design of buttons, microphone and camera. In sum, it seems that both individual and design factors are relevant to the general association between anthropomorphism and social needs.

General Discussion

Previous research implies that interactive technologies which are perceived as anthropomorphic can support humans in restoring their threatened social needs (e.g., Mourey et al., 2017). The aim of our research was to investigate the relationship between anthropomorphism and social needs more systematically. Furthermore, we intended to explore the role of relevant person variables such as individual differences in anthropomorphism. We hypothesized that for individuals feeling socially excluded, the interaction with anthropomorphic products would reduce needs for social interaction, operationalized through the behavioral intention to socialize and willingness to socialize. We also anticipated main effects of social exclusion (vs. no social exclusion) as well as anthropomorphism (vs. no anthropomorphism) on behavioral intention and willingness to socialize. While in our first study, anthropomorphism was manipulated implicitly by asking participants anthropomorphic vs. non-anthropomorphic questions regarding their smartphones, our second study used a more explicit manipulation of anthropomorphism through smartphones with humanlike vs. regular design cues. The following sections discuss the combined results of the two studies concerning our central research questions and connections to previous studies.

In line with the SEEK-Modell (Epley et al., 2007), which describes the need and desire for social connections with others as one of three psychological determinants relevant for anthropomorphism to occur, we found an overall significant positive correlation between social needs (here: willingness to socialize) and perceived anthropomorphism in both our studies. These results are compatible with research implying that the individual need to belong, defined as the "need to form and maintain at least a minimum quantity of interpersonal relationships" (Baumeister & Leary, 1995, p. 499), may foster individuals' sensitivity to social cues (e.g., Pickett et al., 2004). In line with this, other study results further support that loneliness and individual need to belong can enhance the perception of anthropomorphism or social presence in technologies (e.g., Lee et al., 2006; Eyssel & Reich, 2013). This may come along with increased attribution of anthropomorphic qualities to a technology (e.g., Epley, Akalis, et al., 2008; Niemyjska & Drat-Ruszczak, 2013).

However, unlike previous research (Mourey et al., 2017), both of our studies showed neither an effect of experimentally manipulated anthropomorphism, nor experimentally manipulated social exclusion on social needs. The failed replication of such effects may also be at least partly due to

limitations of our study design and operationalization. The manipulation of social exclusion could have been problematic, for example, due to the online character of the study. Moreover, our chosen manipulations of anthropomorphism combined with only limited interaction with the smartphone, might not have been intense enough.

While this does not speak against product interaction as a sort of social need fulfillment in general, it seems that the particular role and manipulation of anthropomorphism is more complex than previous research might have suggested. In both our studies, individual perceptions and person variables, namely, individual differences in anthropomorphism, were more deciding than experimentally manipulated anthropomorphism. As argued by Waytz et al. (2014), individuals generally differ in the extent to which they perceive objects as anthropomorphic and such differences can amongst others predict the extent to which individuals can be influenced by these objects. Accordingly, in Study 1, we could find an overall correlation between willingness to socialize and perceived anthropomorphism, highlighting the importance of individual perception rather than external manipulation of anthropomorphism. In Study 2, considering individual differences in anthropomorphism as an additional variable, we also found a significant correlation between willingness to socialize and perceived anthropomorphism for the overall sample as well as specifically for individuals with a high tendency to anthropomorphize (IDAQ $\geq$ 3.2). Thus, our studies underline the role of certain predispositions (i.e., individual and product-related factors) in the interrelation of anthropomorphism and social needs. When considering the individual tendency to anthropomorphize in our second study, only within individuals with a high tendency to anthropomorphize did willingness to socialize correlate in a significant positive manner with perceived anthropomorphism. In addition, this correlation could only be found within the anthropomorphic smartphone condition. Thus, apart from the individual precondition of a certain tendency to anthropomorphize, humanlike design cues were also necessary.

Implications for Theory

Our research offers various implications for theory. First, our findings complement previous research (e.g., Eyssel & Reich, 2013; Bartz et al., 2016) in supporting an interrelation between social needs (here: willingness to socialize) and anthropomorphism. Although not implying causality, considering previous research on this interrelation, our results could be interpreted to the extent that the higher peoples' individual social needs are, the more they appear to anthropomorphize non-human objects or agents. Thus, our insights offer further empirical support for the SEEK-Modell (Epley et al., 2007), which describes that humans are more likely to anthropomorphize when they are in need of social connection to other humans.

Furthermore, our research highlights the relevance of individual differences in anthropomorphism. Namely, based on our results, individual differences in anthropomorphism as well as anthropomorphic design cues in a product appear as preconditions to observe an interrelation between social needs and perceived anthropomorphism. The consideration of such individual tendencies and their interplay with design cues therefore seems important for future research in this regard. Still, the interrelations and causalities between these variables need to be further investigated in a systematic manner.

Finally, in line with the above-described theoretical implications, our research also underlines the importance of considering individually perceived anthropomorphism as a variable besides manipulations of anthropomorphism, for example, by means of visual or interaction design of products. As anthropomorphism of non-human agents or objects appears to be influenced by individual differences in anthropomorphism or other individually varying factors such as the need for social interaction, it could be insightful to explicitly consider perceived anthropomorphism as a measure within empirical studies.

Implications for Practice

Our research also points out directions for practice. According to our findings, individual differences in anthropomorphism as well as anthropomorphic design cues in a product appear as preconditions to observe an interrelation between social needs and perceived anthropomorphism. These insights could be valuable for various domains.

For example, in marketing, anthropomorphism has increasingly gained popularity. This ranges from humanlike names for products, anthropomorphic product design up to the use of avatars, for example, in advertising. Based on our results, practitioners in this field should consider that anthropomorphism might affect potential users differently, amongst others depending on their individual tendency to anthropomorphize.

Furthermore, within the field of healthcare or technology design for private households, where technologies are often explicitly designed to address social needs, such results should be considered. Although, based on our studies, the question whether the interaction with anthropomorphic products has the potential to satisfy people's social needs, remains unclear, our results support a relationship between social needs and the perception of anthropomorphism under certain preconditions. On the one hand, practitioners aiming to activate this interrelation should focus on offering the precondition of anthropomorphic product design. On the other hand, practitioners should be aware that individuals who are more in need of social connection to other humans might be more likely to anthropomorphize the technology or product in question. Yet, as our study results do not allow for causal result interpretation, the interrelation of anthropomorphism and social needs calls for further systematic exploration in experimental studies.

Limitations and Directions for Future Research

One central limitation of our studies was their online character. Thus, we could not measure the intensity and duration individuals lasted in the social exclusion task or the interaction with the anthropomorphic vs. non-anthropomorphic product they were confronted with. An insufficient completion of the social exclusion task or a too short interaction with the products could therefore have affected the manipulations in a negative manner. Similarly, due to the online character of the study, we could not control whether participants were alone while answering the items. A companion of any kind could also have influenced the manipulation of social exclusion in a way that individuals might not have felt excluded at the time of task completion albeit describing a situation of social exclusion. Such a biasing factor could also have influenced individuals' needs for social interaction, measured by behavioral intention and willingness to socialize within both our studies. These limiting factors should be considered in future research aiming to systematically manipulate social exclusion and anthropomorphism in experimental studies.

Another limitation is the cross-sectional design of our studies. Therefore, no long-term effect of interacting with anthropomorphic products could be observed. It is likely that a long-term study would have been necessary to observe a possible effect or even a hypothesized "social saturation" through anthropomorphism on needs for social interaction. Longitudinal studies on the interrelation between interaction with anthropomorphic products and social needs thus build an important task for future research. Thereby, variables focusing on the satisfaction of social needs should be assessed to allow for ratings on willingness to socially interact with others or even actual social behavior to be led back to social need satisfaction. Furthermore, within longitudinal research, measurable social behavior such as interaction duration with close others could foster external validity of results.

Finally, we did not yet consider further dispositional factors and personality traits that could be relevant for behavioral intention or willingness to socialize and mediate the considered effects, such as the need to belong (Baumeister & Leary, 1995) or the individual need for

solitude (Long & Seburn, 2003). Further studies should include such traits or long-term needs of individuals to investigate their role regarding the effect of manipulated anthropomorphism on individuals' perception.

Conclusion

Anthropomorphic design becomes increasingly prevalent in interactive technologies of everyday use, such as smartphones, conversational chatbots, or digital voice assistants. Yet, their possibly lasting effects on users, for example, regarding their social needs, have rarely been systematically addressed in research. In sum, the results of our two studies underline a relationship between anthropomorphism and social needs, but also highlight the complexity of the issue, as a number of factors seem to play a role in this interrelation. In particular, our results support the importance of individual factors, that is, the tendency to anthropomorphize as well as situational factors, that is, anthropomorphic design cues, for the interrelation of social needs and anthropomorphism. In sum, the question whether an anthropomorphic product or technology comes with the potential of satisfying individuals' social needs demands further research. Future studies looking into this matter should focus on long-term interaction between human and product or technology, respectively. Thereby, actual social behavior toward close others should be measured and individual as well as situational factors, as found within our studies, should be considered.

Overall, as products within our everyday lives are being developed with more and more humanlike characteristics, the possible societal impact of anthropomorphic design shifts into focus. In this regard, one central question refers to the relationship between anthropomorphism and social needs. Naturally, such findings might be challenged in their stability throughout the years as humans will get increasingly used to the interaction with such technologies with or without anthropomorphic cues. It is thus even more important to understand the general psychological mechanisms behind anthropomorphism as well as its effects on different individual and societal levels such as its interrelation with social interaction.

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Data Availability

The data supporting the conclusions of this article will be made available by the authors upon request.

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