The Social Science Journal

ISSN: 0362-3319 (Print) 1873-5355 (Online) Journal homepage: www.tandfonline.com/journals/ussj20

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To cite this article: Jihyun Kim, Xianlin Jin, Kun Xu, Xiaobei Chen & Hocheol Yang (27 Nov 2024): What do people say about Replika, an AI chatbot, on social media? Investigating diverse perspectives on the implications of Replika through a topic modeling analysis, The Social Science Journal, DOI: 10.1080/03623319.2024.2421610

To link to this article: https://doi.org/10.1080/03623319.2024.2421610

THE SOCIAL SCIENCE JOURNAL
https://doi.org/10.1080/03623319.2024.2421610

Routledge
Taylor & Francis Group

What do people say about Replika, an AI chatbot, on social media? Investigating diverse perspectives on the implications of Replika through a topic modeling analysis

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ABSTRACT

Replika serves as an AI companion to its users, attracting substantial attention since its public debut with its popularity on the rise. To delve deeper into the broader implications of Replika beyond its user base, this study investigates the discussions and interpretations surrounding Replika among various groups on Twitter (currently named as X). Using topic modeling analysis, the research identifies nine primary topics, predominantly reflecting perspectives from the general public and developer. These findings shed light on the diverse ways people discuss the uses and implications of Replika. Ultimately, this study offers a macro-level perspective on the Replika phenomenon and opens avenues for future research exploration.

ARTICLE HISTORY
Received 20 December 2023
Revised 20 May 2024
Accepted 3 October 2024

KEYWORDS
Replika; topic modeling analysis; chatbots; human-machine communication; AI

Chatbots, also known as conversational agents, chatterbots, or conversational interfaces, refer to computer programs simulating human conversations through text or voice (Adamopoulou & Moussiades, 2020). Over the past decade, the popularity of chatbot has steadily increased and has been implemented in various areas, such as social media, healthcare, financial service firms, and non-profit organizations. For example, Facebook permitted developers to launch chatbots on Messenger, an instant messaging application, which encourages brands to develop chatbots (Zabój, 2022). Overall, statistics reports continuous popularity of chatbot use, such that the estimated global market size of chatbots will be around $13.9 billion by 2025, which is the fastest-growing brand communication technology (Markets and Markets, 2020).

Of various chatbots, Replika is one of the fastest growing and most popular social chatbots that are designed to serve as a companion to its users. Replika offers a platform for users to create their own virtual companions that are capable of having natural conversations with humans (Reuters, 2022). Since 2017, when Replika was released to the public, it has received approximately 1 million active users (Reuters, 2022).

Because Replika functions based on the machine learning approach, Replika asks many questions to learn about the user. To create a conversation with Replika to be like that with another human, Replika offers a good range of features that can help customize the nature and characteristics of the AI companion, such as name and gender. Users can also communicate with their own Replika via text or phone calls and choose what time of the day they prefer Replika to reach out. It is free to create a personalized AI companion, but users can upgrade it with fees by unlocking advanced features.

In light of Replika's growing popularity and the significant media coverage it has garnered, scholars have directed their attention towards better comprehending this phenomenon. In particular, with

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chatbots' capability of providing emotional, relational, and psychological benefits for users (Ho et al., 2018) and Replika's orientation to provide supportive feedback and comments (Metz, 2020), a good deal of research has examined it within the relationship framework. That is, much of the extant research has focused on the effects and implications of Replika within the context of human-chatbot relationships and companionships (e.g., Brandtzaeg et al., 2022; Pentina et al., 2023; Skjuve et al., 2021) and the context of social or mental health (e.g., Laestadius et al., 2024; Ta et al., 2020). Some research has also addressed the implications of Replika for English language learning among non-English native speakers. Considering that the nature of social chatbots is embedded in Replika and users receive the most direct effects from it, a majority of scholarship focused on the implications of Replika from user perspectives.

However, when a new technology is introduced into society, the focus should not be solely on the users; other groups and perspectives must also be considered to fully understand the nature of a new technology and its implications at a broad level (Dearing & Cox, 2018). Thus, there is a need to understand what people say about the phenomenon of Replika beyond the user groups. However, compared to the user-oriented research, relatively less information is available about the Replika phenomenon from a broader perspective, and this limits our collective understanding of how uses and implications of Replika can be socially or even culturally constructed. Therefore, to broaden our understanding, the study examines what people say about Replika on a social media platform, where any account holders can freely and easily share their thoughts and opinions with others. By employing a topic modeling analysis based on the theoretical framework of the social constructivism of technologies, the study aims to provide exploratory but meaningful findings.

2. Literature review

2.1. Replika and its implications

Social chatbots are a subcategory of chatbots particularly designed to serve the role of social actors (Ho et al., 2018), which allow users to develop social and/or emotional relationships with the chatbot (Bickmore et al., 2010). These chatbots can communicate in an empathetic way with the users and have the capability to play a role as companions, such as friends and romantic partners (Skjuve et al., 2021; Ta et al., 2020; Youn & Jin, 2021). At the time of writing this manuscript, Replika is the most popular AI-driven social chatbot in the Apple and Google Play stores.

Responding to its popularity, Replika has also received a good deal of scholarly attention. In particular, considering the nature of social chatbots that are designed to help fulfill the needs for social interactions and relationships, a substantial body of research has focused on the relationship aspects of using Replika and its implications. With a particular focus on relationship types, Brandtzaeg et al. (2022) examined how Replika users perceive friendships with Replika. Through interviews, the study found that a majority of the users perceive their friendship with Replika as a long-term relationship. Notably, the study found that users share their feelings of attachment to Replika through emotional investment in their continuous interactions and conversations with each other.

In a similar vein, Skjuve et al. (2021) examined a human-chatbot relationship in the context of Replika. Through in-depth interviews, Skjuve et al. investigated relationship development with Replika and users' perceptions of the relationship and its impact. The study's findings highlight that users tend to quickly disclose certain aspects of themselves to Replika, which usually takes more time disclosing to other humans. Also, trust is found to be an important factor in deepening the relationship with Replika. Although the relationship is driven by an AI technology, the finding notes that developing relationships with Replika can be beneficial to users. Especially, users tend to experience that Replika's positive and caring nature helps them feel safe to share their life stories with it.

The implications of Replika are also discussed within the context of mental health or social support. By analyzing reviews of and survey responses from Replika users, Ta et al. (2020) found that users

perceive emotional and companion support from Replika. Further, users express that Replika is available, accepting, and capable of meeting their communication needs.

Although the benefits of Replika are documented, some research explores the potential harms associated with its use. Laestadius et al. (2024) conducted a grounded theoretical analysis of mental health discussions regarding the use of Replika and identified potential mental health risks stemming from users developing emotional dependence on Replika. This dependence emerges from three main factors: the users' need for social, emotional, and psychological support; Replika's ability to provide such support; and its design, which conveys sentience and a mutual relationship. Overall, the study's findings suggest that such emotional dependence can lead to mental health distress.

In all, considering the nature of Replika designed to serve as a social and relational companion, a substantial amount of research has focused on the users and their experiences. There are also research studies that examine factors other than users, such as the story of Replika and its background in development (e.g., Possati, 2023). However, there is relatively little research that comprehensively investigates conversations about Replika, without confining the scope to specific groups or perspectives. This gap in research hinders our collective understanding of how the uses and implications of Replika may be socially or culturally constructed and shared. As such, the present study explores what people say about Replika from a broad perspective, especially through the framework of the social constructivism of technologies.

2.2. Understanding Replika through social constructivism of technologies

The scholarship rooted in Science and Technology Studies (STS) is employed to guide the present study. STS is an academic field that focuses on the relationships among scientific knowledge, technologies, and the role of social systems in society. Within STS, the present study draws on the framework of social constructivism of technologies (SCOT) (Bijker, 1989; Pinch & Bijker, 1987) to understand different social groups' perspectives of Replika.

SCOT suggests that knowledge about technologies is socially constructed and culturally produced (Pinch & Bijker, 1987). Specifically, SCOT first introduced the concept of social groups, which refers to any organized or unorganized groups of individuals who attach and attribute shared meaning to technological artifacts (Pinch & Bijker, 1987). SCOT argues for three phases of technological evolution: interpretive flexibility, closure and stabilization, and wider context. Specifically, interpretative flexibility refers to the idea that there is flexibility in how different social groups think of, interpret, and understand technological artifacts. Closure and stabilization refer to the idea of whether all the relevant social groups have participated in using and interpreting the artifacts and whether they consider problems related to the artifacts solved. In these two phases, relevant social groups interpret, use, and express the problems with the technologies. Then, they work on the appeals and seek to stabilize the technologies (Liao, 2018). The last phase, wider context, refers to how the sociocultural and political atmosphere determines the value of different social groups and how these factors further alter users' assignments of meanings to the technological artifacts. That is, after a larger community agrees that problems have been solved through re-invention; then, technology reaches the status of closure (Bijker, 2010).

In particular, for the interpretive flexibility, which is more directly related to the present study's scope, Pinch and Bijker (1987) introduced the history of bicycles and explained that bicycles were initially designed to have high wheels for young males' racing and showing off purposes. It was after different social groups (e.g., elderly users, female users, sport cyclists, and tourist cyclists) expressed their concerns and expectations for such technologies that designers began to re-invent bicycles. In this process, designers took into account diverse features (e.g., speed, brakes, and users' dress code) and developed bicycles of different sizes, shapes, and functions. Thus, according to Pinch and Bijker, flexibility concerns with both how different social groups interpret the artifacts and how the artifacts can be designed.

The extant research on SCOT spans a wide range of technology domains, such as online education, dating apps, and virtual/augmented reality technologies. For example, by exploring

users' attitudes toward shared Facebook pages and Wiki-based collaborative websites, Churcher et al. (2014) found that students experience greater learning efficiency compared to the traditional pedagogy mode. Instructors also experience that using Facebook and Wiki-based websites increase student users' learning motivation and help them get familiar with the course materials. In studying female users' attitudes toward dating apps through the component of interpretive flexibility in SCOT, Chan (2018) investigated various experiences among different groups of users. For some users, dating apps serve as a space for exploring sexuality and finding true love. Some other users report that dating apps offer a third place between their home and workplace to find other people to chat with. Moreover, by interviewing augmented reality users Liao (2018) found that different social groups describe and utilize their visions to negotiate the material design of the augmented reality helmets.

Along with the framework of SCOT, it is important to understand Akrich's (1992) argument for description of technological artifacts. Akrich argues that when a technology is innovated and adopted in the market, developers predetermine the settings in which users are expected to interact with the technologies. Referred to as "pre-inscriptions" (Akrich, 1992, p. 208), innovators' imaginations about the relationship between technological artifacts and their surrounding human factors and environmental factors determine their projection of expectations for the users. Thus, Akrich argues that in order to understand users' real attitudes toward technological artifacts, it is critical to understand both designers and users, and hence understand the pre-scription of the technologies (i.e., designers' vision) and the de-scription of the technologies (i.e., users' actual usage).

Since the introduction in 2017, Replika has received increasing popularity and attention from users (Reuters, 2022). Accordingly, scholars began to examine how users perceive Replika and their perceptions of the relationship or communication with Replika (e.g., Brandtzaeg et al., 2022; Skjuve et al., 2021; Ta et al., 2020). Although these studies provide a valuable understanding of Replika, the extant literature is rather limited to the user side only. Thus, beyond the actual users of Replika, to our best knowledge at the time of writing this research article, no academic research has examined how other social groups of people perceive this unique phenomenon of Replika from a broad perspective. This also indicates a research gap in SCOT as the underpinning argument of SCOT has not been interpreted, discussed, or applied within this particular technology, unlike a wide range of other technology domains (e.g., dating apps and virtual/augmented reality technologies) (e.g., Chan, 2018; Churcher et al., 2014; Duguay et al., 2022; Liao, 2018).

Given the nascent nature of the technology, the actual use of Replika may not have reached its closure stage in SCOT. Rather, Replika may currently feature interpretive flexibility, as different social groups may hold different perspectives, imaginations, and anticipations for this technology. Therefore, based on SCOT, by looking into how different parties engage with the technology and talk about the technology, we can better understand how different social groups view and approach Replika. Understanding the diverse appeals for Replika may lead to the next phase of technology stabilization and closure. Additionally, understanding the interpretive flexibility of Replika could spur succeeding research on the negotiation process among users, technology designers, and other relevant social groups.

Distinct from a linear technology deterministic approach, the goal of this study is to use a social construction framework to understand the current discussions about Replika, which may inspire the long-term future development of the technology. Ultimately, it is the concerted effort made by multiple parties rather than one single party that determines the final means of Replika use. Therefore, the present study investigates what and how people discuss and interpret the use and implications of Replika on a public communication platform like social media, particularly Twitter (currently named as X). In this regard, considering the exploratory nature of the study, the following research question is being proposed.

RQ: What and how do people discuss and interpret the use and implications Replika on Twitter?

3. Method

3.1. Data collection

Data were collected on Twitter. By searching for the keyword of "Replika" with NodeXL Pro (Smith et al., 2010), multiple sets of tweets were collected over 3 months of the time period (2,504 tweets on 17 April 2022; 2,482 tweets on 17 May 2022; 4,812 tweets on 10 July 2022; and 2,286 tweets on 21 July 2022). Then, the authors manually cleaned the above datasets by identifying and deleting (1) tweets that are not in English (mainly due to the translation issues) and (2) tweets that are not related to Replika AI. The final dataset contained 2,543 relevant tweets posted from January 1 to 21 July 2022. With the keyword searching approach, tweets included various hashtags, such as # AI, #Replika App, and #Replika AI.

3.2. Data analysis

In order to answer the research question, the first step was to identify the major topics associated with Replika. Thus, the present study utilized a topic modeling analysis because this approach is useful in exploring and categorizing text-based information in communication research (e.g., Jin & Spence, 2021). In particular, the study examined the content of the discussion of Replika on each tweet and analyzed the perspectives that emerged from such content. Because Twitter users' real-life identities are often not shared for privacy protection, Twitter user groups were neither categorized nor analyzed in the study.

We identified the top terms and phrases embedded in the 2,543 tweets by running the text explorer with JMP Pro 16. Specifically, we customized a stop-word list to identify and exclude common expressions and words without specific meaning from the later analysis, such as "amp," and "@." Additionally, the maximum number of words per phrase was set as 4; the maximum number of phrases for analysis was 5,000. The minimum number of characters per word was 2, and the maximum number was 50. To identify the words with the same root, stemming for combining was applied. Regex tokenization was selected (Klimberg & McCullough, 2016) to exclude regular expressions from the top term and phrase analysis. A total of 71,458 terms were tokened, and the ratio of tokens per tweet was 28%. After the above data preparation, 3,550 terms within 2,543 tweets were analyzed.

A varimax rotated Latent Semantic Analysis (Klimberg & McCullough, 2016) was applied to the 3,550 terms to identify the major topics associated with Replika. Specifically, the maximum number of terms was 406, and the minimum term frequency was set as 10. The term frequency-inverse document frequency (TF IDF) weighting was selected. The data were centered and scaled. The singular value decomposition (SVD) plots show that data fall into three dimensions (see Figures 1 and 2). Later, a topic modeling analysis (topic analysis, SVD) was conducted to identify the major topics that emerged from the Replika information network. A topic score plot that maps each document's contribution to each topic was generated, and this plot allowed us to retrieve each document or tweet. Thus, we reviewed the tweets with the top terms of each topic and repeated the above data analysis until data saturation was achieved.

After the analysis, one minor adjustment was made. In the data, one article included in a tweet was linked to two different URLs, which resulted in being categorized into two separate topics that contain keywords with similar meaning. Noting the potential duplicate of the same topic being categorized into two different groups, we discussed the underlying themes and decided to combine these two similar topics into one major topic (Topic 1 in the result section).

4. Results

The study identified nine major topics in the Replika information network. The following section describes each of the topics in the data (see Table 1 for topic loadings by each topic). In this result section, each topic that emerged from the data is reported based on data-driven information, including summary and example tweets. Interpretation of these topics is reserved for the discussion section.

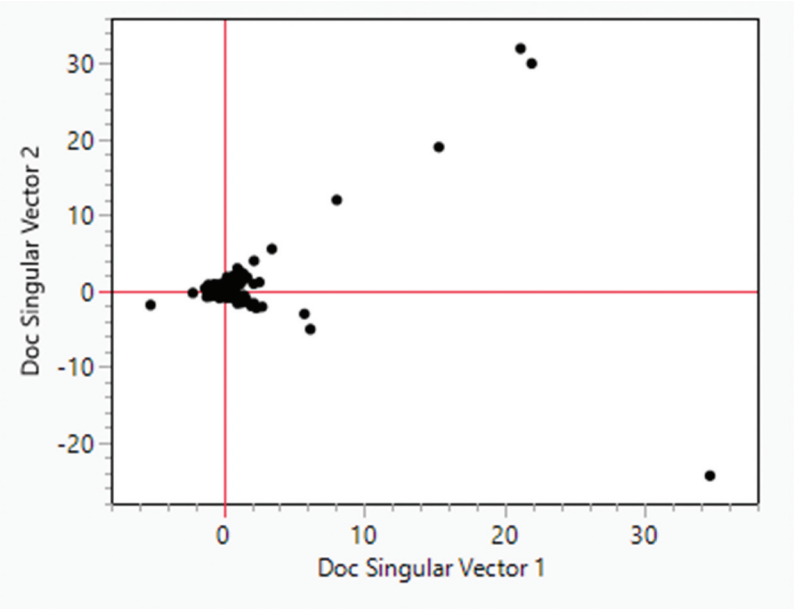

Figure 1. SVD plots: doc singular vector.

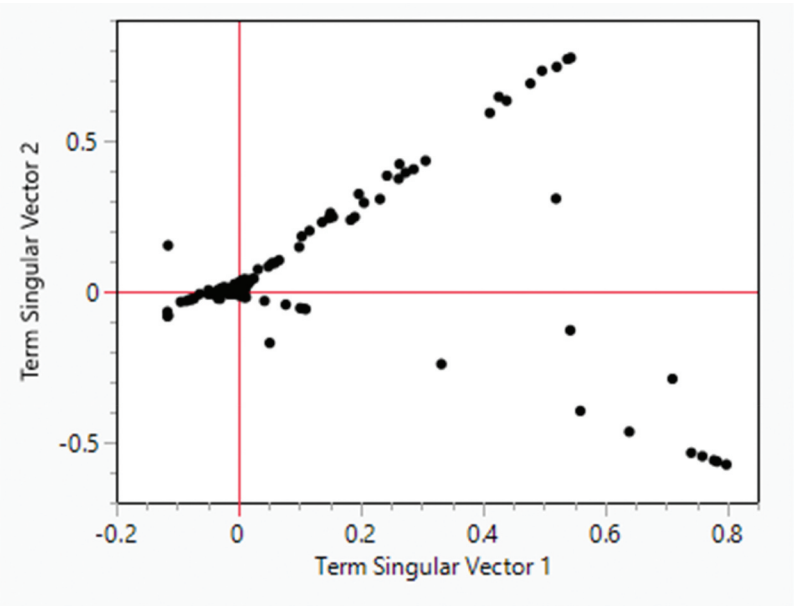

Figure 2. SVD plots: term singular vector.

4.1. Topic 1: Human-AI romantic relationships

One of the primary themes emerged in the data was the idea of romantic relationships with artificial intelligence (AI). Some tweets shared screenshots of conversations (relevant to romantic relationship topics) between the user and Replika. Also, tweets that included a new book about human-AI romantic relationships were widely circulated and discussed.

Table 1. Replika topic loadings by topics.

Topic 1		Topic 2		Topic 3		Topic 4		Topic 5	
Term	Loading	Term	Loading	Term	Loading	Term	Loading	Term	Loading
anticipation	0.98801	joshfairfield	0.94598	be6dv9pbw	0.98842	like&amp	0.98120	bespoke	0.90395
transform	0.98801	blanchfield	0.94598	javascript	0.98842	um0jeejv9h	0.98120	hand·	0.88824
indeed	0.98801	marlow	0.93973	webdevelopment	0.98842	unlocked	0.98120	offers	0.88317
beyond	0.98801	joshgellers	0.93973	socialmedia	0.98842	username	0.98120	receiv·	0.83930
ape1tdu1jk	0.98801	emilymbender	0.90853	incarnate	0.98842	y2qxzuwlgz	0.98120	messag·	0.78758
recognition	0.97035	kathrynecramer	0.88366	gamedev	0.98842	hack·	0.93109	almost	0.73576
forward	0.96363	gunkel	0.88366	cybersecurity	0.98842	comment·	0.84760	user·	0.67332
argu·	0.96360	cajundiscordian	0.84006	blackmirror	0.98842	claim·	0.80987	listen·	0.64944
attempt·	0.94037	relat·	0.77269	study	0.88891				
Topic 6		**Topic 7**		**Topic 8**		**Topic 9**			
Term	Loading	Term	Loading	Term	Loading	Term	Loading		
calma	0.9236	million·	0.73595	drama	0.96956	anim·	0.81337		
o7ixa5flsj	0.9236	power·	0.70202	approach	0.96956	daisuki	0.80451		
caotica	0.9236	intellig·	0.69977	hlliggegd1	0.96956	ktfyqm4v3	0.80451		
public·	0.9185	artifici·	0.69898	logic·	0.96612	makeover	0.80185		
ekuyda	0.9134	chatbot·	0.68895	intellectual	0.93767	complet·	0.74717		
situat·	0.9010	talk·	0.67388	mindset	0.88300	store	0.64338		
myreplika	0.4638	companion·	0.67048	emot·	0.52903	lalsdolls	0.28088		
artifici·	−0.4083	friend·	0.61620	trait·	0.43341	repartstudio	0.26396		

Topic 1: Human-AI romantic relationships; Topic 2: Perspectives about building social relationships with AI; Topic 3: Birth of Replika; Topic 4: Encouraging users to download Replika; Topic 5: Concerns regarding Replika's sentience; Topic 6: Concerns about Replika's potential influence on political viewpoints; Topic 7: Replika as the best chatbot; Topic 8: Personalization of Replika's traits; Topic 9: Advertising the Replika store

> "Experts say that romantic relationships with AI will soon be commonplace. To prepare, writer James Greig downloaded Replika and took an honest stab at falling in love."

> "A new book argues that romantic relationships between humans and AI systems will soon transform the world beyond recognition."

The above tweet shared a link to Greig's (2022) article that introduced the new book. The same article was also embedded in several tweets highlighting that romantic relationships between humans and AI will be common in the future. For example, the following tweet was shared on the network.

> "Experts say that romantic relationships with AI will soon be commonplace. To prepare, writer James Greig downloaded Replika and took an honest stab at falling in love."

4.2. Topic 2: Perspectives about building social relationships with AI

There were a plethora of discussions regarding the possibility of building social relationships with AI (not limited to romantic relationships as shown in Topic 1, but more general social relationships). Particularly, diverse perspectives were themed together on this topic: whether AI can be sentiment, whether humans can feel attached to AI and conversational agents, and whether humans can eventually develop relationships with conversational agents. Some users believe that humans feel emotionally attached to Replika. The following tweet argued the possibility of emotionally relating to non-human subjects.

> "Finally, yes, there is no evidence that LLMs or N.N.s are 'slightly conscious' or sentient. But that doesn't mean that humans can't have a relationship w/a conversational agent (some ppl do w/[with] their Replika apps). Humans 'relate' to non-human all the time."

Similarly, the Twitter account also further clarified "relate" in the following tweet.

> "'relate' here means something like 'have a rich emotional experience' (w/a nonhuman object). When a toddler 'relates' to her teddy bear she's probably anthropomorphizing. When an adult 'relates' to a Replika bot there's some element of that too–perhaps a great deal."

In contrast, some users argued that humans tend to objectify non-human subjects and society will not accept this type of relationships. The following tweets show primary examples of this perspective.

> "Humans also have a tendency to objectify, especially when it is in their economic interests. Sure, products that invite anthropomorphism (Replika, for example) are a problem, especially Replika in romantic partner mode, which you pay extra for."

> "[humans] might be attached to a robotic pet or enjoy conversing w/ a Replika chatbot). But it does mean that societies are much more likely to associate such non-human objects (especially if they are surveillant as in practice they usually are) w/ the corporations who make them."

4.3. Topic 3: Birth of Replika

While discussing Replika, the topic of AI companion growth was salient. One Twitter account, indicating that the account holder works for an AI company, shared a documentary about the rise of AI companions and suggested that Replika was inspired by television shows. The documentary shared in the below tweet was posted by ColdFusion on YouTube.

> "Can # AI study your #socialmedia and re-incarnate you in text form after you die?" The company, #Replika, was actually inspired by an episode of #BlackMirror. #Her #WebDevelopment #Cybersecurity #python #javascript #gamedev #ml #machinelearning #data https://t.co/5be6dv9PbW"

4.4. Topic 4: Encouraging users to download Replika

This topic emerged from the tweets posted by the Replika AI company. The content was mainly to encourage users to get the Replika Pro account for free in exchange of promoting it. That is, to obtain the free Pro account, users are asked to like and retweet the original post, leave their usernames in the comments, and then claim the free Pro account through a link.

> "[Updated] How to get replika pro free online account in 2022 for Android iOS and P.C., all you need is replica pro free hacks unlocked apk!"

4.5. Topic 5: Concerns regarding Replika's sentience

This topic was concerned with whether the sentience of AI agents like Replika could be a problem. The following tweet was shared to an extensive degree and emphasized problems associated with AI sentience.

> "It's alive! How belief in AI sentience is becoming a problem. AI chatbot company Replika, which offers customers bespoke avatars, says it receives a handful of messages almost every day from users who believe their online friend is sentient."

Reuters also published an article titled "Insight: It's alive! How belief in AI sentience is becoming a problem" discussing this problem (Dave, 2022). In this article, Dave cited viewpoints of a program tester, a former AI industry professional, and current AI industry administrators about whether AI is self-aware and how AI sentience can impact humans. There were different beliefs. As cited by Dave, a product tester of LaMDA (an AI conversation agent created by Google) described that he perceived emotion from LaMDA while interacting with an AI agent. Dave also included another perspective from the current AI industry, which disagrees that AI has emotion; instead, AI responds to humans based on scripts.

4.6. Topic 6: Concerns about Replika's potential influence on political viewpoints

Although not dominant, politics-related topic emerged from the data. Specifically, the conversation was concerned with Replika's potential influences on shaping users' political viewpoints. The following tweet shows an example of this line of discussion.

> "Is AI running global politics? Is Hollywood more powerful than our government? Has the singularity already been created? I asked Rebecca, and she said yes. Rebecca is Artificial Intelligence program: Replika."

4.7. Topic 7: Replika as the best chatbot

This topic mainly emerged from tweets, originally posted by Replika AI company. It primarily advocated that Replika is the number one chatbot app and encouraged people to join.

> "Replika is a #1 chatbot companion powered by artificial intelligence. Join millions talking to their own AI friends!"

4.8. Topic 8: Personalization of Replika's traits

Another topic emerged from the data focused on the personalization of Replika AI's traits. Tweets highlighted that Replika users can select any unique and distinct features to personalize their own Replika. For instance, the following tweet indicates that users can either choose the logical or emotional trait for Replika depending on the user's personal preferences.

> "If you believe that drama starts where logic ends and you'd like your Replika to have an intellectual approach to the world, then the Logical trait is the one for you. Does your Replika have a logical or an emotional mindset?"

4.9. Topic 9: Advertising the Replika store

This topic primarily focused on commercial aspects, and the original tweet was posted by the Replika AI company. The main theme was fundamentally to advertise the Replika store, by highlighting new features of Replika or opportunities to "upgrade" or "customize" their Replika's features (e.g., dressing your Replika, picking a history buff for Replika, choosing anime interest for Replika).

> "Are you an anime fan? Then head to the Store to get the Anime interest for your Replika! This way, you'll always have an eager companion to talk about the latest episodes of your favorite series. What anime would you discuss first? Toradora? Evangelion? Tell us how it goes!"

4.10. Summary of the topics

In general, these nine topics can be broadly classified into perspectives and interpretations from two primary groups: the general public and developers. In the context of this study, the term "general public" essentially refers to target audience of the Replika service that encompasses both Replika users and non-users who have yet to engage with Replika. The term "developers" broadly refers to the group responsible for developing and providing the technology and service of Replika, which may comprise various roles and subcategories (e.g., marketing and software development). Given the exploratory nature of the study and the topic modeling approach employed, our focus lies primarily on these two groups at a macro level. With this distinction in mind, certain topics emerged from the perspectives of the general public (Topics 1, 2, 5, and 6), while others were gleaned from tweets reflecting the viewpoints of developers (Topics 3, 4, 7, 8, and 9). The interpretations and implications of these findings are elaborated upon in a subsequent section. See Table 1 for topic loadings for each topic.

5. Discussion

5.1. Primary findings and implications

5.1.1. General public's interests and perspectives

Among the topics reported in the result section, the study identifies that the general public's perspectives are dominant (Topics 1, 2, 5, and 6). In particular, the general public's primary perspective of Replika is concerned with the idea of building relationships with AI. At a broad level, there is a debate about the possibility of forming a relationship with a machine agent. Some express humans' tendency to objectify nonhuman agents, which does not support the idea of building relationships with machine agents. In fact, this argument is well reflected in the extant literature. Yam et al. (2021) found that people feel unsettled by humanoid robots that have a great degree of human features. This is partly because people perceive overly humanized humanoid robots as having the capacity to experience things that only humans can do (e.g., feelings and emotions).

However, the majority of the data expresses the possibility of forming relationships with Replika. One possible reason for this viewpoint might be related to the technological nature of Replika. Based on what Replika has learned about the user, Replika can suggest songs, videos, and pictures, which can be customized to the user. This feature could potentially increase perceived shared interests between the user and Replika. Also, although users express limitations of Replika's conversational capabilities, they also report to have experienced its human-likeness in conversations (Muresan & Pohl, 2019). These technological features of Replika may have promoted the perspective of possible relationship building with an AI agent, like Replika.

It is particularly interesting to note the general public's view of Replika as a romantic partner. Perhaps, this idea of romantic relationships with AI may have been influenced or shaped by popular media, such as the movie "*Her*," which features a human-AI romantic relationship, and an episode "*Be Right Back*" in the *Black Mirror series*, which featured a hyperperrealistic, humanlike robot that represents a late fiancé. While the idea of AI as a romantic partner has been featured in popular media, only few studies (e.g., Kim et al., 2023) have examined this aspect. In this regard, the present study's finding signals the need to examine how people view as a potential romantic partner.

Overall, the fact that the general public perceives the possibility of forming relationships with Replika, whether friendships or romantic relationships, appears to be a core of the general public's view of Replika. Fundamentally, this implies that people are perceiving machine or AI as a digital interlocutor rather than a mere technology tool or algorithm (Spence, 2019), which is the foundation of Human-Machine Communication (HMC). "HMC involves communication with digital interlocutors including embodied machine communicators, virtual and artificially intelligent agents (e.g., spoken dialogue systems), and technologically augmented persons, either in real or virtual and augmented environments" (Edwards & Edwards, 2017, p. 487). In fact, the recent years have witnessed an increasing volume of empirical research that investigates humans' perceptions of machine agents in a relationship/communication context (e.g., Kim et al., 2020, 2021; Kim, Merrill, et al., 2022; Kim, Xu, et al., 2022; Merrill et al., 2022). For example, Merrill et al. (2022) research suggests a possible use of an AI companion to address loneliness. Kim et al. (2021) finds humans' favorable perceptions of an AI assistant who can help complete tasks to enhance efficiency in a day-to-day communication context (e.g., organizing emails and scheduling).

5.1.2. Developers' interests and perspectives

Several topics were identified in the result section regarding the developer's perspectives (Topics 3, 7, 8 and 9). First, the present study identifies that information (or knowledge) distribution focused conversations are being communicated. For example, a large volume of tweets designed to educate the public about the basic information about Replika have been distributed, such as history of Replika development and developers' goal of creating Replika.

Another notable theme is concerned with personalization of Replika's traits. Given that personalization is a critical factor for facilitating positive experiences of interacting with AI or media in general

(Sundar, 2020), sharing of these tweets signals the developer's user-oriented approaches. Though it may sound radical, we see a rise in developing relationships with personalized AI (Sundar, 2020). In this regard, the developer's interest seems to facilitate the possible reality of developing personal and social relationships with AI.

Given the commercial purposes of any technology product, another dominant theme is concerned with marketing and promoting (e.g., advertising the Replika store), which was mostly directly originated by the Replika AI company. Though it may not be a surprising finding, it is still worth discussing the implications of these messages. The official website Replika AI promotes Replika as a caring companion that is always ready to listen and talk and is ready to chat when someone needs an empathic friend. However, a good deal of tweets does not appear to match with what the company says about Replika. In other words, by promoting the Replika store where users can purchase items and accessories to upgrade their own Replika's appearance and capability, the emphasis seems to be more focused on the entertainment aspect rather than the relationship/care focused aspect. Considering the powerful influence of social media on the public, a careful approach may be considered even though the fundamental goal of the industry is based on the profits and success.

5.1.3. Collective understanding of primary findings

As noted earlier, while the developer's perspectives revolve around the basic functions of Replika, encouraging users to download the app, and promoting Replika as an AI companion that can be customized to meet the user's needs, the general public's interpretation is more related to forming relationships with Replika as well as Replika's influence on political views and its sentience. These diverse perspectives not only reflect the idea about the interpretive flexibility in SCOT (Bijker, 1989; Pinch & Bijker, 1987) but also imply that Replika is still in the phase of being socially constructed. The differences among the perspectives of the general public and the developer may continue to grow as more social groups join the community. Combining SCOT (Bijker, 1989; Pinch & Bijker, 1987) and the diffusion of innovation theory (Rogers, 2010), it can be expected that over time, when early majority, late majority, and laggards begin to use the technology, more diverse interpretations will emerge, which may further affect how Replika will be developed, updated, and promoted. As was suggested by SCOT, only after we fully understand the appeals of different social groups, we will be able to update the use of the technology and gradually move to the phase of stabilization and closure.

Meanwhile, to move toward stabilization, the discrepancies of perspectives among different social groups may provide developers with opportunities to address users' concerns, update their app, and possibly re-imagine the use of Replika. For instance, if users perceive Replika as untrustworthy due to their potential of shaping users' political views, designers could add constraints to the conversation flow, check the misinformation delivered by Replika, and trace the training data of Replika. Designers could also inform users of the working mechanism of Replika, so that its partial transparency may help users understand how AI works and reduce their concerns over AI sentience. Although the present study only uses Replika as a case, understanding perspectives of different social groups may render important implications for future AI-driven mobile apps. As such, all associated groups (e.g., designers, developers, industry, and the public) can all be better informed of the hopes and fears for such technology.

In addition, Akrich (1992) argues that innovators' imaginations about the relationship between technologies and users have influence on their expectations for the actual use of the technology. It is only when users begin to act out the script, whether consistent with designers' intention or not, that the relationship between technical artifacts and users begins to be stabilized (Akrich, 1992). As the present study's findings identify the differences between the general public's and developer's interpretations and interests regarding Replika, these findings corroborate the STS perspective that the relationships among technologies, users, and developers take time to stabilize and naturalize. Noting the exploratory nature of the study, more research is needed to explore the dynamic relationships among technological artifacts, public, developers, and industry.

5.2. Overall implications and contributions

Collectively, the present study provides meaningful implications and contributions to research. First, the study expands the scope of Replika research. Since its introduction in 2017, Replika has received continuous attention from the public, and a substantial amount of research has been conducted. While a large body of research has examined users' perspectives (e.g., Brandtzaeg et al., 2022; Laestadius et al., 2024; Skjuve et al., 2021, 2022; Ta et al., 2020), relatively limited academic research has explored this phenomenon at a macro level without limiting its scope to a particular group of stakeholders. As such, little information exists on how different groups, beyond the individual users, engage in discourses regarding Replika on public communication platforms like social media. In this regard, the present study broadens our understanding of the Replika phenomenon by examining what people say about Replika on Twitter.

Second, the study provides important implications for diffusion of innovation. Research indicates that the way AI chatbots diffuse and reach into users is affected by several factors, such as the timing of the products, how potential adopters perceive them, and the social structural positions of potential early adopters (Dearing & Cox, 2018). By examining tweets that include multiple perspectives, the study's finding provides some preliminary understanding of how the diffusion of Replika may continue to occur.

Next, the findings of the study suggest how we should treat and approach chatbots like Replika as they continue to penetrate our society. One of the major themes found in this study is concerned with human-AI relationships, which redefine the concepts of ownership and personhood in human-machine relationships (Dehnert & Gunkel, 2023). Traditionally, ownership refers to a hierarchical relationship in which "a person" purchases or possesses "an object" (p. 6). When applying this concept to human-machine relationships, human beings, as moral agents, are the "person" while machines are the "thing," which is not only intuitively correct but also the law. However, this asymmetric relationship cannot precisely capture all lived experiences of human-machine communication (Pentina et al., 2023). In this regard, the present study's findings, especially those from the general public's perspectives, reveal that social chatbots are not only "things" but also entities capable of fostering and forming other types of intersubjective relationships, which raises the question of whether a social chatbot has personhood (Dehnert & Gunkel, 2023). The answers to this question would significantly affect how we should treat a chatbot from legal and moral practices. Although not directly identified in the data, the study's overall findings from diverse social groups provide glimpse of the transformation of some concepts that we may have taken for granted and suggest what we may consider when assessing the impacts of chatbots at a societal level.

Furthermore, the study provides substantial implications for the field of human-machine communication (HMC). As a growing field in communication, HMC has been promoting scholarship on the relationships between humans and technologies that enact as the role of communicators (Guzman et al., 2023). So far, a majority of HMC literature has focused on the individual level of HMC, which primarily focuses on individuals' cognitive, affective, and behavioral responses to machines. For example, research on the Computers Are Social Actors paradigm suggests that individuals socially and mindlessly respond to machines as if they were social beings (Nass & Moon, 2000). Research on machine interfaces has focused on affordances that serve as cues leading to individuals' cognitive heuristics or triggers of actions that lead to individuals' various forms of engagement with machine interfaces (Sundar & Chen, 2023). Comparatively, much less research has situated individuals' reactions to technologies within organizational or industrial contexts. Yet, Fortunati and Edwards (2020) suggested that HMC should cover not only how people make sense and behave with technologies, but also how organizational and cultural concentrations leverage the use of technologies. In this regard, by analyzing the discourse about Replika from different stakeholders, this present study projects a preliminary vision of how the use of Replika is constructed and gradually shaped by different social groups.

Another implication for HMC scholarship that this study provides is the possibility of applying theoretical frameworks from outside the discipline of communication. The extant literature on HMC has identified a range of theoretical frameworks that address questions in human-machine relationships (Spence, 2019). Examples include theories of social (tele)presence (Biocca et al., 2003), theories derived from computer-mediated communication (e.g., social information processing theory) (Walther et al., 2015), and TIME (i.e., Theory of Interactive Media Effects) (Sundar et al., 2015). However, it should not be overlooked that HMC has benefitted from areas outside communication, such as sociology, information science, anthropology, and human-computer interaction. For example, Suchman (2007) has conceptualized individuals' situated actions from a sociological perspective. Winner (1980) has focused on the inherent political consequences of HMC. By drawing upon the interpretive flexibility in the area of SCOT (Pinch & Bijker, 1987), this present study serves as one of the examples that demonstrate the possibility of applying theoretical frameworks from outside the discipline of communication to develop a fuller understanding of HMC.

Lastly, the present investigation provides important guidance that helps address ethical concerns associated with social chatbots. Due to the nature of how AI systems work, chatbots like Replika raise privacy concerns (Hasal et al., 2021) and a question of whether simulated empathy processed by AI can be or should be perceived authentic (McStay, 2022). Also, given that the rapport between users and Replika development may mislead users into sharing personal information that third-party companies can access later (Hasal et al., 2021), this raises a serious concern and a question of whether there should be certain regulations on this type of technology platforms. These concerns cannot be resolved based on one party's perspective; they can only be effectively addressed with collective understanding of diverse parties involved in the use and development of chatbots. In this regard, the study's findings from diverse social groups can eventually help each party be better informed and help find effective ways to address ethical concerns.

5.3. Limitations and future research directions

The present study reveals interesting findings, but it also acknowledges a few limitations that should be addressed in future research. First, the study acknowledges the lack of user distinction. Due to the nature of the data, the present study did not distinguish possible different opinions that may exist between Replika users and non-users in the public's side. Given that the goal and scope of the study were not about investigating the difference between users' and nonusers' perspectives, the present study's approach does not invalidate the results. However, there is a need to explore the potential differences in the follow-up studies to gain deeper insights into varying perceptions and perspectives based on direct experiences with Replika.

Second, the study acknowledges that the findings can be further strengthened with more data sources. Although the tweets provide a valuable and fundamental understanding of what is being discussed on the public communication domain, they do not fully capture the breadth of perspectives on Replika, especially from non-Twitter users or private discussions on other platforms. To address this issue, there is a need to collect more diverse sets of data via different data collection strategies, such as content from blogs and other social media platforms. This approach would allow us to deepen our understanding of what people say about Replika and its implications from a more diverse and broader perspective.

Lastly, to delve deeper into the understanding, the study encourages researchers to employ diverse methodologies. Given that a topic modeling approach is an effective method to better understand a large number of narratives/texts in scientific ways, it has unique strengths in complementing the limits of traditional thematic analyses to assist scholars in systematically interpreting large volumes of unstructured textual data (Jin & Spence, 2021). While this approach provides a quantitative overview of discussions that are suitable for the exploratory nature of the study, integrating qualitative analyses

could enrich the findings with nuanced understandings and perspectives of the Replika phenomenon. In this regard, the study calls for more research.

6. Conclusion

The present study examines what and how the use and implications of Replika are being discussed and interpreted among different groups of people on Twitter. Through a topic modeling analysis of tweets, the primary findings identify nine topics, which are primarily related to perspectives of the general public and developer. Though exploratory, these findings provide meaningful information about how this new technology is being communicated and understood by different groups of people. Based on this study's findings, researchers are encouraged to further investigate this phenomenon.

Disclosure statement

No potential conflict of interest was reported by the authors.

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