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# When intentions are translated into actions: A thematic qualitative investigation of the factors associated with caregivers' engagement with a non-AI chatbot-led parenting intervention in South Africa

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## Abstract

# Introduction

While previous research has demonstrated the feasibility of chatbots in delivering low-cost digital health interventions, further research is needed to understand the factors that enhance user engagement and intervention effectiveness.

# Objective

This study examines the facilitators and barriers to engagement in a chatbot-led parenting intervention delivered to caregivers of adolescent girls in low-income South African communities.

# Methods

This qualitative study was nested within a 2 x 2 factorial cluster randomised trial testing external human-delivered components designed to support engagement in the ParentText chatbot. Ninety-seven participants were purposively recruited from the larger sample for focus group discussions. Thematic analysis was used to identify facilitators and barriers to engagement, informed by the Digital Health Engagement Model and the Health Action Process Approach.

# Results

Caregivers reported that engagement with the chatbot contributed to reductions in physical punishment and parent–adolescent conflict while promoting greater openness to discussions of sensitive reproductive health topics. Caregiver perceptions of both content quality (perceptions of how useful the chatbot was in supporting adolescents' wellbeing) and delivery quality (safe and empathetic delivery by the chatbot) motivated initial and ongoing chatbot use. Social influence emerged as an important facilitator of ongoing use and application of positive parenting skills, while lack of internet and smartphone access were major drivers of disengagement. Access to human support for troubleshooting chatbot errors helped re-engage users when they felt less motivated due to challenges with troubleshooting chatbot errors. Gender-related barriers also emerged, such as women's disproportionate caregiving and household responsibilities limiting their completion of chatbot parenting modules, underscoring the need for gender-intentional design in digital parenting interventions. A major barrier to adopting more positive parenting practices was the entrenched beliefs that non-violent forms of discipline are ineffective.

# Conclusion

This is the first known African study investigating qualitatively user engagement with a chatbot-delivered parenting intervention. Our findings underscore the importance of adopting a participatory approach while distinguishing strategies that enhance the technology itself from those that support caregivers' behaviour change. Our results also provide unique insights into the key role of integrating person-centred design and community partnerships alongside strategies to address structural barriers to engagement.

# Trial Registration:

Registry: Pan African Clinical Trial Registry

## Introduction

Digital health interventions (DHIs), including those delivered via chatbots, offer a potential cost-efficient solution for improving access to health services and overcoming implementation barriers related to geographic and socio-economic constraints, as well as disability or illness that restricts mobility (1). Chatbots may be a feasible option for scaling up health interventions, with initial evidence supporting their use in promoting psychological wellbeing (2), weight loss (3), and positive parenting behaviour (4). However, despite the potential effectiveness of chatbot-led interventions among users who actively engage with them, limited engagement may constrain their overall impact. To maximize an intervention's potential and improve its effectiveness, it is crucial to understand and address facilitators and barriers to sustained user engagement.

Four key attributes characterise engagement: 1) initiation of DHI use, 2) ongoing DHI use, measured by the frequency, duration, and proportion of content accessed, 3) disengagement with the DHI over a defined period, and 4) re-engagement and ongoing DHI use (5). Engagement is also conceptualised as the application of skills and behaviours promoted within the DHI to real-life contexts (e.g., caregiver spending one-on-one time with their adolescent) as translating informative content into real-life application is pivotal to intervention effectiveness (6). Optimal DHI use and the application of acquired behaviours depend on both nudging strategies and self-regulatory mechanisms (7). Self-regulation relies on an individual's willpower to engage with the DHI and consistently apply the learned skills. In contrast, nudging focuses on shaping the environment in ways that make engagement easier and more likely to occur.

Systematic reviews investigating the feasibility of delivering chatbot-led parenting interventions report that individual perceptions such as perceived usefulness and easy-to-understand content are major facilitators of caregiver use of parenting programmes (8). A qualitative meta-synthesis of ten reviews investigating patient use of mental health chatbots found that aspects of chatbot design, such as the capacity to personalize human verbal and nonverbal behaviour and anonymity, can enhance engagement (9). The chatbot's ability to simulate human-like face-to-face interaction, incorporating natural speech tone and pacing, as well as gestures and facial expressions, also contributed to user engagement. The use of a virtual entity with embodied features to communicate with the user further motivates use.

Additionally, findings indicate that users' perceptions of a chatbot's ease of use, empathy, and enjoyability positively influence engagement (9).

Existing evidence on facilitators and barriers to engagement has mostly been derived from studies in high income countries, while evidence from low- and middle-income countries (LMICs) remains limited (8). Barriers to sustained engagement include limitations in technological features, and the absence of enabling structural support (e.g., lack of internet access or digital literacy training). For example, constraints in verbal communication capacity, such as limited conversational flow, repetitive chatbot responses, and confusing replies, have been shown to hinder engagement. Technical issues, including screen freezing, limited options to customise session content and length, and the amorphous appearance of embodied agents, have also been identified as factors that negatively affect continued use (9). Low engagement with DHIs is exacerbated by structural inequalities, with individuals from rural areas, those with lower levels of education, limited digital literacy and competing employment and caring responsibilities are less likely to benefit from such interventions (4). In low-income and remote communities, limited internet access and the affordability of computers and smartphones may hamper users' motivation to utilise DHIs, as these remain significant barriers (10). Similarly, parental busyness poses a significant barrier to ongoing use (4).

## User engagement With DHIs Within the South African Context

Digital health interventions in LMICs, including South Africa, gained significant traction during the COVID-19 pandemic. They were initially used for disease surveillance (11) and a range of preventive services, including early childhood development (12) and postnatal care (13). Chatbots have also been tested in South Africa for the prevention of gender-based violence (14), and parenting support (15) .

Increasing access for families who cannot participate in in-person interventions due to geographic or socioeconomic barriers may be particularly important for interventions targeting caregivers of adolescent girls in low-income South African communities with high HIV prevalence (16). Low-income South African adolescent girls are more likely to live in father-absent households and face elevated risks of sexual and physical violence, early pregnancy, anxiety, and depression (17). In such contexts, parenting interventions delivered via chatbots have significant potential to improve adolescent health and wellbeing, especially in rural and low-income areas where access to traditional parenting programmes is limited.

An initial small-scale pilot of a chatbot-led parenting intervention adapted from the Parenting for Lifelong Health in-person programmes in Cape Town, South Africa, reported low content completion among study participants (18). Findings from a larger quantitative study in Mpumalanga, South Africa, suggest that behavioural determinants (e.g. ease of use, usefulness, attitude, habit, price value, and social influence) and intentions explain up to 2% of the variance observed in user engagement (measured as modules and goals completed, and days interacting) (19). Given that established engagement factors such as behavioural determinants and intentions explain so little of the variance in usage, gaining a deeper

understanding of the drivers of user engagement is essential for supporting the long-term scalability and sustainability of digital parenting interventions.

# Objectives

This study qualitatively examined the facilitators and barriers to engagement among caregivers of adolescent girls using a chatbot-delivered hybrid parenting intervention, *ParentText*, in low-income South African communities. We addressed the following research question: What are caregivers' perceptions of the facilitators and barriers to user engagement (actual chatbot use and application of skills) in the ParentText chatbot?

## Methods

# Study Design and Setting

This qualitative study was nested within a 2 x 2 factorial cluster randomised trial in which clusters were assigned to receive ParentText alone or combined with in-person sessions and a facilitated WhatsApp support group. The trial investigated caregivers' engagement (N = 1,034) with ParentText in low-income communities in South Africa. Trained community facilitators guided caregivers through enrolment in the chatbot during group onboarding sessions and allocated them to their assigned cluster. The study was implemented in collaboration with mothers2mothers (m2m) as part of a national HIV-prevention project from August to December 2023 across municipalities in the Ehlanzeni and Nkangala Districts (i.e., rural and peri-urban zones) of Mpumalanga Province. Ethics approval for this study was obtained from Research and Health institutions in both South Africa and the United Kingdom. Further information on the study design, setting, and ethical considerations can be found in the published study protocol (20).

The Consolidated Criteria for Reporting Qualitative Research (COREQ) was adopted to report important aspects of the study (Table S1, Supplementary File 1).

## Recruitment

Due to participant unavailability related to employment and caring responsibilities, this study adopted purposive sampling at the facilitator level based on the different conditions of the larger randomised factorial trial to ensure a balanced representation across the four trial conditions. Participants enrolled in the larger trial were beneficiaries of mothers2mothers Children and Adolescents Are My Priority (CHAMP), which provides support across health and education for adolescent girls and young women.

Convenience sampling was then conducted within the groups to ensure participants were sampled evenly across facilitator groups. Participants were invited to focus group discussions via telephone.

## Research Team, Reflexivity and Positionality

The research team comprised a multidisciplinary group of researchers with backgrounds in Medicine, Psychology, Public Health, Social Science and Computer Science. The first author conducted this research as part of her Doctor of Philosophy degree and received substantial training on advanced qualitative research methodology.

This study was primarily informed by post-positivist epistemological paradigm (21). To minimise the authors' subjectivity and bias on the subject, we aimed for objectivity by adopting a theory-informed approach to investigate whether the findings align with existing theoretical frameworks (22). Drawing on her early access to and support for digital technologies in a neighbouring middle-income African country, the first author reflected on her positionality and acknowledged the need to consider how gender norms may have influenced engagement with the chatbot among female caregivers in low-income South African communities.

# The ParentText Chatbot-led Health Intervention

ParentText is one of the digital adaptations of the Parenting for Lifelong Health (PLH) programmes developed initially as a response to the COVID-19 restrictions on in-person parenting programmes (20). The rule-based chatbot aims to promote positive parenting behaviour and improve adolescents' health and well-being (20). The content is delivered conversationally across 37 modules and 9 goals helping caregivers reflect on and practice non-violent forms of discipline and learn about topics such as adolescent reproductive and mental health. The pre-programmed messages in ParentText were pre-written by the team of experts from the PLH and the University of Oxford in collaboration with South African partners from the University of Cape Town and Clowns Without Borders South Africa. Initial piloting of ParentText in South Africa informed further refinement of the content and design to support engagement (18).

The content in ParentText focuses on three main themes: 1) fostering positive adolescent-caregiver relationships through communication and quality time, 2) reinforcing positive adolescent behaviours, and 3) understanding adolescent mental, physical and social development (20). Additionally, the chatbot content covers stress reduction techniques for caregivers, family budget management, and intimate partner violence prevention. The chatbot also included a virtual agent, introduced as Ayanda, featuring both male and female embodied characteristics during the delivery of video content (Fig. 1).

Participants were able to access the learning modules in ParentText delivered daily and respond to a fixed set of reply options. Content messages included a) text, audio and video introducing the key topic or parenting skill and explaining how to apply it, b) culturally adapted illustrated comics and vignettes modelling specific parenting skills and strategies for stress relief, c) home practice assignments to apply the skills with the adolescent girl (20). A safeguarding system was also available to provide referrals for additional support and emergencies, as well as a help menu to assist users in tracking their progress. Caregivers randomly assigned to the in-person condition (i.e., an additional three group-based sessions with parents and adolescents) or to WhatsApp support groups (including six weekly facilitated human-

delivered online sessions) as part of the factorial trial design received additional training on the programme and support for troubleshooting limitations of the chatbot.

## Data Collection Procedures

Ten focus group discussions (FGDs) with ninety-seven caregivers were conducted. Each FGD included between four and twelve caregivers and explored participants' general perceptions of ParentText and the factors that facilitated or hampered their sustained engagement with the chatbot. FGDs took place in local schools, a church, a library, and a crèche across Ehlanzeni and Nkangala Districts, providing a familiar and comfortable setting that encouraged spontaneous and open dialogue. Facilitators collected written informed consent from participants before starting interviews. Of the 100 participants initially recruited, three did not consent to participate. The FGDs included both male and female caregivers and participants from different regions of Mpumalanga.

FGDs lasting 1–2,5 hours were conducted at the end of the six-week intervention in the subdistricts of Bushbuckridge and Nkomazi. Discussions were facilitated by two trained qualitative researchers and one translator. The quality of most audio recordings and transcripts was good and repeat interviews were not required. Prior to recording, participants were asked to provide permission, and in cases where consent was not granted and declined, detailed notes were taken instead. No reasons for declining participation were disclosed or recorded. Participants in FGDs 1 and 10 were recruited from clusters assigned to receive ParentText and one onboarding session, while the remaining FGDs included participants from clusters assigned to receive ParentText plus remote WhatsApp and additional in-person support. Except for FGD 1, which included one participant from Condition 3, all FGDs were homogeneous with respect to intervention condition.

To align with the methodological approach of the study, the concept of *information power* was adopted, meaning that the collection of meaningful data was prioritised over quantity of respondents (23). To ensure interviews were standardised, interviewers followed an interview guide that was developed collaboratively among the research team including the first author. The guide was structured around three key themes: 1) participant perceptions of ParentText features and content, 2) the perceived impact of the parenting chatbot on parenting practices and teen behaviour, and 3) the perceived impact on family relationships. Questions on barriers and facilitators to engagement were embedded within the three themes to answer the research question (Table S2, Supplementary File 1).

Data collection was led by South African researchers (HG, SL and ZM) from the University of Cape Town, who, despite having different professional and economic backgrounds from the study population (i.e., most participants lived in communities where agriculture, fishing and mining are the main economic sectors), served as a cultural bridge to enhance trustworthiness.

## Qualitative Analysis

Qualitative thematic analysis was conducted using NVivo and Microsoft Excel by the first author, who familiarised herself with the data through repeated, in-depth readings (24). Guided by a theory-based approach and informed by interview data, both facilitators and barriers to caregiver engagement (i.e., actual chatbot use and application of skills) were identified. Using the Digital Health Engagement Model (DHEM) and Health Action Process Approach (HAPA) framework (Fig. 2), the first author analysed participants' language to identify themes and subthemes, conceptualising their experiences with the chatbot (15, 25). By adopting a multilevel approach, the DHEM provides a comprehensive understanding of the individual perceptions, community nurturers and structural enablers that facilitate users' uptake of DHIs. The HAPA offers insight into action and coping planning strategies that enable the enactment of behaviours such as salient situational cues (i.e., when and where) and the sequence of actions (i.e., how) needed to perform the behaviour and strategies to overcome potential barriers (26).

Transcriptions of the group discussions were completed by experienced local research assistants to support the rigour of fieldwork procedures. To enhance dependability, the first author devoted time and effort to develop a "qualitative sensibility" by critically reflecting on the data and fieldwork notes (written by the South African research team) within the study context to ensure meaningful and credible interpretation of findings (21). To support transferability, study findings were compared to evidence from different contexts to understand how they relate or compare to existing literature (27).

Data were systematically broken down into incidents (e.g., participants' experiences connecting to and using ParentText) and units of observations (individual FGDs) and then coded into themes to identify patterns, relate and compare underlying ideas and conceptualisations, rather than providing just descriptive accounts. The identification of themes was not dependent on quantifiable measures but rather on whether it captured essential information relevant to the research question. The coherence and consistency of themes and subthemes were assessed in meetings between the first author, and authors SV, JML and FG and meetings with the South African research partners who supported with the interpretation and better contextualisation of final themes. The authors engaged in an interactive process that led to the finalisation of themes. Final themes were grounded in the domains of DHEM and HAPA theoretical frameworks and centred around participant reports to inform facilitators and barriers to caregivers' engagement. Participants were not involved in the transcription or analysis of the data.

## Results

# Demographics

Ninety-seven participants participated in the FGDs as part of the post-intervention assessments. Most were partnered (58,7%, n = 57/97), and the vast majority were females (83.50%, n = 81/97). Participants' average age was 38 years (SD 9), and 87.6% (n = 85/97) were from Ehlanzeni District. Goal completion ranged from 0% to 57.8% out of 8 or 9 goals (depending on whether the participant was in a partnered relationship), with FGDs 1 and 10 having the highest average completion rates and FGD 6 having the lowest (Table 1).

Table 1
Composition of FGDs and summary of caregiver's use of the chatbot

| **Summary of participant engagement and focus group numbers by intervention components allocated** | | | | | |
|---|---|---|---|---|---|
| FGD Number (Trial Condition) | Number of participants | Goals completed, mean (SD) | Modules completed, mean (SD) | Home activity completed, mean (SD) | Number of days interacting, mean (SD) |
| 1 (1) | 11 | 57.8 (48.6%) | 66.1 (47.1%) | 3.8 (36.64%) | 64.6 (36.6) |
| 2 (4) | 12 | 19.6 (25.8%) | 49.2 (37.6%) | 8.6 (31.8%) | 39.7 (31.8) |
| 3 (4) | 10 | 16.4 (32.7%) | 30.6 (41.2%) | 4.6 (30.9%) | 26.7 (30.9) |
| 4 (3) | 13 | 22.0 (36.5%) | 34.5 (40.4%) | 4.1 (65.5%) | 53.9 (65.5) |
| 5 (3) | 12 | 21.2 (36.4%) | 41.4 (36.6) | 5.8 (30.4%) | 53.5 (30.4) |
| 6 (2) | 11 | 0.0 (0.0%) | 0.0 (0.0%) | 0.0 (0.0%) | 0.0 (0.0) |
| 7 (2) | 4 | 3.2 (4.3%) | 28.3 (38.3%) | 7.7 (48.9%) | 42.2 (48.9) |
| 8 (2) | 7 | 7.4 (6.8%) | 12.4 (6.3%) | 1.8 (36.8%) | 59.6 (36.8) |
| 9 (2) | 6 | 21.3 (44.0%) | 32.4 (46.3%) | 3.9 (63.5%) | 39.4 (63.5) |
| 10 (1) | 11 | 28.3 (38.1%) | 46.7 (44.2%) | 6.2 (36.0%) | 53.5 (36.0) |

Note: Condition 1: Onboarding + ParentText; Condition 2: Onboarding + ParentText + WhatsApp support sessions; Condition 3: Onboarding + ParentText + In-person support sessions; Condition 4: Onboarding + ParentText + In-person and WhatsApp support sessions.

# Qualitative Findings

# Themes and Subthemes Across the Actual Chatbot Use and Translation of Skills

Four main themes emerged from the findings related with actual use of the chatbot, 1) caregivers' perceptions of the value of the chatbot and the capacity to use it, 2) community nurturers' support for chatbot use, 3) structural factors influencing chatbot use, and 4) action and coping planning strategies. Two additional themes were associated with the application of skills: 1) the translation of skills to the parenting context and 2) community nurturers' support for the translation of these skills. Figure 3 summarises the themes that emerged from the FGDs.

# Actual use of the chatbot

**Theme 1: Caregiver's perceptions of the value of the chatbot and the capacity to use it**

The perceived value of the chatbot in strengthening caregivers' capacity to adopt positive parenting behaviours served as a key motivator for sustained engagement, as identified by the subthemes: 1) quality of the chatbot content, 2) competence in using the chatbot, and 3) quality of chatbot content delivery.

# Quality of the chatbot content

Caregivers reported they were motivated to complete the goals in ParentText because the content was relevant and context-specific, focusing mainly on the impact of parenting practices on parent-adolescent relationship functioning. This included positive dimensions (e.g., warmth, connectedness, effective communication) and negative dimensions (e.g., high conflict, hostility, harsh physical and emotional interactions) of the relationship. One caregiver explained, *"The chatbot helps because it also simplifies work. It taught you how to treat and talk with your child. You don't have to take your child to someone like a social worker for help, but you can deal with your child by yourself…"* [Caregiver-FDG 1].

Ongoing engagement was also supported by caregivers' perceptions of adolescents' greater openness in discussing sensitive topics related to reproductive health. One caregiver recognised that before the intervention she was not a "safe place" to her daughter by explaining, *"She started seeing her periods in August and she didn't tell me about it; she only told me recently in November and it was already three months since she started. I asked her why she didn't tell me, and she told me that she was scared and that made me realize that I am not a safe place for my daughter, and she doesn't trust me… That opened my eyes, and I was glad because we had already joined ParentText. I have learned that I have to be open with my daughter and be able to talk to her about things no matter how sensitive they are. ParentText is not a joke, it has helped us a lot; it changed our ways of thinking."* [Caregiver-FGD 10]. However, engagement was discouraged by the exclusion of adolescent boys from the intervention, due to the focus of the USAID PEPFAR DREAMS initiative on adolescent girls. As one caregiver noted, *"Okay. My concern with ParentText is that ParentText only works with women. We have boys in our homes and they are of the same ages* as *the girls, but they are not able to participate because of their gender… I think choosing girls only than boys was not good at all."* [Caregiver-FGD 5].

# Competence to use the chatbot

Caregivers' self-efficacy and confidence in their ability to use ParentText were identified as important facilitators of continued engagement. One caregiver described self-belief as an important element to troubleshoot errors in the chatbot "*I was not assisted by anyone even though our facilitator told us that we should let her know whenever we have challenges. I just told myself that I will overcome the challenge by myself because I was the one working on ParentText and indeed I overcame."* [Caregiver-FGD 10]. Conversely, perceived difficulty in interacting with the chatbot, including a lack of understanding of its design and interface, was a barrier that contributed to disengagement. Participants pointed out that older caregivers, those with low levels of education or those with limited digital literacy, felt less confident in their ability to navigate the chatbot. In some instances, participants were hampered by fear as one caregiver explained

*"Myself for the first time I came across challenges, being afraid, asking myself here…. what is going on. I was scared a lot, but as time went by while learning, I started to notice that I am going somewhere… it helps a lot and now I am happy and enjoy it so at the beginning I was scared, I don't want to lie."* [Caregiver-FGD 9].

# Quality of intervention delivery by the chatbot

Caregivers' initial motivation to use the chatbot and complete the goals was influenced by the design, free access, layout (e.g., an easy-to-navigate interface and self-guided design) and vibrant interface of ParentText. One caregiver reported, *"I can say it was well-designed in a way that when it explains something, it also shows a video or pictures of the stories it is talking about at that time. The way it brought us stories was good…"* [Caregiver-FGD 2]. The combination of text and audiovisual content also supported ongoing use as one caregiver described, *"What I liked the most about the audios was that I was able to listen to them and I was able to read the texts at the same time. None of those were interrupting the other."* [Caregiver-FGD 10]. A caregiver in a different group discussion described the benefits of the free access to the chatbot:

*"What is interesting is that it helps you for free. You don't pay for anything. You don't have to spend money on transport and get the service in the house. As long as you have data, you can use the chatbot. Both you and your child will get help. You will educate your child the way you like for free. As we said, you won't be disturbed by anyone and won't be judged."* [Caregiver-FGD 1].

Ongoing engagement was also facilitated by perceptions of the chatbot as safe, competent and empathetic. Its anonymity and confidentiality fostered a sense of safety allowing caregivers to share their parenting concerns over the phone more comfortably compared to in-person interactions. One caregiver explained, *"It can help us because I won't share to someone, someone can tell someone and that one but if I use the phone it will be me and my phone only."* [Caregiver-FGD 3]. The perceived therapeutic effects of interacting with the chatbot also contributed to ongoing use. One caregiver stated *"Sometimes, you are stressed, but when you finish using the app, you feel relieved. You feel as if you were talking with someone; meanwhile, it was not like that. It was an app"* [Caregiver-FGD 1]. While another caregiver valued the chatbot's ability to "listen" without interruption, saying: *"What I liked the most about it is when she explained things to us because it was clear to understand, and her voice was clear as well. She listened to us when we speak without interrupting us."* [Caregiver-FGD 2]. The self-guided design of the chatbot and reminder triggers facilitated reengagement as expressed by one caregiver, *"One other thing that I liked about the app was that if you wanted to proceed to another activity without finishing the one you started, it was able to notify you that you have an incomplete task that you need to finish; then it takes you back to that activity."* [Caregiver-FGD 2].

However, some caregivers reported frustrations when the chatbot repeated the same question multiple times, even after they had responded. One caregiver described how limited interactivity contributed to interruptions in use *"The challenge that I had the most is when Ayanda would repeat the same question. When I answer, they would come back with a question I have answered, it was frustrating, and I would end*

*up putting the phone away and say I would see it tomorrow."* [Caregiver-FGD 2]. Another barrier included the chatbot's inability to recognise the user's emotional state. As another participant stated, *"My emotions over the phone are not visible but face-to-face, you are able to see my facial expression and how much I'm hurt…"* [Caregiver-FGD 3]. Preferences also varied by literacy levels. Caregivers with higher literacy appeared to prefer text content, while those with lower literacy found the audiovisual content more engaging. One caregiver whose first language was not English added, *"On that chatbot we were using English, and it was difficult to understand sometimes."* [Caregiver-FGD 6]. Additionally, some caregivers were discouraged by the perceived length of the modules as one participant explained, *"To me it was very long as I spent more time on one section, and I changed to another one without finishing the first one. Those modules were very long…"* [Caregiver-FGD 10].

Another caregiver who experienced difficulties in completing a goal explained, *"I found it difficult when I had to do my last goal. I clicked on it, but it took me somewhere else, I kept on trying and it was still not taking me to that goal."* [Caregiver-FGD 10].

Finally, a caregiver reported a sense of loss at the end of the intervention — almost like losing a friend:

*"Also myself, it worked well but the problem with Ayanda once you have finished the programme, she is no longer talking to you (there is a laughter). If you go back to her, she said, she didn't understand your question and she doesn't continue. Once you finish the programme, she is out from you even if you greet her, she doesn't care anymore."* [Caregiver-FGD 3].

# Theme 2: Community nurturers supporting the use of the chatbot

Nurturers such as peer and family members were also identified as important facilitators for ongoing use. In some instances, caregivers shared the knowledge they had gained from the chatbot with their partners and neighbours. As one caregiver explained: *"I remember telling them that they say we should have a good communication with our children instead of being harsh so that they can be able to tell us about their challenges… My neighbour was able to be open with her child and the child was able to be open to her mother and tell her about what was bothering her…"* [Caregiver-FGD 2].

Conversely, gender imbalance of enrolled participants in the group-based components of the intervention was a notable barrier to engagement for men. For instance, one father reported being less motivated due to the small number of male participants in the study *"I was not really encouraged because I was the only man in the group."* [Caregiver-FGD 6].

# Theme 3: Structural enablers supporting the use of the chatbot

# Influence of structural factors on DHI participation

Most participants identified mobile data costs and access to smartphones as major barriers to engagement. Caregivers faced data constraints and network issues, which likely contributed to low levels of chatbot content completion. For example, a caregiver living in a rural area stated: *"I have a network challenge where I stay. I'm staying in the deepest of the village where there are streams and sometimes, we have network, sometimes we don't and that is why it took me time to complete, most of the time I was far behind."* [Caregiver-FGD 5]. Some caregivers also reported not having enough data to update their expired WhatsApp accounts. Many used the limited data they received on personal needs (e.g., communicating with family and friends), realising later that this prevented them from fully participating in the programme. Additional challenges arose regarding phone usage, including lost or damaged cell phones during the intervention and sharing cell phone with other family members. One caregiver described "*Sometimes our phone got damaged, or we are all using one phone in the family, so that's the difficulty that I come across when it comes to using it.*" [Caregiver-FGD 7].

## Access to human support

Receiving technical support from facilitators and their teenage children for troubleshooting errors in the chatbot was also identified as an important facilitator to re-engagement. One caregiver shared:

*"It was difficult but not that much because I WhatsApped my facilitator and she told me to type start then questions followed, and she told me to read the sentence and click continue so I told her that this will be difficult to me because I don't have enough time because of work. She told me that the moment you get, use it even if is during lunch break, use it..."* [Caregiver-FGD 9].

# Theme 4: Action and coping planning strategies

## Pre-defined time, place to interact with the chatbot and person to provide support

Having a pre-established place to interact with the chatbot and a person (i.e., a professional, peer, or family member) to troubleshoot chatbot errors also facilitated ongoing use. For participants with access to remote support, NGO facilitators were considered an important resource for resolving issues with the chatbot. Participants with internet access at the workplace reported interacting with the chatbot during lunch breaks. Others sometimes completed modules collaboratively with their teenage child or interacted with the chatbot in the evenings before bed, as noted by one caregiver:

*"When I am doing night shifts, I usually get home around 23:00 and I would freshen up first and before I sleep, I would open the app and it was always active and ready to respond. So, I was very curious to know why Ayanda was always awake, and I was wondering if it's human or it's just a robot with auto responses."* [Caregiver-FGD 10].

However, unexpected life events, employment and competing parental caring responsibilities emerged as major barriers to interacting with the chatbot as described by a female caregiver, *"I have been*

*disturbed because I have a newborn baby."* [Caregiver-FGD 4].

# Application of skills

# Theme 1: Translation of skills to parenting context

Interactions with the chatbot also raised awareness of the importance of positive parenting practices. One mother recognised becoming more patient as a result of using the chatbot, stating "*ParentText has helped me to understand that children need parents to be patient with them regardless of how many mistakes they make. I was easily angered and that has changed because I have learned about handling pressure from ParentText. I was not a mother who would do some activities with a child, but I have changed. I am now able to do activities with my child and play with her*." [Caregiver-FGD 10]. Another caregiver highlighted the importance of spreading awareness across communities about the existence of parenting programmes, such as ParentText: *"For people to use ParentText, there should be information given to the whole community so that each individual can decide if they want to be part of it or not."* [Caregiver-FGD 2]. Some mothers reported that the intervention increased their awareness of the potential risks of sexual abuse associated with unsupervised exposure of their adolescent daughters to intimate partners and their key role in reporting perpetrators in situations of sexual child abuse:

*"I have learned that if there is a man abusing children, we shouldn't ignore it or act like we don't see what is happening. We should report them to the police so that they can be arrested for what they did. We were doing a lot of things the wrong way, but ParentText has taught us, and we are changing."* [Caregiver-FGD 6].

The application of skills learned in daily family interactions contributed to reduced parent-adolescent conflicts, and improved educational achievement, reinforcing the continued adoption of positive parenting practices. One caregiver explained how the chatbot improved parent-adolescent communication: *"I would like to say now I am able to sit down with my child and talk together and we are settling our challenges that made us to fight. Now, instead of fighting we are able to talk."* [Caregiver-FGD 8]. Another caregiver who acknowledged previous use of physical maltreatment when supporting the child with school assignments explained,

*"I was not patient when it comes to a child, more especially when I was to help doing homework… I felt as if the child is too slow to concentrate and I use to beat her while teaching... Before, my child was even scared to show me or to ask for help if she has homework… But since we joined ParentText programme, everything changed. Now we have good time to help each other without fear. She is free now."* [Caregiver-FGD 5].

The application of the parenting skills also resulted in adolescents' improved sleep behaviours, as one caregiver reported, *"I got help when it comes to my child sleeping time. ParentText helped me. By the time I was going to sleep, it was my child's time to wake up (There was laughter) ... By the time we started to use ParentText, she changed as she is sleeping earlier than before."* [Caregiver-FGD 8]. Likewise, participants also reported improved family dynamics through the cultivation of positive and equitable perspectives of gender roles with partners as noted by a male caregiver *"I think ParentText has improved us when it*

*comes to household activities for women in particular. I can also give an example: Sometimes you are doing household activities until you get tired, we didn't help you but now we are helping. If you have washed clothes, I can take them off from the washing line as a husband and there is no harm there. It does not mean that a woman is the one who is responsible for doing that because of her gender…"* [Caregiver-FGD 4].

The chatbot content also fostered the adoption of a collaborative approach when planning family finances that prioritises the adolescents' needs, as one caregiver explained, *"If we make our budget right now, we first check whether this can't affect our child's money for travelling to school and pocket money… Now, our budget is manageable through the help of ParentText."* [Caregiver-FGD 5].

A major barrier to adopting more positive parenting behaviours was the persistence of entrenched beliefs that non-violent forms of discipline are ineffective, as reflected in the views expressed by the following caregiver *"I don't think I changed immediately, maybe it took me 3 to 4 weeks to completely change my ways of disciplining the children… we were raised to believe that children only understand their parents when there is beating involved as a form of punishment."* [Caregiver-FGD 6].

# Theme 2: Community nurturers supporting the translation of skills

Participants developed relationships with other caregivers through their participation in the intervention and encouraged one another to apply the skills they had learned. As one caregiver stated:

*"Before we participated in ParentText we didn't know each other as parents and now we are. I had a problem before with my child and after our meetings; I was able to visit P3 to ask if her child is doing the same thing like mine. When I am there, I started to see that with me I thought it was a big problem but because of communicating with P3, who reminded me to breath in and gave me her advices, I got helped. But before joining the ParentText, I was not able to talk freely to someone like me, to someone who is a parent. But now I can*". [Caregiver-FGD 5].

Participants generally described community interactions as supportive and no community-level barriers to the translation of skills were identified.

## Discussion

This is the first African study offering insights on the barriers and facilitators of user's engagement with a chatbot-delivered parenting intervention. Despite cautious views on the use of DHIs in rural and low-income settings, particularly among populations facing infrastructural and literacy challenges, low-income South African caregivers reported positive perceptions of the parenting chatbot following their six-week engagement with ParentText. Our findings suggest that caregivers' intentions were translated into engagement when positive individual perceptions of the value of the chatbot were supported by community nurturers and a digitally supportive environment, enabled by structural resources (i.e., access

to the internet and smartphone, and access to human support) and translated into enhanced parent-adolescent interactions.

# Actual Chatbot Use

Ongoing use of the chatbot was facilitated by self-regulation strategies, such as caregiver motivation and digital nudges, including gamification features, which helped to create a more user-friendly environment. Consistent with research, the cognitive process of evaluating the benefits of ParentText in supporting adolescents' well-being facilitated caregivers' initial motivation to engage with it (28). Moreover, the chatbot's gamification features, including trophies and badges awarded upon completing modules and goals, generated enthusiasm among users and further facilitated decision-making, that led to continued use.

Caregivers' perceptions of the quality of intervention delivery by the chatbot also supported ParentText goal completion. In some instances, engaging with the chatbot was perceived as an outcome in itself. For example, interacting with the chatbot was described as enjoyable and, in some instances, perceived as a therapeutic tool, despite the interventions primary design being focused on behaviour change.

In the FGDs, some participants consistently referred to ParentText as "she" and "Ayanda" suggesting they had developed an emotional bond with the conversational agent. The chatbot was regarded as a friend or personal assistant that caregivers could refer to for advice or to relieve stress. The use of an embodied anthropomorphous character might have contributed to this emotional bond and the continued use of the chatbot, consistent with previous mental health research showing that participants can develop relationships with the conversational agent (9).

The quality with which a facilitator delivers a parenting programme has previously been associated with improved intervention adherence (29). In this study, the chatbot served as the vehicle through which caregivers received the programme, standardising the skill and style of delivery and ensuring greater consistency in the delivery of intervention components. The chatbot was also perceived as a good listener and empathetic, frequently providing positive reinforcement (e.g., trophies and badges awarded upon module completion). These characteristics were praised by caregivers when discussing the qualities of the mothers2mothers facilitators. Aligning with previous research, the convenience of accessing parenting content from home at any time was also valued by caregivers (30).

In contrast, perceived difficulty in using the chatbot increased the cognitive burden of interaction, leading to disengagement. Lack of self-efficacy (i.e., an individual's belief in their ability to achieve a specific goal) might have negatively affected continued use among caregivers with lower levels of digital literacy, particularly older, female adults in South African low-income settings (31). Gender disparities have also been found to contribute to lower digital literacy levels among adolescent girls and young women in LMICs, which can result in fear or reluctance in interacting with new digital technologies (32).

Structural barriers such as lack of internet and smartphone access also contributed to disengagement reflecting South Africa's digital divide across different socio-economic and demographic groups. While the gap in phone ownership by gender is small, the gender gap in home internet access is substantial at 45.4% (31). Women and individuals with lower income and those with lower levels of education are more likely to have lower internet access.

Additionally, it is unclear the extent to which family decision-making dynamics limit use among female caregivers who shared a family mobile phone, potentially reducing privacy and autonomy in engaging with the chatbot. Collectively, these findings highlight the importance of implementing strategies to improve internet connectivity among women and less educated and low-income populations. Furthermore, adopting gender intentional designs may support improved inclusion of digitally excluded women in South Africa.

Moreover, due to the broader intervention delivery context, adolescent boys were excluded from the trial and some fathers felt less encouraged to participate because of the low proportion of men in the onboarding session. These findings underscore the need for male-centred approaches that promote father engagement in parenting interventions. Such strategies may include targeted outreach in male dominated spaces or referrals through mothers given they often play a central role in encouraging fathers' participation (33). The integration of male-only community-based support groups could also encourage fathers' engagement.

Finally, self-regulatory strategies such as establishing a time and place to interact with the chatbot appeared to support continued use and completion of goals. While digital nudges such as reminder triggers helped re-engage caregivers who had temporarily discontinued use, disproportional performance of routine household chores might have challenged women in finding a time and place to use the chatbot (34). Human support and reminder triggers should be designed to be self-tailored, allowing users to autonomously adjust the intensity, frequency, and modality (e.g., text message, email) according to their preferences (35). Facilitating self-regulatory strategies, such as guiding users to define a place and time to use the technology and identify a person to help troubleshoot potential technology issues, can also support ongoing use. Social nudges, allowing content track completion or skills application by other caregivers, can further motivate use. Additionally, feedback nudges could also be incorporated into digital parenting interventions, allowing users to record the daily or weekly frequency of adoption of specific positive parenting skills (36).

## Application of Skills

It is essential that chatbot-delivered parenting interventions incorporate evidence-based theoretical strategies based on behavioural principles such as social learning (i.e., children learn and adopt positive and negative behaviours by observing and modelling and being reinforced by their parents) and attachment (i.e., parental sensitivity and responsive caring encourage secure attachment) theories as they facilitate caregivers' knowledge and skills acquisition.

The development of the chatbot was informed by social learning theories and a participatory design approach (37), ensuring that the content was closely aligned with caregivers' needs and supportive of behaviour change. For instance, the chatbot's personalized nature supported caregivers in safely challenging their existing practices, drawing on examples of communication and assisted parents to manage more difficult issues such as adolescent risk-taking attitudes (e.g., school truancy, substance use). The chatbot reduced barriers related to ideas and knowledge and enhanced parents' confidence and motivation to engage in activities with their adolescent daughters. These findings are consistent with evidence from human-delivered parenting interventions, which demonstrate that addressing barriers related to capability and motivation increases parental engagement in child activities (38).

Aligning with the body of literature social influence and human support facilitated the completion of goals as well as the application of positive parenting practices (39). The WhatsApp community support groups from which some caregivers were assigned to was viewed as a source of support and advice on parenting-related concerns, as well as a platform for sharing trophies and badges obtained upon completion of modules and goals. Caregivers who had access to the WhatsApp community of caregivers and the mothers2mothers facilitator as resources for troubleshooting problems encountered during interaction with the chatbot coped better with technical challenges and reported better ongoing use and reengagement than those without human support. Our findings align with previous evidence associating human support with highest use and lowest attrition in digital parenting interventions (40).

# Study Strengths and Limitations

Our findings provided a nuanced understanding of user engagement in DHIs. The theory-driven approach facilitated the identification of individual-level, community-level, and structural facilitators and barriers to the optimal chatbot use and application of parenting skills. Likewise, the dataset captures a broad range of intervention experiences, with caregivers represented across different intervention conditions, levels of engagement, age groups, and genders, despite our inability to formally stratify the findings by these subgroups.

However, several limitations need to be considered when interpreting our findings. First, although the interviewed caregivers had experience with the piloted parenting chatbot, their digital literacy levels varied as some discussion groups were primarily composed of high engagers, while others had mostly low engagers. For this reason, some were unable to provide in-depth feedback on certain aspects of the technology design. Additionally, we were unable to match interviewed caregivers to their assigned cluster. Nevertheless, the inclusion of participants with varying levels of engagement with the chatbot supports the breadth of our analysis. It reflects the diverse perspectives users may have in the real world. Despite the limitations, our study provides relevant findings that contribute to the improved development and implementation of DHIs delivered via chatbots.

# Future Directions

To improve service delivery through DHIs and optimise user engagement, future studies should adopt longitudinal designs to explore the expansion of the digital health engagement model to better understand the synergetic relationship between actual DHI use and application of learned skills. In behaviour change interventions, what matters is not the extent of DHI use but the translation of the informative content into practice. Geospatial mapping of digital exclusion in LMICs like South Africa is also needed to better understand structural factors (e.g., internet and digital device access) and guide strategies that address health inequities worsened by digitalising health interventions. Future research should further investigate how gender dynamics might contribute to self-regulatory challenges during the engagement process among female caregivers, such as forgetting to engage, missing opportunities to engage, and failing to participate in preparatory behaviours (i.e., including finding a suitable time and place to engage).

## Conclusion

This study provides both theoretical and practical insights into the facilitators of engagement when delivering low-cost, scalable parenting support through digital platforms that reach caregivers, especially those in low-income contexts and with limited digital literacy. Our findings highlight the importance of distinguishing between strategies that enhance the technology itself and those that strengthen implementation through enabling services and community partnerships. Chatbot-led parenting interventions should adopt a collaborative design approach with potential users to ensure interventions that meet the specific contextual needs of caregivers and effectively support the translation of positive parenting behaviours into daily practice. The adoption of gender-intentional design is also essential to enhance access to DHIs among caregivers in LMICs. While digital platforms such as chatbots offer a promising opportunity to widen access to health interventions and provide user-centred services, they should incorporate ethical and safety safeguards. In particularly maintaining transparency with users about the nonhuman profile of chatbots and ensuring ethical standards in user interactions.

## Abbreviations

| |
|---|
| **DHIs:** Digital Health Interventions |
| **DHEM:** Digital Health Engagement Model |
| **LMIC:** Low- and middle-income country |
| **MOST:** Multiphase Optimisation Strategy |
| **PLH:** Parenting for Lifelong Health |
| **CHAMP:** Children and Adolescents Are My Priority |
| **HAPA:** Health Action Process Approach |
| **FGD: Focus Group Discussion** |

# Declarations

### Human ethics and consent to participate

Ethics approval for this study was obtained from the University of Cape Town Centre for Social Science Research Ethics Committee (reference: CSSR 2023/05), the University of Oxford Social Sciences and Humanities Interdivisional Research Ethics Committee (reference: R88177/RE001), and the Mpumalanga Department of Health and Department of Social Development (reference: R69569/RE003). All methods and procedures in this study were carried out in accordance with the guidelines and regulations of the University of Oxford and the Mpumalanga Department of Health. Participants provided informed consent before enrolling in the study and completing paper-based baseline surveys. Facilitators collected written informed consent from participants before starting interviews. Of the 100 participants initially recruited, three did not consent to participate.

### Consent for publication

Not Applicable

### Availability of data and materials

Due to the sensitive nature of the data collected (e.g., violence against children reports) and the need to protect participant privacy and confidentiality, the interview data generated and analysed during this study are not publicly available. De-identified excerpts may be available from the corresponding author upon reasonable request and subject to prior approval from the Principal Investigator.

### Competing interests

JML is the CEO and LM the Chief of Solutions at Parenting for Lifelong Health (PLH), a UK-based charity that developed ParentText, which is open access under a Creative Commons 4.0 Attribution Share-Alike license. JML has participated as an investigator in multiple studies of the program, with the University of Oxford and the University of Cape Town receiving related research funding. MDGA, JS, SL, ZM, FG, SV, HS, PZ, LM, and GJMT worked on other studies by PLH have collaborated on other PLH studies. Investigators receive no financial benefit from implementation or dissemination. KB previously worked for Clowns Without Borders South Africa. Funders and sponsors had no role or influence in study design, execution, analysis, or dissemination.

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# Authors’ Contributions

MDGA led study conceptualisation. MDGA led the thematic analysis, with SV, JML, FG, JS, ZM, and SL contributing. AS, KB, SL, PZ, JS, ZM, HG, LM, and CF conducted project implementation; MDGA led the development of the study methodology, with SV, FG, and JML contributing to it. MDGA led writing, editing and reviewing of the original manuscript with contributions from SV, JML, GJMT and FG. All authors approved the original manuscript.

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## Figures

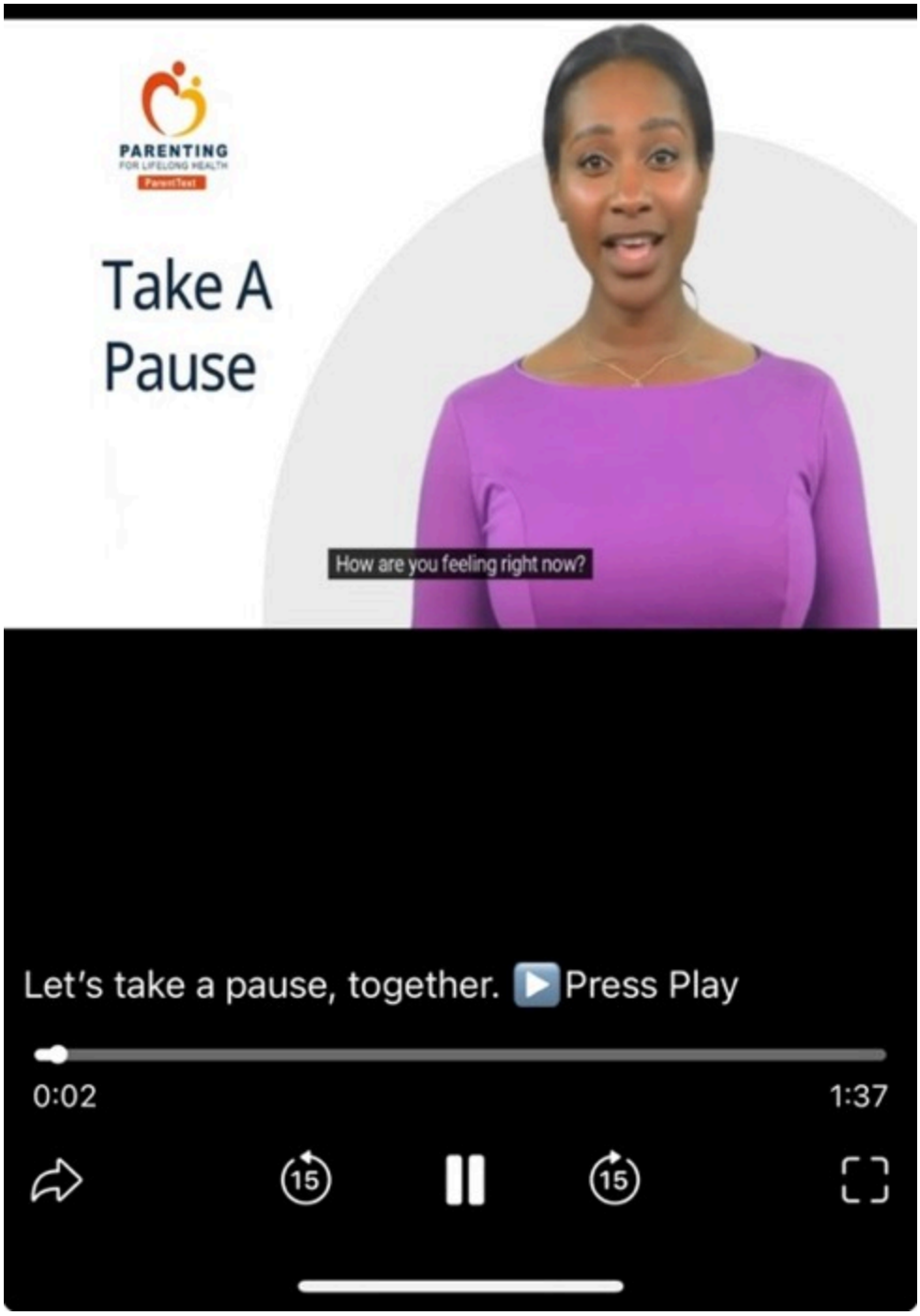



**Figure 1**

A stress relief video presentation by the embodied agent Ayanda in ParentText chatbot displayed on a smartphone screen

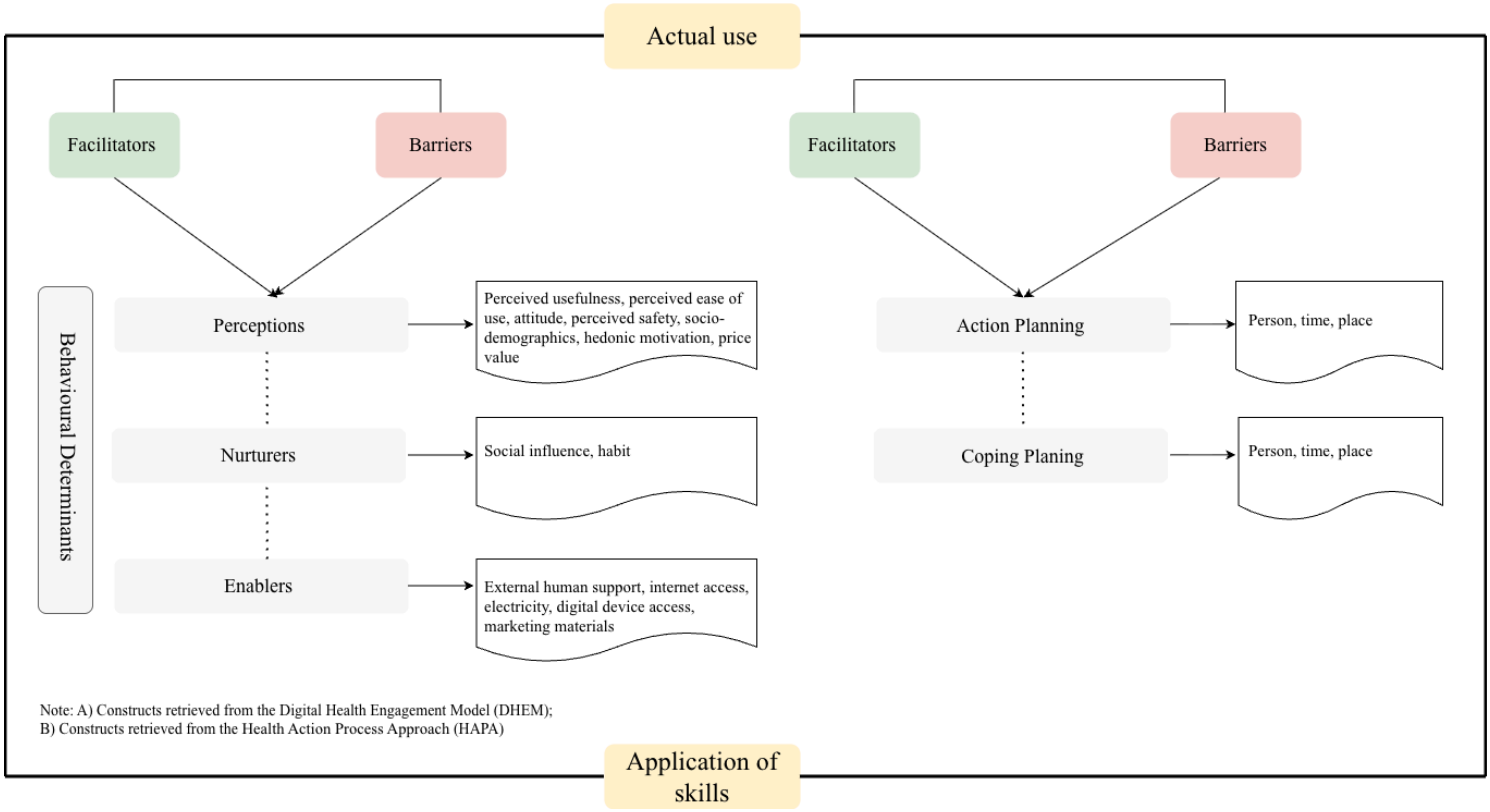



**Figure 2**

Tree map for examining the facilitators and barriers to caregivers' engagement

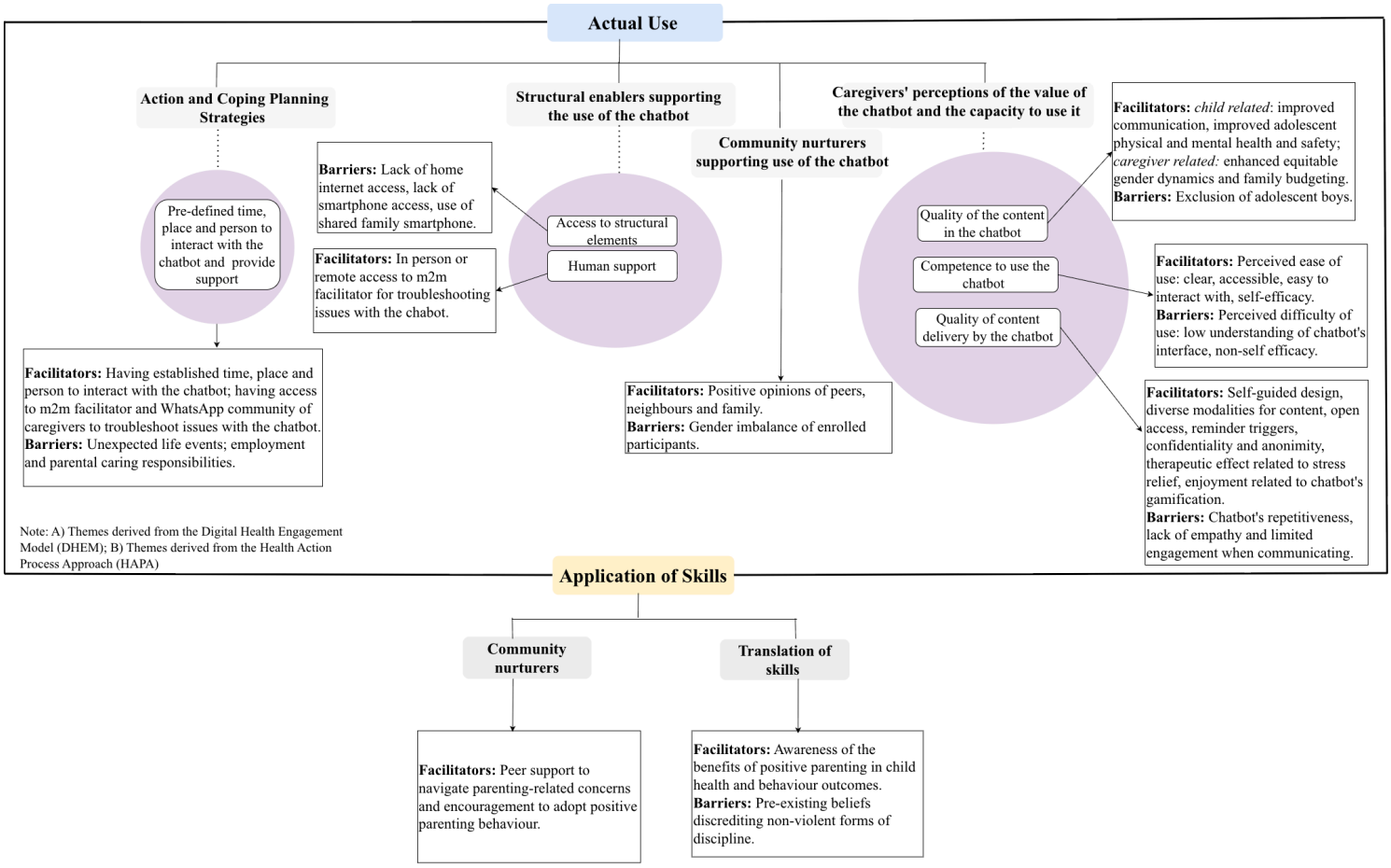



**Figure 3**

Summary of themes and subthemes

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1.docx