Getting Started in the Correct Stage: Designing Conversational Strategies for Proactive On-boarding in a Conversational Agent

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Abstract—This study investigates the impact of different conversational strategies on retention rates and system trust in behavior change interventions delivered through a conversational agent (CA). Utilizing a between-subject experiment with three distinct conversational strategies, namely Control, Empathetic, and Extended Conversation, we aimed to assess their effectiveness in on-boarding users and facilitating stage assessment within a physical activity behavior change intervention. Thirty participants across the three strategies engaged in a 5-day experiment, providing categorical data on stage assessment accuracy and trust scores, complemented by qualitative insights from post-interaction interviews. Statistical analyses, including Chi-squared tests and qualitative synthesis, revealed nuanced findings. While no significant differences were observed in perceived effectiveness among the strategies, interviews unveiled critical features for enhancing user engagement, such as clearer prompts, personalized interactions, and a balanced approach to human-likeness in CA responses. Despite encountering challenges like low retention rates and technical issues, our study underscores the potential of CA-based behavior change interventions, contingent upon addressing user preferences and refining CA design. Moving forward, integrating user-centered design principles and conducting further research will be pivotal in harnessing the full potential of CAs to drive positive health outcomes through physical behavior change interventions.

Keywords—Human-computer interaction, Conversational agent, Chatbot, Behaviour change, Personalisation, Stage theory, Transtheoretical model, Physical activity

I. Introduction

According to the World Health Organization (WHO), over 80% of adolescents and 23% of adults do not meet the recommended levels of physical activity, negatively impacting the inactive individuals and the healthcare service system [1]. Lack of physical activity can shorten life expectancy and decrease quality of life by contributing to multiple health concerns such as obesity, cardiovascular disease, diabetes, and increasing the risk of cancer [2]. Furthermore, it can harm mental and emotional well-being, leading to lack of energy, stress, worsening sleep, anxiety, and depression [3]. Unfortunately, increasing physical activity requires people changing their existing behaviour - a notoriously difficult problem. Multiple fields from economics to psychology have come up with more than 82 theories on how to effectively change people's behaviours [4]. These theories generally fall into *continuous* and *stage* theories [5].

Continuous models like the Health Belief Model and the Social Cognitive Theory view behaviour change as a gradual process, where the focus is on the individual's beliefs, their attitude and the surrounding environment as factors that would shape a new behaviour [6, 7]. On the other hand, stage models like the Transtheoretical model (TTM) view behaviour change as a series of distinct, sequential stages, characterized by different cognitive and behavioural processes [8]. While both offer valuable insights into behaviour change, stage models such as the TTM tend to be preferred in practical application as they offer a clear framework to understand and follow progression, as well as offering a more tailored experience which has shown positive effects in various studies, including those related to physical activity [9, 8, 10].

To address the lack of physical activity, researchers have long developed behaviour change interventions aimed at supporting people in adopting a physically active lifestyle. Traditional physical activity interventions, such as one-to-one or group counseling, self-monitoring or motivational support have had varying success in terms of engagement and sustaining positive behaviour change [11]. These interventions usually involve a human practitioner which limits their reach and accessibility or are a "one-size-fits-all" approach, where the content is too general and lacks tailoring to individuals specific needs which decreases the effectiveness [12, 13, 14]. Tackling these issues and conveying the benefits of physical activity more effectively might require going past the traditional behaviour change interventions and exploring alternatives that offer a more personalised approach.

But while the TTM has seen some good success and provides a personalised approach to adopting a new behaviour, it still might not alleviate some of the flaws that come with traditional interventions, such as the need of a human practitioner and the face-to-face counseling which requires one to be physically present at a specific time and place to receive support. Therefore, distributing TTM-based interventions in a more accessible way could benefit from the use of technology. With recent developments in machine learning models and AI, conversational agents (CAs) are becoming a viable alternative in many fields, including healthcare, personal tracking and behaviour interventions, offering quick and easy access to content on most hand-held devices, such as smartphones. Compared to traditional procedures, CAs can offer more convenience and better accessibility, as they can automate the processes that are usually tied to telephone calls, emails or face-to-face interventions, and the user can engage with them at any time, from anywhere. CAs can also host diverse content and allow for a certain level of penalization, such as what content the user receives, when and how they receive it. Therefore, leveraging the capabilities of a CA and integrating the stage and progression theory from the TTM into one can be a promising approach to delivering personalised content in real time and promoting sustained healthier behaviours, including in the context of physical activity. However, doing so comes with many unknowns, as there is currently little or no research around how the TTM can be integrated into a CA, how the user can be onboarded and what content the CA should provide in each stage. To our knowledge, questions like how can the CA determine the stage in which the user should be appended to initially or when does the CA know that the user should progress to the next stage remain unanswered. Different interactions between the CA and the user should also be considered, as they are of crucial importance in relation to the the trust and the long-term relationship between the two [15]. Despite not proving important in all contexts, a human-like conversation could be the desired way of providing content in the context of healthcare and well-being [15]. Furthermore, the initial interaction with the CA can be important for the first impression that the user gets and could affect how the user anticipates the CA in the long run. Thus, the CA should be designed in a way where the initial interaction can catch and hold the user's attention, and keep them engaged for an extended period of time, so that they use the CA in a longer period of time. Doing so requires exploring multiple conversational strategies and ways of providing TTM content through the CA. Appending the user to the correct stage in the initial interaction is important for providing them with the appropriate content for their stage and case is also crucial for the final outcome of the intervention.

With this study, we aim to integrate the TTM into a CA and to provide guidelines on how a CA can be designed to accurately determine the initial stage of the user. We also look into different interaction strategies and ways of providing the content of the initial interaction to the users, and investigate if that has an effect on their levels of retention and trust in the agent. We have designed a mobile application, hosting a CA that utilises parts of the stage theory from the TTM, which aims to successfully onboard users and positively influence their physical activity behaviours.

II. Background

a. Transtheoretical Model

The Transtheoretical Model (TTM) is a comprehensive framework combining cognitive, motivational, and behavioural constructs from different theories, and providing a holistic understanding of the complex processes involved in adopting and sustaining new behaviours [8]. The TTM has been used in multiple domains, such as tackling negative habits like smoking, alcohol abuse and over-eating, and promoting positive habits like physical activity, studying and decreasing food waste [8, 16, 10]. The TTM argues that individuals go through five *stages of change*, each representing a specific set of mind or attitude towards adopting a new behaviour (see Table 1) [8]. Furthermore, the TTM consists of different cognitive, motivational and behavioural constructs such as the processes of change, self-efficacy and decisional balance which are what determines progression through the stages, and helps adopting and sustaining new behaviours [8]. For example, stimulus control has little effect on people in pre-contemplation are still unaware of their problematic behaviour, while being a useful tool for people in the action stage, where people can use it to counter their problematic behaviour [17]. However, these processes will only guide the person if their stage is determined correctly in the initial assessment prior to the intervention, making stage assessment an important step.

Determining a persons stage requires assessing several factors including their awareness of their problematic behaviour, their motivation to change it, exploring what and how they intend to change, and the observable actions they are taking[8, 17]. The most reliable and accurate method of determining a person's stage is through a costly series of conversations with a therapist. However, there are various questionnaires that can be used for accurate stage assessment, while keeping the production and facilitation costs low. These stage assessment questionnaires often require adapting to the specific context that they are used in and usually need rephrasing or adjustment to the number of items they include. That, combined with varying interpretations and definitions related to the given context, such as what might be considered as being physically active, means that there is no standardised stage assessment questionnaires. Instead, there are questionnaires that can be used as a base and customised to fit a specific purpose like smoking cessation [18], weight management [19] or physical activity [20]. One such questionnaire is the Stages of Change Questionnaire, which can be used to append the individual to a certain stage by assessing their current, past or future engagement in a given activity. The questionnaire is a self-report measure which comes in the form of close-ended questions, which could be tailored to a specific context. Haas and Nigg [20] have previously adapted that questionnaire to the context of physical activity, and have managed to accurately do stage assessment.

Integrating TTM into interventions provides practitioners with a powerful tool for developing personalised strategies that can guide individuals at various stages in adopting healthy behaviour. Unfortunately, such personalisation requires continuously updating practitioners on their subjects' progress, and scaling it to multiple people requires a lot of planning and effort, putting extra stress on the practitioner.

#	Stage	Definition
1	Pre-contemplation	Individual is not intending to take action in the foreseeable future, usually in the next 6 months
2	Contemplation	Individual is intending to take action in the foreseeable future, usually in the next 6 months
3	Preparation	Individual are intending to take immediate action, usually within the next month
4	Action	Individual has taken action within the past 6 months
5	Maintenance	Individual has made appropriate lifestyle changes and attempts to prevent relapse

TABLE 1: TABLE DESCRIBING EACH STAGE OF THE TRANSTHEORETICAL MODEL

Furthermore, practitioners' availability to their subjects is limited to certain times and places, or through telephone calls or emails, which limits accessibility to the intervention. This makes the whole behaviour change process less efficient and reduces the cost-effectiveness as well. Overcoming these limitations requires incorporating the TTM into a scalable digital medium that allows for partial or full automation of interventions without the limitations of traditional practitioner. However, automating these interventions would require the medium of choice to account for correctly determining people's current stage, as it dictates the personalised content it should provide them with to assure that they progress to the next stage.

b. Conversational Agent

With advancements in technology, CAs have emerged as a promising and flexible tool for behaviour change interventions in different domains [21, 22, 23]. They can be deployed on anything from web pages to smartphones and wearable devices, making them a very accessible and cost-effective solution for reaching a wider audience. Furthermore, CAs can provide personalised content, assessment and feedback, such as workout plans tailored to a specific person's case and preferences, empathetic or comforting messages based on their input, or notifications at a convenient time frame set by them. Having such levels of personalisation makes it easier for the users to understand their problem, increases their engagement, their motivation to change and their adherence to the new behaviour they are trying to adopt [14, 24]. Providing more comprehensive content and feedback can increase the effectiveness of the intervention as long as the content is provided in a digestible manner [24]. That makes CAs a possible medium for distributing various behaviour change models from psychology, such as the TTM, into a quick, easily-accessible and user-tailored form. The immediate support and real-time feedback that users can get at any time through a CA allows for positive reinforcement and a timely reaction to any challenges that might arise and interfere with the adoption of new behaviour [24]. The relatively cheap and wide deployment of a CA also makes it a cost-effective alternative to having a human practitioner [25, 26].

To get a better understanding of how the TTM and a CA can be combined to promote behaviour change, we carried out research on a total of 30 articles acquired from the Association for Computing Machinery (ACM), using the search term shown in figure 1. We also included four articles from the National Institutes of Health (NIH & PubMed) data libraries, which were also found using free-search keywords. The primary focus of our research was to investigate effective strategies and design ideas that would allow deploying the TTM through a CA. Thus, after a thorough scanning of the abstract and conclusion of each of the 30 articles from the original search sequence, we discarded 14 articles that were deemed irrelevant, leaving us with 16 articles which actually included the terms "transtheoretical model" and "conversational agent", as well as their abbreviations.

The research of CA use cases is split into three categories: Exercise Related (37.5%), Health Related, which includes alcohol, smoking and stress (50%) and Uncategorised (12.5%). The majority of the research within the exercise field focuses on motivation as the primary factor in encouraging positive physical behavioural change. DeVries et al. [27], Jung et al. [28], Ren et al. [29] and Olafsson et al. [21] investigated how to motivate users to increase their physical activity. Ren et al. [29] and Olafsson et al. [21] utilised cooperation from co-workers and motivational remarks to increase physical activity, through a mobile application and a conversational agent respectively. Both interventions were effective in successfully promoting positive behaviour change, which resulted in more physical activity. However, despite

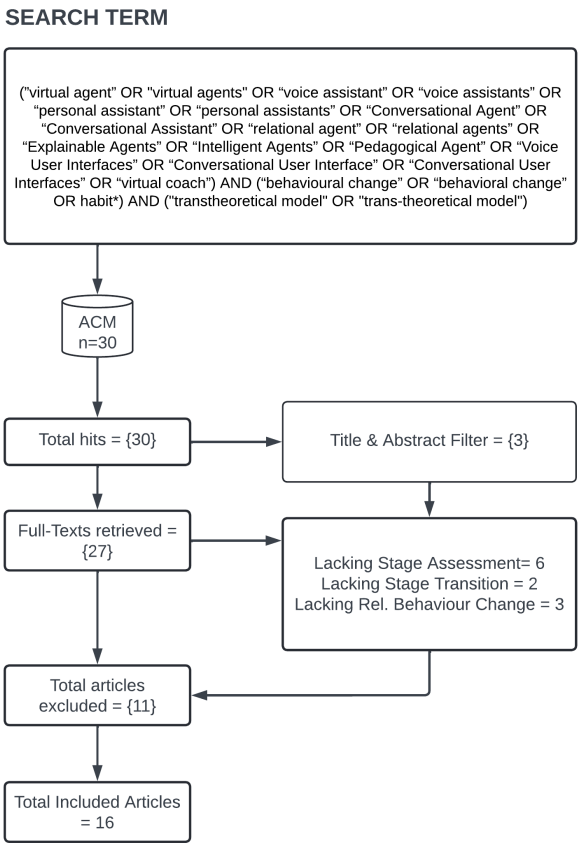

Fig. 1: Diagram of articles collected as well as their exclusion criteria

Ren et al. [29] not utilizing a conversational agent, they did relevant user identification and stage assessment. They selected participants, who had been co-workers for at least a year and had good relations in their leisure time. Their stage assessment was done through a stage of change questionnaire with a focus on physical activity. Observations made from these papers indicate that by understanding where users are in their respective process of behavioural change, one can design an intervention that can effectively promote physical activity. Additionally, Jung et al. [28] did stage assessment by excluding the people in the pre-contemplation stage and the maintenance stage. It seems that when other researchers utilise the TTM they look into concrete stages and design interventions specific to those stages instead of doing so for all of the stages. While this is a promising beginning for designing an effective positive behavioural change intervention, a full-scale deployment would require taking all stages into consideration, since that allows the intervention to be more generalisable, as well as making the intervention applicable to a larger scale of people. Furthermore, the paper looked specifically into goal setting by introducing a margin that would range slightly outside of the user's original goal, and consider that to be "good enough" which had a positive effect on users. It drove their users to either push themselves to reach their original goal or they would remain with the feeling of success since they reached their marginal goal. Overall, the research indicates that you can effectively promote positive physical activity change, when designing specifically for an individual user's needs and keep in mind where they are in their respective stage of change following the TTM. The studies that focused on physical activity indicate that motivation is the main driving factor for successfully promoting physical activity. It indicates that with the correct strategy, you can design interventions specific to each stage which increases the chances of successful behavioural change. Oyebode et al. [30] investigated multiple different strategies which they correlated with each stage of the TTM and measured if there was any significant difference. In an experiment conducted on over 500 participants, they focused on the following strategies: self-monitoring, social role, praise, reminder, and suggestion, which they implemented into high-fidelity prototypes. From their results, they concluded that a user's current stage plays a significant role in the perceived persuasiveness of the aforementioned strategies. These results indicate that by having a system which is capable of tailoring itself specifically to each stage and providing personalised aid with respect to the strategies, one can further increase the likeliness of helping users make successful behavioural changes.

c. Different Ways of Delivering Information

Initial interactions with the CA are crucial in the long run as they set the tone for the entire user experience [31]. The initial steps in the interaction with the CA can establish trust, familiarity and shape up the user's perception and overall impressions of what the system is capable of and whether or not it is reliable [31]. Intuitive design and clear communication during the on-boarding process can significantly impact the user's engagement and retention with the CA [31]. Moreover, a well-executed initial interaction could guide the user through the capabilities and limitations of the agent, and can help ensure that they understand how to use it and know what to expect from it. Thus, the early interactions lay the foundation for meaningful and engaging experience, which could be key in increasing retention and the chances of achieving a successful behaviour change intervention.

In the case of this study, the primary goal of the CA's first interaction with the user is to present them with its purpose, its capabilities and how it can assist them, as well as correctly identifying their current stage in accordance to the TTM. And while the CA could simply provide the user with the necessary information and the questions from a stage assessment questionnaire in a very brief and competent manner, a surface-level interaction that is also relatively short might affect how the user perceives the CA in a a negative way and reduce the chances of them using the system in the future. Alleviating such scenario requires looking beyond just the competence of the CA to provide accurate information or assessment, and exploring ways of providing a more in-depth interaction, similar to what one would get with a practitioner. Bickmore et al. [32] suggests that human-likeness and what they describe as *relational skills*, such as showing empathy and having a social dialogue, are key to building a strong and longer-lasting relationship between the user and the CA, which in turn has a positive impact in physical activity interventions. In the between-subject experiment they carried out, the group that interacted with a human-like CA with relational skills showed a significant increase in their desire to work with the system and to actively view health information, compared to a group interacting with a CA with no relational skills [32]. Incorporating human-likeness through relational behaviours and empathy into a CA has a positive effect on user engagement and interaction, and users tend to respond favorably to qualities like social dialogue, empathetic feedback and sense of humor, which increase user satisfaction and motivation in the initial stages of the intervention [32]. To outline the benefits of human-likeness even further, Olafsson et al. [16] investigated the difference between a constrained, option-based dialogue and a freely spoken dialogue, where their findings suggest that the freely spoken dialogue is generally preferred and that the CA's human-like qualities affected the users positively, due to the conversation feeling more natural. Empathetic feedback, especially the ability of the CA to show understanding and to express concern about the user's well-being, also seems to be a very desired quality in a CA, as it tends to increase the motivation to engage in behaviour change interventions [32]. Samrose et al. [33] looked into the differences between an empathetic and non-empathetic CA, and their findings indicated that users prefer the empathetic CA due to its capability to modulate their users' mood and performance. Furthermore, empathy plays a crucial role in building trust and creating a sense of connection between the user and the CA, which can ultimately influence the user's willingness to use the CA in longer periods of time and to adopt the new behaviour over time [32]. Therefore, it is important that the CA provides responses that convey understanding, validation and support. This can be done through providing personalised feedback, actively listening and acknowledging of the user's emotions, and offering them encouragement and reassurance. The way that content is distributed in the initial interaction might have

an effect on how people perceive the CA and could impact their trust in the system, as well as their desire to use the CA again. Comparing different ways of delivering content in the initial interaction could help set guidelines on how a CA should be designed so that it keeps retention rates high. As empathy and human-like conversations appear to be very desirable in interactions with CAs, it could be worthy comparing different on-boarding strategies that include a CA showing empathy, based on the user's input and a CA providing an extensive conversation based on the user input, to a baseline strategy that includes less human-like features.

d. Summary

Integrating the TTM into a CA could benefit users in various ways and might prove as a very strong tool in aiding the adoption of new behaviours. Providing the accessibility of a CA could alleviate the need of a practitioner or provide support when one is not available [26]. CAs can further expand upon the personalisation of the intervention that the TTM provides, by letting users choose when and how they want to receive support. That, and the real-time monitoring, immediate feedback, and extended interactivity can contribute to a dynamic and engaging user experience that would stimulate adherence and positive behaviour change. And while human practitioners are considered an essential part of tackling bad behaviours, CAs are a viable tool that can either enhance the work of a practitioner or work independently, to provide a more accessible, personalised and effective support. However, application of the stage theory from the TTM to CAs, particularly in the context of physical activity, remains a relatively unexplored area with some unknowns. Despite the effectiveness of the TTM in guiding behaviour change [8, 30, 9, 10] and the few studies investigating how the TTM and CAs can work along together [25, 21], there is limited insight into how a CA should be designed to foster the TTM's stage theory. Furthermore, there is lack of research on how the initial interactions with a CA that utilises the stage theory should be carried out and what they should include, and there is very limited insight into the initial user identification, which is normally done outside of the system. There are no clear design guidelines on how a CA can be designed to correctly determine the user's stage, nor on how the initial interaction and stage assessment should be carried out so that the user's inclined to use the system again. Correctly determining the initial stage in which an individual belongs to is a crucial step in the process of adopting a new behaviour, as it dictates how the entire intervention goes. Appending the individual to the wrong stage could slow down the process and reduce the effectiveness of the intervention, or it could have no effect at all. Achieving a successful adoption of a new behaviour also requires the user to use the system frequently and requires high retention rates and trust in the system. So the initial user identification and the first impressions that the user gets about the system are crucial, and require picking the correct strategy of providing the necessary information to them. With the findings observed in subsection c, we have formulated the following research questions:

*Research Question 1(**RQ1**):* How do a non-human-like conversation, an empathetic conversation and an extended conversation compare to each other in terms of retention rate and trust?

*Research Question 2(**RQ2**):* Will an empathetic conversation outperform an non-human-like conversation, while being outperformed by an extended conversation in terms of retention rate and trust?

*Research Question 3(**RQ3**):* To what extent do all three strategies exhibit consistent performance in determining the current stage of the users?

Answering these research questions should provide enough ground for us to answer the final problem statement which we are looking to solve in this paper, namely:

"How can a conversational agent be designed so that it correctly determines the current stage in accordance to the Transtheoretical model's stage theory, in which the user is in, while also maintaining high retention rates and supporting a successful behaviour change intervention?"

III. Design

To try and answer our research questions, and test whether the way content is provided to the user would affect retention rates and trust, we developed a mobile application that hosts a CA which includes three conversational strategies that introduce the user to the purpose of the CA and deliver a stage assessment questionnaire in three different conversational manners.

a. Stage Assessment

Doing stage assessment in the context of physical activity, required us using a stage assessment questionnaire. Despite there not being a standardised one, we chose the Stage of Change for Physical Activity Questionnaire (SCPAQ) by Haas and Nigg [20], which we briefly mentioned in subsection a in chapter II. Their questionnaire consists of four items, which assess a person's engagement in *regular physical activity*, and a scoring system that can append the same to a certain stage based on their answers (see fig. 2). They also provide a definition of what regular physical activity is, which essentially translates to 30 minutes of one of various physical activities per day, for at least 5 days per week. Their take on the questionnaire fits the purpose of our study.

Please answer all questions with either Yes or No.
According to the definition above:

1. Do you currently engage in regular physical activity?	YES	NO
SKIP PATTERN: If YES go to #4, if NO go to #2		
2. Do you intend to engage in regular physical activity in the next 6 months?	YES	NO
SKIP PATTERN: If YES go to #3, if NO finish		
3. Do you intend to engage in regular physical activity in the next 30 days?	YES	NO
SKIP PATTERN: If YES or NO finish		
4. Have you been regularly physically active for the past six months?	YES	NO
SKIP PATTERN: If YES or NO finish		

SCORING	
If item 1 = NO and item 2 = NO	**Precontemplation**
If item 1 = NO and item 2 = YES and item 3 = NO	**Contemplation**
If item 1 = NO and item 2 = YES and item 3 = YES	**Preparation**
If item 1 = YES and item 4 = NO	**Action**
If item 1 = YES and item 4 = YES	**Maintenance**

Fig. 2: The Stage of Change for Physical Activity Questionnaire (SCPAQ) and its scoring system, as designed by Haas and Nigg [20].

b. Conversational Strategies

We designed three on-boarding strategies for the initiating stage in the interaction with a CA, which provide the content that the user can interact with or respond to (in this case the SCPAQ), in a different conversational manner to see if it affects their trust in the CA and their retention after the very first interaction with it. The introductory message and the final message, were kept the same throughout the three strategies, to alleviate the possibility of them affecting the outcome.

Control Strategy assess the user's stage in accordance to the stage theory (as seen in 1) by simply providing the Stages of Change questionnaire in its binary form to the user and collecting their answers, without providing any feedback throughout this part of the interaction. Once the user submits their answers, their score is calculated based on the scoring system that comes with the questionnaire, their current stage is assessed and the interaction comes to an end.

Empathetic Strategy expands on that by adding empathetic responses after each of the user's answers to the questionnaire. Similar to what Bickmore et al. [32] suggested, here the CA shows a basic level of understanding, positivity and compassion based on the user's input.

Extended Conversation Strategy employs a slightly more human-like behaviour, where the CA aims to provide an extended conversation, more similar to that one can have with a human practitioner, where the CA asks follow-up questions based on the user's response to the questions and tries to form a more freely-spoken dialogue. The goal of this strategy is also to provide a more personalised experience by delving deeper into each question and wanting to get to know the user better.

c. Mobile Application

The proposed mobile application features a CA, a built-in questionnaire handling system see Figure 3, back- and front-end server connectivity through server sockets, and a front-end user interface built using React Native, making the application fully standalone and accessible from anywhere, and providing smoother user experience. For the purpose of our test, the mobile application was designed so that each user is able to access only one of the strategies. We cover this in more detail in section IV. Each strategy requires altering the messages in which the questions from the SCPAQ are provided. Thus, we used the RASA framework which provides a flexible way of building CAs and allows for full customisation of the CA's replies. Furthermore, RASA provides Natural Language Processing (NLU), meaning that it can classify the user's intents and provide natural language replies, which helps with achieving better human-likeness. Furthermore, the CA is capable of providing users with questionnaires directly in the application, with an additional overlay that displays quick-access buttons when the questionnaire is initiated. This was done to make it easy for users to quickly answer questions without having to write every message directly. Once all the questions have been answered the data logging system sends the answers through the back-end server to the database where it calculates the stage score (as seen in 2), whereas the system automatically assigns the user to their current stage.

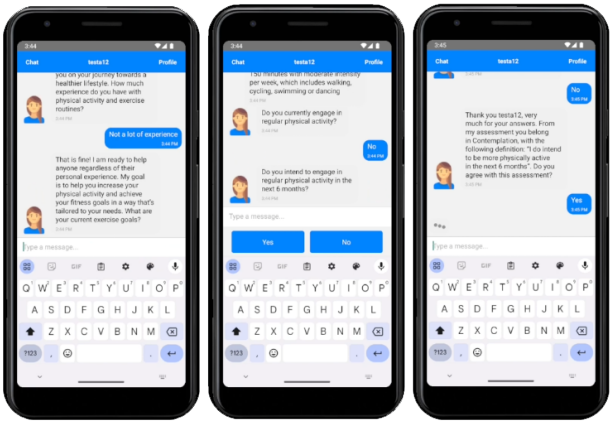

Fig. 3: Figure showcasing parts of the interaction with the conversational agent on the mobile application

IV. Methods

In this paper, we seek to understand whether a CA could accurately do stage assessment and successfully on-board users into a physical activity behaviour change intervention. We are testing the three conversational strategies, as seen in subsection c. of chapter II, which are supposed to help with on-boarding. We have conducted a 5-day between-subject experiment with 3 groups, with one representing each strategy, and we recruited 10 participants in each group, to a total of 30 participants for the experiment. There were a total of 29 males and 1 female across the three groups, with their age ranging between 18 and 36. The majority of the participants(29) were university students and had a strong technical background. The procedure itself consisted of two parts: First the participants had to engage in a short interaction with the CA, after which they had to fill out a trust questionnaire and take part in a short structured interview. Each participant was assigned a strategy randomly, but the content that the CA provided and the procedure was the same for each, apart from the way the questions of the Stages of Change questionnaire were delivered to them, based on the strategy they were assigned to. Their interaction with the CA was recorded so that we could analyze how they perceived the CA and what they struggle with, if necessary.

To begin the test, each participant had to download the mobile application with the CA, log in using the credentials provided by us, which corresponded to their numerical order of recruitment and the letter of the given strategy (a=Control Strategy, b=Empathetic Strategy, c=Extended Conversation Strategy), and begin the interaction with the agent. To evaluate whether or not the CA assessed their stage correctly, the participants were provided with a definition of the stage and asked if they agree with it or not. As part of the interaction with the CA, they were asked if they want to provide their phone number, which was used as a replacement to a push-notification system to distribute a reminder to log in on the day after, where their participation was optional and only required them to log in the application so we could have an estimate of the retention rate after the initial interaction. Once they have concluded their interaction with the CA, they proceeded to the second part of the experiment, where

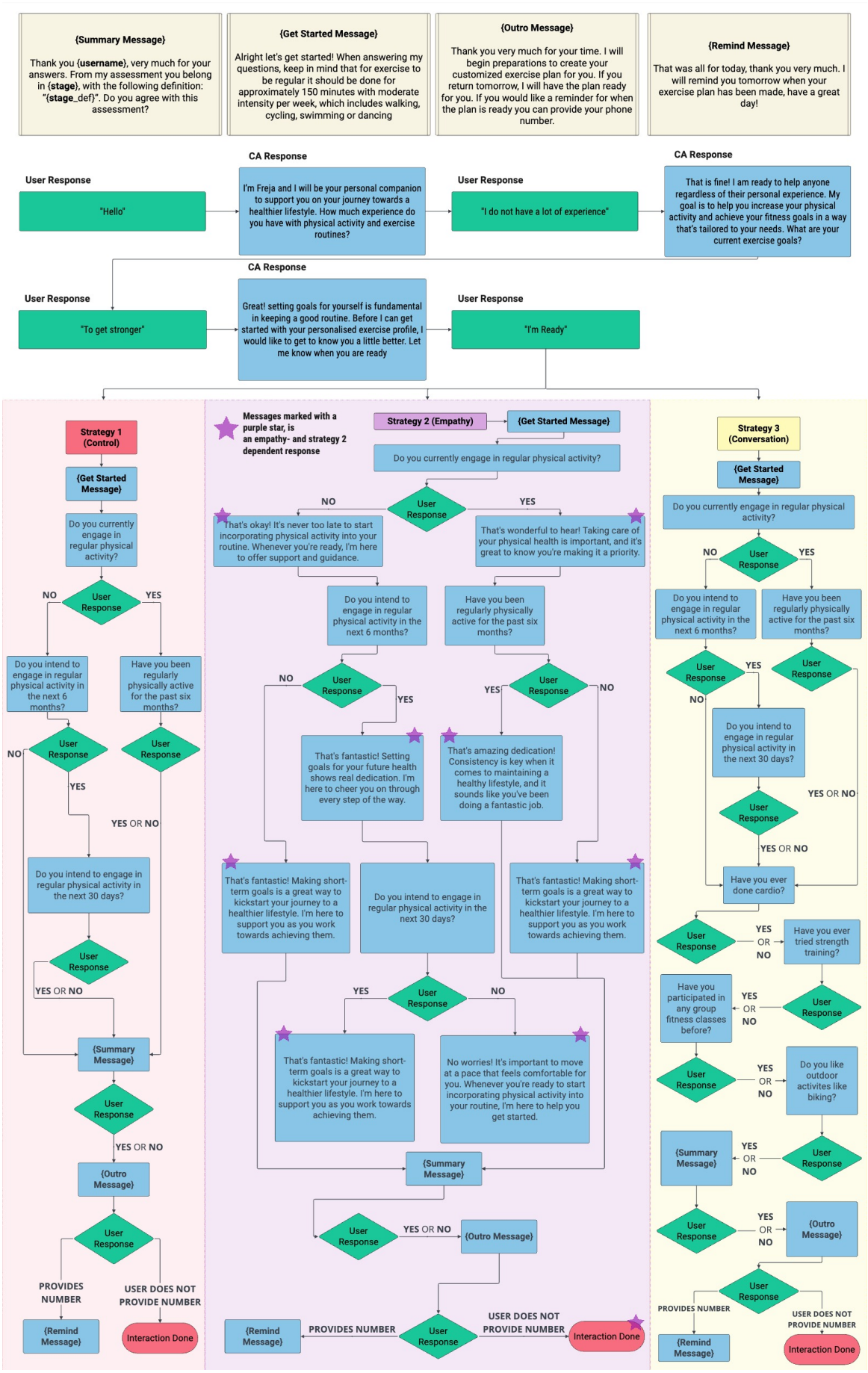

Fig. 4: Flowchart depicting an example of how a conversation could be carried out in each of the three strategies. From left to right in the coloured blocks: control strategy, empathetic strategy and extended conversation strategy.

they filled out a 7-item Trust in Automated Systems Test (TOAST) to measure their trust in the system. The test was followed by open-ended questions in the form of a structured interview to get their initial impressions of the application.

The mobile application which the participants used was deployed on a local server hosted on a desktop computer with the following specifications: NVIDIA GeForce RTX 3060 Ti Graphics Card, AMD Ryzen 5 5600X 6-Core Processor and 32GB RAM. The servers are able to run smoothly without any breakdowns or problems with the listed specifications. However, one issue arose with the tunneling service (NGROK) which was used to open the connection, so that participants could connect to the servers from outside of the local network. The NGROK service was running on a free plan which had a limited amount of requests available which resulted in a minor server stop during the deployment.

V. Results

The data collected from the study was categorical, non-parametric and lacked normal distribution. Thus, to evaluate if there were any significant differences, we conducted a Chi-squared test, which can be used to calculate if there is any statistically significant difference between two or more categorical variables. In this study, we have evaluated the relationships between all categorical variables, extracted from the data. To evaluate whether stage assessment was accurate, each participant was provided with a definition of the stage they were assigned to and asked whether they agree or not. Trust scores were also calculated, using the TOAST scoring system. As for the collected qualitative data from the post-interaction interviews, we have extracted the most interesting findings from each and have made a short synthesis, which can give a further insight into what the numerical data shows.

a. Stage Distribution & Stage Agreement Rates

A general distribution of the participants in relation to each TTM stage, based on the assessment by the CA, can be seen in Figure 5. Figure 6 shows the distribution in each stage, taking each of the three strategies into account.

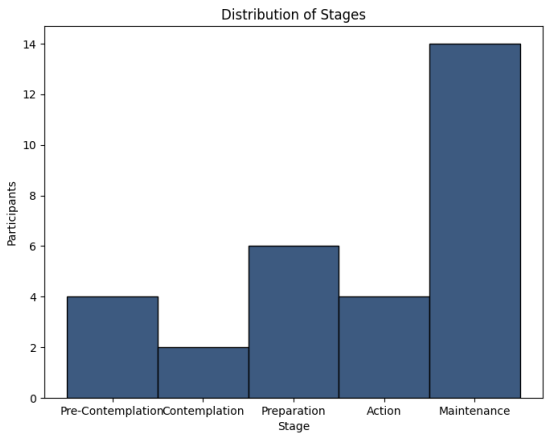

Fig. 5: Histogram showcasing the amount of participants in each stage.

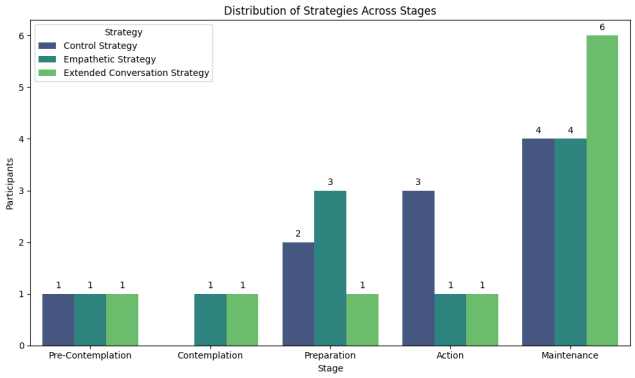

Fig. 6: Bar chart showcasing the amount of participants in each stage by strategy.

From the two figures it can be observed that Maintenance is the stage that has the vast majority of participants and therefore creates an imbalance in the distribution. Furthermore, the stage distribution does not follow a normal distribution which was taken into consideration when doing the pair-wise comparison analysis. In terms of stage agreement, figures 7 and 8 show a general agreement between participants with the stage that they were assigned to by the CA. It can be observed that, overall the participants seemed to agree with the stages that the CA assigned them to, based on the answers they provided in the stage assessment questionnaire.

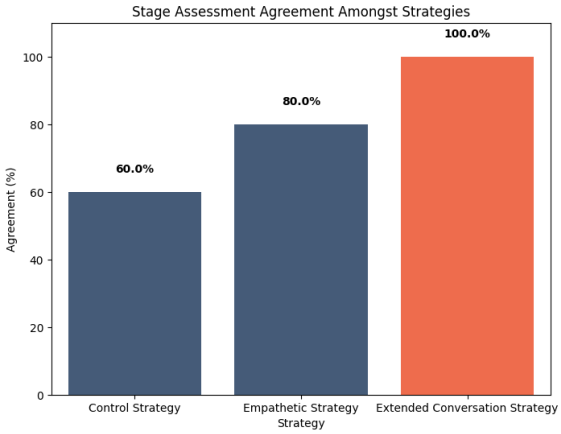

Fig. 7: A bar chart showcasing the percentage of agreement with the assigned stage by strategy.

Figure 7 shows that the control strategy had the lowest overall agreement with 60%, the empathetic lies in-between with 80% agreement and lastly the extended conversation strategy had 100% agreement. Figure 8 shows the agreement by stage, where it can be seen that there was full agreement for all participants in Pre-Contemplation, Contemplation and Preparation, whereas Action and Maintenance are the only stages with any disagreement with stage assessment.

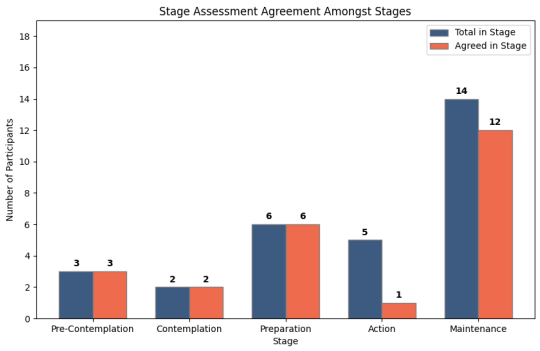

Fig. 8: A bar chart showcasing the amount of participants that agree with the stage they were assigned to.

b. Retention Rates

Figure 9 shows that there was a relatively low retention rate amongst participants in all three strategies, with only 13 participants across all strategies returning on the following day.

c. Trust Scores

Figure 10 shows the Understanding Subscale (p-score) and Performance Subscale (p-score) which are used to calculate overall trust in the system across the three strategies. A higher u-score indicates the user has a better understanding of how the system works, whereas a higher p-score indicates user perceives the system to be performing well in performing certain action or helping them achieve their goals [34]. From the Student's t-test, significant differences were observed in users' trust in the system when comparing the control to both the empathetic strategy ($t(18) = -5.270$, $p < .001$) and the extended conversation strategy ($t(18) = -4.216$, $p = .001$). These results suggest that users had varying levels of trust depending on the strategy employed.

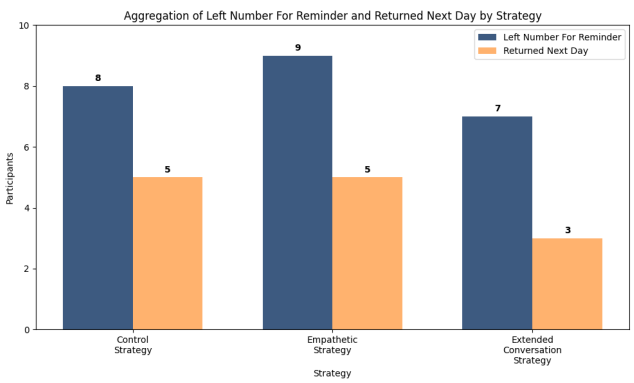

Fig. 9: A bar chart showcasing the retention rates amongst strategies

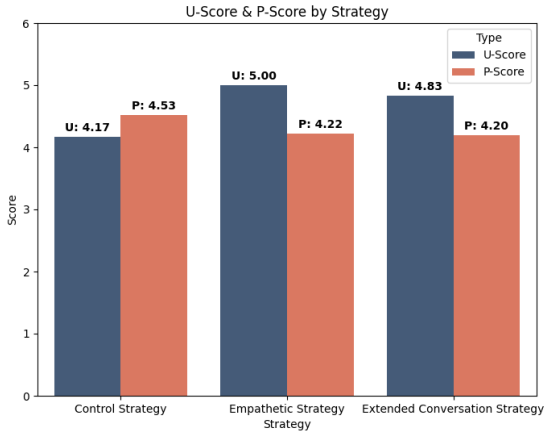

Fig. 10: Bar chart showcasing the u- and p-scores from the Trust in Automated Systems Test (TOAST)

d. Participant Drop-off

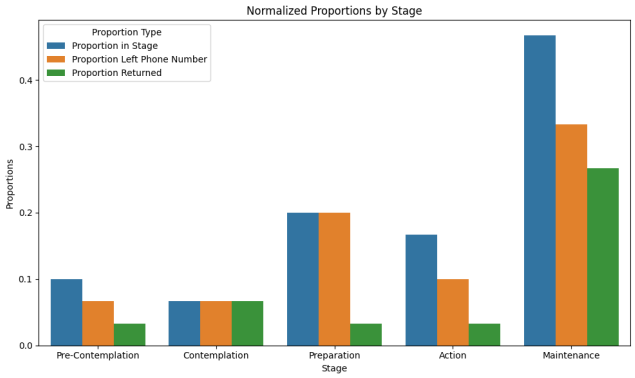

Fig. 11: Bar chart showcasing how many out of the total in each stage left their phone number and returned. Values are normalized from the total amount of participants in the experiment (30)

Figure 11 was made to acquire a more proportionate understanding of the differences between the participants who left their phone number and those who returned on the day after. A few large drop-offs can be observed at Preparation and Action stages. Potential significant differences were calculated between those who left their number and those who returned. A pair-wise chi-squared test was conducted on each stage. None of the pair-wise comparisons showed any significant differences between the drop-off across stages, $p=1.0$.

e. Percentage & Proportion Significance Tables

Table 2 represents the percentages of participants who left their phone number for the reminder during the experiment across all stages, along with their respective significance values (p-values) of differences between the pair-wise comparison between the stages. From the percentage pair-wise comparison in Table 2 and 3, it can be observed that there were no significant differences, with the lowest being $p>0.2$ and the highest being $p>0.9$ between any of the stages, both in terms of who left their number or returned. The same pattern is shown in table 4 and 5 with less significant differences, where the lowest was $p>0.8$ and the highest was $p>0.9$.

f. Interviews

The conducted interviews gave us further insight about the participants' experience with the application and some of their initial impressions, which pointed to several interesting findings. Despite the different strategies not being of major significance, we were still able to extract some data that can influence the design of future applications like that.

Several key themes emerged from the interviews in the control strategy, where 70% (7) of participants found the interaction with the CA confusing and expressed the need for a clearer prompt in the beginning of the interaction. Additionally, 80% (8) expressed a desire for more personalised CA, specifically in creating personal exercise plans and routines, which supports our findings from our initial research, pointing to personalisation being a key feature. While this strategy was the least human-like one, opinions on the CA's human-likeness varied, as 60% (6) of the participants preferred a more human-like interaction, citing it as a factor that could enhance trust and engagement. When it comes to motivation, 70% (7) believed that the CA had potential to influence them positively in exercising more, given that the CA provided personalised guidance. However, most of the participants (8) needed help in their interaction or with rephrasing their responses so that the CA would react accordingly, and noted its lack of robustness.

In the empathetic strategy, similar to the control strategy, a notable 40% (4) of participants found the initial interaction confusing and were not sure how to initiate a conversation. They suggested clearer and more guided prompts that would help alleviate that. In terms of responses, 30% (3) found the responses too lengthy, while another 30% (3) appreciated the clarity, despite some issues they encountered like receiving the wrong answer from the CA. 40% (4) expressed concerns about the responses feeling too general and lacking personalisation, despite this strategy including empathy. Opinions on human-likeness were mixed, as 50% (5) thought the CA was not human-like enough. However, two participants explicitly preferred the more robotic nature of the CA and did not find human-likeness important. Three participants suggested adding a fake or longer delay to responses, which would make the conversation feel more natural. The empathetic responses, however, were met with mixed feelings - some participants found them uplifting and motivating, while others insisted that they lacked authenticity and personalisation. Furthermore, several participants noted that the empathetic messages felt too generic, inconsistent and conveyed false positivity. Additionally, empathetic responses were found unnecessary and disruptive to the conversation.

Similar to the previous two strategies, the extended conversation strategy was perceived with varying levels of satisfaction, as some participants found the responses clear and informative, while others found them too lengthy and irrelevant. When it comes to personalisation, participants in this strategy were consistent in their desire for more tailored responses. 60% (6) participants believed that the CA could impact their motivation to exercise positively, but only if the application included certain features like motivational notifications, progression tracking, or personalised training and diet plans. Opinions on human-likeness were divided again, as some found the responses to be very robotic and other found them very balanced. Preference for balance between human-likeness and robotic replies seemed to be a recurring theme, with participants noting that too much human-likeness might come off as "creepy" or unsettling. Interestingly, 40% (4) preferred if the CA was more robotic or did not mind the lack of human-like features or responses. The follow-up questions were generally perceived well and were found beneficial towards improving personalisation. Participants thought these questions could help the CA understand their needs better and tailor an exercise plan in accordance to their responses to the questions, indicating that they made sense. Furthermore, the follow-up questions contributed to better clarity and informativeness, but participants suggested refinement in their complexity and depth.

VI. Discussion

The findings in our study show that content delivery through different conversational strategies did not have any significant impact on retention rates. There are several reasons for that, supported by some of data we extracted from the interviews. There was problems with phrasing and intent classification by RASA in every of the proposed strategies, which resulted in confusion and misunderstanding in participants. Out of the 30 total participants, only 6 could go through the interaction with the CA without facing such issues and without needing help from the interviewer with rephrasing or clarification. This seemingly affected their experience with the CA negatively, as most participants mentioned dissatisfaction with the CA's responses and it understanding their intents in their post-interaction interview. Furthermore, errors in classification happened throughout all stages of the interaction, prolonging it and breaking the flow of the conversation, which most participants were not pleased with. This could have had a major impact on their desire to return, due

Percentage Significance Table					
Stage	**Pre-Contemplation**	**Contemplation**	**Preparation**	**Action**	**Maintenance**
(%) who left number	66.67%	100.00%	100.00%	60.00%	71.43%
Pre-Contemplation (3)		p=0.8	p=0.7	p=0.9	p=0.5
Contemplation (2)			p=0.7	p=0.6	p=0.3
Preparation (6)				p=0.7	p=0.6
Action (5)					p=0.7
Maintenance (14)					

Table 2: Significance table showing the differences (p-value) of the pair-wise chi-squared test between the percentage of people who left their phone number and those who did not, between stages. Number in parenthesis is the amount of people in each stage.

Percentage Significance Table					
Stage	**Pre-Contemplation**	**Contemplation**	**Preparation**	**Action**	**Maintenance**
(%) who returned	33.33%	100.00%	16.67%	20.00%	57.14%
Pre-Contemplation (3)		p=0.5	p=0.8	p=0.9	p=0.5
Contemplation (2)			p=0.3	p=0.4	p=0.2
Preparation (6)				p=0.9	p=0.6
Action (5)					p=0.6
Maintenance (14)					

TABLE 3: SIGNIFICANCE TABLE SHOWING THE DIFFERENCES (P-VALUE) OF THE PAIR-WISE CHI-SQUARED TEST BETWEEN THE PERCENTAGE OF PEOPLE WHO RETURNED AND THOSE WHO DID NOT, BETWEEN STAGES. NUMBER IN PARENTHESIS IS THE AMOUNT OF PEOPLE IN EACH STAGE.

Proportionate Significance Table					
Stage	**Pre-Contemplation**	**Contemplation**	**Preparation**	**Action**	**Maintenance**
People who left number	0.067	0.067	0.200	0.100	0.333
Pre-Contemplation (3 / 30)		p=0.9	p=0.9	p=0.9	p=0.8
Contemplation (2 / 30)			p=0.9	p=0.9	p=0.8
Preparation (6 / 30)				p=0.9	p=0.9
Action (5 / 30)					p=0.9
Maintenance (14 / 30)					

TABLE 4: SIGNIFICANCE TABLE SHOWING THE DIFFERENCES (P-VALUE) OF THE PAIR-WISE CHI-SQUARED TEST BETWEEN THE PROPORTION OF PEOPLE WHO LEFT THEIR NUMBER AND THOSE WHO DID NOT, BETWEEN STAGES. NUMBER IN PARENTHESIS IS THE AMOUNT OF PEOPLE IN EACH STAGE.

Proportionate Significance Table					
Stage	**Pre-Contemplation**	**Contemplation**	**Preparation**	**Action**	**Maintenance**
People who returned	0.033	0.067	0.033	0.033	0.267
Pre-Contemplation (3 / 30)		p=0.9	p=0.9	p=0.9	p=0.8
Contemplation (2 / 30)			p=0.9	p=0.9	p=0.8
Preparation (6 / 30)				p=0.9	p=0.9
Action (5 / 30)					p=0.9
Maintenance (14 / 30)					

TABLE 5: SIGNIFICANCE TABLE SHOWING THE DIFFERENCES (P-VALUE) OF THE PAIR-WISE CHI-SQUARED TEST BETWEEN THE PROPORTION OF PEOPLE WHO RETURNED AND THOSE WHO DID NOT, BETWEEN STAGES. NUMBER IN PARENTHESIS IS THE AMOUNT OF PEOPLE IN EACH STAGE.

to them perceiving the CA as very primitive and failing to do its task.

The way that reminders were delivered might be another reason that affected the return rates for the second day negatively, as 6 out of the 30 participants did not agree to leaving their phone numbers, even after being informed that they would only be used for sending out notifications. Another factor that might have had influence on retention rates is the way we conducted the study and let them know about the second day, as we informed them that it was not mandatory for them to return to alleviate any bias. However, we can not draw any conclusions on whether that had a positive or a negative impact as each participant might have interpreted it differently.

Empathetic responses and the extended conversation strategy with the follow-up questions also had mixed success in how they affected participants' perception of the CA. While personalisation was deemed important by most participants, it was not exclusively represented by the empathetic messages and the follow-up questions. There was an overall disagreement on whether the CA was human-like or not in all three strategies, with some stating that even in the two strategies where it is supposed to show human-likeness, it still felt robotic and the responses were generic. In fact, some participants explicitly preferred having less human-like replies. For most, a key part of personalisation were personal training and diet plans, as opposed to the way the CA responds to their messages. However, there seemed to be an overall consensus that if human-likeness is done correctly, it could enhance trust and engagement, which in turn might provide a more enjoyable experience and increase retention. That is partly supported by the results from the TOAST, which hinted at slightly higher trust rates in the empathetic and the extended strategies.

The lack of effect of the conversational strategies on retention rates can be strengthened by the short duration of the study as well. The TTM suggests that going through the different stages takes a longer period of time, meaning that the different strategies could produce a different outcome and users might be more inclined to return to the CA if we measured progression through the stages in an extended period of time and tried to help them adapt an actual new behaviour.

Stage assessment appears to be a feature of the CA that was met with positive input, as 24 out of the 30 participants across the three strategies agreed with the stage they were assigned to, once provided with the stage definitions. The agreement rates in the empathetic and the extended strategies appear to be drastically higher than that of the baseline strat-

egy. This indicates that despite the CA struggling with providing the correct response and the responses feeling generic and not very natural in many cases, the strategies that included some human-like features were trusted more by the participants in terms of stage assessment. That implies that human-likeness might still be a very important element, if executed properly, even without people realising it. We can also answer *RQ3* and say that at least two out of the three strategies can determine a user's stage accurately, with a relatively high consistency as well.

Despite not providing concrete answers to two out of our three research questions, we believe that our study can still provide some good insights into what should be taken into consideration when designing a CA that promotes behaviour change. While we could not provide proof that different strategies affect the users' desire to use the CA again after the on-boarding interaction, we still believe that behaviour change models such as the TTM can successfully be implemented in a CA and leverage its accessibility. However, to provide a smoother user experience and achieve better trust and retention rates, some design decisions need to be reevaluated. There are many considerations that should be taken into account when designing the responses of the CA, such as avoiding messages that are too lengthy or generic, and finding a good balance between human-like and robotic replies. Furthermore, a proper natural language processing implementation is a must, in order to alleviate any conversational errors and provide a more natural interaction with an undisrupted flow. A push-notifications system, as suggested by some of the participants in our study, is also needed to deliver any reminders safely and at the correct time. Overall, despite the issues with the CA and the relatively short duration of the study, it uncovered some interesting findings, which can serve as simple design guidelines for any upcoming developments in the fields of personalised CAs and behaviour change.

VII. Conclusion

In conclusion, we could not answer if and how different conversational styles can affect retention rates and make it more likely for users to return to using a CA after the initial interaction. Our between subject experiment did not point towards any significant differences in how the different strategies were perceived, but the conducted interviews helped us define important features that a CA should include in any future work in this field to achieve better results. Furthermore, we showed that behaviour change interventions are applicable within CAs and can fully utilise their potential in terms of ease of access and customisability, if the issues we faced are alleviated. While further tests are required to state any specifics in regards to a specific CA design, that would increase retention rates and improve on-boarding, participants still deemed a CA to be a potentially viable option in helping them becoming more physically active.

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