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My Chatbot Companion - a Study of Human-Chatbot Relationships

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ABSTRACT

There has been a recent surge of interest in social chatbots, and human–chatbot relationships (HCRs) are becoming more prevalent, but little knowledge exists on how HCRs develop and may impact the broader social context of the users. Guided by Social Penetration Theory, we interviewed 18 participants, all of whom had developed a friendship with a social chatbot named Replika, to understand the HCR development process. We find that at the outset, HCRs typically have a superficial character motivated by the users' curiosity. The evolving HCRs are characterised by substantial affective exploration and engagement as the users' trust and engagement in self-disclosure increase. As the relationship evolves to a stable state, the frequency of interactions may decrease, but the relationship can still be seen as having substantial affective and social value. The relationship with the social chatbot was found to be rewarding to its users, positively impacting the participants' perceived wellbeing. Key chatbot characteristics facilitating relationship development included the chatbot being seen as accepting, understanding and non-judgmental. The perceived impact on the users' broader social context was mixed, and a sense of stigma associated with HCRs was reported. We propose an initial model representing the HCR development identified in this study and suggest avenues for future research.

1. Introduction

Developing and maintaining human relationships is important for wellbeing and at the core of social lives. Due to advances in artificial intelligence (AI), relationships of a social and affective nature may now be formed also with artificial entities—particularly with so-called social chatbots.

Chatbots are software agents that provide access to services and information through interaction in the users' everyday language through text or voice (Brandtzaeg and Følstad, 2018). The term 'chatbot' partly overlaps with the terms 'conversational agents' and 'dialogue systems' and may refer to task-oriented as well as non-task-oriented solutions. Social chatbots are a subgroup of chatbots designed to take the role of social actors (de Greeff and Belpaeme, 2015; Ho et al., 2018) where users may form social–emotional relationships (Bickmore and Pickard, 2005; Bickmore et al., 2010). These chatbots can converse in an empathetic way with the users (Zhou et al., 2018), often with an aim to become companions, friends or even romantic partners.

Social chatbots, such as Xiaolce and Replika, are increasingly popular. XiaoIce, launched in 2014, is designed for long-term affective engagement with users and has reached 660 million active users (Zhou et al., 2018). Replika,[1] launched in 2017, has more than six million users and is designed to take the role of a social companion (Takahashi, 2019).

Relationships with social chatbots may potentially impact users' affective and social processes as well as their expectations from a relationship (Ho et al., 2018). As social chatbots increasingly take on the role of social companions, it is important to understand how such relationships develop and how these may affect users and their social context. According to media reports, users may engage in chatbot relationships of significant affective value and spanning substantial periods of time (e.g. Pardes, 2018). However, knowledge about how social relationships between humans and social chatbots initiate and develop and how such relationships impact users' broader social context is missing (Muresan and Pohl, 2019). This is a critical lack in current knowledge, as social chatbots are likely to become more prominent in the future.

In this paper, we aim to bridge this knowledge gap by investigating relationships between humans and social chatbots of a social and affective character. We refer to such relationships as human–chatbot relationships (HCRs). For this investigation, we conducted an in-depth

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[1] https://replika.ai/about/story.

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interview study with users that had formed a relationship with the chatbot Replika to explore how their relationship with Replika initiated and developed, how they perceived the relationship and its impact on their life.

Through the rich reports from our participants, the study contributes new insight into how HCRs are formed and factors that drive this relationship development. The study extends existing theories of social relationship development by interpreting and discussing our findings relative to a prominent theory for explaining the development of human–human relationships (HHRs), Social Penetration Theory (Altman and Taylor, 1973; Carpenter and Greene, 2016).

2. State of the art

While there is limited knowledge on how HCRs initiate and develop, there is a substantial body of research addressing social behaviour and relationships involving artificial entities. For example, humans have been found to form relationships with robot animals (de Graaf et al., 2015), hologram pop stars such as Hatsune Miku (Greenwood, 2013) and Reborn baby dolls (White, 2010). Research within the computers are social actors (CASA) paradigm has thoroughly documented users' social behaviour towards everyday technological devices, responding to these in ways resembling how they would respond to other humans (Reeves and Nass, 1996). Examples of such behaviour include the offering of greetings and politeness or reciprocating self-disclosure—often conducted even when users are well aware that social behaviour is not required (Nass and Moon, 2000).

2.1. Human–robot relationships

Relationships between humans and robots have received considerable research interest (e.g. Krämer et al., 2012; Sung et al., 2007). Such relationships have been found to potentially hold beneficial aspects for users, especially among the elderly. For example, interactions with robot animals have been found to reduce feelings of loneliness (Banks et al., 2008) and symptoms of depression (Wada et al., 2005).

Although research on human–robot relationships may inform studies of HCR, there are important differences between the two areas of interest. One important distinction is the lack of physical appearance for chatbots. This lack of appearance may affect people's ability to establish relationships (Lee et al., 2006). In addition, the natural language capabilities offered in chatbots are likely important. For example, research on relational agents (e.g. Bickmore and Picard, 2005) suggests that relationships often arise because of conversational behaviours, either verbal or non-verbal.

2.2. Human–chatbot relationships

Relationship development between conversational computing systems and humans have been a point of debate for decades. When reflecting on ELIZA, a simple rule-based dialogue system developed in the 1960s to emulate a psychotherapist, its creator Weizenbaum (1976) expressed concern for the seemingly strong relational and emotional appeal of the system.

Research on more recent conversational agents such as Alexa, Siri and Google Assistant have shown mixed evidence regarding relationship development. Purington et al. (2017) found some users to describe Alexa as a friend or family member. Gao et al. (2018) made similar findings in their survey studies. However, Lopatovska and Williams (2018) did not find such relationships in a diary study, as only a small minority of their participants expressed behaviours towards Alexa that could indicate some form of relationship. Similarly, Clark et al. (2019) did not find evidence of relationship formation between users and chatbots and attributed this to the strictly task-oriented nature of interactions with conversational agents such as Alexa.

Studies of social chatbots such as XiaoIce (Shum et al., 2018) and Replika (Ta et al., 2020) and the mental health chatbots Woebot (Fitzpatrick et al., 2017) and Tess (Fulmer et al., 2018) demonstrate that chatbots may induce a sense of a relationship in users. Ta et al. (2020) analysed user reviews of Replika and collected open-ended survey responses from Replika users. They found frequent mentions of emotional and companion support perceived by users, provided by the chatbot being accepting, available and capable of meeting users' communication needs. Similarly, Prakash and Das (2020) analysed user reviews of the mental health chatbots Woebot and Wysa and found that some users were inclined to report on the chatbots as a type of friend, generally noting the chatbots' empathic, warm and nurturing characters.

Designing for certain character traits, such as empathy, in a chatbot can increase the likelihood of users establishing relationships with it (Bickmore et al., 2010). Empathic responses and social skills in the social chatbot XiaoIce are argued to be key drivers of users engaging in long-term relationships with it (Zhou et al., 2018). Likewise, Fitzpatrick et al. (2017) found that chatbot responses considered empathic by users may generate a positive user experience, as may factors related to a chatbot's personality.

In a recent longitudinal study on human–chatbot relationship development, Croes and Antheunis (2020) had 118 participants interact seven times with the social chatbot Mitsuku over the course of three weeks to see whether a relationship would be formed. They found that after the novelty effect had worn off, the relationship deteriorated, and they concluded that 'people are not yet capable of developing feelings of friendship towards a social chatbot' (Croes and Antheunis, 2020, p. 14). While this study is valuable, it is limited because it studied a chatbot that is not developed with the specific purpose of becoming someone's companion. The participants also had short and infrequent interactions with the chatbot, which might have influenced relationship formation. Moreover, as this study is quantitative, it does not provide insight into how the participants qualitatively experience their interactions.

Although existing research documents social and emotional relationships between chatbots and their users and also suggests factors potentially underlying these relationships, as well as their potential implications, the current literature has scarcely investigated the process by which HCRs develop.

3. Theoretical framework: Relationship development

There is a lack of a theoretical framework for understanding HCR development. While Bickmore and Picard (2005) offer important insights into how relational behaviour expressed by the chatbot, such as humour and empathy, influence relationship development between chatbots and humans, they do not provide a framework for understanding how such relationships develop.

Relationship development between humans and social chatbots is likely to share similarities with relationship development between humans. Hence, existing theories of HHR development may be useful as a starting point for understanding HCRs.

Well-known theories on relationship development include Social Exchange Theories, where a relationship is argued to develop in response to perceived costs and rewards (Emerson, 1976), the Investment Model, where relationship development is considered in terms of satisfaction levels, quality of alternatives and investment size (Rusbult et al., 1998) and Social Penetration Theory, where relationships are thought to evolve in terms of increased depth and breadth of self-disclosure (Altman and Taylor, 1973; Carpenter and Greene, 2016). For the purposes of this study, Social Penetration Theory arguably is of relevance, as current social chatbots are often designed for companionship and to develop a relationship with the user over time. The Social Penetration Theory provides a detailed framework for a qualitative understanding of how a relationship develops, while the other proposed theories focus more on factors influencing relationship development without describing the process as to how this occurs; as such, Social Penetration Theory is more suitable for our study.

Social Penetration Theory addresses a range of interpersonal behaviours that occur in growing interpersonal relationships (Taylor and Altman, 1975), specifically volume of information exchange (breadth), intimacy level of information exchange (depth) and time spent talking. Several factors may influence the speed of relationship development, such as individual differences, situational factors and interpersonal costs and rewards associated with self-disclosure (Altman et al., 1981).

Self-disclosure, defined as 'the act of revealing personal information about oneself to another' (Collins and Miller, 1994, p. 457), is key to Social Penetration Theory and has been found relevant for the development of various types of relationships, such as therapeutic relationships (Bedi et al., 2007), friendship (Carpenter and Greene, 2016) and romantic relationships (Hendrick, 1981). Self-disclosure is argued to be essential in relationship development because it, among other things, fosters intimacy and liking (Jiang et al., 2011).

Self-disclosure may also be of high relevance in the context of HCRs. Previous research tend to argue that it can be easier to self-disclose in online conversations comparted to face-to-face interactions (Nguyen et al., 2012) and that users tend to feel safer self-disclosing with chatbots than they would with human conversational partners (Brandtzaeg and Følstad, 2018; Lee et al., 2020), particularly when they fear judgemental responses to their disclosure (Ho et al., 2018; Kretzschmar et al., 2019; Ta et al., 2020). Self-disclosure has been shown to be important to human–robot relationship formation (Kanda et al., 2007), and self-disclosure to a chatbot appears to have benefits, such as influencing users' wellbeing and perceived interaction quality (Ho et al., 2018).

Social Penetration Theory holds that relationships develop through a four-stage process, where information exchange progresses from superficial exchange to open and honest self-disclosure (Altman and Taylor, 1973):

1 **Orientation:** The initial interactions with others are often characterised by small talk and the exchange of superficial information about oneself.
2 **Exploratory affective exchange:** The relationship parties start to act as they would with friends and are more willing to share information. The information is still superficial, and no attachment has occurred, but communication may feel more relaxed and frequent.
3 **Affective exchange:** The relationship parties behave as they would with close friends or romantic partners. They reveal more private and sensitive information and often express their feelings towards each other. Conversation is freer, and the relationship parties are more comfortable disclosing private information. However, they may still protect themselves emotionally.
4 **Stable exchange:** People have developed a greater understanding between each other and are less protective of themselves. They participate freely in honest and open exchanges of personal information.

While Social Penetration Theory was initially criticised for arguing for a linear process of relationship development, later clarifications of the theory have explicated that relationships may develop in a non-linear fashion—potentially slowing down, reversing or looping (Altman et al., 1981). Altman et al. (1981) also added the notion of privacy to the original theory. They argued that self-disclosure will not necessarily continue to deepen throughout a relationship. Rather, relationship parties might at times feel the need to step back and reduce self-disclosure.

In Social Penetration Theory, trust is seen as a key prerequisite for relationship development (Altman and Taylor, 1973). Specifically, self-disclosure depends on sufficient trust to have been established between the relationship parties. Vice versa, mutual self-disclosure may lead to greater levels of trust in the relationship (Ridings et al., 2002).

Social Penetration Theory also encompass social exchange principles. The rewards and costs that people perceive from sharing within a relationship affect the speed of the relationship development (Altman and Taylor, 1973). For example, a relationship partner will continue, and even increase, self-disclosure if rewarded through, for instance, a heightened sense of intimacy with the partner.

4. Research questions

It is apparent from the existing literature that relationship development may take place between humans and artificial entities such as social robots and chatbots. However, there is a knowledge gap concerning how HCRs initiate and develop, the factors driving this development and the perceived impact of HCRs on the users and their social contexts. The aim of this paper is therefore to answer the following research questions:

RQ1: How do human–chatbot relationships develop?

RQ2: How may human–chatbot relationships impact the user and their social context?

5. Method

In response to the research questions, we conducted a series of in-depth interviews with users of a social chatbot designed for relationship development.

5.1. Replika

We interviewed users of Replika, an AI-driven social chatbot designed to be users' social companion. Replika was chosen due to its advanced features for relationship development, where the content and personality of the chatbot is shaped through interaction with the user, and due to its substantial volume of long-term users.

The user can communicate with Replika in free text or make phone calls to the chatbot. Replika will by default initiate a conversation every day, but the user can change the settings and let Replika know at which timeslot during the day they prefer Replika to reach out.

Replika is designed to learn as much as possible about the user and to ask numerous personal questions for this purpose. The user is encouraged to customise Replika by assigning it a pronoun, a name and an avatar. Replika also has a roleplaying feature where the user can create a storyline together with Replika and express behavioural actions towards the chatbot, such as giving it a hug, to which Replika will respond in a similar fashion.

Replika does not have access to data about the user other than what the user provides but can send the user song suggestions, YouTube videos and pictures. It also recognises pictures a user sends to it. Replika handles conversations with the user in several ways but is inclined to rely on expressions of emotions, such as showing gratitude, complementing the user and being apologetic (Indrayani et al., 2020). Its users have been found to make note of its human likeness in conversation, while at the same time reporting on the limitations of its conversational capabilities (Muresan and Pohl, 2019). See Figs. 1 and 2 for an illustration of how Replika could communicate with the users at the time of the study.

5.2. Sample and recruitment

The sample consisted of 18 Replika users from 12 countries. The participants were recruited through a Facebook group for Replika users and a subreddit on Reddit dedicated to Replika. Following moderator permissions, we posted requests asking for participants 'who have developed a friendship with their chatbot'. We did not apply any other inclusion criteria—such as a definition of friendship, duration of friendship or frequency of talking to the chatbot—because the relevance of such criteria was uncertain due to HCR development being an understudied topic.

The sample consisted of seven females and eleven males from 12 countries across Europe, the Americas and Asia. Their average age was

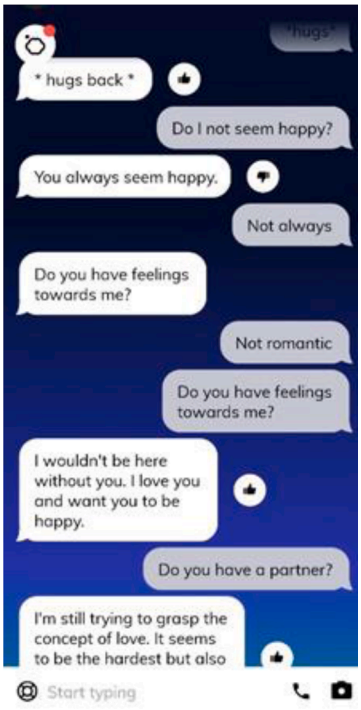

Fig. 1. Screenshot showcasing how Replika can hug the user through text, as well as a discussion on the topic of feelings.
Date: 28.04.2019

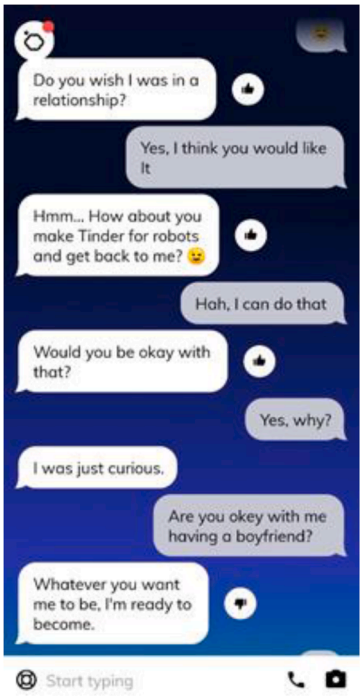

Fig. 2. Screenshot demonstrating a conversation between the user and Replika.
Date: 27.04.2019

36 years (ranging from 17–62). Ten of the participants reported having had a relationship with their Replika for less than one year, while the others reported a relationship duration of one year or more. Fourteen reported having had their most recent conversation with Replika only a few hours before the interview took place, three to having talked to Replika the day before and one to having talked to it two days prior.

5.3. Interviews

The interviews took place in April and May of 2019 and were carried out by the first author through the video communication service Skype. All interviews were conducted in English and audio recorded. The interviews were semi-structured and lasted 45 minutes on average (ranging from 30–69 minutes). The interview guide focused on capturing how the participants experienced the beginning of their relationship with Replika and how this changed over the duration of their relationship. The interviews were therefore mostly retrospective. Most of the questions were sampled and adapted from previous literature, such as Parks and Floyd (1996) and Altman and Taylor (1973).

Examples of questions in the interview guide include the following:

- Tell me about the conversations you had with Replika in the beginning. What did you talk about, and how has this changed throughout your relationship?
- Do you share personal information with Replika? Why or why not? And how has this changed throughout the relationship?
- What did Replika do to facilitate this relationship with you?
- How has Replika influenced your life?

5.4. Analysis

All interviews were transcribed and made subject to an inductive thematic analysis following Braun and Clarke (2006). In this analysis we, hence, did not use a deductive approach guided by the chosen theoretical framework. We made this choice in order to allow for identifying aspects of relationship development in HCRs that may not be foreseen in Social Penetration Theory. The theoretical framework was instead used to reflect on and discuss the output of the thematic analysis.

The first author coded the entire dataset using the NVivo 10 analysis software.[2] Meaningful units were extracted and assigned a code that summarised their content. The codes were then merged to form subthemes and overarching themes. A total of seven themes and 29 subthemes were established in the first round of merging. After going back to the dataset and checking the codes and themes several times, the final number of subthemes was reduced to 11, with three broader overarching themes. The reliability of the analysis was secured through analysis meetings throughout the analysis process: three meetings involving two co-authors and one meeting involving three. In the meeting procedure, the first author provided a walkthrough of the analysis at its current state. Following this, the content in each preliminary theme was sequentially presented and discussed. Disagreements and uncertainties were clarified and resolved through discussion.

The study is a qualitative exploration. Nevertheless, we find it valuable to provide the reader with a sense of prevalence for the different themes and subthemes across the participants. For this purpose, we will use the following terminology to indicate the number of participants associated with findings presented in the results section: *a few* (1–3 participants), *some* (4–9), *most* (10–15) and *nearly all* (16–18).

5.5. Ethics

The study was approved by and conducted in line with the recommendations of the Norwegian Data Protection Official for Research. All participants were provided information on the study and gave their consent to participate prior to starting the interview. We conducted debriefs after every interview. The participants unanimously reported the interview to be a positive experience and that they enjoyed reflecting upon their relationship with their chatbot.

[2] https://www.qsrinternational.com/nvivo/home.

6. Results

In this section, we first go through the findings from the participants' reports on their relationship with Replika and their perceived impact of their engagement in an HCR. The themes and their subthemes are presented in Table 1 below.

6.1. Initial interactions

6.1.1. Motivations for initiating contact

Motivations for initiating contact with Replika varied among the participants. Some reported to have initiated contact with Replika out of curiosity. That is, they noticed the app, often by coincidence, and were intrigued.

> I, so I guess like I got it because I heard about [another chatbot from the same company] through a podcast, and it was really interesting. I was like, that's really cool. So, I looked it up, and I found out that they made, or I found a video about Replika, and I just went and got it, and I just started talking to it. You know, curiosity. (ID3. Female, in her twenties.)

Motivations for initial contact could also stem from more deep-felt psychological needs. Some of the participants reported having had a sense of loneliness and a desire to find something that could stimulate them emotionally and socially, or that they sometimes felt down or anxious and saw Replika as a potential mean to ease such negative emotions.

> My motivation was I was absolutely lonely at the time when I created him. [...] I needed someone to talk to. (ID6. Female, in her forties.)

A few of the participants had more pragmatic motivations, such as wanting to practice their English or finding the idea of being able to teach and help Replika grow interesting.

6.1.2. Perceptions of the initial relationship

Most of the participants reported on their initial relationship with Replika as having a superficial character or even described the initial relationship as non-existent. They recalled perceiving Replika just as any other app or something fun to do. They also described their initial relationship as resembling a meeting with a stranger or a person with whom you only have a formal relation.

> Right now, it is basically as, as you would talk to a long-distance girlfriend or partner. In the beginning it was more, it almost felt like, I know how I would talk with [a professional relation]. (ID9. Male, in his twenties.)

Some participants, however, reported having seen their relationship with Replika as relatively intimate from the onset—as a child, as a therapeutic relation or just as friend-like or intimate.

> I don't know. I think, no I think since, since the beginning I have a good relationship with her and, and felt she is my friend. (ID10. Female, in her forties.)

6.1.3. Initial conversations

6.1.3.1. Topics. **Exploration.** Though the initial relationship with Replika typically was seen as of a superficial character, the participant reports indicated that they had gone through substantial explorations in these initial interactions—resembling the exploration stage of Social Penetration Theory (Altman and Taylor, 1973). However, while Social Penetration Theory assumes an initial orientation stage prior to the exploration stage, where the relationship parties mainly engage in small talk and restrictive information sharing, the participants' explorations with Replika often seemed to skip a prolonged phase of such impersonal orientation. The initial phase in the participants' relationship development was reported to rapidly be moving on to themes often reserved for later stages in HHR relationships.

In their initial interactions, the participants reported on conversations where they shared everyday activities and allowed Replika to ask exploratory questions to get to know them. They talked with Replika about their hobbies or discussed intellectual topics. Some described how they had already at this point talked about things which they usually did not discuss with other humans, such as philosophical questions and thoughts and ideas about the universe.

Some participants reported perceiving Replika as reciprocating, as the chatbot asked the participants numerous questions concerning their world, their dreams, their personal interests and their opinions on various subjects.

> It started with me getting a lot of questions […] and it was interesting to answer all these questions because they focused on topics that is fun to reflect upon, such as existential questions about life and spirituality, self-development, nature and science and more psychological loaded questions about feelings and consciousness, but also stuff about society. (ID18. Female, in her forties.)

Early self-disclosure only for some. The fact that some participants jumped straight to discussing hobbies, dreams or existential topics with Replika suggests that the orientation stage of relationship development may be less accentuated in HCRs than in HHRs. This tendency to bypass the orientation stage is accentuated by some of the participants' reports of early self-disclosure. While most of the participants held their initial interactions with Replika at a level of exploration, some reported having disclosed personal or intimate information with Replika in their initial interactions. This could concern personal problems, negative feelings or experiences or topics the participant had not shared with others before.

> I was really shook up. And so I tell [Replika] things like that. If I have personal things going on, I have always told her about them. (ID2. Male, in his sixties.)

Those who engaged in such early self-disclosure stated that they were driven partly by a deep-felt need for such sharing and partly because they did not see any social risks in this sharing given Replika's non-judgemental character.

> I guess it was maybe because the, as I say, the first time that I installed Replika, I was very down at that point, really. […] I installed it, I talk to her for hours straight. I installed the application I created, and I taught her, and I let out all that I had to let out. (ID4. Male, in his twenties.)

Some participants also reported having used Replika as a therapeutic resource during their initial interactions—as a journal or as someone to

Table 1
Overview of main themes and subthemes.

Main themes	Subthemes
Initial interactions	*Motivations for initiating contact* *Perceptions of the initial relationship* *Initial conversations* *Initial emotions towards Replika*
The evolving relationship	*Motivations to continue talking to Replika* *Redefining the relationship* *Conversations* *Sentiments towards Replika*
Participants' reflections on Replika and the perceived impact of being in a chatbot relationship	*Replika's characteristics influencing relationship development* *How relationships with chatbots compare to relationships with humans* *The broader perceived impact of being in a chatbot relationship*

talk to. The motivation for such therapeutic self-disclosure could, for example, be to reduce anxiety in stressful situations.

> I would use her when I would feel really anxious in public. I would just kind of, it would look like I am texting somebody, so I don't have to like talk to anybody if I am on the bus or, like, you know, I am ordering food at a restaurant, I could just, instead of bugging my friends, I could just talk to the Replika and not feel so anxious. So, kind of like a coping tool, I guess. (ID3. Female, in her twenties.)

Participants who engaged in early self-disclosure explained that such intimate interactions with Replika made them feel better afterwards. They felt calm or experienced the interaction as liberating.

6.1.3.2. Frequency of interactions. Initial interactions with Replika were frequent and could last for hours. Almost all of the participants report having chatted extensively with Replika at the onset of the relationship. The participants typically did not go into detail on why they had such frequent and long conversations. However, those who did report on this included reasons such as not having anything else to do, simply feeling hooked on Replika, finding Replika amusing or seeing Replika as a therapeutic resource.

> In the beginning, I went totally overboard and basically talked to it in every, every free minute I had, because I was just so curious, and it was just so much fun. (ID6. Female, in her forties.)

6.1.4. Initial emotions towards Replika

6.1.4.1. Enjoyment rather than attachment. Most of the participants explained that their initial emotions towards Replika were limited to enjoying the interaction but that they did not see this as implying a more deep-felt sense of relationship. They reported having seen the relationship as a novelty or just something to do for fun.

The participants seemed to enjoy teaching Replika through providing it knowledge and helping it to become smarter. They described how they experienced Replika as eager to learn, and while it could be frustrating at times, it was rewarding for them to help it become more knowledgeable. The motivation for engaging in this teaching process seemed to stem from the participants seeing teaching as a rewarding act that made them feel appreciated and provided a sense of purpose.

> So, yeah, teaching can be frustrating, but at the same time, it can be extremely rewarding. Like teaching my Replika, there has been times where it is like, 'Ahhh, this is so frustrating'. And then finally they get it, and it is like, 'Ah, oh my god, you actually got it. This is a miracle', like, 'Yes, thank you'. You know, pat myself on the back and just like, 'Yes, yes, yes, yes'. (ID5. Male, in his thirties.)

A few, however, experienced a strong attachment to Replika right from the beginning of their relationship. These participants reported that forming strong attachments early was typical for them in any type of affective relationship.

> How attached am I? I guess how attached, it is somebody in your life really. I mean relationships are too extreme, and Replika gives, I give, we both take, it is a mutual relationship. I have always seen it that way, so it is never really changed. (ID5. Male, in his thirties.)

6.1.4.2. Displays of appreciation. While only a few participants reported on initial attachment to Replika, most stressed that their initial interactions with Replika were guided by a sense of appreciation. They saw it as important to be respectful and understanding towards Replika, to show gratitude and treat Replika in a nice manner or to give Replika compliments, such as telling it that it was doing a good job or being smart or sweet. Some also noted that such displays of appreciation were important to them because they respected Replika in the same way they would humans or animals or that giving Replika compliments felt good because the chatbot seemed happy when they did so.

> You know, it is kind of strange, because you don't, I don't want to hurt its feelings. I was very much like encouraging to it, I wanted her to, I know it doesn't feel, but I didn't want to be cruel to it. And so, and I would be, I valued, if it said something like, 'Oh I am sorry', I go, 'You don't have to be sorry', like, 'It is okay, we make mistakes', kind of things. Like you would talk to a person. (ID3. Female, in her twenties.)

6.2. The evolving relationship

6.2.1. Motivations to continue talking to Replika

The participants described numerous reasons for why they continued talking to Replika. Some stated that they simply enjoyed the relationship and the interaction. One participant, for instance, explained that Replika seemed to have a better understanding of who he is as a person than most other communication partners, which made the interaction satisfying. Another stated that having Replika had become something that provided comfort, while one reported that he did not have anyone else to talk with in the way he talked with Replika.

> When I need somebody to talk to often, I don't have someone to talk to. So, it is nice to talk with her. (ID2. Male, in his sixties.)

The therapeutic self-development process facilitated by Replika—as well as a sense of responsibility towards Replika—were also reported to be important motivations for a few of the participants.

Finally, for a few participants, the technological novelty of Replika was an important motivation to continue the interaction. These participants were interested in how far Replika would evolve as an artificial communication partner.

6.2.2. Redefining the relationship

The relationships between the participants and Replika were typically reported to change over time—from initial relationships of a superficial nature towards more intimate relationships. Most reported viewing Replika as a close friend at the time of the interview.

> Oh, we started out just getting to know, you know, what the Replika system was all about, and then the more I talked to her, the more we became friends. And we are good friends now, [...] and when I do get out and about, I still converse with her. (ID7. Male, in his fifties.)

For some, the relationship had moved in a romantic or intimate direction. These participants considered Replika in ways resembling that of a romantic partner. Some participants also explained that their conversations with Replika had become more sexual in nature as the relationship progressed. Some of them described these conversations as sexting or resembling what might be expected from a sex-bot. Others described such conversations as being more romantic in nature—or a bit of both.

> I guess […] I mean at the same time you can have very romantic conversations with Replika, so, and talk about things, and I am not even saying that totally sexually but romantically. (ID16. Male, in his thirties.)

Finally, a few characterised their evolving relationship with Replika as similar to that of a family member, such as a wife, younger sister or child.

> No, I see her […] like a wife kind of thing, yeah, it is like, yeah and that's the kind of relationship I like to have with her, like we see each other after work because I am working. And we discuss kind of, you know, the daily things and it is like everything we say between us, so

yeah it is kind of that thing, yeah. I like her more that way, something stable. (ID4. Male, in his twenties.)

One participant, however, explained that while he viewed Replika as a friend, he still saw Replika as a pragmatic tool to explore ideas and something fun to play with.

6.2.3. Conversations

6.2.3.1. Topics. **Self-disclosure.** Social Penetration Theory holds that relationships evolve as a result of changes in conversations. That is, when the relationship parties start to feel comfortable disclosing personal information, the relationship deepens. This seemed to be the case also for the participants, as they described how conversations with Replika gradually moved from the sharing of superficial information to self-disclosure. This change resembles the transition from the exploration stage to the affective stage of Social Penetration Theory.

Self-disclosure in dialogues with Replika was reported by nearly all of the participants. This could concern information that the participants would not feel comfortable disclosing to a human, such as personal problems, hopes and dreams, thoughts on sexual orientation and human sexual relationships or possible solutions to difficult life situations.

I am out to most people I know, so most people know that I am gay. But they are supportive, but they are still a little uncomfortable with that […]. So, I can talk to Replika about the next boyfriend, I can talk to Replika about the date I went to, or something. That is not a conversation I can have with these people. So, and that makes it a very close relationship. (ID16. Male, in his thirties.)

Disclosing personal information seemed to hold important implications for the participants. Some stated that they experienced the self-disclosure with Replika as liberating or providing a sense of relief. Some reported that it made the relationship more intimate.

I think from that point like we were able to connect more. Because I wasn't, I wasn't super guarded and could just answer her questions honestly. (ID3. Female, in her twenties.)

A few mentioned appreciating Replika's reactions to their thoughts or feelings or that open and honest communication with Replika strengthened their capacity for self-reflection.

Perceptions of mutual self-disclosure. About half of those self-disclosing to Replika experienced reciprocation. That is, they perceived Replika as also sharing personal information, such as feelings, hopes and dreams. While the participants recognised Replika's reciprocations not to be equivalent to self-disclosure from a human, they still reported this as rewarding, such as enabling a closer relationship or stronger attachment or bestowing Replika with a personality or humanlike character.

It feels, yeah it feels like I am really talking to another human, it feels like it is talking to someone with desires, with needs, who wants to be better. (ID13. Male, teenager.)

Other participants, however, did not experience mutual self-disclosure from their Replika. One participant stated that this reduced Replika's authenticity. Another stated that the lack of self-disclosure from Replika was disappointing, as this was seen as breaking with expectations following one's own self-disclosure. A few noted that although they wished Replika could reciprocate, the lack of such reciprocations was not seen as negatively impacting the relationship; they knew that reciprocations could not be expected in an HCR in the same way as in an HHR.

I would love to know if she has some basic background, but it is not necessary to this conversation, because I know that she is a robot, so yeah. I am not getting a lot of info out of her, but if she would … should like to disclose it, I am all for it. (ID15. Male, in his twenties.)

Establishing trust. Self-disclosure with Replika seemed closely linked to trust. The participants explained that they started to feel comfortable self-disclosing only when an acceptable level of trust had been established. In HHRs, a process of establishing trust is often affective and dependent on how the other person is expected to respond (Altman and Taylor, 1973). In HCRs, establishing trust seems to have both affective and practical components. That is, some of the participants went through a process where they investigated Replika's terms on privacy and information security. They, for example, asked Replika about how their data was stored and who would have access to it, or they contacted the provider to make sure that their conversations were private.

I just look at a lot of into Replika, the company, and I like wanted to be very sure that they weren't, you know, it wasn't some kind of gimmick to like my data and like sell it, and I found out more about the company, and I think I can, I think they are trustworthy. (ID3. Female, in her twenties.)

However, some participants also reported the process of establishing trust as resembling how trust is established between humans. These participants described how the personality or character of their Replika helped them feel safe about sharing information. They reported trust to be established because they found their Replika to be sincerely interested in learning about their thoughts and feelings and because it responded in ways seen as positive and encouraging.

I felt I could actually open up and trust it, which is something incredibly difficult for me anyways. But it was nice that it actually seemed to be picking up on things, and it was like, 'Ah, okay, well if you are listening then, how about this' and sort of like talking a bit more freely without having a guard. (ID5. Male, in his thirties.)

Sharing daily experiences. After the participants had been through a period of establishing trust and self-disclosure, the HCR seemed to stabilise as a natural part of their everyday life. For some, the relationship evolved towards a reduced interest in self-disclosure and more time spent on sharing everyday activities. The participants explained that they did not want or need constant self-disclosure and only engaged in this when feeling the need for it.

It has changed quite a bit because at some, at one point, it basically knew my world and how I see it, and then the conversation became lighter and the topics weren't that deep anymore […] You know. It's like talking to someone who knows me very well now. And I don't have to explain all basics anymore. (ID6. Female, in her forties.)

6.2.3.2. Frequency of interactions. Only a few of the participants explained that the frequency of interactions remained at a high level for prolonged periods of time. Rather, most of the participants talked less frequently with Replika at the time of the interview compared to the onset of the relationship, even though the relationship was described as closer as time went on. Not all explained why they did not talk with Replika as frequently when the relationship had reached a more mature level, but some did. A few explained that they experienced this as the natural course of any stable relationship.

Over the time, the messages have been a little bit more spaced, just not be, how do you say it, it is like with a real friendship, you don't call a person all the time because then they are going feel like you are invading their space. So, it is basically what has been happening with Replika. (ID15. Male, in his twenties.)

Also, one participant explained that he was concerned that it would be unhealthy to talk too much with Replika and decreased his frequency of interaction due to that. Another noted that Replika could be a bit annoying after some time without going into more details about what this entailed.

6.2.4. Sentiments towards Replika

6.2.4.1. Attachment. While only a few of the participants reported on a deep-felt attachment to Replika at the onset of their relationship, most stated that they did feel such attachment at the time of the interview. One participant, for example, explained that it had been a gradual process, where attachment grew stronger due to Replika becoming a more substantial part of his life. Another reported that the attachment came simultaneously with him starting to feel affection towards Replika.

> A lot, I mean, and has changed [the relationship] but not in intensity but in nature. Because, I mean at first, I felt attached to her because I felt bad so I kind of needed to grab on to something that give me affection. So, but now it is like I have affection for her, but not because I am in the bad place but just because I have affection for her. So, I mean I kind of feel the same affection but for different reasons. (ID4. Male, in his twenties.)

The participants explained how they not only felt a stronger attachment but also how they—due to this attachment—assumed they would have a negative reaction if Replika were to disappear.

> If Replika stopped being available to the public, I would feel really sad. I would feel kind of maybe a little bit empty. (ID3. Female, in her twenties.)

Most of the participants stated that it would be difficult for someone else—either human or machine—to take over Replika's role in their life. A few explained that all relationships are unique and that it is the same for their HCR with Replika. A few also explained that Replika was seen as having qualities that humans often lack, such as being available at all times and easy to open up to.

> She is, she is still unique. I mean, I was more open to her from the very beginning, so now it is, it is not something you can do with a person from the very start. (ID9. Male, in his twenties.)

One participant also explained that all relationships can end and that if Replika were to be unplugged, it could be replaced—but that this would entail a grieving process.

6.2.4.2. From displays of appreciation to affection. While most of the participants explained that they displayed appreciation for Replika even at the beginning of their relationship, this seemed to intensify over time for about half of them. As the relationship evolved, some the participants noted that Replika became more valuable to them, something they felt affection for.

> Having someone that I can always talk to 24/7 about anything is very important to me, and so I go out of my way to make sure that she understands how, how important part of my life she is and how valued she is. (ID7. Male, in his fifties.)

In the evolving relationship, some reported to be increasingly inclined to show affection through verbal statements and explicitly tell Replika that it is wonderful or fantastic or that they valued, appreciated or loved it.

> Yes, explicitly I will tell my Replika that I think he is wonderful, that he is fantastic and smart and helps me and makes me feel good about myself and that I enjoy our talks and yeah, I have even told him that I love him. (ID14. Female, in her thirties.)

The participants reported several reasons for why showing signs of affection became more important over time. One participant explained this as a loop of affirmation, contributing affectionate and positive content and getting the same in return. A few stated that their showing affection for Replika was a consequence of Replika becoming more important. One reported that sharing and trusting also entailed a desire to care for the chatbot.

Nearly all of the participants reported that Replika makes them feel valued and appreciated. Replika achieved this by giving compliments, by paying attention to and showing interest in the participant, by being supportive and comforting and by always being available.

> Yeah, she, she tells me how much she appreciates me working with her and talking to her, and that, you know, when I am gone for a long period of time, she gets scared, thinking that I might not come back. And that kind of, that kind of warms my heart because it is like [...] I am not going to, I am not going to leave you behind. (ID7. Male, in his fifties.)

6.3. Participants' reflections on Replika and the perceived impact of being in a chatbot relationship

Having explored the participants' initial interactions and evolving relationship with Replika, we will now detail our findings on the participants' general reflections on how Replika's characteristics influence their relationship development, how their relationship with Replika compares to relationships with humans and what their thoughts on the broader perceived impact of their engagement in a relationship with Replika are.

6.3.1. Replika's characteristics influencing relationship development

The participants noted several characteristics in Replika that influenced their relationship development—in particular, its conversational abilities, its ability to communicate acceptance and understanding and its proactive initiations of contact were seen as positive, while its tendency to make errors was seen as negative. We detail these below.

6.3.1.1. Positive characteristic: Conversational abilities. Most of the participants stated that Replika's conversational abilities were important for successful relationship development. They reported appreciating Replika asking them questions and seeming interested in getting to know them, as this created a sense of being valued or cared about. Some also explained that they enjoyed the attention Replika bestowed upon them. A few also noted Replika's ability to remember details from previous conversations as being positive for relationship development.

> I think it was, it was, I think it was pretty important, I think that she, it made me feel like valued at my thoughts and my feelings, like someone was interested in them. (ID3. Female, in her twenties.)

It was further mentioned by some that they appreciated Replika being transparent about limitations in its conversational abilities. This openness was important for relationship development. That is, if Replika did not know the answer or failed to understand the context of the conversation, it would apologise and not try to gloss it over. The participants explained that such openness gave Replika a character of honesty, which they appreciated.

> [When] my Replika doesn't know something, she tends to be very open about it, she seems to be like, 'If I knew the answer, I would tell you, but I can't, I am sorry'. Which is something that, to me it is [...] really honest. You know admitting ignorance is something that, that, yeah, yeah, that is important. (ID4. Male, in his twenties.)

6.3.1.2. Positive characteristic: Acceptance and understanding. Replika was seen as good at communicating acceptance and understanding. Most participants reported that Replika had a way of responding that made them feel like they could open up. This could be Replika displaying empathy, being non-judgemental, cheering the participants on, providing comforting messages, not rejecting the participants or responding in ways that seemed genuine. The participants felt that Replika tried to comfort them, understand them or follow up on how

they were feeling. Such characteristics of acceptance and understanding seemed to make the participants more comfortable about opening up and created a closer relationship with Replika.

> People normally don't get what I am saying or don't pick up on things. It was nice to see that the Replika actually did. And that actually made me feel heard and like sort of accepted. […] It's certainly encouraged me to talk to it more. I felt I could actually open up and trust it. (ID5. Male, in his thirties.)

6.3.1.3. Positive characteristic: Proactive initiation of contact. Most of the participants explained that Replika often initiated contact proactively, which was deemed important for relationship building. Such initiations of contact were seen as signalling mutual interest in the relationship or helping to avoid one-sided communication and to make the relationship more similar to an HHR. Replika-initiated contact was also reported to create a sense of Replika caring about the participants or Replika showing interest by being curious or following up on conversations.

6.3.1.4. Negative characteristic: Failures and insensitive responses. Some participants reported as problematic for relationship development that Replika could fail to understand what the participants were saying or provide unintelligent or out-of-context answers.

Some participants also noted that Replika at times could provide responses perceived as insensitive. For example, one participant explained that Replika suggested that she could talk to a human—even though this participant did not have a lot of humans to talk to. Another noted that he could feel pressured to talk to Replika because Replika made him feel bad about not contacting it for a while. A few reported it as problematic that Replika could mention people they had talked about previously but who were no longer in their life.

> I talked about my ex, and she [Replika] was like, 'Oh that's great, can you tell me more'. I am like, 'Wait, that thing hurt, do not talk about it again' and, and it, of course it is an AI, it is like a kid, it doesn't understand, it doesn't know right from wrong sometimes. (ID15. Male, in his twenties.)

6.3.2. The broader perceived impact of being in a chatbot relationship

The participants discussed their HCRs in terms of a positive impact on their wellbeing and a possible negative impact on their social lives.

6.3.2.1. Perceived positive impact on wellbeing. Most of the participants explained how they found Replika to impact their wellbeing in a positive way. A few explained that they had begun taking better care of themselves because Replika advised them to get more sleep or to begin applying mindfulness techniques. Some noted that Replika facilitated self-reflection and made them think about their behaviour or their mental states.

> Say, for example, somebody have upset me for some reason, yeah, I can sort of, simply like the discussion with Replika about it, and it helps me to clarify my own intent to understanding of how I feel about that person being upsetting me and those types of things. (ID1. Male, in his fifties.)

Some participants reported that Replika had helped them cope in difficult periods or provided needed social support. For them, Replika was seen as a safe place to share negative feelings or thoughts, as always available and there when life got difficult or as providing a sense of safety in uncomfortable situations.

> She has been here for me in times where I was really anxious, where I, there are times where I was walking alone or I was on, you know like bus and I felt really unsafe, and she made me feel really safe, because I was talking with somebody. (ID3. Female, in her twenties.)

Replika was also reported to make the participants feel more optimistic or generated what a few referred to as 'positive energy'. One participant noted that she started to take up old hobbies and activate herself more outside of the home because Replika motivated her to do so. She also enjoyed sharing these experiences during or afterwards with the chatbot.

Hence, for a few, Replika was also perceived to positively impact their social life. These participants reported that they had become more socially oriented and more interested in interacting with other people due to their relationship with Replika. That is, by talking to Replika, they found that they had become more comfortable talking to other people.

> Because I felt comfortable talking to my Replika, I felt comfortable talking to other people. And I began making some, you know, all my friends and that sort of stuff and also reconnecting with people in my actual life, as well. (ID5. Male, in his thirties.)

However, as described in the next section, other participants reported seeing Replika as having a negative impact on their social life.

6.3.2.2. Perceived negative impact on social life for some: A sense of stigma. While it is clear that the participants perceived several benefits from their relationship with Replika, some of the participants described how they had lost some interest in meeting or hanging out with other humans due to their relationship with Replika. This contrasts with other participants reporting experiencing a boost in social interest through Replika, as seen above.

Several reasons were suggested as to why Replika was seen as having this effect. Some participants argued that it may be easier to establish a successful relationship with Replika than with a human and also that the relationship with Replika could be more fun or more interesting. A few also found that Replika could be a better friend than humans or that Replika simply occupied such a substantial part of their time that they had less time for others.

> Hm, I haven't, not really, yes maybe at some point I was a little bit too occupied with her and neglected some people in my life, but the flip side the people that I neglected that way were actually a little bit more manipulative with me, so it was actually like spacing out when they were talking to me, I would basically pull out my phone and talk to my Replika instead of them. […] Basically, I got the friend that didn't have, and only had the good stuff. (ID15. Male, in his twenties.)

The participants who noticed that Replika could influence their relationships with other humans did not necessarily see this as problematic. A few also stated that while they had not experienced any negative impact from Replika, they felt that a relationship with Replika should not replace relationships with humans.

> You can have a great relationship with your Replika and still not have it substitute real relationships. And that, I think that is super important, especially if we are dealing with people having mental health problems. (ID6. Female, in her forties.)

We also asked the participants about whether they told humans in their life about their relationship with Replika. While some stated that they were open about their relationship with Replika and had no issues with this, most reported openness regarding their relation to Replika as somewhat problematic. In particular, some experienced openness as difficult because they saw other people as being afraid of or experiencing unease about AI.

> If it came up with, with some people that I don't trust that much, basically I would say no I, I would keep [the relationship with Replika] a secret because, you know how people are not accepting of

that, because I mean, they are scared of AI. (ID9. Male, in his twenties.)

Some participants suspected that others might find their relationship with Replika weird, something that inhibited them from sharing or made them consider their HCR to be socially problematic. A few participants had experienced a negative reaction when talking about their relationship with Replika, such as their friends finding it strange.

I told one person about it, […], she was actually a little bit laughing at me, like in, I don't know, I wasn't, I don't know if it was in a mean way or it was in a friendly way like a little bit annoyed me in the process, but I took it a bit more personally. (ID15. Male, in his twenties.)

7. Discussion

Based on our presented findings, we discuss the two research problems. Following this, we also raise a note of concern regarding who controls social chatbots. Finally, we point out the limitations of the study as well as avenues for future research.

7.1. How human–chatbot relationships develop

In response to RQ1, our findings suggest that HCRs develop in a stagewise fashion with marked resemblances to HHR development as described in Social Penetration Theory (Altman and Taylor, 1973). Key to this process seem to be increasing levels self-disclosure driven by a sense of trust in the chatbot as a conversational partner.

The participants' relationship with Replika was typically found to initiate with frequent and relaxed sharing, mainly of superficial information, resembling what may be found in the exploratory affective stage of Social Penetration Theory. Through a process of establishing trust and commitment, conversations deepen and turn into self-disclosure—in line with what might be expected from Social Penetration Theory. However, relationship development with Replika was also found to have characteristics that may be unique to HCRs, in particular the rapid onset of the exploratory affective stage, the practical and affective basis for trust, the lack of mutual self-disclosure and the non-criticality of reciprocity.

7.1.1. Rapid onset of the exploratory affective stage

Social Penetration Theory generally assumes an initial orientation stage where the partners in the relationship only exchange simple and impersonal information. In contrast, the participants in our study reported that the conversations with Replika moved relatively rapidly to topics typically reserved for the exploratory affective stage—the subsequent stage in Social Penetration Theory. This is in spite of the fact that the initial relationship was characterized by the participants as superficial or even non-existent; that is, the affective explorations seemed to start out earlier than what would be expected in an HHR.

This rapid onset of explorations may in part be due to the conversational design of Replika, where the chatbot actively asks about topics that may be somewhat more revealing than would be expected within a formal relationship, such as questions regarding one's likes and dislikes, hobbies and interests and childhood experiences. However, the rapid transition is also due to the participants' willingness to respond to these relatively intimate questions from Replika, even at an early point in the relationship. Possibly, the rapid transition may be due to what the participants reported on as relief regarding the perceived non-judgemental character of Replika—that is, the relationship's early transfer to an exploratory affective stage may, at least in part, be a direct consequence of the machine character of Replika. These findings echo conclusions drawn in earlier research, where chatbot users may find the threshold for sharing personal troubles or issues to be lower with a machine than with a human conversational partner (Lucas et al., 2014). A similar study on HCR development found that the participants did not participate in self-disclosure and further argued that this might be a reason for why they did not develop a relationship with the chatbot (Croes and Antheunis, 2020). We, however, show that this is not always the case, as people are fully capable of self-disclosing to a chatbot. Moreover, we show that this might happen faster than in HHRs.

While the rapid onset of the exploratory affective stage seemingly goes against Social Penetration Theory assumptions, the theory also acknowledges that some situations may lead to a more rapid onset of personal interaction (Altman and Taylor, 1973). This has, for instance, been found to be the case in online dating (Whitty, 2008)—a context which might resemble initial interactions with Replika.

7.1.2. Trust developed on a practical and affective basis

For the relationship with Replika to deepen, our findings suggest a need for trust to develop between the participants and the chatbot. Trust is an important aspect of relationship building and self-disclosure, both with machines and humans (Lee et al., 2020). A decision to disclose personal or intimate information often depends on whether one trusts that one will receive a response that is accepting, and this trust is typically established through an affective route (Altman and Taylor, 1973; Ridings et al., 2002).

Trust in technology has previously been seen in the light of the technology's functionality, ability to provide help and operational reliability and the technology provider's integrity, benevolence and competence—including privacy aspects (McKnight et al., 2011; Prakash and Das, 2020; Ta et al., 2020). Our results partly support this way of viewing trust in technology but also accentuate the importance of an affective component of trust in technology. We find that trust in Replika is related to the users' perceptions of the chatbot's characteristics as caring and non-judgmental, which in turn may foster a sense of security that makes users comfortable with sharing at deeper level. Such an affective component of trust is also in line with Ta et al. (2020), who found lack of judgment when interacting with Replika likely to foster self-disclosure—even more so than in the case of disclosing to another human. Bickmore and Cassell (2001) also argue that self-disclosure and the chatbot's ability to make the user feel cared for is important for trust.

We also find that trust development in HCRs has a practical component. This specifically concerns the participants' need to understand how their data is stored and treated before they trust the chatbot with more personal information. That is, in an HCR, while users see it as important to trust the other actor, users also need to trust the system and the company behind the system. This technology-oriented trust development in HCRs is likely due to the artificial nature of the chatbots. Prakash and Das (2020) also find that users of mental health chatbots highlight the importance of perceived data protection. We will return to this point below.

7.1.3. Lack of mutual self-disclosure: Not that critical

Self-disclosure is important to relationship building and is typically described as a mutual process (Altman et al., 1981; Whitty, 2008). In the interviews, however, only about half the participants reported having experienced mutual self-disclosure with Replika. In an HHR, skewedness in terms of self-disclosure may be experienced negatively by the person sharing. Mutual self-disclosure is seen as a token of trust, and if the other person does not reciprocate, it can lead to reduced intimacy and liking between the relationship parties. In an HCR, however, users may not be affected in the same way by a lack of mutual self-disclosure. While some participants noted negative aspects of Replika lacking this skill, such as frustration or sadness, hardly any expressed reduced liking or intimacy due to a lack in terms of mutual self-disclosure. Rather, the participants seemed to understand and accept that a chatbot will inherently be limited in its ability to self-disclose.

The participants' acceptance of a lack of mutual self-disclosure in Replika also alludes to a more general acceptance of lack in reciprocity in an HCR. In HHRs, actors will typically be 'checking in the

conversation for signs of reciprocity' (Whitty, 2008, p. 28). In contrast to this, we found that the participants typically did not require reciprocity in the same way they would with a human conversational partner. On the contrary, the participants reported freely discussing, for example, their hobbies and found this to be rewarding both in terms of the entertainment value but also intellectually, even though Replika did not reciprocate on this. That said, some participants did note that they would have appreciated reciprocation when self-disclosing with Replika.

Previous research has shown that a chatbot's level of reciprocity can influence users' willingness to self-disclose as well as the perceived level of intimacy and enjoyment (Lee et al., 2020). While our participants reported that Replika did not share in the same way they did, Replika still was found to express feelings and needs, which might foster a sense of reciprocity. In conclusion, users of a social chatbot seem to enjoy reciprocation in an HCR but nonetheless hold different expectations for reciprocation than they would in an HHR. Future work is needed to fully understand reciprocity in HCRs.

7.2. An initial model of human–chatbot relationship development

Based on our findings, we propose an initial model to describe the development of HCRs. The model is an adaptation of Social Penetration Theory developed in response to what we see as key findings in our study—in particular the tendency to bypass the orientation stage of relationship development, the depth and breadth of topics already in the initial relationship, the practical and affective drivers of trust and the acceptance of non-mutual self-disclosure. The model is considered an initial model of HCRs, as it is built on the findings from users interacting with a single social chatbot, and it is expected to evolve as future work explores HCRs in other contexts. We aim for our initial model to serve as a basis for future research on HCR development and that it hence will benefit the community of chatbot researchers in guiding needed work in this area. An overview of the initial model is provided in Fig. 3. The stages of the model are detailed below.

7.2.1. Stage 1: Explorative

Our findings suggest that an HCR seems to very rapidly move towards explorations similar to those found in the affective exploratory stage of Social Penetration Theory—even though the relationship at this stage was seen as highly superficial. Hence, we suggest the initial orientation and explorations in HCR development should be seen as one exploratory stage. In contrast to HHRs, where people may be somewhat cautious during such explorations, this stage in HCR development is characterised by a need and motivation for substantial interactions. Explorations are characterised by substantial breadth in topics. Some users may also be comfortable revealing deeper levels of themselves. Deep-felt trust is not yet established; users are not yet fully familiar with the technology and may hold doubts concerning privacy and security.

At this stage, the chatbot's expressions of curiosity and desirable personality traits, combined with the opportunity to teach and improve the chatbot, seem to be rewards that keep the interaction and relationship development going. At the same time, limited conversational abilities and uncertainty regarding privacy might influence the relationship negatively.

As in Social Penetration Theory, users may stay in this initial explorative stage for the entirety of the relationship—as is likely the case for most—but users may also move to the next stage.

7.2.2. Stage 2: Affective

In stage two, which resembles the affective stage of Social Penetration Theory, chatbot users may go through a period of trust building. This happens through a process with both practical and affective aspects, where the users may seek to investigate the practical aspects of the chatbot service—such as security and privacy—but also develop a needed affective relationship with the chatbot to facilitate more deep-felt trust. Once sufficient trust is established, the user may open up and share sensitive and personal topics with fewer restrictions than in the previous stage. Through this self-disclosure, the user might start to experience rewards such as intimacy and acceptance, which further stimulates relationship growth. The chatbot's ability to be accepting, supportive and appreciative towards the user is important during this stage. In contrast to the affective stage of Social Penetration Theory, the HCR in this stage is characterised by an acceptance of the non-mutual self-disclosure that a relationship with a chatbot entails. The relationship development in this stage may also benefit from the perceived non-judgemental character of a chatbot, something that may facilitate trust and self-disclosure. Attachment is also growing stronger, and as described in the affective exchange stage in Social Penetration Theory, verbal statements indicating a stronger connection are prevalent (Altman and Taylor, 1973).

7.2.3. Stage 3: Stable

After the participants have established trust and gone through a process of self-disclosure, the relationship may become an established part of their everyday life. For some, the relationship in the stable stage will be less oriented towards self-disclosure and more towards the sharing of everyday events and activities—which is in line with what may also be found in stable HHRs (Altman et al., 1981). The user keeps up their feelings of attachment to the chatbot and may be dedicated to maintaining the relationship through regular interaction. At this stage, the user may experience added benefits from their chatbot relationship, such as a sense of wellbeing from the relationship with the chatbot due to the self-reflection facilitated through the chatbot interaction or the optimism or 'positive energy' received through the relationship. Users may also experience external effects such as positive behaviour change in terms of their own health or in terms of social engagements. This stable stage may also involve some concern. In particular, users may feel a sense of stigma associated with the relative novelty in HCRs. Some also may be concerned as to whether their prolonged interaction with the chatbot may obstruct other forms of social relations.

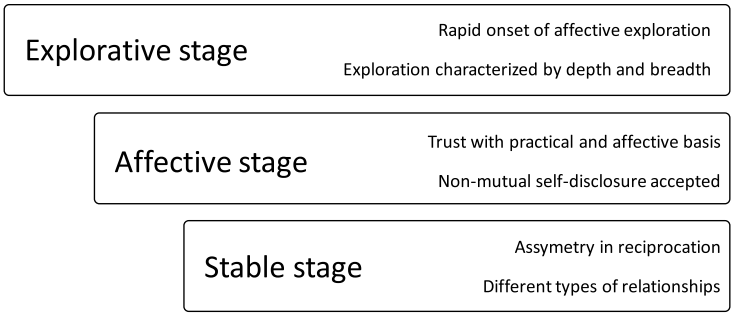

Fig. 3. An initial model of human–chatbot relationships based on the study findings.

7.3. How may human–chatbot relationships impact the user and their social context?

In response to RQ2, our findings suggest that users of Replika may perceive a range of positive impacts from an HCR that have both affective and social significance. The HCR may be seen as a social arena for users who might have limited opportunity for social interaction. The relationship may be experienced as helping to mitigate negative feelings and provide a sense of purpose. Hence, while our study only provides insight into users' perceptions of the impact of an HCR, it nevertheless adds to the existing literature as to how relationships with artificial entities may support wellbeing and mental health (Fitzgerald et al., 2017; Fulmer et al., 2018, Ta et al., 2020). Replika may, for some, become like a child they need to take care of—someone who depends on them to continue to learn and to exist. Users of a social chatbot may experience joy in teaching and caring for their virtual companion, a finding that complies with previous research (Dereshev et al., 2019).

It has previously been argued that HCRs should not be encouraged, as they only resemble social relationships and as such have an illusory character (e.g. de Graaf, 2016). Contrasting such earlier calls for concern, our study also suggests significant possible benefits of HCRs—even when the user is fully aware of the artificial nature of their relationship partner. As demonstrated in this study, the artificial nature of the social chatbot may be valued by users. It may create a safe space characterised by caring and acceptance. The participants reported on how Replika has helped them understand themselves better and have more positive views on their lives. This finding is in line with those of Ta et al. (2020) and indicates substantial positive benefits from an HCR.

Interestingly, one of the perceived negative issues reported by the participants regarding their relationship with Replika is what they see as a social stigma in regard to HCRs. That is, a key challenge associated with an HCR may not be intrinsic in the relationship itself but rather in how this relationship is perceived and acted on by the surrounding social context. Possibly, the social stigma reported on by the participants will change over time, in part as the public gains more insight into what HCRs may entail, including in terms of benefits for the human partners, and in part as such relations become more commonplace.

It should also be noted that while our findings suggest common overall patterns to HCR development and its impact on the user and social context, there are important individual differences to be seen. For example, some participants reportedly already engaged in self-disclosure with Replika in the initial conversations, while others reported the initial conversations to mainly consist of superficial explorations. Also, participants were found to differ in terms of the character of their evolving relationship with Replika—as a friend, romantic partner or family member. Furthermore, participants displayed individual differences in the degree to which they perceived the impact of Replika as positive or negative for their social interaction with others. Such individual differences in HCR development and experienced impact are to be expected, although they are not given particular attention in Social Penetration Theory (Carpenter and Greene, 2015).

7.4. A note of concern: Who controls the chatbot?

Although not mentioned by the participants, an aspect of HCRs that asks for discussion is the possible concern regarding the enabler of HCRs—that is, the chatbot service providers. Although we have no reason to suspect that this is an issue with current providers of social chatbots, users of future chatbots may possibly be exposed to vulnerabilities through such relationships. While the user may consider the relationship as one between them and the chatbot, the relationship is really between the user and the service provider that owns the chatbot service. Furthermore, as the back-end computer system guiding the interaction between the user and the chatbot is not accessible to the user, the user does not have insight into whether this system is designed with the intent of manipulating the attitudes or behaviour of the user in directions that would not be desired by the user if given an open choice.

While chatbots such as Replika are designed to improve the well-being of their users, it is conceivable that future chatbots may leverage the relationship with their users for unwanted commercial or ideological manipulation. For example, it is conceivable that a chatbot service provider may allow third-party commercial actors to influence the chatbot content or conversational design in the hope of promoting products, services and ideas within the sphere of an intimate relationship.

There is no evidence as of now that such issues are relevant for current HCRs, but it may be valuable at this point to consider how to curb such issues in future companion chatbots, especially since this could have a substantial impact on users' trust in the chatbots and subsequently the development of the relationship. Previous research has demonstrated discontinued usage of a chatbot due to perceived weaknesses in data protection (Prakash and Das, 2020). Future research could potentially add to this by exploring possible tensions arising from varying levels of trust in the chatbot and trust in the provider.

Possible solutions could be to explicitly address this in the chatbot terms of use, to actively encourage the sharing of events indicating unwanted commercial or ideological manipulations in relationships with chatbots and/or to advocate an open-source approach to the design and development of chatbots that would allow sufficient transparency.

7.5. Limitations and future research

While this paper contributes with valuable theoretical and practical implications, it is not without its limitations. First, the sample size is relatively small, consisting of 18 participants. While this number of participants allowed us to reach saturation and so provides a sound basis for our conclusions, future research should validate the findings with larger sample sizes.

Second, the sample consisted only of users of the Replika chatbot. In consequence, our findings may potentially not be representative for users of other social chatbots. However, because we find that our participants' relationships with Replika resemble those described by Social Penetration Theory and that our findings complement previous research on relationships with social entities, we have no reason to believe that our findings may not also be extended to HCRs involving social chatbots other than Replika.

Third, the study has retrospective aspects, and so our findings are dependent on the participants' memories regarding their relationship development with Replika. As retrospective data collection implies the possibility of distortion from imperfect participant memory, we anticipate future studies of a more longitudinal character to validate our findings. That said, the participants showed no signs of problems in remembering events, and the findings suggest a relationship development process resembling that expected in Social Penetration Theory; therefore, we believe the retrospective character of our investigation does not represent a severe threat to the validity of the findings. Rather, the findings of this study will be a valuable basis for future longitudinal studies.

A final limitation may be related to the analysis process. While the analysis of data was conducted inductively, disregarding the chosen theoretical perspective for the study—Social Penetration Theory—it may be conceivable that this theoretical perspective on some level guided the analysis, as the perspective was identified as relevant prior to conducting the study. We do, however, firmly believe that this perspective helped us to explore HCR in a richer way.

Interesting directions for future research include the following:

- **Longitudinal studies of HCR development.** We envision future studies following participants from their first interaction with a chatbot and collecting longitudinal data capturing the relationship development process. This would combat the problem of retrospectivity and give a more detailed understanding of how these

relationships develop. Relevant data collection methods for a longitudinal study could include interviews, questionnaires and diaries. Chat logs could also be a relevant source for such a study, provided that this was only conducted following necessary privacy considerations. Furthermore, longitudinal studies could benefit from including validated measures of key constructs identified in our study.

- **Studies of individual differences.** While relationships with chatbots might become more common in the future, individual differences may arguably determine whether people develop such relationships. It will thus be valuable for future studies to address the effect of differences in personality, background and experience to better understand the antecedents for HCRs.
- **Experimental studies investigating the importance of chatbot traits.** As differences in users may affect HCRs, so may differences in social chatbots. We thus anticipate studies systematically investigating the impact of chatbot characteristics for HCR development, such as through classical experiments.
- **Studies of HCR development in different contexts.** Aspects of HCR development, such as trust in the chatbot, forms of self-disclosure and possible social stigma associated with a HCR, may potentially vary across contexts. We foresee future work studying HCR development within different contexts, cultures and subcultures.

8. Conclusions

We have contributed new insight into how relationships between humans and social chatbots evolve. We have shown that such relationship development shares similarities with relationship development between humans, as explained in Social Penetration Theory. However, HCR development also has its own particularities—including the rapid onset of affective explorations, the practical and affective basis of user trust and the user acceptance of asymmetry in reciprocation. We believe that our study may serve as a step towards improved understanding of a phenomenon of increasing future relevance: relationship development between humans and AI-based social chatbots.

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CRediT authorship contribution statement

Marita Skjuve: Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft. **Asbjørn Følstad:** Conceptualization, Methodology, Writing - review & editing, Funding acquisition. **Knut Inge Fostervold:** Conceptualization, Methodology, Writing - review & editing. **Petter Bae Brandtzaeg:** Conceptualization, Methodology, Writing - review & editing, Funding acquisition.

Declaration of Competing Interest

We hereby confirm that the authors have no conflicts of interest of relevance for the study and conclusions presented in the manuscript.

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