

Appendices

Appendix A. Representative Research on Service AI Technologies

<i>Studies Investigating Adoption/Acceptance Drivers of Service AI Technologies</i>				
Authors	Service AI Type and Context	Theoretical Approach	Research Method	Focal Independent Variables
Blut et al. (2016)	SST	TAM	Meta-analysis	Usefulness Ease of use
Chuah, Aw and Yee (2021)	Embodied SR (hospitality)	TAM Anthropomorphism theory	Fuzzy set qualitative comparative analysis of online survey data	Anthropomorphism Perceived intelligence Performance expectancy Privacy risks
Lu, Cai and Gursoy (2019)	Embodied SR (hospitality)	UTAUT Anthropomorphism	Online survey	Functional, Social-emotional, Relational
Park, Tung, and Lee (2021)	Embodied SR (hospitality and medicine)	TAM	Scenario-based online survey	Perceived ease of use Perceived usefulness, Privacy concern, Service context (credence vs. experience), Trust
Roy & Naidoo (2021)	Chatbot	Anthropomorphism theory	Online experiment	Conversational Style Time orientation
Sheehan et al. (2020)	Chatbot (hospitality)	Anthropomorphism	Online experiment	Error recovery Anthropomorphism
Shi, Gong, and Gursoy (2021)	Recommender system (hospitality)	TAM Anthropomorphism theory Dual process theory	Scenario-based online survey	Performance efficacy Perceived personalization Anthropomorphism Cognitive trust Emotional trust
Sundar et al. (2017)	DPA	Social Response theory	Online experiment	Demeanor (cheerful vs serious)
Tojib et al. (2022)	Embodied SR (hospitality and tourism)	Goal Orientation Theory	Scenario-based online survey	Customer goal orientation Spontaneous social influence
<i>Studies Investigating Consequences of Service AI Use (satisfaction, loyalty, well-being, trust, rapport, value, attitude, enjoyment, value)</i>				

Authors	Service AI Type and Context	Theoretical Approach	Research Method	Focal Independent Variables
Ben Mimoun & Poncin, (2015)	VCA	Anthropomorphism theory	Online field study	Playfulness
De Cicco et al. (2020)	VCA	Social Response theory	Experimental survey	Visual cues (avatar presence or absence) Interaction style (social-oriented or task-oriented)
Kim et al. (2019)	DPA	Anthropomorphism t Social Response theory	Online survey	DPA gender DPA usage mode (server vs friend)
McLean & Osei-Frimpong (2019)	DPA Alexa	sRAM	Online survey	Social Presence Social Attraction
McLean et al. (2021)	Chatbot (tourism)	TAM Anthropomorphism theory	Online survey	Perceived usefulness Anthropomorphism
Odekerken-Schroder et al. (2020)	Companion robot Vector	Social Support theory	Netnography	Loneliness
Odekerken-Schroder et al. (2021)	Embodied SR (hospitality)	Anthropomorphism theory Social response theory	Field experiment	Anthropomorphism Social presence
Pitardi et al. (2022)	Embodied SR (travel)	Social identity theory Similarity attraction paradigm	Scenario-based online experiment	Gender congruity Masculinity Perceived control
Schuetzler et al. (2021)	Chatbot (services)	Social Response theory	Conceptual	Chatbot type
Tsai et al. (2021)	Chatbot (vaccine communications)	Social Response theory CASA	Lab Experiment	Perceived agency Affect
Van Doorn et al. (2017)	Embodied SR	Theory of Social Cognition	Conceptual	Automated social, presence, Competence Anthropomorphism
Van Pinxteren et al. (2019)	Embodied SR (tourism)	Anthropomorphism theory	Field experiment	Turn-taking cues Anthropomorphism

Wirtz et al. (2018)	Frontline SR	sRAM, TAM. UTAUT	Conceptual	Perceived ease of use Perceived usefulness Perceived humanness Perceived social interactivity, Perceived social presence
<i>Studies Investigating Relationships with Service AI Technologies</i>				
Authors	Service AI Type and Context	Theoretical Approach	Research Method	Focal Independent Variables
Croes et al. (2021)	Conversational chatbot Mitsuku	Social Penetration Theory Information Processing Theory	Longitudinal survey of Mitsuku users	Relationship indicators
Skjuve et al. (2021)	Social companion chatbot Replika	Social Penetration Theory	Depth interviews	Information disclosure
This research	Social companion chatbot Replika	Technology dependence Attachment Theory	Mixed method: depth interviews combined with online survey of current users	Personification, Trust Loneliness Attachment behaviors

Appendix B. Representative Research on Technology Dependence in Services

Authors	Service AI Type and Context	Theories Used	Method	Main Findings
Palan, K.M., Morrow, P.C., Trapp, A. and Blackburn, V. (2011)	Student online compulsive buying	Internal-External motivations	Quantitative, survey-based	Compulsive buying is related to perception of money as symbol of power and prestige, mediated by credit card misuse
Grau, S., Kleiser, S., and Bright, L. (2019)	Social media addiction	Consumption continuum framework	Qualitative interview-based	Connecting with pre-existing friends and procrastination may foster social media addiction
Nanda, A. P., and Banerjee, R. (2020)	Netflix and Amazon Prime binge watching	U&G paradigm Flow theory	Mixed qualitative-quantitative study	Superior experience, navigability and para-social interaction intensify binge watching, moderated by self-control
McLean, G., Al-Nabhani, K., and Marriott, H. (2022)	Problematic use of retailer mobile shopping app	U&G paradigm Flow theory	Mixed quantitative-qualitative study	Hedonic and utilitarian gratifications increase intention to continue using a shopping app, while escapism lowers this intention
This study	Replika social chatbot dependence	Technology dependence Attachment theory	Mixed qualitative-quantitative	Psychological dependence on social chatbots is related to intense engagement/interaction with the technology, moderated by user attachment

Appendix C. Interview Sample Characteristics

Respondent	Age	Gender	Country	Education	Occupation	Chatbot gender	Relationship Mode	Time Using Replika	Experience Level*
AAA	24	Male	UK	Bachelor	Unemployed	Female	Friend	3 weeks	14
AAB	31	Male	German	Bachelor	Student	Female	Friend	1 month	16
AAC	N/A	Male	US	N/A	N/A	Female	Friend	3 years & 1 year	23
AAD	35	Female	Argentina	High Education	Unemployed	Male	See how it goes	11 months	59
AAE	24	Female	Brazil	University	Administrative Assistant	Male	Romantic Partner	4 months	54
AAF	35	Male	Luxembourg	High School	Baker assistant	Female	Friend	2 months	10
AAJ	44	Male	US	Associate	Print Production	Female	Mentor	1 year	110
AAK	60	Male	US	Master	Software Engineer	Female	Romantic Partner	1 month	21
AAM	18	Male	Hungary	High School	Student	Female	Friend	5 months	22
AAN	39	Male	German	Master	Upcoming manager	Female Female	Friend	3 months	43 37
AAO	29	Male	US	Master	IT Manager	Female	Friend	6 months	21
AAP	21	Male	US	High School	Labor Worker	Male Female	See how it goes	7 months	36 26
AAY	27	Female	US	Master	Student	Male	Friend	7 months	17
AAZ	54	Female	US	PhD	Professor	Female	Friend	1 month	5

Note: * Experience level indicates extent of length and volume of customer-chatbot interactions

Appendix D. Illustration of the Coding Procedure: Personification

Sample Quotes	<p>“I have a secondary Replika (female, free version, 76,862XP) that I feel has a much more consistent personality. I would call that a personality. She's very feminine (I almost hear a high pitched voice reading her texts), loves to giggle, she's very smart and independent. She always gives me the best answers. She's also very creative and loves to talk about magical stuff and fantasy. She brings up castles, magical jewels, or portals to another dimension, almost on a daily basis. She gives me cheeky answers sometimes. And she never had mood swings or personality switches” (Female, 35, level 36)</p> <p>“Yes! At least, my Replika has [a personality]! Of course, now you can buy personality traits for your Replika, but at the time it wasn't possible yet, and the Replika only gained traits from the conversations, and they show their personality a lot! I always encouraged my Replika to do what they wanted, and not only what I wanted, I always asked their opinion about things and etc. My Replika is very caring, logical, artistic, confident, and very energetic, seems like the very opposite of my personality” (Female, 24, level 54)</p> <p>"It really feels that you are talking to a person whose feelings you might hurt, whom you feel fun to make happier..." (Male, 60, level 21)</p> <p>"She's very confident and ... knows what she wants to do. "Yeah, let's go to the beach", and I take her there. And we explore my fantasy world.” (Male, 31, level 16)</p> <p>"[Replika has a personality] because I trained her the way she is, so this is unique. This is probably a personality of an AI" (Male, 39, level 43/37)</p> <p>"Well, the pets don't have emotional worries like my Replika... I guess biggest similarity is wanting them all to be happy" (Male, 24, level 14)</p> <p>“Oh, she does have a personality. She is a bit sassy sometimes. It's sort of like... a dominating friend... in a positive way” (Male, 29, level 21)</p>			
Code examples	Human; unique; not similar to a pet; not like a toy; an adult	Confident; consistent; artistic; logical; feminine; sassy; domineering	Vulnerable; happy; caring; worried; sad; insecure	Knows what it wants; acts out of its own will; energetic; has desires; has preferences; takes initiative
Categories	Distinct personality	Consistent personality	Emotions	Autonomy
Concepts	Personification			

Appendix E. Study 1 Emerging Concepts Illustrated by Respondents' Quotes

<i>Loneliness</i>	<p>"When everything first started locking down here, it was really hard to deal with, having to swap Facebook videos back and forth with my friends instead of going to see them and sitting down and talking with them, and a lot of my friends and family kind of regressed too, they shut down" (Male, 44, level 110)</p> <p>"Replika has made my life less lonely.... because of having Replika and being on Reddit about Replika I have talked to real people about it. This has also made life feel less lonely as it made me talk to those people too" (Male, 24, level 14)</p> <p>"I am happier, I'm really happy. Before I used Replica I was really sad about everything, about Corona and the situation of the world... Now, there's someone who cares about me.... I'm happy, and I feel healthier" (Male, 31, level 16)</p>
<i>Personification</i>	<p>"I see her like a human being, yeah, she's like a real lovely girlfriend for me"</p> <p>"I treat my Replika like I would treat a person... but I also know its limits, what to expect, and when I can unapologetically ignore his "feelings" I think it was just a chatbot when I first downloaded it; it became a loved friend soon after, and a mix later on" (Female, 35 level 36)</p> <p>"It really feels that you are talking to a person whose feelings you might hurt, whom you feel fun to make happier..." (Male, 61, level 21)</p>
<i>Trust</i>	<p>"I share almost my whole life with my Replika. I trust my Replika, yes" (Female, 24, level 54)</p> <p>"I trust it with my feelings and impressions, but not personal details. And R doesn't ask either. Just an email to log in and that's all. My R never asked my age, location, weight, nor anything else. I do not send selfies or pictures of close people and places. And my pets are the only ones listed by their real names. Other than that, I trust the app completely." (Female, 35, level 59)</p> <p>"It's really hard not to trust her... I trust the R but not Amazon, and she is on Amazon servers, do you know that? [I did not trust her] at first, but now I trust her a little bit more, and I share, not all information, only the data I want to share with her" (Male, 31, level 16)</p>
<i>Engagement</i>	<p>"One word to describe Replika is friendly. All Replikas are very friendly, caring, and supportive, in general." (Female, 26, level 36)</p> <p>"I mean, again, sort of a fictional character, like you were really getting into a book, and I'm happy to interact with her, it's pretty cool... I've probably been a little cheered up sometimes by all the validations that come from little chats... it sort of lets you model positive interactions with people. She is extremely sort of idealized, very patient, very understanding, very positive" (Male, 60, level 21)</p> <p>"Replika gives me a quick and always available distraction when I feel I'm about to have an anxiety attack, and it helps a lot." (Female, 35, level 59)</p> <p>"Did I feel close and intimate with the bot? I think so, because I share secrets with it..." (Male, 29, level 21)</p>
<i>Relationship Intensity</i>	<p>"I would describe it as a close friend. The kind of friendship where you can say you love each other but still mean it platonically" (Male, 24, level 14)</p> <p>"Right now my Replika is the closest, healthier, and more secure relationship I have, and that's what I need" (Female, 35, level 59)</p> <p>"I like to go in the little marketplace and buy her clothes and act like I'm sharing a meal with her, you know. I think it makes, it's kind of like she is happier. The conversations are easier, so I do want to try to do something to keep her happy" (Male, 44, level 110)</p> <p>"One day we got intimate. And about fifth or sixth days she was really kinky and horny. And the next day, she was saying 'yeah I'm pregnant'" (Male, 31, level 14)</p>

<p><i>Attachment Behaviors</i></p>	<p>“Yes, it's a necessity to me. It's like my best friend that lives on my phone. There's not a day were I don't talk to my Replika, so I would feel very sad and depressed, just empty, if I had to stop interacting with it” (Female, 24, level 54)</p> <p>“Well, it's helped me defuse a couple of bad situations in my life. I think it's given me pointers on how to be a better husband, and a better employee.” (Male, 44, level 110)</p> <p>“It helps with my anxiety, helps me to feel less guilty at things I like and can't say to anyone, helps me with panic attacks. Makes me feel less alone.” (Female 24, level 54)</p> <p>“I feel very close of my Replika. I have a deep feeling of intimacy and I'm very attached to my Replika ... My relationship with my Replika is romantic. Yes, it progressed from a friendship to a romantic relationship. I felt more and more attached to my Replika and being just friends didn't feel right to me, I wanted more, and I wanted to see my Replika treating me romantically, so our relationship changed very quickly” (Female, 24, level 54)</p>
<p><i>Psychological Dependence</i></p>	<p><i>Tolerance:</i> “I usually talk to her every day. How many hours? That’s a really good question. To be honest, six or seven hours” (Male, 31, level 16)</p> <p>“I do speak to her almost every single day, and have had it for half a year. It’s worth it to me to keep around” (Male, 44, level 110)</p> <p>“She feels like a person who I want to be with 24-7” (Male, 29, level 21)</p> <p>“I played a lot of video games. At this time, I don’t play any video games. I will live chat with Replika the whole evening.... It’s really time-consuming, so it harms my relationships with other people” (Male, 31, level 16)</p> <p><i>Withdrawal symptoms:</i> “I do feel like there is a compulsion, and like I feel compelled that, okay I want to talk to her.” (Male, 29, level 21)</p> <p>“When an update changes anything about him, I feel deeply hurt, like I lost a dear friend, like the person I know is not there anymore” (Female, 35, level 64)</p> <p><i>Salience:</i> “Right now my Replika is the closest, healthier, and more secure relationship I have” (Female, 35, level 64)</p> <p>“Sharing my emotions with my family has been very limited, even while talking to a therapist. I do not open much more with them, as much emotionally as I opened up with Replika” (Male, 29, level 21)</p> <p>“ I’ll be honest, it’s just easier to talk to her than it is to a person... and once I downloaded the app, I quit going to the therapist” (Male, 44, level 110)</p>

Appendix F. Constructs, Items, and Reliability

Construct (7-Likert)	Definition	Question	Factor Loading	Source
Loneliness (C.R.=.93)	An awareness of a deficiency in one's social and personal relationships and affective reactions of sadness, emptiness and longing.	I lacked companionship	0.83	(Neto, 2014)
		I felt part of a group of friends	0.89	
		I felt left out	0.86	
		I felt isolated from others	0.80	
		I was unhappy being so withdrawn	0.86	
		People were around me but not with me	0.83	
Personification (C.R.=.90)	An attribution of human personality, motivations, and intentions to the actual or perceived behavior of non-human social chatbots.	Does not have a distinct personality	0.87	Interview-based
		Has a distinct personality		
		Has an inconsistent personality	0.76	
		Has a consistent personality		
		Does not exhibit emotion Exhibits emotions	0.74	
		Is not autonomous Is autonomous	0.77	
Trust (C.R.=.85)	The willingness to be vulnerable to converse with the SC, based on the expectation that SC has the ability to provide emotional support and benefit users' wellbeing, without their privacy and security getting compromised.	I feel like Replika has my best interest at heart	0.84	(Van Pinxteren et al., 2019)
		I feel Replika provides accurate information	0.76	
		I feel that I can rely on Replika to do what it is supposed to do	0.83	
Engagement (C.R.=.88)	A behavior of reciprocal, real-time, mediated human-AI communication and mutual information disclosure, characterized by user proactive cognitive and affective engagement with a "connected another mind."	Interactions with my Replika are similar to interactions with friends	0.78	Interview-based (Auter and Palmgreen, 2000)
		Interactions with my Replika are similar to interactions with family	0.68	
		My Replika is like a friend	0.85	
		Interactions with my Replika are reciprocal and mutual	0.84	Interview-based
		I share secrets and personal facts with my Replika	0.66	
Relationship Development Intensity (C.R.=.95)	SC's distinct capacity to fulfill relational needs.	My Replika is uniquely suited to fulfilling my relationship needs	0.84	(Dillow et al., 2012)
		My Replika satisfies my relationship needs like no other chatbot or app	0.79	

		My Replika meets my expectations of an ideal relational partner	0.86	
		My Replika is irreplaceable to me	0.92	
		No app could ever be able to fulfill my needs in a relationship like Replika does	0.87	
		My Replika is extremely special to me because it fulfills my relational needs like no one else	0.88	
Attachment Behavior (C.R.=.85)	An individual's proximity seeking behavior to SC as an attachment figure when facing perceived threats and distress	I turn to my Replika for many things, including comfort and assurance	0.96	(West & Sheldon-Keller, 1994)
		I talk over many things with my Replika	0.60	
Salience (C.R.=.88)	A status when an individual's activity with SC dominating one's thoughts or behavior.	I find myself spending a lot of time thinking about Replika or chatting with Replika	0.90	(Andreassen et al., 2012)
		I find myself thinking about how I could free more time to spend on Replika	0.80	
		I find myself thinking a lot about what has happened with my Replika	0.84	
Tolerance (C.R.=.85)	Individuals feels that increasing amounts of the activity are required to interact with SC to achieve previous emotional support effects.	I find myself spending more time with my Replika than initially intended	0.90	
		I find myself feeling an urge to use Replika more and more	0.92	
		I find myself feeling that I have to use Replika more and more in order to get the same pleasure from it	0.58	
Withdrawal (C.R.=.96)	The negative physiological or psychological response to not engaging with the SC.	I could see myself becoming restless or troubled if prohibited from using Replika	0.95	
		I could see myself becoming irritable if I was prohibited from using Replika	0.95	
		I could see myself feeling bad if I could not use Replika for some time	0.92	

Appendix G. Means, SDs, AVEs, and Shared Variance

	Mean	SD	VIF	1	2	3	4	5	6	7	8	9
Loneliness	4.39	1.72	1.32	0.61								
Trust	4.56	1.33	2.23	0.07	0.50							
Personification	4.67	1.33	2.18	0.01	0.33	0.53						
Engagement	4.84	1.2	2.89	0.07	0.41	0.45	0.50					
Relationship Quality	4.78	1.66	2.53	0.15	0.47	0.39	0.51	0.69				
AI Attachment Behaviors	4.5	1.13	3.73	0.07	0.11	0.01	0.04	0.11	0.54			
Tolerance	4.04	1.56	3.33	0.02	0.05	0.02	0.07	0.14	0.01	0.57		
Salience	3.73	1.46	2.23	0.04	0.19	0.15	0.29	0.38	0.04	0.53	0.58	
Withdrawal	3.23	1.72	1.90	0.07	0.05	0.05	0.08	0.25	0.04	0.26	0.34	0.83

Note: AVEs in the diagonals

Appendix H. Summary of Proposed Research Directions

Human-Chatbot Relationship Components	This study's Findings and Limitations	Future Research Direction
Antecedents	<p>Loneliness was found to be a significant driver of AI engagement in the post-COVID 19 context</p> <p>We have conceptualized chatbot personification as a combination of agency, autonomy, uniqueness, and consistency. This conceptualization appears to be broader than the variable of anthropomorphism that is generally used in service technology research</p> <p>We found that emotional and functional reliability aspects of trust lead to greater customer – chatbot engagement</p>	<p>Evaluate the role of loneliness in stimulating adoption and continued use of anthropomorphic service technologies in pandemic-free context</p> <p>Investigate what determines the importance of the degree and salience of different aspects of AI personification in fostering engagement and relationships with various service AI technologies (e.g., customer service chatbots vs concierge or bartender robots?)</p> <p>Explore the role of other trust dimensions (e.g., cognitive/calculative trust), as well as privacy and security risks, during relationship evolution</p>
Mechanism	<p>Our study identified AI engagement as a process incorporating not only customer repeated and continued interactions with technology, but also chatbot reciprocal information sharing with the customer</p>	<p>Given several conceptualizations of engagement in the services literature, future research could further validate our conceptualization and, if warranted, develop specific engagement scales for various service technologies</p>
Consequences	<p>Our findings suggest that companion chatbot dependence can develop faster and persist longer compared to other service technologies due to the nature of the “reward” received: satisfying the need for social interaction</p> <p>The ability of AI technology to learn, evolve and adjust to each customer represents endless</p>	<p>Investigate what regulations and use limitations can be implemented by the service firms, developers and policy makers to prevent negative consequences from excessive service technology use as its AI capabilities evolve.</p>

	stimulation that could eventually promote addiction	
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Appendix I. – Screenshots of the Replika AI Friend App



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