Let's chat about sex, baby!

Leveraging chatbots for sexual health promotion

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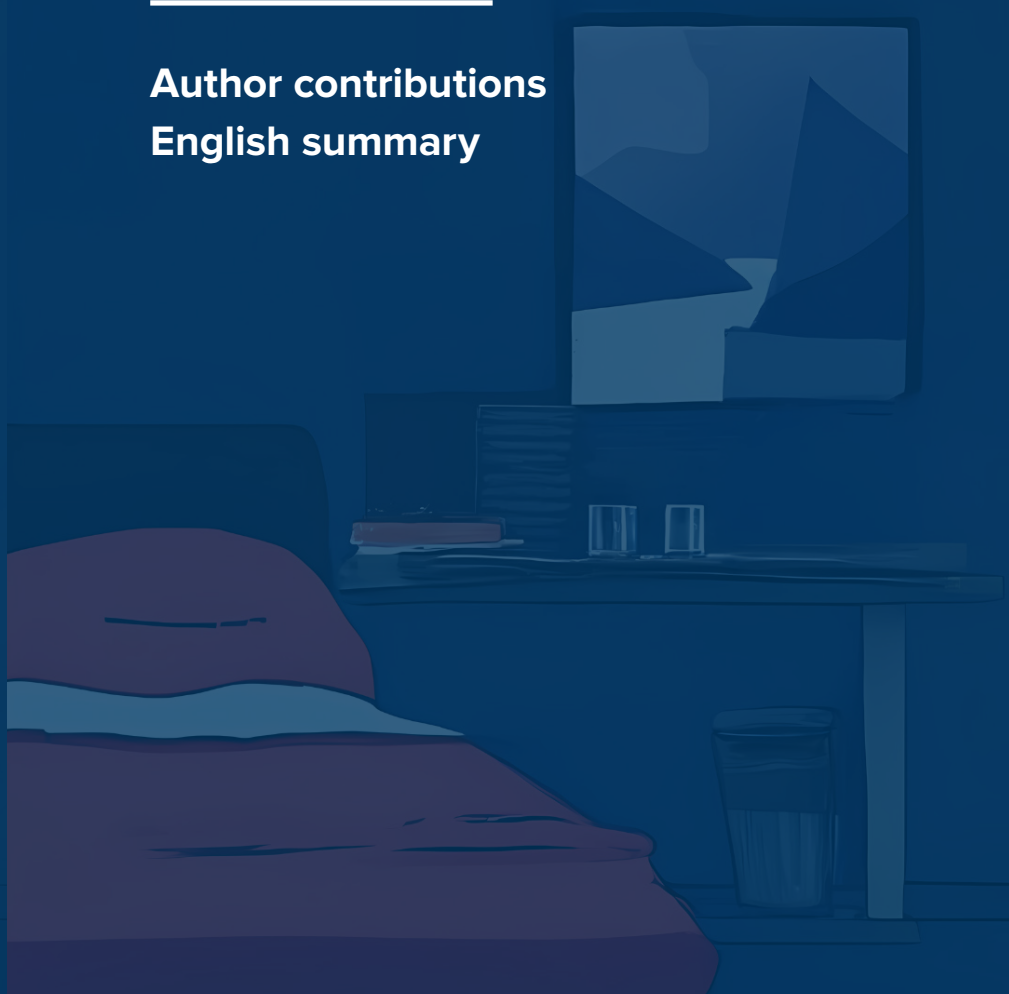
Publication date
2025

APPENDICES

Author contributions
English summary



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Chapter 2 - Effectiveness and Acceptability of Conversational Agents for Sexual Health Promotion: A Systematic Review and Meta-Analysis

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Chapter 3 - Using counselling-inspired relational strategies to facilitate self-disclosure with a chatbot in a sensitive domain: A qualitative study

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Chapter 4 - Designing a couples-based conversational agent to promote safe sex in new, young couples: A user-centered design approach

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Chapter 5 - It takes three to tango: Exploring users' perceptions of a couples-based conversational agent for sexual health promotion

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English Summary

Research Overview

The increasing prevalence of sexually-transmitted infections (STIs) continues to pose a significant public health concern, especially among young people aged between 15 and 24 years old. Specifically, young couples that have just entered a new, exclusive relationship are particularly susceptible as they often decide to quickly forgo condom use. In contrast to other health domains, addressing sexual health can be complex due to the dyadic nature of how sexual health behaviors are negotiated and carried out.

Digital sexual health interventions address the barriers accompanying human-delivered interventions (e.g. costs, training), offer a non-judgmental online environment, and support advanced digital features (e.g. personalization, querying databases). Conversational agents (CAs) (also referred to here as chatbots), which are computer programs that are able to simulate natural language conversations with humans, have the potential to be an effective way to deliver digital sexual health interventions. Compared to other digital media, chatbots can engage more effectively with users by mimicking natural conversations we have with others, while their dialogical nature allows information to be communicated more effectively and can leverage language-based strategies (e.g. active listening). Importantly, chatbots not only behave like a communication partner with individual users, but can also mediate other human-human conversations (e.g. between couples) as an additional third communication partner.

Studies have found that sexual health CAs are perceived positively, but users often do not intend to continue using them in the future. It becomes important to understand *why* users experience low engagement with sexual health CAs, so that the chatbot design can better address users' needs. This is more appropriately studied through qualitative means, as quantitative methods (such as surveys) are less able to shed light on the reasons underlying a specific perception, and are therefore less informative for making an informed design choice. Participatory methods (e.g. user-centered design, co-creation) can also be a useful approach to ensure users' needs are met, particularly in the case of novel technologies such as couples-based chatbots.

Towards improved CAs that can engage new, young couples through interactions about condom use for STI prevention, this dissertation takes a progressive approach to design, and assess the user acceptance of, two conversational agents: Mish (for individual use), and MishSync (for couple use). Specifically, this dissertation provides an overview of sexual health CAs and identifies user acceptance factors relevant for this context (Chapter 2), after which Mish (Chapter 3) and MishSync (Chapters 4 and 5) are designed and evaluated (on the basis of the identified user acceptance factors) through interviews (see Table 1 for an overview of Mish and MishSync).

Table 1. Overview of Chatbots: Mish and MishSync

	Mish	MishSync
Intervention Characteristics		
Target Group	New, young couples in exclusive relationships	New, young couples in exclusive relationships
Target Users	Young individuals in new, exclusive relationships	New, young couples in exclusive relationships
Target Behavior	Condom use	Education & awareness, Intra-couple communication
Theoretical Framework	Motivational Interviewing	-
Design		
Design Approach	Top-down	Bottom-up (user-centered design)
Chatbot Components	The chatbot guided users through the following motivational interviewing stages: • Engage • Focus • Evoke • Plan	The chatbot interacted with couples via triadic (i.e. group chat) and guided them through the following activities: • Icebreakers • Text adventure • Quiz
Technical Implementation	Fully-automated	Wizard-of-Oz
Evaluation		
Sample	Heterosexual, sexually-active individuals between 18 and 25 years old	Heterosexual couples in a new relationship (6 months or less) between 16 and 20 years old
Method	Individual, semi-structured interviews	Individual, semi-structured interviews
Constructs of Interest	• User Experience • Information Quality • Comfort and Self-Disclosure • Therapeutic Alliance • Motivational Interviewing • Usage Intentions	• User Experience • Information Quality • Therapeutic Alliance • Usage Intentions • Interaction Activities
Analysis	Hybrid thematic analysis on the individual-level	Hybrid thematic analysis on the individual- and couple-level

Chapter-Wise Conclusions

Chapter 2: Effectiveness and Acceptability of Conversational Agents for Sexual Health Promotion: A Systematic Review and Meta-Analysis

A systematic search of databases yielded 31 studies about the evaluation of sexual health CAs (until 2021), and the narrative synthesis of results pertaining to effectiveness and user acceptability outcomes was supplemented by a meta-analysis. These findings supported the notion that CAs for sexual health may not only be effective but that users also find these useful and satisfying for a range of sexual health behaviors. While CAs are already capable of supporting antiretroviral therapy adherence through simple two-way interactions, more studies are required to understand how the potential of CAs can be leveraged for more complex and preventive behaviors such as safe sex practices (i.e. condom use). The study identified five constructs in addition to those present in the DeLone and McLean Information System Success model that may be important for user acceptability with sexual health CAs: privacy, trust, social presence, emotional support and comfort.

Chapter 3: Using counselling-inspired relational strategies to facilitate self-disclosure with a chatbot in a sensitive domain: A qualitative study

In this study, we translated a core set of five strategies from motivational interviewing into Mish, a text-based chatbot that discusses safe sex with young people in a way that was both effective and favorably perceived by users. User interviews indicated that the selected strategies played an important role in their experiences of comfort and therapeutic alliance with the chatbot, which in turn positively influenced if and how they chose to self-disclose personal but relevant information (e.g. demographic information, sexual attitudes and behaviors) to the chatbot. While participants acknowledged several chatbot characteristics that motivate self-disclosure, they preferred to disclose to a human as they perceived more benefits to doing so. This study illustrates how chatbots can successfully implement motivational interviewing as a counselling approach to address sexual health, and can create a conducive environment for relevant self-disclosure. However, participants did not experience a *strong* therapeutic alliance with the chatbot, which can be explained by the need to improve the chatbot design, as well as the activation of *machine schemas*, which refer to specific expectations that users have about what machines i.e. chatbots can and should (not) do.

Chapter 4: Designing a couples-based conversational agent to promote safe sex in new, young couples: A user-centered design approach

This chapter describes a two-stepped user-centered design approach taken alongside our target group (i.e. interviews with young people) and experts (i.e. co-design workshop

with sexual health counselors) to develop MishSync, a couples-based chatbot. Both young people and counselors agreed that the chatbot should adopt a holistic sexual health focus, addressing multiple topics including communication and pleasure. Both groups also agreed that the chatbot should not interfere directly in the couple's (sexual) relationship through explicit counselling or sexual health-related behavior change, instead focusing on facilitating intra-couple communication and educating the couple on important topics. Young people additionally expressed concerns about motivating their (new) partner to use the chatbot, while the counselors emphasised the importance of using motivational interviewing techniques (but not counselling) to build rapport, and using gamification to increase user engagement.

Chapter 5: It takes three to tango: Exploring users' perceptions of a couples-based conversational agent for sexual health promotion

In this chapter, we conducted a wizard-of-oz study to evaluate the couples-based chatbot MishSync (designed in Chapter 4). User interviews revealed that participants valued the triadic interaction format, perceiving it as engaging, interesting, and useful for open discussion and alignment on different topics. The findings illustrated the potential of triadic chatbot interactions to address sexual health in couples. The study also identified several considerations for future efforts: In addition to partner presence emerging as an additional facilitator and inhibitor of self-disclosure in a triadic context, participants also did not experience a strong therapeutic alliance with the chatbot, which can be explained by the activation of *machine schemas*, which refer to specific expectations that users have about what machines i.e. chatbots can and should (not) do. Ultimately, intra-couple differences in perceptions and preferences underscores the need to consider how couple-level user acceptance may influence the joint use of the chatbot.

Key Theoretical and Practical Takeaways

User acceptance of sexual health chatbots (CAs) is highly context-dependent.

Using the DeLone and McLean Information System Success Model (DeLone & McLean, 1992), this study identified additional key acceptance factors: social presence, emotional support, and comfort. Participants highlighted these factors even without prompting, suggesting their significance in sexual health CAs. While privacy and trust are known influences, this research provides preliminary qualitative evidence for the added value of humanlikeness, therapeutic alliance, and comfort. Despite positive perceptions of chatbot interactions, many still preferred existing alternatives (such as human interactions and internet resources), due to innovation characteristics like relative advantage, compatibility, and observability.

While humanlike chatbots often include social cues to activate social scripts, this study suggests that simply disclosing the chatbot's identity can lead users to also apply machine-specific schemas that they have developed based on prior experiences.

In this dissertation, we identified instances where machine schemas interfered with forming a strong therapeutic alliance, hindered self-disclosure, reduced confidence in in the chatbot's capacity to provide advice on emotional or interpersonal matters, and made it less acceptable for the chatbot to engage in explicit behavior change and couples counselling. Overall, while surface-level humanlike characteristics (e.g. friendly tone, jokes, polite behavior) were found to be highly acceptable and even desired, complex humanlike behaviors (e.g. showing empathy, perceived understanding, providing relationship advice) were more likely to be perceived as unique to humans, making it inauthentic and less desirable in chatbots. Future research should explore strategies to mitigate these effects.

A balanced approach that integrates both theory-driven and stakeholder-driven design may lead to more effective and widely accepted digital health interventions.

This research compared theory-driven and stakeholder-driven design approaches in developing two chatbots, Mish and MishSync, for sexual health. Despite targeting the same behavior, the chatbots differed significantly. Mish followed a structured, theory-based approach, focusing solely on condom use and employing motivational interviewing. In contrast, stakeholders favored a holistic approach for MishSync, covering broader sexual health topics and emphasizing education over direct behavior change. These differences highlight the research-practice gap. While focused interventions may be more effective, holistic ones enhance user acceptance. Combining user-centered design with theory-based approaches may create more effective, widely accepted digital health interventions.

Motivational interviewing (MI) remains a viable approach for conducting sexual health counselling with couples.

This research found that Mish successfully conducted MI-based counseling, while MishSync facilitated triadic interactions that improved communication. While user-centered design findings indicated that chatbots should not actively engage in direct behavior change or counseling, participants found the use of motivational interviewing techniques acceptable and even desirable. Couples-based chatbots can support sexual health by enhancing intra-couple communication and facilitating key dyadic processes by leveraging new frameworks for couples-based motivational interviewing. Given MI's autonomy-supportive nature, it remains a promising approach, and future chatbot designs can incorporate additional mechanisms to ethically support users in exploring and refining their health-related volitions.

Conclusion

This dissertation delves into the potential of conversational agents (CAs) for sexual health promotion, particularly in encouraging condom use among young couples. By systematically designing and evaluating two chatbots—Mish for individual use and MishSync for couples—this research sheds light on key factors influencing user acceptance of sexual health chatbots, and highlights the role of machine-specific schemas in shaping user perceptions of chatbot interactions. Findings reveal that motivational interviewing can be successfully adapted for a chatbot-based sexual health intervention, fostering comfort and self-disclosure. Moreover, the user-centered design approach demonstrated that couples-based CAs are well-received but require distinct considerations, particularly regarding trust-building and partner dynamics. While CAs show promise for engaging young people in sexual health discussions, future research is needed to refine human-chatbot interactions for greater real-world adoption.

Acknowledgements

Even after I hit send on the email that would allow the committee to receive my dissertation, it hadn't really sunk in. A few months later, I held the test print of my dissertation in my hands and brimmed with an unfamiliar sensation: pride. I wrote this book. Cover to cover. With my blood, sweat and tears (if you know, you know). The PhD journey is often portrayed as a lonely one; mine couldn't have been further from this. Let's recap, shall we? *cue flashback harp glissando*

I remember being incredibly anxious before the first round of PhD interviews for this position, only to be met by the cheerful faces of Gert-Jan, Reinout and Tibor. All of you set me at ease, and made the interview feel more like a brainstorming session over coffee.

I had the pleasure of starting off the project with Gert-Jan as my daily supervisor, who was always open to discussing my ideas as well as making sure meetings didn't clash with my nocturnal persona. Gert-Jan, you always maintained a positive and easy-going outlook on, well, everything, and were a strong source of support while I made my way towards the first year paper deadline during lockdown. It was unfortunate, then, that this dynamic couldn't last as you took on a new opportunity Antwerp.

No fear, because I was soon under the wing of Margot, who dove headfirst into the project as a completely new member of the team, and embraced the role of being my new daily supervisor. Margot, your involved and detail-oriented approach combined with your expertise in precisely the focus of my research allowed me to quickly adjust despite all the changes that were happening. I really appreciated the amount of time you put into just sitting with me and going over the smallest details, and doing everything in your power to lighten my load over the next couple years. You were my biggest cheerleader! Even after you returned from your leave, you devoted your limited energy to supporting the rest of my PhD journey until the end, and I'm truly grateful!

Now at this point, you must be thinking, "Wait...how many supervisors is that?" You read that correctly. By the end of my third year, Carolin stepped into the role of my final daily supervisor, and was determined to help me over the finish line - this was easier said than done. Carolin, you were so patient and quick to grasp the project as well as my chaotic trains of thought, taking a calm, structured approach to keeping me focused, and wrapping up my dissertation. Thank you for being exactly what I needed to get where I needed to go.

What I haven't addressed yet are the two pillars that stayed constant throughout the last four years; I can't thank you both enough, Tibor and Reinout, for remaining two of

the few constants of my PhD. Tibor, I was consistently amazed at how insightful and quick your feedback was. You may have been a third, external supervisor on paper but your involvement, enthusiasm, and support throughout the project made you much more than that. Reinout, you quickly jumped in to provide research- and non-research related support during the ups and downs of the project, and always made me feel welcome in the psychology department and even in your own lab meetings. Your lighthearted and easy-going nature always put me at ease during times of stress.

I can't, in good faith, say that this experience was smooth-sailing; in fact, it was quite tumultuous. That said, in the absence of stability, I found myself becoming more resilient and adaptable as a result, and so looking back, I'm extremely thankful to my somewhat large but cozy supervision team for always believing in me, my ideas, and my capabilities, and constantly reminding me of my successes when I lost sight of them.

I'd like to give a shoutout to the Look Who's Talking project team. We didn't always get to meet often, let alone in person (thanks covid), but when we did, it was nothing but good food and good times! A special shout-out to Emiel, for bringing us all together in this consortium and spearheading the monthly meetings, and for being an involved, enthusiastic, and encouraging presence, even for those you didn't directly supervise i.e. me!

I'd also like to thank my committee members - Karolien, Theo, Rob, Barbara and Helle - for taking the time to read my dissertation!

This project wouldn't have been possible without my fellow PhDs in my project, and more importantly, close friends and paranymphs, Erkan and Linwei. Many people have pointed out how lucky we are, and how well we work together. Unsurprising and true. Not many PhD candidates have the luxury of working in a team, let alone forming a close bond with them, and I'm so glad I got to work with you both! I really enjoyed our weekly catchups (read: support group meetings). It felt effortless and chill almost immediately, where we could talk about both work and our personal lives without really thinking about it, and that effortless dynamic made the PhD that much more enjoyable. Thank you both for listening to my rants, validating my experiences with your own, and putting me back on track when I forgot things. I also think it's important to point out that by the end of our PhD journey, all of us owned a cat, and I'm proud of this fact. Erkan, our chatbots would not exist with you, and I loved brainstorming with you! As a non-technical person, I really appreciated that you took the time to explain things, and you were passionate about the things you built while also taking an interest in our work. Thank you for being your considerate, caring, and calm self. Linwei, you really did become my conference buddy! I could always count on you to be a supportive, sassy, and chill presence both in and outside of work, and I've

loved the coffees, brunches, dinners and conversations we had over the years. One day, we'll successfully find a massage room at a conference hotel, I know it. I know we're all done, but I hope the three of us continue hanging out long after this is over!

Starting your PhD in the middle of a global pandemic put a bit of a damper on things. To make matters worse, I lived in a city at the opposite end of the country, and often worked from home.

But PhD club made it worth going to the office every other Monday. Thank you to my fellow ASCoR PhDs for the discussions, advice, and connection that I got to be a part of. Daisy, special thanks to you, my other paranymph! We don't see each other that often, but when we do, it feels like we see each other everyday. Thank you for being so easy to talk to, and for being the reality check that I sorely needed every now and then. I love running into you, whether it be in the hallway, at lunch, or during drinks, and I appreciate all the support over the years.

One of the best things about collaborating with other universities during your PhD is that you gain a home (or two) away from home. Thank you to all the lovely people I met at Radboud and Tilburg who made me feel welcome – more often than not, I considered myself one of you. I'd like to call out all the lovely people I met along the way – through research group meetings, conferences, or just dropping by Nijmegen, Tilburg and Antwerp – I probably only met most of you once or twice, some more often than others, but I appreciate every meaningful interaction we had, however small.

Now, what's worse than having to put up with me at work? It's having to put up with me outside of work. Here's to the people that helped me stay sane even when they had little to no idea what was up.

Rithwick, Anand, and Yannik, thanks for being with me on this journey. Y'all were my Whatsapp emotional support group, experiencing my PhD with me through the supervision changes, conferences, submissions, and all the happenings along the way. When we met in person, I'd tune you in to *this week's episode of Divyaa's PhD*, and you didn't need to understand my research to be there for me. I'm glad that I can now celebrate the final milestone with you too! Rithwick and Yannik, thank you for validating my PhD experiences with your own, and making me feel a little less crazy in this academic world. Anand, thank you for the cat reels.

I can't forget to thank Nami. Looking past the fish-breath and killer claws, she always somehow knew when I was stressed, and quietly spent many nights curled up behind

me on my chair, or on my desk, while I worked late. If I was ever feeling low, all I would have to do is walk through the house looking for her - she'd find me with a squeak and even if it was just for a moment, I'd forget my struggles. Zoro, you were the best; I know if you were still here, you would've joined your sister in being the best furry emotional support duo a girl could ask for.

Tarun, thank you for single-handedly receiving every stray thought that leaves my mind at any moment of the day. From day one, you steadfastly listened to my rants, brainstormed ideas with me, read my writing, tested my chatbots, talked me through the stress, cheered me up when I was upset, stayed up with me while I chased deadlines, and reminded me of my worth when I couldn't see it. I succeeded as a direct consequence of your unwavering support, and I'll never forget that.

And finally, a big thank you to my parents, who made sure I had access to the best education and opportunities, and making this path even possible, even if that meant me leaving the nest. It's difficult to support your child when they're over 10,000 kilometres away, but I could always expect a phone call to ask how I was doing, if I ate, and how my PhD was going. Most importantly, they encouraged me to pursue my interests even if they didn't always fully comprehend what I was doing (and really, who does?)