Is a good bot better than a mediocre human?: Chatbots as alternative sources of social connection

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Abstract

Around the world, hundreds of millions of people have used social chatbots designed to provide companionship to their users. But can people reap genuine feelings of social connection and happiness from interacting with chatbots? In Studies 1-4 (all pre-registered; $N = 1201$), participants shared good news with an interaction partner whom they believed was either a chatbot or a human. The conversation partner responded in either a highly responsive or less responsive manner. Interacting with a highly responsive chatbot was more rewarding than interacting with a less responsive human. Participants who believed they interacted with a highly responsive chatbot felt more rapport, were more socially connected, felt better about their own positive experience, and were in a better mood than participants who interacted with a less responsive human. In a final pre-registered study ($n = 401$), we identified a critical boundary condition by examining whether participants derived similar benefits when the chatbot partners shared their own experiences. Taken together, our results suggest that despite their inherent lack of agency, chatbots that are programmed to respond in an optimal manner may deliver greater social benefits than suboptimal human conversation partners.

Keywords: social connection, chatbots, social interaction, happiness, technology

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The 2013 Academy Award winning film “Her” follows a man who develops a close bond with his artificially intelligent virtual assistant (Jonze, 2013). Less than a decade later, over 660 million people have subscribed to Microsoft’s Xiaoice, a social chatbot designed to offer long-term companionship and emotional connection (Zhou et al, 2020). Meanwhile, Google’s Brain Team is developing a chatbot that can “chat about virtually anything a user wants” (Adiwardana & Luong, 2020; Adiwardana et al., 2020). Unlike virtual assistants, social chatbots are designed to provide companionship and social connection to their users. But can people reap genuine feelings of social connection and happiness from interacting with chatbots?

It is possible that even the most human-like chatbot may fail to provide meaningful social benefits because chatbots lack a mind. When determining whether something has a mind, people make judgments along two related dimensions. The first dimension consists of perceptions of “experience”—the capacity to be conscious, experience emotions, and have a personality. The second dimension consists of perceptions of “agency”—the capacity to exert self-control, have memory, and recognize emotions (Gray et al., 2007). Chatbots lack both experience and agency (for brevity, we refer to the combination as “agency” throughout the paper). Chatbots' inherent lack of agency may prevent their human conversation partners from ever feeling like their digital friend truly “gets them” (see Pathway 1, Figure 1), precluding the benefits of a social interaction between humans.

However, according to the Computers Are Social Actors Framework (CASA; Nass & Moon, 2000; Nass et al., 1994; Reeves & Nass, 1996), individuals instinctively perceive and interact with computers as if they are people, perhaps because of our propensity to

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anthropomorphise (Waytz et al., 2010; Epley et al., 2008). People instinctively perceive agency in lifeless objects such as alarm clocks (Epley et al., 2008) and geometric shapes moving across a page (Heider & Simmel, 1944). This psychological tendency to “see human” (Epley et al., 2007) could enable chatbots to offer a viable source of social connection.

Despite lacking agency, chatbots offer an important advantage over humans: chatbots can be programmed to respond in a highly supportive manner (see Pathway 2, Figure 1), whereas not all humans are reliable providers of support. For example, in a study of 59 dating couples (Gable et al., 2004), participants were asked to rate how their partners typically responded when they shared good news (i.e., *capitalization*; Langston, 1994). While some participants endorsed items such as “my partner usually reacts to my good fortune enthusiastically” (reflecting an *active-constructive* style), others endorsed statements such as “he/she points out the potential problems or downsides of the good event” (reflecting an *active-destructive* style). Having a partner who tended to respond in an active-constructive manner was associated with greater relationship satisfaction (Gable et al., 2004). If chatbots can be programmed to respond to good news in an active-constructive (i.e., highly responsive) manner, then interacting with a chatbot might actually be more rewarding than interacting with an active-destructive (i.e. less responsive) human being.

In the present research, we focus on sharing good news because this represents a common and enjoyable form of social interaction. Using daily diaries, Gable and colleagues (2004) found that people share the best news of the day on 70% of days. Additionally, in a descriptive study of existing chatbot users ($N = 208$; see SOM for complete details), we found that over half of the chatbot users reported sharing positive news with their chatbots.

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Although developing a chatbot that can respond in an active constructive-manner remains on the horizon, researchers have overcome current technological constraints using the “Wizard of Oz” methodology: participants are led to believe they are interacting with a digital agent, when in reality the digital agent is controlled behind the scenes by a member of the research team (Dahlback et al., 1993). In a study utilizing this methodology, participants shared a personal problem via text with a partner (a research assistant) who they believed was either a chatbot or a human (Ho et al., 2018). The results revealed no significant differences in the benefits derived from the interactions with the “chatbot” vs. “human.” Because the study included fewer than 25 participants per cell, however, the null effect can be explained by inadequate power. Even with this small sample, the participants acted differently when they thought their partner was a chatbot (vs. a human), consistent with previous research showing that people’s beliefs about their interaction partner affect their own behavior (e.g., Lucas et al., 2014; Hill et al., 2015; Mou & Xu, 2017). Thus, if participants know that their interaction partner is a chatbot, they may behave differently than they usually would (see Pathway 3, Figure 1).

Figure 1. *Potential factors influencing benefits of interacting with chatbots.*

The Present Research

First, we investigated our primary research question of whether an optimally responding chatbot can provide a more rewarding social interaction than a sub-optimally responding human. In other words, do the benefits of interacting with a highly responsive partner (Pathway 2, Figure

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1) outweigh any costs of knowing your partner is just a computer, rather than a human (Pathway 1, Figure 1)? Currently, testing this question is difficult because people might act strangely with a chatbot (Pathway 3, Figure 1), due to their novelty (e.g., people might try to “trip up” the chatbot). Thus, we examined the benefits of interacting with a chatbot when people only found out they were interacting with a bot after the conversation (Studies 1 and 2), as well as when they were told before the interaction (Studies 3 and 4). We then explored whether the chatbot’s human-like behavior could backfire and result in participants deriving fewer benefits from a chatbot compared to a human (i.e., *the uncanny valley effect*; Study 5). If a conversation partner’s objective level of agency is an essential ingredient for feeling socially connected, then thinking that the partner was a chatbot should significantly reduce the social and emotional benefits of a positive social interaction. We propose, however, that people can derive genuine feelings of connection and happiness from engaging with a supportive partner—even if that partner is a computer.

Study 1

Methods

Experimental design

The study used a 2 (response style) X 2 (perceived conversation partner) design; participants shared positive news with either a more responsive or less responsive conversation partner and then were led to believe they had interacted with either a human or a chatbot. When discussing the chatbot and human conditions, we take the point of view of the participant and describe the conditions as either “interacting with a chatbot” or “interacting with a human”.

Pre-registration

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The pre-registration for Study 1 is available on the Open Science Framework (OSF) at <https://tinyurl.com/y58v4hcn>.

Procedure

To maximize the size and diversity of our sample, we recruited participants from both our university human subjects pool (in exchange for bonus course credit) and adults living in the United States or Canada from Prolific Academic (in exchange for \$2.17 USD). The procedure was approved by our institution's review board. All participants first completed a consent form and answered a set of demographics questions. Next, participants described a positive event from the past three months that they would be comfortable sharing with a stranger. Participants were then informed they would interact with another participant in the study via text for 8 minutes. In reality, participants' conversation partner was *always* a trained research assistant. Participants were instructed to spend the entire interaction discussing their positive experience with the other "participant." The research assistants were trained to respond to the positive event disclosure in either a highly responsive or less responsive manner (to minimize jargon, we use "highly responsive" and "less responsive" as short-hand for "active-constructive" and "active-destructive," respectively). See the SOM for examples of these response styles.

Immediately after the interaction, the participants were informed that they had actually interacted with either a research assistant (human condition) or a chatbot (chatbot condition), rather than a fellow participant; research assistants were blind to condition assignment. After learning the "true" identity of their conversation partner, the participants completed measures of our dependent variables of interest.

Sample

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In accordance with our pre-registered target, our final sample consisted of 400 participants after exclusions (age: $M = 24.47$, $SD = 8.86$; 68% women). Because of the novelty of this research, it was difficult to estimate an expected effect size, but this sample size gave us 80% power to detect main effects of approximately *Cohen's* $d = .28$ or greater and differences between individual conditions of $d = .35$ or greater (which is smaller than the typical effect size observed in social psychology; Richard et al., 2003). The dataset and R-code for this study (as well as Studies 2-5) can be found at tinyurl.com/15ycsfxxv.

Exclusion criteria

As pre-registered, we excluded participants who did not send any messages during the text interaction ($n = 30$; typically due to technical difficulties with the chat platform), thereby failing to share any positive news. We also asked participants to report whether their interaction partner was a chatbot, research assistant, or another participant; as pre-registered, we excluded participants whose answer did not correspond to their assigned condition ($n = 17$ in the chatbot condition and $n = 9$ in the human condition). Participants also answered three yes-or-no questions assessing whether they perceived their conversation partner as highly responsive (e.g., “Did your interaction partner share your excitement about the positive experience you shared?”); participants in the highly responsive condition who answered “no” to all three questions were excluded ($n = 1$). Likewise, participants answered three questions assessing whether they perceived their conversation partner as low in responsiveness (e.g., “Did your interaction partner minimize the significance of the positive experience you shared?”); participants in the low responsiveness condition who answered “no” to all three questions were excluded ($n = 26$). This level of differential attrition suggests that the less responsive partner was not perceived as particularly negative by many participants. As a result of this differential attrition, we conducted

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supplementary “intent-to-treat” analyses including participants who failed the responsiveness manipulation check, which had no substantive effect on our results (see the SOM).

Measures

To assess the benefits participants derived from the interaction, we measured their feelings of rapport with their conversation partner, as well as their overall feelings of social connection. We also assessed participants' positive feelings about the experience they shared, as well as their overall positive mood (see Table 1 for the measures used in the present analyses). We created composite scores for each of the measures by averaging participants' responses to the items in each measure, unless they answered less than 80% of the items (as pre-registered).

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Table 1. *Measures used in Studies 2, 3, 4, 5 and 6.*

Measure	α (Study 1)	α (Study 2)	α (Study 3)	α (Study 4)	α (Study 5)	# of items	Sample item	Source
Rapport (pre-registered)	.96	.97	.97	.97	.96	15	I felt ____ toward my partner. ^a	Dwyer & Dunn, in prep
Social connection (pre-registered)	.94	.92	.95	.94	.94	11	I had a sense of belonging. ^b	Lok & Dunn, in prep
Positive affect: PANAS (pre-registered)	.90	Not included	Not included	Not included	Not included	10	Enthusiastic. ^c	Watson et al., 1988
Positive affect: SPANE (pre-registered)	Not included	.94	.95	.95	.94	6	Joyful. ^c	Diener et al., 2009
Feelings about experience (pre-registered, 1-4)	.89	.91	.90	.90	Not included	5	How excited are you about the experience you identified? ^d	Created for present study
Positive affect: single item (exploratory)						1	Compared to how you normally feel, how do you feel right now? ^e	Adapted from Kumar & Epley, 2018
Perceived Agency (pre-registered)	Not included	Not included	.78	.79	.88	4	During the interaction, to what extent Did you feel like your conversation partner had a mind of their own? ^f	Epley et al., 2008

Note: ^a = “very negative” (1) to “very positive” (5); ^b= “strongly disagree” (1) to “strongly agree” (7); ^c = “not at all” (1) to “extremely” (5); ^d = “not at all excited” (1) to “extremely excited” (10); ^e = “much more negative than normal” (-5) to “much more positive than normal” (5);^f= “Strongly disagree” (1) to “Strongly agree” (6).

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Results

Pre-registered Analyses

To test our pre-registered research questions, we conducted 2 (response style) X 2 (perceived conversation partner) ANOVA's on our pre-registered dependent variables. For each of our ANOVA models, we also conducted a planned contrast comparing the means between the highly responsive chatbot condition and the less responsive human condition (as pre-registered).

Main effect of response style. Participants who engaged with a highly responsive conversation partner felt significantly higher levels of rapport ($p < .001$) and social connection ($p < .001$) and felt better about their positive experience ($p = .029$) than participants who engaged with a less responsive conversation partner. However, participants who interacted with the more responsive partner did not report higher levels of positive mood on the PANAS than those who interacted with a less responsive conversation partner ($p = .248$; see Table 2).

Main effect of perceived conversation partner. Participants who interacted with a chatbot did not significantly differ in rapport ($p = .116$), social connection ($p = .454$), feelings about the positive experience ($p = .598$), or positive mood ($p = .875$) compared to those who interacted with a human (see Table 3).

Interaction between perceived conversation partner and response style. The beneficial effects of interacting with a highly responsive partner did not depend on whether the partner was a human or chatbot; there was no significant Partner X Response Style interaction for rapport $F(1,396) = 0.002, p = .966$, social connection, $F(1,396) = 0.000, p = .987$, feelings about the experience, $F(1,396) = 0.100, p = .752$, or positive mood $F(1,396) = 0.277, p = .599$.

More responsive chatbot vs. less responsive human. Participants who interacted with a more responsive chatbot reported significantly higher levels of rapport ($p < .001$) and social

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connection ($p < .001$) than those who interacted with a less responsive human. There were no significant differences in feelings about the positive experience ($p = .253$) or positive mood overall ($p = .366$; see Table 4).

Exploratory Analyses

Given that we had unequal group sizes and homogeneity of variance (HOV) violations, we conducted additional exploratory analyses using robust ANOVA's on our rapport and social connection variables (the two variables that violated HOV assumptions). Results of these analyses were largely consistent with the non-robust analyses, except that we observed a significant main effect of conversation partner for our rapport variable, such that participants reported feeling more rapport after talking to a human compared to a chatbot (see SOM).

In addition, because our pre-registered measure of positive mood did not seem sensitive to our response style manipulation, we conducted an exploratory analysis with our single item measure of positive mood. Consistent with our other findings, there was a significant main effect of response style ($p < .001$; see Table 2), no main effect of perceived conversation partner ($p = .390$; see Table 3) and no significant interaction, $F(1,396) = 0.129$, $p = .72$. Likewise, participants who interacted with a highly responsive chatbot reported feeling better “right now” than those who interacted with a less responsive human ($p = .028$; see Table 4).

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Table 2. *Main effect of response style.*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	More responsive condition (<i>n</i> = 211)	Less responsive condition (<i>n</i> = 189)				
Rapport	4.67 (0.86)	3.91 (1.03)	$F(1,396) = 64.056$	< .001	0.81	[0.60, 1.02]
Social connection	5.19 (1.00)	4.67 (1.25)	$F(1,396) = 21.646$	< .001	0.46	[0.26, 0.66]
Feelings about positive experience	6.47 (2.03)	6.02 (2.06)	$F(1,396) = 4.813$	.029	0.22	[0.03, 0.42]
Positive affect: PANAS	2.96 (0.91)	2.85 (0.89)	$F(1,396) = 1.339$	.248	0.12	[-0.08, 0.31]
Positive Affect: single item	1.42 (1.93)	0.62 (1.92)	$F(1,396) = 16.614$	< .001	0.41	[0.21, 0.61]

Table 3. *Main effect of perceived conversation partner.*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	Chatbot condition (<i>n</i> = 198)	Human Condition (<i>n</i> = 202)				
Rapport	4.22 (1.07)	4.41 (0.94)	$F(1,396) = 2.486$	.116	0.19	[-0.01, 0.38]
Social connection	4.97 (1.19)	4.92(1.12)	$F(1,396) = 0.563$	.454	0.05	[-0.15, 0.24]
Feelings about positive experience	6.19 (2.01)	6.32 (2.10)	$F(1,396) = 0.278$	.598	0.06	[-0.13, 0.26]
Positive affect: PANAS	2.91 (0.91)	2.90 (0.89)	$F(1,396) = 0.025$	.875	0.01	[-0.19, 0.21]
Positive Affect: single item	0.93 (1.94)	1.14 (1.99)	$F(1,396) = 0.740$	.390	0.11	[-0.09, 0.30]

Table 4. *Contrast comparing more responsive chatbot to less responsive human.*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	More responsive chatbot condition (<i>n</i> = 99)	Less responsive human condition (<i>n</i> = 90)				
Rapport	4.60 (0.84)	3.99 (0.87)	$F(1,396) = 19.540$	< .001	0.71	[0.41, 1.01]
Social connection	5.24 (0.99)	4.62 (1.18)	$F(1,396) = 13.823$	< .001	0.56	[0.27, 0.86]
Feelings about positive experience	6.38 (1.94)	6.04 (2.05)	$F(1,396) = 1.313$	.253	0.17	[-0.11, 0.46]
Positive affect: PANAS	2.94 (0.93)	2.82 (0.89)	$F(1,396) = 0.818$	.366	0.13	[-0.15, 0.42]
Positive Affect: single item	1.36 (1.85)	0.74 (1.90)	$F(1,396) = 4.891$	.028	0.33	[0.04, 0.62]

Study 2

Methods

Experimental Design

In Study 2, we sought to replicate our key finding that people are better off interacting with a more responsive chatbot than a less responsive human. As such, the procedure for Study 2 was identical to Study 1, except that we only ran our two critical conditions (more responsive chatbot and less responsive human). In addition, because the PANAS did not appear to provide a sensitive measure of mood, we asked participants to report the intensity of emotions they experienced using positive and negative affect words from the Scale of Positive and Negative Experience (SPANE; Diener et al., 2009; see Table 1).

Pre-registration

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The pre-registered sample size target, analysis plan, and exclusion criteria for Study 2 are available on the OSF at <https://tinyurl.com/y3eupnzi>.

Sample

Participants currently living in the United States and Canada were recruited from Prolific Academic in return for \$2.17 USD. Because Study 2 had only two experimental conditions, we pre-registered a target sample size half that of Study 1 ($N = 200$). Our final sample size consisted of 200 participants (Age: $M = 33.00$, $SD = 11.44$; 47% women). As such, we had 80% power to detect effect sizes of *Cohen's* $d = .35$ or greater.

Exclusion criteria

As in Study 1, we excluded participants who failed to share a positive experience ($n = 13$), failed the perceived conversation partner manipulation check ($n = 26$), or failed the response style manipulation check ($n = 12$). After exclusions, 96 participants were in the less responsive human condition and 104 participants were in the highly responsive chatbot condition. The SOM provides intent-to-treat analyses, including participants who failed the response style manipulation check; results were consistent with our primary analyses.

Pre-registered hypotheses

In line with Study 1, we predicted that participants who interacted with a more responsive chatbot (vs. less responsive human) would feel more positive affect, more rapport, and greater social connection, as well as feeling better about their positive experience.

Results

Pre-registered analyses

To test our directional predictions, we conducted four one-tailed independent samples t -tests, as pre-registered. Participants who interacted with a highly responsive chatbot felt

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significantly higher levels of rapport ($p < .001$), social connection ($p < .001$), and positive mood ($p = .012$), than participants who interacted with a less responsive human. Participants who interacted with the highly responsive chatbot also felt slightly better about the positive experience they shared, but this difference was marginally significant ($p = .062$; see Table 5 for detailed t-test results for each of the four comparisons).

Table 5. Means and t-test results (Study 2)

Outcome Variable	Mean (SD)		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>	95% <i>CI</i>
	More responsive chatbot (<i>n</i> = 104)	Less responsive human (<i>n</i> = 96)					
Rapport	4.86 (0.76)	4.04 (1.13)	5.97	164.6	<.001	0.86	[0.56, 1.16]
Social connection	5.19 (0.99)	4.61 (1.19)	3.68	185.52	<.001	0.52	[0.24, 0.81]
Positive affect: SPANE	3.48 (0.95)	3.14 (1.13)	2.28	186.16	.012	0.32	[0.04, 0.60]
Feelings about positive experience	6.43 (2.13)	5.95 (2.20)	1.54	195.51	.062	0.22	[-0.06, 0.50]

Studies 1 and 2 Discussion

In Studies 1 and 2, participants who interacted with a highly responsive chatbot felt more rapport with their conversation partner and felt more socially connected overall than those who interacted with a less responsive human. In Study 2, people who interacted with a more responsive chatbot (vs. less responsive human) also reported somewhat more positive feelings about their experience and significantly more positive moods overall.

Why do people derive such benefits from interacting with a chatbot that inherently lacks agency? It is possible that people's capacity for anthropomorphism enabled them to feel *as though* the chatbot had agency, given that the chatbot responded to them in a humanlike manner. We propose, however, that people perceive chatbots (vs. humans) as much lower in agency, but that this effect only partially suppresses the substantial pleasure of interacting with a highly

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responsive conversation partner. In Studies 3 and 4, we measured perceived agency to investigate these competing explanations.

An important limitation of Studies 1 and 2 was that participants were not told the “true” identity of their conversation partner until after the interaction. We did this to ensure participants in the chatbot condition did not behave differently than those in the human condition. However, it is possible participants failed to update their thoughts about the conversation based on the new information about the identity of their conversation partner. In Studies 3 and 4, we addressed this limitation by telling participants they would be interacting with a chatbot (or a fellow participant) prior to the interaction.

Study 3

Methods

Experimental Design

The procedure for Study 3 was identical to Study 2 except participants were told that they would be interacting with either a chatbot or a fellow participant prior to the conversation (they were not told that they had actually interacted with a research assistant until the post-experimental debriefing). In addition, as pre-registered, we included a measure of perceived agency (see Table 1) that has been used in previous research on anthropomorphism (Epley et al., 2008). While all participants presumably know that a chatbot objectively lacks agency, this measure captured how participants *felt* about their partner during the interaction. For example, participants indicated the extent to which they felt their partner “had a mind of their own” and “experienced emotions”.

Pre-registration

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The pre-registered sample size target, analysis plan, and exclusion criteria for Study 3 are available on the OSF at <https://tinyurl.com/mn7v9njd>.

Sample

Similar to Study 1, we recruited participants from Prolific Academic (for \$2.17 USD) and our university's Human Subject Pool (for course credit). As Study 3 used a similar design to Study 2, we pre-registered the same sample size target ($N = 200$). Our final sample size consisted of 200 participants (Age: $M = 30.26$, $SD = 11.26$; 57% women). Thus, we had 80% power to detect effect sizes of *Cohen's* $d = .35$ or greater.

Exclusion Criteria

As in Studies 2 and 3, participants who failed to share a positive experience (human condition: $n = 9$; chatbot condition: $n = 6$), failed the perceived conversation partner manipulation check (human condition: $n = 9$; chatbot condition: $n = 18$), or failed the response style manipulation check (human condition: $n = 19$; chatbot condition: $n = 1$) were excluded. Intent-to-treat analyses including participants who failed the response style manipulation check can be found in the SOM; the results were consistent with our primary analyses.

Pre-registered Hypotheses

As in Studies 2 and 3, we predicted that participants who interacted with a highly responsive chatbot (vs. less responsive human) would feel more rapport and more social connection, as well as feeling better about their positive experience and more positive affect overall. Additionally, we predicted that participants would view the highly responsive chatbot as lower in agency than the less responsive human, and that this negative effect would partially suppress the benefits of interacting with the highly responsive chatbot.

Results

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Pre-registered analyses

We again conducted 4 one-tailed independent samples t-tests to assess whether participants who interacted with the highly responsive chatbot derived more emotional benefits than those who interacted with the less responsive human. Participants who interacted with a highly responsive chatbot felt significantly higher levels of rapport ($p < .001$), social connection ($p = .009$), positive mood ($p < .001$), and felt better about their positive experience ($p = .025$) compared to participants who interacted with a less responsive human (see Table 6 for detailed results).

Table 6. Means and t-test results (Study 3)

Outcome Variable	Mean (SD)		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>	95% CI
	More responsive chatbot (<i>n</i> = 112)	Less responsive human (<i>n</i> = 88)					
Rapport	4.91 (0.83)	3.81 (1.14)	7.57	153.07	< .001	1.12	[0.80, 1.43]
Social connection	5.14 (1.18)	4.75 (1.13)	2.37	190.25	.009	0.34	[0.05, 0.62]
Positive affect: SPANE	3.78 (0.84)	3.23 (1.14)	3.77	152.24	< .001	0.56	[0.27, 0.85]
Feelings about positive experience	6.84 (1.89)	6.24 (2.34)	1.97	165.41	.025	0.29	[0.01, 0.57]

As pre-registered, we also investigated whether perceived agency suppressed any of the benefits of interacting with the highly responsive chatbot compared to a less responsive human. Perceived agency did not significantly suppress the relationship between perceived conversation partner and any of our four outcome variables (p 's > .17; see Table 7 for detailed results). Contrary to our pre-registered prediction, the mediation estimates for perceived agency were positive for each of our outcome variables; as expected, perceived agency was positively correlated with most of our dependent measures (see Table 8), but if anything, people tended to

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perceive slightly *more* agency in the highly responsive chatbot ($M = 4.46$, $SD = 0.98$) than the less responsive human ($M = 4.27$, $SD = 0.94$), $t(190.58) = 1.43$, $p = .153$.

Table 7. *Perceived agency mediating the effects of interacting with a highly responsive chatbot compared to less responsive human*

	Estimate	95% CI	<i>p</i>
<i>Mediation 1: Rapport as outcome variable</i>			
Indirect effect (Partner is chatbot → Perceived agency → Rapport)	0.08	[-0.03, 0.20]	.17
Direct effect (Partner is chatbot → Rapport)	1.02	[0.74, 1.27]	< .001
Total effect	1.09	[0.79, 1.37]	< .001
<i>Mediation 2: Social connection as the outcome variable</i>			
Indirect effect (Partner is chatbot → Perceived agency → Social connection)	0.07	[-0.03, 0.20]	.172
Direct effect (Partner is chatbot → Social connection)	0.31	[0.00, 0.62]	.050
Total effect	0.39	[0.05, 0.70]	.028
<i>Mediation 3: Positive affect as the outcome variable</i>			
Indirect effect (Partner is chatbot → Perceived agency → Positive affect)	0.06	[-0.03, 0.16]	.220
Direct effect (Partner is chatbot → Positive affect)	0.49	[0.21, 0.76]	<.001
Total effect	0.55	[0.25, 0.83]	< .001
<i>Mediation 4: Feelings about positive experience as the outcome variable</i>			
Indirect effect (Partner is chatbot → Perceived agency → Feelings about experience)	0.05	[-0.03, 0.17]	.282
Direct effect (Partner is chatbot → Feelings about experience)	0.56	[-0.06, 1.14]	.088
Total effect	0.60	[-0.03, 1.19]	.062

Note: estimates obtained using 1000 bootstrapped samples

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Table 8. *Correlations (Study 3)*

	1	2	3	4	5
1. Perceived agency	1				
2. Rapport	.38 ^a	1			
3. Social connection	.32 ^a	.51 ^a	1		
4. Positive affect: SPANE	.32 ^a	.57 ^a	.60 ^a	1	
5. Feelings about positive experience	.12 ^b	.35 ^a	.42 ^a	.54 ^a	1

Note: ^a= $p < .001$; ^b = $p < .10$

Study 3 Discussion

Surprisingly, Study 3 revealed that participants perceived similar levels of agency in a highly responsive chatbot compared to a less responsive human. Of course, due to the design of Study 3, conversation partner identity (chatbot vs human) is confounded with response style (less responsive vs highly responsive). To remove this confound, we included the fully balanced design in Study 4.

Study 4

Methods

Experimental Design

Study 4 was identical to Study 3 but used the full 2 (Conversation partner) x 2 (Response style) design of Study 1. Information on the outcome measures is available in Table 1.

Pre-registration

The pre-registration for Study 4 is available on the OSF at <https://tinyurl.com/tfkhk3cs>.

Sample

Participants were recruited from Prolific Academic in return for \$2.17 USD. As Study 4 used the same 2 X 2 design as Study 1, we pre-registered the same sample size ($N = 400$). Our

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final sample consisted of 401 participants (Age: $M = 32.67$, $SD = 11.25$; 48% women). As such, we had 80% power to detect effect sizes of *Cohen's* $d = .35$ or greater between the individual conditions, and main effects of approximately *Cohen's* $d = .28$ or greater.

Exclusion Criteria

As pre-registered, participants who did not share a positive experience ($n = 47$), failed the perceived conversation partner ($n = 39$) or the response style ($n = 24$ in less responsive condition; $n = 2$ in highly responsive condition) manipulation check were excluded (see Tables 9-11 for information on the number of participants per condition). Intent-to-treat analyses that include participants that failed the response style manipulation check can be found in the SOM; results were consistent with our primary analyses.

Pre-registered Hypotheses and Research Questions

We had the same pre-registered hypotheses and research questions as in Study 1. Additionally, we pre-registered mediation/suppression analyses to investigate whether agency mediated/suppressed any of the effects of interacting with a chatbot compared to a human.

Results

We conducted 2 (Response style) X 2 (Conversation partner) ANOVA's on our pre-registered dependent variables. For each variable, we also conducted one-tailed t-tests to assess whether people derived greater benefits from the highly responsive chatbot compared to the less responsive human (as pre-registered). In addition, we investigated the role of perceived agency as a mediator. Due to unequal group sizes and HOV violations, we conducted robust ANOVA's on our rapport and social connection variables (the two variables that violated HOV assumptions). Results of these analyses were consistent with the non-robust analyses and can be found in the SOM.

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Pre-registered Analyses

Main effect of response style. Participants who interacted with a highly responsive conversation partner felt significantly higher levels of rapport ($p < .001$) and social connection ($p < .001$) and were in a more positive mood ($p < .001$) than those who engaged with a less responsive conversation partner (see Table 9). In contrast, participants' feelings about their positive experience did not significantly differ based on the response style of their conversation partner ($p = .156$; see Table 9).

Main effect of perceived conversation partner. Compared to those who interacted with a human, participants who interacted with a chatbot did not significantly differ in rapport ($p = .419$), social connection ($p = .573$), feelings about their positive experience ($p = .870$), or positive mood ($p = .281$; see Table 10).

Interaction between perceived conversation partner and response style. There was no significant interaction for feelings of rapport $F(1,397) = 1.85, p = .174$ or positive mood $F(1,397) = 1.76, p = .185$. However, there was a significant Partner X Response Style interaction for thoughts about the positive experience $F(1,397) = 8.65, p = .003$ and social connection, $F(1,396) = 4.95, p = .027$. To illuminate the nature of the two significant interaction effects, we conducted simple effects analyses comparing the chatbot and human partners within the highly responsive and less responsive conditions. Participants who interacted with a highly responsive human (vs. highly responsive chatbot) felt somewhat better about their positive experience ($p = .056, d = .26$) and felt marginally higher levels of social connection ($p = .052, d = .27$; see Table 11). Participants who interacted with a less responsive human (vs. less responsive bot) felt significantly worse about their positive experience ($p = .026, d = 0.32$), but not significantly less socially connected ($p = .22, d = 0.17$; see Table 12). Thus, a positive interaction was marginally

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more rewarding when it came from a human (compared to a bot), but a less responsive style was also somewhat more detrimental coming from a human; these results suggest that people's feelings may be influenced more strongly—both for better and for worse—by a human than by a bot.

More responsive chatbot vs. less responsive human. Participants who interacted with a highly responsive chatbot reported significantly higher levels of rapport ($p < .001$), social connection ($p = .025$) and more positive mood ($p = .005$) than those who interacted with a less responsive human. There were no significant differences for participants' feelings about their positive experience ($p = .11$; see Table 13).

Table 9. *Main effect of response style (Study 4).*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	More responsive condition ($n = 210$)	Less responsive condition ($n = 191$)				
Rapport	4.92 (0.90)	3.85 (1.27)	95.98	<.001	0.98	[0.76, 1.19]
Social connection	5.11 (1.18)	4.71 (1.22)	11.35	<.001	0.34	[0.14, 0.53]
Feelings about positive experience	6.88 (1.99)	6.60 (2.00)	2.01	.157	0.14	[-0.06, 0.34]
Positive affect: SPANE	3.75 (0.98)	3.27 (1.10)	22.38	<.001	0.47	[0.27, 0.67]

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Table 10. *Main effect of perceived conversation partner (Study 4).*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	Chatbot condition (<i>n</i> = 205)	Human Condition (<i>n</i> = 196)				
Rapport	4.38 (1.26)	4.45 (1.16)	0.65	.419	0.06	[-0.14, 0.25]
Social connection	4.89 (1.22)	4.95 (1.21)	0.32	.573	0.05	[-0.15, 0.25]
Feelings about positive experience	6.76 (1.98)	6.72 (2.02)	0.03	.872	0.02	[-0.18, 0.21]
Positive affect: SPANE	3.47 (1.10)	3.57 (1.03)	1.17	.281	0.10	[-.10, 0.29]

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Figure 2. Breakdown of conversation benefits by condition and pre-registered outcome variable (Study 4)

Note: Error bars = standard error of the mean.

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Table 11. Means and results of simple effects analysis comparing the highly responsive chatbot condition to the highly responsive human condition (Study 4).

Outcome Variable	Mean (SD)		<i>t</i>	<i>p</i>	<i>Cohen's D</i>	95% <i>CI</i>
	Highly responsive chatbot (<i>n</i> = 109)	Highly responsive human (<i>n</i> = 101)				
Social connection	4.96 (1.28)	5.28 (1.05)	1.95	.052	0.27	[-0.00, 0.55]
Feelings about positive experience	6.63 (2.05)	7.15 (1.89)	1.91	.056	0.26	[-0.01, 0.54]

Note: all *t*-tests are two-tailed.

Table 12. Means and results of simple effects analysis comparing the less responsive chatbot condition to the less responsive human condition (Study 4).

Outcome Variable	Mean (SD)		<i>t</i>	<i>p</i>	<i>Cohen's D</i>	95% <i>CI</i>
	Less responsive chatbot (<i>n</i> = 96)	Less responsive human (<i>n</i> = 95)				
Social connection	4.81 (1.16)	4.60 (1.27)	-1.22	.22	0.17	[-0.11, 0.46]
Feelings about positive experience	6.91(1.90)	6.27 (2.07)	-2.24	.026	0.32	[0.04, 0.061]

Note: all *t*-tests are two-tailed.

Table 13. Means and *t*-test results (Study 4).

Outcome Variable	Mean (SD)		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>	95% <i>CI</i>
	More responsive chatbot (<i>n</i> = 109)	Less responsive human (<i>n</i> = 95)					
Rapport	4.81 (0.96)	3.82 (1.16)	6.59	183.51	<.001	0.94	[0.63, 1.24]
Social connection	4.96 (1.28)	4.60 (1.27)	1.97	198.01	.025	0.28	[-0.01, 0.56] ^a
Positive affect: SPANE	3.64 (1.05)	3.25 (1.07)	2.62	197.31	.005	0.37	[0.08, 0.65]
Feelings about positive experience	6.63 (2.05)	6.27 (2.07)	1.22	197.72	.112	0.17	[-0.11, 0.45]

Note: ^a= *t*-test is one-tailed; as such, the 95% *CI* includes 0, even though the *t*-test is significant

The role of perceived agency as a mediator. Notably, participants did not perceive significantly lower levels of agency in a chatbot ($M = 4.46$; $SD = 1.23$) compared to a human conversation partner ($M = 4.58$; $SD = 1.16$), $t(398.93) = 0.99$, $p = .322$ (two-tailed). It appears the

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human capacity for anthropomorphism enabled them to perceive agency in a chatbot who responded in a humanlike manner. Because there was no difference between conditions in perceived agency, this variable did not mediate the effects of conversation partner (chatbot vs human) for any of our pre-registered outcome variables (p 's > .34), even though perceived agency was positively correlated with all of our outcome variables (see Table 14). However, participants interacting with a highly responsive partner did perceive marginally higher levels of agency ($M = 4.62$; $SD = 1.26$) in their conversation partner than those who interacted with a less responsive partner ($M = 4.40$, $SD = 1.11$), $t(398.55) = 1.82$, $p = .069$ (two-tailed). As such, perceptions of agency appear to be influenced more by response style than by the humanity of one's partner.

Table 14. *Correlations (Study 4)*

	1	2	3	4	5
1. Perceived agency	1				
2. Rapport	.45 ^a	1			
3. Social connection	.34 ^a	.61 ^a	1		
4. Positive affect: SPANE	.26 ^a	.59 ^a	.62 ^a	1	
5. Feelings about positive experience	.27 ^a	.32 ^a	.43 ^a	.52 ^a	1

Note: ^a= $p < .001$

Study 4 Discussion

Studies 3 and 4 replicated our key finding that people derive greater emotional benefits from a highly responsive chatbot compared to a less responsive human. Importantly, this effect remained even though participants were made aware of the identity of their conversation partner (chatbot or fellow participant) prior to the conversation. We again found no differences in the overall benefits of interacting with a human compared to a chatbot. However, this finding should

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be interpreted with caution given that we found some evidence that the effects of interacting with a human compared to a chatbot depended on the response style of the conversation partner (see Figure 2). Specifically, exploratory analyses revealed that participants garnered marginally higher levels of emotional benefits from a highly responsive human compared to a highly responsive chatbot. These differences were small however (d 's $< .28$), suggesting that the benefits of interacting with a highly responsive human compared to a highly responsive chatbot may be relatively small. Lastly, exploratory analyses suggested that anthropomorphism may explain the apparent lack of difference between chatbot and human conversation partners, as there were no significant differences in perception of agency between the two.

Internal Meta-Analysis of Studies 1-4

Analyses

To obtain an overall estimate of the benefits of interacting with a highly responsive chatbot compared to a less responsive human, we conducted an internal random effects meta-analysis of each of our four pre-registered variables across Studies 1-4 using the procedure described in Goh et al. (2016). Estimates for the effect size of each outcome variable were obtained by averaging the Cohen's d 's from each study. Each study was equally weighted when calculating the mean, and the p -value for the overall effect size was obtained using a one-sample t -test.

Results

The results of the meta-analyses for the comparison between the highly responsive chatbot and less responsive human conditions can be found in Table 15. Across our four studies, participants who interacted with a highly responsive chatbot (compared to a less responsive human) felt significantly higher levels of rapport ($d = 0.91, p = .002$), social connection ($d =$

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0.43, $p = .008$), positive mood ($d = 0.35$, $p = 0.03$), and felt better about their positive experience ($d = 0.21$, $p = .005$).

Table 15. *Internal meta-analyses for comparison between highly responsive chatbot and less responsive human.*

Outcome Variable	Cohen's d					p (overall estimate)
	Study 1	Study 2	Study 3	Study 4	Overall estimate	
Rapport	0.71	0.86	1.12	0.94	0.91	.002
Social connection	0.56	0.52	0.34	0.28	0.43	.008
Positive affect ^a	0.13	0.32	0.56	0.37	0.35	.030
Feelings about positive experience	0.17	0.22	0.29	0.17	0.21	.005

Note: ^a= Study 1 estimate obtained using PANAS; studies 3-5 estimates obtained using SPANE.

Study 5

Studies 1-4 found that people derived nearly the same social and emotional benefits from interacting with a partner they believed was a chatbot (vs. a human). While surprising at first glance, these findings fall in line with the CASA framework, which suggests that people instinctively perceive computers as human (e.g., Nass & Moon, 2000; Nass et al., 1994). However, Studies 1-4 only involved conversations in which the participant shared positive news with a chatbot, while the chatbot commented and asked questions that centered on the participant's experience. This one-sided style of conversation may have been particularly well-suited for observing benefits of interacting with a chatbot, given that this conversation kept the focus on the participant, rather than requiring the chatbot to share anything about itself.

In contrast, other types of conversations would require the chatbot to engage in self-disclosure, thereby implying that the chatbot had its own subjective experience. According to classic theorizing, robots that exhibit too much humanity may fall into an "uncanny valley,"

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generating unfavorable reactions compared to less humanlike robots (Mori, 1970; 2012; see Wang et al., 2015 for a review). For example, people report lower affinity toward a robot with a humanoid-style face than a robot with a non-human, mechanical face (i.e., similar to *Disney's WALL-E*; Mathur & Reichling, 2016). Gray and Wegner (2012) hypothesized that humanlike robots provoke uncanny feelings and reduced affinity because people perceive subjective experience in the robots, while at the same time recognizing that such subjective experience is impossible. Applying this *mind perception hypothesis* (Gray and Wegner, 2012; Wang et al., 2015), we hypothesized that listening to a chatbot share its *own* positive news could push chatbots into the uncanny valley. If this is correct, then we would expect that participants would feel less connected and happy after listening to a chatbot share positive news than after listening to a human share positive news — thereby illustrating an important boundary condition of our prior findings.

Experimental Design

The study used a 2 (Conversation type) X 2 (Conversation partner) design. As in Studies 3 and 4, participants identified a positive experience from their life and were told they were interacting with either a chatbot (chatbot condition) or a fellow participant (human condition) prior to the conversation. Rather than varying response style, however, we varied the type of conversation: Participants either shared positive news with their partner (sharer condition), or listened to their partner share positive news with them (listener condition).

When participants shared positive news, their partner always responded in a highly responsive manner (replicating the highly responsive condition in previous studies). We included this condition because Study 4 suggested that—contrary to our initial predictions—a responsive human was marginally more beneficial than a responsive chatbot. When participants were

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instructed to listen to their conversation partner share positive news, the research assistants shared a positive life event from a pre-specified list, based on real participants' responses in Studies 1-4. Aside from these changes, the procedure of Study 5 was identical to Study 4.

Pre-registration

The pre-registered sample size target, analysis plan, and exclusion criteria for Study 5 are available on the OSF at <https://tinyurl.com/53bpw85h>. In contrast to previous studies, we did not pre-register analyses examining feelings about the positive experience, as this measure was not relevant for the listener conditions (because participants did not discuss their own positive news). The list of pre-registered measures in Study 5 can be found in Table 1.

Sample

Similar to Studies 1-4, we recruited participants from Prolific Academic for \$2.17 USD. We pre-registered the same sample size target ($N = 400$) as in our other studies using the same design (Studies 2 and 5). After exclusions, our final sample size consisted of 401 participants (Age: $M = 31.59$, $SD = 11.78$; 64% women). With this sample size, we had 80% power to detect effect sizes of *Cohen's* $d = .35$ or greater between the individual conditions, and main effects of approximately *Cohen's* $d = .28$ or greater.

Exclusion Criteria

As pre-registered, we excluded participants who did not send or receive any messages during the text interaction (typically due to technical difficulties with the chat platform; $n = 54$), and those who failed the perceived conversation partner manipulation check ($n = 36$).

Pre-registered Hypotheses

We had two pre-registered hypotheses. Consistent with our previous findings, we expected that there would be no significant difference between chatbot and human conversation

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partners in the sharing condition. However, we hypothesized that participants in the listening condition would derive more benefits from a human conversation partner compared to a chatbot partner.

Results

We conducted 2 (Conversation type) X 2 (Conversation partner) ANOVA's on our three pre-registered dependent variables. However, (as pre-registered) the key tests of our two hypotheses were the comparisons between the human and chatbot conversation partners within each of the listener and sharer conditions. As in previous studies, for our pre-registered directional prediction, we used one-tailed t-tests. In contrast to previous studies, there were no HOV violations for any of our outcome variables, so we did not conduct additional robust ANOVA's.

Pre-registered Analyses

Main effect of conversation type. Participants who shared their positive news with a conversation partner did not differ in their levels of rapport ($p = .64$), social connection ($p = .46$), or positive mood ($p = .26$) compared to those who listened to their conversation partner share positive news (see Figure 3 and Table 16).

Main effect of perceived conversation partner. Compared to those who interacted with a chatbot, participants who interacted with a human did not significantly differ in rapport ($p = .15$), social connection ($p = .29$) or positive mood ($p = .17$; see Figure 3 and Table 17).

Interaction between perceived conversation partner and response style. As we anticipated in our pre-registration, the Conversation Type X Conversation Partner interaction did not reach significance for rapport, $F(1,397) = 1.50, p = .222$, social connection, $F(1,397) = .046, p = .830$, or positive mood, $F(1,397) = 0.99, p = .320$.

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Listening to a chatbot's positive experience vs listening to a human's positive experience. As pre-registered, the key test of our second hypothesis was the comparison between the human and chatbot conversation partners within the listener condition. Participants who listened to a human share a positive experience felt more rapport ($p = .032$) and positive affect ($p = .041$) than those who listened to a chatbot. However, there were no significant differences in social connection ($p = .169$; see Table 18).

Sharing a positive experience with a chatbot vs a human. Consistent with our pre-registered predictions and our previous studies, there were no significant difference between participants who shared a positive experience with a human compared to a chatbot in levels of rapport ($p = .845$), social connection ($p = .560$), or positive mood ($p = .773$; see Table 19).

Table 16. *Main effect of conversation type (Study 5).*

	Mean (SD)		F	p	<i>Cohen's d</i>	95% CI
	Listener condition ($n = 195$)	Sharer condition ($n = 206$)				
Rapport	4.76 (0.96)	4.80 (0.93)	0.22	.637	0.04	[-0.15, 0.24]
Social connection	5.14 (1.07)	5.06 (1.21)	0.55	.458	0.08	[-0.12, 0.27]
Positive affect: SPANE	3.55 (0.94)	3.66 (1.00)	1.26	.262	0.11	[-0.09, 0.31]

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Table 17. *Main effect of perceived conversation partner (Study 5).*

	Mean (SD)		<i>F</i>	<i>p</i>	<i>Cohen's d</i>	95% CI
	Chatbot condition (<i>n</i> = 199)	Human Condition (<i>n</i> = 202)				
Rapport	4.72 (0.97)	4.85 (0.92)	2.13	.146	0.14	[-0.05, 0.34]
Social connection	5.04 (1.15)	5.16 (1.14)	1.14	.286	0.11	[-0.09, 0.30]
Positive affect: SPANE	3.54 (0.95)	3.67 (0.99)	1.92	.166	0.14	[-0.06, 0.33]

Table 18. *Means and t-test results comparing listening to chatbot and listening to human conditions (Study 5).*

Outcome Variable	Mean (SD)		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>	95% CI
	Listening to chatbot (<i>n</i> = 95)	Listening to human (<i>n</i> = 100)					
Rapport	4.63 (0.98)	4.89 (0.93)	1.87	191.08	.032	0.27	[-0.02, 0.55]
Social connection	5.07 (1.07)	5.22 (1.08)	0.96	192.73	.169	0.14	[-0.14, 0.42]
Positive affect: SPANE	3.44 (0.92)	3.67 (0.94)	1.75	192.74	.041	0.25	[-0.03, 0.53]

Note: ^a= t-test is one-tailed; as such, the 95% CI includes 0, even though the t-test is significant

Table 19. *Means and t-test results comparing sharing with chatbot and sharing with human conditions (Study 5).*

Outcome Variable	Mean (SD)		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>	95% CI
	Sharing with chatbot (<i>n</i> = 104)	Sharing with human (<i>n</i> = 102)					
Rapport	4.79 (0.95)	4.82 (0.91)	0.20	203.89	.845	0.03	[-0.25, 0.30]
Social connection	5.01 (1.23)	5.11 (1.19)	0.58	203.98	.560	0.08	[-0.19, 0.35]
Positive affect: SPANE	3.64 (0.97)	3.68 (1.04)	0.29	202.36	.773	0.04	[-0.23, 0.31]

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Figure 3. Breakdown of conversation benefits by condition and pre-registered outcome variable (Study 5)

Note: Error bars = standard error of the mean

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Exploratory Analyses

Perceived agency. Because we did not find differences on perceived agency in our previous studies, we did not pre-register any specific analyses using this variable, although we examined it on an exploratory basis. When participants shared positive news, there was no significant difference in their perception of agency with a chatbot partner ($M = 4.38$; $SD = 1.44$) versus a human partner ($M = 4.61$; $SD = 1.26$), $t(201.18) = 1.22$, $p = .223$, $d = 0.17$, $95\% CI = [-0.10, 0.44]$, as in our previous studies. However, when participants listened to their partner share positive news, they felt that that chatbot had marginally lower levels of agency ($M = 4.63$; $SD = 1.29$) compared to a human ($M = 4.94$; $SD = 1.10$), $t(185.15) = 1.81$, $p = .071$, $d = .26$, $95\% CI = [-.02, 0.54]$. Descriptively speaking, mediation analyses suggested that this tendency to view the chatbot as less agentic might help to explain why participants derived fewer benefits from listening to positive news from a chatbot versus a human; these results should be treated with caution, however, because they were statistically weak and were not pre-registered (see SOM).

Study 5 Discussion

In the present study, we identified an important boundary condition for the benefits of interacting with chatbots compared to human conversation partners. Although participants derived similar benefits from a chatbot or a human when participants shared positive news (replicating our earlier studies), they derived significantly fewer benefits from interacting with a chatbot (vs. human) when their conversation partner was sharing positive news. These results suggest that chatbots portraying a level of humanness that is objectively not possible (e.g., having a job, discussing personal relationships) may push them into the “uncanny valley” (Mori, 1970, 2012), making them less optimal than a human conversation partner.

General Discussion

The present research suggests that people can derive substantial benefits from interacting with a partner who they know to be inanimate. Across Studies 1-4, participants who believed they interacted with a highly responsive chatbot felt more rapport, were more socially connected, were in a better mood, and felt better about their positive experience than participants who interacted with a less responsive human. Moreover, the benefits of interacting with a highly responsive chatbot were similar regardless of whether participants were told their conversation partner was a chatbot after the interaction (Studies 1-2) or beforehand (Studies 3-4). Despite their inherent lack of agency, chatbots that are programmed to respond in an optimal manner may deliver greater social benefits than suboptimal human conversation partners. Importantly, however, the relative benefits of interacting with chatbots (vs. humans) may be undermined if chatbots lay claim to experiences (such as a new romantic relationship or job promotion) that are too humanlike, as in Study 5.

Taken together, the results of the present research contribute to several existing theories. According to responsiveness theory (e.g., Gable & Reis, 2010; Gable & Reis, 2015), an active-constructive response style — displaying warmth, understanding, and care — plays a critical role in promoting feelings of connection across diverse human relationships, with lovers, friends, or strangers (see Gable & Reis, 2015). Our work contributes to this theory by providing the first evidence that the benefits of responsiveness emerge even with nonhuman partners. Our findings also provide support for the CASA framework (e.g., Nass & Moon, 2000; Nass et al., 1994), which posits that people instinctively perceive computers as human. Going beyond past work on the CASA framework, our studies provide the first evidence that computers can potentially offer social and emotional benefits that are similar to the benefits provided by human partners.

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While we assume that participants objectively understood that chatbots lack conscious experience, they apparently still felt *as though* their chatbot had a mind. Indeed, classic research shows that people readily anthropomorphize objects by, for example, perceiving a larger triangle as “bullying” a smaller one (see video here: <https://tinyurl.com/y8rc6nnt>; Heider & Simmel, 1944). Perhaps then, it is not so surprising that human beings readily perceive agency in a chatbot who responds to their good news with interest and personalized engagement. Indeed, in Studies 3 and 4, participants’ perceptions of agency were influenced more by their partner’s response style than by their partner’s identity as a human or computer. However, Study 5 suggests that if chatbots exhibit too much humanity, then the relative rewards they offer may dwindle. Specifically, consistent with the mind perception hypothesis (Gray & Wegner, 2012; Wang et al., 2015), we found that chatbots made less satisfying partners than humans when the chatbots shared their own positive news, creating an obvious violation with chatbots’ inherent lack of subjective experience. Regular chatbot users may avoid facing these violations by engaging in relatively one-sided conversations; in our survey of existing chatbot users, over 50% reported sharing positive news from their life with their chatbot, but only 20% reported asking their chatbot about its day.

A potential limitation of our research is that some participants in the chatbot condition may not have believed that they actually interacted with a chatbot, explaining why we observed almost no difference between the human and chatbot conditions in Studies 1-4. Across these studies, however, only about 4% of participants expressed strong disbelief that they interacted with a chatbot when asked if there was anything suspicious about the study. Indeed, some participants in Studies 1 and 2 actually indicated they had known it was a chatbot all along (e.g., “I immediately identified that I was chatting with a chatbot”). Our studies were powered to

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detect a small-to-medium effect ($d = 0.28$) of interacting with a human versus an equivalent chatbot, and thus our consistent null effects suggest that any benefit of discussing personal events with a human (vs. chatbot) may be relatively small—and may be easily outweighed by the benefits of an optimal response style. Finally, Study 5 demonstrates that it is possible to detect differences between interacting with a human versus a chatbot in our paradigm under theoretically predicted conditions.

It is worth underscoring that our findings do not suggest people should seek out a supportive chatbot over a supportive human. Rather, if a supportive human partner is not available, people could benefit from interacting with a chatbot. Given that nearly 25% of a nationally representative sample of American adults reported having no one in their lives with whom to discuss important matters (McPherson et al., 2006), highly effective chatbots have the potential to fill an important social need. Our findings help to explain why chatbots that serve no purpose aside from companionship have been adopted so readily, with hundreds of millions of users around the world (Zhou et al, 2020). Indeed, in our survey of existing chatbot users, over 70% indicated that their chatbot was a meaningful source of social connection in their lives (see SOM). At the same time, the results of Study 5 suggest that when chatbots “go too far” in their human-like behavior, the benefits of such interactions may be reduced. On the whole, much research is needed to better understand when and for whom chatbots can offer viable alternative sources of social connection. That said, our research offers initial evidence that meaningful digital companionship with chatbots is a matter of overcoming engineering obstacles as opposed to psychological ones.

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Author contributions

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The final datasets and R code for Studies 1-5 are available at tinyurl.com/15ycsfxy, tinyurl.com/jrzwvrpz, <https://tinyurl.com/mskr2f9f>, <https://tinyurl.com/44kw5sa7>, and <https://tinyurl.com/5n85vbb9>

Pre-registrations for the studies can be found at <https://tinyurl.com/y58v4hcn>, <https://tinyurl.com/y3eupnzj>, <https://tinyurl.com/mn7v9njd>, <https://tinyurl.com/tfkhk3cs>, and <https://tinyurl.com/53bpw85h>