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Participatory Design of a Robotic Mental Well-being Coach

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***Abstract*— Recent research is emerging in the field of Social Robotics where robots have the potential to serve as tools to improve human well-being. However, research exploring the expectations and perceptions of prospective users of such robots, and the professionals who currently deliver these interventions, is limited. In this paper, we present qualitative analysis of discussions with prospective users and experienced coaches regarding the design of robot well-being coaches. We invited participants interested in well-being practices to take-part in a Participatory Design (PD) study, consisting of individual interviews and a focus group discussion ($N_P = 8$). Discussions focused on ideating how a robot could function as a mental well-being coach, based on their experiences with well-being practices. Data triangulation was employed by interviewing three professional coaches as additional sources of information. This resulted in a rich set of data, which we transcribed and analysed using Thematic Analysis (TA). The developed themes regarding robot features, form, behaviours, robot-led well-being practices, and the advantages and disadvantages these could provide, were compiled and are discussed in detail. We present this data together with tabulated quotes from the participants and coaches, to pave the way towards designing robot coaches that can provide supportive interventions to improve the mental health and well-being of their users.**

I. INTRODUCTION

Common mental disorders (including depression, anxiety, obsessive-compulsion disorder, and phobias) have been increasing in England from 1997 to 2014, with total prevalence in the most recent survey in 2014 being 17% among adults of all genders [1]. Additionally, the COVID-19 pandemic has resulted in people experiencing negative consequences to their mental health, such as depressive and stress-related symptoms [2]. Some effective interventions for psychological well-being include mindfulness, meditation and coaching. *Mindfulness* and *meditation* practices have been recommended as potential solutions for alleviating anxiety and depression in individuals, by encouraging them to pay attention to present-moment experiences with curiosity and compassion. Research has shown that these practices improve the following skills: resilience to stress, fostering emotion regulation strategies and lowering depressive moods [3], [4]. *Coaching* is another non-clinical intervention that addresses coachee's issues ranging from lifestyle (e.g. smoking cessation), to working life (e.g. learning a new skill), to personal relationships (e.g. addressing an issue with a partner) by establishing measurable and attainable goals, developing action plans, and reviewing progress. It has been shown to play a role in maintaining psychological well-being, and preventing mental health issues [5].

This paper examines the potential use of a social robot as a well-being coach. Human-led well-being interventions can be difficult to access, due to the lack of availability of resources or finances [6]. Technological interventions, such as social robots, could be applied to address this shortage. Social robots used in conjunction with human-led practice could potentially increasing the engagement in the practice [7]. Robotic coaches could also work as a preventive measure, by creating awareness and helping people focus on their mental health before problems are exacerbated.

In order to gather perspectives about the design and functionality of a robotic well-being coach, we conducted a Participatory Design (PD) study consisting of interviews and focus group discussions. We invited participants to share their experiences with well-being practices, both guided and individual, and their perspectives on a potential robotic well-being coach. Additionally, we interviewed three well-being coaches for their perspectives on the use of robots for well-being coaching. We analyzed the interview and focus group data using the qualitative research method, Thematic Analysis (TA). We present findings on the design of a prospective robotic well-being coach and discuss the advantages and disadvantages of a robotic coach for well-being as envisioned by the participants and the coaches.

II. RELATED WORK

Recent studies have investigated the use of social robots for delivering well-being interventions such as positive psychology interventions and evoking behavioural changes during dieting [8], [9]. However, successful acceptance of these robots by various stakeholders may depend on factors such as user expectations as well as concerns regarding robot design and functionality. For example, influence of cultural differences on psychologists' acceptance of the use of the robot in clinical settings are discussed in [10]. Understanding the motives of prospective users will enable the long-term adherence to the interventions delivered by the robots [11].

For these reasons, we employ PD, a methodology where multiple stakeholders, especially prospective users participate in the design of the product or system as co-designers [12]. PD has previously been used in well-being-focused Human-Robot Interaction (HRI), e.g. to design a robot to teach sign language to children with autism [13], for dementia caregiving [14], for older adults with dementia [15], and for rehabilitative therapy [11]. These studies gather and generate information by employing methods such as interviews and workshops with prospective users and relevant stakeholders. For example, dementia caregivers took part in the PD of the

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robot in Moharana et al. [14]. In this study, we use PD in order to take into account viewpoints of prospective users of a robot, as well as well-being instructors with relevant expertise and knowledge.

To analyse qualitative data, HRI studies have previously used TA. For example, TA was used to analyze data collected from family caregivers for themes encountered in dementia care [14], to identify key themes for rehabilitative robots from workshops with therapists [11], and to examine how families perceive robots taking part in activities at home [16]. In light of these relevant works, we select TA as an appropriate method to analyze data gathered from our PD interviews and group discussions.

III. METHODS

A. Well-being practices led by the human coaches

We discuss below some well-being practices we use as an experiential basis for the discussions in this paper. The participants we recruited have experienced these practices personally and/or have participated in another study where these practices were led by human coaches. The three coaches we interviewed are also experienced in conducting the one or more of the following well-being practices.

Meditation and Mindfulness practices are considered as well-being approaches that can be attained with regular practice, rather than merely being a treatment or a therapeutic intervention. Individuals aiming to learn these practices seek mindfulness courses (e.g. [3]) from experienced coaches who teach them how to integrate these practices into daily life by providing an introduction to relevant techniques (e.g. breathing exercises and body-scan) and discuss well-being related topics (e.g. importance of pausing, kindness etc.).

Solution-Focused Practice (SFP) consists of one-to-one sessions where the coach interacts with each individual and focuses on looking for resources, and exploring possible and preferred futures [17]. The coach establishes a key topic to focus on in the first session together with the coachee, and deals with exploring change in behaviour and establishing further signs of progress in the subsequent sessions. The individuals participate by discussing what signs of progress might look like.

Life Coaching is focused on improving the coachee's well-being by identifying concrete goals and ways to work toward them together with the coach [18]. Goals can include dealing with stress, creating more meaningful relationships, and generally creating a more fulfilling and purposeful life. Life coaches can use visualization, writing, drawing, or body-awareness exercises to work toward the goals with the coachee. Life coaching emphasizes making the coachee feel heard and giving them space to examine their life.

B. Participatory Design

We investigate requirements for a potential robotic platform that can promote mental well-being by delivering well-being interventions (some of which have been described above in Section A). For this purpose, we designed a study where participants who took part in either a [19] or a SFP study were invited for an individual interview and a focus group discussion. However, these previous HRI studies are not examined as part of the study presented here. Additionally, we interviewed three well-being instructors in order to triangulate findings. Triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena [20]. Triangulation has also been viewed as a qualitative research strategy to test validity through the convergence of information from different sources. All interviews and focus group discussions were recorded.

TABLE I: Structure of the focus group discussions

Item	***Approx. duration***
Pre-discussion survey (in writing)	5 mins
Welcome & introduction	3 mins
Warm-up discussion about well-being practices	10 mins
Introduction to social robots and demo videos	7 mins
Ideating the purpose of a robot wellbeing coach	15 mins
Discussion on robot's features	20 mins
Conclusion	2 mins
Post-discussion survey (in writing)	5 mins

1) Individual Interviews: Before the interviews, we conducted surveys with each participant in order to gather information on their experience with well-being practices as a preparation phase. The survey was structured based on whether the participant (excluding the study they had previously taken part in) (i) is currently doing well-being practice (3 participants), (ii) not doing well-being practice but considering it (3 participants), and (iii) previously did well-being practice but stopped (2 participants). Based on responses collected from the surveys, each participant took part in a personalized, semi-structured interview with the researcher. The interviews focused on the participants' experiences with well-being practices and use of technology for these. Participants' experiences and opinions were used to inform the discussions during the focus groups, with the researcher bringing up participants' statements from the interviews, as relevant.

2) Focus Group: The researcher conducted two focus groups, with four participants each, both of which lasted ≈ 60 minutes. The researcher followed the structure indicated in Table I to conduct the discussions. We used the online tool *Miro*[1] to enable the participants to interact in a digital *physical realm* with post-its, voting dots and ranking numbers. Participants' ideas about technology in well-being practices, as gathered from the individual interviews with a preliminary TA, were also placed on the Miro board before the focus group, to aid group discussion. The focus groups had four main themes: i) warm-up discussion about participants' well-being practices, ii) introducing the concept of a social robot and showing demonstration videos of robots created by their manufacturers, iii) ideation on a robotic well-being coach, and iv) detailed discussion on what a robotic well-being coach should be like.

[1]https://miro.com

3) Surveys: Each participant filled out three surveys: a well-being practice survey before individual interviews, and a robot attitude survey (see IV-E) before and after the focus group. In the post-focus group survey, participants also provided brief feedback on what well-being activities a robot could do, what types of users it would be useful for, and if they had additional comments.

4) Coach interviews: The researcher conducted semi-structured interviews ($\approx$ 70 mins each) with three well-being coaches, experienced in delivering mindfulness/meditation, SFP, and life coaching, respectively. Questions were based on background research conducted by the researchers. Interviews focused on the coaches' methods of instruction, benefits and goals for the participants, previous experiences with technology, as well as ideas on how a robotic coach could help, and what its advantages and disadvantages might be. Coach interviewees were also shown the same demonstrations videos of robots as participants of the focus groups.

C. Thematic analysis

We use Thematic Analysis (TA) as a method to analyze qualitative data collected from the interviews and the focus group discussions. We employ the 6-step method exemplified by Braun and Clarke in [21]. We use transcribed data from 8 interviews with prospective users (3 hours and 39 minutes of data), two focus groups with these 8 prospective users facilitated by the researcher (3 hours and 24 minutes of data), written data generated by the participants in these workshops, and 3 interviews with the instructors of well-being practices (3 hours and 21 minutes of data).

IV. FINDINGS

The themes defined as a result of the TA are presented in Figure 1, however not all themes (e.g. motivation and expectations) are discussed in this paper due to further research needed. Themes and related findings are discussed in the following subsections, with quotes from the transcripts summarised where appropriate. Participant quotes (with minimal editing for clarity) are provided in Tables II—V.

A. Robot-led well-being practice

During the workshop, participants were asked to discuss what well-being practices they could picture a robot helping them with. Things that came up during discussion were conducting *mindfulness*, *meditation*, *yoga* and *SFP*. The robot was envisioned to conduct these practices, logging emotions and providing feedback. The well-being coaches we interviewed also thought that certain aspects related to mindfulness, meditation, SFP, and life coaching could be designed to be delivered by a robot.

B. Robot Capabilities

Participants discussed what capabilities a robotic well-being coach would encompass. Detailed comments from the participants and coaches are presented in Table II.

Engaging in practice — A robot was seen as potentially helping participants engage with their practice, e.g. by *doing the practice together* with them, or the robot could have a *sense of agency* that could motivate them to interact with it on a daily basis. Participants remarked that a robot may not be able to replace the human coach for the entire practice, but could handle some of the instructor's activities.

Expressing empathy & feelings — Participants remarked that they would like the robot to *praise* them, *react to how they feel* and *change expressions* according to the conversation. The SFP coach remarked that it is important to have the right level of expressivity to avoid the *uncanny valley* effect while the life coach suggested that *expressing empathy* will be beneficial to the user.

Feedback & evaluation of practice — Discussions indicated preferences for *positive affirmation* and *encouragement* by the robot during the practice, collecting feedback about the practice and providing points for improvement. However, care should be taken to avoid the positive feedback coming across too mechanical which might be the case with some apps. Some participants and coaches felt that it may not be necessary to provide judgement and feedback to users during practices, as the goal is not correction, but practice.

Interactive & adaptive responses — Participants highlighted the need for robot interactivity and adaptivity, specifying that a robot should be *responsive*. *Summarizing their thoughts* was seen as important, with the robot probing what the participant meant with their statements, so they could confirm or deny. A participant noted that the robot could also work by exhibiting simple *expressive behaviours and movement* instead of being verbally responsive, referring to Paro, that has been used with elderly people (e.g., [22]).

Instructing & demonstrating — Participants thought a robot would be helpful by *demonstrating* and *conducting activities*, e.g. yoga poses, in conjunction with a human coach. Participants also wanted the robot to be a source of instruction/knowledge. Coaches felt that the robot could be used for activities that are *skill-based* rather than conversation-based. For example, the robot can teach breathing exercises, ask pre-planned questions and conduct visualization exercises.

Pattern analysis & progress tracking — Participants remarked that the robot should *analyze their practice patterns* and *track their progress*, thus improving their practice in the long-term. The coaches suggested that the robot can track certain outcome measures related to the practice.

Personalization & customization — Participants wanted the robot to personalise to their *practice, behaviour* and *mood*. Other suggestions included customisation based on social and environmental factors, as well as customisation of the robot's physical form. They expressed that customisation might *remove the perception of a scripted interaction*. Coaches suggested that the robot could alter exercises based on the participant's preferences. Concerns were also raised that personalisation might feel intrusive.

Reminders to practice — Participants remarked that the robot could help by *intervening at the right time* and reminding them to practice. The robot could remind users about *take-home practices* assigned by a human coach. A participant who was skeptical about a robotic coach remarked that

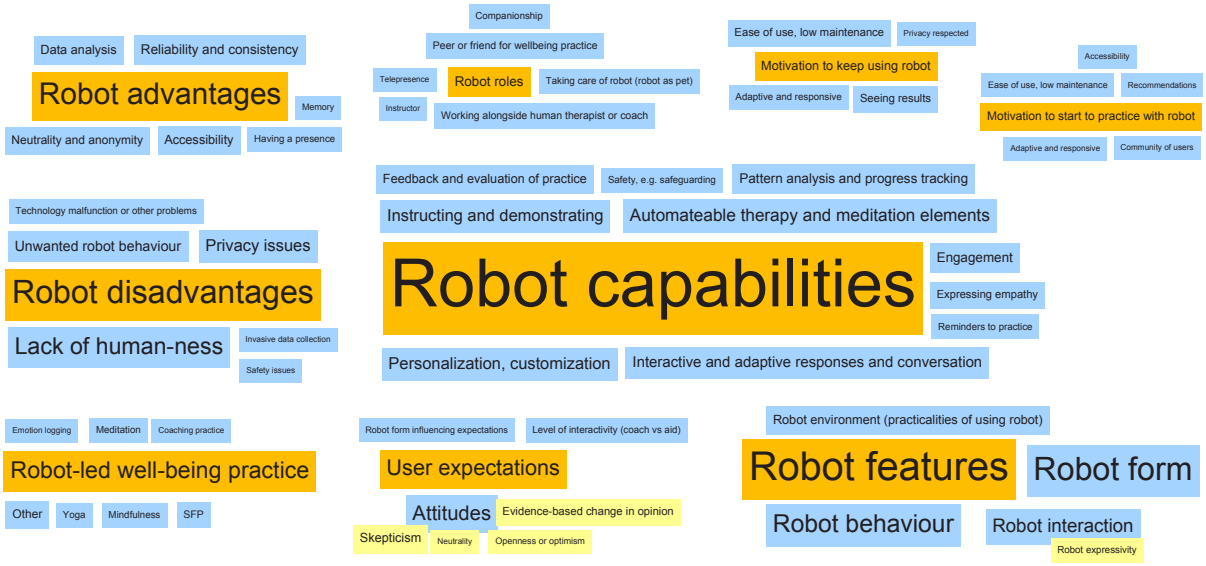

Fig. 1: Themes defined in the TA are presented in orange, while codes related to these themes are presented in blue, and sub-codes are presented in yellow (best viewed in colour).

reminders might be one of the robot's strengths. Concerns were also raised about persistent reminders feeling intrusive.

C. Robot roles

Five distinct roles for the robot were discussed: *instructor*, *peer or friend for well-being practice*, *pet to take care of*, *telepresence*, and *working alongside human coach*. Being an instructor for well-being practice was a feature several participants wanted to see in the robot as it can be easily accessible and act as a visual reminder to practise. The life coach remarked that robots would be useful as coaches if they could provide a sense of empathy, presence, and motivate people to focus on themselves. Some participants hoped the robot would provide a sense of companionship or act as a peer for the well-being practice. Participants also liked the idea of taking care of themselves by taking care of the robot where the robot would act as a pet (one participant described *Neopets*, an internet game where players care for virtual pets). The robot acting as a telepresence host for a human coach was also briefly discussed where the participants felt that it would bring the coaches *into the room* virtually and that the physical presence would make it more engaging, in comparison to video instruction. The robot being helpful while working alongside a human coach was mentioned several times by the participants to *supplement instruction from a human coach*. The coaches mentioned that the robot could collect feedback from the practices and could be used at home, as an addition to their coaching sessions.

D. Robot Features

Participants discussed about desirable robot features, focusing on form, behaviour, interaction and environment.

1) Form: Participants were asked to consider what the robot's form/embodiment should be. They were asked to rank 5 robots; *Jibo, Pepper, Miro, Cozmo* and *Pleo* from most appropriate (1) to least appropriate (5) to function as a well-being robot coach (Figure 2). The results are presented in Table III, with reversed scores (highest points indicating the best scores). Jibo received the highest points, followed closely by Pepper and Miro. Participants' opinions varied on which robot they preferred, as well as whether they would prefer a humanoid or a more abstract looking robot. While some participants showed clear preference for abstract looking robots like Jibo, others preferred the humanoid form. Participants mentioned that the form of the robot should match its function, i.e. expectations would be gauged based on how it looked, and if it looked like a human, then it would be expected to act like a human.

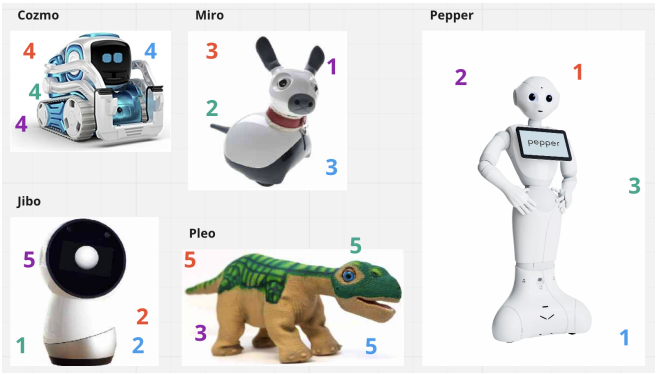

Fig. 2: Results of participant voting on robot embodiment for well-being coaching (discussion group of four participants, each having their own colour). While Pepper was preferred by this group, Miro and Jibo were also preferred by some, indicating that preferences vary across individuals.

2) Interaction: Participants were asked to select which interaction modalities they found useful. Voice and speech were considered most important, followed by gestures, sounds (other than voice and speech) and lights. Movement, facial expressions and screens were given lower importance, and touch and smell even less. Quotes from the participants

TABLE II: Quotes from participants ($Pi, (i = 1, ..., 8)$) and coaches ($Ci, (i = 1, 2, 3)$) regarding the robot features. $+/-$ signs indicate positive and negative statements, neutral statements do not contain signs.

Robot capabilities	***Quotes from participants and coaches***
Engaging in practice	P6+: "If the robot were to do it with you, like sit together [...] it might feel like you're doing it with someone." P8+: "If there was some sense of agency to it, like I needed to talk to it every day or it would be sad [...] that would motivate me to interact with [it] regularly ... make me engage in the practice more." C3+: "... could give the person, the sense of someone is there for you, present." P7: "... to replace the human coach with the robot coach, I don't think that may be a good idea as of now. But, probably offsetting some of the activities to the robot who could conduct it or just be engaging with people."
Expressing empathy & feelings	C3+: "If it was empathetic, it can give a sense of presence for people, to focus on themselves and stop for a while." C1: "... like the Uncanny Valley, you don't want it to be too expressive. [...] I think there could be like a 'Goldilocks' [level of expression]. You might not want it to be super unexpressive[...] I think if it's going to have a high rate of incongruent expressions, it would be better for it not to be expressive, and if it generally got it right, then it probably is ideal if it can be a bit expressive."
Feedback & evaluation of practice	P3+: "Maybe if I'm taking a really deep breath and the robot is impressed by that. Give me kudos." P3-: "[Some practices] like meditation and mindfulness do not really require judgement." P4: "Positive affirmation [...] and encouragement for what you're doing [can help]. [But], that [might] come across a bit mechanical, if it was coming from a robot, but it's worth a try [...]." P2: "... it's probably better if it also knows when to pick up something to improve. Then positive responses seem more genuine."
Instructing & demonstrating	P3: "Yoga with teaching poses, mindfulness with customized dynamics (as opposed to same meditation every time), guided meditations." P1: "Mindfulness, therapy, meditation, yoga, exercise, eating habits/disorders etc." P5: "A well-being robot coach [...] would probably help combat loneliness and promote general well-being at the same time."
Interactive & adaptive responses	P7: "Maybe simply summarizing, 'oh so you mean this, this and this', at the end of what I just said, that could be really helpful. [But], once I see [the examples of previous research like Paro], and I know for the fact that some of these have actually really worked, [...] I want to go back and say maybe it could be designed differently as well, and not [necessarily] be verbally interactive." P4: "It's interactive and you get, like [a] kind of response. Like something, someone is there with you [...]."
Pattern analysis & progress tracking	P6: "... if it could tell me that: 'Oh one year ago when this happened you reacted in this manner, but now you react in a much better or healthier way so there's improvement.' There can be some sort of analysis. Or understanding, sort of give me an insight into my personality that I wasn't aware of before." P6: "I think it would be very discouraging if you've been using the robot for like a year and then you told the robot something and then the robot says something like you're overreacting. As in I guess it's quite hurtful. We've been building up this relationship with it for a long time, and if it's going to be so disappointing, you might just think, 'Oh, what's the point'." P7: "Give me an analysis based on what it understands of me." C1: "Tracking outcome measures."
Personalisation & customisation	P1+: "Maybe [the robot can] adapt to the type of person you are [and] to your responses." P3+: "[The robot can say] something that is based on my feelings, based on the weather, that day. Or [if] there's a pandemic going on, probably mention the pandemic and the feelings around it. Definitely, that will help." P6: "if we could [...] change something physical about it, it could make it seem like it's yours, like your instructor, your robot. P3: "I think I would appreciate if something is customized for me personally. While it's not intruding my privacy." C3: "The robot could give, for example, two to four choices like 'Hey, I hear you have this challenge. Pick exercises that fit for yourself the best.' There could be a drawing exercise, imagination exercise, [etc.]."
Reminders & notifications	P8+: "Part of the support I needed to work on myself was working through the practice throughout the week. If I had some kind of at-home reminder at the right time, to prompt me to reflect briefly, that could be really effective." P2+: "One advantage is the availability of it, it is sort of there all the time [...] the fact of having something on your desk or in your house that is there, that will help in some way all of the time, I think provides a benefit. [...] If that's your working environment where you might feel like you need to take a break or remember [to do the practice when seeing the robot], [you] can do some sort of mindfulness exercises." P3: "Other than the notifications and making the meditation a bit personal, I don't see other advantages [of using the robot]."

and coaches regarding these aspects are presented in Table IV. Participants agreed that it is important to design potential two-way communication carefully so that the robot understands and responds appropriately. Some participants saw the screen of the Pepper robot as a potential help for visual exercises. The life coach also saw this as a possibility, where users could draw or write words on Pepper's screen.

3) Behaviour: Aspects of wanted and unwanted robot behaviours were discussed in Section IV-B. Emphasis was placed on the robot not being too repetitive and not following a script. Participants mentioned that a robot should not be too forceful as an instructor (e.g. with intrusive reminders). However, they also wanted the robot to warn them if they are not practicing enough, and potentially also to start the practice without them (if acting as a buddy) to *make them feel bad*. Emphasis was placed on the need for a balance between the robot being *patronizing* vs. *not direct enough*.

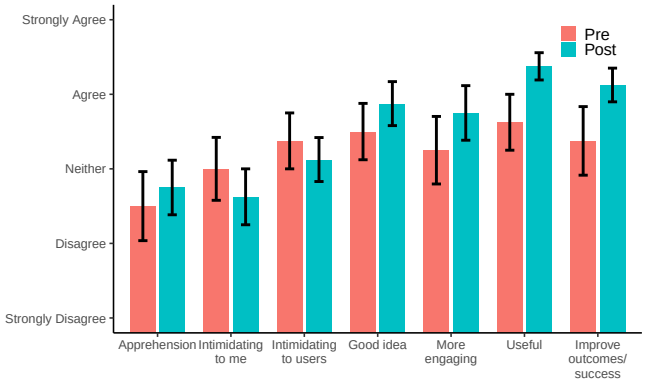

Fig. 3: Mean and standard errors of participant ratings on attitudes towards a robotic coach pre and post focus group.

4) Environment: Participants mentioned picturing the robot present at home, or at the workplace, and using it while taking a break. They considered an easily accessible

TABLE III: Voting on robot form (from most to least preferred) with quotes from participants (*Pi*) and coaches (*Ci*) regarding the robot forms. $+/-$ signs indicate positive and negative statements, neutral statements do not contain signs.

Robot	***Score***	***Quotes from participants and coaches***
Jibo	30	C2+: "I liked Jibo myself. As it looks quite neutral, so it doesn't raise much reaction [...] so it wouldn't be distracting. I like the simplicity of it. It could be an accessory on table or something like that." P2+: "[Jibo is] not trying to be something that you would relate to it. It's something new and more abstract." P1-: "Jibo gives surveillance vibes, how it's scanning the room and you don't know whether it's recording or what it's doing with the data[...]. It has that 'eye' look, like in 1984 [the novel by Orwell]."
Pepper	24	P1+: "Pepper is nice. It's the one that so far I like [...] Though, it's lacking in human expression." P5+: "... Pepper is the most engaging so far [...] if they don't physically resemble humans, then they might not seem so real." P4-: "I think I wouldn't feel comfortable [if] it was a humanoid guiding me through internal thinking, my emotions and stuff. So I would want it to be a robot in the classical sense." P8: "My expectations would be gauged based on how it looked and if it looked like a human I would expect it to act or instruct me like a human."
Miro	24	P8+: "[Miro] could be used as a well-being buddy at home." P1-: "Yeah, [Miro] is like a toy as well, an animal toy. It would be nice to have it as a company, but I don't think it would be the most appropriate for a well-being thing." C3: "Well [Miro is] somewhat cute [...] with the dog like features [...]. It would be nice to pet the Miro, maybe share your sorrows and joys with Miro, but it [might] be weird because we are not accustomed to be hearing dogs to talk to us."
Cozmo	17	P1+: "I don't think [Cozmo is] super appropriate but [...], I would say it's #2 because it's cute. It can still make some gestures with that [face screen]. It's portable, maybe that could also be a benefit. It has that screen that could be expressive." P2-: "Cozmo and the Miro look like children's toys."
Pleo	10	P3+: "I think my thought process was, the less resemblance it has to a human, it is better [...]. I don't want anything to replace humans at any point. So, I gave the dinosaur #2 because it's kind of abstract for me and you don't have dinosaur in the real world. [It] helps me to know, you know the dinosaurs are there for mindfulness." P1-: "Yeah, Pleo last because it would be even weirder to talk to a dinosaur [than the dog, Miro]." P4-: "To be fair it's kinda cute, but I don't think that I want it to be teaching me mindfulness."

TABLE IV: Quotes from participants and coaches regarding the interaction modalities. $+/-$ signs indicate positive and negative statements, neutral statements do not contain signs.

Interaction Modality	***Quotes from participants and coaches***
Speech/Voice	P2: "If there's sort of two way communication, you really want it to be good. Trying to understand what you said to give appropriate response. So it's not just you talking to an object. You're talking so they can respond to what you say."
Gestures	P8+: "When I saw that little cute dog [...] Miro. I just imagined [...], if the coach gave it to me and was like, 'whenever you see Miro just think about that one thing that's working for you', and if it walked towards me, I'd be like, 'Oh yeah, I should think about that and maybe tell Miro.'" P1+: "There's that saying that only like 20% of our [...] feelings are expressed through language and like 80% are expressed through gestures and facial expressions and so, I think they contribute a lot to a conversation."
Sounds (non-speech)	P1: "I think the sounds it makes are pretty good. The sound he makes: 'Hmmm...' [imitates Pepper's sound]..."
Lights	P1-: " I don't know if I would necessarily like it with a screen and lights. It might look too artificial."
Movement	P3+: "So yeah, in the physical activities like yoga, I see you know many advantages of having a humanoid robot. You know who can show you the movements and probably correct you if you're doing. Which is, you know, kind of weird, but you know if you're doing something wrong and you know putting a lot of pressure on your knee, it can probably detect it and correct it for you."
Facial expressions	P8+: "Yeah, if it's a humanoid, maybe it could make different faces. Or if it's some animal, wag its tail or if it's one of these [abstract ones] like Jibo, wag its head or something personable."
Screen	P1: "The screen [wouldn't] be necessary for a mindfulness session. If you would do visual exercises, [it] would be an option."
Touch	C3+: "Well [Miro is] cute, with the dog like features. If it [is] fluffy, it would be nice to pet."
Smell	P3+: "I like good smell. Whenever I go to yoga practice or meditation, [the room] smells of lavender or some [essential oils]."

robot as being part of building motivation to use it. Other aspects discussed regarding ease of use were charging, getting software updates and upgrades, and affordability.

E. Attitudes toward a robotic well-being coach

Participants filled a survey about their attitudes towards the robot before and after the focus group, adapted from [23]. The ratings on different questions are shown in Figure 3, with no statistically significant results found. Comparing pre- and post- focus group, participant ratings on positive attitudes, i.e. *good idea*, *more engaging*, *useful*, and *improving outcomes/success*, increased while ratings for negative attitudes, i.e. *intimidating to me* and *intimidating to users* decreased except for *apprehension*, indicating a generally positive change. Overall apprehension may have increased due to the in-depth discussions about robot disadvantages (such as privacy issues), during which participants may have become more aware of potential disadvantages.

Participants' attitudes analyzed using TA reflect *skepticism*, *neutrality*, *openness or optimism*, and *evidence-based change in opinion* (Table V). Some participants were neutral, saying that they actually need to see the robot before judging while some were skeptical of the idea of a robotic well-being coach. We also found evidence-based change in participants' opinions, where they felt more open and less skeptical after the group discussion, after being shown previous examples of robots improving users' well-being. Expressly, while partic-

ipants' reception on robotic well-being coaches were mixed, most indicated that their opinions changed more positively after viewing scientific evidence of their potential benefits.

F. Advantages and disadvantages

Participants and coaches were asked about the perceived advantages and disadvantages of a robotic well-being coach. As seen in Figure 4 (showing results from one discussion group of four participants with each participant having their own colour), participants used voting dots to indicate which robot features would stop them from using the robot, indicating problems ranging from privacy issues to interactive qualities. Participants were asked to use their voting dots freely, selecting the amount of dots they deemed appropriate, to indicate importance. The original post-it items were extracted from initial one-on-one interviews. Participants could also add their own suggestions on the post-its.

While a robot was noted by many participants and the meditation instructor as not being able to replace a human as a primary method of delivery, it was seen to have the potential advantage of being more *accessible* than a human coach, similarly to mobile apps. Robot's physical *presence* was seen as an advantage over mobile apps as it can be used for demonstrations (e.g. during yoga) and serve as a stronger visual reminder. However, participants also noted that *technological malfunctions* such as poor internet connection, a poorly designed interface, and lack of software updates could negatively impact the aforementioned advantages.

Reliability, consistency and uniformity were among other perceived advantages of a robotic coach. The life coach remarked that a robot could cater to more clients in a day than a human coach, as it does not get tired. The SFP coach also emphasized that a robot would not be emotionally affected by the nature of coaching, or experience burnout or compassion fatigue. A robot could also be *consistent* due to not being affected by a daily routine of sleeping and eating. A robot could maintain uniform interactions as it would not become nervous when meeting new coachees; wait for the coachee to speak when needed, not feeling pressure to talk; and maintain sufficient emotional distance without reacting in an inappropriate way. However, these traits may be perceived as *lack of human-ness*, which was seen by participants as a major disadvantage.

Unwanted robot behaviour concerns overlapped somewhat with lack of human-ness. The SFP coach noted if the robot responded to the wrong thing or misunderstood the user, the robot may go off on a "different tangent". One participant remarked that they would feel less connected if the robot responded in the wrong way.

The mindfulness/meditation instructor remarked a robot could be useful for *analyzing feedback data*. A participant also remarked that a robot could adapt its practice according to the user based on gathered data.However, *invasive data collection* was mentioned by the SFP coach as something potentially harmful — e.g., if users had their biological signals (such as pulse) measured explicitly, it might affect outcomes by making them more anxious. Additionally, data analysis comes with *privacy issues* which was mentioned as another major concern. While the SFP and the life coach saw that a robot could actually provide additional privacy, many participants did not share this view.

Neutrality and anonymity was a major advantage perceived by the coaches, however participants did not bring up this advantage. The SFP coach remarked a robot could be neutral in gender, as well as less intimidating than a human coach if it was smaller in size. The SFP coach and the meditation instructor both described a robot as less judgemental than a human instructor. The life coach said that a robot would be more neutral due to not having a life history, and would not try to solve people's issues in an unproductive way.

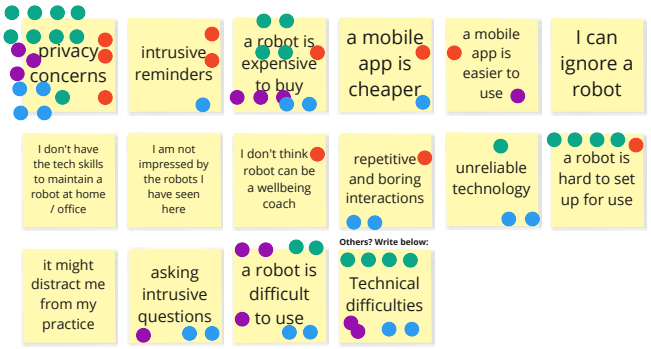

Fig. 4: Results of participant votes to indicate what would stop them from using the robotic well-being coach.

V. CONCLUSION

We conducted TA on data collected from interviews with prospective users ($N_P = 8$) and well-being coaches ($N_C = 3$), as well as focus groups, for the purpose of PD of a robotic mental well-being coach. Through our TA, it becomes clear that while there is a range of potential application areas for a robotic well-being coach, prospective users and well-being instructors bring up similar expectations for robot capabilities, as well as robot advantages and disadvantages.

However, no conclusion could be reached regarding the robot's embodiment or its level of interactivity. Some participants preferred a humanoid robot with verbal expressions, as their expectations from a robotic coach would be similar to those of a human. Others emphasized the need for an abstract looking robot, which should not imitate a human, animal or an object, and which should employ expressive communicative behaviours other than speech (such as gestures). Participants emphasized that if two-way communication were to be implemented, it would need to be sufficiently technically sophisticated to not cause disappointment. However, the three coaches noted that some well-being exercises could in fact be implemented verbally with relatively little input from the user. This leaves open the avenue of judgement for researchers to examine which types of robot features are most applicable to which robot-led well-being practices.

The 8 prospective user participants represent a limited demographic. However, small sample sizes are often applied in qualitative research, as the goal is not to generalize results to the whole population, but rather to examine a phenomenon

TABLE V: Quotes of participants and coaches on attitudes towards the robotic coach, before and after the focus group.

Attitudes	*Quotes from participants and coaches*
Skepticism	P5: "Skeptical! I don't think the experience would be close to a human interaction. However, if the robot were a medium to allow a remote human coach to interact then that would certainly add to the experience." P2: "[Robot coach] just would seem strange, I think. Maybe you wouldn't feel as open to expression. [...] [I] don't think I would interact in the same way." P3: "This would be the end for my practice."
Neutrality	P6: "I wouldn't base it so much on what the robot looks like or my initial impression of it. I think I would reserve judgement until my session is over, and see if there's any improvements for me." C2: "I don't want to sound like I'm against it, but I also see a bit of limitations, but it's quite helpful as well. For, most situations, you're using [robots successfully]."
Openness/ Optimism	C3: "I find this whole research super interesting and it's so important that we try to find different kind of ways to improve people's content about their lives, and raise emotional intelligence, etc. Robotics really gives super fascinating approach to this coaching."
Evidence-based change	P5: "I am always receptive to evidence, if it has been shown to be beneficial I would certainly give it a try, it lessens my skepticism." P1: "Now, I'm more positive and hopeful, that this could improve people's lives." P2: "You know it does make it seem like OK [...] I would try it therefore. But yeah, still apprehensive." P3: "[...] if I see scientific data that it's helping, I will feel that I'm getting left behind and there is something cool going on, that is showing effect. So, I would definitely give it a try. Give it room to grow on me." P4: "I think knowing that there's research out there showing that it's worthwhile definitely makes me more willing to try it. And obviously it has been helping in various other domains. So sure, why not."

in depth, with an adequate sample size being one that sufficiently answers the research questions posed [24]. Guest et al. argue that data saturation (i.e. the point where no new information or themes are observed within the data) occurs within 12 interviews, and basic meta-themes are present as early as 6 interviews [25]. We conducted 11 interviews with participants and coaches, as well as 2 focus groups with participants. Additionally, themes observed by the researchers were consistent across participants and coaches, leading us to conclude that our data is sufficiently saturated to begin to answer the relevant research question of what we can learn about the needs of prospective users and coaches to be able to then design a robotic well-being coach that addresses those needs. As both prospective users and coaches were open to the idea of a robotic coach conducting certain types of well-being practices, our future research will continue gathering information from both groups to further inform the design of such a robot, as well as formalize design guidelines and recommendations for a robotic well-being coach.

REFERENCES

[1] C. Baker, "Mental health statistics for england: prevalence, services and funding," 2020.

[2] C. S. Ho, C. Y. Chee, R. C. Ho, *et al.*, "Mental health strategies to combat the psychological impact of covid-19 beyond paranoia and panic," *Ann Acad Med Singapore*, vol. 49, no. 1, pp. 1–3, 2020.

[3] J. Galante, G. Dufour, M. Vainre, A. P. Wagner, J. Stochl, A. Benton, N. Lathia, E. Howarth, and P. B. Jones, "A mindfulness-based intervention to increase resilience to stress in university students (the mindful student study): a pragmatic randomised controlled trial," *The Lancet Public Health*, vol. 3, no. 2, pp. e72–e81, 2018.

[4] L. Wimmer, L. von Stockhausen, and S. Bellingrath, "Improving emotion regulation and mood in teacher trainees: Effectiveness of two mindfulness trainings," *Brain and behavior*, vol. 9, no. 9, 2019.

[5] S. Palmer and K. Gyllensten, "How cognitive behavioural, rational emotive behavioural or multimodal coaching could prevent mental health problems, enhance performance and reduce work related stress," *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, vol. 26, no. 1, pp. 38–52, 2008.

[6] S. Saxena, G. Thornicroft, M. Knapp, and H. Whiteford, "Resources for mental health: scarcity, inequity, and inefficiency," *The lancet*, vol. 370, no. 9590, pp. 878–889, 2007.

[7] A. A. Scoglio, E. D. Reilly, J. A. Gorman, and C. E. Drebing, "Use of social robots in mental health and well-being research: systematic review," *Journal of medical Internet research*, vol. 21, no. 7, 2019.

[8] S. Jeong, S. Alghowinem, L. Aymerich-Franch, K. Arias, A. Lapedriza, R. Picard, H. W. Park, and C. Breazeal, "A robotic positive psychology coach to improve college students' wellbeing," in *Proc. RO-MAN 2020*, 2020, pp. 187–194.

[9] C. D. Kidd and C. Breazeal, "Robots at home: Understanding long-term human-robot interaction," in *Proc. IROS 2008*, 2008.

[10] D. Conti, A. Cattani, S. Di Nuovo, and A. Di Nuovo, "Are future psychologists willing to accept and use a humanoid robot in their practice? italian and english students' perspective," *Frontiers in psychology*, vol. 10, p. 2138, 2019.

[11] K. Winkle, P. Caleb-Solly, A. Turton, and P. Bremner, "Social robots for engagement in rehabilitative therapies: Design implications from a study with therapists," in *Proc. HRI 2018*, 2018, pp. 289–297.

[12] C. Spinuzzi, "The methodology of participatory design," *Technical communication*, vol. 52, no. 2, pp. 163–174, 2005.

[13] M. Axelsson, M. Racca, D. Weir, and V. Kyrki, "A participatory design process of a robotic tutor of assistive sign language for children with autism," in *Proc. RO-MAN 2019*, 2019, pp. 1–8.

[14] S. Moharana, A. E. Panduro, H. R. Lee, and L. D. Riek, "Robots for joy, robots for sorrow: community based robot design for dementia caregivers," in *Proc. HRI 2019*. IEEE, 2019, pp. 458–467.

[15] H. R. Lee, S. Šabanović, W.-L. Chang, S. Nagata, J. Piatt, C. Bennett, and D. Hakken, "Steps toward participatory design of social robots: mutual learning with older adults with depression," in *Proc. HRI 2017*, 2017, pp. 244–253.

[16] B. Cagiltay, H.-R. Ho, J. E. Michaelis, and B. Mutlu, "Investigating family perceptions and design preferences for an in-home robot," in *Proc. IDC 2020*, ser. IDC '20. Association for Computing Machinery, 2020, p. 229–242.

[17] E. George, H. Ratner, and C. Iveson, *Briefer: a solution focused manual*. Brief, 2006.

[18] A. M. Grant and M. Cavanagh, "Life coaching," *The complete handbook of coaching*, pp. 297–310, 2010.

[19] I. P. Bodala, N. Churamani, and H. Gunes, "Teleoperated robot coaching for mindfulness training: A longitudinal study," in *Proc. IEEE RO-MAN 2021*, 2021.

[20] M. Q. Patton, "Enhancing the quality and credibility of qualitative analysis." *Health services research*, vol. 34, no. 5 Pt 2, p. 1189, 1999.

[21] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative research in psychology*, vol. 3, no. 2, pp. 77–101, 2006.

[22] H. Robinson, B. MacDonald, N. Kerse, and E. Broadbent, "The psychosocial effects of a companion robot: a randomized controlled trial," *Journal of the American Medical Directors Association*, vol. 14, no. 9, pp. 661–667, 2013.

[23] K. Winkle, P. Caleb-Solly, A. Turton, and P. Bremner, "Mutual shaping in the design of socially assistive robots: A case study on social robots for therapy," *International Journal of Social Robotics*, pp. 1–20, 2019.

[24] M. N. Marshall, "Sampling for qualitative research," *Family practice*, vol. 13, no. 6, pp. 522–526, 1996.

[25] G. Guest, A. Bunce, and L. Johnson, "How many interviews are enough? an experiment with data saturation and variability," *Field methods*, vol. 18, no. 1, pp. 59–82, 2006.