ARTICLE

the british
psychological society
promoting excellence in psychology

Virtually in love: The role of anthropomorphism in virtual romantic relationships

Mayu Koike[1] ⓘ | Steve Loughnan[2] | Sarah C. E. Stanton[2]

[1]Department of Psychology, Hiroshima University, Hiroshima, Japan

[2]Department of Psychology, University of Edinburgh, Edinburgh, UK

Correspondence
Mayu Koike, Department of Psychology, Hiroshima University, Hiroshima, Japan.
Email: mayukoike@hiroshima-u.ac.jp

Abstract

Romantic relationships are a cornerstone of human nature. Today, these relationships can potentially be fulfilled by virtual agents. Although previous psychological research has examined how human needs can be met by anthropomorphized agents, it has neglected virtual romantic relationships. This paper introduces the concept of *romantic anthropomorphism* (i.e. giving a non-human agent human-like characteristics in a romantic context) to help understand virtual romance. In three laboratory studies, we used romantic video games (RVGs) to examine how romantic anthropomorphism predicts relationship authenticity, desire for real-world relationship and mood (Studies 1A, 1B and 2) as well as real-world interpersonal behaviour (Study 2). Study 1A revealed that romantic anthropomorphism of a virtual agent predicted desire for a real-world relationship with the virtual agent and greater positive affect via feeling that the relationship built with the virtual agent was authentic. Study 1B replicated these results using a larger sample and a different RVG. Study 2 replicated these results, but revealed that playing RVGs failed to predict real-world behaviour in a subsequent interaction with a human confederate. This research identifies a unique way that people find connection in the modern world and provides novel insight into the fields of anthropomorphism, virtual interactions and relationship science.

KEYWORDS
anthropomorphism, behaviour, mood, romantic relationships, virtual agents

INTRODUCTION

Virtual agents play an increasingly central role in our modern world. From offices, to call centres, to our living rooms (e.g. Alexa, Cortana, Siri), virtual agents are increasingly common. To date, virtual agents have been primarily developed to replace human labour; however, as these agents increase in complexity, they are moving into other, more social domains (for a review, see Koike & Loughnan, 2021). Our romantic lives reflect one such important social domain witnessing the growing involvement of virtual agents. The need to love and to be loved is an enduring, universal aspect of human psychology (Baumeister & Leary, 1995). For most of our history, fulfilling this need required another person—someone to love and to love back. Today, a virtual agent can potentially fulfil this need.

Romantic video games (RVGs) provide millions of people with the opportunity to pursue, nurture and enjoy a romantic relationship with a virtual agent. These games contain virtual characters who are increasingly interactive and responsive, simulating some core characteristics of romantic relationships. They also play an increasingly important role in peoples' psychological lives. For example, *LovePlus*, a male-oriented romantic video game, proved so successful that numerous men reported falling in love with their virtual girlfriends (Mainichi, 2010; Sankei, 2010), even to the point of preferring them to real women (Rani, 2013). The RVG market is growing rapidly; for example, female-oriented Chinese RVGs are estimated to have earned approximately $8 billion in 2020 (Xu, 2019). The popularity of RVGs is also growing in anglophone countries (e.g. United States, United Kingdom) and within continental Europe, with around 50-million players worldwide (Marsh & Ogura, 2017). Finally, virtual romances are an increasingly common element of top-selling video games (e.g. *The Witcher 3, Mass Effect*). In short, romances with virtual agents are popular and are experiencing rapid growth.

Despite this critical change in how people may interact romantically, researchers have yet to systematically investigate virtual romances. As virtual agents become increasingly complex and interactive, we may come to view them as essentially like other humans (anthropomorphism). If so, then our relationships with these virtual agents might feel real and authentic, leading to positive emotions and a desire to continue the relationship. In three laboratory studies, we explore how anthropomorphism—seeing a virtual agent as human-like—may help explain virtual romance, and whether virtual romance is linked to players' perceptions of their virtual relationships, mood and subsequent real-world behaviour.

Anthropomorphism and relationships

Psychologists have long recognized that meaningful interactions with others, and the sense of social connection that this interaction creates, is a fundamental human need (Baumeister & Leary, 1995; Maslow, 1968). However, we can have meaningful social interactions without another person. To achieve this, people often render an inanimate object 'human-like' to help meet their social needs. The tendency to imbue non-human entities with human-like characteristics is called *anthropomorphism* (Epley et al., 2007; Soanes & Stevenson, 2005). In a theoretical account of this process, Epley and colleagues (Epley, 2018; Epley et al., 2007) proposed the SEEK model to explain when and why people are likely to anthropomorphize. The model presents three factors: *Effectance motivation*, the motivation to explain and understand the behaviour of other agents; *Elicited agent Knowledge*, the accessibility and applicability of anthropocentric knowledge; and most relevant for the current work, *Sociality motivation*, the desire for social contact and affiliation.

The role of sociality motivation in determining when people anthropomorphise has been robustly examined in recent years. Feeling a lack of social connection leads people to anthropomorphize non-human agents more (Eyssel & Reich, 2013; Im Shin & Kim, 2018) and chronically lonely individuals are more likely to anthropomorphize (Epley et al., 2008; Koike et al., 2020). Loneliness, however, is not the only social motivator of anthropomorphism. Similar effects emerge among people with unstable social connections and insecure attachment orientations (Timpano & Shaw, 2013). For example, women with high attachment avoidance or high attachment anxiety—the degree to which individuals

are uncomfortable with intimacy and the degree to which individuals worry about their close relationships, respectively (Mikulincer & Shaver, 2016)—tend to anthropomorphize objects more than less avoidantly or anxiously attached women (Neave et al., 2016). This prior work has focused on the factors, which lead people to anthropomorphize, such as sociality motivations, and neglected the potential role of anthropomorphism in helping us form relationships (see Koike & Loughnan, 2021). We propose that once anthropomorphism begins, it may help us build a deeper relationship with non-human entities (see also Kwok et al., 2018).

To date, all prior social psychological work on anthropomorphism has examined platonic relationships. While platonic social ties are undoubtedly important, romantic relationships have been identified as a particularly strong determinant of well-being (Dush & Amato, 2005; Selcuk et al., 2016), and both mental and physical health (for reviews, see Slatcher & Selcuk, 2017; Uchino, 2006). Additionally, individuals in satisfying romantic relationships have a higher level of subjective well-being than individuals in unhappy relationships (Gere & Schimmack, 2013). Although research has demonstrated that anthropomorphism can facilitate empathy, responsiveness and liking in interactions with virtual agents and robots (e.g. Birnbaum et al., 2016; Nowak & Rauh, 2005; Riek et al., 2009; Salem et al., 2013), no studies to date have focused on romantic relationships with anthropomorphized non-human entities.

If anthropomorphism is attractive to people who lack platonic connections (Epley et al., 2007) and helps alleviate loneliness (e.g. Jakobek, 2019), might it also help us understand romantic experiences with a virtual agent? Preliminary evidence supports this general idea; Koike et al. (2020) found that RVGs were particularly attractive to lonely individuals. Understanding romantic relationship experiences with non-human entities likely requires investigating a domain-specific experience of anthropomorphism. We, therefore, argue that *romantic anthropomorphism*—the act of giving a non-human agent human-like characteristics in a romantic context—should play an important role in virtual romances and their outcomes (e.g. associations with higher positive and lower negative mood).

When considering romantic anthropomorphism, it is important to distinguish between two types of potential relationship experiences. The first involves fostering a genuine and intimate romantic connection with the virtual agent (e.g. I feel this agent cares for me), which we call *relationship authenticity*. The second involves an imaginary 'if/then' type relationship (e.g. If this agent were real, then I would want to be in a relationship with them), which refers to the desire to have a real-world relationship with the virtual agent. People could potentially experience either or both relationships with a virtual agent, and both relationship experiences may be facilitated by greater romantic anthropomorphism. However, given that the feeling of relationship authenticity more accurately captures the idea that the player is actually in a relationship with the virtual agent, and perceiving authenticity in real-life romantic partners contributes to relationship quality (Wickham, 2013), we propose that it should be an antecedent for the feeling of desire for imaginary relationships (desire for real-world relationship), as players are likely to desire a 'real' relationship with a virtual agent because their virtual romance felt authentic.

RESEARCH OVERVIEW AND HYPOTHESES

In this paper, we conducted three laboratory studies examining romantic anthropomorphism in virtual relationships. Across our studies, we recruited only heterosexual female participants, as we chose female-oriented RVGs. Study 1 used an exploratory-confirmatory approach where we tested our hypotheses in one sample and then sought to replicate the findings in a different sample. In Study 1A, participants played an Asian-style RVG in English. In Study 1B, we employed a Western-style RVG with a larger sample. In Study 2, we examined whether romantic anthropomorphism could also predict behaviour in a subsequent interaction with a male confederate. Based on previous findings from the anthropomorphism and romantic relationships literatures (e.g. Birnbaum et al., 2016; Epley et al., 2008; Koike et al., 2020; Nowak & Rauh, 2005; Selcuk et al., 2016; Wickham, 2013), in all three studies we hypothesized that after playing an RVG greater romantic anthropomorphism would predict stronger relationship authenticity which, in turn, would predict greater desire for a

real-world relationship with the virtual agent, as well as higher positive and lower negative mood (Hypothesis 1). In Study 2, we further hypothesized that greater anthropomorphism would predict stronger relationship authenticity, which would then be associated with more flirtatious behaviour towards a male confederate via greater desire for real-world relationship with a virtual agent and higher positive mood (Hypothesis 2).

STUDY 1A/1B

Study 1 sought to provide preliminary evidence that romantic anthropomorphism plays a critical role in virtual relationship experiences. We tested the associations between our variables of interest in two separate samples: Study 1A was an exploratory study and Study 1B was a confirmatory study. Data collection was based on time constraints on the project. In Study 1A, we were able to recruit 61 participants in the time allotted for data collection, achieving statistical power of 0.53 for our mediation models. In Study 1B, we collected 104 participants, achieving statistical power of 0.83 for our models (Schoemann et al., 2017).

METHOD

Participants

Study 1A (exploratory sample)

Sixty-one heterosexual women aged 19–39 years old (M = 24.46, SD = 4.70) were recruited. Participants identified as Asian (N = 42) or Caucasian (N = 19). Twenty-three participants were in a relationship and all others were single. All participants were native or proficient English speakers with no prior experience playing the RVG (i.e. *Castaway*). We recruited unpaid volunteers and university students who participated in return for course credit.

Study 1B (confirmatory sample)

One hundred and four heterosexual women aged 18–36 years old (M = 20.94, SD = 4.40) were recruited. Participants identified as Asian (N = 21) or Caucasian (N = 83). Thirty-nine participants were in a relationship and all others were single. All participants were native or proficient English speakers with no prior experience playing the RVG (i.e. *Choices: Stories You Play*). We recruited unpaid volunteers and university students who participated in return for course credit.

Procedure

In each study, participants first completed a basic demographic questionnaire and a pre-gameplay measure of positive affect (PA) and negative affect (NA). Next, they read a description of the RVG (Study 1A: *Castaway*; Study 1B: *Choices: Stories You Play*) before downloading it onto their smartphones and completing the first two episodes (~35 minutes). Following gameplay in the lab, participants completed the PA and NA measures again, as well as measures of anthropomorphism of the romantic interest virtual agent (Study 1A: Clyde; Study 1B: Chris), relationship authenticity and desire for a real-world relationship with the virtual agent.

Measures

The full study materials are available at (https://bit.ly/3L4Bs4j).[1] Study 1A/B used an exploratory-confirmatory approach where we tested our hypotheses in one sample and then sought to replicate the findings in a different sample. Although the RVG we used differed between Study 1A and Study 1B, the self-report questionnaires were identical in both samples except for the virtual agents' name (Clyde in *Castaway*, Chris in *Choices: Stories You Play*).

Romantic anthropomorphism

The extent to which participants imbued the virtual agent with human characteristics was assessed by 18 items (e.g. 'Clyde/Chris is capable of conveying thoughts or feelings to others,' 'Clyde/Chris is capable of understanding how others are feeling') rated on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*). These items were adapted from prior work (Gray et al., 2007).

Relationship authenticity

This 6-item scale measured how much participants felt their romantic relationship with the virtual agent felt 'real' and intimate (e.g. 'I feel that Clyde/Chris and I were connected in the game', 'I feel Clyde/Chris cared for me in the game'), on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*).

Desire for a real-world relationship with the virtual agent

Romantic relationships between people and virtual agents are different than those among people in at least one critical respect: Virtual agents do not physically exist in the world. We created a scale to measure participants' desire to have a real-world relationship with the virtual agent. The scale measures desire to be in a relationship with a virtual agent 'if they were real'. Six items (e.g. 'If Clyde/Chris was a real person, I would ask him out', 'If Clyde/Chris was a real person, he would make me a very happy girlfriend') were rated on a 7-point scale (*1 = strongly disagree, 7 = strongly agree*).

Positive and negative affect

Participants completed a measure of PA and NA before and after gameplay. Eight items measured PA (i.e. enthusiastic, interested, excited, inspired, happy, content, secure, hopeful) and eight items measured NA (i.e. upset, distressed, anxious, irritable, hostile, lonely, stressed, sad) rated on a 5-point scale (1 = *very slightly or not at all*, 5 = *extremely*). In analyses, we calculated pre–post difference scores for PA and NA by subtracting pre-gameplay scores from post-gameplay scores.

RVG for study 1A: Castaway

Castaway is an English-language RVG developed by Voltage, a popular Japanese gaming app company. In the game, participants select a romantic interest and then interact with them via making a series of choices in the game. The game opens with the following premise:

---

[1]In Study 1A specifically, we had some additional measures that were included as part of the first author's PhD thesis but were not of primary interest to the present research. At the request of an associate editor, we ran auxiliary exploratory analyses testing if these additional measures were correlated with our primary variables of interest. The results may be viewed in our online supplementary materials (https://bit.ly/3jYNZdA); these extra measures were uncorrelated with our primary variables of interest.

> We're stranded here, aren't we? You are a journalist hired onto a special cruise ship by a reclusive millionaire with unknown motivations. You think everything is going great, but when the weather takes a turn for the worse, your dream job becomes your worst nightmare! Now you're stranded on a tropical island with nothing but your wits and 5 sexy strangers. You're trying to focus on survival, but things start to get heated… are these feelings real or is the island sun getting to you?

We asked all participants to choose Clyde (a male virtual agent) as their romantic partner. Thus, across two episodes the protagonist (a female character in the game) flirts and interacts romantically—but not sexually—with Clyde.

RVG for study 1B: Choices: Stories you play

Choices: Stories You Play is an English-language RVG developed by Pixelberry, a popular American gaming app company. The graphics and stories are designed with Western players in mind. The game opens with the following premise:

> Welcome to Hartfeld University! You'll make friends for life, and maybe even find true love. YOU control what happens next!

We asked all participants to choose Chris (a male virtual agent) as a romantic target. Thus, across two episodes the female participants' protagonist (a female character in the game) flirts and interacts romantically and sexually with Chris.

RESULTS AND DISCUSSION

Descriptive statistics, reliability information and correlations among Study 1A and Study 1B variables are presented in Table 1. We tested our hypotheses using Model 4 of the PROCESS macro for SPSS (Hayes, 2018). In each study, we tested three models, one for each of our outcome variables of interest: desire for a real-world relationship with the virtual agent, change in PA and change in NA. In all analyses, romantic anthropomorphism of the virtual agent (Study 1A: Clyde and Study 1B: Chris) was the predictor variable, and relationship authenticity was the mediator (see Figures 1 and 2). The data analytic strategy in Study 1B was identical to Study 1A.

As seen in Figure 1, Study 1A revealed that greater romantic anthropomorphism was linked to greater feelings of relationship authenticity with the virtual agent, which then predicted more desire for a relationship with the virtual agent in the real world and an increase in PA. Interestingly, romantic anthropomorphism and relationship authenticity did not predict change in NA, suggesting that the bonds established between participants and the virtual agent Clyde were specifically tied to PA. Study 1B fully replicated these associations (see Figure 2). This same pattern emerged despite using a different RVG and participant sample, suggesting that these findings generalize beyond a specific RVG and capture a broader process involved in the development of virtual romantic relationships. Although the sample in Study 1A was somewhat underpowered, the approach we used is in line with the idea of 'exploring small, confirming big' (Sakaluk, 2016). Additionally, the replication across studies bolsters our confidence in our findings. Taken together, Study 1A and 1B provide preliminary evidence that romantic anthropomorphism plays an important role in virtual relationships.

TABLE 1 Study 1A/1B: Descriptive statistics, reliability information and correlations among study variables

	Variable	M (SD)	α	1	2	3	4	5
						Correlations		
Study 1A								
1	Romantic anthropomorphism	5.00 (0.96)	.94	—	.42**	.46**	.03	−.18
2	Relationship authenticity	4.65 (1.26)	.91		—	.73**	.28*	−.05
3	Desire for real-world VA relationship	4.56 (1.27)	.94			—	.20	.03
4	Pre–post positive affect	−0.26 (0.76)	.92				—	−.09
5	Pre–post negative affect	−0.29 (0.54)	.84					—
Study 1B								
1	Romantic anthropomorphism	4.86 (1.01)	.93	—	.53**	.54**	.07	−.17
2	Relationship authenticity	4.87 (1.33)	.91		—	.60**	.27**	−.08
3	Desire for real-world VA relationship	4.21 (1.47)	.93			—	.13	−.10
4	Pre–post positive affect	−0.13 (0.62)	.88				—	−.01
5	Pre–post negative affect	−0.36 (0.53)	.83					—

Note: $N = 61$ women (Study 1A), $N = 104$ women (Study 1B). VA = virtual agent. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g. greater romantic anthropomorphism). For pre–post positive and negative affect, the α value represents the mean of the αs of the pre- and post-gameplay measures.

*$p < .05$, **$p < .01$.
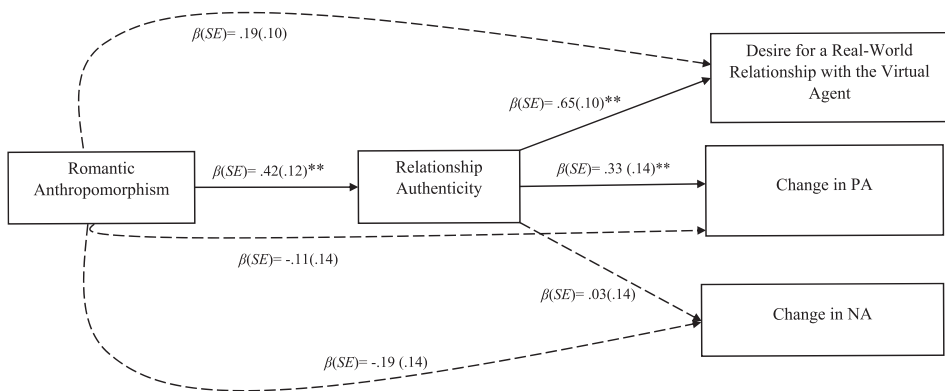
FIGURE 1 Direct and indirect associations between romantic anthropomorphism and desire for a real-world relationship with the virtual agent, change in PA and change in NA via relationship authenticity in study 1A. **$p < .01$

STUDY 2

Study 1A and 1B revealed robust links between romantic anthropomorphism and a range of outcomes via relationship authenticity. Study 2 aimed to build on these findings in two distinct ways. First, we aimed to replicate the previous models with a sample of single women, rather than a blended sample of single and partnered women, given that the former group should be more motivated to seek a
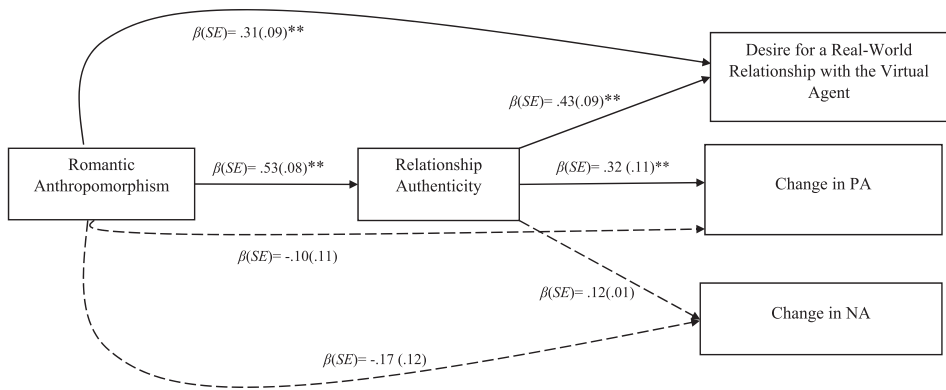
FIGURE 2   Direct and indirect associations between romantic anthropomorphism and desire for a real-world relationship with the virtual agent, change in PA and change in NA via relationship authenticity in study 1B. $**p<.01$

relationship with a new partner. We also examined in a new model whether the outcomes of a virtual romance (desire for a real-world relationship with the virtual agent and PA) influence real-world relationships. We know RVG play can make people want a real-world relationship (desire for a real-world relationship with the virtual agent) and feel good (PA). We examined whether these feelings in turn predicted how they interacted with real potential partners. In Study 2, we were able to recruit 78 participants in the time allotted for data collection, achieving statistical power of 0.67 for our mediation models (Schoemann et al., 2017).

Participants

Initially, we recruited 87 participants, but we removed nine participants from analyses due to incomplete questionnaires ($N = 5$) or having met the male confederate beforehand ($N = 4$). Thus, 78 single heterosexual women aged 18–33 years old ($M = 22.64$, $SD = 3.04$) participated. Participants identified as Asian ($N = 19$) or Caucasian ($N = 59$). All participants were native or proficient English speakers with no prior experience playing the RVG (i.e. *Choices: Stories You Play*). We recruited university students in return for 6 pounds.

Procedure

The procedure of Study 2 was similar to our previous studies. After completing the first two chapters of the RVG *Choices: Stories You Play* and questionnaires assessing romantic anthropomorphisms, relationship authenticity, desire for a real-world relationship with the virtual agent, and PA and NA, we invited participants to have a short (~5-minute) one-to-one video-recorded conversation with an attractive male confederate. Two male confederates were recruited, and their attractiveness ratings were pretested in a separate pilot sample. There were no significant differences between Confederate A's ($M = 6.84$, $SD = 1.62$) and Confederate B's ($M = 6.32$, $SD = 1.46$) attractiveness levels, $t(76) = 1.49$, $p = .14$. The confederate asked the participants to describe their ideal holiday and chatted until 5 minutes had

TABLE 2 Study 2: Descriptive statistics, reliability information and correlations among study variables

	Variable	M (SD)	α	1	2	3	4	5
				Correlations
1	Romantic anthropomorphism	5.02 (0.81)	.91	—	.30**	.60**	−.03	.02
2	Relationship authenticity	4.82 (1.09)	.86		—	.60**	.32**	.10
3	Desire for a real-world VA relationship	4.11 (1.28)	.91			—	.14	.06
4	Pre–post positive affect	−0.13 (0.64)	.84				—	−.16
5	Pre–post negative affect	−0.15 (0.50)	.78					—

Note: N = 78 single women. VA = virtual agent. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g. greater romantic anthropomorphism). For pre–post positive and negative affect, the α value represents the mean of the αs of the pre- and post-gameplay measures.

*p < .05, **p < .01.

elapsed. After participants left the interview room, they completed a brief exit questionnaire and were debriefed.

Exit questionnaire

Participants were asked two questions when they exited the interview room: 'To what extent do you think the interviewer is attractive?' and 'To what extent did you feel comfortable to talk with the interviewer?' on a 10-point scale (1 = *not at all*, 10 = *very attractive/comfortable*). Overall, confederates were considered attractive (M = 6.56, SD = 1.56) and the interaction was considered comfortable (M = 7.95, SD = 1.67).

Videotapes of the interaction were presented to two coders, blind to the hypotheses of the study. The two coders rated 'How flirtatious was the participant?' 'How happy was the participant?' and 'How relaxed was the participant?' with a 7-point scale (1 = *not at all*, 7 = *very much*). Kappa values from 0.41 to 0.60 indicate that the two coders had a moderate level of agreement for flirtatious (Kappa = 0.41, p < .001), happy (Kappa = 0.44, p < .001) and a fair level of agreement for relaxed (Kappa = 0.39, p < .001). Correlation analysis shows that three variables were highly correlated: relaxed and happy (r = .78), relaxed and flirtatious (r = .61) and happy and flirtatious (r = .72). Therefore, we combined the items to create an overall flirtatiousness score (a = .87).

RESULTS AND DISCUSSION

Descriptive statistics, reliability information and correlations among study variables are presented in Table 2. The data analytic strategy for our initial mediation models aimed at replicating our prior studies was the same as Study 1A/1B (see Figure 3).

Study 2 replicated the results of Study 1A/1B. Romantic anthropomorphism predicted desire for a real-world relationship with the virtual agent and change in PA—but not change in NA—via relationship authenticity.

We then examined how romantic anthropomorphism and romantic authenticity might predict human-human interactions. To test this parallel mediation model (Hayes, 2018; Model 81), the outcome variable for the analysis was subsequent real-world flirtatiousness (as coded by objective observers of the videotaped interactions) and the predictor variable was romantic anthropomorphism, romantic authenticity as the first mediator and desire for a real-world relationship with the virtual agent and PA change were the second mediators (see Figure 4).
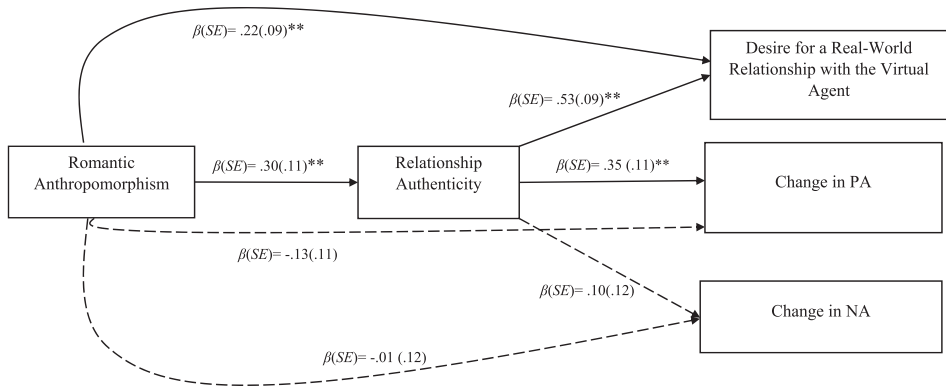
Indirect effect via Relationship Authenticity

Desire for a Real-World Relationship: $CI_{95\%}$ [.05, .37]

PA Change: $CI_{95\%}$ [.01, .28]

NA Change: $CI_{95\%}$ [-.05, .13]

FIGURE 3 Direct and indirect associations between romantic anthropomorphism and desire for a real-world relationship with the virtual agent, change in PA and change in NA via relationship authenticity in study 2. $**p < .01$

The results from these latter models are clear; there was no link between perceptions of the virtual relationship and subsequent interactions with a male confederate. Despite romantic anthropomorphism and relationship authenticity appearing to be robust predictors of desire for a relationship and positive emotions across three studies, they failed to predict our real-world outcomes.

INTERNAL META-ANALYSIS

We combined the three datasets for an internal meta-analysis of multiple mediation models. This new dataset contains 243 participants and exceeds the recommended number of participants for a model of this complexity (i.e. $N = 106$; see Tabachnick & Fidell, 2014) and achieved statistical power of 0.99 (Schoemann et al., 2017). The model is presented in Figure 5.

The internal meta-analysis revealed that, consistent with our individual studies, romantic anthropomorphism predicted desire for a real-world relationship with the virtual agent and change in PA—but not change in NA—via relationship authenticity. The pattern of this model was also confirmed with women who are not in a relationship dataset. Additionally, as an exploratory analysis we conducted a reverse mediation model, switching the positions of anthropomorphism and relationship authenticity. This reverse mediation model tested the idea that feelings of authenticity encourage anthropomorphism, leading to change in PA, NA and desire for a real-world relationship with the virtual agent (see Figure 6).

The reverse mediation model did not explain the data as well as our original mediation model. Specifically, while the reverse model replicated the effects for desire for a real-world relationship, it failed to replicate the effects for PA. In short, the results of the meta-analysis confirm the individual findings of each study and provide us with a more robust estimate of the model parameters, as well as demonstrate that our initial model best fit the data.

Auxiliary exploratory analysis

In Studies 1A/1B, we had some participants who were single and others who were in a romantic relationship. In Study 2, all participants were single. At the suggestion of an anonymous reviewer, in our dataset
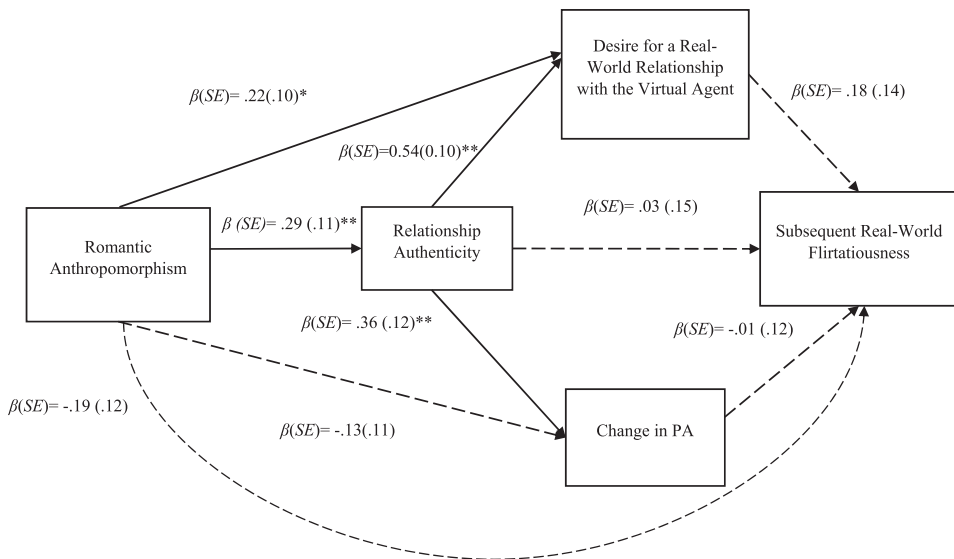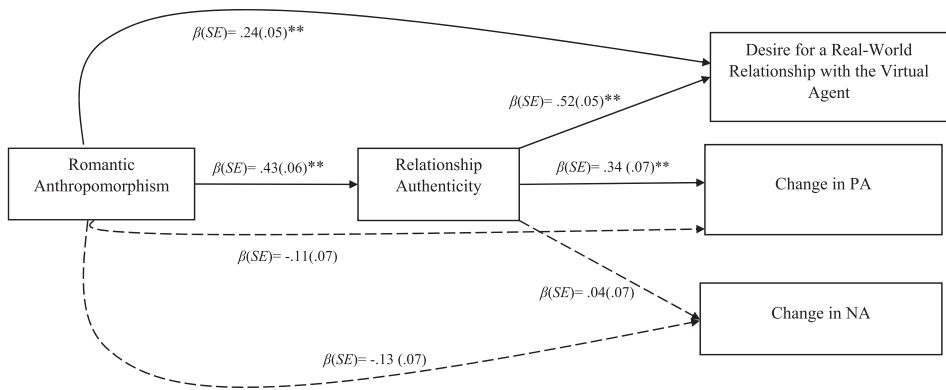
F I G U R E 4 Direct and indirect associations between romantic anthropomorphism and desire for a real-world relationship with the virtual agent, change in PA, and change in NA, subsequent real-world flirtatiousness via relationship authenticity in study 2. *$p < .05$, **$p < .01$

combining all three studies we ran auxiliary exploratory analyses testing moderated mediation models to examine whether our primary mediation paths varied as a function of participants' relationship status (−1 = single, 1 = in a relationship). We ran these models using Model 59 of the PROCESS macro for SPSS (Hayes, 2018). Relationship status did not moderate any links in the models. Importantly, all primary mediation results remained robust when relationship status was tested. The results of these analyses are reported in full in Appendix S1 (see https://bit.ly/3jYNZdA).

GENERAL DISCUSSION

Across three studies and an internal meta-analysis, we examined people's romantic anthropomorphism in the context of virtual relationships. The findings regarding relationship experiences were highly consistent: greater anthropomorphism of the virtual agent predicted greater relationship authenticity, and this, in turn, robustly predicted desire for a relationship with virtual agent in the real world and increased PA. However, we did *not* find evidence that romantic anthropomorphism, relationship authenticity, desire for a real-world relationship with a virtual romantic partner or change in PA were associated with behaviour in a subsequent interpersonal human-human interaction.

Prior work has focused heavily on factors that predict the extent to which people anthropomorphize others (Bartz et al., 2016; Burgess et al., 2018; Epley et al., 2008). For example, we know that people anthropomorphize when they feel lonely (Epley et al., 2008; Eyssel & Reich, 2013; Feng, 2016). Our work inverts this traditional approach by moving from what predicts anthropomorphism into what

FIGURE 5 Direct and indirect associations between romantic anthropomorphism and desire for a real-world relationship with the virtual agent, change in PA and change in NA via relationship authenticity in meta-analysis. **$p < .01$

anthropomorphism predicts, showing that judging a target (virtual agent) to be 'human-like' is associated with judging a relationship with that target to feel more 'real' and authentic. This additional step is sensible from a SEEK model perspective (Epley et al., 2007). For instance, while it is known that loneliness predicts greater anthropomorphism (Epley et al., 2008; Eyssel & Reich, 2013; Feng, 2016), it is unlikely that simply believing that an entity is human-like will make a person feel less lonely. Rather, it is more likely that the relationship *afforded* by this perceived human-like entity is what reduces loneliness. In this way, our work helps move the literature towards understanding the social consequences of anthropomorphism.

The core pathway uncovered across these three studies reveals that romantic anthropomorphism is linked with outcomes via relationship authenticity (i.e. people feeling that their connection and relationship with the virtual agent was genuine). This finding suggests that it is not anthropomorphism per se—there is no reliable direct link between anthropomorphism and outcomes—but rather how anthropomorphism feeds through relationship authenticity that predicts a desire for a real-world relationship with a virtual agent and positive mood. This result is in some ways unsurprising, as authenticity is known to play an important role in human-human relationship outcomes (Lopez & Rice, 2006; Wickham, 2013). Nevertheless, identifying this central mediating variable is an important step in advancing the literature on anthropomorphism within the social domain.

We hypothesized that single women's romantic anthropomorphism, virtual relationship experiences and mood might predict their interactions with a male confederate. We did not find an association between playing RVGs and any interactions with real potential partners. The association between video game playing and subsequent behaviour is complex. For example, research has shown a link between playing violent video games and increased aggressive thoughts and behaviours (e.g. Anderson et al., 2010; Calvert et al., 2017; Denson et al., 2020; Greitemeyer & Mügge, 2014). Recently, however, several studies have found no causal link between violent video games and subsequent aggression (e.g. Ferguson et al., 2020; Przybylski & Weinstein, 2019), or even that increased play can reduce aggression (Lee et al., 2021). Given that we saw no evidence that playing romantic video games makes people more romantic, our results might align more closely with this second school of thought that there is no robust link between games and real-world behaviour. One alternative possibility is that our effect failed to emerge as a function of the type of game participants played. In all three studies participants played a 'cartoon-like' video game with largely static, 2D characters (*Castaway*, *Choices*). Work on violent video
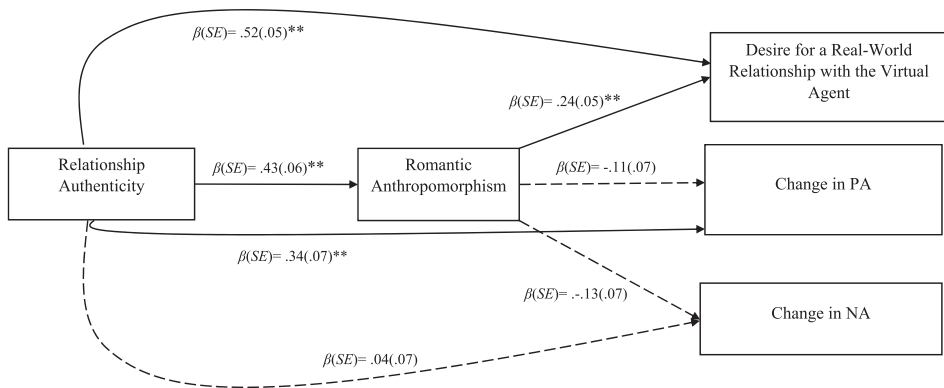
FIGURE 6 Direct and indirect associations between relationship authenticity and desire for a real-world relationship with the virtual agent, change in PA and change in NA via romantic anthropomorphism in meta-analysis. **p < .01

games has robustly shown that realistic violence (e.g. *Call of Duty*) is more predictive of later aggression than unrealistic, 'cartoon' violence (e.g. *Super Smash Bros.*, Calvert et al., 2017). If the same relationship holds for romantic video games, then more realistic romantic interactions may be more predictive of later, real-world romantic behaviour. This possibility awaits future examination.

LIMITATIONS AND FUTURE DIRECTIONS

We recruited women across all studies because the RVGs that we employed primarily target heterosexual women. However, there are certainly a range of RVGs that target men (e.g. *LovePlus, Tokimeki Memorial*), which warrant further investigation. Prior anthropomorphism work has typically found little to no gender differences in anthropomorphism (e.g. Chin et al., 2004); however, it is possible that men and women would differ in *romantic* anthropomorphism and their relationship experiences with a virtual agent. Our participants in Study 2 completed their interactions with the confederate in a laboratory space. Whilst this facilitated reliable and unobtrusive recording of the interaction, and we took care to make the room as comfortable as possible, it is not as realistic as a naturally occurring interaction.

Our studies were conducted within-subjects. We adopted this approach as it mirrors the natural experience of players; they have baseline desires and emotions, which can be altered through gameplay. Although we cannot firmly establish causality, the failure of the reverse mediation model to yield similar effects to our core model does lend support to a link from anthropomorphism to affect and desire for a relationship occurring via relationship authenticity. To more robustly establish the causal relationship between these variables, future work should manipulate anthropomorphism directly (e.g. Waytz et al., 2010) and include a control condition. For instance, we know that certain targets are more likely to be anthropomorphized than others—targets which seem human-like in both appearance (Schroeder & Epley, 2016) and movement (Morewedge et al., 2007)—and future work could systematically vary the extent to which a romantic interest is likely to elicit anthropomorphism. This presents an important future direction for this field.

Our studies measured relationship authenticity as a mediating variable. Relationship authenticity is close to an existing construct in the human-computers interaction literature called social presence,

the feeling that an interaction with a virtual entity is like an interaction with a real person (Short et al., 1976). Virtual entities differ in their ability to produce social presence, and anthropomorphism is one factor, which increases this experience (Araujo, 2018; Choi et al., 2001; Kang & Watt, 2013; Nowak & Biocca, 2003). Importantly, prior work on social presence has been dominated by the study of avatars or virtual representations piloted by real people rather than autonomous virtual agents. Future work could seek to delineate between a virtual agent's ability to generate social presence versus a more holistic judgement that the relationship feels authentic.

We considered some of the individual differences established in the previous literature on anthropomorphism (e.g. loneliness, attachment orientations) in auxiliary exploratory analyses (see Appendix S1: https://bit.ly/3jYNZdA); however, the results of Study 1A revealed that these measures were unrelated to our key variables (e.g. romantic anthropomorphism). However, there may be other individual difference variables that could play a role in the context of virtual relationships. For example, extraversion predicts people's tendency to anthropomorphise robots (Kaplan et al., 2018). The novelty of forming relationships with virtual agents may also appeal to individuals scoring higher on openness to experience. It would be beneficial for future research to examine whether personality traits or other individual differences influence whether people engage in romantic anthropomorphism.

We examined romantic anthropomorphism via the medium of RVGs. Due to their interactive nature, romantic games may be particularly good at fostering anthropomorphism and virtual romances. Romantic anthropomorphism, however, should not be limited to video games. In Japan, the phenomenon of developing romantic feelings and attachment towards a virtual character is sufficiently common that it has its own label ('Moe', 萌え). Importantly, this emotion is frequently experienced with comics and animated characters, as well as video games (Matsubara & Sato, 2013). This points to the scope of romantic anthropomorphism extending well beyond video games and into other domains containing virtual agents.

In our studies, effects consistently emerged for PA but not NA. It may be that building an in-game relationship with a virtual agent was an energizing experience for participants (cf. Luke et al., 2012). This idea dovetails with prior research demonstrating that feelings of love, connection and romantic excitement are often tied to PA in particular (e.g. Dush & Amato, 2005; Laurenceau et al., 2005; Stanton et al., 2014). On the other hand, other relationship experiences not explored in the present research (e.g. a virtual agent being responsive during times of distress; cf. Birnbaum et al., 2016) may downregulate NA. We expect the links between virtual relationships and affect to become clearer as more work is done in this area.

CONCLUSION

People want to love and be loved, desires that can now be potentially fulfilled by virtual agents. Our work examined whether anthropomorphism plays an unrecognized role in these virtual romances. Across three studies, we showed that anthropomorphism predicts relationship experiences with a virtual agent, as well as the desire for real-world virtual agent relationships and positive mood via relationship authenticity. The relationship effects, however, stayed in the virtual domain; virtual romances did not predict subsequent real-life romantic interactions. Most romantic relationship research has been focused on human-human social domains, and most previous anthropomorphism research has concentrated on platonic anthropomorphism. Our research helps to cultivate a new field bridging the gap between anthropomorphism and relationship science.

AUTHOR CONTRIBUTIONS

ACKNOWLEDGEMENT

CONFLICT OF INTEREST

The authors declare no conflicts of interest with respect to the authorship or the publication of this article.

DATA AVAILABILITY STATEMENT

Data are available at OSF https://bit.ly/3L4Bs4j

ORCID

Mayu Koike 🔟 https://orcid.org/0000-0002-5922-6720

REFERENCES

Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., Rothstein, H. R., & Saleem, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and Western countries: A meta-analytic review. *Psychological Bulletin*, *136*(2), 151–173. https://doi.org/10.1037/a0018251

Araujo, T. (2018). Living up to the chatbot hype: The influence of anthropomorphic design cues and communicative agency framing on conversational agent and company perceptions. *Computers in Human Behavior*, *85*, 183–189. https://doi.org/10.1016/j.chb.2018.03.051

Bartz, J. A., Tchalova, K., & Fenerci, C. (2016). Reminders of social connection can attenuate anthropomorphism: A replication and extension of Epley, Akalis, Waytz, and Cacioppo (2008). *Psychological Science*, *27*(12), 1644–1650. https://doi.org/10.1177/0956797616668510

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497. https://doi.org/10.1037/0033-2909.117.3.497

Birnbaum, G. E., Mizrahi, M., Hoffman, G., Reis, H. T., Finkel, E. J., & Sass, O. (2016). What robots can teach us about intimacy: The reassuring effects of robot responsiveness to human disclosure. *Computers in Human Behavior*, *63*, 416–423. https://doi.org/10.1016/j.chb.2016.05.064

Burgess, A. M., Graves, L. M., & Frost, R. O. (2018). My possessions need me: Anthropomorphism and hoarding. *Scandinavian Journal of Psychology*, *59*(3), 340–348. https://doi.org/10.1111/sjop.12441

Calvert, S. L., Appelbaum, M., Dodge, K. A., Graham, S., Nagayama Hall, G. C., Hamby, S., Fasig-Caldwell, L. G., Citkowicz, M., Galloway, D. P., & Hedges, L. V. (2017). The American Psychological Association task force assessment of violent video games: Science in the service of public interest. *American Psychologist*, *72*(2), 126–143. https://doi.org/10.1037/a0040413

Chin, M. G., Sims, V. K., Clark, B., & Lopez, G. R. (2004). Measuring Individual Differences in Anthropomorphism Toward Machines and Animals. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *48*(11), 1252–1255.

Choi, Y. K., Miracle, G. E., & Biocca, F. (2001). The effects of anthropomorphic agents on advertising effectiveness and the mediating role of presence. *Journal of Interactive Advertising*, *2*(1), 19–32. https://doi.org/10.1080/15252019.2001.10722055

Denson, T. F., Dixson, B. J., Tibubos, A. N., Zhang, E., Harmon-Jones, E., & Kasumovic, M. M. (2020). Violent video game play, gender, and trait aggression influence subjective fighting ability, perceptions of men's toughness, and anger facial recognition. *Computers in Human Behavior*, *104*, 106175.

Dush, C. M. K., & Amato, P. R. (2005). Consequences of relationship status and quality for subjective well-being. *Journal of Social and Personal Relationships*, *22*(5), 607–627. https://doi.org/10.1177/0265407505056438

Epley, N. (2018). A mind like mine: The exceptionally ordinary underpinnings of anthropomorphism. *Journal of the Association for Consumer Research*, *3*(4), 591–598. https://doi.org/10.1086/699516

Epley, N., Waytz, A., & Cacioppo, J. T. (2007). On seeing human: A three-factor theory of anthropomorphism. *Psychological Review*, *114*(4), 864. https://doi.org/10.1037/0033-295X.114.4.864

Epley, N., Waytz, A., Akalis, S., & Cacioppo, J. T. (2008). When we need a human: Motivational determinants of anthropomorphism. *Social Cognition*, *26*(2), 143–155. https://doi.org/10.1521/soco.2008.26.2.143

Eyssel, F., & Reich, N. (2013). *Loneliness makes my heart grow fonder (of robots)? On the effects of loneliness on psychological anthropomorphism.* Proceedings of the 8th ACM/IEEE conference on human-robot interaction, 121–122.

Feng, W. (2016). When lonely people encounter anthropomorphic products. *Social Behavior and Personality: An International Journal*, *44*(10), 1649–1660. https://doi.org/10.2224/sbp.2016.44.10.1649

Ferguson, C. J., Copenhaver, A., & Markey, P. (2020). Reexamining the findings of the American Psychological Association's 2015 task force on violent media: A meta-analysis. *Perspectives on Psychological Science*, *15*(6), 1423–1443. https://doi.org/10.1177/1745691620927666

Gere, J., & Schimmack, U. (2013). When romantic partners' goals conflict: Effects on relationship quality and subjective well-being. *Journal of Happiness Studies*, *14*(1), 37–49. https://doi.org/10.1007/s10902-011-9314-2

Gray, H. M., Gray, K., & Wegner, D. M. (2007). Dimensions of mind perception. *Science*, *315*(5812), 619. https://doi.org/10.1126/science.1134475

Greitemeyer, T., & Mügge, D. O. (2014). Video games do affect social outcomes: A meta-analytic review of the effects of violent and prosocial video game play. *Personality and Social Psychology Bulletin*, *40*(5), 578–589. https://doi.org/10.1177/0146167213520459

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). Guilford Press.

Im Shin, H., & Kim, J. (2018). My computer is more thoughtful than you: Loneliness, anthropomorphism and dehumanization. *Current Psychology*, *39*(2), 445–453. https://doi.org/10.1007/s12144-018-9975-7

Jakobek, J. (2019). *You are never lonely with a robot: A qualitative content analysis on the use of anthropomorphic technologies (Doctoral dissertation)*. https://qspace.library.queensu.ca/bitstream/handle/1974/26174/Jakobek_Julianne_S_201905_MA.pdf?sequence=2

Kang, S. H., & Watt, J. H. (2013). The impact of avatar realism and anonymity on effective communication via mobile devices. *Computers in Human Behavior*, *29*, 1169–1181. https://doi.org/10.1016/j.chb.2012.10.010

Kaplan, A. D., Sanders, T., & Hancock, P. A. (2018). The Relationship Between Extroversion and the Tendency to Anthropomorphize Robots: A Bayesian Analysis. *Frontiers in Robotics and AI*, *5*, 135.

Koike, M., Loughnan, S., Stanton, S. C. E., & Ban, M. (2020). What factors attract people to play romantic video games? *PLoS One*, *15*(4), e0231535. https://doi.org/10.1371/journal.pone.0231535

Koike, M., & Loughnan, S. (2021). Virtual relationships: Anthropomorphism in the digital age. *Social and Personality Psychology Compass.*, *15*(6), e12603. https://doi.org/10.1111/spc3.12603

Kwok, C., Grisham, J. R., & Norberg, M. M. (2018). Object attachment: Humanness increases sentimental and instrumental values. *Journal of Behavioral Addictions*, *7*(4), 1132–1142. https://doi.org/10.1556/2006.7.2018.98

Laurenceau, J.-P., Troy, A. B., & Carver, C. S. (2005). Two distinct emotional experiences in romantic relationships: Effects of perceptions regarding approach of intimacy and avoidance of conflict. *Personality & Social Psychology Bulletin*, *31*(8), 1123–1133. https://doi.org/10.1177/0146167205274447

Lee, E. J., Kim, H. S., & Choi, S. (2021). Violent video games and aggression: Stimulation or catharsis or both? *Cyberpsychology, Behavior and Social Networking*, *24*(1), 41–47. https://doi.org/10.1089/cyber.2020.0033

Lopez, F. G., & Rice, K. G. (2006). Preliminary development and validation of a measure of relationship authenticity. *Journal of Counseling Psychology*, *53*(3), 362. https://doi.org/10.1037/0022-0167.53.3.362

Luke, M. A., Sedikides, C., & Carnelley, K. (2012). Your love lifts me higher! The energizing quality of secure relationships. *Personality and Social Psychology Bulletin*, *38*(6), 721–733. https://doi.org/10.1177/0146167211436117

Mainichi. (2010). https://web.archive.org/web/20091201015607/http://mainichi.jp/enta/mantan/archive/news/2009/09/12/20090912mog00m200004000c.html

Marsh, J., & Ogura, J. (2017). https://edition.cnn.com/2016/11/21/asia/romance-gaming-japan/index.html

Maslow, A. H. (1968). *Toward a psychology of being*. Van Nostrand.

Matsubara, N., & Sato, T. (2013). A study on a perspective on a candidate, value and emotion of "MOE". *Ritsumeikan Journal of Human Sciences*, *26*, 21–34.

Mikulincer, M., & Shaver, P. R. (2016). Adult attachment and emotion regulation. *Handbook of attachment: Theory, research, and clinical applications*, *3*, 507–533.

Morewedge, C., Preston, J., & Wegner, D. (2007). Timescale bias in the attribution of mind. *Journal of Personality and Social Psychology*, *93*(1), 1–11. https://doi.org/10.1037/0022-3514.93.1.1

Neave, N., Tyson, H., McInnes, L., & Hamilton, C. (2016). The role of attachment style and anthropomorphism in predicting hoarding behaviours in a non-clinical sample. *Personality and Individual Differences*, *99*, 33–37. https://doi.org/10.1016/j.paid.2016.04.067

Nowak, K. L., & Biocca, F. (2003). The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *12*(5), 481–494. https://doi.org/10.1162/105474603322761289

Nowak, K. L., & Rauh, C. (2005). The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction. *Journal of Computer-Mediated Communication*, *11*(1), 153–178.

Przybylski, A. K., & Weinstein, N. (2019). Violent video game engagement is not associated with adolescents' aggressive behaviour: Evidence from a registered report. *Royal Society Open Science*, *6*(2), 171474. https://doi.org/10.1098/rsos.171474

Rani, A. (2013). BBC news website: https://www.bbc.co.uk/news/magazine-24614830

Riek, L. D., Rabinowitch, T. C., Chakrabarti, B., & Robinson, P. (2009). *How anthropomorphism affects empathy toward robots*. In Proceedings of the 4th ACM/IEEE international conference on human-robot interaction (pp. 245–246).

Sakaluk, J. K. (2016). Exploring small, confirming big: An alternative system to the new statistics for advancing cumulative and replicable psychological research. *Journal of Experimental Social Psychology*, *66*, 47–54. https://doi.org/10.1016/j.jesp.2015.09.013

Salem, M., Eyssel, F., Rohlfing, K., Kopp, S., & Joublin, F. (2013). To err is human (−like): Effects of robot gesture on perceived anthropomorphism and likability. *International Journal of Social Robotics*, *5*(3), 313–323.

Sankei. (2010). https://web.archive.org/web/20100812062400; http://sankei.jp.msn.com/entertainments/game/090910/gam0909100759001-n1.htm

Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science*, *8*(4), 379–386. https://doi.org/10.1177/1948550617715068

Schroeder, J., & Epley, N. (2016). Mistaking minds and machines: How speech affects dehumanization and anthropomorphism. *Journal of Experimental Psychology: General*, *145*(11), 1427. https://doi.org/10.1037/xge0000214

Selcuk, E., Gunaydin, G., Ong, A. D., & Almeida, D. M. (2016). Does partner responsiveness predict hedonic and eudaimonic well-being? A 10-year longitudinal study. *Journal of Marriage and Family*, *78*(2), 311–325. https://doi.org/10.1111/jomf.12272

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. Wiley.

Slatcher, R. B., & Selcuk, E. (2017). A social psychological perspective on the links between close relationships and health. *Current Directions in Psychological Science*, *26*, 16–21. https://doi.org/10.1177/0963721416667444

Soanes, C., & Stevenson, A. (2005). *Oxford dictionary of English* (2nd ed.). Oxford University Press.

Stanton, S. C., Campbell, L., & Loving, T. J. (2014). Energized by love: Thinking about romantic relationships increases positive affect and blood glucose levels. *Psychophysiology*, *51*(10), 990–995. https://doi.org/10.1111/psyp.12249

Tabachnick, B. G., & Fidell, L. S. (2014). *Using multivariate statistics*. Pearson Education Limited.

Timpano, K. R., & Shaw, A. M. (2013). Conferring humanness: The role of anthropomorphism in hoarding. *Personality and Individual Differences*, *54*(3), 383–388. https://doi.org/10.1016/j.paid.2012.10.007

Uchino, B. N. (2006). Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine*, *29*, 377–387. https://doi.org/10.1007/s10865-006-9056-5

Waytz, A., Cacioppo, J., & Epley, N. (2010). Who sees human? The stability and importance of individual differences in anthropomorphism. *Perspectives on Psychological Science*, *5*(3), 219–232. https://doi.org/10.1177/1745691610369336

Wickham, R. E. (2013). Perceived authenticity in romantic partners. *Journal of Experimental Social Psychology*, *49*(5), 878–887. https://doi.org/10.1016/j.jesp.2013.04.00

Xu., T. (2019). *China moves to monetize its growing female gamer market*. https://technode.com/2019/09/24/china-moves-to-monetize-its-growing-female-gamer-market/

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Koike, M., Loughnan, S., & Stanton, S. C. E. (2023). Virtually in love: The role of anthropomorphism in virtual romantic relationships. *British Journal of Social Psychology*, *62*, 600–616. https://doi.org/10.1111/bjso.12564