

Designing and Evaluating Mindfulness Conversational Agents for Persons with Dementia and Caregivers.

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Statement of Originality

This is to certify that the thesis submitted by me is, to the best of my knowledge, an outcome of my independent and original work. The assistance received in preparing this thesis and sources has been acknowledged. This thesis has not been submitted for any degree or other purposes.

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Conflicts of Interest

The research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

The data sets generated and analysed for this study are available upon request.

Abstract

Dementia is a major global health challenge and cause of dependency and disability worldwide. It is a debilitating disease that impacts both persons with dementia and caregivers (dyad). Mindfulness interventions have positive effects for dyads but are rigid, time consuming and not designed for dyads. Furthermore, using voice based conversational agents has not been done for dyadic mindfulness and may enhance accessibility and personalisation. This thesis explores how novel dyadic mindfulness conversational agents can be designed to benefit dyads, identifying user preferences and user needs, through the development and usage of a working prototype. We explored mindfulness interventions for dyads and technologies like conversational agents for health, before conducting a user research study through virtual semi-structured interviews with 10 experts and 5 dyads to understand potential needs for the intervention. After which, we developed a working prototype through a user centred design approach comprising 4 cycles, incorporating the feedback from 10 dyads and 4 experts. Lastly, through a 30-day guideline assessment study using the working prototype, 6 dyads were eligible to participate, and completed the study. Assessments, surveys, and interviews were done pre and post study, while dyads filled in daily worksheets to track progress. From the various studies conducted, we identified initial user needs based on participants visualising the prototype. We then developed a working prototype and understood usage preferences and enhanced user needs based on dyad's experiencing the prototype virtually. After the 30-day guideline assessment study, pre-post assessments showed improvement. Intervention and usage preferences further reveal that dyadic mindfulness conversational agents created using a user centred design approach, integrating user needs iteratively, can be beneficial for dyads. The novel intervention enabled dyads to cope better, by reducing stress, worries, and improving sense of control. Detailed design recommendations and examples provide guidance on how future interventions should be designed.

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Acronyms

Acronym	Definition
ACT	Acceptance and Commitment Therapy
BPSD	Behavioural and psychological symptoms of Dementia
BPD	Borderline personality disorder
CBT	Cognitive behavioural therapy
CP	Compassion practice
CA	Conversational agents
DBT	Dialectical Behavioural Therapy
GP	Gratitude practice
KP	Kindness practice
MS	Making space
MB	Mindful breathing
MM	Mindful movement
MBCT	Mindfulness Based Cognitive Therapy
MBSR	Mindfulness Based Stress Reduction
MBI	Mindfulness-based interventions
RCT	Randomized controlled trials

Chapter 1. Introduction

Dementia refers to a progressive “decline in cognition and loss of functional ability”, severe enough to negatively impact activities of daily living, feelings, behaviour, independence and relationships, which are caused by atypical brain changes (Foy & Starr, 2000) (Alzheimer's Association, 2024). It is one of the most prevalent global public health challenges (Alzheimer's Disease International, 2018), presently the 7th leading cause of death and part of the major causes of dependency and disability worldwide (World Health Organisation, 2023). In 2019, dementia costs globally were 1.3 trillion US dollars, with around half of the costs attributed to care provided by informal carers (World Health Organisation, 2023). Dementia is not only challenging for persons with dementia but also for the whole family, and in particular, the caregiver. It can be extremely stressful and exhausting for caregivers (Cheng, Au, Losada, Thompson, & Gallagher-Thompson, 2019).

There are a multitude of beneficial therapies for persons with dementia – behavioural therapy, reality orientation, validation therapy, reminiscence therapy, art therapy, music therapy, complementary therapy, aromatherapy, bright-light therapy, multi-sensory approaches, cognitive behavioural therapy, interpersonal therapy, motor rehabilitation, occupational therapy, cognitive stimulation therapy, animal assisted therapy and counselling (Douglas, James, & Ballard, 2004; Zucchella, et al., 2018; Hulme, Wright, Crocker, Oluboyede, & House, 2010). For beneficial caregiver programmes, they include caregiver education, behavioural management sessions, skills training, caregiver support, self-care training, counselling, psychoeducational programmes, specialised skill training and psychotherapy (Cooper, et al., 2012; Brodaty & Arasaratnam, 2012; Gallagher-Thompson, et al., 2012). Some newer approaches involve both persons with dementia and their caregivers (dyad), and these include dyadic psychosocial interventions, memory loss support groups, education programmes and environmental skill building (Dyer, Harrison, Laver, Whitehead, & Crotty, 2017; Leven, et al., 2013). Apart from these interventions that have been designed to help persons with dementia and their families. There is also a plethora of mindfulness interventions that have shown different levels of success for cognitive decline, perceived stress, quality of life, well-being, depression, anxiety, mood, subjective caregiver burden, and more (Wells, et al., 2013) (Larouche, Chouinard, & Goulet, 2016) (Fam, et al., 2019) (Russell-Williams, et al., 2018) (Chan J. M., 2015) (Brown, Coogle, & Wegelin, 2015) (Epstein-Lubow, McBee, Darling, Arney, & Miller, 2011) (Ho, et al., 2017) (Oken, et al., 2010) (Whitebird, et al., 2013)

(Danucalov, et al., 2013) (Leach, Francis, & Ziaian, 2015) (Waelde, Meyer, Thompson, Thompson, & Gallagher-Thompson, 2017) (Norouzi, Golsari, & Sohrabi, 2014) (Hoppes, Bryce, Hellman, & Finlay, 2011) (Hurley, Patterson, & Cooley, 2016). Mindfulness is explored in this thesis as it has many benefits for persons with dementia and caregivers.

Despite their success, mindfulness interventions have many challenges, they can be rigid, as they are often done in structured group sessions, and face to face in a fixed location. The programmes are often fixed for a period of approximately 8 weeks, done on a weekly basis. It is also time consuming as sessions are generally long, of 2 to 2.5 hours. Also, the programmes were often designed for person with dementia groups and caregiver groups separately, and not for person with dementia and their caregiver dyads, even though the paired approach might be useful.

To address these challenges, we explore how conversational agents (CA) can enhance such interventions. CAs refer to computer programmes that use natural language processing to enable conversations with people (Cristancho-Lacroix, et al., 2014). Using mediums like voice based CAs has yet to be done for dyadic mindfulness and may provide many benefits. Most dyadic mindfulness-based interventions (MBI) studies were done in physical group settings (Epstein-Lubow, McBee, Darling, Arney, & Miller, 2011; Berk, Warmenhoven, Os, & Boxtel, 2018; Paller, et al., 2015; Boxtel, Berk, de Vugt, & Warmenhoven, 2019), recordings (Wang, et al., 2020) or telephone calls (Brown, Coogle, & Wegelin, 2015). Introducing more advanced technologies like CAs to dyadic mindfulness is a novel approach and may provide more benefits than other existing forms of technologies.

CAs allow dyads to use the intervention daily, for however long they wish, with no fixed expiration date. It also provides short bite-sized mindfulness activities instead of 2 to 2.5-hour sessions. Dyads can do mindfulness activities anywhere and anytime they wish, as opposed to having to travel to a fixed physical location, or waiting for a guide through physical group or telephone calls. Furthermore, the use of CAs enables scalability as compared to physical groups or guided telephone calls, thereby enhancing accessibility, as it does not require an expert to be present each time, allowing for automation and larger outreach whilst not compromising on the guidance that the intervention can provide. CAs can also support people with limited digital competencies, lowering barriers of use, by using voice as a communication medium compared

to a graphical interface device. Users can speak directly to CAs instead of learning to navigate digital interfaces, enhancing accessibility. CAs provide more personalisation and guidance as compared to recordings, by guiding dyads step by step in an interactive personalised manner, as opposed to a static video or voice recording. Personalised choices can also facilitate dyad's interest using CAs, instead of sticking to a fixed structure when done in a group. Lastly, it also enables dyadic use instead of group activities with caregiver groups or person with dementia groups. In essence, using CAs can improve accessibility, scalability, guidance, and personalisation, offering opportunities for mindfulness to be integrated seamlessly into the daily lives of dyads.

Although CA research on persons with dementia was relatively scant (Ho, et al., 2017), a recent study revealed that persons with dementia can use embodied CAs independently in their home environment (Whitebird, et al., 2013), showing good engagement with the system, revealing the potential for CAs to meet basic and higher-level needs of people living with dementia (Whitebird, et al., 2013). This may also signal similar potential of CAs in dyadic mindfulness use cases.

The overall goal of this thesis is to understand how these new “dyadic mindfulness conversational agents” can be designed to benefit persons with dementia and their caregivers. As user preferences and needs pertaining to such interventions were not defined in the literature, it was also further explored through the development and usage of a working prototype. Breaking down the aims of the thesis, chapter 2 aimed to understand what had been done in previous studies that could be beneficial for dyads, and identify the gap in the literature. Chapter 3 aimed to explore expert's and user's perspectives about dyadic mindfulness conversational agents, understanding the viability and needs. Chapter 4 aimed to create a working prototype through a user-centered design approach, and understand the in-depth needs of dyads after using a working prototype. Chapter 5 aimed to understand if dyadic mindfulness conversational agents design guidelines were beneficial for dyads, and how stress, worries, sense of control and relatedness were impacted. It explored whether the intervention was easy to use, what user's preferences were and what were the areas each mindfulness exercise should be improved on. It also explored whether extended usage of the intervention was feasible, and if it encouraged future usage. Chapter 6 aimed to give an overview of the key findings.

In chapter 2, we first reviewed the literature of mindfulness interventions to better understand what had been done for persons with dementia, their caregivers, and dyads. We also explored the use of technologies and CAs for health. Chapter 3 is a user research study to understand the potential needs of dyads pertaining to a dyadic mindfulness conversational agent. The needs identified by users and experts were based on them visualising what the intervention might be like as it did not yet exist. Chapter 4 develops a dyadic mindfulness conversational agent through an iterative user centred design approach incorporating the feedback from experts and users. It also identifies usage preferences, as well as the user needs for designing such interventions. Chapter 5 comprises a guideline assessment study where dyads used the final prototype over 30 days, which identified their intervention and usage preferences, as well as the intervention benefits and challenges. Assessments on sense of control, stress, worry and relationship, reflected changes over time, which indicated that the intervention may be a useful tool. The chapter also provided detailed recommendations on how future interventions could be designed to be helpful for dyads. Lastly, Chapter 6 concludes the thesis.

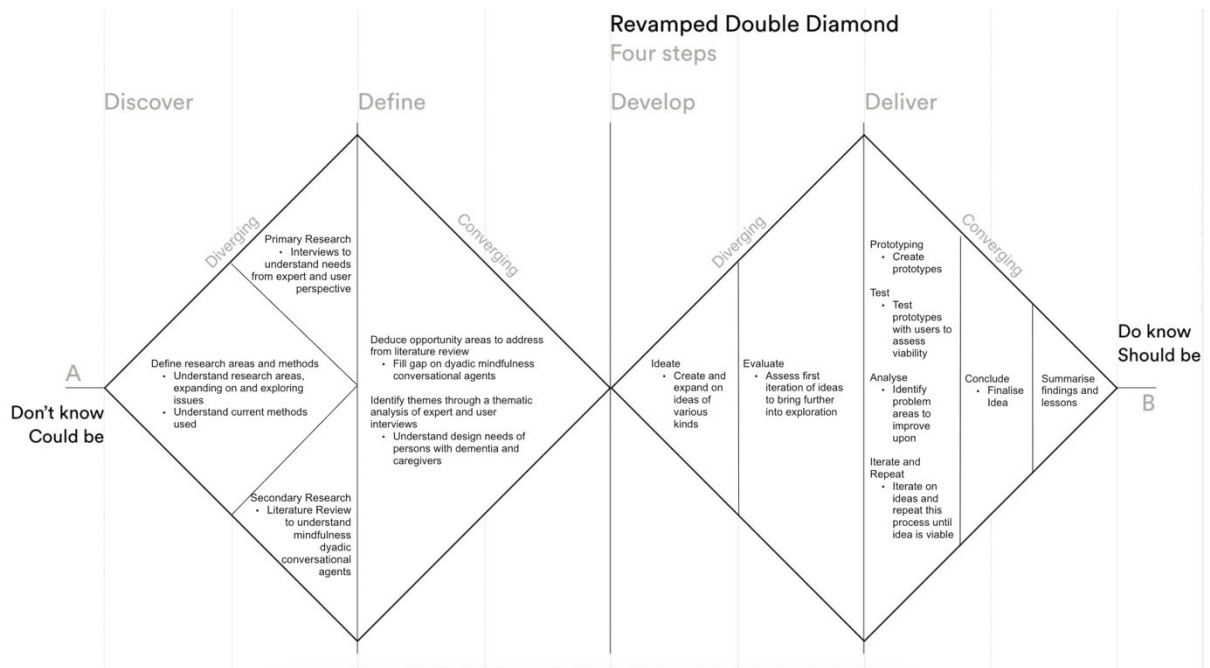
Exploration of the literature in Chapter 2 enabled an understanding and probing of the areas that could benefit dyads, Dyadic mindfulness conversational agents was a potential area for further exploration, as it seemed to be able to provide benefits theoretically, but had not yet been explored by previous studies. This led to the further exploration of dyadic mindfulness conversational agents through primary research, understanding the viability and needs of such novel interventions through user and expert feedback in Chapter 3. However, as users and experts provided feedback in Chapter 3 based on participants imagining what the intervention would be like, it was necessary to create a prototype through a user centred design approach for participants to experience using an actual prototype. As both experts and users went through the iterative process, providing feedback after experiencing each improved prototype in Chapter 4, this resulted in a final working prototype as well as a better understanding of user needs. In order to understand whether these needs were going to be useful for designing such interventions, a guideline assessment study was done in Chapter 5. With the benefits and mostly positive results from the guideline assessment study, this meant that the needs utilised to create the intervention was useful, and could be beneficial for future designers, developers or researchers to utilise.

1.1 Double Diamond Approach

The choice of design method can have an impact on the final outcomes. A very commonly used method is the double diamond design approach that addresses challenges in four main steps, to discover, define, develop, and deliver (Design Council, n.d.). The double diamond approach is an agile and iterative design process used to aid design development (Nessler, 2018). However, it has also been proposed to aid literature review processes (Gimenez & Johnson, 2020). As the focus of this thesis was on the design and evaluation of a novel intervention, using the double diamond approach could be beneficial in aiding the research process from literature review to empirical studies. The nature of the double diamond approach focuses on discovering and defining, before developing and delivering (Nessler, 2018), it can potentially be applied to designing (discover, define and develop) and evaluating (discover, define, further develop and deliver) novel interventions for academic research purposes due to the similar nature of both applications. Furthermore, as the iterative process enable better prototypes to be developed in the typical design process, as designs are constantly evolving and improved upon, it may be beneficial to apply the same approach in the academic research process to refine the research results.

For the thesis structure, I used the revamped double diamond approach (Nessler, 2018), as seen in *Figure 1*, where I discovered potential research areas and current methods used, through primary and secondary research. I then moved on to the converging stage, defining opportunity areas to address and themes to design based on. After which, I identified and developed activities to incorporate in the intervention, obtaining feedback and improving on the activities. For the final converging stage, I delivered prototypes, based on feedback, and refined iteratively until a final working product was created. The final iteration was used for a guideline assessment study. Each of the individual chapters also followed the double diamond approach as can be seen in the detailed explanation in *Figure 1*.

Figure 1. Double diamond approach



Chapter 1 Introduction Overview of study direction and reasoning Elaborate on (Discover) and define (define) study motivations, scope and structure.	
Chapter 2 Literature Review Explore dyadic mindfulness tech for persons with dementia and caregivers (Discover) research areas, expanding on and exploring issues, understanding current methods used and their effects (Define) research areas and methods (Develop) ideas on topics that could be explored, which would be beneficial for dyads (Deliver) deciding to explore dyadic mindfulness technologies	
Chapter 3 User and Expert Feedback Thematic analysis on needs of dyads from the expert's and user's perspective (Discover) user needs and preferences through interviews with experts and users (Define) needs identified and preferences for technology (Develop) guidelines for designing dyadic mindfulness conversational agents (Deliver) guidelines for the novel intervention	
Chapter 4 User Centred Design Prototyping Low & High-fidelity iterative prototyping with feedback to create working product through a user centred design process (Discover) activities and implementation methods that may be suitable for dyads through development and user feedback (Define) activities and methods (Develop) activities for the intervention based on feedback (Deliver) to users and obtain feedback Process went through 4 iterations before the final prototype was developed	
Chapter 5 Feasibility Study Testing working prototype to assess benefits, qualitative and quantitative to determine effectiveness of guidelines (Discover) how dyads respond to the intervention over 30 days (Define) define results on effectiveness, needs and preferences (Develop) final guidelines through the entire iterative double diamond process (Deliver) findings of the thesis	

Chapter 2. Literature Review

2.1 Introduction

Dementia is one of the most prevalent global public health challenges (Alzheimer's Disease International, 2018), and interventions need to be able to address the needs of persons with dementia. In addition, caring for seniors with dementia can be challenging, causing stress and exhaustion for caregivers (Cheng, Au, Losada, Thompson, & Gallagher-Thompson, 2019). Interventions should also address the needs of caregivers, as the needs of caregivers and persons with dementia are interconnected (Kuzuya, et al., 2011) (Mohamed, Rosenheck, Lyketsos, & Schneider, 2019). To address these needs, mindfulness is a popular approach that has been introduced in multiple clinical settings, showing benefits for both persons with dementia and caregivers individually.

However, to meet the needs of both individuals simultaneously, a dyadic mindfulness approach has also been explored by a few studies, showing preliminary benefits like improved wellbeing (Berk, Warmenhoven, Os, & Boxtel, 2018), quality of life (Paller, et al., 2015) and social connectedness (Kok & Singer, 2016) for the pair. Having a dyadic approach may enhance relationships between the dyads while providing mindfulness benefits (Kok & Singer, 2016). These studies, however, were conducted physically, potentially preventing overstretched caregivers and persons with dementia from participating in some studies. Participation in person may not always be feasible as caregiving responsibilities, health issues and having to travel to and from a physical location may pose obstacles to programme participation (Goodridge, et al., 2021). Having a physical intervention also limits when mindfulness for the pair can be accessed. A CA approach to dyadic mindfulness may mitigate these issues, providing more accessibility, allowing for users to access dyadic mindfulness at any time of the day or night, in the comfort of their own home. CA approaches to mindfulness have yet to be implemented for dyads, revealing a gap in the literature. With an increasing number of seniors with dementia, new strategies are essential in providing support for the dyad (Berk, Warmenhoven, Os, & Boxtel, 2018). A mindfulness CA approach may address the needs of the dyad while enhancing accessibility. As there is a gap in providing mindfulness CAs for dyads, (1) mindfulness, (2) dyadic mindfulness as well as (3) mindfulness using CAs will be discussed in this literature review.

2.2 Mindfulness

Mindfulness is a quality of consciousness, defined as “a receptive attention to and awareness of present events and experiences” (Brown, Ryan, & Creswell, 2007). Paying attention to and being aware of the present moment is important, as the mind is adept at focusing on the past and planning for the future, leaving current reality ignored or partially experienced (Brown, Ryan, & Creswell, 2007).

Awareness is the most direct contact with reality and refers to the conscious registration of stimuli—encompassing the mind’s activities, kinaesthetic senses and five physical senses (Brown, Ryan, & Creswell, 2007). Stimuli, when substantial enough, are often kept within focal attention for a short period before a person comes into awareness of the object and an emotional and cognitive response is assigned to them (Brown, Ryan, & Creswell, 2007). The appraisal of the object is, with the self as a reference, categorised into categories—good, bad, or neutral, resulting in sensory objects and events rarely seen as unprejudiced as they really are (Brown, Ryan, & Creswell, 2007).

In contrast, the mindful mode of processing involves having the mind stay in a receptive state, being fully present to reality and observes experiences as part of an “ongoing stream of consciousness” allowing unbiased insights into reality and an awareness of experiences which otherwise would have remained hidden from consciousness (Brown, Ryan, & Creswell, 2007). With mindfulness, individuals could view experiences through objective, factual and non-judgmental lenses, which prevents automatic impulsive reactions (Bishop, et al., 2006) (Ryan & Deci, 2004).

Mindfulness may create an opportunity to think about what response to stimulus would be appropriate instead of reacting habitually (Baumeister & Sommer, 1997) creating flexibility in thoughtful responses. Brown and colleagues indicated that self-control difficulties were identified by automatic responses. Studies have shown that individuals with higher mindfulness traits had higher levels of self-control, preventing themselves from acting on undesirable impulse behaviour, having the ability to interrupt and change thought processes (Tangney, Baumeister, & Boone, 2004) leading to more autonomous self-regulation (Brown & Ryan, 2003).

Some MBIs include “Mindfulness Based Stress Reduction (MBSR), Mindfulness Based Cognitive Therapy (MBCT), Dialectical Behavioural Therapy (DBT) and Acceptance and Commitment Therapy (ACT)” (Henderson, 2019). All four interventions include observing one’s thoughts and emotions without judgement, categorising them to promote the act of decentering, preventing the latching of thoughts or emotions to self (Brown, Ryan, & Creswell, 2007). The aim of all four programmes is to promote acceptance and mindfulness, inculcating practices of non-discriminatory observation of experiences which may translate to improved well-being (Brown, Ryan, & Creswell, 2007). MBSR and MBCT focuses on mindfulness as its core whereas for ACT and DBT, mindfulness is only a part of the treatment programme. Each MBI and its benefits for persons with dementia and their caregivers will be explored in the following sections.

Benefits and Drawbacks of Mindfulness for Persons with Dementia

Studies and randomised controlled trials (RCT) on mindfulness in participants who have dementia, mild cognitive impairment or subjective cognitive decline reported reduced cognitive decline and perceived stress, as well as improved cognition, quality of life and well-being (Wells, et al., 2013) (Larouche, Chouinard, & Goulet, 2016) (Fam, et al., 2019) (Russell-Williams, et al., 2018) (Chan J. M., 2015). MBI could be a viable solution to address symptoms of dementia. Drawbacks to mindfulness could not be found but no significant cognitive changes were detected as reported in one study (Wells, et al., 2013).

Benefits and Drawbacks of Mindfulness for Dementia Caregivers

MBI also had significant benefits for caregivers of persons with dementia on self-reported stress, depression, anxiety, burden, quality of life, cognition and mood (Brown, Coogler, & Wegelin, 2015) (Epstein-Lubow, McBee, Darling, Arney, & Miller, 2011) (Ho, et al., 2017) (Oken, et al., 2010) (Whitebird, et al., 2013) (Danucalov, et al., 2013) (Leach, Francis, & Ziaian, 2015) (Waelde, Meyer, Thompson, Thompson, & Gallagher-Thompson, 2017) (Norouzi, Golsari, & Sohrabi, 2014) (Hoppes, Bryce, Hellman, & Finlay, 2011) (Hurley, Patterson, & Cooley, 2016). Drawbacks to mindfulness could not be found but two studies reported no changes in self-reported sleep, mindfulness, quality of life, affect and cognitive performance (Oken, et al., 2010; Leach, Francis, & Ziaian, 2015).

2.2.1 Mindfulness Based Stress Reduction

MBSR helps individuals realise the interconnectedness of their physical, emotional, and cognitive experiences, understanding that the way they respond to and perceive experiences, as opposed to automatic reactions, may be important tools for building resilience (Kabat-Zinn, 2013). Kabat-Zinn advocates responding to experiences instead of reacting to them. This is done through pausing, noticing emotions and physical sensations in response to the experience and spending some time choosing whether to intentionally respond to the situation using emotions or practical coping methods (Kabat-Zinn, 2013). Kabat-Zinn (2012) highlights the importance of interrupting automatic reactions to negative experiences that may cause rumination and avoidance and replacing it with mindful responses.

MBSR focuses on enhancing mental health and wellbeing with mindfulness as its core (Brown, Ryan, & Creswell, 2007). It promotes 7 pillars of mindfulness encompassing non-judgment, patience, beginner's mind, trust, non-striving, acceptance and letting go, which are consciously cultivated through mindfulness practice and interconnected with each other (Kabat-Zinn, 2013). In addition to the seven pillars, other qualities also contribute to the embodiment of mindfulness, and they include non-harming, generosity, gratitude, forbearance, forgiveness, kindness, compassion, empathic joy, and equanimity (Kabat-Zinn, 2013).

The practice is used mostly in nonclinical groups, focusing on psychoeducation to encourage participants to identify ineffective behaviours (Cheung, et al., 2020). The 8-week intervention includes formal mindful practices like yoga or guided meditation and informal mindful practices like being present while doing everyday tasks like eating (Kabat-Zinn, 2012). Breathing activities, body scans, walking meditations and silent retreats are part of the 8-week intervention (Kabat-Zinn, 2013). The full MBSR programme comprises weekly sessions lasting 2.5 hours for 8 weeks and includes 45 minute long, formal mindful practices done at home for six out of seven days a week (Santorelli, 2014). It is conducted in groups of 15-40 individuals per class and may include family members (McEachern, 2018). The successful completion of the programme includes completing the pre-programme orientation, 8 weeks of mindfulness sessions, home-based activities, a day-long session, and an exit interview (McEachern, 2018).

Benefits and Drawbacks of MBSR for Persons with Dementia

One study explored MBSR for persons with dementia and reported increase calmness, awareness, acceptance, and resilience, which may translate to being able to handle difficult situations (Berk, et al., 2019). Based on studies on people with cognitive impairment other than dementia, MBSR can be applied without drastic changes on cognitive function, where duration were shortened and number of sessions were increased, more time was provided to reflect, group size was reduced, written information was provided for home sessions and increased amount of repetition was done (Chan, Leung, Walton, Wong, & Spector, 2020). This may be a useful reference in designing for people with dementia. One study reported a decrease in quality of life for persons with dementia (Berk, et al., 2019). Also, one participant experienced sadness and such situations should be mitigated, should they arise (Berk, et al., 2019).

Benefits and Drawbacks of MBSR for Dementia Caregivers

Studies and RCTs on MBSR for dementia caregivers showed improved mental health, self-efficacy, and mindfulness, as well as reduced stress, anxiety, depression, depressive symptoms, subjective caregiver burden, tension and anger (Whitebird, et al., 2013) (Liu, Sun, & Zhong, 2018) (Berk, Warmenhoven, Os, & Boxtel, 2018) (Hou, et al., 2014) (Cheung, et al., 2020) (Brown, Coogle, & Wegelin, 2015). Contributing factors like good attendance rates, increase in trait mindfulness and no adverse events, also suggested that MBSR could be useful for dementia caregivers, enabling them to develop a more mindful attitude (Cheung, et al., 2020). One study on the other hand reported a single adverse event relating to yoga practices at home (Liu, Sun, & Zhong, 2018), which should be managed if they arise.

A summary of the mechanism that the MBSR protocol utilises was provided to understand how it can meet caregivers' needs (McEachern, 2018), but may also provide similar benefits for seniors with dementia, as seen in *Figure 2*.

Figure 2. Caregiver need and mechanism summary on MBSR (McEachern, 2018) Image reproduced with permission of the rights holder.

Caregiver Need	Mechanism of Meeting Need
Provides Social Support	• Group based learning in an interactive format.
Improved Sense of Physical Wellbeing	• Learn to notice needs and state of the body in the present moment in a curious and nonjudgmental way.
Increase Coping Skills	• Cultivate openness to all experiences, including painful ones. • Learn how to respond rather than react to stress. • Contextualize painful internal states as transient and not permanent ones.
Improve Resilience	• Learn to approach and cultivate an appreciation of all parts of experience, including difficult aspects.

2.2.2 Mindfulness Based Cognitive Therapy

MBSR had cognitive theory and cognitive behavioural therapy (CBT) incorporated into the protocol to create MBCT (Gu, Strauss, Bond, & Cavanagh, 2015). MBCT focuses on techniques to identify depressive thinking patterns and to disengage from negative thought processes (Cheung, et al., 2020) aiming to prevent the relapse of depression and other mental illnesses (Gu, Strauss, Bond, & Cavanagh, 2015). It seeks to increase metacognitive awareness and focus on the present moment with a non-judgemental lens on experiences (Segal, Williams, & Teasdale, 2002) which may help participants recognise negative thought patterns and prevent relapse (Brown, Ryan, & Creswell, 2007). The difference between MBCT and CBT is that CBT focuses more on thoughts, emotions and physical feelings, whereas the MBCT protocol encourages participants to view thoughts and emotions as a temporary state that will pass (Sears, 2015) with the viewpoint that participants experience thoughts and emotions as opposed to a participant being their thoughts and emotions (Segal, Williams, & Teasdale, 2013).

Segal and colleagues elaborated on the four main lessons MBCT encompasses—(a) halting rumination patterns, (b) recognise how automatic thoughts and mindless states fuel suffering, (c) hone skills to understand negative experiences, (d) learn how to appreciate and manage positive and negative experiences. MBCT also draws heavily from Jon Kabat-Zinn’s MBSR protocol (McEachern, 2018), fundamentally building on patience, non-judgement, trust, non-

striving, having a beginner's mind, acceptance, and learning how to let go (Segal, Williams, & Teasdale, 2013).

MBCT was developed to treat people who experience chronic depressive states (McEachern, 2018), resulting from experiential avoidance and rumination (Segal, Williams, & Teasdale, 2013). It is used mostly in clinical groups—people with depression and other mental illnesses (Cheung, et al., 2020). The MBCT protocol comprises informal and formal seated practices with body-oriented exercises (McEachern, 2018) like breathing or seeing thoughts differently, practiced across 8 weeks with a written self-reflection at the end of each session (Teasdale, Williams, Segal, & Kabat-Zinn, 2014). Each weekly session comprises 2.5 hours of group therapy done in a structured manner, together with individual practices and homework (Segal, Williams, & Teasdale, 2013). Whether the protocol is conducted with a group facilitator or done alone with a workbook, participants learn how to perform individual practices like body scans and breathing activities, as well as why they do them (McEachern, 2018). McEachern shares on how the MBCT protocol often begins with a body scan and awareness with regard to routine activities like washing and eating before moving on to bringing awareness to movement activities like stretching and walking, learning to focus on breathing and then using imagery both as an educational tool and rehearsal strategy to invoke negative thoughts and emotions. Typical MBCT group sizes were groups of 12-15 people (Michalak, Schultze, Heidenreich, & Schramm, 2015). The successful completion of the programme includes completing 8 weeks of the programme including homework, and is not measured through the achievement of benchmarks or improved outcomes (McEachern, 2018).

It was also noted that a modified MBCT protocol was more effective at reducing stress, burden and depression for dementia caregivers as compared to a modified MBSR protocol (Cheung, et al., 2020). This could be due to the ability of MBCT to address negative thoughts, as rumination leading to a prolonged pattern of negative thinking may aggravate chronic stress, higher levels of depression, anxiety and lower life satisfaction (Romero-Moreno, Losada, Marquez-Gonzalez, & Mausbach, 2016) (Gerin, et al., 2012). MBCT focuses more on addressing negative thoughts as compared to MBSR, encouraging participants to recognise habitual unnecessary reactions to challenges, and may be why MBCT may be a more useful protocol for caregivers of persons with dementia (Cheung, et al., 2020) who experience high levels of depression and psychological distress (Clare, et al., 2002) (Cooper, Balamurali,

Selwood, & Livingston, 2007). However, there were no standard guidelines for recommending either protocol to dementia caregivers (Fjorback, Arendt, Ornbøl, Fink, & Walach, 2011).

Benefits and Drawbacks of MBCT for Persons with Dementia

A study on MBCT for persons with dementia showed improved self-compassion, positive emotions, and present moment awareness (Douglas, et al., 2021). Based on studies on people with cognitive impairment other than dementia, MBCT can be applied without drastic changes to cognitive function, where duration were shortened, number of sessions were reduced, an increased amount of repetition was done, simple visual aids and verbal instructions were provided (Chan, Leung, Walton, Wong, & Spector, 2020). Drawbacks of MBCT for persons with dementia could not be found.

Benefits and Drawbacks of MBCT for Dementia Caregivers

Studies and RCTs on MBCT for dementia caregivers showed reduced caregiver stress, depressive symptoms and subjective caregiver burden, as well as improved psychological well-being but no change in cognition and mindfulness levels (Oken, et al., 2010) (Pui, Yat, & Wai, 2019) (Cheung, et al., 2020). Drawbacks of MBCT for caregivers could not be found but two studies reported no significant changes in resilience (Pui, Yat, & Wai, 2019), fatigue, self-efficacy, mindfulness and cognitive function (Oken, et al., 2010).

A summary of the mechanism that the MBCT protocol utilises was provided to understand how it can meet caregivers' needs (McEachern, 2018), but may also provide similar benefits for seniors with dementia, as seen in *Figure 3*.

Figure 3. Caregiver needs and mechanism summary on MBCT (McEachern, 2018) Image reproduced with permission of the rights holder.

Caregiver Need	Mechanism of Meeting Need
Provides Social Support	• Group based treatment using relational learning and group process.
Improved Sense of Physical Wellbeing	• Learn to notice needs and state of the body in the present moment in a curious and nonjudgmental way.
Increase Coping Skills	• Learn how to step out of thinking patterns which are ruminative. • Teach recognition and awareness of how states of mindlessness and automatic thought habits may maintain states of depression or suffering. • Hone skills to relate to all aspects of experience, including difficult ones.
Improve Resilience	• Learn to approach and cultivate an appreciation of all parts of experience including difficult aspects.

2.2.3 Dialectical Behavioural Therapy

The DBT approach hinges on CBT practices with Zen principles, focusing on helping participants live in the present moment, regulate emotions, provide for skilful interaction with others, and learn how to tolerate distress appropriately (Linehan, 1993). DBT has three overarching characteristics, with the first relating to the interconnectedness of reality, understanding the immediate and wider context of behaviour and behavioural patterns (Gemignani, 2009). The second addresses a rigid mindset of polarities and encourages synthesis of experience, while the third characteristic touches upon the fundamental nature of reality of constant changes, helping individuals to be comfortable with change (Gemignani, 2009).

The DBT treatment programme encompasses four skill modules that address the difficulties individuals face (Gemignani, 2009). Emotional regulation, the first skill module, addresses reactive emotional responses, where mindfulness is a core component (Gemignani, 2009). The second skill addresses difficult interpersonal relationships through a module on effective interpersonal skills (Gemignani, 2009). The third skill has a module on distress tolerance skills, teaching individuals how to tolerate distress to have enough time to identify an effective solution (Gemignani, 2009). Lastly, the final module on mindfulness seeks to teach conscious experience and observation of one's self and environment to address dysregulation of the self (Gemignani, 2009).

DBT was developed for people with borderline personality disorder (BPD) and chronic suicidality (Linehan, 1993). The DBT protocol comprises both formal and informal mindfulness practices, formal practices inclusive of guided imagery meditation and breathing activities (McEachern, 2018) while informal practices comprise engaging in a range of activities where participants can be completely present—singing in the shower or dance class (Linehan, 2015). DBT utilises imagery to illustrate thoughts and feelings and focuses on not being controlled by negative experiences (McEachern, 2018). It also educates participants on alternative methods—Tai Chi and yoga—helping participants to identify what works most effectively, acknowledging that not every activity will cater to each person in the same manner (McEachern, 2018). McEachern suggests that DBT participants are expected to utilise both informal and formal techniques in their daily lives and keep a record in the form of a diary, on how they utilised the skills. There are also intentionally brief phone consultations with therapists to help participants during difficult times (McEachern, 2018). It is an intensive treatment comprising group skills training lasting 2 to 2.5 hours weekly, individual therapy lasting 1-1.5 hours weekly (McEachern, 2018). DBT skills group, usually held in groups of 6-8 participants (Linehan, 2015), are educational and rely on participants sharing on their experiences, providing learning for the group and normalising challenges (McEachern, 2018). A comprehensive model of the DBT protocol may take 1 year to complete (Linehan, 1993) and in certain instances, have incorporated a family format (Linehan, 2015). The successful completion of the programme includes completing weekly sessions, including homework assignments (Blackford & Love, 2011). The time and resource requirement for a comprehensive DBT programme may deter participants from participating and the protocol is generally used for clinical conditions, which may feel inapplicable to participants who do not fall within that scope (McEachern, 2018).

Benefits and Drawbacks of DBT for Persons with Moderate Cognitive Impairment

DBT is commonly used for people with BPD but may be considered as a treatment for people with moderate cognitive impairment (MOD-CI) due to the similarities both groups have (Gemignani, 2009). With the empirically validated tool for BPD and the parallels between the diagnostic features, treatment needs, and skills deficits BPD individuals and MOD-CI individuals have, the same approach using DBT could be explored (Gemignani, 2009). Although studies on DBT for seniors with dementia could not be found, we may refer to RCTs done on DBT for individuals with BPD to understand how this may apply for people with

MOD-CI and thereby seniors with dementia. 4 RCTs on DBT for BPD individuals were conducted, showing a reduction in anger expression, hopelessness, depression, and impulsive behaviours (Feigenbaum, 2007). However, although Gemignani proposed that DBT might be useful for persons with moderate cognitive impairment, the individual practices might be too challenging for persons with dementia to utilise in its original form as many activities required metacognitive abilities. Furthermore, some activities from DBT encouraged present moment awareness and non-judgmental attention to experiences, which could also be found in activities from MBSR and MBCT in more accessible formats. Drawbacks of DBT for persons with dementia could not be found.

Benefits and Drawbacks of DBT for Dementia Caregivers

DBT skills were adapted for caregivers of seniors with dementia, reporting less fatigue and depressed mood, as well as improved psychosocial functioning, emotional well-being, and reliance on problem-focused coping strategies (Drossel, Fisher, & Mercer, 2011). Drawbacks of DBT for caregivers could not be found.

A summary of the mechanism that the DBT protocol utilises was provided to understand how it can meet caregivers' needs (McEachern, 2018), but may also provide similar benefits for seniors with dementia, as seen in *Figure 4*.

Figure 4. Caregiver need and mechanism summary on DBT (McEachern, 2018) Image reproduced with permission of the rights holder.

Caregiver Need	Mechanism of Meeting Need
Provides Social Support	• Group therapy. • Individual therapy.
Improved Sense of Physical Wellbeing	• Not an active target of treatment. • Incorporates maintaining physical wellbeing as a means to reduce emotional vulnerability.
Increase Coping Skills	• Teaches a large variety of skills to encourage individuals to develop their own repertoire of what is effective for them.
Improve Resilience	• Learn how to tolerate distress in a way that is effective. • Notice and act effectively with transient experiences of happiness or suffering.

2.2.4 Acceptance and Commitment Therapy

ACT encourages participants to embrace pain, using mindfulness to change how participants perceive experiences (Hayes & Smith, 2005). Through forming a new relationship to suffering (McEachern, 2018), participants become open to experiencing pain and have more flexibility in approaching distressing experiences (Hayes, Strosahl, & Wilson, 2012). ACT encourages participants to be observers of their experiences, requiring metacognition capabilities (Luoma, Hayes, & Walser, 2007), promoting a mindset shift to act despite pain, rather than to focus on reducing pain (McEachern, 2018). ACT, however, is more complex in terms of the techniques, requiring a higher level of metacognitive abilities with individuals having to put in more time and effort to understand ACT rationale and methods (Losada, et al., 2015). It also encompasses concepts that are opposite to cultural and social norms (Losada, et al., 2015).

The six processes that ACT addresses include (1) present-moment awareness, (2) dimensions of self, (3) defusion, (4) acceptance, (5) connecting with values and (6) committed action (Hayes, Strosahl, & Wilson, 2012). Present-moment awareness refers to having awareness and being in the here and now, not focusing on the past or the future (Hayes, Strosahl, & Wilson, 2012). Dimensions of self, refer to being able to take on different perspectives by undermining attachment to the conceptualised self, and exploring the perspectives of others in the user's life (Hayes, Strosahl, & Wilson, 2012). Defusion refers to being able to separate one's thoughts from one's perception of self, where thoughts are merely thoughts and not facts, allowing users to step back and not be consumed by them (Hayes, Strosahl, & Wilson, 2012). Acceptance refers to making room, to allow for unpleasant thoughts and emotions to be experienced (Hayes, Strosahl, & Wilson, 2012). Connecting with values refer to following the principles of what one most cares about (Hayes, Strosahl, & Wilson, 2012). Lastly, committed action refers to taking effective action and acting in ways that are guided by values (Hayes, Strosahl, & Wilson, 2012).

ACT was originally developed for participants with depression and anxiety but has been useful for treating varying issues like stress and chronic pain (McEachern, 2018). It provides mindful body scan meditations, breathing exercises as well as incorporates other activities - providing psychological flexibility by reframing thoughts into humour or less hurtful versions (Hayes & Smith, 2005). Imagery is used to categorise thoughts, judgments, and emotions to deal with intrusive thoughts and sensations (Hayes & Smith, 2005). Other semi-formal practices, like

mindful eating and music listening, are utilised with daily diary records on experiences (Hayes & Smith, 2005). They are often guided by therapists to aid participants in slowing down to be more aware, as well as to quickly and effectively shift perspectives (Hayes & Smith, 2005). ACT can be done by participants in a self-help format and also with the help of a trained therapist (McEachern, 2018). The programme does not mandate connecting with others to provide social support but does not prohibit it (McEachern, 2018). McEachern (2018) suggests that it may be used in a group format even though it was developed for individual therapy and for self-help. There is a lot of flexibility as ACT does not require a certain number of sessions to be completed and can be adjusted as slowly or as quickly as a participant would like, with no definitive end, participants can learn and return to the programme as and when needed, lessening the pressure to reach a pre-determined goal (McEachern, 2018). The primary goal is to improve psychological flexibility and is considered completed once participants feel that they have gained sufficient skills to end treatment (McEachern, 2018).

Benefits and Drawbacks of ACT for Persons with Dementia or Cognitive Impairment

Studies on ACT for seniors with dementia or cognitive impairment could not be found possibly because of the complex nature of ACT.

Benefits and Drawbacks of ACT for Dementia Caregivers

ACT is an under explored therapy for dementia caregivers, focusing on accepting and adapting to challenging thoughts instead of trying to challenge and change them, which may be particularly helpful for caregivers as dementia decline is unavoidable, and having this form of therapy may be useful to help caregivers to adapt by reducing depression and anxiety (Cheng, Au, Losada, Thompson, & Gallagher-Thompson, 2019).

A pilot study and RCT was conducted to test ACT on dementia caregivers, which concluded with a decrease in experiential avoidance, depression and anxiety (Marquez-Gonzalez, Romero-Moreno, & Losada, 2010) (Losada, et al., 2015). Another study showed reasonably low dropout rates, showing that even with caring responsibilities, participants found ACT to be useful (George, 2016). Also, through hearing other participant's experiential exercises, metaphors and situational application, ACT in a group format may verbalise and normalise challenging emotions and thoughts instead of avoiding them, resulting in a source of comfort and reduced isolation (George, 2016). Drawbacks of ACT for caregivers include an increase in

frustration/embarrassment and a decrease in positive behaviour management strategies used although findings did not reach significance (George, 2016).

A summary of the mechanism that the ACT protocol utilises was provided to understand how it can meet caregivers' needs (McEachern, 2018), but may also provide similar benefits for seniors with dementia, as seen in *Figure 5*.

Figure 5. Caregiver need and mechanism summary on ACT (McEachern, 2018) Image reproduced with permission of the rights holder.

Caregiver Need	Mechanism of Meeting Need
Provides Social Support	• ACT can be provided in a group format but this is not a critical part of the approach.
Improved Sense of Physical Wellbeing	• Reduce the impact of physical pain on actual life functioning, but is not intended to improve the actual experience of physical wellbeing.
Increase Coping Skills	• Provide coping skills, referred to as defusion.
Improve Resilience	• Improve resilience by increasing flexibility in relating to painful thoughts and experiences. • Foster self-efficacy through values centered action.

2.2.5 Existing Guidelines in Designing Mindfulness Programmes

As most of the literature explored focused on the effectiveness and feasibility of mindfulness programmes, lacking a focus on designing such interventions, these design guidelines were compiled from the studies as they were mentioned scantily.

Designing mindfulness programmes for persons with dementia

1. Understand individual needs and capabilities - This enables personalised care for each individual, potentially enhancing quality of care (Wilkinson, Tong, Zare, Kanik, & Chignell, 2018).
2. Ensure activities are simple and easy to understand without complicated abstract concepts - This ensures that users can easily access the activities, using simple visual aids, verbal instructions and providing written information for home-based self-help activities (Chan, Leung, Walton, Wong, & Spector, 2020).

3. Provide shortened duration and increased number of sessions with reminders to encourage adherence - Shortened and regular activities with reminders help to promote ease of use and mindful habit formation, meeting the needs of persons with dementia who may have worsened memory and shorter attention spans (Chan, Leung, Walton, Wong, & Spector, 2020) (Azulay, Smart, Mott, & Cicerone, 2013).
4. Provide opportunities for open discussions and feedback - This encourages feedback to be given, doubts to be clarified and learning to occur. As seniors with dementia may forget details, questions can be asked right after activities, to understand what they think (Gemignani, 2009).

Designing mindfulness programmes for dementia caregivers

1. Ensure that trainers have the appropriate training and expertise - Trainers should be properly trained to ensure that the lessons they impart are accurate (McEachern, 2018).
2. Hold live sessions on weekends to cater to working caregivers - Working caregivers may not have time or capacity to participate in mindfulness activities if they are held on the weekdays (Zarei, Lakhanpal, & Sadavoy, 2020).

2.2.6 Challenges and Researcher Suggestions for Mindfulness Based Interventions

As mindfulness interventions had challenges like rigidity of its content and implementation methods, some suggestions were proposed by the researcher. Many studies on mindfulness programmes explore benefits for persons with dementia and their caregivers where programmes are often taken as it is or adapted through modifying the duration or frequency. There is a lack of focus on how mindfulness programmes content are designed. Although mindfulness programmes may cater to the needs of persons with dementia and their caregivers, for seniors with deteriorating conditions, it may be challenging to provide and sustain activities, as some activities require participants to utilise higher-level metacognitive capabilities. Mindfulness programmes must take into consideration not only the cognitive capabilities that persons with dementia can employ as their condition deteriorates, but also the increasing time and resources limitations most caregivers face. In designing mindfulness programmes, care must be taken to understand how each activity can contribute to the needs of both parties in the dyad and ensure sustainability in the long run. For example, more time could be provided for reflection in sessions with repetition of concepts and written information to aid understanding.

User centred design methodologies could address this by understanding and meeting dyadic needs.

Also, regarding MBI formats, most of the interventions—MBSR, MBCT and DBT had a fixed duration - 8 weeks to a year to complete the programme. Each programme was structured and had a standard 2 to 2.5 hours to do formal mindful practices in a physical setting. Informal practices were done based on individual preferences. The rigidity of such implementation methods limit the translation of mindfulness programmes to habitual use. ACT, however, had no fixed duration and was considered complete when the participant had gained enough skills to end treatment. It may be beneficial to provide for more accessibility, where shortened (10 minute) and more mindfulness activities (daily) are embedded into user's everyday life, as opposed to having 2.5 hour long, weekly mindfulness in a fixed physical location. It would also be useful to allow for more flexibility on choices to be made on what practices to do, with no pre-determined completion duration, as opposed to having pre-determined practices with a fixed completion duration.

2.3 Dyadic Mindfulness

Most studies focus on mindfulness solutions for seniors with dementia and caregivers separately but a few studies investigated mindfulness with a dyadic approach showing preliminary benefits for both groups (Berk, Warmenhoven, Os, & Boxtel, 2018) (Berk, et al., 2019) (Paller, et al., 2015). Studies support the feasibility of dyadic mindfulness interventions to preliminarily improve wellbeing (Berk, Warmenhoven, Os, & Boxtel, 2018), quality of life (Berk, et al., 2019), depressive symptoms (Paller, et al., 2015) (Ozen, et al., 2022) perceived stress, mood, sleep and blood pressure (Innes, Selfe, Brown, Rose, & Thompson-Heisterman, 2012). A dyadic approach with an adjusted MBSR training called TANDEM for 8 weeks resulted in reports of calmness, awareness, acceptance, and resilience benefits (Berk, et al., 2019). The study revealed that participating with their partners was valuable as it positively influenced their relationship, suggesting that the training provided opportunities for the dyad to support each other (Berk, et al., 2019). Participants appreciated that the training could be done for both seniors with dementia and caregivers (Berk, et al., 2019). Apart from dyadic benefits, caregivers showed a substantial improvement in mindfulness with most integrating exercises into their routines and intention to pursue the practice after the mindfulness training ended (Berk, et al., 2019). Berk's study also reported an increased acceptance for caregivers to

adapt to the disease, which was initially hindered by the lack of information, focus on loss and challenges in accepting change (Berk, et al., 2019).

Overall, these studies show that it is beneficial for dyadic mindfulness interventions to be conducted for persons with dementia and their caregivers even though majority of studies have separated these groups. The wellbeing of seniors with dementia and their caregivers are interconnected, a study on 1222 seniors with dementia showed that their suffering contributed to caregiver depression and burden (Berk, Warmenhoven, Os, & Boxtel, 2018). Also, caregivers and seniors with dementia experience the same stressful situations and they may gain advantage from dyadic mindfulness interventions (Berk, Warmenhoven, Os, & Boxtel, 2018). Given the interconnectedness and similar problems the dyad face, it could be beneficial to address them with dyadic mindfulness (Berk, Warmenhoven, Os, & Boxtel, 2018).

2.3.1 Existing Guidelines in Designing Dyadic Mindfulness Programmes

Designing dyadic mindfulness programmes for persons with dementia and caregivers

There were few studies available on dyadic mindfulness, and as they explored the effectiveness and feasibility rather than the designing of such interventions, these design guidelines were compiled from the studies as they were mentioned scantily.

1. Provide options for separate and dyadic use – Caregivers may be reluctant to share about their fears and may also be unable to fully focus on their own needs while worrying about the well-being of persons with dementia during a dyadic session (Berk, Warmenhoven, Os, & Boxtel, 2018). It may be useful for mindfulness programmes for dyads to provide options for separate use and dyadic use on different occasions (Berk, Warmenhoven, Os, & Boxtel, 2018).
2. Provide flexible practice times - This could accommodate for different timing needs of dyads (Innes, Selfe, Brown, Rose, & Thompson-Heisterman, 2012).
3. Shorten programme or sessions – To make them more accessible for persons with dementia and caregivers, programmes and sessions can be shortened (Berk, Warmenhoven, Os, & Boxtel, 2018) (Paller, et al., 2015). This would meet the needs of caregivers who have limited time (Berk, Warmenhoven, Os, & Boxtel, 2018), and the needs of persons with dementia who may have shorter attention spans.
4. Ensure ease of use – Challenges in activities could hinder persons with dementia from participating (Innes, Selfe, Brown, Rose, & Thompson-Heisterman, 2012). This was

alleviated by using easy to follow language with visual cues (Berk, et al., 2019). More time was also provided for more important themes to ensure persons with dementia and caregivers had enough time to digest information (Berk, et al., 2019).

2.3.2 Challenges and Researcher Suggestions for Dyadic Mindfulness

As dyadic mindfulness interventions had some challenges, some suggestions were proposed by the researcher. Caregivers may worry about persons with dementia and not be able to focus, activities should be something that the dyad can easily perform and benefit from so that caregivers need not worry. Long mindfulness activities may not be accessible for dyads who have limited time and shorter attention spans, and should be personalised to meet dyadic needs. Activities should also be easy to understand, as complex language with short thinking time could cause understanding problems for dyads. As mindfulness activities would be done for dyads with different cognitive abilities, activities need to meet both of their individual needs. It would be essential to have activities that cater to the needs of persons with dementia as they decline, while ensuring caregivers still benefit from the same activity.

Certain topics may be too sensitive to share about during dyadic exercises, activities could avoid intense topics to prevent negative experiences. Another method could be to identify the best way of expressing negative thoughts each individual in the dyad face, as they may be concerned about each other. It may be beneficial to be comfortable with the negative experience instead of avoiding it through separate mindfulness interventions for each individual.

2.4 Conversational Agent Mindfulness for Dyads

Mindfulness interventions for persons with dementia and caregivers were conducted physically, and CA or technological approaches to mindfulness for dyads, could not be found. Mindfulness using CA approaches for person with dementia or caregiver groups were also not available. Technological approaches to mindfulness for persons with dementia could not be found as well. However, some recent studies on mindfulness for dementia caregivers have implemented other technological approaches - live online (Zarei, Lakhanpal, & Sadavoy, 2020) and app-based approaches (Goodridge, et al., 2021) with promising results. An online MBCT intervention was conducted for caregivers of seniors with dementia through an 8 weekly online training session and mindfulness practices done at home with results showing improvement in self-compassion and coping strategies (Zarei, Lakhanpal, & Sadavoy, 2020). The study concluded with online MBCT being a viable solution that may improve psychological outcomes and adaptive coping

for caregivers (Zarei, Lakhanpal, & Sadavoy, 2020). A different study incorporating a tailor-made mobile application that supports mindfulness exercises reported an improvement of emotional well-being of caregivers of persons with dementia (Goodridge, et al., 2021).

Technological approaches like live online and app-based mindfulness enhance accessibility, providing alternatives for users who may not have the flexibility or ability to attend frequent in-person activities. Without the need to travel to a physical location, it enables greater accessibility and potentially higher attendance rates. However, live online sessions require a facilitator to be present, and users cannot access mindfulness whenever they wish to do it, having to arrange a meeting prior to mindfulness sessions. They also must know how to navigate the internet space. This limits the scalability and accessibility of the mindfulness solution. Live online sessions are also not fully embedded in user's daily lives, and cannot provide flexibility to meet each individual's preferences when done in a group, which may hinder lifelong habit formation. An app-based mindfulness approach could address these needs. However, users would still have to know how to navigate using mobile devices, having digital literacy, which may be difficult for older populations as they lag in terms of engagement with digital technology (Schreurs & Quan-Haase, 2017).

A novel approach of using CAs to implement mindfulness for dyads has yet to be explored and may meet accessibility, scalability, and digital literacy needs. CA mindfulness has multiple benefits, allowing for dyads to access mindfulness whenever needed, without having to travel to a physical location, being available to many dyads at each point in time and is easy to use as dyads just have to speak to the CA. CAs also provide opportunities for mindfulness activities to be embedded in dyad's daily lives, allowing for choices to be made on what practices to do, fostering opportunities for lifelong habits formation. CAs may be a better implementation format as compared to live online and app-based approaches. Future studies should explore how CAs used for dyadic mindfulness may benefit persons with dementia and their caregivers.

As existing studies were scant, the scope was extended to examine literature on how to design CAs based on general and e-health papers. In terms of activity script materials presented to users, papers suggested for CAs to provide knowledgeable responses (Rheu, Shin, Peng, & Huh-Yoo, 2021) that are accurate and personalised to engage users (Jadhav & Thorat, 2019). There should be more functions the CA can do, allowing for improved flexibility during communications (Meier, Beinke, Fitte, & Behne, 2019). Responses provided should also be

context aware (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021). It was recommended for the CA to provide small talk, and honesty about the CA's shortcomings in terms of performance (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Loveys, Sebaratnam, Sagar, & Broadbent, 2020). Lastly, the CA should provide a high level of self-disclosure (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021), cooperative behaviour (Loveys, Sebaratnam, Sagar, & Broadbent, 2020), be wordy instead of taciturn (Loveys, Sebaratnam, Sagar, & Broadbent, 2020), and provide variability in dialog structure and language (Curtis, et al., 2021).

Regarding CA activity script styles, it should be empathic (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Stal, Kramer, Tabak, Akker, & Hermens, 2020) (Curtis, et al., 2021) with high empathic accuracy (Stal, Kramer, Tabak, Akker, & Hermens, 2020), caring, likeable (Stal, Kramer, Tabak, Akker, & Hermens, 2020), humourous (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Stal, Kramer, Tabak, Akker, & Hermens, 2020) (Curtis, et al., 2021), and enjoyable (Stal, Kramer, Tabak, Akker, & Hermens, 2020). Using a first-person perspective (Loveys, Sebaratnam, Sagar, & Broadbent, 2020), socio-emotional dialogue (Rheu, Shin, Peng, & Huh-Yoo, 2021) should be used with relational language (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021), assuming a friend role with small social distance (Stal, Kramer, Tabak, Akker, & Hermens, 2020). Both positive emotion, negative emotion, social-oriented, and task-oriented language should be used (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) where using a stereotypically trustworthy voice or accents is preferred (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Stal, Kramer, Tabak, Akker, & Hermens, 2020). Culturally familiar communication styles are preferred (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Stal, Kramer, Tabak, Akker, & Hermens, 2020), with a high similarity with users (Stal, Kramer, Tabak, Akker, & Hermens, 2020). A young female human voice could be used, as opposed to an older male, synthesized voice (Stal, Kramer, Tabak, Akker, & Hermens, 2020) (Rheu, Shin, Peng, & Huh-Yoo, 2021). There could also be options to choose the type and gender of the CA's voice (Meier, Beinke, Fitte, & Behne, 2019). Regarding the speech rate and tone, a slower speech rate with a calm tone was preferred (Loveys, Sebaratnam, Sagar, & Broadbent, 2020). Lastly, polite ringtones should be used for notifications (Curtis, et al., 2021).

On technical suggestions, CAs should provide high quality performance (Rheu, Shin, Peng, & Huh-Yoo, 2021), with the lack of application disruption (Meier, Beinke, Fitte, & Behne, 2019).

CAs should have high speeds, and an improved system reliability to enable long-term usage (Meier, Beinke, Fitte, & Behne, 2019).

2.4.1 Existing Guidelines in Designing Conversational Agent for Health

No studies on designing mindfulness CAs for dyads could be found. Therefore, we refer to existing guidelines on designing CAs for health, where relevant results were relatively scant.

Designing conversational agents for health

1. Trustworthy - CAs should use a stereotypically trustworthy voice or accent (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Stal, Kramer, Tabak, Akker, & Hermens, 2020).
2. Similar to users - Culturally familiar communication styles are preferred (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Stal, Kramer, Tabak, Akker, & Hermens, 2020), with a high similarity with users (Stal, Kramer, Tabak, Akker, & Hermens, 2020).
3. Voice options - A young female human voice could be used (Stal, Kramer, Tabak, Akker, & Hermens, 2020) (Rheu, Shin, Peng, & Huh-Yoo, 2021). There could also be options to choose the type and gender of the CA's voice (Meier, Beinke, Fitte, & Behne, 2019).
4. Slow and calm - Regarding the speech rate and tone, a slower speech rate with a calm tone was preferred (Loveys, Sebaratnam, Sagar, & Broadbent, 2020).
5. Polite ringtones - CAs should use polite ringtones for notifications (Curtis, et al., 2021).
6. Match between CA and real world - Ensure that CAs match users' language, timing for response, tone, and speed of dialogue rather than use system-oriented terms, especially for stress management contents like meditation (Shin & Huh-Yoo, 2020). Voice must sound natural and not robotic (Gardiner, et al., 2017).
7. Provide clear communication of steps - This enables users to differentiate transitions—start, transitions to next steps, and end of content (Shin & Huh-Yoo, 2020).
8. Include only necessary details - Content provided should be sufficient, not containing too little or too many details (Shin & Huh-Yoo, 2020). Although another study suggested for CAs to be wordy instead of taciturn (Loveys, Sebaratnam, Sagar, & Broadbent, 2020), it may be beneficial to only include necessary details.
9. There should be more functions the CA can do to provide flexibility of use - CA allows users to tailor usage, where users could individualise content based on preferences (Shin & Huh-Yoo, 2020) (Meier, Beinke, Fitte, & Behne, 2019).

10. Ensure consistency across skills - This ensures coherence across skills and ease of use for users as compared to varying skill commands and sequences (Shin & Huh-Yoo, 2020). Although another study suggested for CAs to provide variability in dialog structure and language (Curtis, et al., 2021), consistency should be applied instead.
11. Recognition instead of recalling - As users express difficulties memorising commands, it may be useful for users to hear and recognise commands instead of having to recall them (Shin & Huh-Yoo, 2020).
12. Error prevention - Where commands are not captured or when users use CAs in ways it was not designed for, CAs should have means to allow users to correct the mistake and continue using the agent (Shin & Huh-Yoo, 2020).
13. Personify CAs - Personifying agents increase accessibility, satisfaction, and emotional connection (Shin & Huh-Yoo, 2020). Provide different forms of personification based on individual needs (Ahmad, Siemon, Gnewuch, & Robra-Bissantz, 2022).
14. Trustworthy content - Content CAs use should be knowledgeable (Ahmad, Siemon, Gnewuch, & Robra-Bissantz, 2022) (Rheu, Shin, Peng, & Huh-Yoo, 2021), and rely on trustworthy sources (Shin & Huh-Yoo, 2020) (Gardiner, et al., 2017) (Jadhav & Thorat, 2019).
15. Personalisation - CAs should provide personalisation to engage users (Jadhav & Thorat, 2019).
16. Context awareness - Responses provided should be context aware (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021).
17. Small talk - CAs should provide small talk (Rheu, Shin, Peng, & Huh-Yoo, 2021) (Loveys, Sebaratnam, Sagar, & Broadbent, 2020).
18. Performance honesty - CAs should provide honesty about the CA's shortcomings in terms of performance (Rheu, Shin, Peng, & Huh-Yoo, 2021).
19. Self-disclosure - CAs should provide a high level of self-disclosure (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021).
20. Co-operation - CAs should provide cooperative behaviour (Loveys, Sebaratnam, Sagar, & Broadbent, 2020).
21. Positive values embodied - CAs should come across as empathic (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Stal, Kramer, Tabak, Akker, & Hermens, 2020) (Curtis, et al., 2021) with high empathic accuracy (Stal, Kramer, Tabak, Akker, & Hermens, 2020), caring, likeable (Stal, Kramer, Tabak, Akker, & Hermens, 2020), humorous (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Stal, Kramer, Tabak, Akker, &

Hermens, 2020) (Curtis, et al., 2021), and enjoyable (Stal, Kramer, Tabak, Akker, & Hermens, 2020).

22. Balance - Both positive and negative emotion language should be used (Loveys, Sebaratnam, Sagar, & Broadbent, 2020). Similarly, both social-oriented and task-oriented language should be used (Loveys, Sebaratnam, Sagar, & Broadbent, 2020).
23. First person perspective - CAs should use a first-person perspective (Loveys, Sebaratnam, Sagar, & Broadbent, 2020).
24. Friend role - Socio-emotional dialogue (Rheu, Shin, Peng, & Huh-Yoo, 2021) should be used with relational language (Loveys, Sebaratnam, Sagar, & Broadbent, 2020) (Curtis, et al., 2021), assuming a friend role with small social distance (Stal, Kramer, Tabak, Akker, & Hermens, 2020).
25. Ensure 24/7 availability - Provide 24/7 access to CAs for users whenever they wish to use it (Ahmad, Siemon, Gnewuch, & Robra-Bissantz, 2022).
26. High quality performance - CAs should provide high quality performance (Rheu, Shin, Peng, & Huh-Yoo, 2021), with the lack of application disruption (Meier, Beinke, Fitte, & Behne, 2019).
27. High speed - CAs should have high speeds (Meier, Beinke, Fitte, & Behne, 2019).
28. Strong system reliability - CAs should have improved system reliability to enable long-term usage (Meier, Beinke, Fitte, & Behne, 2019).

2.4.2 Challenges and Researcher Suggestions for Dyadic Mindfulness Conversational Agents

Some suggestions were proposed by the researcher to address challenges dyads may face. As dyads expressed difficulties memorising commands, activation commands for activities should be easy to remember and visual reminders could be provided to aid recall. The robotic nature of CAs may make it challenging for dyads to understand it. Therefore, when implementing CAs as a medium for dyadic mindfulness, it may be beneficial to use a local accent, personifying the CA. With the dementia condition, persons with dementia may find it difficult to understand or perform some activities. Description of activities could incorporate more detail with some repetition if needed, to aid their understanding. More time for processing may also be useful to provide time to digest information. In the event where the device does not capture commands, or when users use CAs in ways it was not designed for, CAs should provide clear

information with different but more detailed ways of presenting information with each clarifying user attempt. Lastly, although studies suggest to provide more choices, enabling personalisation, flexibility needs to be balanced, as too many choices when presented, may confuse persons with dementia.

2.5 Conclusion

Many mindfulness interventions had positive results when studies were conducted individually for person with dementia or caregiver groups. Few mindfulness studies utilised a dyadic approach, even though dyadic approaches showed positive results. As caregivers are often overburdened, it would be useful for interventions to not only help persons with dementia but also simultaneously address the needs of the people who care for them. Apart from enabling both individuals to benefit from mindfulness, this provides opportunities for dyads to foster better relationships with each other. Dyadic mindfulness interventions, however, were done in person, requiring caregivers and persons with dementia to travel to a physical location. This deterred some participants from participating in previous studies because of the time requirement. A CA approach to dyadic mindfulness could be a better alternative, providing access to mindfulness activities whenever and wherever needed, enhancing accessibility. CAs also provide scalability, don't require high levels of digital literacy, can be embedded in dyad's daily lives, and allow for choices to be made on what practices to do.

It may be novel to explore the cross sections of dyadic mindfulness conversational agents, meeting the needs of persons with dementia and caregivers. While it could be a novel way to cater to the needs of the dyad, guidelines that may be useful when designing these interventions should be considered. Guidelines were explored in the literature, however, only scant suggestions were provided by studies that primarily focused on assessing effectiveness of the interventions. Dedicated exploration of the needs of dyads regarding designing mindfulness CAs should be done.

Chapter 3. User and Expert Feedback

This chapter is largely adapted from a previous paper I published in JMIR Aging.

“Designing Mindfulness Conversational Agents for People with Early-Stage Dementia and Their Caregivers: Thematic Analysis of Expert and User Perspectives”

3.1 Introduction

While dyadic mindfulness studies reveal positive benefits, there is a lack of focus on how the interventions are designed for the stakeholders. Studies often adapted mindfulness interventions without stating the specific adaptations or the reasons they were made (Chan J. M., 2015).

Most dyadic MBI studies were done in physical group settings (Epstein-Lubow, McBee, Darling, Arney, & Miller, 2011; Berk, Warmenhoven, Os, & Boxtel, 2018; Paller, et al., 2015; Boxtel, Berk, de Vugt, & Warmenhoven, 2019), with one study conducting home sessions using recordings (Wang, et al., 2020) and another using guided telephone calls (Brown, Coogole, & Wegelin, 2015). Introducing more advanced technologies like CAs to dyadic mindfulness for persons with dementia and their caregivers is a novel approach, and no study could be found.

CAs refer to artificial intelligence or computer programmes, that use natural language processing, to have a conversation with people (Cristancho-Lacroix, et al., 2014). The use of CAs could improve accessibility as they allow users to access them in the comfort of their own homes, instead of travelling to a physical location. They also allow users to access them at any time, as opposed to having to wait for a guide through physical groups or telephone calls. CAs may also support individuals with limited digital competencies, which may be beneficial not only for older adults but also for people with cognitive challenges (Even, et al., 2022), offering lower barriers of use by using voice as a communication medium, as opposed to using a graphical interface device. Users simply need to speak to CAs instead of learning how to navigate through digital interfaces, thereby enhancing accessibility. CAs may also provide more personalisation and guidance as compared to recordings, by guiding dyads step by step in an interactive personalised manner, as opposed to a static video or voice recording. They may also provide more scalability as compared to physical groups or guided telephone calls, as they do not require a mindfulness expert to be present each time, allowing for automation,

as opposed to a manual approach. CAs could benefit current mindfulness interventions for dyads by improving accessibility, scalability, guidance, and personalisation, offering opportunities for mindfulness to be seamlessly integrated into dyads' lives. To understand it, research on CAs for persons with dementia which were relatively scant (Ho, et al., 2017) were explored, with some interesting use cases like dementia detection (Oken, et al., 2010). Unfortunately, CAs for dementia, is inadequately discussed in the scientific community, with studies that lack rigour (Ho, et al., 2017). However, a recent study reveals that persons with dementia can use embodied CAs independently in their home environment (Whitebird, et al., 2013). This showed good engagement with the system, revealing the potential for CAs to meet basic and higher-level needs of people living with dementia (Whitebird, et al., 2013). To our knowledge this is the first study of dyadic MBIs supported by technologies like CAs.

Dyadic mindfulness conversational agents may be a more useful way to engage persons with dementia and their caregivers. While dyadic mindfulness has shown benefits for persons with dementia and caregivers, physical group settings and guided telephone calls were used, which were not scalable as they required a trainer for each session and were not accessible as users could not use them whenever they wanted. Physical group settings were also not accessible, as they required users to travel to a physical location. Recorded formats provide for accessibility and scalability needs, given that users know how to navigate the digital space, but are not personalised and guided like physical group sessions or telephone calls. A way to bridge this is to utilise CAs for dyadic mindfulness, providing accessibility and scalability whilst ensuring guidance and personalisation for users. However, in order for future studies to design and test the effectiveness of dyadic mindfulness conversational agents, the needs, and preferences of persons with dementia and their caregivers first need to be understood.

Recommendations from existing literature only addressed parts of the proposed intervention - dyadic mindfulness, or CAs for persons with dementia. Recommendations on dyadic MBIs using CAs for persons with dementia and their caregivers could not be found. Therefore, this study's research aims involve understanding dyadic mindfulness conversational agents needs of persons with dementia and caregivers. It seeks to address the aim, through feedback from both expert and user perspectives. This would enable future designers and developers to create appropriate dyadic mindfulness conversational agents based on user needs.

3.2 Research Question

“What is important when designing mindfulness conversational agents for persons with dementia and their caregivers?”

3.3 Methods

3.3.1 Ethical Considerations

Ethical approval was granted for this study by the Imperial College Research Ethics Committee (ICREC) (21IC6573). The ethics process was lengthy and rigorous to ensure the safety and well-being of persons with dementia and their caregivers. As the study involved human participants, and in addition to that, conducting research on vulnerable groups, the study was deemed to be high risk due to the health conditions of participants. Therefore, there were many considerations that had to be set in place to ensure that the study would have minimal risk and impact on participants. A study protocol and ethics application form was written up explaining the (1) details of the principal investigator and co-investigators, (2) study description, background literature, and rationale, (3) study objectives, summary, and design, (4) participant recruitment process and pre-recruitment evaluations, inclusion and exclusion criteria, (5) process for obtaining informed consent with documents prepared for participants, (6) ethical summary, process for mitigation of ethical issues and risks, (7) process for reporting and addressing adverse events, (8) regulatory issues – indemnity, sponsor, audits, (9) confidentiality and management of personal and other research data and (10) publication policy in great detail. The protocol and ethics application form were compiled together with supplementary documents including (1) structured interview questions, (2) survey questions, (3) topic guides, (4) workbooks, (5) scripts of the process, and (6) reminders for participants to note. Participant information sheets explaining the study aims, process, requirements, benefits, risks, funding sources, and contact details, together with consent forms were also compiled and sent to the ICREC. These documents were reviewed by the ICREC administrator, who liaised with the researcher, helping to refine them through multiple cycles over Microsoft Teams meetings and phone calls before it was ready to be presented before an ethics committee. The ethics committee, comprising of researchers and professors from various backgrounds, then reviewed the documents. After which, the researcher did a presentation to the committee, where they clarified any doubts and improved on the study process before conditional ethical approval was granted. The study began after modifications were made to the documents and final approval was granted after confirmation. Participant information sheets and consent forms were

explained to and shared with participants prior to the study. Informed consent was obtained from all participants before they participated in the study.

A challenge faced regarding the ethics process is associated with the time requirements to obtain approval as the process took approximately 8 months from start to end. It also required extensive preparations prior which took up additional time. This, however, was for the benefit of participants as the study needed to be assessed by multiple stakeholders.

Regarding documents submitted, some key insights gathered through this process include consideration of participant's needs throughout all touchpoints of the study. This includes (1) the study structure where persons with dementia do not do surveys, interviews and activities individually, and their caregiver is always present, or where (2) the language used in participant information sheets, emails, video calls and all other touchpoints were catered to persons with dementia, making it as simple and straightforward as possible to prevent potential confusion. It was also important to maintain their dignity, by not emphasizing on the dementia condition or the loss of abilities, and instead focusing on the benefits of the study and how it could help them. Regarding the ethical process, it was important to find the right person in charge for guidance, and to rely on past ethics studies for reference.

This process, although tedious, ensured a well thought through study prior to execution, with feedback from many and different perspectives to help improve on the study, maintaining the safety and well-being of participants.

3.3.2 Study Design

Semi-structured interviews were conducted via Microsoft Teams meetings. 5 dementia experts, 5 mindfulness experts, 5 persons with early-stage dementia and 5 dementia caregivers were interviewed individually, based on a pre-defined topic guide through a 1-hour interview. Dementia and mindfulness experts were recruited between Mar–June 2021. Persons with dementia and caregivers were recruited between Oct–Nov 2021. *Table 1* outlines the structure of the interviews for experts and users, while *Appendix 1* shows the questions asked for each participant type.

Table 1. Expert and user topic guide focus

Activity/ Method	Min	Description	Materials	Outcomes
Welcoming	2	Welcome participants and thank them for participating in the study Explain what would be explored in the interview	-	Familiarise participants with interview aims
Understanding Current Users, Context and Methods	10	Ask about dyads' living situation, socio-economic factors, care needs, hobbies and daily life Ask participants about current challenges dyads face Ask participants what approaches they used that may be useful for dyads, exploring why they work	Interview questions	- Understand dyads - Understand current challenges faced by dyads - Understand current methods used and mechanisms of practices that may work well for dyads
Explaining and Understanding Mindfulness Practices	10	Introduce mindfulness to participants Ask participants about mindfulness preferences	-	- Experts and users understand mindfulness practices - Understand mindfulness preferences
Understanding Dyadic	10	Ask participants about their preferences regarding	Interview questions	Understand dyadic

Mindfulness Conversation al Agent Preferences		dyadic mindfulness conversational agents		mindfulness conversational agent preferences
Understandin g Needs of Designing Mindfulness Conversation al Agents for Dyads	25	Ask participants about the needs of mindfulness conversational agents for persons with dementia and caregivers regarding explaining the intervention, ensuring intervention is suitable for dyads, executing the intervention, ensuring engagement of intervention, format of intervention as well as social component of intervention	Interview questions	• Understand mindfulness conversational agent needs for persons with dementia and caregivers
Closing	3	Thank participants for participating in the study		• Conclude interview

2.3.3 Participants

Participants with expertise in mindfulness training and dementia were recruited from research networks of co-investigators using an opportunity sampling method. Person with dementia and caregiver participants were recruited through dementia groups on social media platform Facebook, where a volunteer sampling approach was used. Persons with early-stage dementia and caregivers individually responded to advertisements on various dementia groups. Since it was particularly challenging recruiting participants who were dementia caregivers or persons with early-stage dementia, caregivers and dementia participants in this study were given 20 GBP and 40 GBP respectively as an appreciation for their time. Interviewees were informed

that they could withdraw at any time without giving a reason. All participants had to be 18 years or older, be able to use Microsoft Teams and communicate in English. In addition,

- Dementia experts had to be a service provider in the healthcare facility working with, and planning programmes, for persons with dementia. Dementia experts were included in this study as they understood the needs of dyads and could articulate the challenges faced and solutions used.
- Mindfulness experts had to be teachers and practitioners of mindfulness methodologies/therapies like MBCT/ MBSR/ Mindfulness activities like meditation without the clinical focus or equivalent. Mindfulness experts were included in this study as they understood the needs of mindfulness practitioners, persons with dementia, and caregivers regarding mindfulness.
- Persons with dementia were in the early stage of dementia (of any type) and able to consent for themselves. Persons with early-stage dementia were included in the study as they have had lived experience and could articulate their needs.
- Caregivers had to be primary caregivers of an individual with a dementia diagnosis (*early stage* of any type) and have provided care for at least three months before recruitment. Caregivers were included in the study as they have had lived experience and could articulate their needs.

2.3.4 Data Collection and Analysis

The sessions were recorded using Microsoft Teams before they were transcribed. The transcripts were analysed using NVivo version 12. A thematic analysis approach was used to identify, analyse, and report patterns within data (Danucalov, et al., 2013). The thematic analysis approach is a flexible approach that organises and describes data sets that are rich in detail, allowing for interpretation of various aspects of the research topic (Danucalov, et al., 2013). This approach was utilised as it enabled the identification of important themes across expert and user feedback.

For expert feedback, an inductive bottom-up approach was used by two PhD researchers independently. Using Nvivo, data was coded as the researchers read through the transcripts. This was done by highlighting and categorising similar data as mentioned by experts into a code. Pattern coding was then done by categorising common codes into a theme, to condense

data into fewer analytical concepts. Codes and themes were re-categorised, as new or similar codes and themes emerged, as the researchers further analysed the transcripts. This went through several iterations until the researchers were satisfied with their individual codes and themes. Themes were subsequently compared by the two researchers, across different expert's data. Themes were chosen based on (A) whether it was identified by both researchers and both types of experts and (B) if it was not identified by both researchers, it had a significant number of codes from expert's feedback that both researchers subsequently explored and agreed to include. Cohen's Kappa coefficient (Leach, Francis, & Ziaian, 2015), was calculated to measure the level of agreement between the two researchers. Calculations using the formula (Waelde, Meyer, Thompson, Thompson, & Gallagher-Thompson, 2017) reflect a value of 0.69, showing moderate agreement between researchers for expert feedback.

For user feedback, attribute codes were first developed based on main topics from interview questions, organising data by (A) living situation, (B) socio-economic factors, (C) health factors and care needs, (D) coping methods, (E) hobbies and daily life, (F) main challenges, (G) use of technology, (H) use of mindfulness, (I) factors to consider for design and (J) individual activity preferences. After which, using Nvivo, two PhD researchers separately used the same inductive method—an open coding approach, before pattern coding was done to condense codes into themes. Codes and themes were re-categorised, as new or similar codes and themes emerged, as the researchers further analysed the transcripts. This went through several iterations until the researchers were satisfied with their individual codes and themes. The two researchers then came together to compare themes, where both researchers came to a consensus about which themes to include after discussion and justification. Themes were chosen based on (A) whether it was identified by both researchers and both types of users and (B) if it was not identified by both researchers, it had a significant number of codes from user's feedback that both researchers subsequently explored and agreed to include. Calculations using the Cohen's Kappa coefficient (Waelde, Meyer, Thompson, Thompson, & Gallagher-Thompson, 2017) reflect a value of 0.77, showing moderate agreement between researchers for user feedback.

Representative data, comprising expert and user quotes, were included to support themes identified. A cross comparison analysis across themes from expert and user perspectives was done to identify similarities. The analysis was then reviewed by four other researchers. Data and all appropriate documents will be stored for a minimum of 10 years after the study is

completed. All video recordings were transcribed in a timely fashion and removed from Microsoft Teams.

3.4 Results

3.4.1 Participants

5 dementia experts and 5 mindfulness experts who fulfilled the inclusion criteria completed the interview, and all 10 interviews were analysed. Most dementia experts interviewed were facilitators at day activity centres (3/5, 60%) and all 5 dementia experts (5/5, 100%) were female. All mindfulness experts (5/5, 100%) were mindfulness teachers, and most mindfulness experts (3/5 60%) were male.

5 caregivers and 7 persons with early-stage dementia responded to advertisements posted on Facebook dementia groups, two persons with dementia were excluded as they had difficulty understanding questions or had challenges using Microsoft Teams. The 10 users completed the interview, and all 10 interviews were analysed. Three caregivers (3/5, 60%) cared for parents with dementia, while two caregivers (2/5, 40%) were spouses of persons with dementia. Most caregivers (4/5, 80%) were female. Four persons with early-stage dementia (4/5, 80%) interviewed were supported by their spouses. They could manage daily tasks with some difficulty but had assistance from others. One person with dementia (1/5, 20%) however lived independently in a retirement village, with assistance from paid caregivers who visit occasionally. Most persons with dementia (3/5, 60%) were female.

More information on the participants can be found in *Table 2*.

Table 2. Participant details

	Type of Participant	Number (N=20)
Dementia Expert		
	Nursing Home Allied Health Professional	1
	Hospital Staff	1
	Day Activity Centre Facilitator	3

Mindfulness Expert		
	Mindfulness Meditation Teacher	1
	Mindfulness Movement Teacher	1
	Mindfulness Teacher	3
Persons with Dementia		
	Person with early-stage vascular dementia	1
	Person with early-stage dementia	1
	Person with early-stage frontotemporal dementia	3
Caregivers		
	Carer for person with early-stage vascular dementia	1
	Carer for person with early-stage frontotemporal dementia	1
	Carer for person with early-stage and/or later stage dementia	3

3.4.2 Preferences for Conversational Agents that support Dyadic Mindfulness

Most participants (5 caregivers and 3 persons with dementia) had past experiences using various forms of mindfulness practices. Although not all users have had experiences with mindfulness, all ten caregivers and persons with dementia mentioned that they would use mindfulness practices, after trying a mindful exercise. This indicates that mindfulness is appealing to participants. Regarding practicing mindfulness as a pair, four out of five caregivers and three out of five persons with dementia expressed interest. However, one caregiver and two persons with dementia preferred to do mindfulness individually. According to most users, dyadic mindfulness is preferred.

Most participants—three caregivers and four persons with dementia - were familiar with using CAs. They used them to contact people, monitor the home, plan things using the calendar, set reminders, set alarms, have conversations, tell the weather, and play music. They had past experiences with various types of CAs—Alexa, Siri, and Google Assistant. Caregivers and persons with dementia were asked to speculate on format preferences (CAs or video conferencing software) to practice dyadic mindfulness and three caregivers as well as three persons with dementia preferred using CAs. CAs were preferred, as it was something users

could do on demand instead of having to arrange and schedule a zoom session. Users mentioned that it would enable them to access it whenever they wanted, and it did not matter whether it was at night. However, two caregivers and two persons with dementia would prefer using video conferencing due to a more personal touch. Overall, mindfulness interventions designed for dyads could incorporate the use of CAs, given the majority's familiarity with the technology and likelihood of using it. However, interviewees were tech savvy and may not represent the target population. It may be helpful for future studies to include participants who are not tech savvy to understand their perspectives as well.

3.4.3 Designing for Dyadic Mindfulness Conversational Agents – Common Expert and User Themes

Nine expert themes and seven user themes were identified from the inductive thematic analysis of expert and user interviews to identify what was necessary in designing mindfulness CAs for persons with dementia and caregivers. Expert and user themes were identified and listed accordingly in *Table 3*, where 5 common themes were identified.

Table 3. Comparison of expert and user themes

Pt.	Expert Themes	User Themes
1	N/A	Alleviate Stress
2	N/A	Alleviate Worries
3	Enhancing Accessibility	Enhancing Accessibility
4	Encouraging Mindful Mindset Shift	Encouraging Mindful Mindset Shift
5	Enhancing Relationships	Enhancing Relationships
6	Cultivating Positivity	Cultivating Positivity
7	Providing Simplified Tangible and Thought-based Activities	Providing Simplified Tangible and Thought-based Activities
8	Embracing Ability	N/A
9	Evoking the 5 Senses	N/A
10	Fostering Engagement	N/A
11	Creating Habits	N/A

Enhancing Accessibility

Firstly, three dementia experts, three mindfulness experts, five caregivers and four persons with dementia emphasised the importance of keeping solutions designed for persons with dementia and their caregivers as accessible as possible with activities explained in a simple and straightforward manner. It was necessary to avoid complex sentences as it may cause difficulties in following instructions according to person with dementia D5. Secondly, providing guidance may also help facilitate accessibility according to two dementia experts, four mindfulness experts and one person with dementia. Having expert guidance could help participants to have clarity and offer more support for people who need it, especially for those who may be progressively getting worse. Thirdly, it would also be essential to consider how the activities designed for the dyad progresses as the person with dementia's condition declines, ensuring that users could still utilise solutions with ease, as mentioned by one dementia expert, four caregivers and five persons with dementia. This could be done by breaking down tasks or simplifying programmes for persons at different stages of dementia.

Dementia Expert D4

"And it has to be as simple as possible, even for early stage, you know, as simple as possible."

Person with Dementia D1

"So, your version of simple and what actually works for me can be very, very different."

Encouraging Mindful Mindset Shift

Participants in the four groups believed that a mindful mindset shift may benefit the dyad through present moment awareness and having no attachment or aversions to experiences. Present moment activities were utilised and preferred by four dementia experts, five mindfulness experts, five caregivers and five persons with dementia to enhance present moment awareness. Worries that come with a progressing illness could be mitigated through the effects of present moment activities where the hustle and bustle stop for a moment and there is a sense of calm, changing the relationship with experience to one of ease rather than one of struggle. Additionally, four mindfulness experts and two persons with dementia identified the need to have no attachment or aversion to events, learning to have acceptance, and to be comfortable with discomfort. Where pleasant or unpleasant feelings arise, thoughts should be

allowed to come and go while being mindful—not reacting to or judging them. This means participants would be comfortable with discomfort, where a “different way of being is actually okay”. Two persons with dementia exemplify this by accepting and acknowledging uncomfortable experiences, waiting patiently for negative emotions to pass. Interventions for dyads should encourage a mindset shift, allowing dyads to stay in the present moment and learn to have no attachment or aversion to experiences.

Dementia Expert D1

“Being in the moment is just so important, isn’t it, for everybody, really, but I think specifically for someone who lives with an illness (dementia) and something which is obviously progressing...”

Person with Dementia D5

“If I’m upset, I just acknowledge that I’m upset and I have a reason to be upset and wait till it passes, really.”

Enhancing Relationships

Social connectedness was widely identified as a factor that should be incorporated into activities for dyads by four dementia experts, five mindfulness experts, five caregivers, and four persons with dementia. In particular, social connectedness between the dyads was important according to mindfulness expert M2 and M5. This was further emphasised by three caregivers and two persons with dementia who mentioned having a worsened relationship because of dementia needs and symptoms. Caregivers found it difficult to live with the person with dementia, grappling with the “huge personality change”. Similarly, two persons with dementia expressed negative changes in the relationships they had with their loved ones. As the person with dementia declines, they lose abilities and have changes in their personalities, resulting in worsened relationships. It would be important for interventions to improve social connectedness between the dyad. Dyadic dynamic needs to be carefully designed to encourage a stronger bond between the pair, as mentioned by mindfulness expert M4 and M5.

Mindfulness Expert M2

“Quality of the relationship between caregiver and the person with dementia is vital”.

Person with Dementia D1

“My husband says you have become a liability to me and that really, really hurt because we had been a team.”

Cultivating Positivity

Two dementia experts, five mindfulness experts, four caregivers, and two persons with dementia identified the need to focus on the positive. They recommended activities that provided calm, appreciation and loving kindness, to enable the dyads to cultivate positivity. Firstly, activities promoting calmness for the dyads were identified by two dementia experts and two mindfulness experts as essential. This resulted in a sense of peace, which was positive. Secondly, five mindfulness experts, two caregivers and two persons with dementia recommended activities that had elements of appreciation. Appreciating the “duality of human nature”, embracing situations in its entirety according to mindfulness expert M2 could be a way to bring some positivity to the lives of dyads. Two other caregivers also mentioned noticing and appreciating the little moments of positivity, instead of ruminating or dwelling on negative thoughts. Two persons with dementia had a positive outlook on life despite having dementia and suggested that it was important to see the positive in the negative and learn to still be joyful and appreciative in the face of adversity. Encouraging appreciation, according to experts and users, is essential, cultivating positivity for dyads. Lastly, two mindfulness experts recommended activities that had elements of loving kindness. Practicing loving kindness may help to cultivate positivity as well. In essence, elements of positivity were recommended to be incorporated into interventions designed for dyads, enabling them to better cope with the challenges that come with dementia.

Mindfulness Expert M5

“What I would really recommend building in would be something on using mindfulness in terms of appreciation and in terms of gratitude, so I think this sort of practices can be really helpful for people.”

Person with Dementia D1

“I’ve re-evaluated and rediscovered there’s a joy and a lightness in this new as well. I’ve looked death in the face and decided that I can dance and do and stand.”

Providing Simplified Tangible and Thought-based Activities

According to experts and users, activities for dyads could be tangible-based or thought-based. Three dementia experts and four mindfulness experts recommended using mindful breathing (MB), where the focus is on noticing the breath, as it was tangible and easy to grasp, which may be particularly useful for dyads. All five caregivers and five persons with dementia similarly would do tangible activities like deep breathing as it was a tangible and effective way to calm them down. One mindfulness expert, three caregivers, and three persons with dementia would recommend or do other forms of tangible activities like body scan meditation where the focus is on the sensations one feels in the body. However, two caregivers and two persons with dementia mentioned not wanting to do body scan meditation, citing reasons of not understanding how to do the activity, lack of interest and potential of feeling overwhelmed.

Two dementia experts and three mindfulness experts conducted thought-based activities that utilised reflection, to help dyads generate insights about the self. Mindfulness expert M4 explained that through mindful reflection, one would be aware of their thoughts, feelings, and sensations, enabling them to prevent automatic rumination of thoughts, breaking the cycle of how fear-based thoughts affect unhealthy behaviour. Five caregivers and four persons with dementia would do thought-based activities, focusing on reflection through dyadic gratefulness, where one reflects on positive things with a partner. Four caregivers and three persons with dementia were open to other thought-based activities like letting go, which helps users to be comfortable with discomfort and to feel less overwhelmed. The activity encourages being open and accepting to difficult emotions and experiences, rationalising the process using metaphors. However, two persons with dementia had difficulties understanding abstract components that had metaphors. Overall, certain simplified tangible and thought-based activities may be suitable for dyads, depending on their individual needs.

Comparison to Prior Work

When compared to design recommendations identified in the literature, most of the themes uncovered were novel and reflected the needs from a holistic perspective, based on user and expert feedback. Existing design recommendations may have been created from the researcher's perspective, which may explain why most of them did not coincide with user and expert themes, as seen in *Table 4*. Existing literature's design recommendations include recommendations for designing mindfulness programmes for persons with dementia (MPwD),

designing mindfulness programmes for dementia caregivers (MC), designing dyadic mindfulness programmes for persons with dementia and caregivers (DMPwDC), as well as designing conversational agents for health (DCA).

Only accessibility themes from the literature coincided with the user and expert themes whilst encouraging a mindful mindset shift, enhancing relationships, cultivating positivity and providing simplified tangible and thought based activities were novel. There were some similarities between expert themes and literature on fostering engagement and creating habits. However, there were no commonalities for some expert (embracing ability and evoking the 5 senses) and user (alleviate stress and worries) themes with the literature. The literature also brought up the importance of (1) providing opportunities for open discussions and feedback, (2) appropriate training and expertise of trainers, (3) separate and dyadic use, (4) voice sounding trustworthy, similar to users, slow and calm, with various voice options and polite ringtones, (5) trustworthy and balanced content, as well as (6) self-disclosure which were not present in user and expert themes.

Table 4. User and expert dyadic mindfulness conversational agent design needs comparison to existing recommendations from literature

Pt.	Expert Themes	User Themes	Design Recommendation (literature)
1	Enhancing Accessibility	Enhancing Accessibility	- Understand individual needs and capabilities (MPwD) - Ensure activities are simple and easy to understand without complicated abstract concepts (MPwD) - Hold live sessions on weekends to cater to working caregivers (MC) - Provide flexible practice times (DMPwDC) - Shorten programme or sessions (DMPwDC) - Ensure ease of use (DMPwDC)

			- Match between CA and real world (DCA) - Provide clear communication of steps (DCA) - Include only necessary details (DCA) - There should be more functions the CA can do to provide flexibility of use (DCA) - Ensure consistency across skills (DCA) - Recognition instead of recalling (DCA) - Error prevention (DCA) - Personify CAs (DCA) - Performance honesty (DCA) - Ensure 24/7 availability (DCA) - High quality performance (DCA) - High speed (DCA) - Strong system reliability (DCA)
2	Encouraging Mindful Mindset Shift	Encouraging Mindful Mindset Shift	
3	Enhancing Relationships	Enhancing Relationships	
4	Cultivating Positivity	Cultivating Positivity	
5	Providing Simplified Tangible and Thought-based Activities	Providing Simplified Tangible and Thought-based Activities	
6	Embracing Ability		
7	Evoking the 5 Senses		

8	Fostering Engagement		- Personalisation (DCA) - Context awareness (DCA) - Small talk (DCA) - Co-operation (DCA) - Positive values embodied (DCA) - First person perspective (DCA) - Friend role (DCA)
9	Creating Habits		- Provide shortened duration and increased number of sessions with reminders to encourage adherence (MPwD)
10		Alleviate Stress	
11		Alleviate Worries	
12			- Provide opportunities for open discussions and feedback (MPwD)
13			- Ensure that trainers have the appropriate training and expertise (MC)
14			- Provide options for separate and dyadic use (DMPwDC)
			- Sounds trustworthy (DCA) - Similar to users (DCA) - Voice options (DCA) - Slow and calm (DCA) - Polite ringtones (DCA)
			- Trustworthy content (DCA) - Balance content (DCA)
			- Provide self-disclosure (DCA)

3.4.4 Designing for Dyadic Mindfulness Conversational Agents—Expert Themes That Were Not Present in User Themes

Four themes were identified by experts and were not present in user identified themes. They include embracing ability, evoking the 5 senses, fostering engagement, and creating habits.

Embracing Ability

Three dementia experts and one mindfulness expert brought up the importance of seeing dyads under a different light, focusing on abilities. They thought that after a diagnosis, dyads may focus on the negative aspects of dementia and learning to see themselves and each other under a different lens, could be useful. Similar sentiments were noted from the sub themes that identified role reversal, autonomy, and empowerment of dyads as important. Role reversal was brought up by two dementia experts and one mindfulness expert, where modifying the role for the persons with dementia could better engage them, preventing passivity. Role reversal was also used to help caregivers step out of their caring role to take a break. Secondly, encouraging autonomy was essential, and according to two dementia experts, could come in the form of providing options for choices to be made by dyads. Thirdly, according to three dementia experts, empowering dyads can help them see that although they are affected by the disease, there are many things they can still do.

Dementia Expert D1

“Actually, he did tell us as well, that he started to see her in a different light...”

Evoking the 5 Senses

Five dementia experts and four mindfulness experts mentioned the use of activities that stimulated the 5 senses. Activities used by dementia and mindfulness experts had an emphasis on the different senses, allowing for non-verbal communication needs to be met. It may be beneficial for activities designed for dyads to incorporate the 5 senses, although care must be taken to prevent overloading their sensory capabilities.

Dementia Expert D5

“We just use everything... all the senses and the garden and nature...”

Fostering Engagement

According to five dementia experts, activities have to be engaging. It was important to create a positive association with the activity. Three dementia experts also identified providing variety as an important component, to engage participants. Dementia expert D1, D3 and D4 provided a wide scope of activities with varying difficulties, providing flexibility for the users to choose what they preferred. Providing choices of format, frequency, and duration may also be important to foster engagement.

Dementia Expert D2

“It needs to be fun.”

Creating Habits

Mindful habits can be created through incorporating mindfulness into current routines and utilising reminders to aid the practice. According to two dementia experts and three mindfulness experts, activities could be woven into existing routines to introduce new habits, rather than having them as separate activities. Reminders on how to do mindfulness activities, what the activities comprise, and reminders to do the activities could also help to facilitate the forming of mindful habits, as mentioned by two dementia experts.

Dementia Expert D3

“What is their routine and then build it into that, the activities list rather than separate because separate will never happen...”

3.4.5 Designing for Dyadic Mindfulness Conversational Agents–User Themes That Were Not Present in Expert Themes

Two themes were identified by users and were not present in expert identified themes. They include alleviating stress and alleviating worries.

Alleviate Stress

Caregivers and persons with dementia are highly stressed, and interventions should address this need. Three caregivers had other caregiving duties on top of caring for persons with dementia, and two caregivers also had other personal illnesses. These factors may have contributed to why four out of five caregivers felt highly stressed and unable to cope.

Additionally, four persons with dementia experienced high levels of stress, because of their dementia symptoms, two of which also had other accompanying illnesses, adding on to their stress levels. Most of both caregivers and persons with dementia experienced high levels of stress, and it is necessary for interventions designed for dyads to lower stress levels.

Caregiver C2

“It does sometimes get completely overwhelming that you just can’t deal with anymore, you know. And I have felt I suppose over the last year I felt waves of being more overwhelmed, getting closer to tears or something more quickly than I have in the past.”

Alleviate Worries

Caregivers and persons with dementia had high levels of worries because of dementia and interventions should address this issue. Four caregivers mentioned struggling with worries they had about the person they care for, revealing an inability to cope with the situation. Also, all five persons with dementia mentioned losing abilities as one of the main challenges they faced, causing them to feel worried. These challenges reflected high levels of worries and it is important for interventions to ensure dyads are better able to manage their worries.

Caregiver C5

“Mostly I worry about him.”

3.5 Discussion

3.5.1 Principal Findings

5 themes, outlining the user needs for designing dyadic mindfulness conversational agents were gathered from expert and user perspectives in this study. These themes could be used to design future dyadic mindfulness conversational agents.

Studies on dyadic mindfulness (Berk, Warmenhoven, Os, & Boxtel, 2018; Paller, et al., 2015; Berk, et al., 2019), and CAs for persons with dementia (Rampioni, Stara, Felici, Rossi, & Paolini, 2021; Stara, et al., 2021) were relatively scant, with a focus on assessing effectiveness rather than on the design and user experience of the intervention. Only four user needs were gathered from past studies on dyadic mindfulness and past studies on CAs for dementia, and it was unclear whether the needs were derived based on user feedback. There were also no studies

on dyadic mindfulness conversational agents, and therefore the user needs also could not be found. This reveals the lack of an understanding of needs from the user's perspective, which is what this study seeks to address. The resulting themes, derived from an inductive process, provide interesting insights that helped meet the study's objective—to fill the gap in the literature concerning the design needs of persons with dementia and caregivers for a dyadic mindfulness conversational agent approach, from expert and user perspectives.

The 5 common themes identified from expert and user feedback inform the design of mindfulness CAs for dyads. These themes incorporate the voices of dementia experts, mindfulness experts, persons with dementia, and caregivers. The value of approaches incorporating user opinion has been amply demonstrated in the literature, notably in the field of designing for persons with dementia and caregivers (Cristancho-Lacroix, et al., 2014; Gowans, et al., 2007). Gathering feedback from a holistic range of stakeholders has advantages, including knowledge co-creation across dementia expertise, mindfulness expertise, and lived experience. In this process, inclusivity and feasibility are enhanced through integrating user and expert perspectives, as they provide insight into important considerations that no one stakeholder group could have identified alone.

From the 5 common themes, we note a few important considerations. Firstly, enhancing accessibility for both persons with dementia and caregiver is essential. This can be done through ensuring activities are simple and straightforward, where guidance is provided. Ensuring that they could still do the intervention as the person with dementia deteriorates should be considered as well. However, what may be simple to designers may not be simple for persons with dementia, so there is a need to test and iterate the design of mindfulness CAs with dyads. Care needs to be taken to ensure that activities can be used by persons with dementia, even as they decline. Providing tangible activities that are less focused on cognitive capabilities, could enable dyads to stay engaged as their condition deteriorates. Further, to enhance accessibility, by providing guidance, technological implementation formats could be utilised for dyadic mindfulness. However, dyads may have a wide spectrum of technological capabilities. For older adults who lack the high comfort and digital literacy skills of digital-native generations (Norouzi, Golsari, & Sohrabi, 2014), it may be useful to provide more accessible and user-friendly technologies. This could be implemented using CAs, as users need not learn how to navigate a digital interface, and simply have to talk to the CA which would guide them through an activity. There may be a learning curve, to use CAs as well, but having

a dyadic arrangement would be helpful as caregivers could guide persons with dementia if needed. Activities should, however, be designed such that persons with dementia could use the activity independently, as the activity should also benefit the caregiver, instead of having them worry about the person with dementia. This can be done by considering the activity difficulty, the phrasing of words used to convey the activity, and ensuring there is enough time for dyads to process and respond.

Secondly, encouraging a mindful mindset shift where (A) staying in the present moment and (B) having no attachment or aversion to experiences is recommended. Present moment activities were utilised by almost all experts and users and should be incorporated into mindfulness interventions for dyads. Although having no attachment or aversions to experiences was identified by only two groups - four mindfulness experts and two persons with dementia, it may be useful for dyads as four caregivers expressed negative situations where they felt like they could not cope, and no attachment and aversion in these situations could help them manage. Similarly, person with dementia D1, D3, D4 and D5 mentioned concerns about not being able to do things they could do before, and it may be essential to alleviate worries by promoting no attachment and aversion to their current situation. Interventions designed for dyads to promote no attachment and aversion, helping them to manage negative situations by learning to be comfortable with discomfort, may be a useful tool to cope as the person with dementia declines. Although both mindful mindset shifts may be useful, it may be easier to stay in the present moment with tangible-based activities like deep breathing, which is easy to follow and to focus on throughout an activity session. Having no attachment or aversion to experiences requires self-control, as it is not a typical response to experiences. When implementing activities of both kinds, designers need to ensure that activities are accessible. Also, to embody a mindful mindset shift, where one lives in the present moment and has no attachment and aversion to experiences, it requires extensive practice and habit formation. This could be facilitated through a technological approach like CAs, where daily reminders and guided practices could aid habit formation, leading to a mindful mindset shift.

Thirdly, there is a need to enhance relationships, as social connectedness was brought up by almost all experts and users as essential. This may be particularly important between dyads, as participants mentioned having worsened relationships because of dementia needs and symptoms. The majority of caregivers interviewed cared for parents with dementia, while most persons with dementia interviewed had spouses who cared for them. Whether it was a spousal

relationship or child-parent relationship, both persons with dementia and caregivers had worsened relationships, that a dyadic mindfulness conversational agent could potentially address. In a previous study, dyadic mindfulness was facilitated by having one partner share whatever came to mind, and another partner listen to the other's contemplation, which increased social connectedness (Hurley, Patterson, & Cooley, 2016). Dyadic interaction could be further explored and integrated, for example, where dyads share with each other about something they are grateful to each other for. It was important to note however, that this would encompass creating interventions for two different individuals and care has to be taken to ensure that both their needs can be met. Although dyadic mindfulness conversational agents may provide opportunities to enhance relationships, a dyadic arrangement may also prevent individuals from sharing their true concerns. For instance, mindfulness experts M4 and M5 mentioned that caregivers may not be willing to share about the exasperation they feel from caregiving, and persons with dementia may not share about the fears they experience with dementia. Thought needs to be given on how to navigate both paths to manage the pros and cons of a dyadic arrangement. Allowing separate interventions on different occasions, as suggested by existing literature, may mitigate this. Similarly, although dyadic mindfulness user preferences reveal that most users (7/10 users) would use mindfulness as a pair, 3 users would prefer to do mindfulness individually. Providing options for individual use can cater to varying needs of dyads.

Fourthly, cultivating positivity is important, and could be done through providing calm, appreciation, and loving kindness. However, according to the 7 attitudes of mindfulness (Hoppes, Bryce, Hellman, & Finlay, 2011), cultivating positivity is not one of the attitudinal foundations of mindfulness practice. Despite that, dementia experts, mindfulness experts, persons with dementia and caregivers mentioned the need to cultivate positivity, and it should still be incorporated into mindfulness interventions for dyads. It is also important to note that cultivating positivity does not necessarily mean to remove negativity, as mindfulness also promotes learning to be comfortable with discomfort. Instead, mindfulness for dyads should provide a balance of activities that cultivates a mindful mindset shift, while also incorporating elements of positivity, as dyads face high levels of stress and worries with the diagnosis.

Lastly, although it was recommended by both experts and users to provide tangible activities, not all tangible activities were straightforward. MB, a tangible activity, was easy to grasp and favoured by most experts and all users. Body scan meditation, on the other hand, was tangible

as well, but was not as straightforward. Some users mentioned feeling overwhelmed when practicing body scan, others did not know how to do the activity. For example, when caregiver C2 tried body scan meditation, she mentioned feeling overwhelmed by existing pain she felt from her body. “By focusing on pain... it was amplifying it”, making her “realise how bad it is and how widespread it is” when she focused on her body. Different activities may elicit different responses from users, with some unexpected and unintended consequences. It may be important to provide choices of tangible activities that users may choose from, or provide alternative paths within the activity itself so that users have alternatives, should one path not work well for them. It was also essential to note that although tangible activities, according to experts, may be easier to grasp for users, certain tangible activities could not be understood by persons with dementia. When abstract components and multiple concepts were introduced to persons with dementia, two persons with dementia could not understand the activity. Even though tangible activities may be easier to grasp, the complexity of the activity and the phrasing used to explain each activity should be simplified, in particular, to cater to persons with dementia’s needs. Similarly, for thought-based activities, simplified versions were also recommended, as metaphors used to explain concepts were too difficult for two persons with dementia to follow. Care must be taken to ensure that users are not overloaded with cognitive tasks that are too challenging.

By comparing and identifying the common themes mentioned by the four groups—dementia experts, mindfulness experts, persons with dementia and caregivers—this provided a comprehensive view of the themes needed to design dyadic mindfulness conversational agents. Most of the existing guidelines from literature also did not coincide with the common themes by experts and users.

3.5.2 Conversational Agent Implementation Method

Dyadic MBIs have been implemented in physical group settings, home settings through recordings, and guided telephone calls (Berk, Warmenhoven, Os, & Boxtel, 2018; Paller, et al., 2015; Boxtel, Berk, de Vugt, & Warmenhoven, 2019; Berk, et al., 2019; Durkin, Hilgeman, & Jacobs, 2021), but has yet to be implemented using more accessible formats and more advanced technologies like CAs. Current implementation methods like physical groups have accessibility limitations, as they require dyads to travel to a physical location, limiting participants who cannot be physically present. Situations like the ongoing Covid-19 pandemic also make it

difficult for people to attend in-person interventions. Physical groups and guided telephone calls also have scalability limitations and limited access, as they require a facilitator to be present, this limits the number of people who can access the intervention at each point in time. Users would also have to schedule a meeting to practice mindfulness and cannot do it whenever they need it. On the other hand, recordings of mindfulness allow for greater scalability and accessibility as it can be used anywhere with 24/7 access, given that users have adequate digital literacy, but do not allow for a personalised or guided experience which physical group settings and guided telephone calls provide.

Using CAs may address these needs, while also providing for accessibility and scalability needs. Mindfulness conducted through CAs would be available to access in the user's homes 24/7, not requiring them to travel to a physical location and allowing them to access it whenever needed. CAs are also more accessible in terms of digital literacy needs, allowing dyads to simply speak to the CA. The technology is scalable, allowing many people to access the mindfulness activity simultaneously. Furthermore, it can also provide personalised and guided mindfulness activities which recordings cannot do.

This study revealed that dyadic mindfulness was of interest, and using novel implementation formats like CAs, ideally one with a more personal touch, was preferred by most users. It was particularly interesting for CAs to be preferred by users, as they were generally older. However, it was important to note that users interviewed could navigate the internet space, using software like Microsoft Teams independently, having strong digital literacy skills which may not be representative of the entire population. Three caregivers and four persons with dementia also had prior experience using CAs.

3.5.3 Strengths and Limitations

This study has multiple strengths, where it provides an understanding of preferences and needs of persons with dementia and their caregivers regarding dyadic mindfulness conversational agents. The insights gathered are novel as dyadic mindfulness conversational agents have not been created, and therefore the needs and preferences are not known. Also, by utilising both expert and user perspectives, this strengthens the study, providing insights from lived-experience pairs as well as experts who have planned and executed dementia and mindfulness programmes. However, there were a few limitations.

Firstly, results may not represent the target population as persons with dementia and caregivers who volunteered to participate in the study, as well as mindfulness and dementia experts who were identified, were tech savvy and able to navigate video conferencing tools and social media. As interviews were conducted digitally because of the COVID-19 pandemic, only interviewees who had adequate competence and confidence in using the digital tools were recruited for the study, limiting the generalisability of the results. As there would likely be interviewees who are not as technologically savvy, this resulted in the study sample being biased. It may be beneficial for future studies to include a more comprehensive range of users.

Secondly, as interviewees had no prior experience with mindfulness CAs for dyads, it was difficult to determine the needs when designing such interventions. To mitigate this, dyadic mindfulness conversational agents were explained to participants, and we had to rely on their knowledge and past experiences with CAs, dementia, and mindfulness programmes. As a result, the responses from users did not have a strong emphasis on CA specific feedback. This could be because users did not have a prototype to experiment with and were providing feedback based on their past experiences. Future research should use prototypes of mindfulness CAs for dyads to experience before obtaining their feedback. This would ensure that their needs are appropriately identified.

Thirdly, it was challenging to recruit persons with dementia and caregivers for the study. Attempts to mitigate this was done by recruitment through multiple research networks and social network groups. This resulted in a small sample size of participants who volunteered to participate, which may affect the validity of the study. Nevertheless, the richness of insight resulting from the interviews' thematic analysis was satisfactory for the purpose of the study. For future studies, larger sample sizes should be recruited.

Fourthly, there may be volunteer bias as the persons with dementia and caregivers in this study volunteered to participate in the study through advertisements posted. They may not represent the general population that includes less empowered or motivated persons, and therefore would affect the validity of the study. It may be useful for future studies to increase volunteer numbers to prevent volunteer bias.

3.6 Conclusion

This study helps fill the gap in the literature concerning the needs of persons with dementia and their caregivers for dyadic mindfulness conversational agents. The results from semi-structured interviews, suggested that dyadic mindfulness for persons with dementia and caregivers was preferred, with potential implementation formats like CAs. Using technologies like CAs could potentially enhance accessibility, scalability, personalisation, and guidance for dyadic mindfulness interventions. Such interventions may be particularly important during circumstances like the COVID-19 pandemic where digital technologies could enable mindfulness services to be provided for dyads. This study also revealed needs to consider when designing dyadic mindfulness conversational agents. Through expert and user interviews five themes were identified. The five themes, defined through an inductive process, include (A) enhancing accessibility, (B) cultivating positivity, (C) providing simplified tangible and thought-based activities, (D) encouraging mindful mindset shift as well as (E) enhancing relationships. Development of mindfulness CAs for dyads should follow recommendations from both expert's and user's perspectives to ensure dyadic needs can be met.

Chapter 4. User Centred Design Prototyping

A part of this chapter was published in conference proceeding Ubicomp.

“Using a User Centred Design Approach to Design Mindfulness Conversational Agent for Persons with Dementia and their Caregivers”

4.1 Introduction

Many studies on mindfulness programmes explore effectiveness for person with dementia groups, caregiver groups, and dyads, where programmes were often taken as it is or adapted through modifying the duration or frequency. Studies lacked user focus on how mindfulness programmes were designed. Furthermore, since the use of CAs as a medium for dyadic mindfulness, may potentially enhance accessibility and scalability needs, providing opportunities for mindfulness to be embedded in dyad’s lives, it would be beneficial to develop a novel prototype using a user centred design approach and evaluated it.

Designing the content of mindfulness activities based on user needs are important, however, designing how they should be implemented should also be considered. Most mindfulness interventions—MBSR, MBCT and DBT had a fixed duration - 8 weeks to a year to complete the programme, with weekly structured sessions generally from 2 to 2.5 hours for formal mindful practices in a physical setting (Santorelli, 2014) (Segal, Williams, & Teasdale, 2013) (McEachern, 2018). However, persons with dementia have worsened memory and shorter attention spans (Chan, Leung, Walton, Wong, & Spector, 2020) (Azulay, Smart, Mott, & Cicerone, 2013) and this may pose challenges in meeting their needs. It may be beneficial for dyadic mindfulness conversational agents to provide more flexibility. Bite sized mindfulness activities done regularly, embedded into user’s everyday life as part of one’s lifestyle, as opposed to having 2.5 hour long weekly mindfulness in a fixed physical location, for a fixed completion duration, can be utilised. It may also be beneficial to allow for choices in mindfulness programmes instead of having structured group sessions. These proposed changes were explored in this chapter to identify how the intervention could promote ease of use and repeated usage, supporting mindful habits as a lifestyle.

Considering the gaps identified, this chapter developed a dyadic mindfulness conversational agent through an iterative user centred design approach involving 2 mindfulness experts, 2

dementia experts and 10 dyads. Four cycles were completed based on feedback from stakeholders, developing various prototypes and eventually a working product. Through users and experts providing feedback across iterations after using a working prototype, it identified common user needs which should be integrated into future designs. As Chapter 3 explored user needs based on users imagining how the intervention would perform, this chapter more accurately defined user needs based on participants experiencing the prototype.

This chapter revealed that the prototype designed was well received by dyads, finding the activities accessible, where shortened durations were just nice. They would also like to do it regularly, integrating it into their daily lives and that mindfulness activities learned through Alexa could translate into something they could do independently in the future after a few months. The dyadic mindfulness conversational agent designed with a user focus had favourable feedback from dyads and could potentially be a useful intervention to aid repeated usage.

4.2 Methods Overview

4.2.1 Ethical Considerations

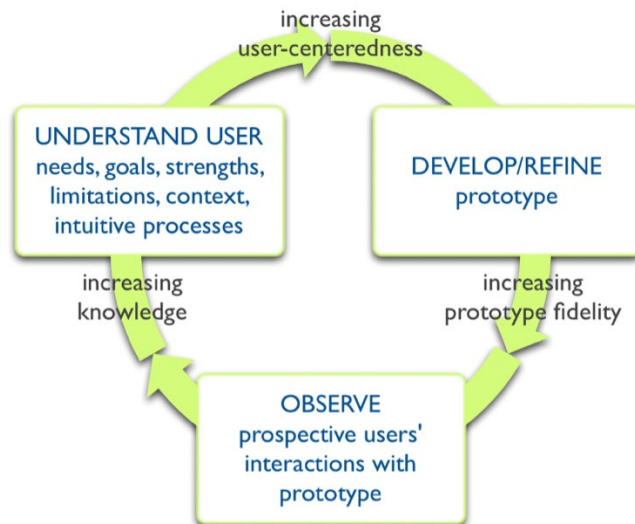
The ethics documents previously submitted were updated with more detailed documentation with an accompanying notice of amendment. These documents were subject to approval from the ICREC committee. After review, ethical approval was granted for this study by ICREC (21IC6573). Participant information sheets and consent forms were then explained to and shared with participants prior to the study. Informed consent was then obtained from all participants before they participated in the study.

4.2.2 Study Design

A user centred design approach was used, as seen in *Figure 6*, where an iterative process focusing on user's needs at every stage was applied. The user centred design approach is a highly iterative approach to integrate user feedback early and often, through the design cycle, ensuring that user needs can be met (Witteman, et al., 2015). It is a longstanding and proven methodology for the development of solutions (Witteman, et al., 2015). Three distinct stages of the user centred design approach reflect understanding the users' needs, developing, or refining the prototype based on user needs, and eventually observing how users interact with the prototype before iterating to improve on it (Witteman, et al., 2015). From this process, I

could understand how well designs could meet user needs before iterating until results were satisfactory.

Figure 6. User centred design framework (Witteman, et al., 2015)



Four cycles of the user centred design framework were done, illustrated in *Table 5*. (1) The first cycle identifies activities that are suitable for dyads based on chapter 3 user challenges and needs, (2) the second cycle refines scripts of the activities and incorporates user feedback and (3) the third cycle refines scripts of the activities, incorporating expert feedback. The scripts were subsequently used to develop the prototype on Voiceflow, a CA platform. (4) These enabled users to experiment with the actual prototype in the fourth cycle, through a CA, allowing for more accurate feedback on the activities, which were then incorporated in the working product.

Table 5. User centred design iteration overview

Ite rat ion	Understand User	Develop/Refine Prototype	Observe Users' Interaction with Prototype	Prototype Activities

1	Users from Chapter 3 expressed 5 key challenges. 5 user needs that should be addressed, based on the challenges, were identified.	Potential design objectives and methods were defined to address key challenges and user needs. Four activities were identified to address the methods used to meet user needs.	The 4 activities and its mechanism were explained to users - 5 persons with dementia and 5 caregivers-individually, through an hour-long interview via Microsoft Teams to understand their thoughts and preferences regarding each activity. Each of the 4 activities was explained and users were asked what they thought of each activity.	Breathing - Practice present moment awareness through focusing on the breath - Enhance self-awareness of thoughts, sensations and feelings Body Scan - Practice present moment awareness through noticing sensations in all parts of one's body - Enhance self-awareness of feelings Letting Go - Practice cognitive diffusion through visualisation - Provide analogies to aid understanding - Enhance self-awareness of thoughts Gratefulness - Breathing and cognitive diffusion to provide calm mood - Provide examples about positive things to be grateful for - Enhance awareness of things to be grateful about - Noticing feelings, emotions and thoughts
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2	Feedback was gathered from 10 users All 4 activities were preferred by most users. 2 suggestions for improvement were provided by persons with dementia. 4 suggestions for improvement were provided by caregivers.	Activities were refined based on the 6 suggestions.	Each of the 4 activities scripts (low fidelity prototype) and its mechanism were explained in detail to 2 dementia experts and 2 mindfulness experts individually, through an hour-long interview via Microsoft Teams. Experts went through the activity scripts using Miro, an online collaborative platform, and added comments on how the scripts should be improved.	Breathing - Practice present moment awareness through focusing on the breath - Enhance self-awareness of thoughts, sensations and feelings - Practice cognitive diffusion to disengage from thoughts Body Scan - Breathing and cognitive diffusion to provide calm mood - Practice present moment awareness through noticing sensations in all parts of one's body - Enhance self-awareness of sensations and feelings Letting Go - Breathing to provide calm mood - Practice cognitive diffusion through visualisation - Enhance self-awareness of thoughts and feelings - Metacognitive awareness, separating self from thoughts Gratefulness - Breathing and cognitive diffusion to provide calm mood - Provide examples about positive things to be grateful for
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				- Enhance awareness of things to be grateful about in their lives - Enhance awareness and appreciation of their partners - Noticing feelings, emotions and thoughts
3	Feedback was gathered from 4 experts 9 suggestions for improvement were provided by dementia experts. 22 suggestions for improvement were provided by mindfulness experts.	Activities were refined based on the 31 suggestions, with the addition of one new activity. Activities were created on Voiceflow, mimicking a smart speaker interaction, in order to obtain more detailed feedback from users.	The 5 activities mechanisms were explained and each activity on Voiceflow (high fidelity prototype) was tested with users - 5 dyads. Two interviews, an hour each, were held with each dyad, comprising 1 person with dementia and 1 caregiver, via Microsoft Teams. Dyads experienced interacting with Voiceflow, verbally communicating with the conversational	Mindful Breathing - Practice present moment awareness through focusing on the breath - Alternative anchor, counting from 1-10 if breathing is difficult to focus on - Enhance self-awareness of thoughts, sensations, and feelings - Practice cognitive diffusion to disengage from thoughts Mindful Movement - Practice present moment awareness through moving and noticing sensations in all parts of one's body - Enhance self-awareness of sensations and feelings Making Space - Breathing to provide calm mood and be an anchor when distracted - Practice cognitive diffusion through visualisation

			agent via Microsoft Teams for each of the 5 activities and answered a few interview questions at the end of each activity to understand their thoughts and preferences. General questions exploring their preferences regarding the intervention were also asked. Individual activity interview questions and general intervention questions can be found in table 6.	- Enhance self-awareness of thoughts and feelings - Metacognitive awareness, separating self from thoughts - Normalize distracted mind Gratitude Practice - Noticing feelings,—emotions, thoughts, and sensations - Practice present moment awareness through focusing on the breath - Provide examples about positive things to be grateful for - Enhance awareness of things to be grateful about in their lives - Enhance awareness and appreciation of their partners Compassion Practice - Kind and caring awareness - Breathing as an anchor when distracted - Noticing feelings-and sensations - Visualising and verbalising calmness, kindness and compassion, whatever they need for themselves and their partners
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4	Feedback was gathered from 10 users 250 feedback on the 5 activities were provided by dyads. Suggestions for improvement, mentioned by at least 3 persons with dementia or caregivers were identified. Suggestions for improvement, although mentioned by only one to two participants were included as well as researchers thought they	Activities were refined based on the final 38 suggestions.	The final prototype was uploaded onto the Alexa Developer Console and was tested with dyads through a smart speaker (high fidelity prototype), for Chapter 5's guideline assessment study.	Mindful Breathing - Enhance self-awareness of thoughts, sensations, and feelings - Practice present moment awareness through focusing on the breath, and using it as an anchor - Practice cognitive diffusion to disengage from thoughts Making Space - Metacognitive awareness, separating self from thoughts - Enhance self-awareness of sensations, -thoughts and-feelings - Practice present moment awareness through focusing on the breath - Practice cognitive diffusion through visualisation - Normalize distracted mind Gratitude Practice - Noticing feelings,—emotions, thoughts, and sensations - Practice present moment awareness through focusing on the breath - Provide examples about positive things to be grateful for - Enhance awareness of things to be grateful about in their lives - Enhance awareness and appreciation of their partners
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	were important to modify for the final prototype.			Kindness Practice - Kind and caring awareness - Enhancing closeness between dyads - Practice present moment awareness through focusing on the breath - Noticing feelings-and sensations - Breathing as an anchor when distracted - Visualising and verbalising calmness, kindness and compassion, whatever they need for themselves and their partners
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Table 6. Overview of iteration 3 dyad interview questions for both interviews (Appendix 2 shows the full list of questions)

Activity/ Method	Min	Description	Materials	Outcomes
Welcoming	2	Welcome participants and thank them for participating in the study Explain what would be explored in the interview	-	• Familiarise participants with interview aims
Try out	3	Interviewer demonstrates how to communicate with the conversational agent through Microsoft Teams and lets participants try it	Voiceflow	• Familiarise participants with how to use Voiceflow through the Microsoft

		out for one to two interactions		Teams interview
Activity 1 Demonstration	10	Participants try out mindful breathing exercise	Voiceflow	• Participants experience using mindful breathing
Understanding Individual Activity Preferences	10	Ask dyads about the difficulty level, whether they would do it again, or do it regularly. Ask dyads if they liked the activity and explore what they liked and disliked about the activity.	Interview questions	• Understand aspects of the activity to keep or modify
Activity 2 Demonstration	10	Participants try out mindful movement exercise	Voiceflow	• Participants experience using mindful movement
Understanding Individual Activity Preferences	10	Ask dyads about the difficulty level, whether they would do it again, or do it regularly. Ask dyads if they liked the activity and explore what they liked and disliked about the activity.	Interview questions	• Understand aspects of the activity to keep or modify
Activity 3 Demonstration	10	Participants try out making space exercise	Voiceflow	• Participants experience using making space

Understanding Individual Activity Preferences	10	Ask dyads about the difficulty level, whether they would do it again, or do it regularly. Ask dyads if they liked the activity and explore what they liked and disliked about the activity.	Interview questions	• Understand aspects of the activity to keep or modify
Activity 4 Demonstration	10	Participants try out gratitude practice exercise	Voiceflow	• Participants experience using gratitude practice
Understanding Individual Activity Preferences	10	Ask dyads about the difficulty level, whether they would do it again, or do it regularly. Ask dyads if they liked the activity and explore what they liked and disliked about the activity.	Interview questions	• Understand aspects of the activity to keep or modify
Activity 5 Demonstration	10	Participants try out compassion practice exercise	Voiceflow	• Participants experience using compassion practice
Understanding Individual Activity Preferences	10	Ask dyads about the difficulty level, whether they would do it again, or do it regularly.	Interview questions	• Understand aspects of the activity to keep or modify

		Ask dyads if they liked the activity and explore what they liked and disliked about the activity.		
Understanding General Intervention Preferences	20	Ask dyads about accessibility aspects, duration, usage preferences Ask dyads about mindfulness habit integration into their daily lives Ask dyads about physical space where they can practice mindfulness	Interview questions	• Understand mindfulness preferences to ensure the prototype is accessible • Understand dyad habits and how mindfulness can be integrated into their lives • Understand physical environment and preferences where dyads can practice mindfulness
Closing	2	Thank participants for participating in the study	-	• Conclude interview

4.3 Iteration 1

The following key challenges, defined in *Table 7*, are a synthesis of the findings from expert and user feedback from chapter 3. Key challenges were explored and supported with quotes, before potential design objectives and methods to address them were identified. Dyad's needs,

as mentioned in Chapter 3 were also linked to the objectives and methods, to show the needs that can be addressed.

Table 7. Objectives and methods to meet challenges and user needs

Key Challenges Dyads Mentioned from Chapter 3	Quotes	Potential Design Objectives	Methods to Address Objectives	Dyad's Needs as mentioned in Chapter 3 Addressed
Accessibility Challenges - Difficulties following complex sentences and concepts - Constantly declining abilities for persons with dementia, and increasing caregiving duties for caregivers, because of dementia condition	<i>Person with Dementia D1</i> <i>"So, your version of simple and what actually works for me can be very, very different."</i> <i>Caregiver C2</i> <i>"I don't know that would apply in the later stages. I mean, obviously I don't think people in the later stages would be able to do that."</i> <i>Caregiver C5</i> <i>"Yes, because that's something you both have, you both have a body and a thing to fixate on, so I would agree that probably is something that you can</i>	- Ensure dyads can understand and perform activities - Provide activities that users could still perform overtime, as dementia condition declines and caregiving duties increase	- Keep instructions clear and concise, with intuitive and user-friendly interaction. Ensure activities are catered to cognitive capabilities. (Intervention Design & Content Design) - Provide simplified tangible and thought based activities that are short in duration and easy to	Enhancing accessibility Providing simplified tangible and thought based activities

	<i>do in tandem together.”</i>		understand. (Intervention Design & Content Design)	
Competence Challenges - Feel like they cannot manage because of losing capabilities and struggles to manage dementia symptoms - Experience high levels of stress and worries	<i>Caregiver C3</i> “It's just so much for me to deal with.” <i>Person with Dementia D5</i> “I suffer more stress or anxiety now than I used to before the dementia... I have always been able to manage my stress but find it more difficult now.”	- Reframe perspectives of experiences faced, changing the inner message in one’s mind - Support dyads in managing negative experiences effectively	- Staying in the present moment, disconnecting from thinking about the past or future (Content Design) - View experiences non-judgmentally and let go of thoughts (Content Design)	Encouraging mindful mindset shift
Relatedness Challenges - Experience worsened relationship between dyads	<i>Caregiver C3</i> “I could just find it so hurtful. She’ll be like: ‘I hate you, you’re evil, you're horrible.’ And even though I knew she didn't mean it and we'd always had a great relationship,”	- Strengthen relationships between dyads	- Foster positive interactions between dyads (Intervention Design & Content Design)	Enhancing relationships Cultivating positivity

	but I found it so hard to cope with.” <i>Person with Dementia D1</i> “My husband says you have become a liability to me and that really, really hurt because we had been a team.” <i>Mindfulness Expert M2</i> “Quality of the relationship between caregiver and the person with dementia is vital”.			
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4.3.1 Developing Prototype

It was necessary to define the activities that could be feasible for dyads. *Table 8* outlines and elaborates on four activities, detailing the mechanism behind each activity to address methods brought up from *Table 7*. Further details on the scripts of each activity can be found in *Figure 7-10*. To enhance accessibility, all activity scripts were modified to be clear and concise, with an intuitive and user-friendly approach. Activities were also adapted to meet the cognitive capabilities of dyads. Both shortened and simplified tangible-based and thought-based activities were also utilised to meet dyadic needs.

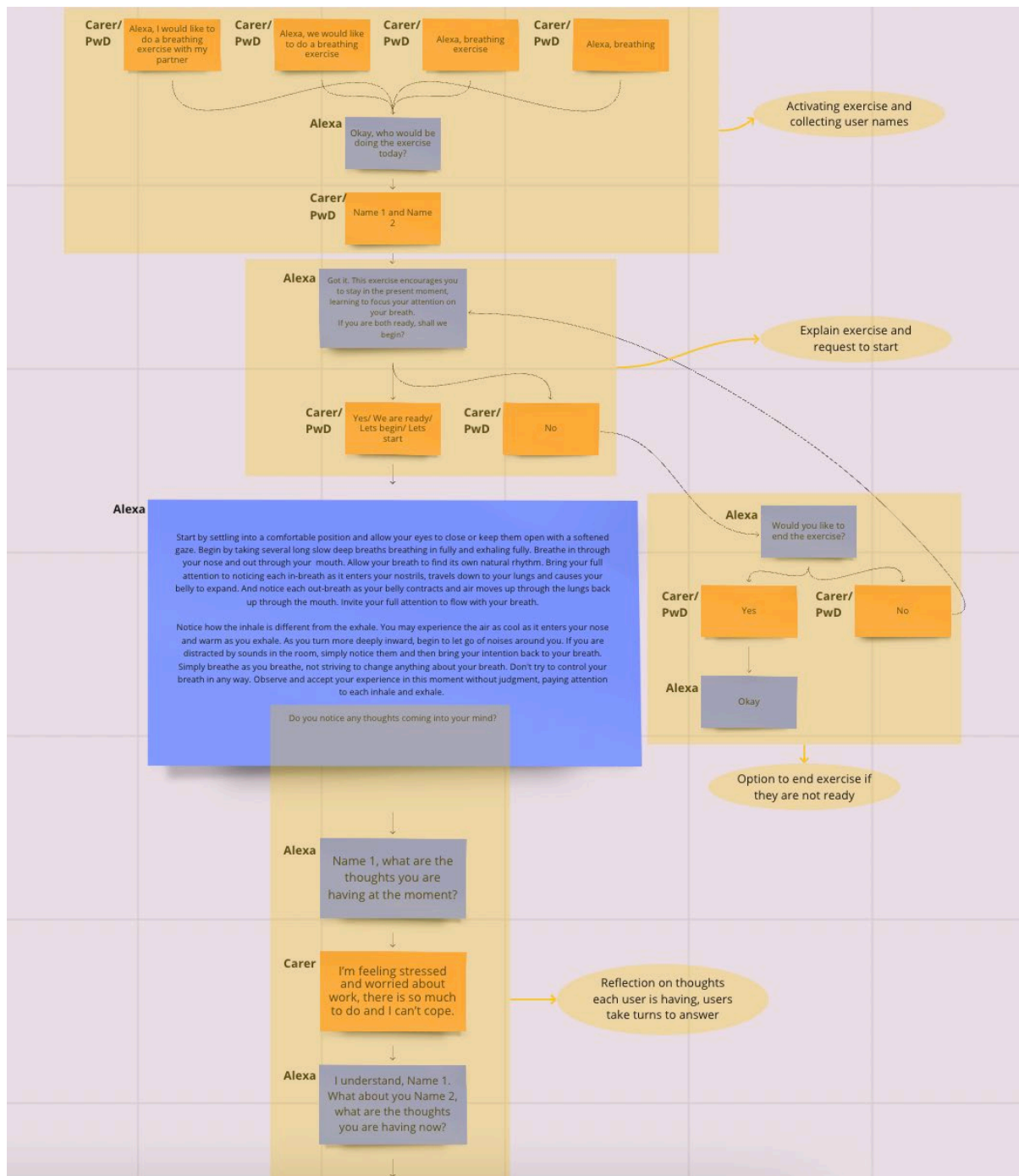
Table 8. Activities to address methods derived from competence and relatedness challenges

Methods to Address Objectives from Table 7	Activity Name	Description	Activity Mechanism

Gain more awareness and <u>staying in the present moment.</u>	Breathing (Tangible Based)	Breathing encourages one to stay in the present moment, focusing on sensations as one inhales and exhales.	Changes inner message in one's mind, by disengaging from negative thought patterns. Uses the breath as an anchor to stay in the present moment, disconnecting from a thinking mind. Provides a space to respond to experiences instead of reacting to them.
	Body Scan (Tangible Based)	Body scan encourages present moment awareness through being aware of any and all sensations one feels in the body.	Changes inner message in one's mind, by disengaging from negative thought patterns. Promotes awareness of bodily sensations, to be aware of any and all feelings, including pain. Uses sensations as an anchor to stay in the moment, disconnecting from a thinking mind. Provides a space to respond to experiences instead of reacting to them.
Gain awareness and <u>non-judgmentally learning to let go of thoughts.</u>	Letting Go (Thought Based)	Letting Go encourages one to let go of all thoughts - positive, negative, or neutral thoughts, as they arrive in one's mind.	Promotes awareness of positive, negative, and neutral thoughts one experiences and learns to let them go, watching them pass by without holding onto specific thoughts. Changes one's perspective by being an observer of one's thoughts instead of being 'fused' with the thought. Promotes defusion of thoughts and self.

			Encourages one to be comfortable with discomfoting thoughts, observing them non-judgmentally as merely thoughts.
<u>Foster positive interactions between dyads.</u>	Gratefulness (Thought Based)	The gratefulness exercise encourages gratitude towards an individual's current experiences and fosters positive feelings and appreciation between dyads.	Facilitates appreciation of things dyads are grateful for. Changes inner message in one's mind about the negative aspects of the relationship to one of positivity. Be aware of the positive aspects not commonly appreciated.

Figure 7. Iteration 1 breathing mindfulness activity



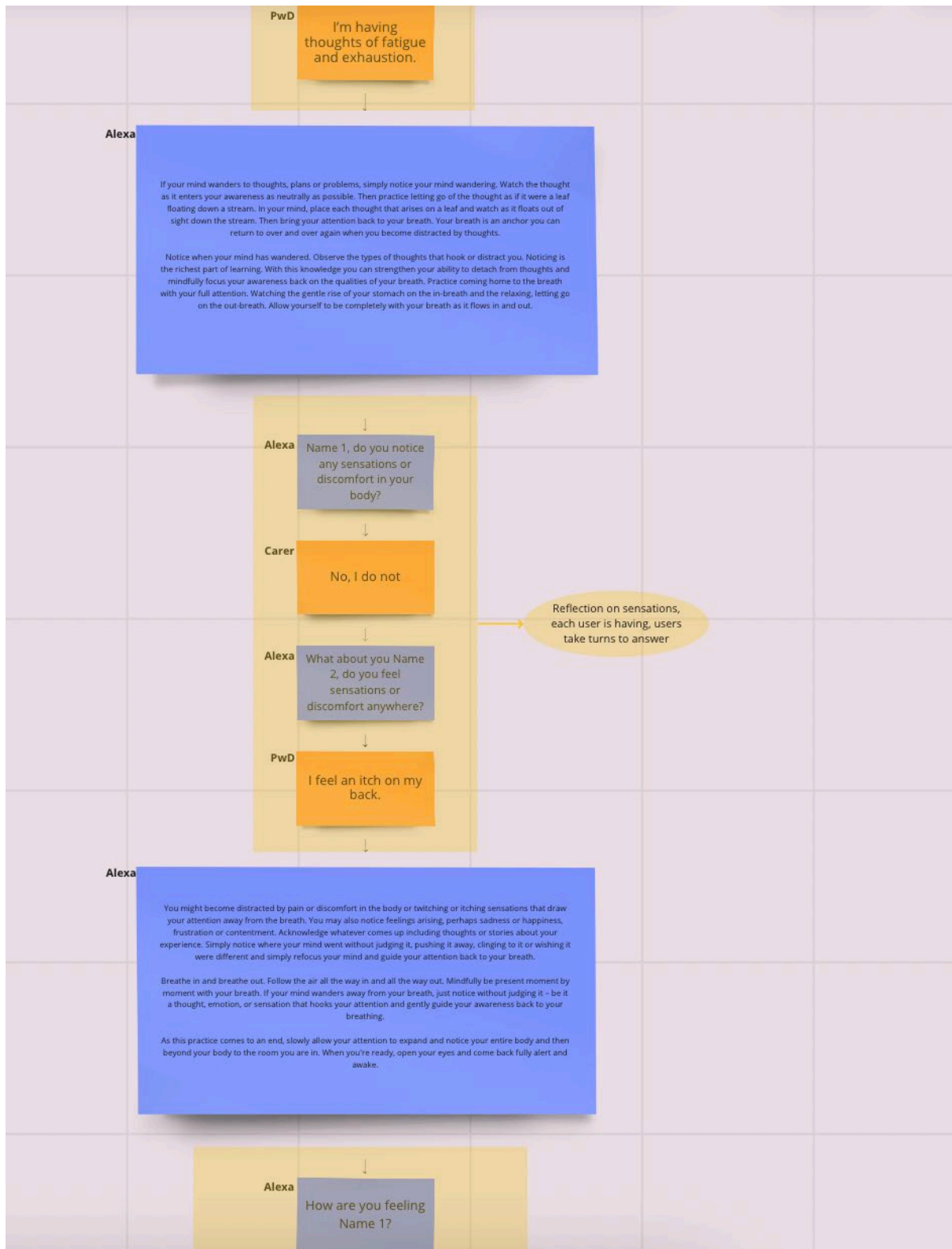
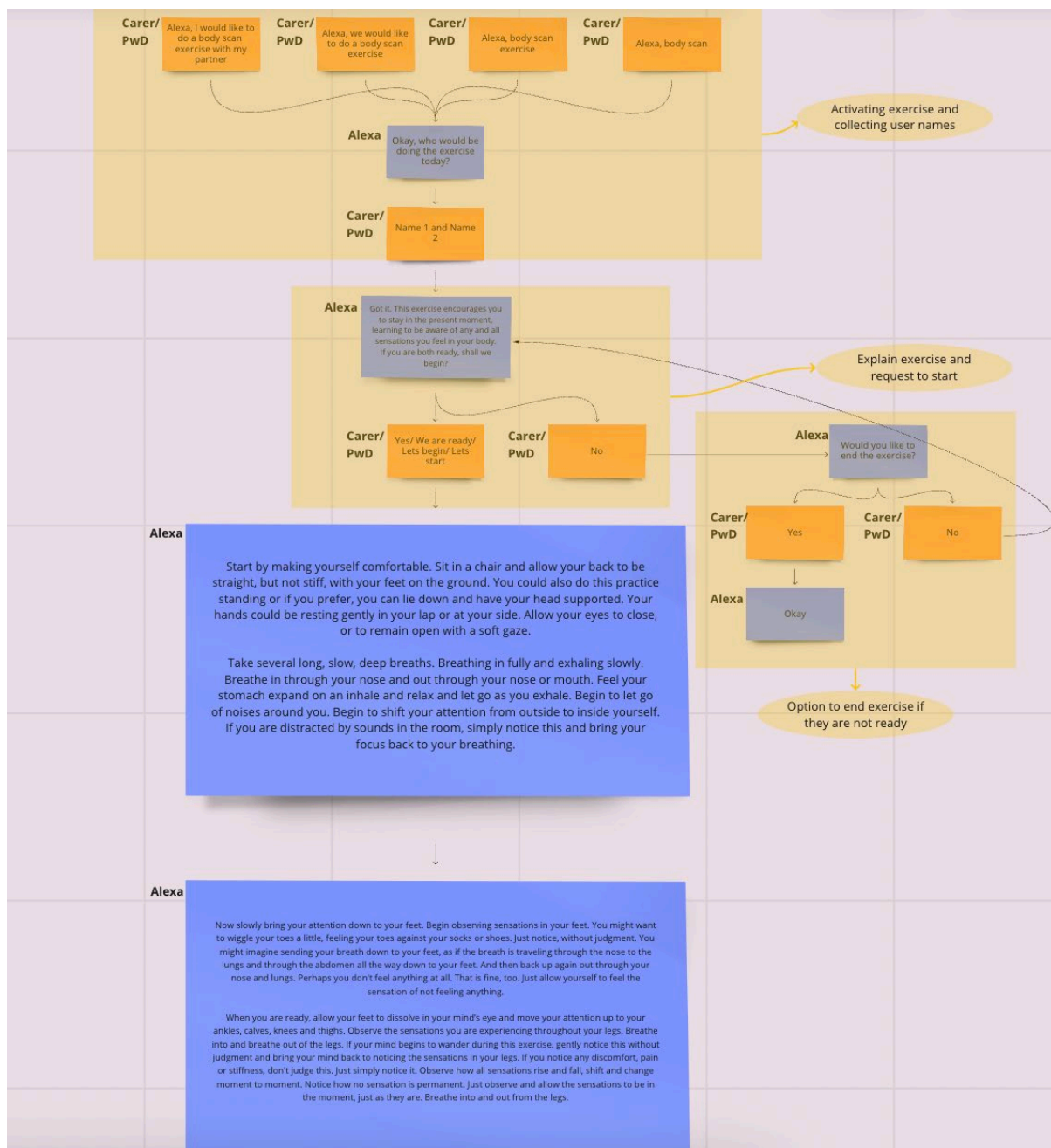




Figure 8. Iteration 1 body scan mindfulness activity



Alexa

Then on the next out breath, allow the legs to dissolve in your mind. And move to the sensations in your lower back and pelvis. Softening and releasing as you breathe in and out. Slowly move your attention up to your mid back and upper back. Become curious about the sensations here. You may become aware of sensations in the muscle, temperature or points of contact with furniture or the bed. With each outbreath, you may let go of tension you are carrying. And then very gently shift your focus to your stomach and all the internal organs here. Perhaps you notice the feeling of clothing, the process of digestion or the belly rising or falling with each breath. If you notice opinions arising about these areas, gently let these go and return to noticing sensations. As you continue to breathe, bring your awareness to the chest and heart region and just notice your heartbeat. Observe how the chest rises during the inhale and how the chest falls during the exhale. Let go of any judgments that may arise. On the next outbreath, shift the focus to your hands and fingertips. See if you can channel your breathing into and out of this area as if you are breathing into and out from your hands. If your mind wanders, gently bring it back to the sensations in your hands.

Alexa

And then, on the next outbreath, shift the focus and bring your awareness up into your arms. Observe the sensations or lack of sensations that may be occurring there. You might notice some difference between the left arm and the right arm - no need to judge this. As you exhale, you may experience the arm soften and release tensions. Continue to breathe and shift focus to the neck, shoulder and throat region. This is an area where we often have tension. Be with the sensations here. It could be tightness, rigidity or holding. You may notice the shoulders moving along with the breath. Let go of any thoughts or stories you are telling about this area. As you breathe, you may feel tension rolling off your shoulders.

On the next outbreath, shift your focus and direct your attention to the scalp, head and face. Observe all of the sensations occurring there. Notice the movement of the air as you breathe into or out of the nostrils or mouth. As you exhale, you might notice the softening of any tension you may be holding.

Alexa

And now, let your attention to expand out to include the entire body as a whole. Bring into your awareness the top of your head down to the bottom of your toes. Feel the gentle rhythm of the breath as it moves through the body. As you come to the end of this practice, take a full, deep breath, taking in all the energy of this practice. Exhale fully. And when you are ready, open your eyes and return your attention to the present moment. As you become fully alert and awake, consider setting the intention that this practice of building awareness will benefit everyone you come in contact with today.

Name 1, how do you feel today after doing the present moment exercise?

Carer

I feel good. The exercise has helped me to be able to be in touch with the sensations of my body.

Alexa

Okay, what about you Name 2?

Pwd

I felt pain when I was focusing on my legs, it amplified the pain for me and I don't like this exercise.

Alexa

Okay, thank you for participating in this exercise, we have come to the end of the session.

Reflection on feelings, each user is having, users take turns to answer

End session

Figure 9. Iteration 1 letting go mindfulness activity



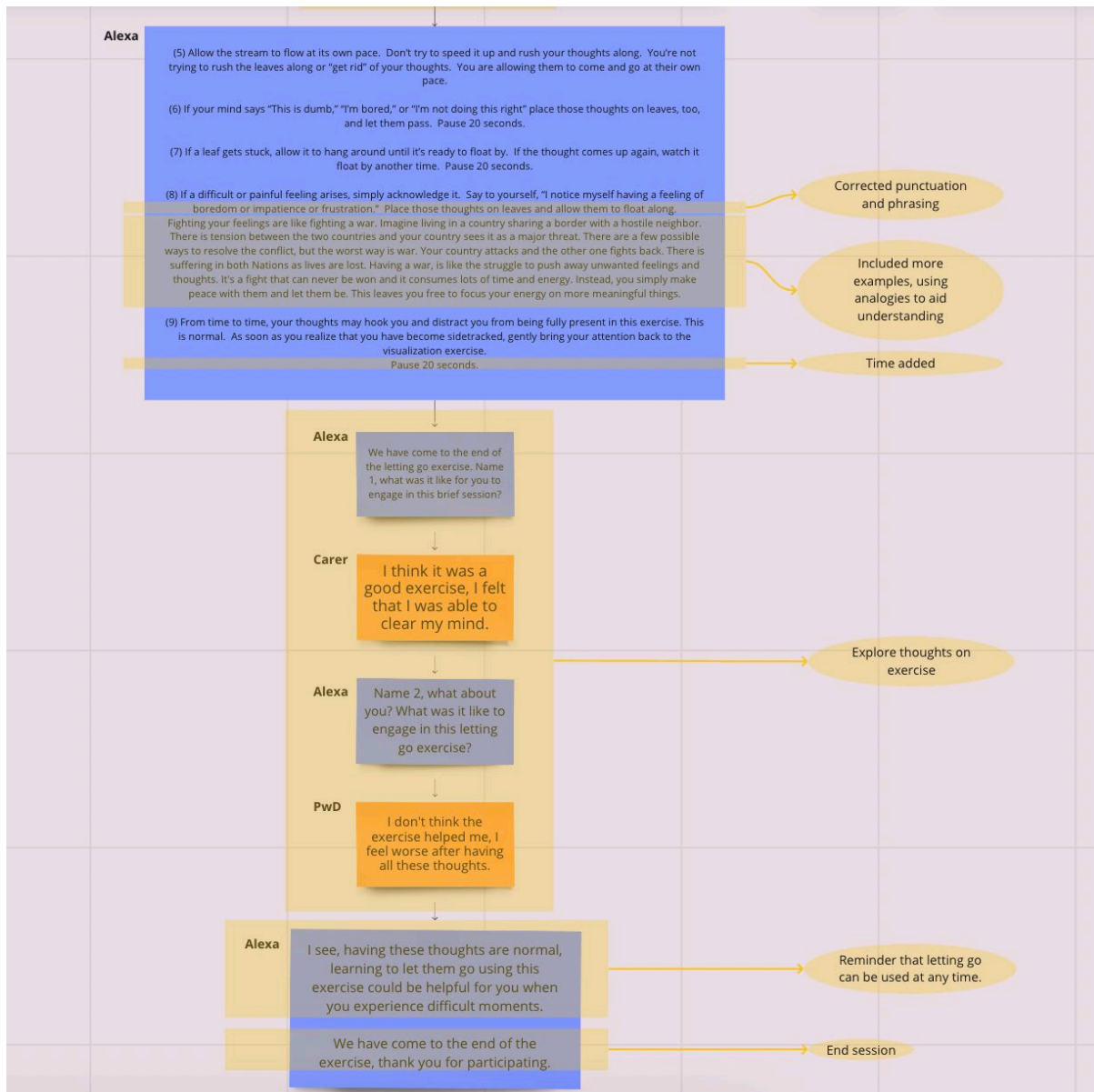
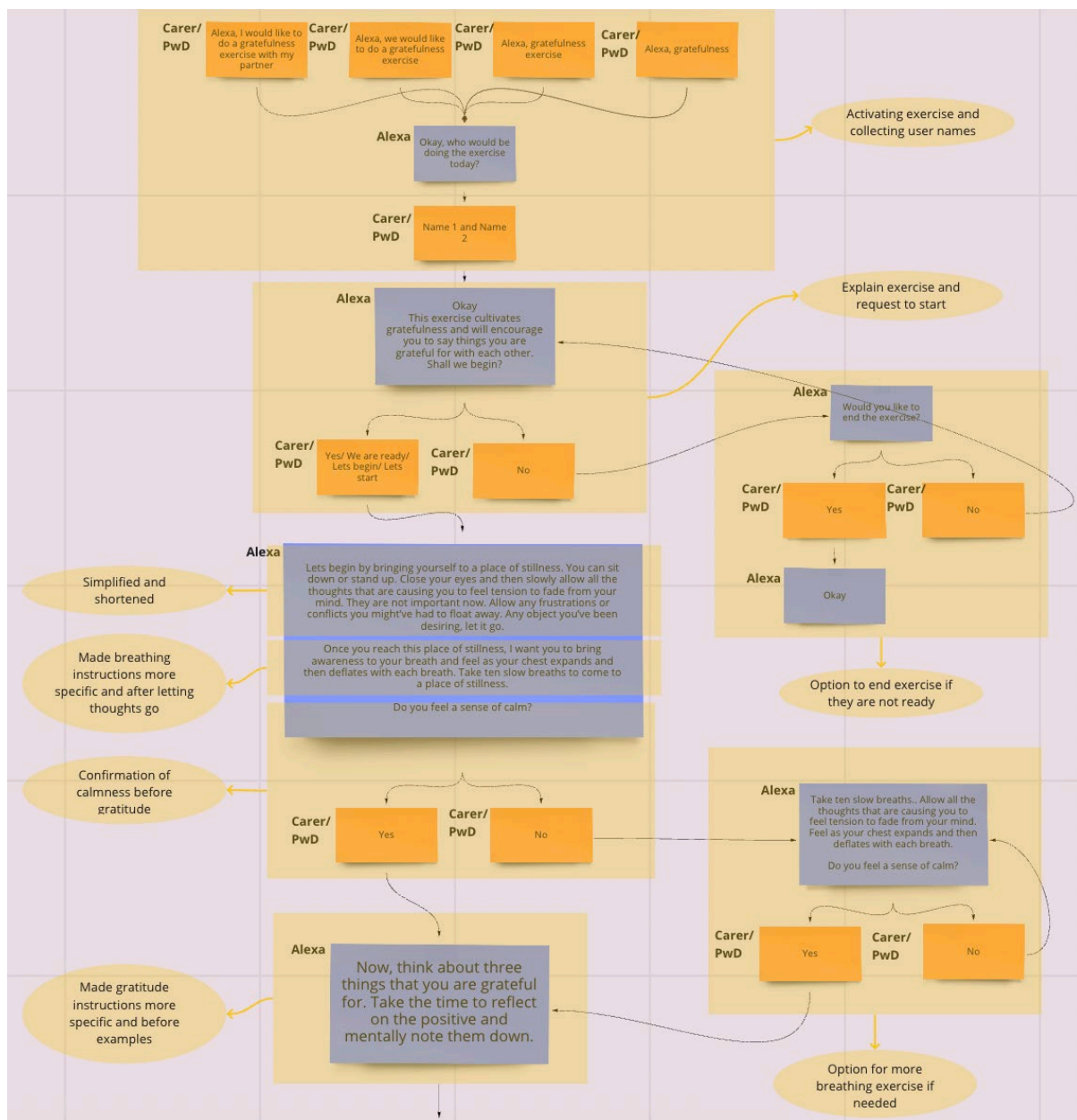
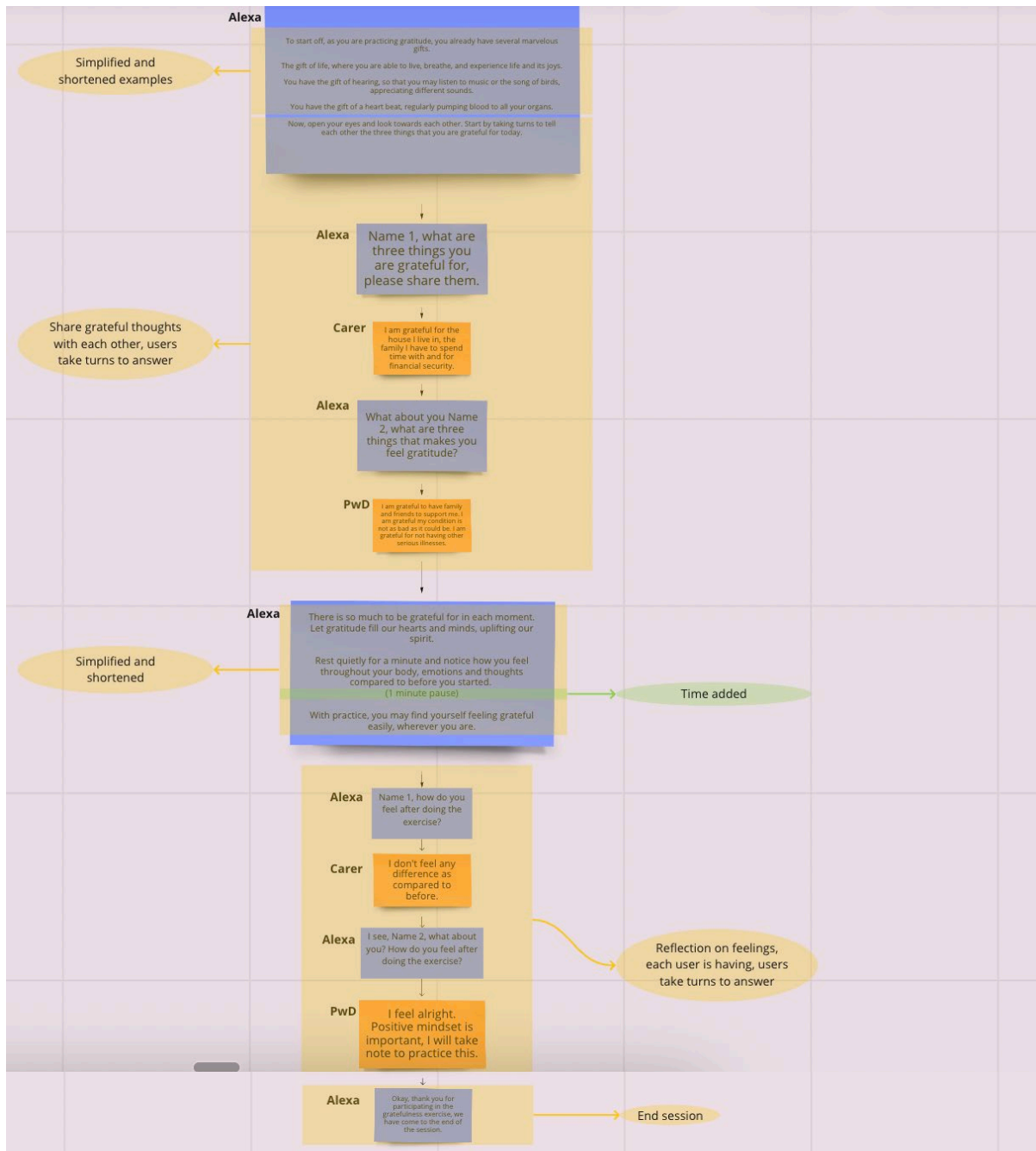


Figure 10. Iteration 1 gratitude mindfulness activity





4.3.2 Persons with Dementia and Caregiver Personas

Personas are fictionalised representations of observed users and are a tool that is commonly used to test activities. Testing activities against the expected requirements of each user persona ensures that each activity is accessible to as many other users as possible. It does not replace subsequent user testing processes but can be useful in the early stages of product development, aiding the creative process as well as communicating user needs to different stakeholders. From the responses of persons with dementia and caregivers in chapter 3, clusters and patterns in the qualitative interviews were analysed and affinity diagrams were created to define each user persona. The personas developed comprise the spectrum of contextual factors, needs, and user preferences. The description of each user persona includes (1) socioeconomic factors; (2) living situation; (3) support network; (4) hobbies and daily activities; (5) use of technology; (6) main challenges—the main issues faced since the diagnosis; (7) health factors & care needs; (8) mindfulness experiences and (9) CA experiences.

6 user personas, 3 of caregivers and 3 of persons with dementia, were identified from the qualities of persons with dementia and caregivers interviewed. Focusing on the users' contextual factors, needs and preferences allowed the use of personas as a guide to ensure that iteration 1 designed for dyads could potentially meet their needs, before user feedback was obtained. This was done by reading and internalising persona needs, before creating the intervention, and iteratively checking if the intervention meets each persona need, before modifying the intervention as needed. The use of personas are beneficial at the first prototype creation stage, where designers would not have had user's direct feedback yet. The personas serve as a guide to help designers to create an intervention to best meet user's needs before testing takes place. Main challenges were also defined comprehensively to ensure interventions designed would be inclusive to most persons with dementia and caregivers use cases. User personas, using fictitious names, aided the intervention creation process and could also be used for future studies or intervention creation for dyads.

Caregiver Lacey McDonald (User Persona A, Figure 11)

Lacey cares for her mother who has early-stage dementia. She visits her mother after work in the evenings and on the weekends to care for her, she does not live with her mother. However, Lacey's mother is in denial about her dementia condition and regularly gives Lacey a hard time when she visits. Lacey is extremely stressed from work and her caregiving duties but feels that

she must step up as she feels that her mother has no one else to rely on. Lacey is a young adult and tech savvy, she has used a multitude of technological devices including CAs and has no problems accessing new technology.

Caregiver Vienna Norman (User Persona B, Figure 12)

Vienna cares for her husband with early-stage dementia, they live together with their son who has bipolar disorder. Vienna also cares for her elderly mother who lives next door. Vienna worries about her husband when she is not around, but needs to take a break from caregiving. Although she is retired, Vienna feels increasingly stressed from having to manage her caregiving duties and her own physical illnesses. Vienna is quite senior and relatively tech savvy, she is familiar with emailing and video conferencing but remains averse to technology she is unfamiliar with like CAs.

Caregiver Renee Stone (User Persona C, Figure 13)

Renee cares for her husband with early-stage dementia. She works three days a week and has some time for herself as her husband is relatively independent. Renee receives support from family, friends and from her husband with whom she lives with. She however worries about her husband and struggles with the "loss" of the person she married. His behaviours and symptoms are a constant battle for her as well. Renee is highly stressed and avoids acknowledging her problems by filling her mind with things to do. Renee is middle aged and tech savvy, she is familiar with technology and uses CAs like Alexa.

Person with Dementia Gina Tannery (User Persona D, Figure 14)

Gina lives with her teenage children. Her partner visits occasionally as he lives across the road. He cares for her and helps around the house. Gina has early-stage dementia and has difficulty making decisions and remembering things. She is losing her abilities and is stressed out from the symptoms of having dementia, however she is starting to accept her condition. Gina is middle-aged but tech savvy and relies heavily on Alexa to cope with daily living activities. She likes that she does not need to learn how to navigate a computer programme and can instead speak to Alexa to get things done.

Person with Dementia Jon Stand (User Persona E, Figure 15)

Jon lives with his wife who cares for him. He resents his wife for not caring enough and causing him to decline quickly. Jon has early-stage dementia and other illnesses. He struggles as he

loses his ability to focus and remember things, but he has developed a checklist system to help him with daily needs. Jon can cope with stress despite facing multiple illnesses. He is quite senior and not very tech savvy. Although he can email and communicate on social media, he is not familiar with video conferencing or new technologies.

Person with Dementia Benjamin Rilton (User Persona F, Figure 16)

Benjamin lives independently in a retirement village, where he has assistance with daily living through aged care services. He has early-stage dementia and is starting to lose his ability to sequence, focus or remember things. He also has behavioural changes, causing him to be more blunt. Benjamin feels the emotional impact of losing these important abilities strongly. Benjamin is sometimes stressed and anxious and finds it increasingly difficult to cope. He has only himself to rely on, which is why he uses a lot of technology to aid daily living. He is quite senior and tech savvy. Benjamin utilises a plethora of technologies, from emails and video conferencing platforms to technologies for behavioural sensing and CAs. He uses technologies to track his living patterns, to detect problems early and locate himself in case he gets lost.

Figure 11. Caregiver Lacey McDonald (User Persona A)

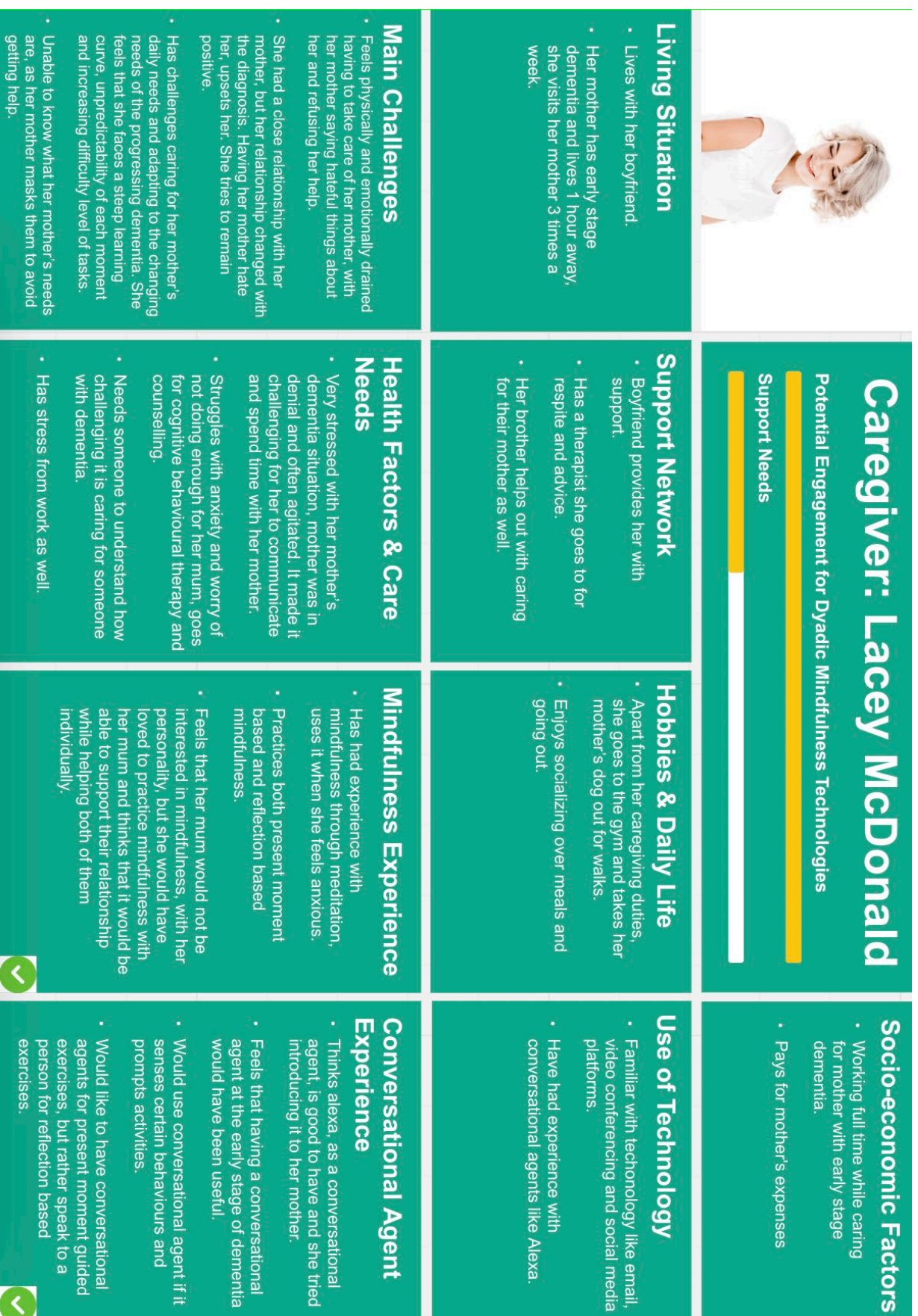


Figure 12. Caregiver Vienna Norman (User Persona B)



Figure 13. Caregiver Renee Stone (User Persona C)



Figure 14. Person with Dementia Gina Tannery (User Persona D)



Figure 15. Person with Dementia Jon Stand (User Persona E)



Figure 16. Person with Dementia Benjamin Rilton (User Persona F)



4.4 Iteration 2

The four activities mechanism was explained, and activities were described to 5 persons with dementia and 5 caregivers individually to understand thoughts and preferences. Users provided suggestions on activity mechanism and phrasing.

4.4.1 Methods

Participant Recruitment

5 persons with dementia and 5 caregivers who provided feedback on iteration 1 for iteration 2 were recruited through dementia groups on social media platform Facebook, where a volunteer sampling approach was used. Persons with early-stage dementia and caregivers individually responded to advertisements on various dementia groups. Since it was particularly challenging recruiting participants who are dementia caregivers or persons with early-stage dementia, caregivers and dementia participants in this study were given 20 GBP and 40 GBP respectively as an appreciation for their time. Interviewees were informed that they could withdraw at any time without giving a reason. All participants had to be 18 years or older, be able to use Microsoft Teams and communicate in English. In addition,

- Persons with dementia had to be in the early stage of the illness and able to consent for themselves.
- Caregivers had to be primary caregivers of an individual with a dementia diagnosis (*early stage* of any type) and have provided care for at least three months before recruitment.

Data Collection and Analysis

Feedback for iteration 2 was recorded using Microsoft Teams, where it was subsequently transcribed. Transcripts were analysed using NVivo version 12 by two PhD researchers independently, where data was coded as the researchers read through the transcripts. This was done by highlighting and categorising similar data into a code. Pattern coding was then done by categorising common codes into a theme. Codes and themes were re-categorised, as new or similar codes and themes emerged, as the researchers further analysed the transcripts. This went through several iterations until the researchers were satisfied with their individual codes and themes. The two researchers compared themes, discussing discrepancies and coming to a consensus on themes identified. Representative data, comprising user quotes, were included to support results.

Data and all appropriate documents will be stored for a minimum of 10 years after the study is completed. All video recordings were transcribed in a timely fashion and removed from Microsoft Teams.

4.4.2 Results

Participants

Participants who provided feedback on the activities included 5 caregivers and 7 persons with early-stage dementia. 2 persons with dementia were excluded as they experienced difficulties comprehending questions or had technical challenges such as using Microsoft Teams. The remaining 10 users completed the interview exploring their feedback on iteration 1, and all 10 interviews were subsequently analysed. 3 out of 5 caregivers cared for parents with dementia, while 2 other caregivers were spouses of persons with dementia. Most caregivers (4 out of 5) were female and participated in the study between October 2021 and November 2021. 4 out of 5 persons with early-stage dementia lived with their spouses and could manage daily tasks with some difficulty. 1 person with dementia however lived alone in a retirement community with some assistance from paid caregivers. 3 out of 5 persons with dementia were female and participated in the study between October 2021 and November 2021.

Table 9. Iteration 2 participant details

Iteration	Type of Participant	Number (N=10)
2	Persons with Dementia	
	Person with early-stage frontotemporal dementia	3
	Person with early-stage vascular dementia	1
	Person with early-stage dementia	1
2	Caregivers	
	Carer for person with early-stage and/or later stage dementia	3
	Carer for person with early-stage vascular dementia	1
	Carer for person with early-stage frontotemporal dementia	1

Iteration 2 Feedback

Iteration 2 incorporated feedback from users and refined the activity scripts before demonstrating them to experts.

Feedback from Users

The mechanism of the activities in *Table 8* were explained and the four activity scripts (*Figure 7-10*) demonstrated to lived-experience users—5 persons with dementia and 5 caregivers, revealed that most users were open to each of the four activities. There were however some improvements on the activities that should be incorporated into the second iteration. This primarily meant that activities should be simplified and accessible not only in terms of the activity mechanism, but also in the way the activity is communicated to users. It was also important to note that using metaphors with multiple concepts may be too complex, as users would have to remember multiple concepts, making it hard to understand.

Deep breathing is a tangible activity that may help persons with dementia place their attention on the breath, not requiring much cognitive skills. All five caregivers and all five persons with dementia mentioned that they would do deep breathing. Deep breathing could calm them down when caregivers felt overwhelmed (C2, C4) and it was a tangible activity (C5) that dyads could both do together. All five persons with dementia think deep breathing is helpful, using it to calm down (D3, D4, D5). Deep breathing may be a feasible activity for both persons with dementia and caregivers to do.

Person with Dementia D2

“Well, I believe deep breathing is good for you. Yeah, and perhaps you know, clearing the mind completely, not thinking about any other day-to-day things.”

Body scan is a tangible activity that encourages noticing the sensations felt in each part of one's body, helping one to stay in the present moment. Three caregivers and three persons with dementia mentioned being open to body scan, while two caregivers and two persons with dementia were not. Body scan was something tangible (C5), but it amplified pain felt in C2's body where she did not want to continue doing it. Three persons with dementia (D1, D3, D5) were open to body scan. However, two persons with dementia did not understand the thought-based components of the activity (D2, D4). Body scan may be feasible for dyads, but it is

crucial for activities to cater to both the needs of persons with dementia and caregivers. Simplified activities that both users understand should be used.

Caregiver C5

“Yes, because that's something you both have, you both have a body and a thing to fixate on, so I would agree that probably is something that you can do in tandem together.”

The letting go activity promotes a mindset shift, learning to be comfortable with discomfort, and is a thought-based activity. Four caregivers and three persons with dementia were open to the letting go activity. Thought-based activities were beneficial, helping them to feel less overwhelmed (C3, C4). Two persons with dementia (D2, D4) however did not understand abstract components of the letting go activity where metaphors were used to explain the activity. Reflection-based activities may be useful according to caregivers and persons with dementia, but when implemented for dyads, they must be further simplified for both users' needs to be met.

Caregiver C1

“Oh 100% think it would be (useful).”

Gratefulness activity is a thought-based activity that encourages dyads to think about and talk to each other about things they are grateful for. It encourages practicing gratitude to promote mindful awareness, as dyads often have negative mindsets, and it is important to also notice what is still good. Five caregivers and four persons with dementia were open to the dyadic gratefulness activity. All five caregivers mentioned that dyadic gratefulness was a good activity. However, needs of persons with dementia as they declined needed to be taken into consideration for a paired activity (C2, C5). Persons with dementia (D1, D3, D4, D5) would utilise dyadic gratefulness, however D2 would not. Overall, dyadic gratefulness may be a feasible activity to be implemented for dyads, while taking their declining abilities into consideration.

Person with Dementia D1

“I think that's absolutely delightful.”

Summary of Activity Guidelines Collated for Iteration 2 Modification

Intervention design and content design suggestions are indicated for each activity feedback.

Activity Script Feedback

Person with Dementia Feedback

- Provide activities that persons with dementia can understand, by simplifying activities. (Content Design)
- Avoid using metaphors as they may cause confusion. (Content Design)

Activity Mechanism Feedback

Person with Dementia Feedback

- Provide calming activities. (Content Design)

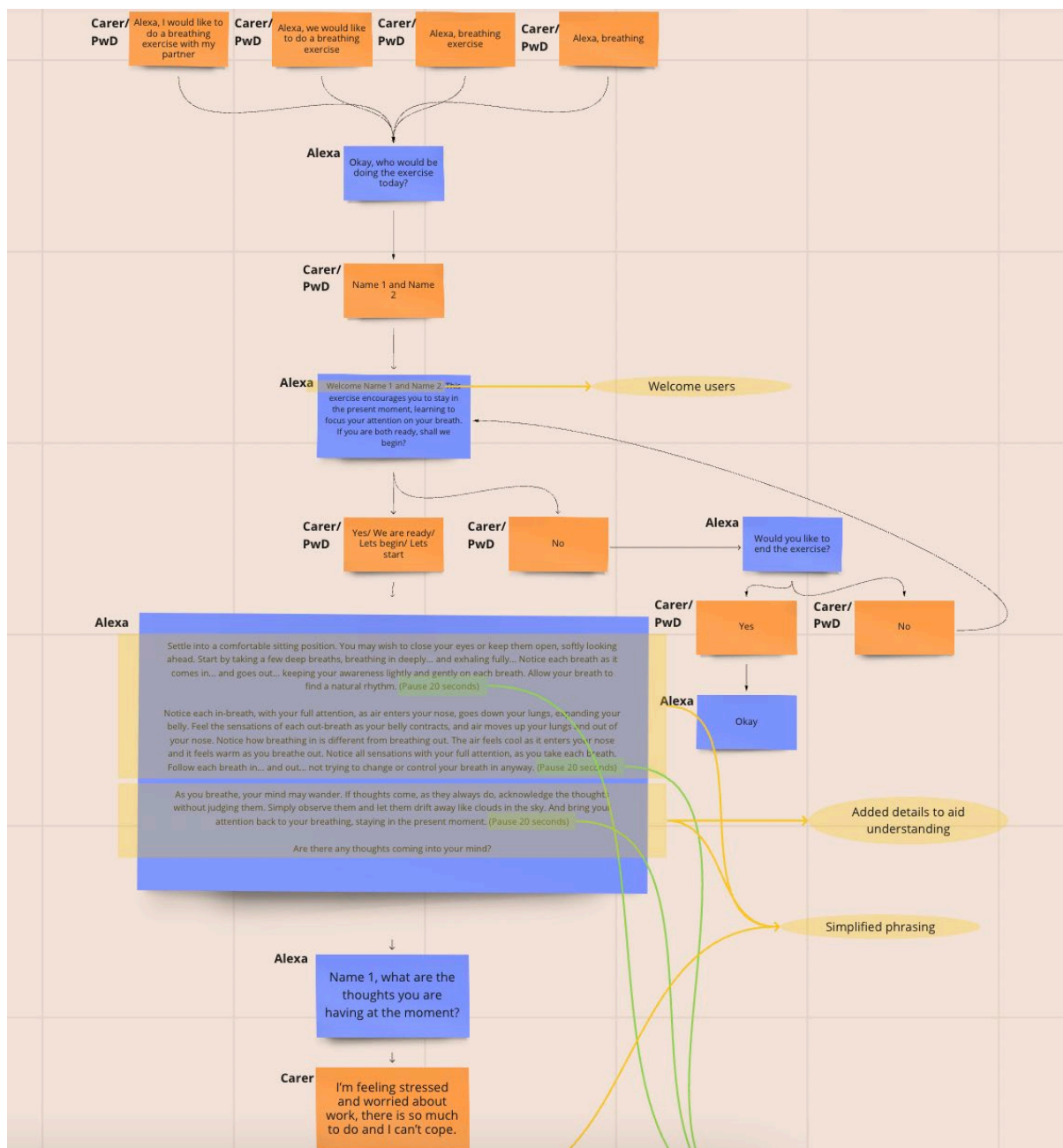
Caregiver Feedback

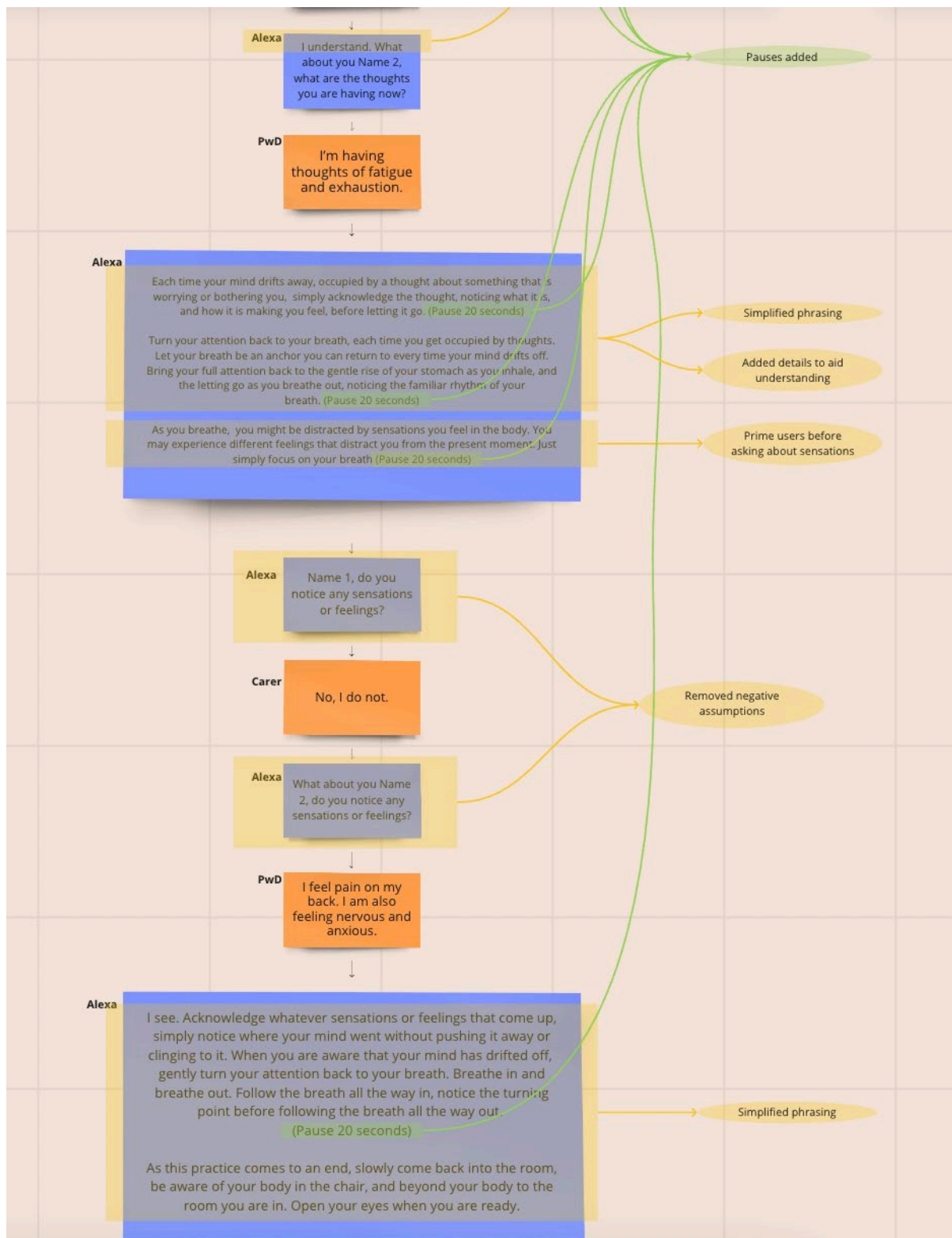
- Provide calming activities, to help users feel less overwhelmed. (Content Design)
- Provide tangible activities that are more accessible. (Content Design)
- Provide alternatives within the activity, to cater to varying needs of users. (Intervention Design & Content Design)
- Consider persons with dementia's needs as they decline (Intervention Design & Content Design)

4.4.3 Refining Prototype

The scripts of the four activities were refined based on the feedback from users and can be found in *Figure 17-20*.

Figure 17. Iteration 2 breathing mindfulness activity





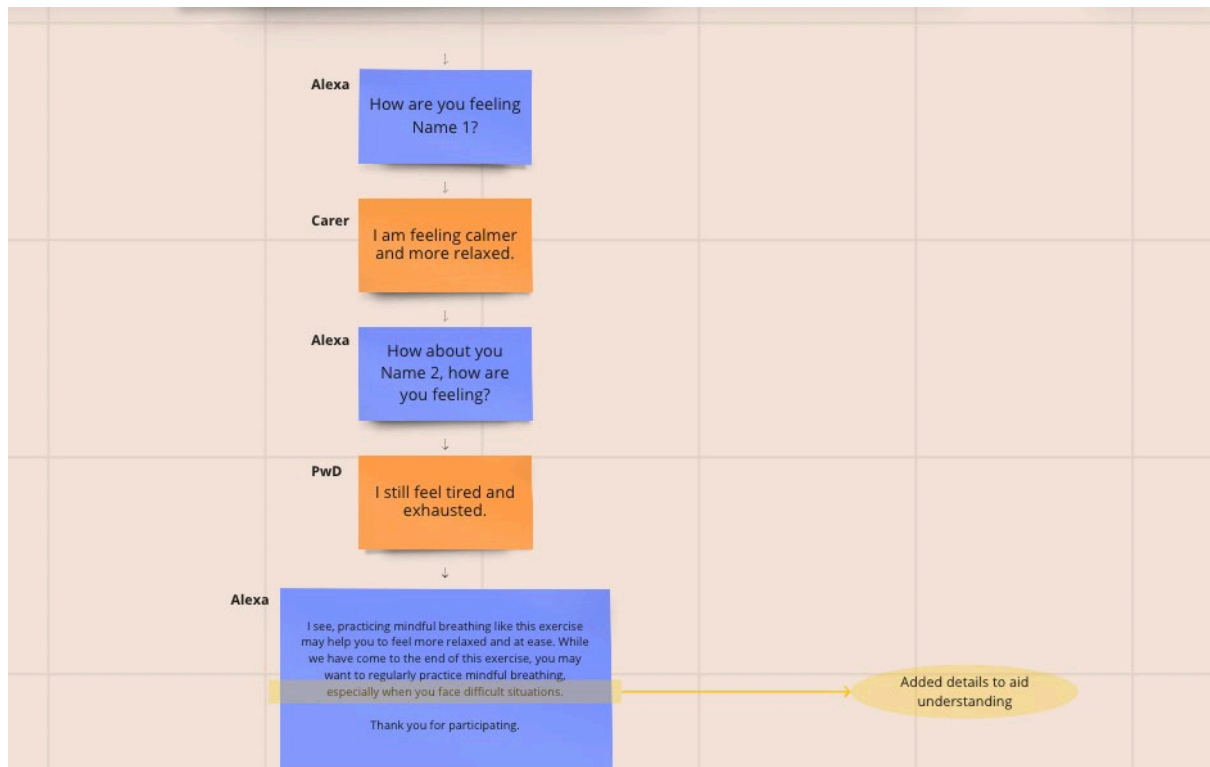
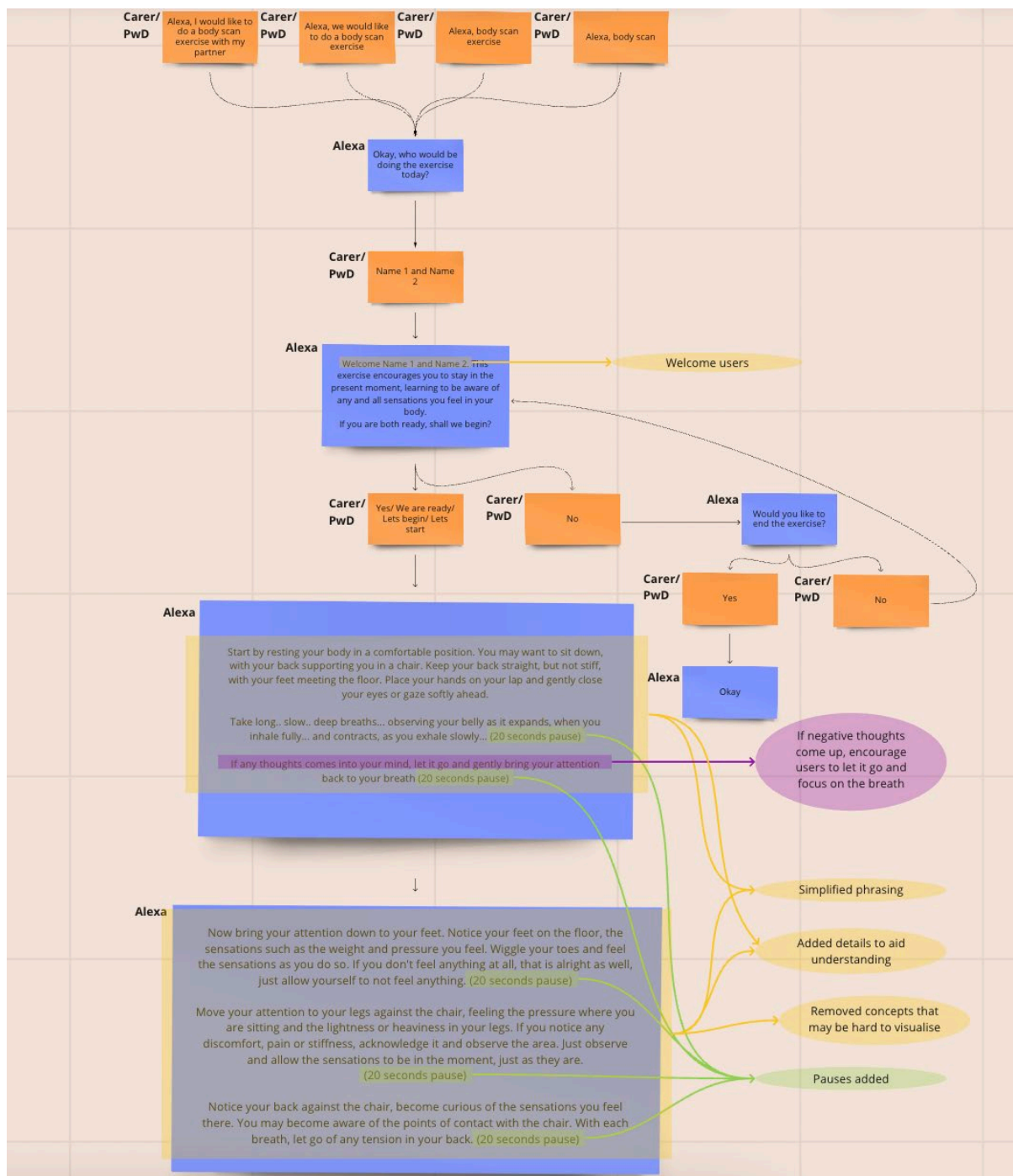
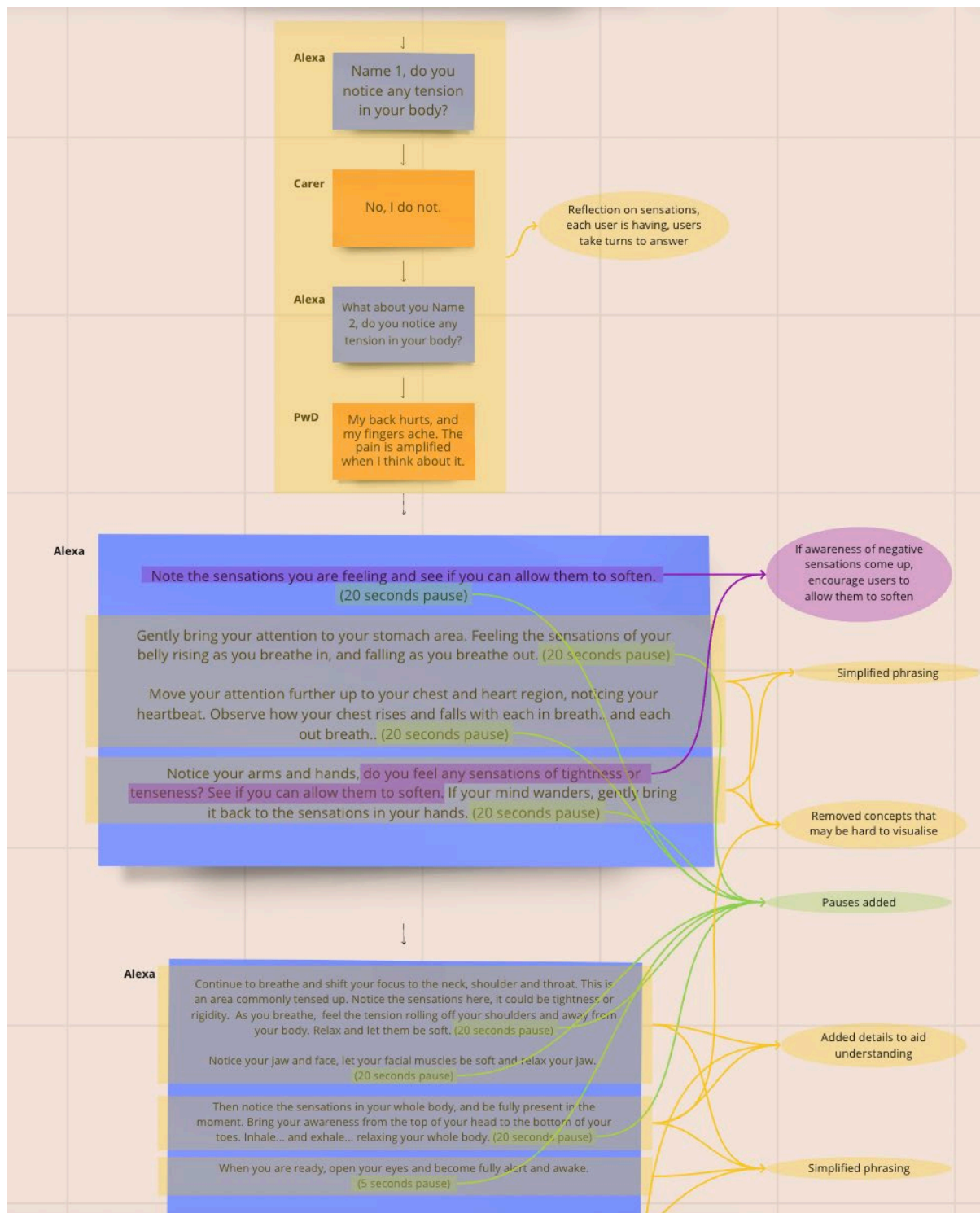


Figure 18. Iteration 2 body scan mindfulness activity





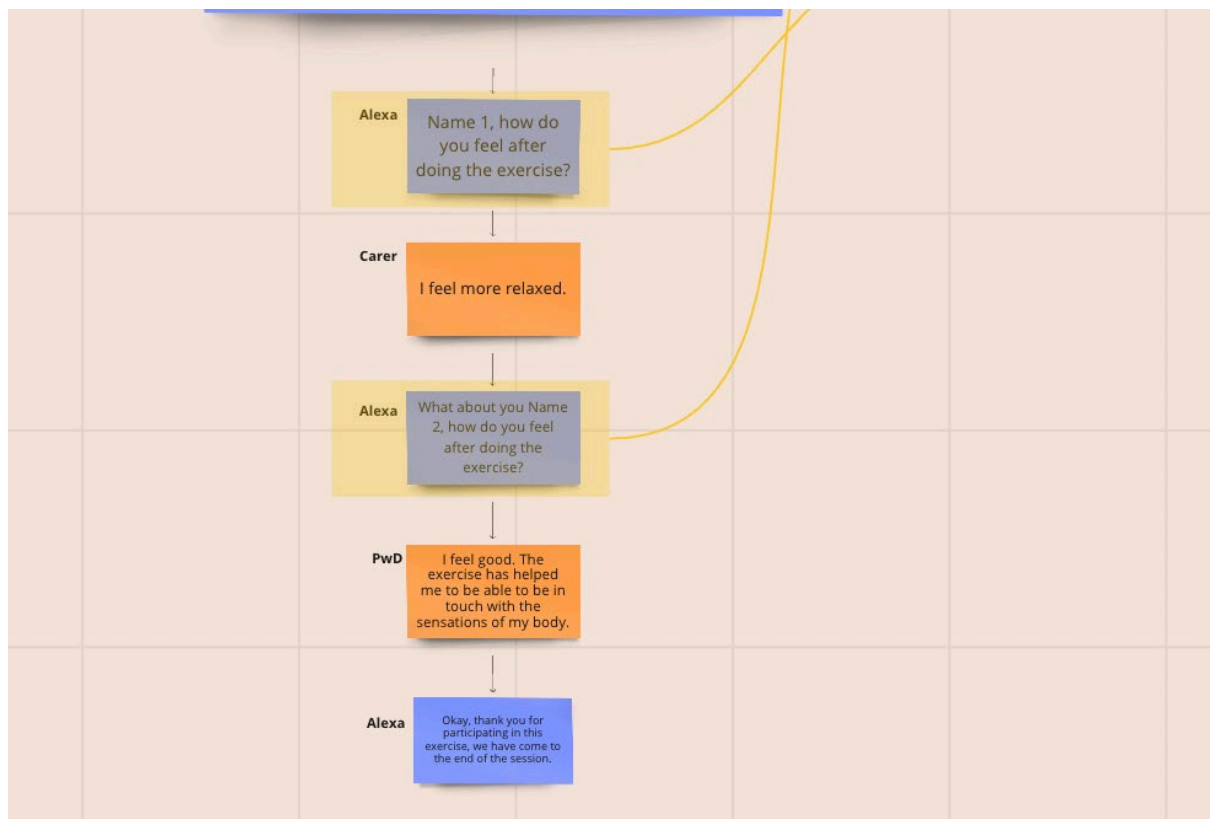
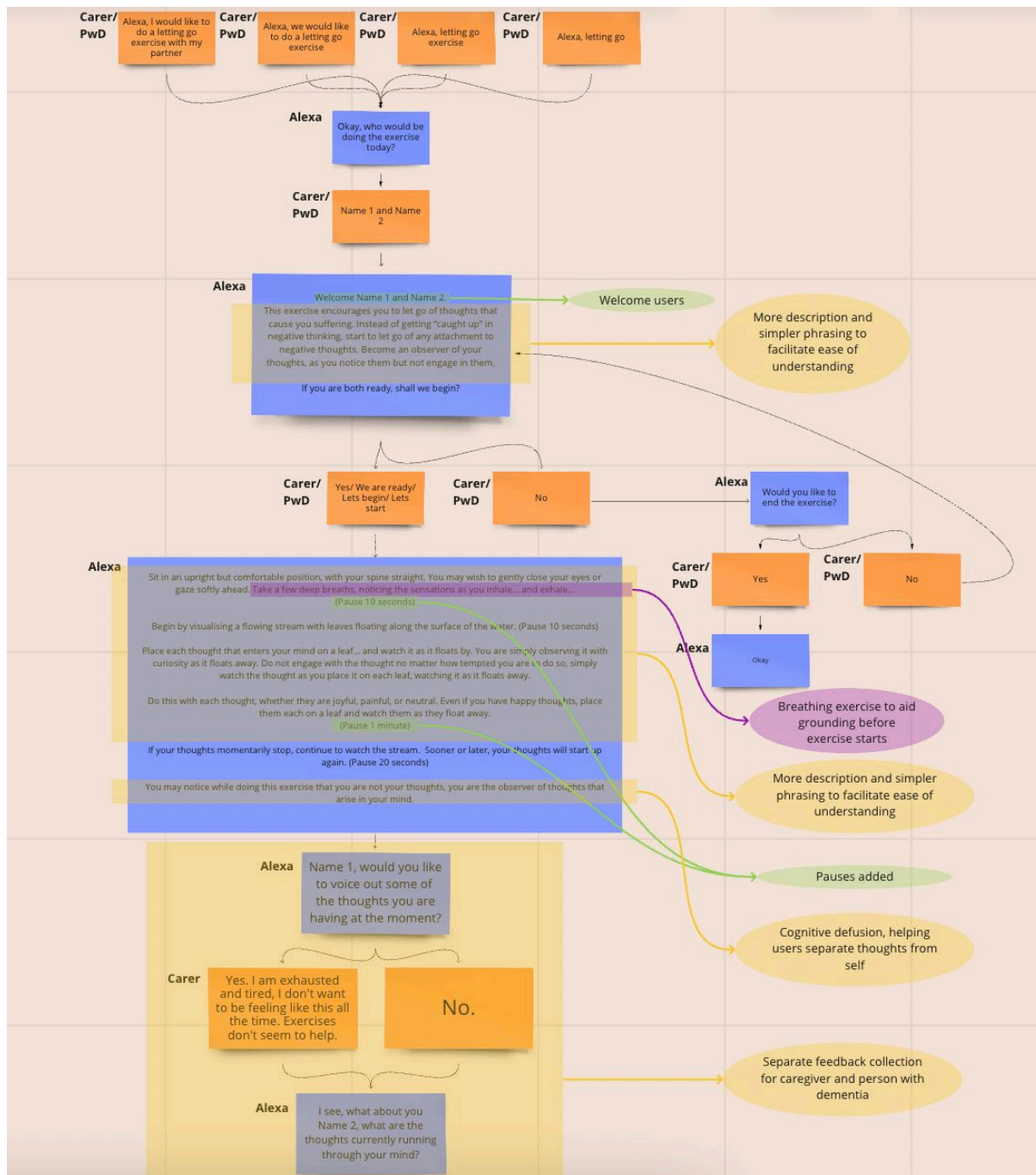


Figure 19. Iteration 2 letting go mindfulness activity



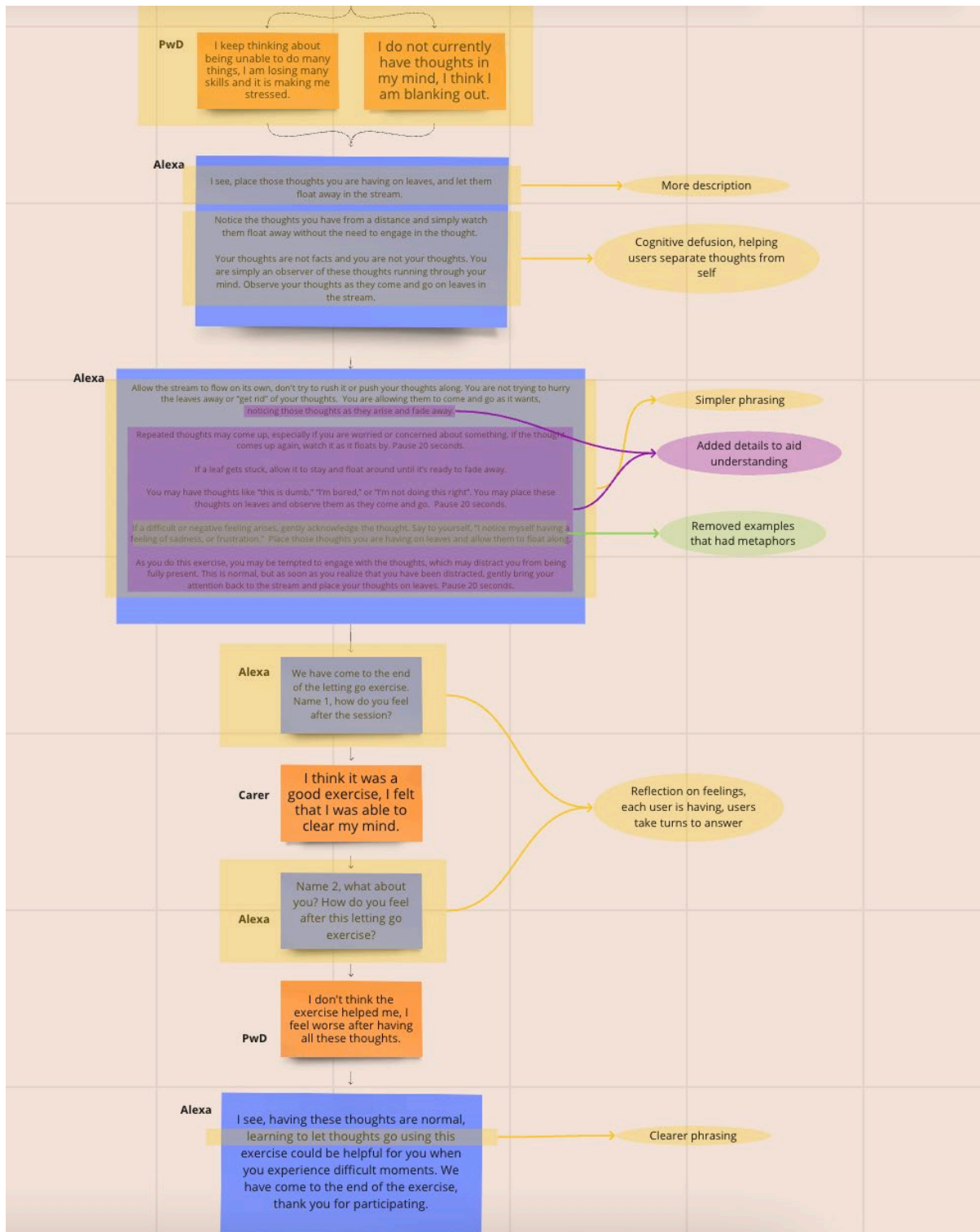
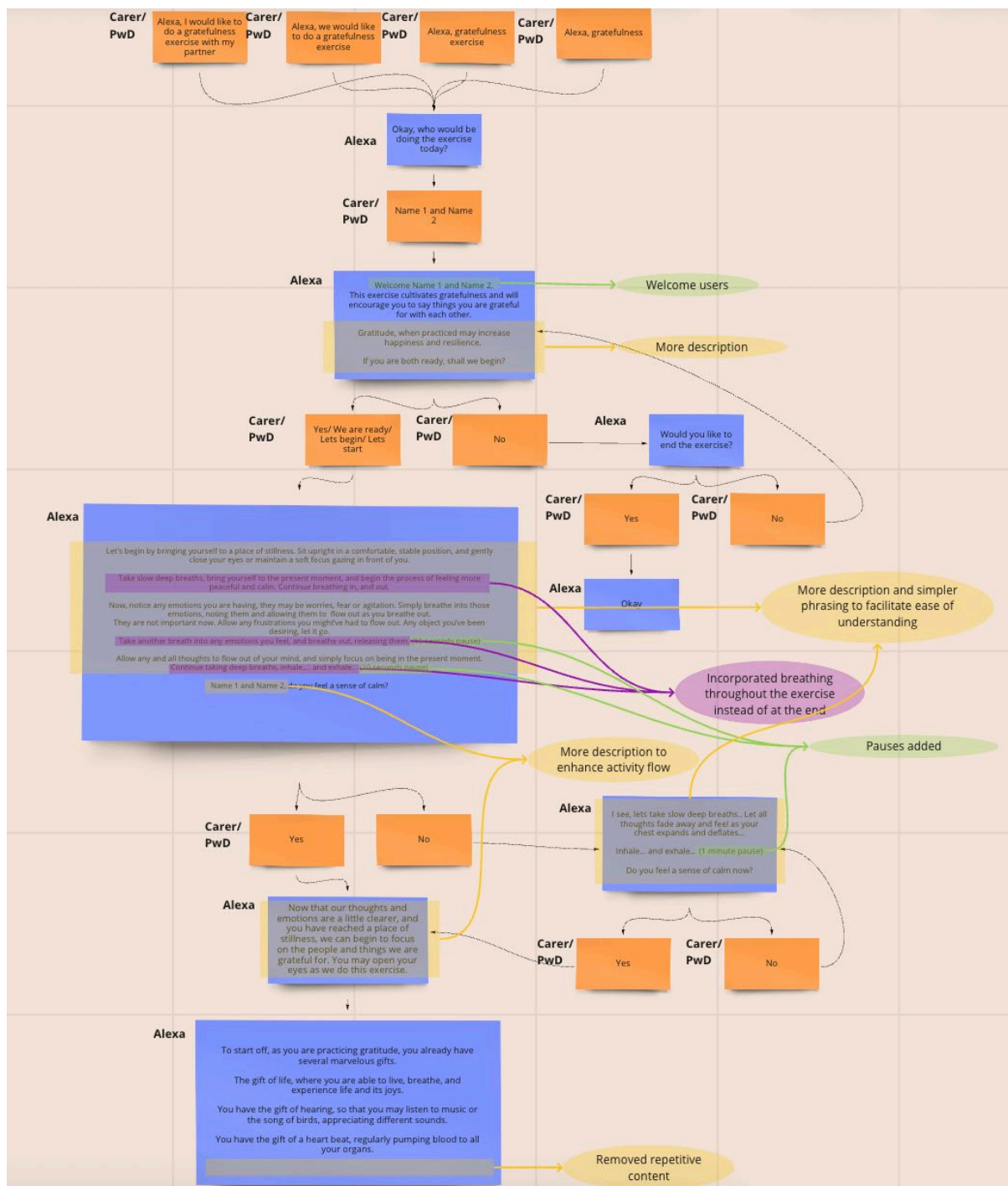
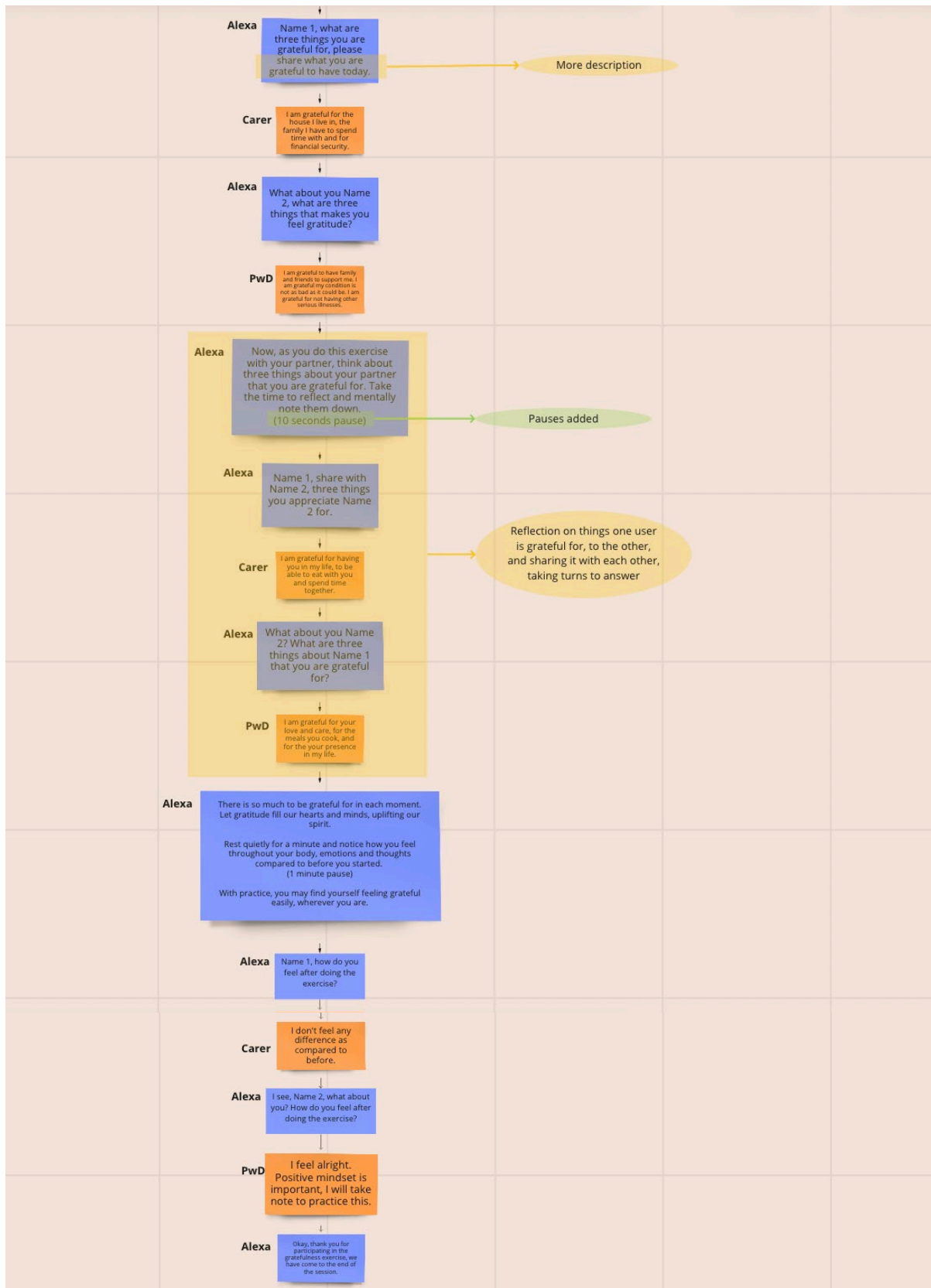


Figure 20. Iteration 2 gratitude mindfulness activity





4.5 Iteration 3

The updated activity scripts were demonstrated to experts in order to understand how the activities could be improved. 2 dementia experts and 2 mindfulness experts, through an hour-long interview each, went through each activity in detail, providing suggestions on the activities' mechanism, phrasing, and technical requirement.

4.5.1 Methods

Participant Recruitment

2 mindfulness experts and 2 dementia experts who provided feedback on iteration 2 for iteration 3 were recruited from research networks of co-investigators using an opportunity sampling method as it was an accessible way to obtain expert's opinions. Interviewees were informed that they could withdraw at any time without giving a reason. All participants had to be 18 years or older, be able to use Microsoft Teams and communicate in English. In addition,

- Dementia experts had to be a service provider in a healthcare facility working with, and planning programmes for, persons with dementia.
- Mindfulness experts had to be teachers and practitioners of mindfulness methodologies/therapies like MBCT/ MBSR/ meditation or equivalent.

Data Collection and Analysis

Feedback for iteration 3 was collected through Miro, where mindfulness and dementia experts read through the mindfulness activities scripts and posted their comments on virtual post its. Comments were put together on Microsoft Excel version 16.62, categorised based on activity script, mechanism, and technical requirement feedback. Subsequently, two PhD researchers independently identified overarching topics brought up, by putting similar topics together, before comparing and discussing discrepancies and agreeing on topics identified. Excel was used in this iteration to analyse data as the volume of qualitative feedback could be easily analysed using Excel, instead of Nvivo which allows for larger volumes of data analysis. Data and all appropriate documents will be stored for a minimum of 10 years after the study is completed.

4.5.2 Results

Participants

Participants who provided feedback for iteration 3 included 2 mindfulness experts and 2 dementia experts. All 4 experts provided feedback on each of the mindfulness activities, leaving comments on Miro which were subsequently analysed. The 2 mindfulness experts were mindfulness teachers of MBCT. Mindfulness experts comprised 1 male and 1 female, and both experts participated in the study in May 2022. The 2 dementia experts comprised dementia related health professionals. Dementia experts comprised 1 male and 1 female, and both experts participated in the study in May 2022.

Table 10. Iteration 3 participant details

Iteration	Type of Participant	Number (N=4)
3	Mindfulness Expert	
	Mindfulness teacher of MBCT for general population	1
	Mindfulness teacher of MBCT for cancer patients	1
3	Dementia Expert	
	Allied health professional in a nursing home	1
	Psychiatrist and professor in translational dementia research	1

Iteration 3 Feedback

Iteration 3 incorporated feedback from experts and refined the activity scripts prototype before creating a working prototype for users to try.

Feedback from Experts

The mechanism of the activities in *Table 8* were explained and the four activity scripts (*Figure 17-20*) were demonstrated to 2 dementia experts and 2 mindfulness experts, who have had experiences designing and executing dementia and mindfulness programmes. Four experts felt that the four activities were feasible, but there were suggestions for improvements incorporated into the third iteration. Suggestions primarily included (1) adding a compassion activity to complement the four existing activities, (2) ensuring activities script and mechanism are simplified and accessible, (3) providing flexibility for guidance and responses, (4) encouraging

a mindful mode of processing, (5) incorporating aspects of positivity, (6) providing opportunities to enhance relatedness, (7) providing reminders to utilise mindfulness, and (8) designing activities such that they do not raise unintended consequences.

Summary of Activity Guidelines Collated for Iteration 3 Modification

Activity Script Feedback

Dementia Expert Feedback

- Shortened sentences for each idea's explanation would be more suitable for persons with dementia. (Content Design)
- Some descriptions may be too difficult for persons with dementia to understand, and need to be simplified. Add in details to help users understand and follow the activity. (Content Design)
- Keep the same few terminologies throughout the exercises, keep it simple and standard for persons with dementia. (Content Design)
- Longer pauses have to be integrated in between sentences or concepts for persons with dementia to understand and keep up. (Intervention Design)
- Having the same instructions over time as they decline can be useful, helping them to do the activity as it becomes muscle memory. (Content Design)
- Provide alternative paths within the exercise to ensure users can continue with the exercise if they make mistakes. (Intervention Design & Content Design)

Mindfulness Expert Feedback

- Add in details to help users understand and follow the activity. (Content Design)
- Incorporate phrasing that brings in attitudes of friendliness, interest, and appreciation. (Content Design)
- Some ideas prime them to focus on negative thoughts at the beginning, and need to be altered to bring in both positive and negative aspects. (Content Design)
- Both at the beginning and at the end of every practice, it may be useful to further expand/amplify the intention at the beginning and then return to the intention again at the end with a further invitation. (Content Design)
- Pre-empt task to be done, or action to be taken prior to asking users to do something, so that they may be prepared to answer a question or voice an opinion. (Content Design)

- For user replies, respond with a positive, welcoming, and allowing attitude, instead of having a robotic and lifeless response. (Content Design)
- Ensure sufficient spaces to reflect for mindfulness, as spaces on activity scripts may translate differently on conversational agents. (Intervention Design)
- Replace 'breathing' title with 'mindful breathing', to be clearer. (Content Design)
- Replace 'body scan' title with 'mindful movement', to make it more tangible, reflecting the changed activity. (Content Design)
- Replace 'letting go' title with 'making space', as letting go seems to be goal oriented, which should not be the aim of the activity. (Content Design)
- Replace 'gratefulness' title with 'gratitude practice'. (Content Design)
- Remove yes/no questions, that elicit fixed responses. Remove phrases that are outcome based, provide flexibility in the guidance. (Content Design)
- Remove phrases that encourage comparisons, to provide for a more mindful mode of processing. (Content Design)

Activity Mechanism Feedback

Dementia Expert Feedback

- Some people may find it difficult to visualise, activities should not be too abstract. (Content Design)
- It would be ideal to focus on strengthening emotions and feelings. (Content Design)
- Ensure that ideas require little cognitive resources to perform. For example, instead of asking users to think about and remember three things they are grateful for, try to limit it to one thing to cater to persons with dementia's condition. (Content Design)

Mindfulness Expert Feedback

- Have a grounding exercise that users can follow and stabilise the attention. This could include anchor points such as focusing on the breath, to help them get back to something more tangible like the body, when doing activities that are more thought based. (Content Design)
- Exercises that are more thought based rather than tangible based may be more suitable for where users have some experience with mindfulness. However, where users would use the exercises with little to no mindfulness experience, the mindfulness expert suggested to ensure that exercises are simplified such that users could access the exercise from the beginning. (Content Design)

- It was important to provide choices within each practice to cater to various needs or preferences users might have. (Intervention Design & Content Design)
- Thoughts may be perceived as facts to users and care needs to be taken to not trigger negative emotions, especially when dealing with negative thoughts. (Content Design)
- Change body scan to include more tangible elements, like mindful movement to cater to dementia population. Make it seated to cater to older population needs. (Content Design)
- Voice only interactions provide users with more freedom of choices on how to interpret the instructions, providing more flexibility. Video interactions may be useful as a guide, but it inhibits people's actions. It may be useful to stick to voice only interactions. (Intervention Design)
- Adding in a 'compassion practice' exercise may facilitate better relationships between the pair. (Content Design)

Activity Technical Requirement Feedback

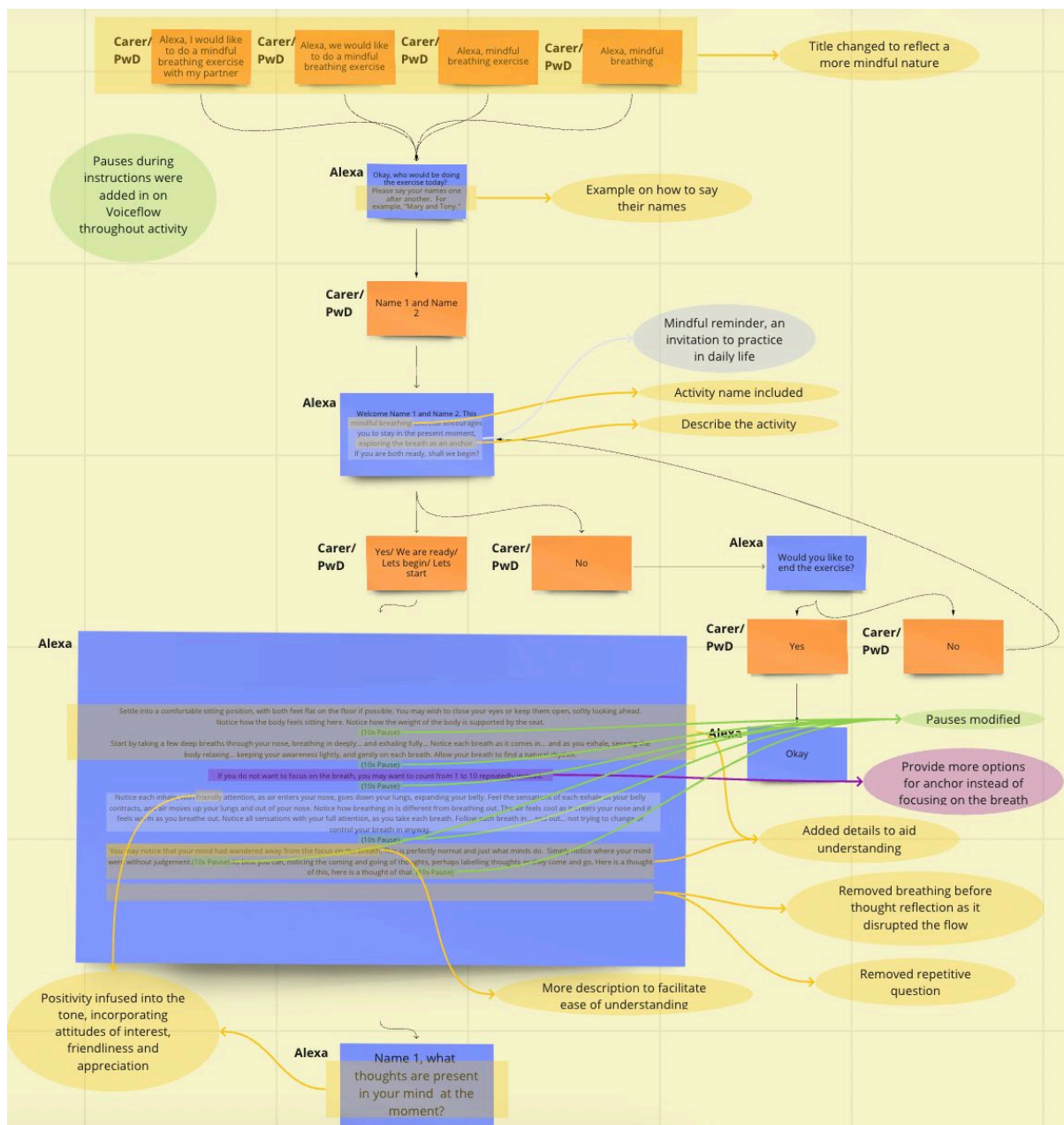
Mindfulness Expert Feedback

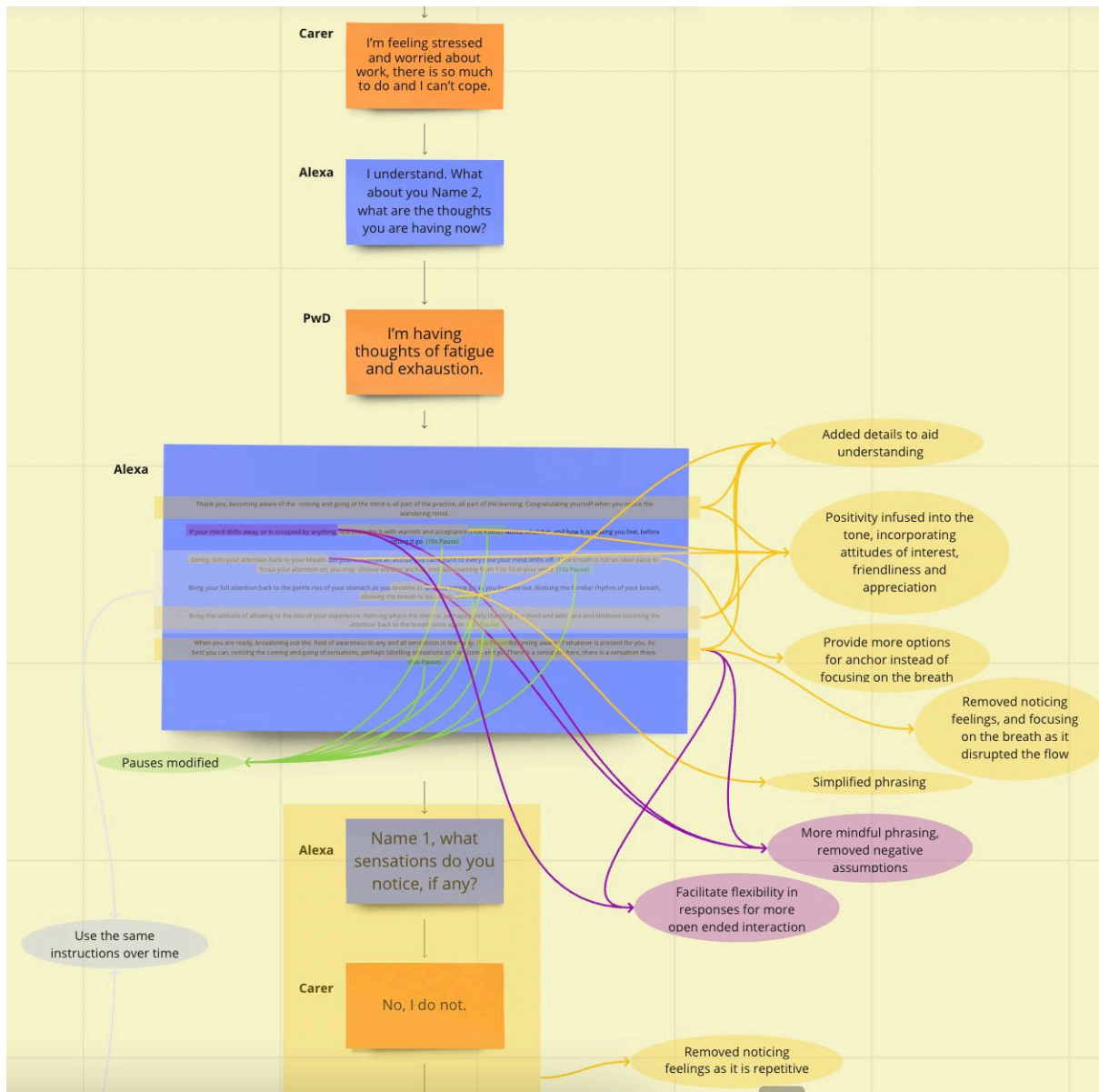
- Conversational agent sound levels need to be at an appropriate level to cater to the hearing issues of older generation. (Intervention Design)
- Using an artificial intelligence voice to perform the mindfulness activities may sound too robotic, and not embodied. Voice recording of a mindfulness expert or pacing the artificial intelligence voice to sound more natural may be useful. (Intervention Design)

4.5.3 Refining Working Prototype

The scripts of the four existing activities were refined based on the feedback from experts. Also, a new activity script that was recommended to be included, "compassion practice (CP)", was written by one mindfulness expert. All five activities can be found in *Figure 21-25*.

Figure 21. Iteration 3 mindful breathing (renamed from breathing)





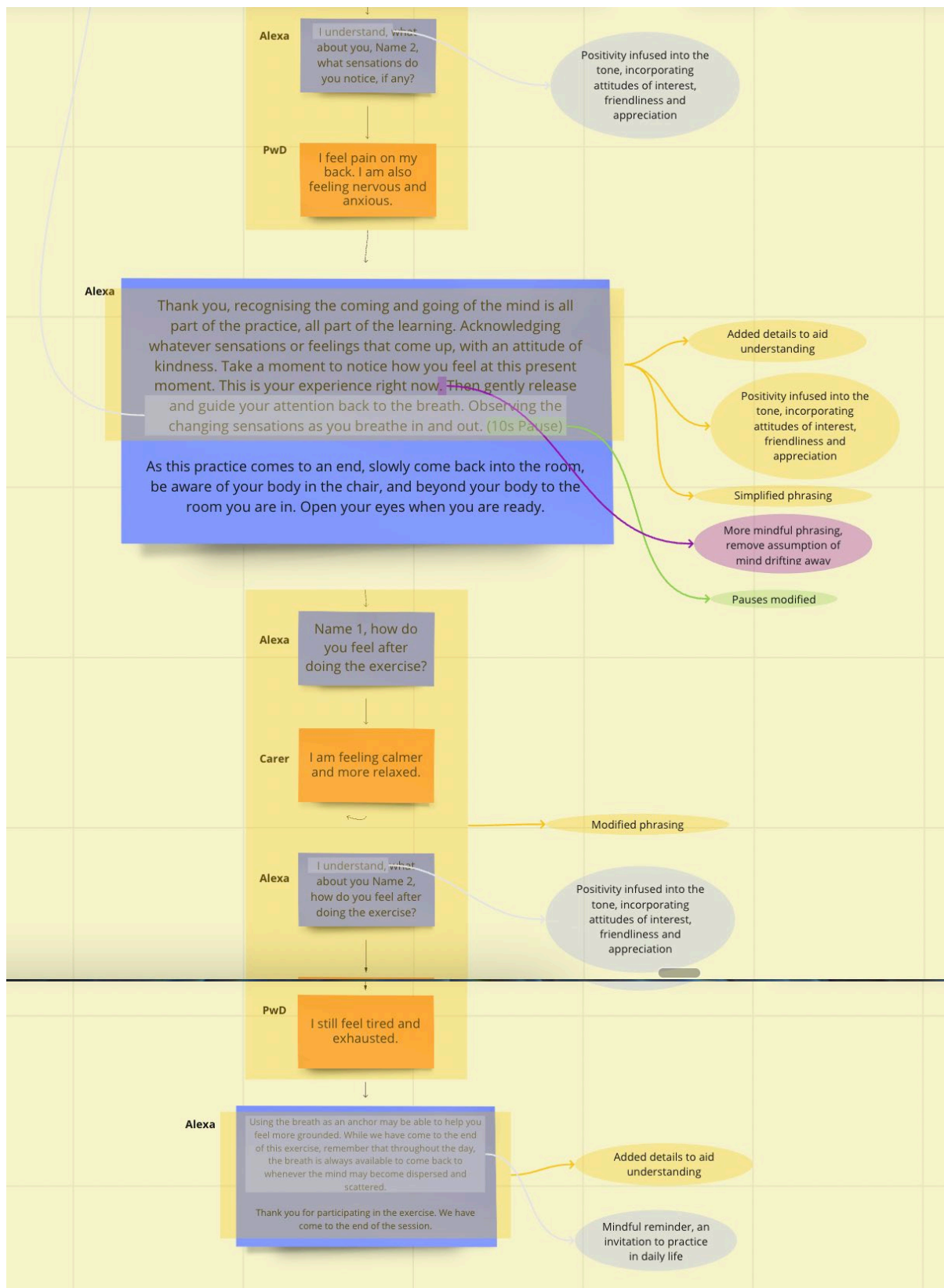
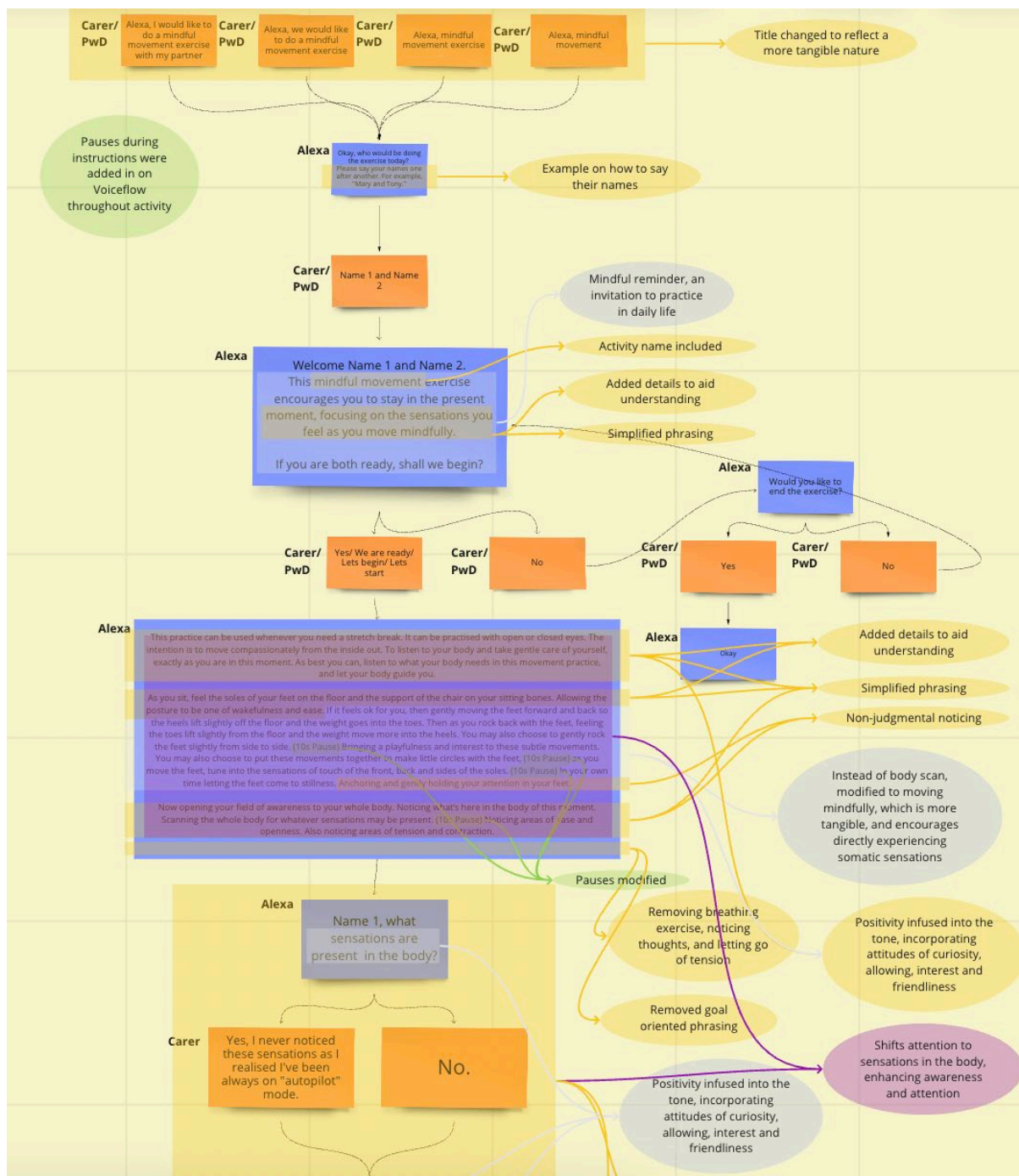


Figure 22. Iteration 3 mindful movement (renamed from body scan)



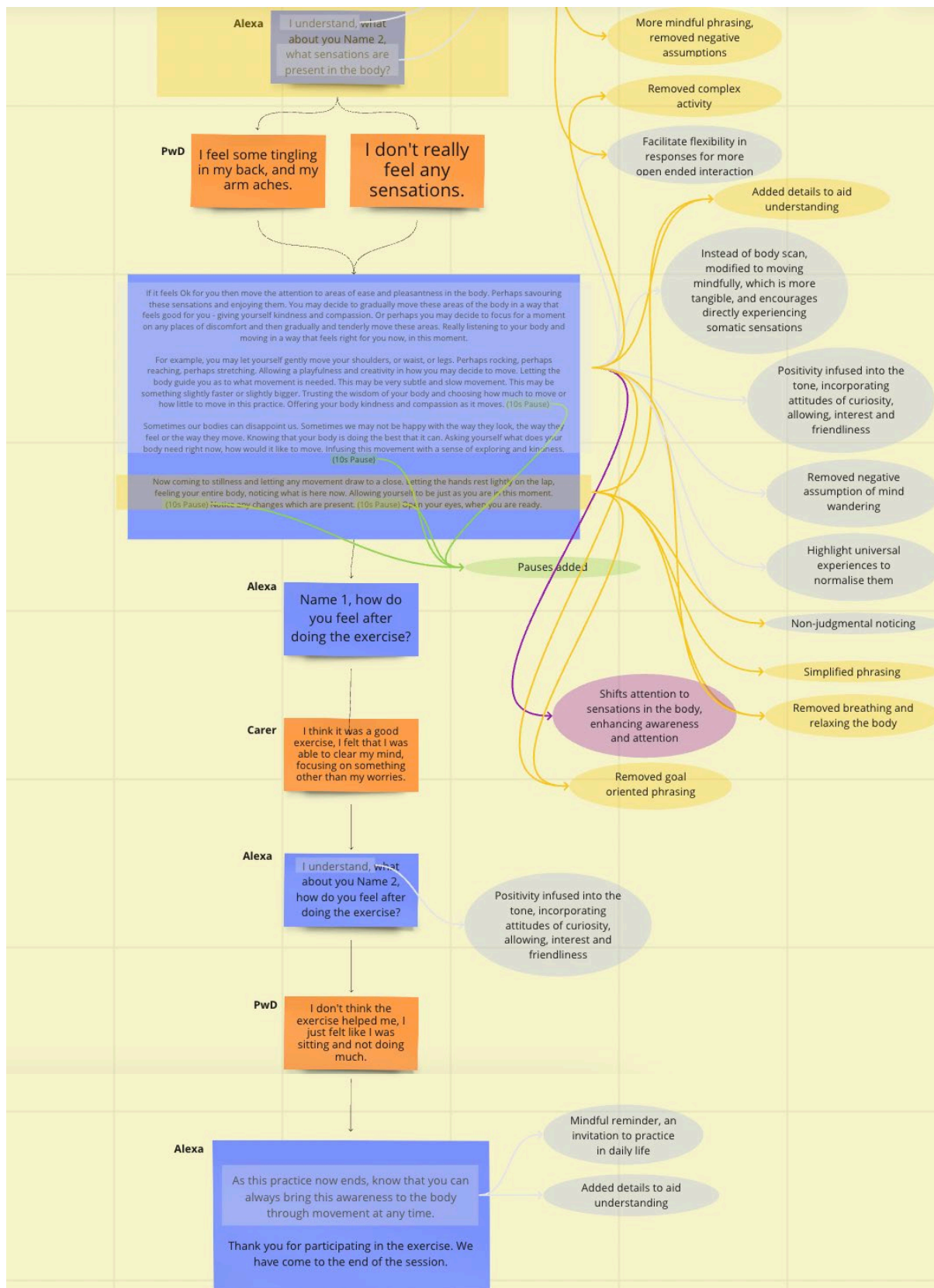
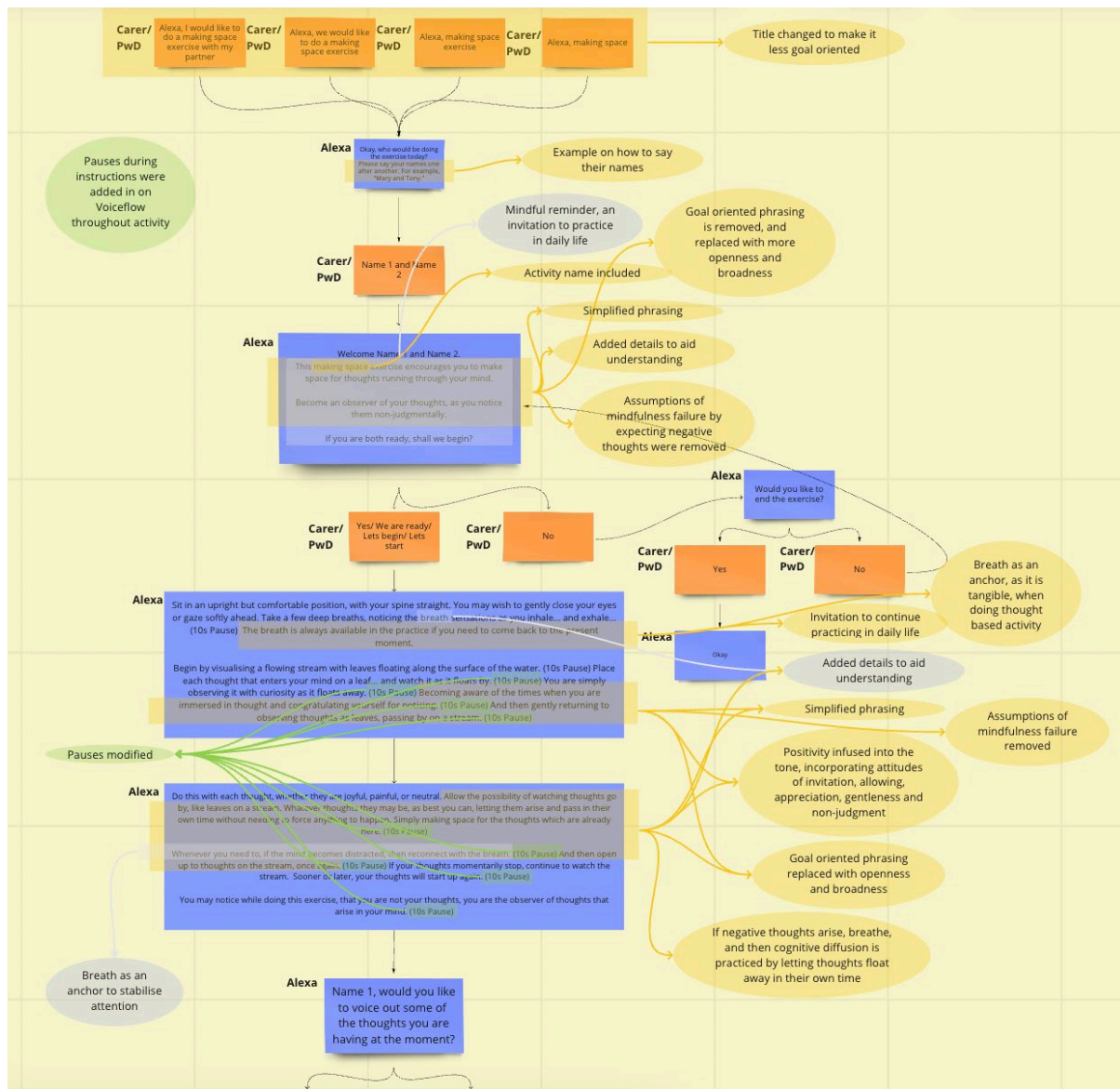
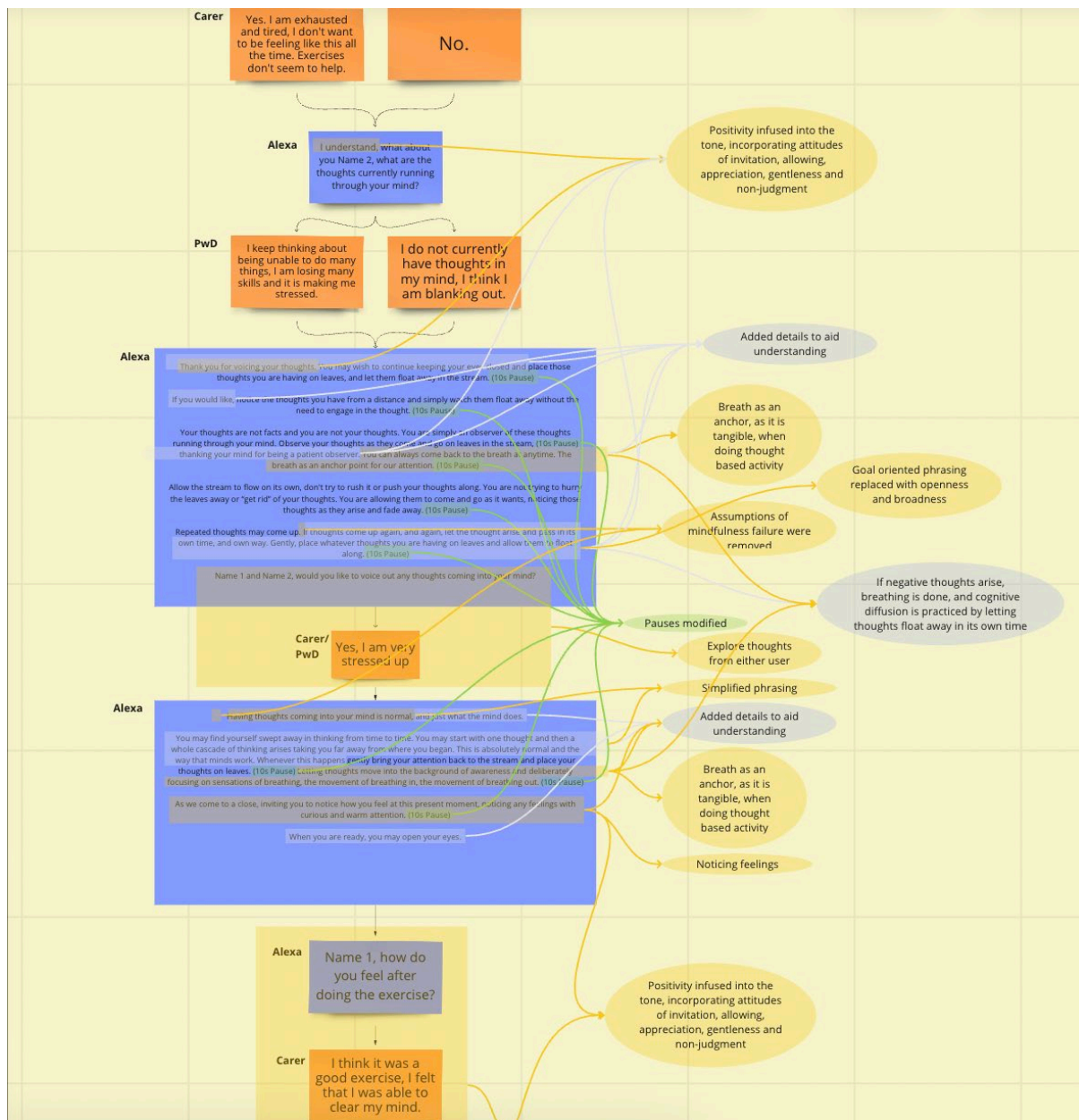


Figure 23. Iteration 3 making space (renamed from letting go)





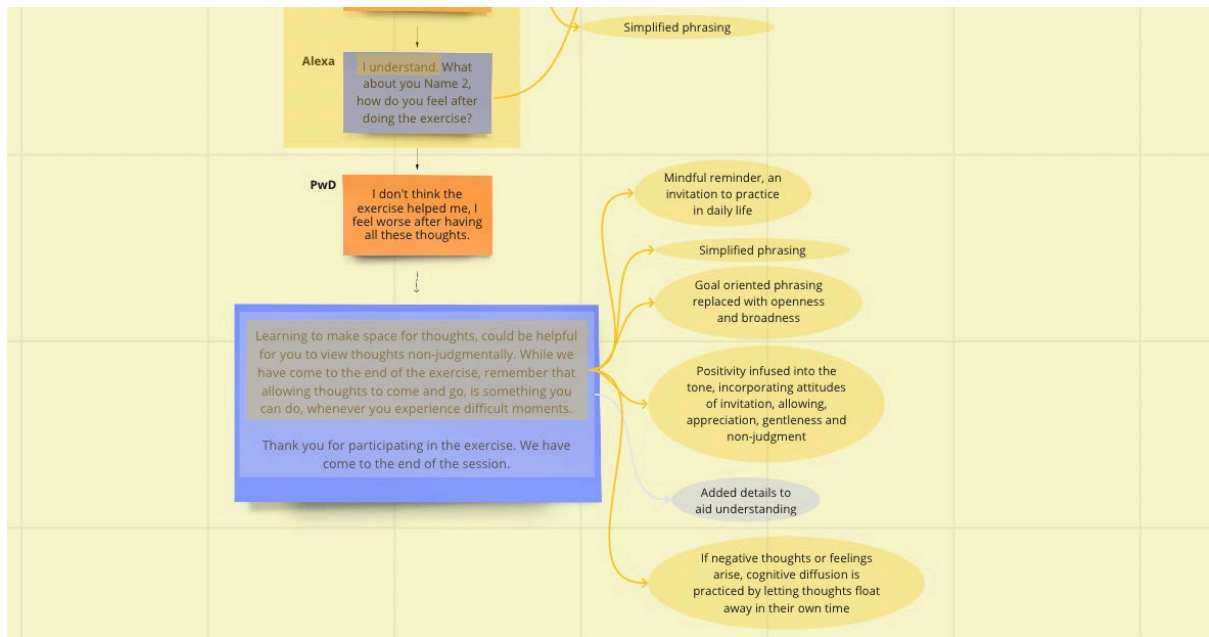
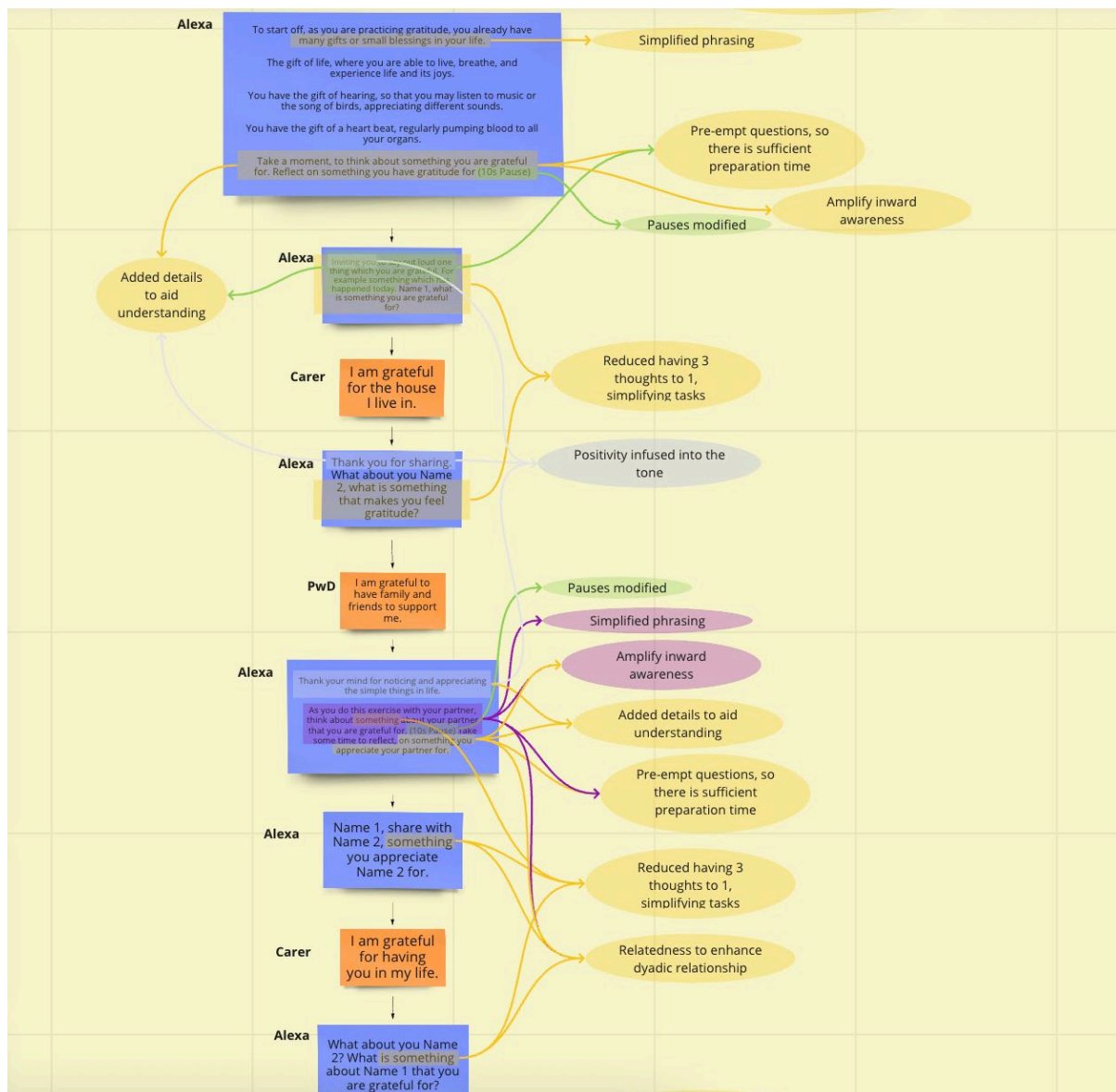


Figure 24. Iteration 3 gratitude practice (renamed from gratefulness)





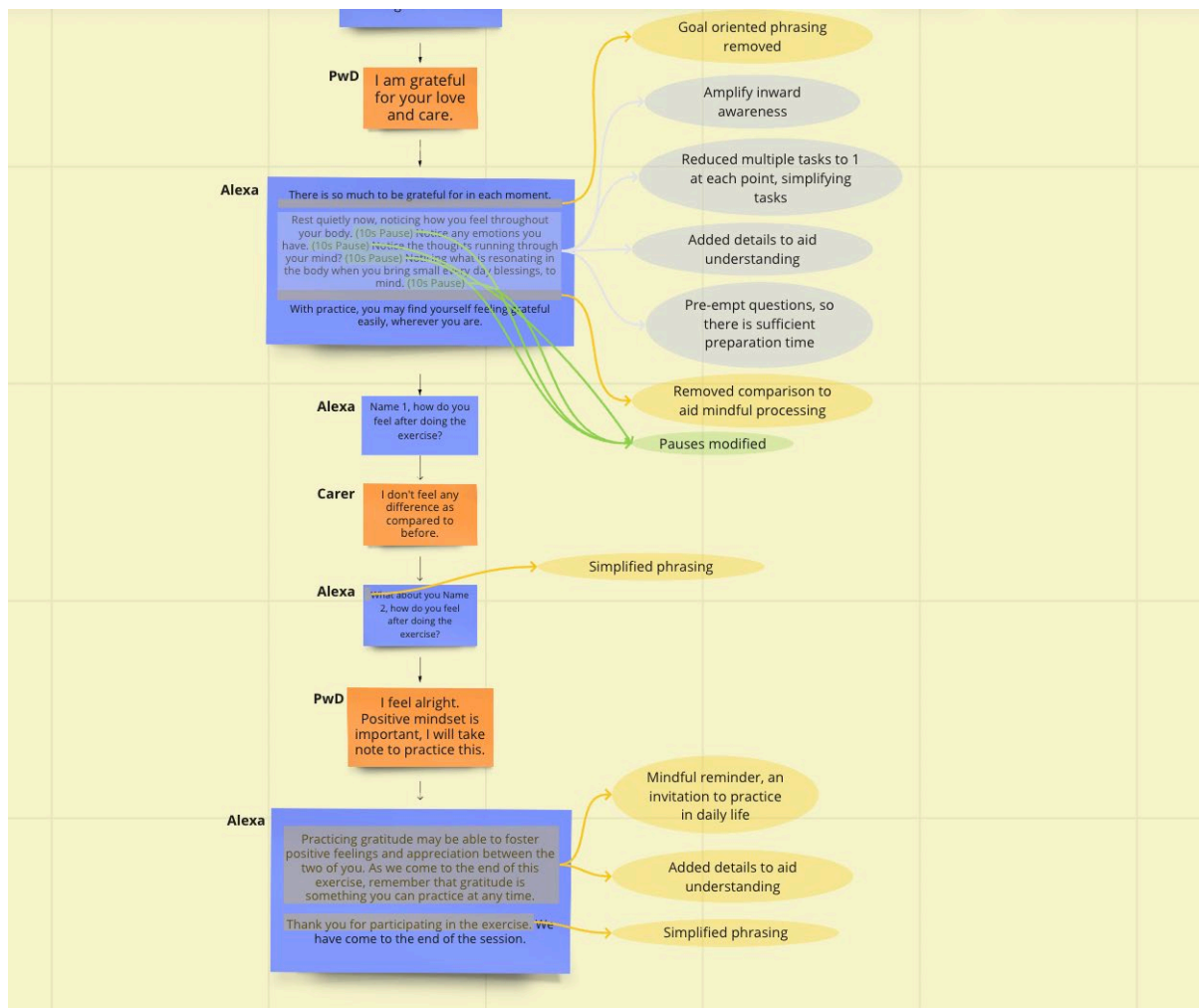
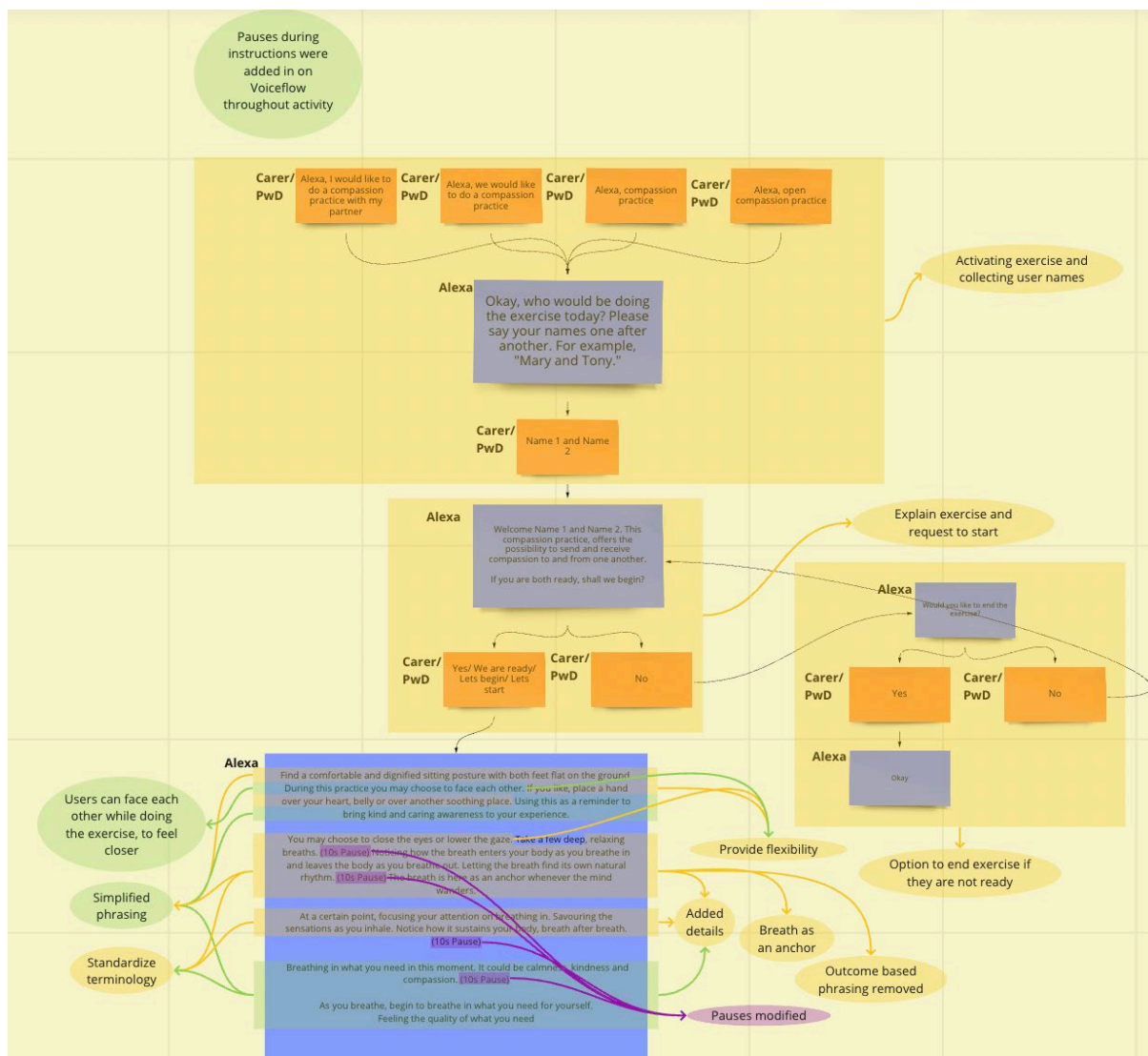
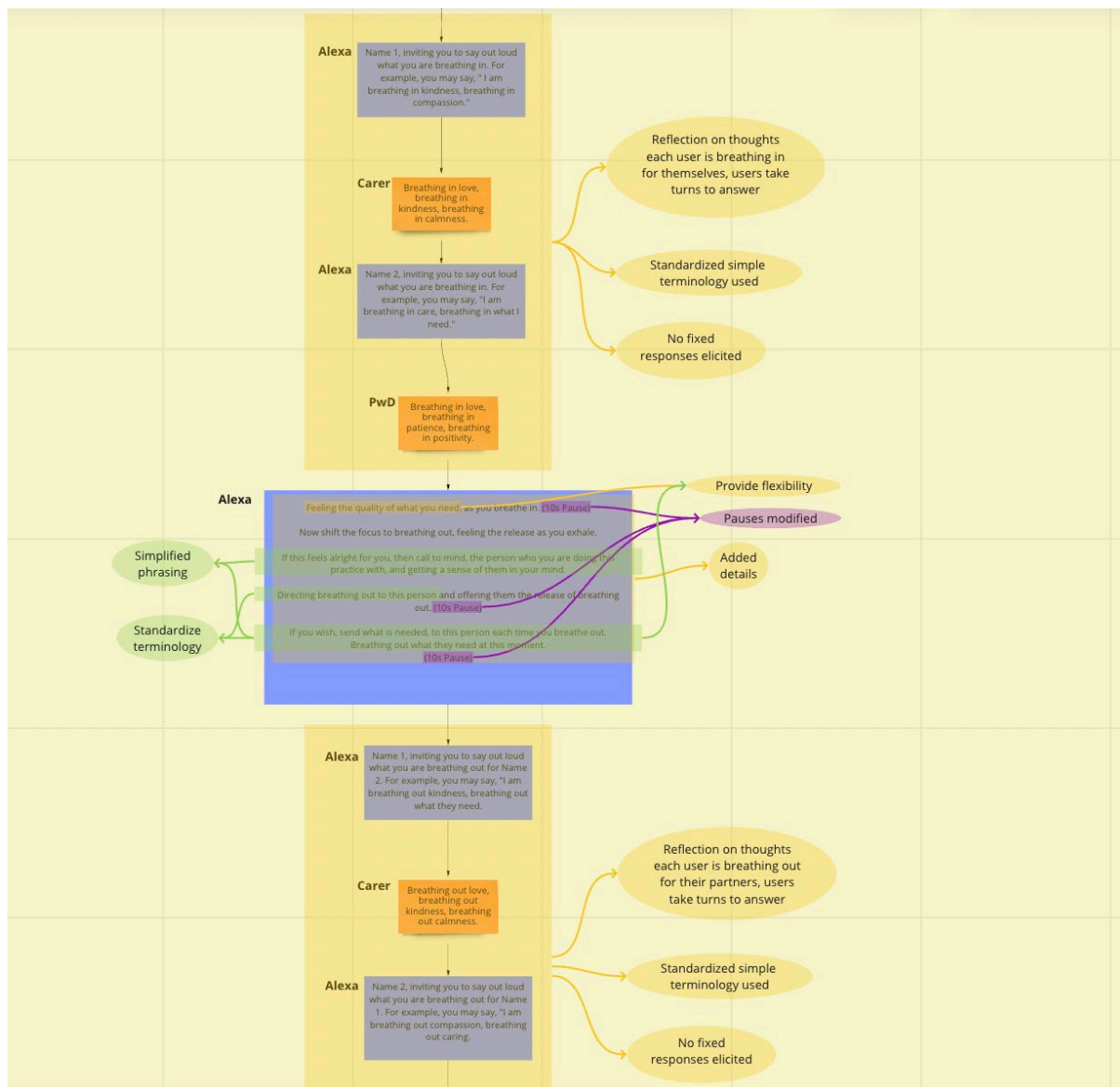
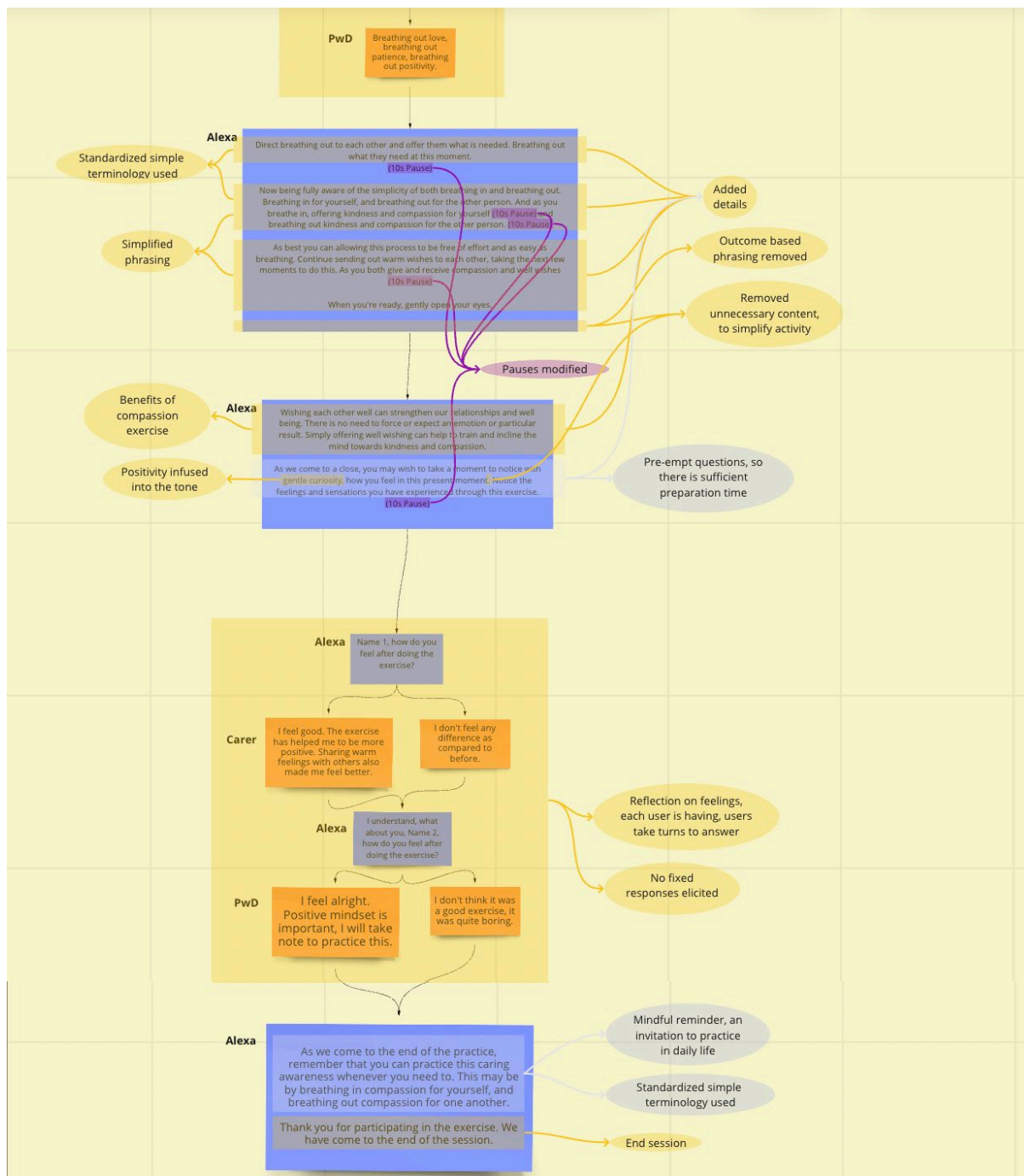


Figure 25. Iteration 3 compassion practice







4.6 Iteration 4

The updated activity scripts were used to create a working prototype on Voiceflow, which was then utilised by dyads to understand how the activities could be improved. 5 dyads went through each activity in detail, as a pair, through two one-hour interviews, providing suggestions on how to improve the activities and explaining what they thought of each activity.

4.6.1 Methods

Participant Recruitment

5 dyads (each dyad comprises 1 person with early-stage dementia and 1 caregiver), who provided feedback on iteration 3 for iteration 4 were recruited from dementia groups on social media platform Facebook, through a volunteer sampling approach. Advertisements were posted on the Facebook pages and users, as a pair, responded with interest. Since it was particularly challenging recruiting dyads, they were given 30 GBP as a pair, per interview, as an appreciation for their time. Interviewees were informed that they could withdraw at any time without giving a reason. All participants had to be 18 years or older, be able to use Microsoft Teams and communicate in English. In addition,

- Persons with dementia had to be in the early stage of the illness and able to consent for themselves.
- Caregivers had to be primary caregivers of an individual with a dementia diagnosis (*early stage* of any type) and have provided care for at least three months before recruitment.

Data Collection and Analysis

Feedback for iteration 4 was recorded using Microsoft Teams and subsequently transcribed. Microsoft Excel version 16.62 was used to generate graphs and analyse the transcripts, where a thematic analysis approach was used to identify, analyse, and report patterns within data (Braun & Clarke, 2006). An inductive approach was used where open coding was done before pattern coding was used to condense codes. Using Microsoft Excel, similar codes were categorised into the same cell, which formed a code. Pattern coding was then done by categorising common codes into a theme, to condense data into fewer analytical concepts. Codes and themes were re-categorised, as new or similar codes and themes emerged. This went through several iterations until the codes and themes were satisfactory. Feedback was included in the analysis as long as at least 3 participants brought it up or if it was observed on at least 3 participants. Aspect of activities to improve on also included feedback that researchers thought

were important even though less than 3 participants mentioned it, or if it was observed on less than 3 participants.

Subsequently, three PhD researchers separately analysed the feedback for iteration 4, and observed data, independently identifying overarching topics brought up using the same method for data analysis. The three researchers then came together to compare and discuss discrepancies before coming to an agreement on each topic identified. The focus of each iteration and observation was then compared and discussed in the discussion section.

Participants were asked what they liked and disliked from each activity in iteration 4, their answers were separately analysed by three PhD researchers, where the satisfaction and frustration of the self-determination theory—autonomy, competence, and relatedness – was deductively applied. The self-determination theory suggests that supporting the three basic psychological needs – autonomy, competence, and relatedness, could enhance psychological well-being (Deci & Ryan, 2008). Autonomy refers to the ability to make decisions independently and perceive them as self-determined (Ryan & Deci, 2020). Competence refers to the feeling of capability and effectiveness (Ryan & Deci, 2020). Relatedness refers to a sense of connection and belonging (Ryan & Deci, 2020). Activities designed for persons with dementia and caregivers should meet autonomy, competence, and relatedness needs. By meeting the three basic psychological needs in health care settings, the modification of health-related behaviours are more likely to be internalised and this may in turn promote behaviour change that can be sustained, and thereby potentially modify health outcomes (Ryan, Patrick, Deci, & Williams, 2008). The deductive application was done by researchers, for example, identifying whether something participants liked about an activity was able to satisfy autonomy, competence or relatedness needs, or on the other hand frustrate them. Needs satisfied were labelled with a “+” sign, and frustrations were labelled with a “-“ sign for each of the self-determination theory components.

This was done using Microsoft Excel version 16.62, where likes and dislikes of each activity mentioned by participants were categorised in individual columns. After which, each like and dislike were assessed to be autonomy, competence or relatedness satisfying or frustrating, labelling them with “+/-“ signs. After the three researchers did their independent categorisation, the results were then compared and discrepancies were discussed before researchers came to an agreement on the self-determination theory’s satisfaction and frustration. All discrepancies

were resolved and agreed upon by all three researchers. The total number of satisfaction and frustration comments were compiled based on each mindfulness activity before it was analysed.

Feedback on the general experience with mindfulness activities, looking at mindfulness usage preferences, potential mindfulness habits and mindfulness set up was recorded using Microsoft Teams and subsequently transcribed. Microsoft Excel version 16.62 was used to generate graphs and analyse the transcripts. The same thematic analysis inductive approach was used for data analysis, where open coding was done before pattern coding was done to condense codes and represent data.

Excel was used in this iteration to analyse data as the volume of feedback could be easily analysed using Excel, instead of Nvivo which allows for larger volumes of data analysis. It also allowed for generating of graphs. Data and all appropriate documents will be stored for a minimum of 10 years after the study is completed. All video recordings were transcribed in a timely fashion and removed from Microsoft Teams.

4.6.2 Results

Participants

Participants who provided feedback for iteration 4 included 5 dyads. All 5 dyads completed two interviews each, exploring their feedback on iteration 3, and all 10 interviews were subsequently analysed. 4 out of 5 dyads were spousal relationships, while 1 other dyad comprised a parent child relationship. All 5 caregivers were female, while 4 out of 5 persons with dementia were male and 1 remaining person with dementia was female. All participants participated in the study in May 2022.

Table 11. Iteration 4 participant details

Iteration	Type of Participant	Number (N=5)
4	Persons with Dementia and Caregiver Dyad	
	Spousal dyads who lived together	3 dyads
	Spousal dyads who lived separately but visited often	1 dyad
	Parent-child dyads who lived separately but visited often	1 dyad

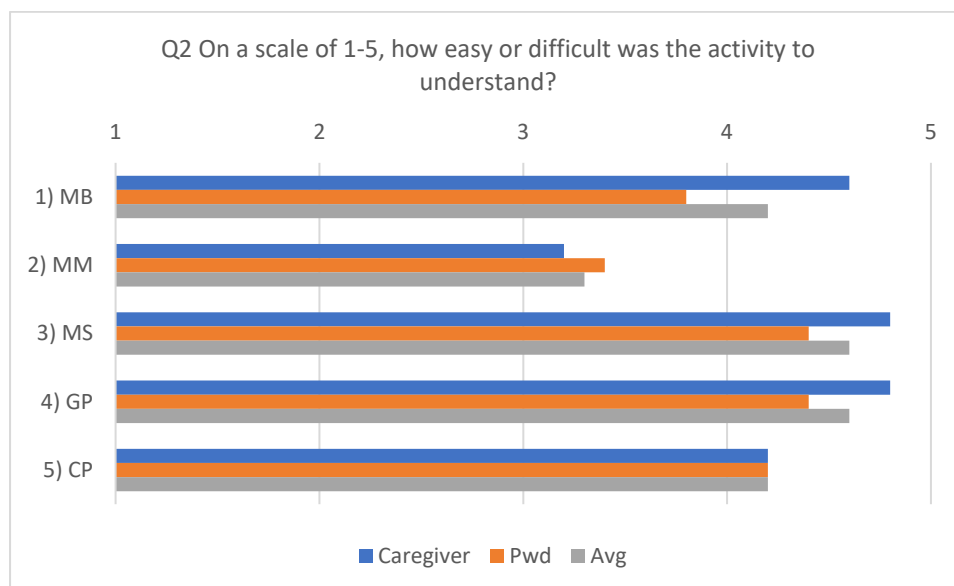
Iteration 4 Feedback

Iteration 4 incorporated feedback from users and refined the working prototype for the guideline assessment study.

Feedback from Users

The mechanism of the activities from *Table 8* were explained and the five activities (*Figure 21-25*) were used by the 5 dyads through Voiceflow, mimicking a smart speaker interaction. The five activities were generally easy to understand with a likelihood of using most activities again and regularly. Persons with dementia and their caregivers also generally liked the activities. There were however suggestions for improvements that should be incorporated into the fourth iteration.

Figure 26. Ease of understanding

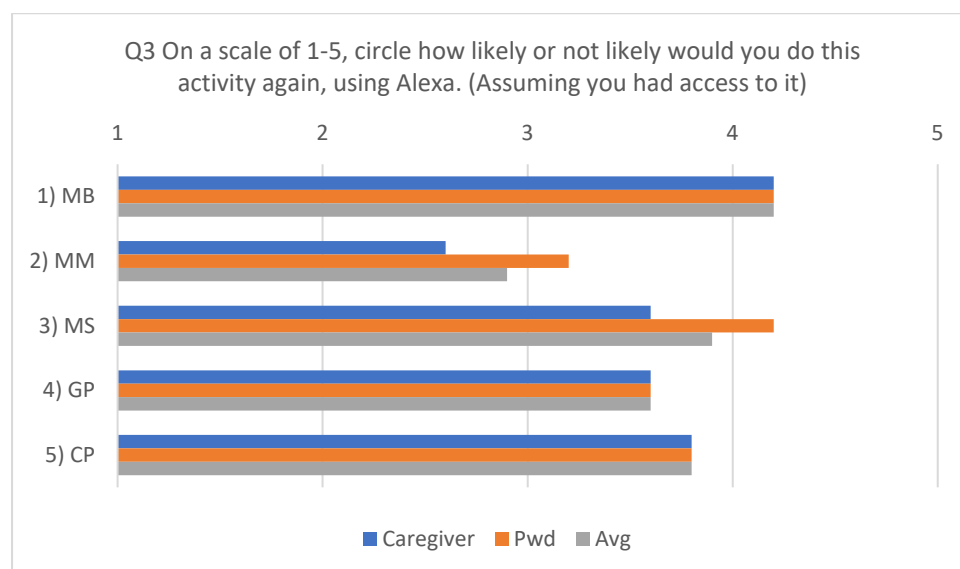


Caregivers and persons with dementia found most of the mindfulness activities highly easy to understand, with a high average rating of more than 4 out of 5, for MB (4.2), making space (MS) (4.6), gratitude practice (GP) (4.6) and CP (4.2). Mindful movement (MM) however, had the lowest average rating of 3.3, suggesting that it was moderately easy to understand. Caregivers generally found the activities easier to understand as compared to persons with dementia.

Caregivers generally found the mindfulness exercises easy to engage with, MB (100%), MS (80%), GP (100%) and CP (60%), mentioning that the activities were “easy to follow” without

“complex phrases”. They, however, mentioned that MM (100%) was not as easy to understand as it was not clear enough and some sections were misleading, needing to be rephrased. Persons with dementia also found the mindfulness exercises easy to engage with, MB (60%), MS (80%), GP (80%) and CP (80%), mentioning that the activities were “easy to follow” and had “clear explanation”. Persons with dementia however mentioned that they needed more clarification for MM (60%), as it was not as easy to understand. Overall, out of 10 participants, most participants found the mindfulness exercises to be easy to understand, MB (8), MS (8), GP (9) and CP (7). MM (8) however, needed instructions to have more clarification.

Figure 27. Likelihood of using activity again

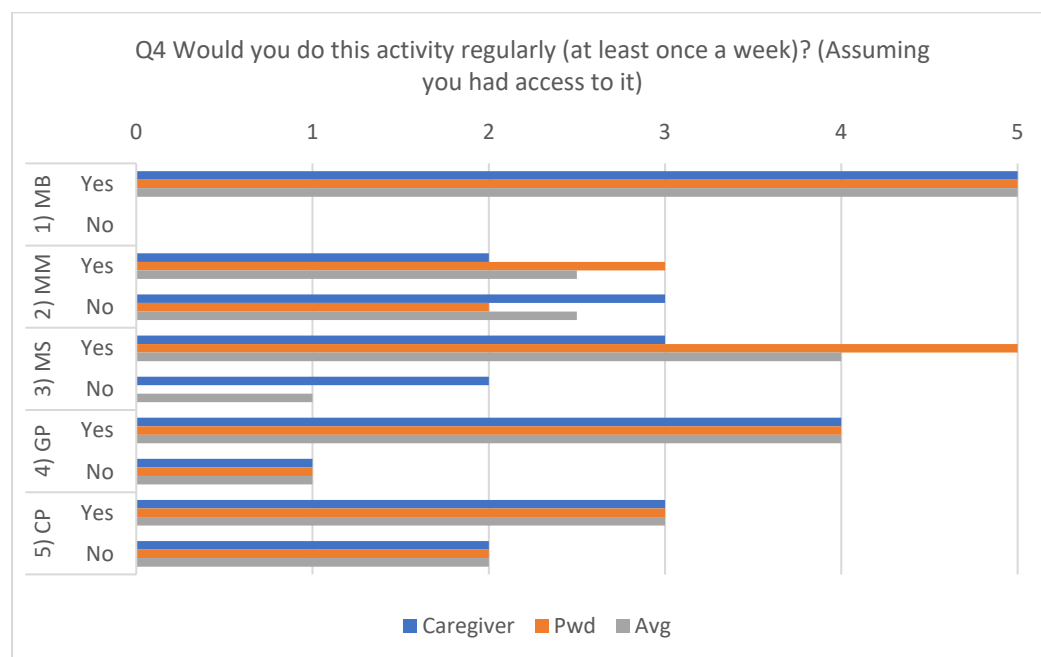


Caregivers and persons with dementia had a moderate to high likelihood of doing the mindfulness activities again, using Alexa. MB (4.2) had a high average rating of more than 4 out of 5, showing high likelihood, while MS (3.9), GP (3.6) and CP (3.8) had ratings from 3.5-4, indicating moderate likelihood. MM had the lowest average ratings, 2.9 out of 5, revealing that participants were not likely to do the activity again, using Alexa.

Caregivers were likely to do most mindfulness exercises again using Alexa, MB (80%), MS (60%), GP (60%) and CP (60%), mentioning that the activities were “useful”, “calming” and they valued the dyadic interaction. Majority of caregivers were not likely to do MM (60%) again, as they preferred other activities, and felt that the activity was badly designed, bringing up pain, negative emotions, and thoughts. Persons with dementia were also likely to do all mindfulness exercises again using Alexa, MB (80%), MM (60%), MS (80%), GP (60%) and

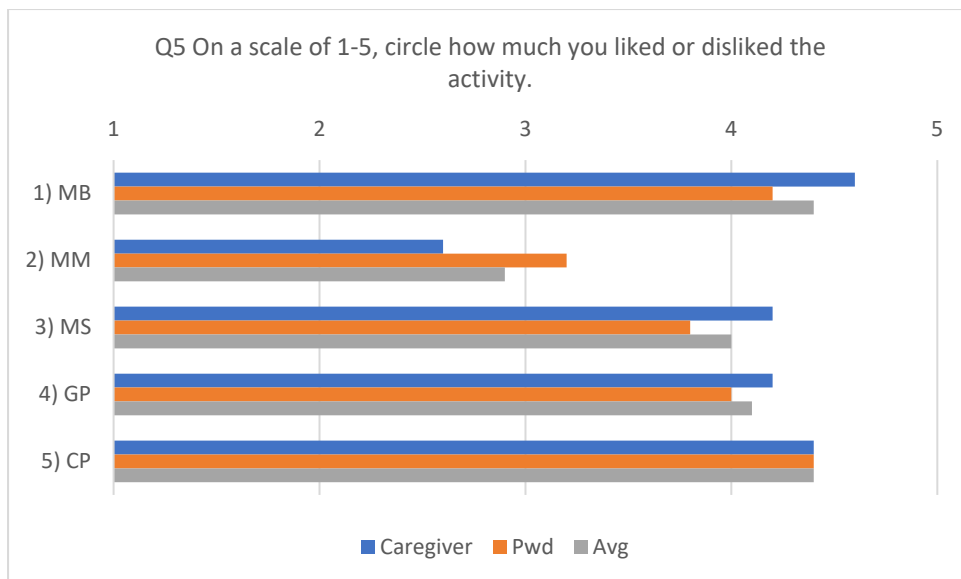
CP (60%), mentioning that the activities were “easy to use”, “relaxing” and “useful”. Overall, out of 10 participants, the majority of participants would do the mindfulness exercises again, MB (8), MS (7), GP (6) and CP (6). Participants would, however, not do the MM (5) activity again, although 4 participants would still do it.

Figure 28. Likelihood of using activity regularly



Caregivers and persons with dementia had a high likelihood of doing mindfulness activities regularly, using Alexa. MB had the highest average rating of 5 out of 5, while MS and GP had a high average rating of 4 out of 5, showing that these activities had a high likelihood. CP had a rating of 3 out of 5, showing that both caregivers and persons with dementia had a moderate likelihood of doing CP regularly. Lastly, MM had the lowest average rating of 2.5 out of 5, revealing that caregivers and persons with dementia had a neutral stance on doing the activity regularly. Similar to results from question 3, persons with dementia were more likely to do MM and MS as compared to caregivers, while interest were equal for dyads for MB, GP and CP.

Figure 29. Activity preferences



Caregivers and persons with dementia liked most of the mindfulness activities, with a high average rating of more than or equal to 4 out of 5, for MB (4.4), MS (4.0), GP (4.1) and CP (4.4). MM however had the lowest average rating of 2.9, suggesting that it was not a preferred activity. Caregivers generally liked the activities more as compared to persons with dementia.

Caregivers liked MB (100%), MS (60%), GP (80%) and CP (80%), mentioning that the activities were “calming”, “helpful”, “easy to use” and they liked the dyadic elements in the activities. An equal number of caregivers disliked (40%) or had an ambivalent view (40%) on MM. Caregivers who disliked MM, preferred other physical activities. Caregivers who were neutral mentioned that MM brought up negative effects, focusing on pain and negative thoughts. Persons with dementia liked MB (100%), MS (80%), GP (80%) and CP (80%), mentioning that the activities were “calming”, “useful” and they liked the dyadic elements in the activities. An equal number of persons with dementia liked (40%) or had an ambivalent view (40%) on MM. Persons with dementia who liked MM, mentioned that it was calming and useful while persons with dementia who had neutral opinions on MM preferred outdoor physical activities. Overall, out of 10 participants, most participants liked the mindfulness exercises, MB (10), MS (7), GP (8) and CP (8). MM had 4 participants who had a neutral stance, 3 participants who disliked it and 3 participants who liked it.

Usage Preferences

Almost all participants (90%) found the accent easy to understand, with one caregiver mentioning she was grateful that the English accent, not an American accent, was used by

Alexa. 90% of participants thought the length of the mindfulness activities was just nice, except for one caregiver (10%) who thought that the activities were too short. When asked about how they would like to activate mindfulness exercises, 80% of participants would like to be reminded by Alexa to do mindfulness exercises, 70% would also like to access mindfulness exercises on command. Participants mentioned wanting to set reminders on certain times and days of the week to practice mindfulness until it becomes habitual. They needed reminders as they said they would “forget to do it”. At the same time, they also wanted to have control over when they would like to do it, allowing them to “do it on (their) own time”.

All participants (100%) would do mindfulness exercises regularly, if they had access to it. This was because they found the mindfulness exercises relaxing (40%), enabling them to reflect (40%). Majority of participants (80%) would do mindfulness 1-3 times a week, and the remaining two (20%) prefer to do mindfulness activities every day. All participants (100%) felt that these mindfulness activities could fit into their daily lives, with 90% mentioning that they would use it to wind down, ideally during bedtime (70%). A minority would additionally use it during periods of stress (10%) or to feel calm when waking up (10%). 80% of participants mentioned that the mindfulness exercises they learned through Alexa could subsequently translate into something they could use whenever they needed, without needing Alexa’s guidance. 70% of participants mentioned that after using Alexa’s guidance for a while, it would “seep into (their) habits” and they could then “do it without the guide”. Two participants (20%) however preferred a guide, as one caregiver could not focus if she did the activity on her own, and one person with dementia felt that he could not do it without a guide. When asked how long it would take for mindfulness to translate into something participants could do in their daily life without the guidance of Alexa, participants said that they needed to use Alexa as a lifestyle (30%), 6 months (20%), 3 months (20%), 1 month (20%) and 1 week (10%). Participants (70%) generally needed a few months to “get into a habit”, however some participants (30%) needed Alexa to guide them because of the dementia condition or they found it difficult to do without a guide.

Majority of participants (70%) would place Alexa in their living room, while 30% of them would have it placed in their bedroom. They needed a space that was quiet (100%) and calming (100%) to do mindfulness. Participants had space to seat (100%), ideally on a chair or sofa (90%), near to each other (100%) as it helped them to feel closer to each other (30%). Majority of participants (60%) would not sit facing each other, because of furniture placement or they

felt that it was too formal. The remaining 40% would face each other during the mindfulness exercise.

Likes and Dislikes

Participants were asked what they liked and disliked of each individual activity. Examples of likes include liking an activity because it made them feel peaceful, and examples of dislikes include not liking an activity because it caused unintended stress. Likes that were included were brought up by at least 3 persons with dementia or caregivers. Similarly, dislikes were brought up by at least 3 persons with dementia or caregivers, with the inclusion of other dislikes fewer than 3 participants brought up, but researchers thought it was important to include.

Mindful Breathing – Caregivers and persons with dementia liked that MB was accessible (60%), effective (40%) and relaxing (30%). Caregivers and persons with dementia, however, brought up a few things they disliked about MB. Participants disliked that they were distracted (40%) during the exercise. Distractions include environmental factors like a ringing phone, dogs walking by and air-conditioning sounds. Instructions for MB also needed to be clearer (30%), as participants requested for simple instructions. There was no need to use lengthy sentences or jargons to convey simple instructions. They also requested for exercises to not provide choices (opposing previous recommendations by mindfulness experts), as persons with dementia may have an easier time concentrating without many distractions with clear instructions on what exactly to do. Lastly, although only one participant brought up the need to address negativity like awareness of pain in the body (10%) should it arise during the exercise, MB should incorporate methods to aid participants in coping with negativity.

Mindful Movement – Caregivers and persons with dementia liked that MM was relaxing (40%), accessible (40%) and helped them to gain more awareness (40%). They also liked that MM helped them to keep movements in their bodies (30%) and found it enjoyable (30%). Caregivers and persons with dementia however brought up a few things they disliked about MM. Participants disliked that MM resulted in unintended consequences (30%) causing them to be aware of pain in their bodies and have negative thoughts, with no way of addressing these issues. Instructions for MM also needed to be clearer (60%), as participants were not sure about what they were supposed to do. Technical jargons also made the instructions confusing for participants. Instructions should be more detailed to make it easier to focus instead of leaving

the instructions broad and open. Lastly, although only one participant brought up the need to reduce the number of activities within MM, keeping the simple activities and repeating the sequence for each activity (10%), MM should incorporate this suggestion to enhance accessibility.

Making Space – Caregivers and persons with dementia liked that MS was relaxing (60%). Caregivers and persons with dementia however brought up a few things they disliked about MS. Participants disliked that MS resulted in unintended consequences (30%), as participants may not be able to visualise the activity, or negative thoughts and emotions may come up, which may be difficult to address. Although only one participant brought up the need for pauses to be adjusted (10%), to provide more time for visualisation and to ensure pauses before explained examples are not too long, it is essential to incorporate this suggestion to enhance accessibility. Only two participants brought up the need for MS to have clear instructions (20%), where participants requested for instructions to remove repetitive content and include more details, but it is essential to improve MS based on this suggestion. Lastly, although only one participant brought up the need to include water background sounds to aid visualisation (10%), it may be useful in helping participants to imagine, instead of asking them repeatedly to visualise the stream.

Gratitude Practice – Caregivers and persons with dementia liked that GP helped them to experience gratitude (90%) and feel relaxed (40%). Caregivers and persons with dementia, however, brought up a few things they disliked about GP. Participants disliked the sequence GP was represented (30%), as it did not give them more opportunities to express gratitude towards each other. The activity sequence should also be modified for a smooth flow, by removing some examples of gratitude and reducing beginning explanations. Although only one participant (10%) brought up the need to remove jargons used, it is essential to incorporate this suggestion to enhance accessibility.

Compassion Practice – Caregivers and persons with dementia liked that CP helped them to feel relaxed (50%), have compassion (30%), be more aware (30%) and focus on others (30%). Caregivers and persons with dementia however brought up a few things they disliked about CP. Participants disliked that CP resulted in unintended consequences (30%), as participants may not be able to visualise the activity, feel emotions, find something positive about themselves or they may experience negative emotions and cannot manage them. Instructions for CP also

needed to be clearer (40%), as participants did not understand technical jargons used, could not relate to the name of the activity (replacing it with Kindness Practice (KP)), found the imaginative components of the activity difficult to do and required more literal description. It also should not be too wordy or repetitive. Participants also disliked the sequence CP was represented (40%), as there was too much repetition and explanation, participants mentioned that there was no need for too many examples. They requested for more interactivity, for example, by holding each other's hands, enquiring about partner's needs, and acknowledging that needs have been met.

Researcher Observations

Dyads were observed as they interacted with the mindfulness activities. All dyads faced some accessibility issues in terms of using the activities and had distractions which prevented them from using the mindfulness activities successfully. A minority of dyads also experienced other problems like experiencing distractions. Some accessibility issues include:

- (1) Alexa being unable to capture responses as speaker spoke too softly.
- (2) Alexa, not activating activity as the speaker did not say the activation name correctly.
- (3) Alexa being unable to capture responses as multiple people spoke at the same time.
- (4) speaker pausing before talking, leading to Alexa repeating the same section as it did not capture a response.
- (5) speaker pausing while talking, leading to Alexa moving to the next section before the speaker can finish responding.
- (6) caregiver clarifying question as person with dementia did not understand, leading to Alexa moving to the next section.
- (7) Alexa capturing information wrongly.
- (8) Alexa, not capturing some responses.
- (9) speaker not responding correctly to the question Alexa asked, leading to Alexa capturing the wrong responses.
- (10) power cut, leading to the lack of Wi-Fi connection in rural areas and inability to use Alexa.
- (11) person with dementia not knowing what to do.
- (12) person with dementia not hearing Alexa clearly because of hearing problems.
- (13) caregiver talking to researcher to clarify, leading to Alexa moving to the next section.
- (14) having too lengthy explanations in the beginning of the activity.

Some also noticed distractions that included:

- (1) external environment noises.
- (2) sleepiness.
- (3) instinctively opening one's eyes to answer questions asked by Alexa.
- (4) needing to use the restroom.
- (5) inability to focus.
- (6) questions from mindfulness activity itself.

Summary of Activity Guidelines Collated for Iteration 4 Modification

Activity Script Feedback

- Pauses should provide more time for visualisation, and to ensure pauses before explained examples are not too long (Intervention Design)
- Include water background sounds to aid visualisation (Content Design)
- Have the right accent for the right audience (Content Design)
- Suitable length of activities, not too long or short (Intervention Design & Content Design)
- Detailed instructions given instead of leaving the instructions broad and open, as providing choices may confuse person with dementia (opposing previous recommendations by mindfulness experts), clear instructions are needed on what exactly to do (Content Design)
- Easy to relate to activity content (Content Design)
- Easy to understand – have clear explanation that are not misleading, rephrase or clarify parts that could be misleading, no complex phrases or technical jargons, use simple instructions, use literal description (Content Design)
- Easy to engage with - activity should have a smooth flow, no lengthy sentences, remove repetitive content, do not provide too many examples or too much explanation just sufficient will do (Content Design)

Activity Mechanism Feedback

- Activities have to be well liked and enjoyable (Content Design)
- Easy to relate to – name of activities and activity content (Content Design)
- Provide dyadic interaction (Intervention Design)

- Provide guidance allowing dyads to follow as some cannot do it without guidance. (Intervention Design)
- Incorporate more interactivity like – holding each other’s hands, enquiring about partner’s needs, and acknowledging that needs have been met. (Intervention Design & Content Design)
- Has to be well designed to prevent unintended consequences – does not cause unintended stress, does not bring up pain in the body, negative emotions and negative thoughts. Some participants may not be able to visualise the activity, feel emotions, or find something positive about themselves (Content Design)
- Incorporate methods to aid coping with negativity should it arise during the exercise (Content Design)
- Reduce the number of things to do within each activity, keeping the simple ones and repeating them for each activity (Intervention Design & Content Design)
- Has to be useful – calming and relaxing, use to wind down and destress, reflective, keep movements in their bodies, help them to experience gratitude, compassion, and to focus on others (Intervention Design)

Activity Technical Requirement Feedback

- Allow for activating of mindfulness exercises through reminders and on command – reminders as they might forget to do it regularly, on command as they wanted control over when they would like to do it. (Intervention Design)
- Allow for personalisation – of activity usage, of time needed for activities to translate into something participants could do in their daily life without Alexa’s guidance, or for participants to do as a lifestyle, of number of opportunities to express gratitude towards each other (Intervention Design)
- Alexa needs to be able to differentiate when speakers pause to think before answering the question, instead of repeating the same section after assuming there is no response. (Intervention Design)
- Alexa needs to be able to capture responses when (1) speaker speaks softly, (2) multiple people speak at the same time. (Intervention Design)
- Alexa needs to be able to differentiate right and wrong responses to the question asked, and respond accordingly. (Intervention Design)

- Alexa needs to be able to differentiate when speakers pause while talking, instead of moving to the next section before the speaker can finish responding. (Intervention Design)
- Alexa needs to be able to differentiate whether the person with dementia is talking, or caregiver is clarifying the question for the person with dementia as they did not understand, instead of moving to the next section. (Intervention Design)
- Alexa needs to be able to differentiate whether the caregiver is answering the question, or speaking to the researcher to clarify, instead of moving to the next section.
- Alexa needs to be able to capture all responses accurately (Intervention Design)
- Need to ensure there is Wi-Fi connection, especially in rural areas, or during power cuts, as that affects ability to use Alexa (Technical Requirement)
- It would be helpful for Alexa to know what activities speakers are requesting for, and activate them, even if speakers say the activation name incorrectly. (Intervention Design)

User Issues

- Person with dementia may not know what to do sometimes because of their condition, Alexa needs to be able to manage such circumstances (Intervention Design)
- Person with dementia may not hear Alexa clearly because of hearing problems, volume has to be well suited to their needs (Intervention Design)
- Potential distractions that may interrupt activities should be addressed - distractions include (1) external noises (ringing phone, dogs walking by and air-conditioning sounds) (2) sleepiness, (3) instinctively opening one's eyes to answer questions asked by Alexa, (4) needing to use the restroom, (5) inability to focus, (6) questions from mindfulness activity itself. (Intervention Design)

Space Requirements

- Allows participants to place Alexa wherever they wish to (Intervention Design)
- Use Alexa in a quiet and calming space (Intervention Design)
- Space needs to have seats (Intervention Design)

- Allow participants to choose the level of closeness they wish to feel - Participants can choose to seat near each other, or face each other if they wish to, helping them to feel closer (Intervention Design)

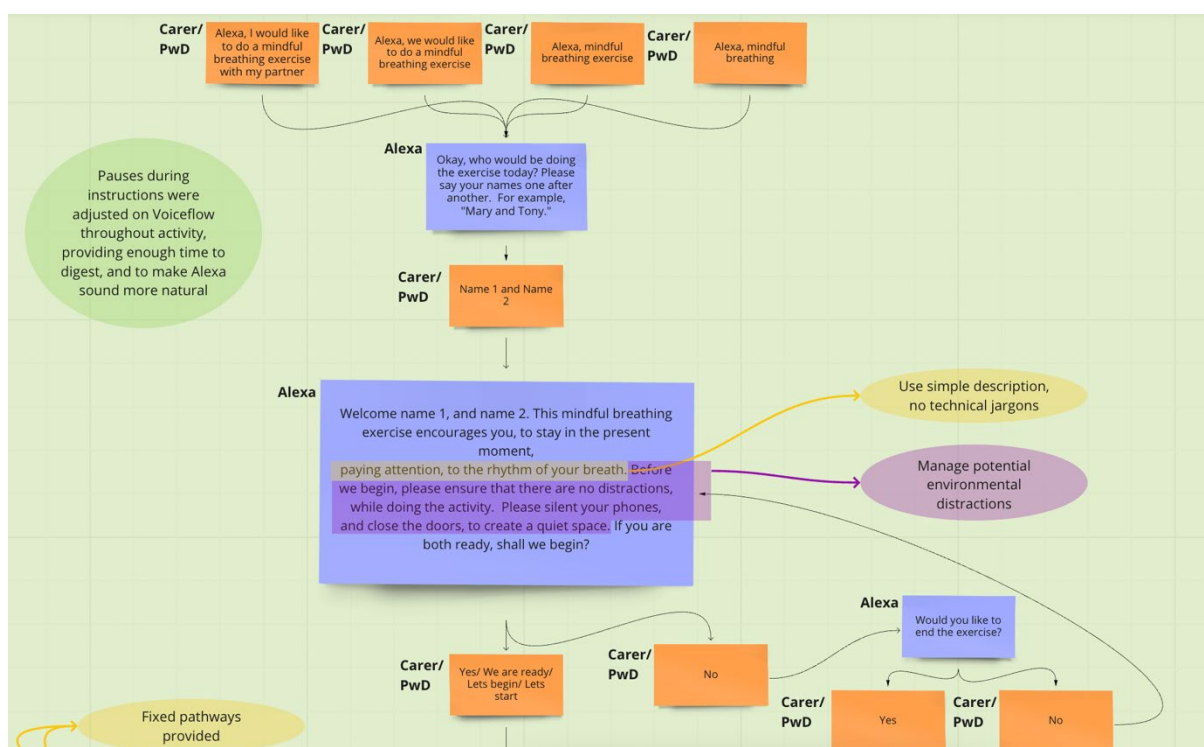
Usage Requirements

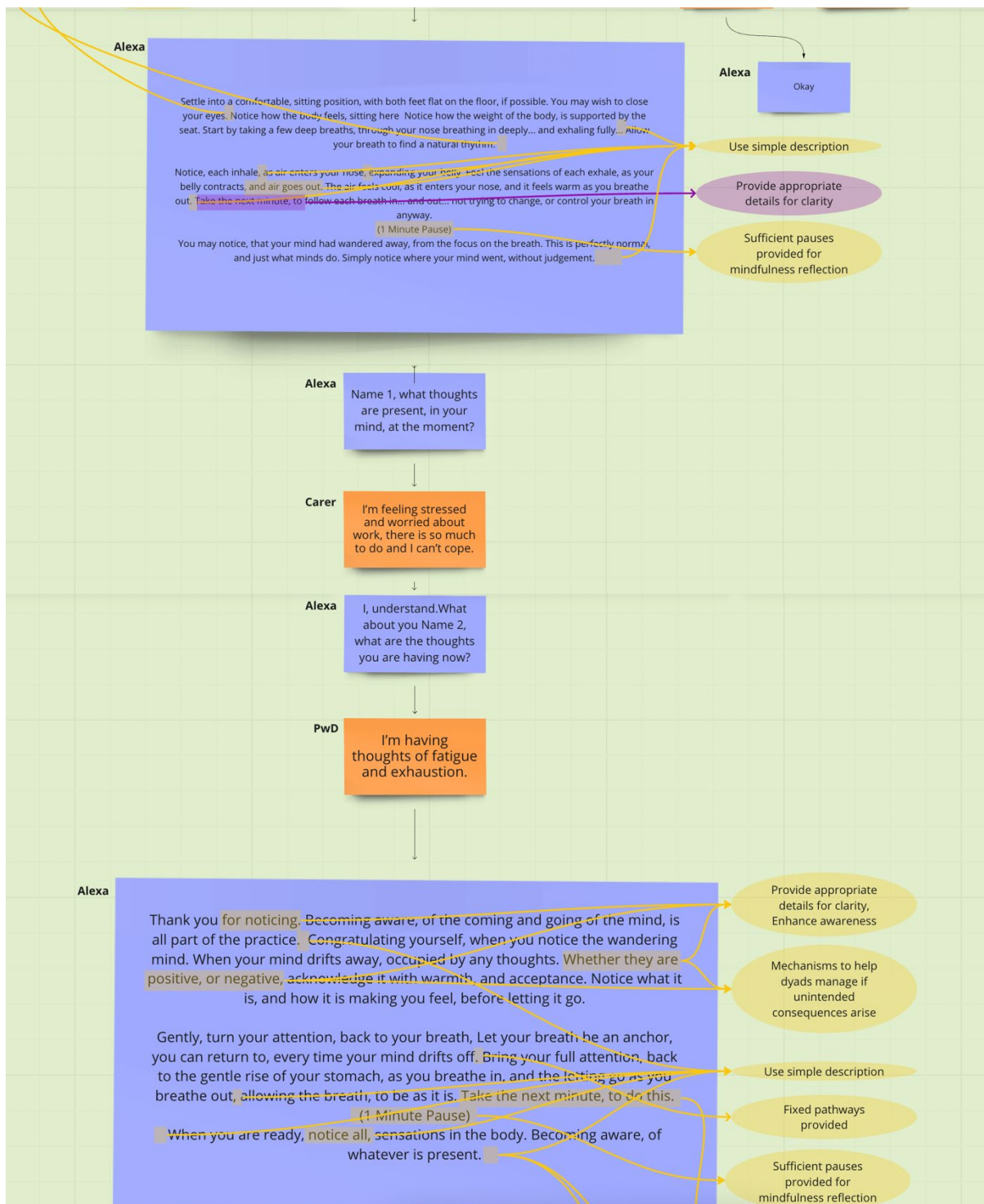
- Encourage using most activities again using Alexa, on a regular basis (Intervention Design)
- Activities should fit into participants daily lives (Intervention Design)
- Activities could subsequently translate into something participants could use whenever they needed, without needing Alexa's guidance (Intervention Design)

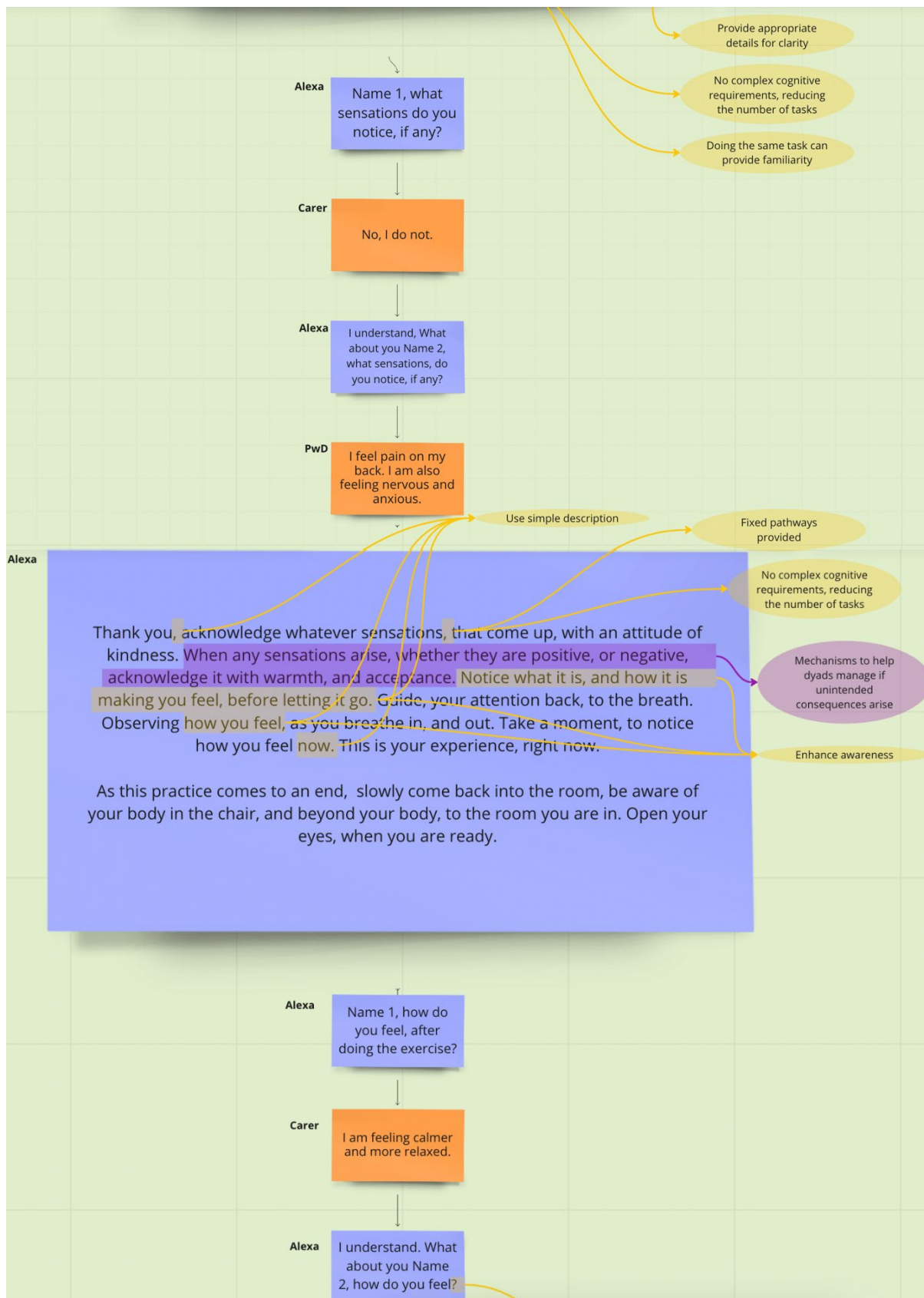
4.6.3 Refining Final Working Prototype

The scripts of the five activities were used to refine the working prototype on Voiceflow, which was then used in a guideline assessment study as a final working prototype.

Figure 30. Iteration 4 mindful breathing







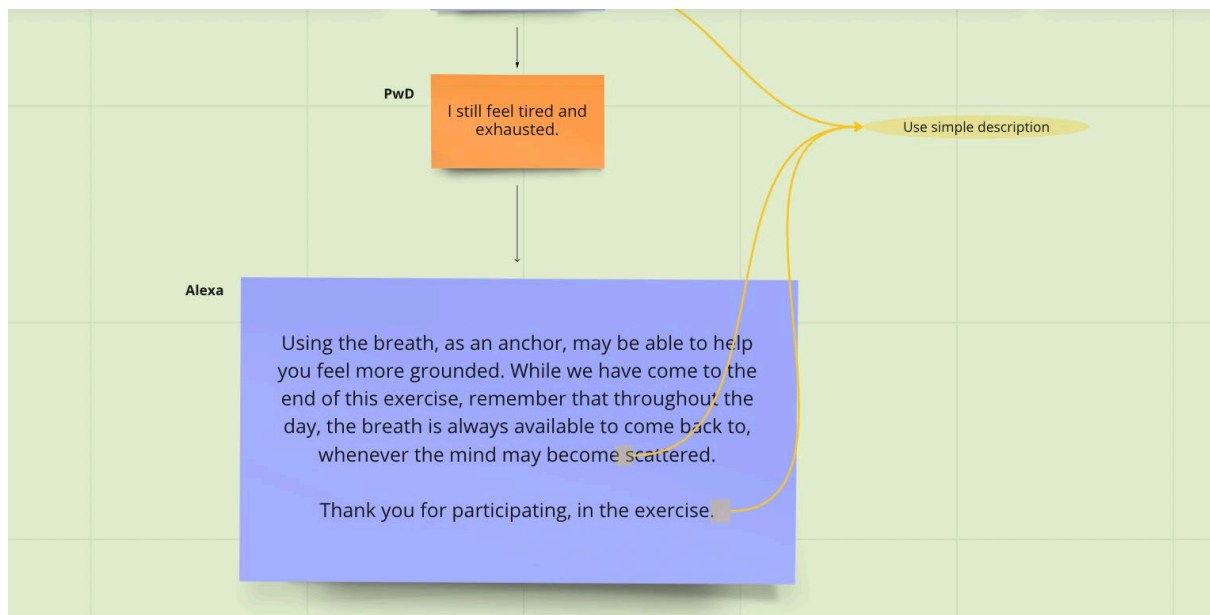
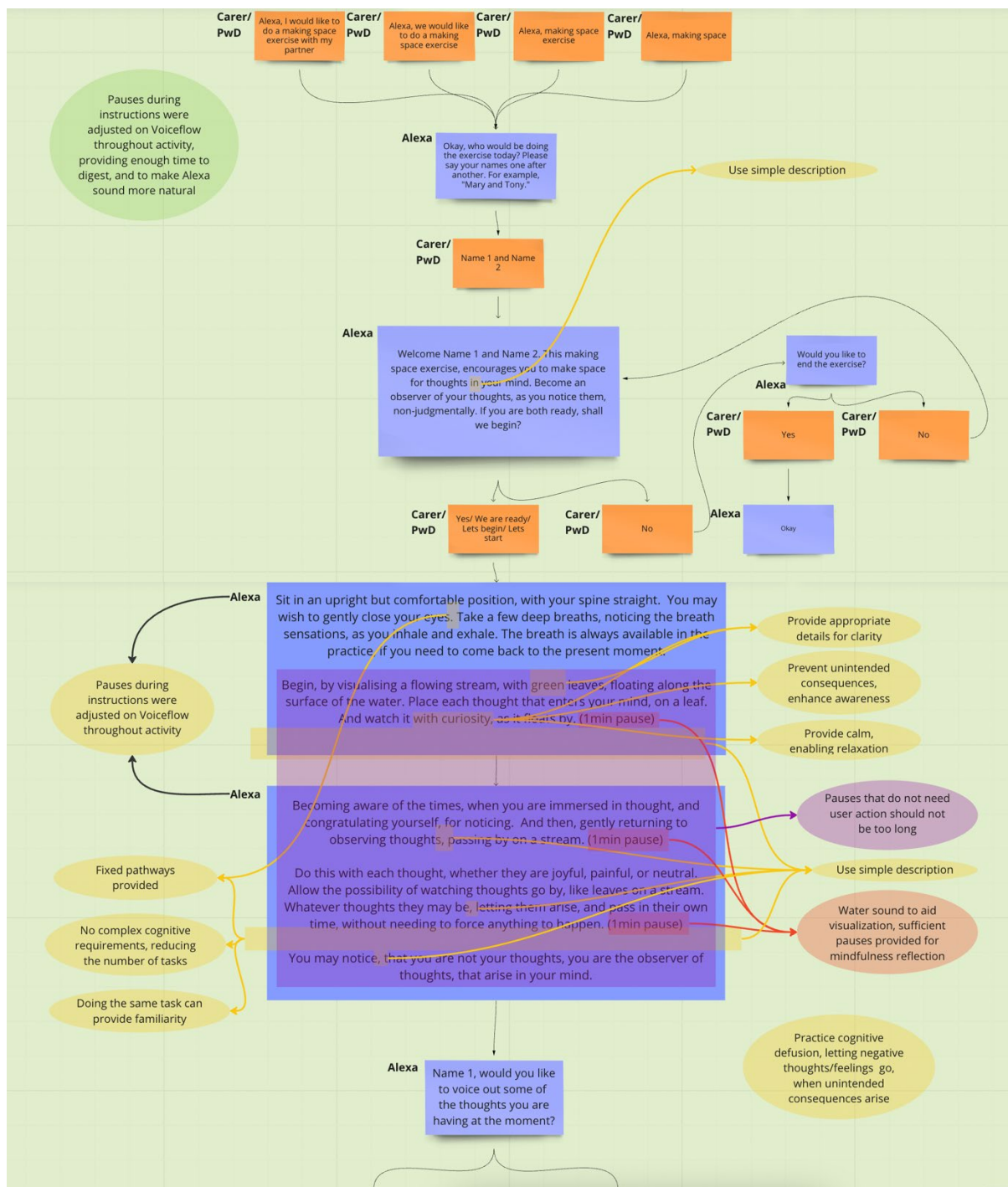


Figure 31. Iteration 4 making space



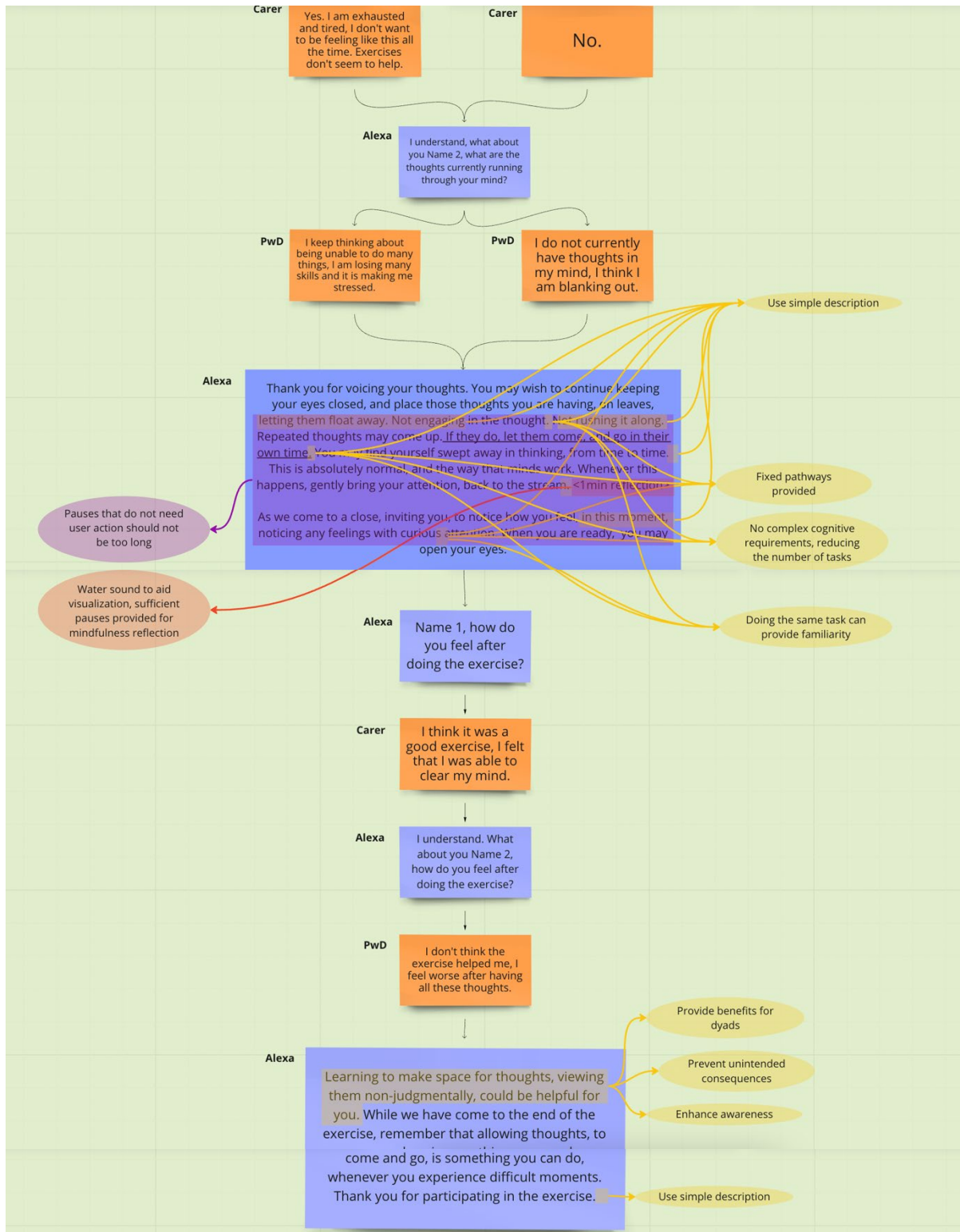
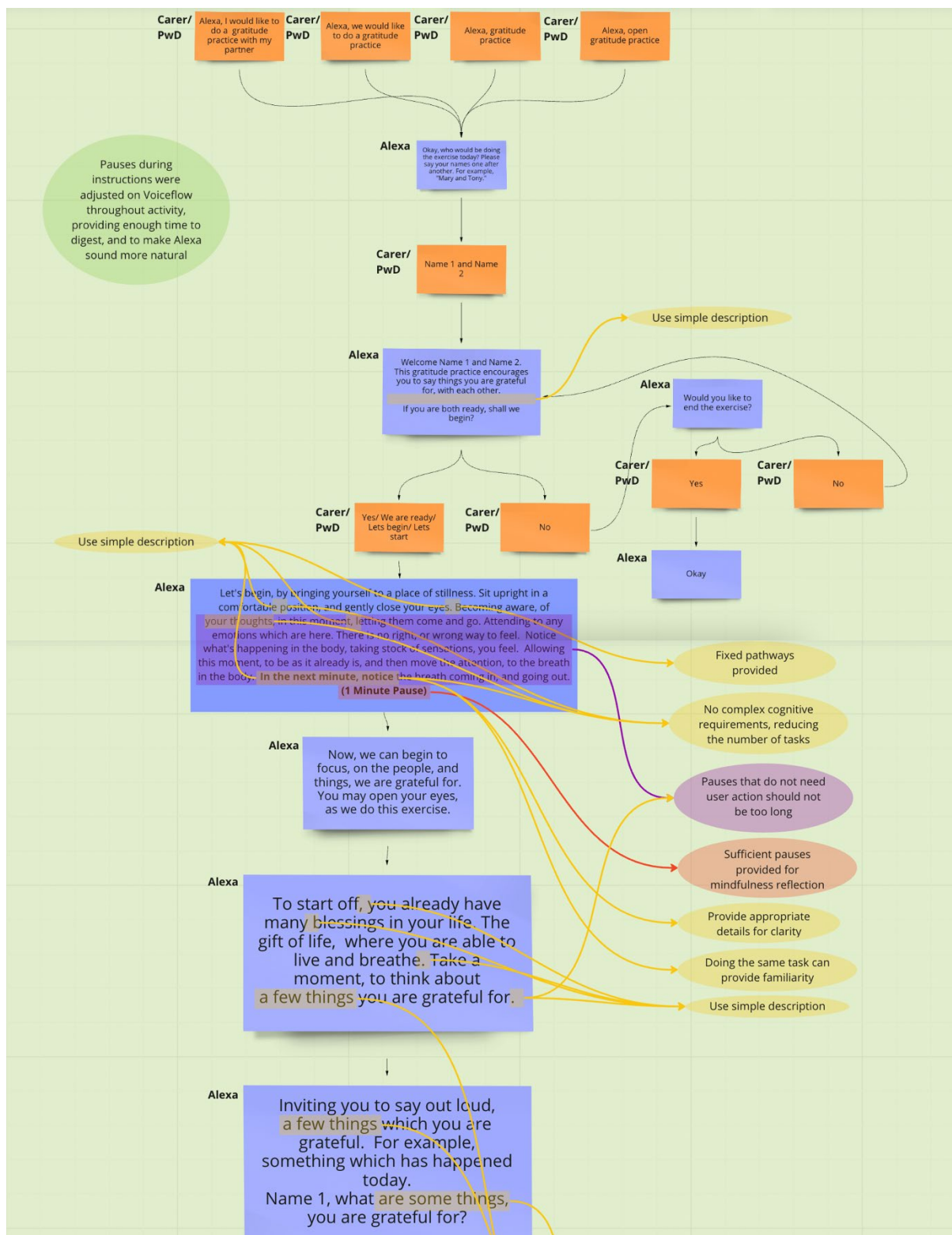


Figure 32. Iteration 4 gratitude practice



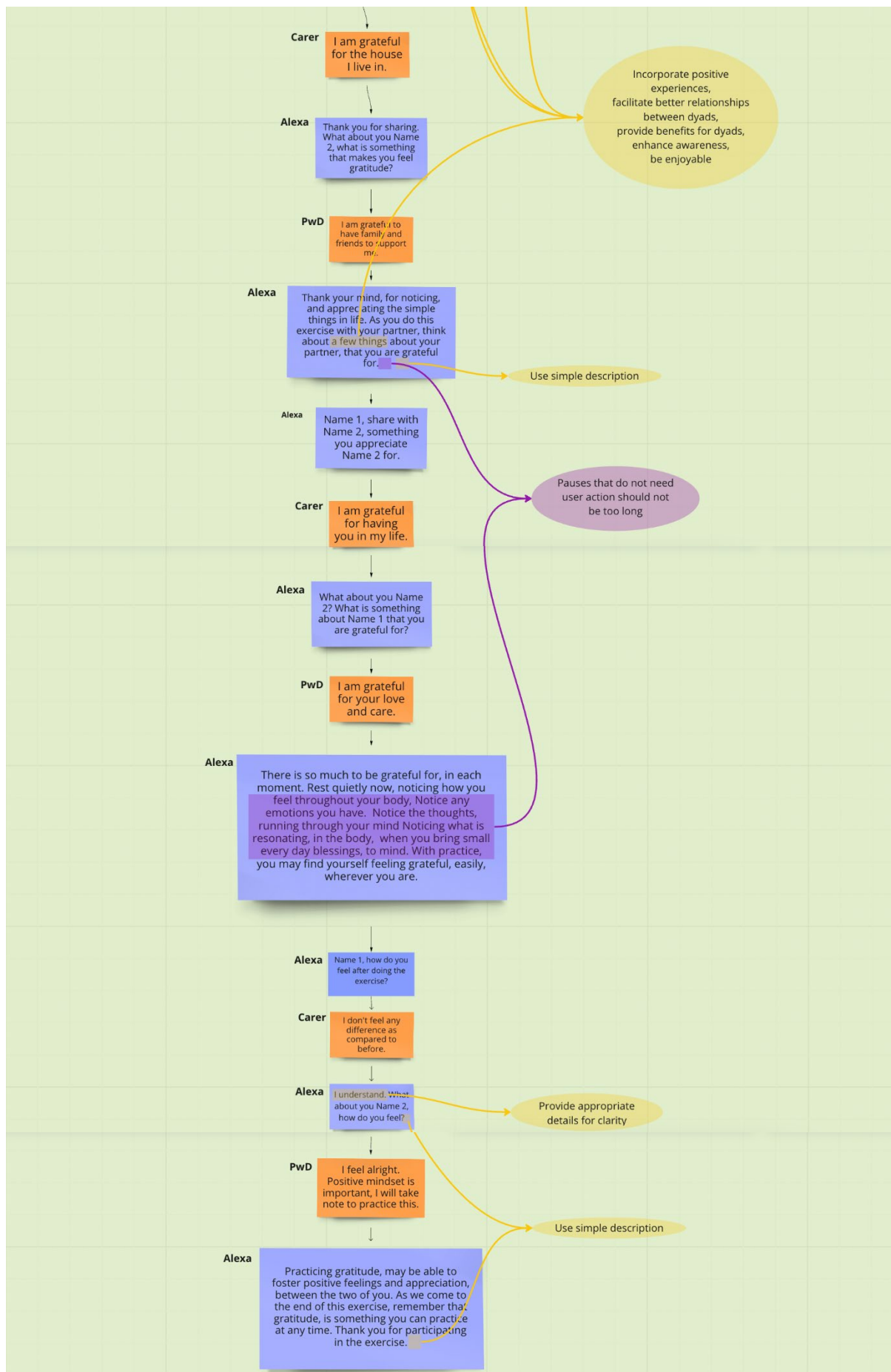
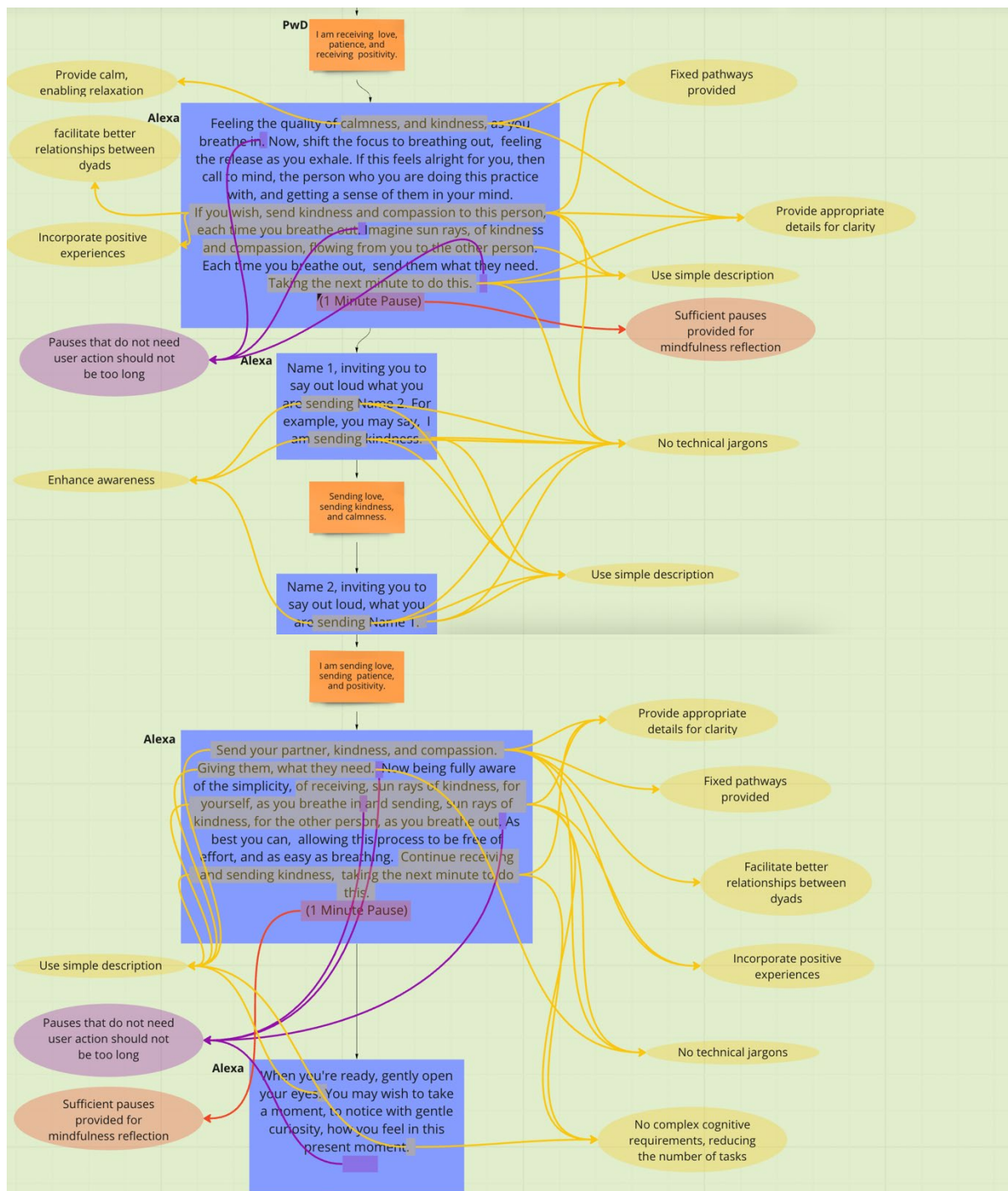
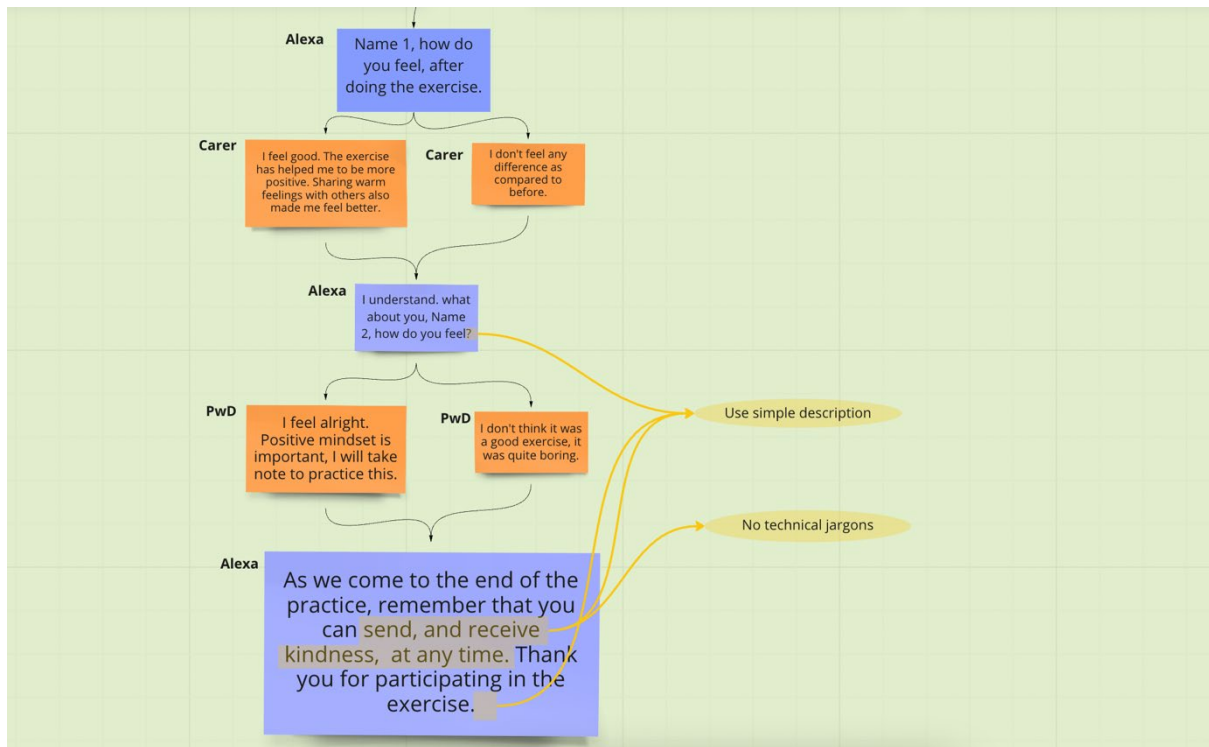


Figure 33. Iteration 4 kindness practice







4.7 Discussion

4.7.1 Principal Results

Understanding user needs helped to define the aims and mechanism of mindfulness activities, leading to more effective designs that have the potential to meet the needs of both persons with dementia and their caregivers. Each iteration aided researchers in understanding user needs, improving the mindfulness activity mechanism and script before a prototype, usable through a CA, could be developed. The multiple design iterations enabled the development of mindfulness activities that addressed the needs brought up by both (1) users—persons with dementia and caregivers, as well as (2) experts—mindfulness experts and dementia experts. It was essential to obtain feedback from users as lived-experience pairs, however, expert feedback was also useful as they have had past experiences developing and running programmes for persons with dementia. A minority of feedback from experts were contradictory to feedback from users. However, in such instances, mindfulness exercises were modified based on user feedback, as they were the ultimate users.

The different iterations relied on feedback from experts and users separately. However, it may have been beneficial for experts and users to provide feedback together as a group. This would have prevented any misalignment in terms of feedback provided by experts on user needs. However, with too many participant types during an interview, it may be difficult to capture information from each participant, as it would have been difficult to go in depth with interview questions for each individual during the hour-long interview. Furthermore, longer interviews would have made it challenging for persons with dementia to focus. Therefore, interviews were held separately to explore user needs in detail.

Having expert and user feedback helped to enhance each iteration, even though they did not interact directly with each other. Some similarities in terms of the focus for each iteration could be found, across feedback from users and experts. Feedback on enhancing accessibility was present across all iteration feedback. Experts and users in iteration 3 and 4 also brought up the need to manage unintended consequences which may arise from doing the mindfulness activities and enhance relatedness between persons with dementia and caregivers. Comparing iteration 4 user feedback to researcher observation of users, enhancing accessibility, addressing unintended consequences, and removing distractions were common themes.

Table 12. Feedback comparison across iterations and researcher observation

Iteration 2 Feedback (User)	Iteration 3 Feedback (Expert)	Iteration 4 Feedback (User)	Researcher Observation (User)
Calming			
Accessible	Accessible	Accessible	Accessibility
	Positivity		
	Mindfulness		
	Reminder		
	Flexibility		
	Unintended consequences	Unintended consequences	Unintended consequences
	Relatedness	Relatedness	
		Remove distraction	Remove distraction

4.7.2 Self Determination Theory Relation to Likes and Dislikes

The likes and dislikes that users mentioned had the self-determination theory deductively applied to determine autonomy, competence and relatedness satisfaction (+) and frustration (-). The total number of satisfaction and frustrations was compiled in Table 13. This enabled an understanding of the psychological needs each mindfulness activity could address, and identified the areas that needed to be improved on.

Table 13. Likes and dislikes categorisation according to self-determination components

		Autonomy		Competence		Relatedness	
Activity	Participant	+	-	+	-	+	-
Mindful Breathing	Caregiver	+4	-4	+2	-1	+1	0
	Person with Dementia	+5	-3	+4	-2	0	0
	Caregiver	+4	-2	+3	-6	+1	0

Mindful Movement	Person with Dementia	+1	-1	+4	-3	+1	-1
Making Space	Caregiver	0	-2	+5	-2	0	0
	Person with Dementia	+1	-1	+4	0	0	0
Gratitude Practice	Caregiver	0	-2	+3	0	+2	0
	Person with Dementia	0	-1	+2	-2	+2	0
Compassion Practice	Caregiver	0	-2	+4	-3	+2	0
	Person with Dementia	0	-1	+2	-3	+3	0

Participants generally responded positively to the MB exercise. Based on what participants liked and disliked about the activity, participants had higher levels of autonomy satisfaction and frustrations. Participants found it easy to use, but aspects of the exercise need to be modified to ensure that environmental distractions are reduced, and the flow of the exercise is smoother. Persons with dementia, however, brought up more competence satisfaction, this may be because MB is a relatively easy activity to do which helped them to feel relaxed, not requiring much cognitive skills, enabling them to stay in the present moment.

Participants did not respond particularly well to MM activity, as it had the lowest scores as compared to the other four activities. Caregivers had high levels of autonomy satisfaction and competence satisfaction as they found MM accessible and useful. However, caregivers had even higher levels of competence frustration, mentioning that the activity lacked clarity which probably led to the low scores MM had as compared to other activities. Persons with dementia had higher levels of competence satisfaction and competence frustration for MM. Although they found it useful, they similarly mentioned that the activity lacked clarity, and they found it confusing to do.

Participants generally responded positively to the MS activity. Participants had higher levels of competence satisfaction as they found the activity useful. This could be because the activity

encouraged them to slow down and let any and all thoughts go, whether they were positive or negative. By practicing cognitive defusion and looking at thoughts rather than from them, they mentioned that they felt like “thoughts were being carried away”, helping to “clear (their) mind”.

Participants generally responded positively to GP. Participants had higher levels of competence and relatedness satisfaction as they could experience gratitude and felt appreciated by their partners. Caregivers, however, had autonomy frustration, as they preferred more gratitude components within the activity and felt that the activity needed a smoother flow. Persons with dementia, however, had competence frustration as examples was confusing to one participant and another had hearing problems.

Participants generally responded positively to CP. Caregivers had higher levels of competence satisfaction where they felt empathy and compassion, however, some caregivers experienced competence frustration from negative feelings which arose when doing the exercise. Persons with dementia, on the other hand, experienced higher levels of competence frustration from being unable to do the activity, as they could not meet the activity cognitive requirements. They did however find the activity relaxing, adding on to their competence satisfaction. Persons with dementia also had high levels of relatedness satisfaction, experiencing empathy and compassion while connecting with their caregivers.

4.7.3 Usage Preferences and Design Implications

Majority of participants found Alexa’s English accent easy to understand. Using an English accent for Alexa to cater to participants in the United Kingdom may be appropriate, as it could make it easier for participants to understand and do mindfulness activities. It is important to design mindfulness activities to meet the needs of the users, and ensuring comprehension based on the type of accent used is essential.

As the duration of the mindfulness activities was considered just nice by almost all participants, the duration of mindfulness activities should not be modified. Keeping mindfulness activities at approximately 10 minutes per session may be useful in helping dyads practice mindfulness and stay focused while doing it, as compared to typical mindfulness group activities, which generally last between 2 to 2.5 hours per session.

Many participants would like to have reminders to help them remember to do mindfulness activities. However, many also needed the option to do mindfulness activities whenever they request for it. Having reminders may be helpful for persons with dementia as their condition decline causing them to become more forgetful, or for caregivers as their burden increases. Having the option to request for mindfulness activities whenever needed also allows them to choose when they would like to do a mindful activity, giving them the autonomy to practice. Having both options available for the dyad facilitates the formation of mindful habits, which may eventually be useful for them as the dementia progresses.

As all participants were keen to use mindfulness activities regularly, with majority potentially using them 1-3 times a week, it indicates that they found the mindfulness activities useful. All participants mentioned that it could fit into their lives and habits, with most using them to relax. Although the aim of mindfulness is to develop “a receptive attention to and awareness of present events and experiences” (Brown, Ryan, & Creswell, 2007), and not to cultivate a sense of calm, most participants seemed to have found it calming and would prefer to use it before bedtime. As dyads have high levels of stress and worries, having mindfulness in their daily habits could inadvertently provide some peace.

Majority of participants mentioned the possibility of mindfulness translating into something they would do in their daily lives, as a habit, without the need to use Alexa. Most of them said that they could do this after using it for a few months. However, it is uncertain if that would be the case for persons with dementia as their condition progresses, although four out of five of them said they require 1 week to 6 months before they can do it without Alexa.

The living room would be a good place for dyads to practice mindfulness, as majority preferred it. They needed a quiet and calming space. However, during the interviews, there were several external environmental distractions like the sound of air conditioner, or dogs walking into the room, which prevented some dyads from focusing during the activity. Activities need to remind dyads to ensure that they minimise potential distractions before starting a mindfulness activity. Regarding choosing where they seat or how they seat during the mindfulness activity, a chair or sofa sitting near to each other, was preferred. Before activities begin, dyads need to be advised on where and how to seat depending on what is needed, as some activities like MM requires moving one’s legs and hands, and others require dyads to face each other.

60% of participants would not face each other while doing mindfulness activities because of furniture placements or finding it too formal. Given the feedback from users to enhance relatedness, the compassion activity for example, could be modified to encourage participants to hold each other's hands and imagine sending each other warmth and care. In such mindfulness activities, participants could be given the option to hold hands if they would like to.

4.7.4 Limitations

Firstly, results may not represent the population because users and experts interviewed were tech savvy. Interviews were held digitally because of the COVID-19 pandemic, and only participants who could use digital tools—video conferencing software and social media, were recruited for the study. This limited the generalisability of the results, as there would likely be participants who are not as familiar with technology, which may cause the bias in the study's sample. Future studies should utilise results from a more comprehensive range of users.

Secondly, the CA prototype was not tested independently with users and experts using Alexa. Iteration 1 feedback from users were based on relatively brief demonstrations but it gave users an idea of what each mindfulness activity aimed to achieve. This however gave researchers an idea of which mindfulness activity might have potential to develop further for iteration 2. Iteration 2 feedback relied on the responses from experts as they read through mindfulness scripts written on Miro. Researchers were also present and discussed comments made by experts before they were written on Miro. Although this did not reflect the actual experience of using mindfulness through CAs, it sufficed to help experts have an idea about what each activity aimed to achieve in terms of the mechanism and phrasing. Iteration 3 was then further developed based on the scripts and put into Voiceflow with pauses to mimic a more realistic interaction. Iteration 3 feedback relied on the responses from users as they interacted with the Voiceflow CA through a Microsoft Teams online meeting with researchers. This had some limitations as the researcher was present and resolved some technical difficulties because of mispronunciation or where the system did not pick up what users mentioned. This did not reflect how users would use the CA in the absence of a researcher and may not represent their true experience. However, this was sufficient for the purpose of the study as it aimed to

understand how users perceived the mindfulness activities, and to understand aspects of each activity that needed to be improved.

Thirdly, a small sample size of users volunteered to participate. This was because it was difficult to recruit persons with dementia and caregivers for the study. Nevertheless, the richness of the insights from the feedback users provided were satisfactory to improve on the prototype iterations.

Lastly, persons with dementia and caregivers who volunteered to participate in the study through advertisements posted on Facebook, may create volunteer bias. This is because volunteers may not represent the general population which may include less motivated persons. Volunteer numbers should be increased to prevent volunteer bias in future studies.

4.8 Conclusion

This study helps fill the gap in the literature concerning the needs of persons with dementia and their caregivers, informed by a user centred design approach involving both user and expert perspectives. The process involved four iterations of understanding users, developing, and refining prototypes as well as observing user's interactions with prototypes, which resulted in an understanding of user needs for each iteration. Each iteration aided the development of the final working product based on increasingly in-depth feedback from using a more enhanced version of the prototype for each round of improvements. Common needs identified across expert and user feedback throughout the iterations include (1) accessibility, (2) designing with unintended consequences in mind, and (3) enhancing relatedness. In essence, mindfulness activities designed based on the iterative feedback from users and experts were relatively well received by dyads. Needs identified by users and experts should be taken into consideration for future designs of dyadic mindfulness conversational agents for persons with dementia and their caregivers.

Chapter 5. Assessing Guidelines Effectiveness

This chapter is being prepared for a paper.

5.1 Introduction

Mindfulness interventions—MBSR, MBCT, and DBT require fixed completion periods - 8 weeks to a year, with weekly structured sessions from 2 to 2.5 hours for formal group mindful practices. However, persons with dementia have reduced memory and shorter attention spans (Arvanitakis, Shah, & Bennett, 2019), which may pose challenges in meeting their needs. They are conducted mostly in a face-to-face group setting, requiring travelling to a fixed physical location. This makes it difficult to embed mindfulness into one's lifestyle. Intervention content and implementation methods are often not personalised to individual needs and preferences. Furthermore, the existing mindfulness apps and other digital interventions have not been designed for dementia dyads. For example, mobile apps may be difficult to use for older adults, especially so, for persons with dementia. Dialogues such as those with CAs might reduce the barriers of use.

In this guideline assessment study, a working prototype designed through a user centred design approach was used. In terms of implementation methods, bite-sized activities done daily, embedded into the user's everyday life, as opposed to having long weekly mindfulness in a fixed group location, at a fixed time, for a fixed completion duration, were utilised. Facilitating choices in mindfulness programmes instead of structured group sessions could be beneficial too.

Considering the gaps identified, this guideline assessment study seeks to understand the preferences of dyads after using the novel intervention for an extended period. It also seeks to understand whether the guidelines were effective, and if the intervention may promote ease of use and encourage future usage.

5.2 Aims

5.2.1 Research Question

“Are dyadic mindfulness conversational agents design guidelines beneficial for dyads?

5.2.2 Supplementary Research Questions

Is the intervention easy to use, and what are the user’s preferences?

Is extended use of the intervention feasible, does it encourage future usage?

How would stress, worries, sense of control and relatedness be impacted?

What are some areas each mindfulness exercise should be improved on?

5.3 Methods

The ethics documents previously submitted were updated with more detailed documentation with an accompanying notice of amendment. These documents were subject to approval from the ICREC committee. After review, ethical approval was granted for this study by ICREC (21IC6573). Participant information sheets and consent forms were then explained to and shared with participants prior to the study. Informed consent was then obtained from all participants before they participated in the study.

5.3.1 Prototype

The intervention involved using Alexa, a CA, for dyads to practice mindfulness. This involved using an Alexa device that had four mindfulness activities—MB, MS, GP, and KP integrated into the system.

MB encouraged dyads to focus on the breath sensations as they inhale and exhale, staying in the present moment, while disregarding thoughts and distractions. MS utilised cognitive defusion to disengage from thoughts, by visualising a stream and watching any thoughts that arise float away without engaging in them. GP encourages expressing gratitude towards each other and oneself, and KP facilitates kindness towards oneself and others.

5.3.2 Study Design

Before the study began, a speech and language therapist conducted Montreal Cognitive Assessment (MoCA) virtually, to determine dementia stage eligibility. Persons with dementia whose MoCA scores were below 18 were excluded. The MoCA document was sent to caregivers to print out prior to the assessment. After which, the assessment was done virtually

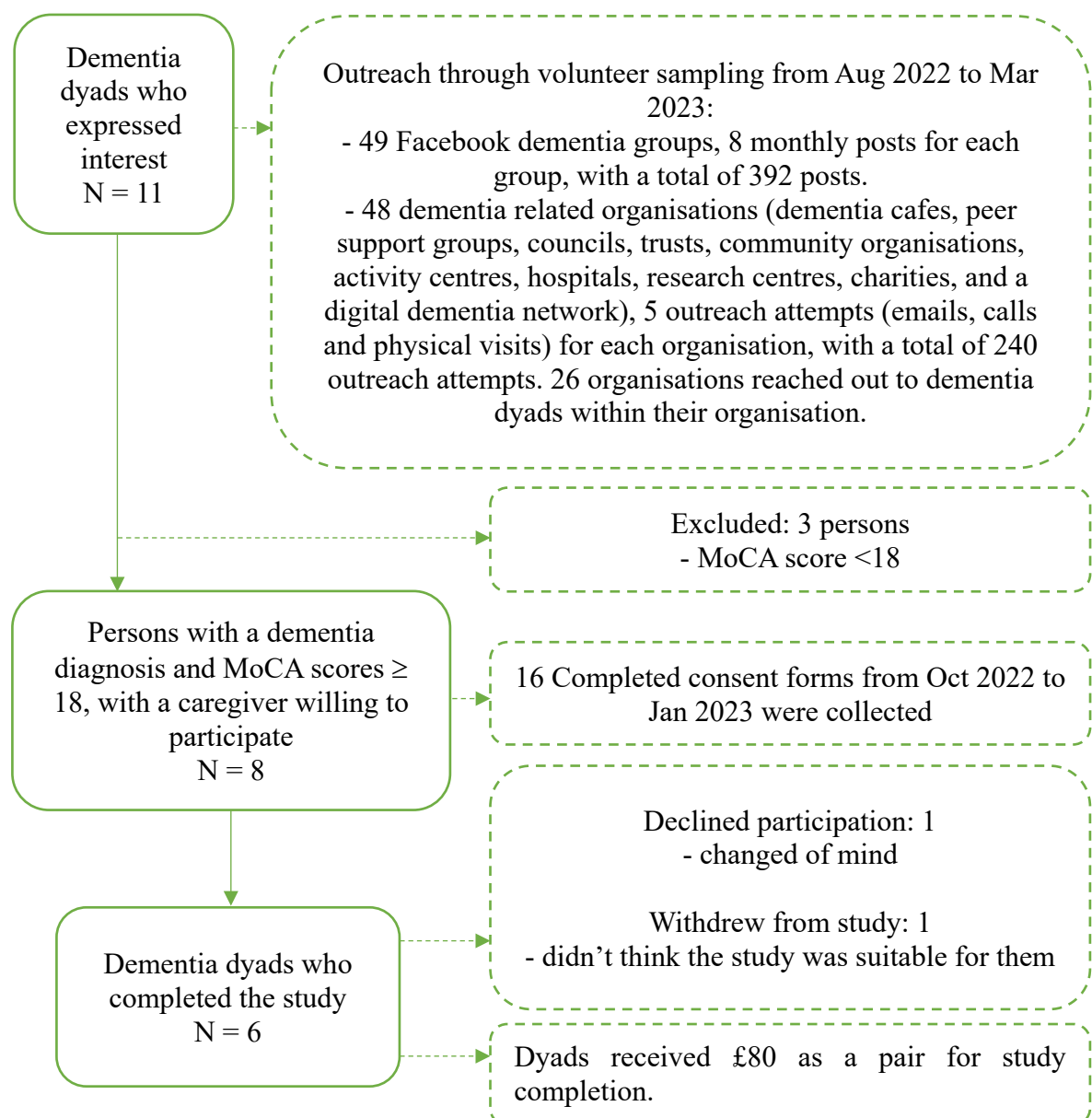
with the speech and language therapist, via Microsoft Teams. After determining study eligibility, two workbooks and one Alexa device were mailed to dyad's homes.

An introductory session, with Alexa set-up, a pre-study assessment, a demonstration, and a pre-study survey of preferences was done virtually. The introductory session comprised a mindfulness introduction, adjusting participant's mindfulness expectations, as well as explaining the study aim, study requirements, time requirements, Alexa commands, description of each mindfulness activity, and things to note about Alexa usage (*Appendix 3 & 4*). Questions raised by participants were answered. For the set-up, participants logged into the Alexa app, connected to the Alexa device, and set it up with the researcher's assistance. Personal information was entered by dyads and researchers did not have access to them. A test of each activity was done by the researcher after the set-up, to ensure a seamless experience for the rest of the study. Pre-study assessments for stress, worries, sense of control and relatedness (*Appendix 5*) were done for each participant. The assessments include the Perceived Stress Scale, Penn State Worry Questionnaire, Midi Sense of Control Scale, and the Unidimensional Relationship Closeness Scale. Perceived Stress Scale is a reliable and valid measure for dementia patients and their caregivers (Deeken, et al., 2018). Penn State Worry Questionnaire had adequate reliability and validity for older adults (Wuthrich, Johnco, & Knight, 2014). Midi Sense of Control Scale is a short self-assessment that can be easily completed (Lachman & Weaver, 1998a). Unidimensional Relationship Closeness Scale has high reliability across familial relationships (Dibble, Levine, & Park, 2012) and was an appropriate tool for measuring older adult relationships (Kimblar, Pierre-Canel, & Davis, 2015). After which, a demonstration of one activity was done by the researcher to show participants how the interaction with the Alexa device was like. The participants then tried an activity of their choice, on their own, while the researcher kept quiet but was available for assistance, and they filled in the worksheet after the activity was done. Permission to contact participants through WhatsApp to send them daily mindfulness reminders if requested, and to collect photos of their completed daily worksheets during the study duration, was obtained. A survey of preferences (*Appendix 6*) was then done to explore participant needs and preferences before they were left to do at least one activity a day, as a pair, for the next 29 days. They were required to fill in a worksheet (*Appendix 7*) for each activity done and to send it to the researcher. 30 days usage was flexible as participants need not do the activities consecutively daily, and they could also do more than one activity a day if they preferred. 362 worksheets were filled up at the end of the study.

At the end of 30 days of usage, a post-study assessment (Appendix 8) and a post-study interview (Appendix 9) was conducted virtually with each dyad to identify thoughts and preferences, before the study concluded. After study conclusion, participants were given the Alexa devices to keep so continued usage was available if they preferred. Dyads could reach out if they wanted to receive information on the published research paper, or Alexa activation commands for mindfulness activities if they wanted to use it outside of the study. All images of completed daily worksheets, surveys, and assessments were sent to researchers. Participants were thanked before they were reimbursed with vouchers for their time.

5.3.3 Participant Recruitment

Figure 34. Process map of participant recruitment



All participants had to be 18 years or older, have Wi-Fi connection at home, be able to use Microsoft Teams, be able to know how to use Alexa or equivalent, and communicate in English. Participants who had hearing difficulties or practiced mindfulness regularly were excluded. In addition,

1. Persons with dementia had to have early-stage dementia and could consent for themselves. Persons with dementia who had hallucinations were excluded.
2. Caregivers had to be primary caregivers of persons with early-stage dementia and have provided care for at least three months before recruitment.

5.3.4 Data Collection and Analysis

The MoCA examination was done virtually using Microsoft Teams where data was collected live and thereafter analysed by the speech and language therapist using Word Document version 16.77. The therapist followed the validated methodology on executing the MoCA examination and tabulating the scores. The pre-study survey, pre-study assessments, post-study assessments and post-study interview was done virtually using Microsoft Teams, where the researcher asked and clarified each question, and participants filled it up on their workbook. Even though interviews were held as a dyad, each individual was asked the same question, and their distinct responses were collected. Participants then sent the researcher pictures of their workbook data via WhatsApp, and the researcher analysed them using Microsoft Excel version 16.77.1. Pre-study and post-study assessment results were tabulated based on the instructions from each assessment tool.

Daily worksheets were sent daily to researchers via WhatsApp when each participant completed the activity. Quantitative data was analysed using Microsoft Excel version 16.77.1. For the open-ended qualitative questions, a thematic analysis approach was used to identify, analyse, and present patterns from data (Braun & Clarke, 2006). Themes were analysed using NVivo version 12.7.0 (3873). An inductive bottom-up approach was used by two PhD researchers independently, open coding data and identifying themes before comparing them across each researcher's analysis. Using Nvivo, data was coded as the researchers read through the responses. This was done by highlighting and categorising similar data as mentioned by participants into a code. Pattern coding was then done by categorising common codes into a

theme, to condense data into fewer analytical concepts. Codes and themes were re-categorised, as new or similar codes and themes emerged, as the researchers further analysed the data. This went through several iterations until the researchers were satisfied with their individual codes and themes. Themes were subsequently compared by the two researchers. Discrepancies were discussed before themes were agreed upon. The top three themes for each activity's likes and dislikes were included in the analysis if it was identified by both researchers. Excel was used to analyse data as the volume of feedback could be easily analysed using Excel. Data will be stored for at least 10 years after the study ends, and user data were removed from WhatsApp after data was collated.

5.4 Results

5.4.1 Participants

Table 14. Participant characteristics

Characteristics	Number of Participants
Age, mean (64.17 years old)	
40-49 years old	1
50-59 years old	2
60-69 years old	
70-79 years old	6
	3
Education	
Secondary school	4
A level equivalent	3
Bachelors	3
Masters	2
Dementia Type	
Alzheimer's	2
Mixed Alzheimer's	2
Early onset Alzheimer's	2
Frontotemporal dementia	4
Early vascular dementia	2
Dementia Period	
1-2 years	2

3-4 years	4
5-6 years	6

5 caregivers (C) and 5 persons with dementia (PwD) had a spousal relationship, while 2 participants (1C, 1PwD) had a parent-child relationship. Most of the participants were aged 60-79 years old, with many being females (4C, 3PwD). The participants had a mixture of educational backgrounds, with a slight majority having completed secondary school education. Most participants had a variety of Alzheimer's disease and frontotemporal dementia, of which, 5-6 years were the most common duration participants have had dementia for.

5.4.2 Participant Responses

Table 15. Participant quantitative responses

Questions	Number of Participants Pre-Study	Number of Participants Post-Study
How loud should the volume be?		
25%	2	
50%	9	
75%	1	
Is the voice and accent easy to understand?		
Yes	12	
No	0	
Would you like a reminder from Alexa to remind you to do mindfulness at a certain time each day?		
Yes	6	
No	6	
How did you activate the mindfulness exercises?		
Ask Alexa to start	10	
Reminder at set time	2	
What time did the both of you do the mindfulness exercises?		
	4	

Morning	4	
Afternoon	2	
Evening	2	
Late Night	2	
No Set Time		
Where did you place Alexa in your home?		
Lounge	4	
Dining Room	2	
Kitchen	3	
Multiple Places	3	
Is the set-up location the same from the start of the study?		
Yes	12	
No	0	
On a scale of 1-5, how easy or difficult was it to use the conversational agent (Alexa)?		
Most Difficult	0	0
Difficult	1	0
Neutral	2	2
Easy	3	6
Most Easy	6	4
Have you had any experience with conversational agents like Alexa or equivalent, prior to this study?		
Yes	7	
No	5	
Do you think that it would be more challenging to use the intervention as dementia declines or as caregiving duties increase?		
Yes	10	
No	2	
Have you had any experience with mindfulness prior to this study?		

Yes	4	
No	8	
On a scale of 1-5, how much did you like or dislike mindfulness activities?		
Disliked Most	0	0
Disliked	0	0
Neutral	4	1
Liked	3	5
Liked Most	5	6
On a scale of 1-5, how much did you like or dislike a paired approach for mindfulness?		
Disliked Most	1	1
Disliked	0	0
Neutral	2	0
Liked	4	2
Liked Most	5	9
On a scale of 1-5, how much did you like or dislike using conversational agents (Alexa) to practice mindfulness with each other?		
Disliked Most	0	0
Disliked	0	0
Neutral	4	2
Liked	3	3
Liked Most	5	7
On a scale of 1-5, how useful or not useful did you find the activities?		
Least Useful	0	
Not Useful	0	
Neutral	1	
Useful	3	
Most Useful	8	

What do you think about the length of the activities?		
Too Short	4	
Just Nice	7	
Too Long	1	
Were there sufficient activities for the both of you to do?		
Yes	12	
No	0	
Were these mindfulness exercises able to fit into your lives or habits?		
Yes	12	
No	0	
Did mindfulness exercises you learned through Alexa, translate to something you practiced whenever you needed? For instance, as you go about your daily life, and felt that a mindfulness exercise was something you needed, you then did it on your own without Alexa guiding you?		
Yes		
No	11	
	1	
How long did/would it take to translate into something you do in your daily life, without Alexa guiding you?		
As a lifestyle	1	
A year	0	
6 months	0	
3 months	2	
1 month	0	
3 weeks	2	
2 weeks	1	
1 week	4	

I do not need Alexa to guide me	2	
Would you do these mindfulness exercises regularly after the study ends (at least once a week)?		
Yes	10	
No	2	
How often would you do these mindfulness activities after the study ends (Assuming you had access to it)?		
Everyday	4	
3x a week	4	
1x a week	2	
1x a month	0	
Seldom	1	
Never	1	
How long would you do these mindfulness activities for, after the study ends (Assuming you had access to it)?		
As a lifestyle	8	
A year	0	
6 months	1	
3 months	0	
1 month	1	
1 week	0	
Never	2	
Were tangible activities like Mindful Breathing or thought-based activities like Making Space easy to use?		
Tangible Based	9	
Thought Based	1	
Both Easy	2	
Did you find any benefits from doing the activities for the last month?		

Yes	12	
No	0	
Were there any challenges you faced in the last month?		
Yes	10	
No	2	
On a scale of 0 to 10, how likely is it you would recommend this intervention to a friend or colleague?		
0 to 10	7.8	

5.4.2.1 Set Up Details

Most participants prefer a 50% volume. Additionally, 5 out of 6 dyads had the same volume preference for both individuals in the dyad, one dyad however had a 50% and 75% volume preference for each individual. The voice and accent were easy to understand for all dyads. The British accent was used for 8 participants who participated in the United Kingdom, a Canadian accent was used for 2 participants in Canada, and an American accent was used for 2 participants in America. Regarding usage methods, at the start of the study, there was an equal number of participants who needed Alexa reminders in case they forgot (3C,3PwD) and those who preferred to do activities on their own time as they had a varied lifestyle (3C,3PwD). Both individuals in the dyad had the same response as a pair. However, at the end of the study, 10 participants (5C,5PwD) preferred to activate Alexa whenever they wished to do the activity. 2 participants (1C,1PwD) preferred to use reminders. Whether they started the activities themselves or used reminders, participants did mindfulness exercises at various times of the day, with most doing them in the morning and afternoons (4C, 4PwD). They had varying routines, and one dyad did not have fixed timings as well. Lastly, Alexa was placed in a variety of home spaces that were quiet and reflective, without the possibility of being disturbed. Participants sat on chairs or sofas in a comfortable and relaxing space. 10 participants (5C, 5PwD) sat near each other for convenience and reassurance, while 2 (1C, 1PwD) did not, as there was no need to do so. 11 participants (5C, 6PwD) did not seat facing each other because of furniture placement and there was no need to do so, also it might be distracting. The set-up location remained the same throughout the study according to all participants (6C, 6PwD).

5.4.2.2 Ease of Use

It was easy to use the CA according to 9 participants (5C, 4PwD) who rated 4 or 5 out of a Likert scale of 1 to 5. Participants gave a high rating as they found it consistent and straightforward with a clear voice. 3 caregivers and 2 PwDs did not have prior experience with using CAs, and from the 5 participants, 1 PwD found it difficult to use as it was difficult to understand and answer Alexa, while 1 caregiver and 1 PwD were neutral. 2 caregivers found it easy to use despite not having prior experience. 1 PwD who had prior experience found the CA easy to use, and 3 caregivers and 3 PwDs who had prior experience found the CA most easy to use. 6 participants (3C, 3PwD) who had prior experience used Alexa while 1 PwD had prior experience using Siri, both for entertainment and necessities. At the start of the study, 5 participants (2C, 3PwD) who had prior experience, were still using Alexa.

At the end of the study, 10 participants (4C, 6PwD) were asked the same question on ease of use using a Likert scale of 1 to 5. They rated the CA 4 or 5 out of 5, finding it easy to use as it was straightforward and responsive, while 2 other caregivers were neutral as it had technical difficulties on some occasions. It was interesting that 2 PwDs found it easier to use after using the CA for a period of time. However, as the dementia condition declines and as caregiving duties increase, 10 participants (5C, 5PwD) would find it more challenging to use because of reduced comprehension, focus, recall, speech patterns and lesser time. 2 participants (1C, 1PwD) would not find a difference. To mitigate challenges, Alexa should be more user friendly, and personalised to declining needs, whilst developing participant's routines through reminders. The mindfulness activities can also be done with small peer support groups, and more assistance can be provided by caregivers or Alexa.

5.4.2.3 Intervention Preferences

8 participants (5C, 3PwD) had no mindfulness experience, while 4 participants (1C, 3 PwD) had experiences with mindful activities like breathing, thoughtfulness, and yoga, which were used for relaxation, awareness, mental space, and gratitude. None of the participants who had prior experiences with mindfulness were still practicing, which fulfilled the study inclusion criteria. After doing the first mindfulness activity, 8 participants (4C, 4PwD) liked the experience as it was a new experience with clear instructions, that helped them have more awareness, relaxation, and a clear mind. 4 participants (2C, 2PwD) were neutral as they needed more practice or just was not very interested. At the end of the study, an increased number of 11 participants (6C,

5PwD) liked the experience as it provided a means to cope and provided benefits like a clear mind, better sleep, and mood. It also allowed them to focus on one thing, which enabled them to relax and reflect, while 1 PwD remained neutral. Looking at caregiver and PwD scores over time, two caregivers changed scores from 3 to 4, and one PwD from 3 to 5. None of the participants disliked the activity throughout the study.

Regarding doing mindfulness as a pair, 9 participants (4C, 5PwD) liked the experience as it was a relaxing shared experience which helped them to feel closer and encourage each other while reinforcing the practice. 2 participants (1C, 1PwD) were neutral as it was difficult to concentrate on oneself and 1 caregiver highly disliked the experience as sharing felt awkward, because she did not have a sharing relationship with her mother. At the end of the study, an increased number of 11 participants (5C, 6PwD) liked the experience as it was a comfortable shared experience not tainted by dementia, that made them closer, facilitated regular usage, was supportive and reflective. The same 1 caregiver however still highly disliked the shared experience as sharing feelings was not ideal. Looking at caregiver and PwD scores over time, 2 caregivers changed scores from 4 to 5 and 1 caregiver from 3 to 5. One PwD changed scores from 3 to 5.

Using CAs as a medium to do dyadic mindfulness, 8 participants (4C, 4PwD) liked the experience as it was easy to use and had clear guidance, while 4 participants (2C, 2PwD) were neutral as it was difficult to concentrate on oneself and participants needed more practice. At the end of the study, an increased number of 10 participants (5C, 5PwD) liked the experience as it was easy to use, guided with a calm and relaxing voice with appropriate intonation, and was more interactive than reading or videos, while 2 participants (1C, 1PwD) remained neutral as Alexa had difficulties with capturing some responses and answering participants, with a lack of human touch. Comparing scores before and after the study, 1 caregiver changed scores from 3 to 4 and 2 PwDs changed scores from 3 and 4 to 5. None of the participants disliked the activity throughout the study. Additionally, the activities were useful, and most useful to 11 participants (6C, 5PwD) as it provided a coping mechanism, was calming and helped them experience gratitude whilst creating a useful routine for them as a pair. It also provided guidance, helping them to just focus on one thing, which made it easier for PwDs. It was, however, neutral to 1PwD.

5.4.2.4 *Usage Preferences*

7 participants (3C,4PwD) found the length of the activities sufficient, while 4 others (2C,2PwD) felt it was too short as more time was needed for enjoyment, deeper immersion, and progressive depth. 1 caregiver however thought it was too lengthy and needed cues to know Alexa was still running.

There were sufficient activities, and the mindfulness exercises could fit into their lives and habits, according to all participants (6C,6PwD). Activities could fit into participant's lives as it was short and able to be done anytime according to their schedules, which enabled forming easy routines and translating to independent usage without Alexa.

The mindfulness exercises learned from the study translated into participant's daily lives, being used whenever they needed, without Alexa's help according to 11 participants (6C,5PwD) as it improved participant's state of mind, became habitual and provided a coping mechanism in difficult situations which led to improved confidence. 1PwD felt otherwise, as Alexa was needed for reminders and guidance.

Participants required a variety of timeframes for mindfulness activities to translate into their daily lives, with majority (2C, 2PwD) stating that 1 week was sufficient as it was enjoyable, clear, easy to follow and use independently before it became habitual.

After the study ended, 10 participants (4C, 6PwD), would do the mindfulness exercises regularly as they were useful, positive, calming, enjoyable and cleared their minds. The activities enabled them to maintain a routine, provided guidance, and facilitated forming of coping mechanisms. It also brought partners closer and provided shared experiences independent of dementia. 2 caregivers would not do it regularly as it is not something they would usually do. On frequency of usage, 8 participants (4C, 4PwD) would do it every day or 3 times a week, while 2 persons with dementia would do it 1 time a week. The remaining 2 caregivers would seldom or never use it. Regarding how long they would do the activities for after the study ends, 8 participants (4C, 4PwD) would do it as a lifestyle as it provided calmness, gratitude, positivity, maintained their routine, helped form coping mechanism and had no completion date.

5.4.2.5 Benefits and Challenges

12 participants experienced a multitude of benefits from doing the activities, like having more calmness, time together, closer relationship, better sleep, clearer mind, self-awareness, and a better coping mechanism. It also gave them the opportunity to recall memories, and express gratitude and kindness towards others. Most participants (5C, 5PwD) were likely to recommend the intervention to a friend or colleague.

10 participants (6C, 4PwD) mentioned facing technical challenges like Wi-Fi issues, or where Alexa could not capture their responses accurately, also participants had limited thinking time before Alexa assumed lack of responses and restarted the section, and Alexa often skipped to the next part assuming the end of the participant's sentence when they paused to think. Participants also had difficulty understanding some instructions, reflecting for too long, finding some activities difficult to visualise, connect to, and enjoy. It was also challenging to find time together and they could not do activities when travelling. Some caregivers also could not focus on themselves when guiding PwDs during the dyadic exercises and requested for some individual practices. 2 PwDs, on the other hand, did not face any challenges.

5.4.2.6 Individual Activity Preferences (30 Day Averages)

Table 16. Mean and total scores for individual activity preferences

	Mean	Total
Overall Activity Usage		
Mindful Breathing	5.20	156
Making Space	3.68	70
Gratitude Practice	3.52	74
Kindness Practice	3.10	62
Ease of Understanding Activity (Likert Scale 1-5)		
Mindful Breathing	4.60	
Making Space	4.47	
Gratitude Practice	4.46	
Kindness Practice	4.31	
Likelihood of Using it Again		

(Likert Scale 1-5)		
Mindful Breathing	4.44	
Making Space	3.91	
Gratitude Practice	3.95	
Kindness Practice	3.79	
Likelihood of Regular Usage (Yes/No Option)		
Mindful Breathing Yes	4.90	
Mindful Breathing No	1.00	
Making Space Yes	2.72	
Making Space No	1.50	
Gratitude Practice Yes	2.75	
Gratitude Practice No	1.36	
Kindness Practice Yes	2.25	
Kindness Practice No	1.42	
How Much Activity was Liked (Likert Scale 1-5)		
Mindful Breathing	4.40	
Making Space	3.93	
Gratitude Practice	4.04	
Kindness Practice	3.81	
Translation to Daily Life Usage Without Alexa (Likert Scale 1-5)		
Mindful Breathing	3.74	
Making Space	3.41	
Gratitude Practice	3.85	
Kindness Practice	3.63	
How Participants Feel After Activity (Likert Scale 1-5)		
Mindful Breathing	4.42	
Making Space	4.29	
Gratitude Practice	4.26	
Kindness Practice	4.29	

Most participants (5C, 5PwD) did one activity a day for 30 days. However, one dyad (1C, 1PwD) did two activities on day 21, but resumed to doing one activity a day for the rest of the study. MB was used 156 times throughout the study, whereas MS, GP and KP were used 70, 74 and 62 times, respectively. All activities were generally easy to understand, well liked, helped dyads feel good after doing them, and likely to be done again, as all activities had high mean scores. A high number of participants would do MB regularly, at least once a week, with very few participants not interested in regular usage. MS, GP, and KP, however, had few participants who would do the activities regularly. Compared to MB, more participants for MS, GP and KP were not likely to engage in regular usage. Without Alexa, activities could potentially translate to something dyads can do whenever they need, as all activities had similar moderately high mean scores.

Tangible activities like MB were the easiest to use according to 9 participants (6C,3PwD) as MS was abstract, required more effort, had lengthy reflection time and distracting river background sounds, as well as was difficult to focus on and visualise. Participants found it more difficult to articulate answers quickly and easily, and because it was more challenging, caregivers needed to help PwDs more as well. 3 PwDs, however, found both easy to use.

Mindful Breathing

Dyads liked that MB helped them to feel calmness, mindfulness, and was enjoyable. Some participants, however, disliked that MB had some technical limitations, with unsuitable lengths, and that they were distracted by external factors.

Making Space

Dyads liked that MS was calming, mindful, and straightforward. Some participants disliked how MS had some technical limitations, was difficult to use and the background sound was too loud.

Gratitude Practice

Dyads liked that GP encouraged gratitude thinking, calmness and the expression of gratitude. Some participants disliked that GP had technical limitations, was too short an activity and was difficult to understand.

Kindness Practice

Dyads liked that KP gave them the opportunity to experience calmness, giving and receiving of kindness and internalising mindfulness. They also felt more connected to their partners. Some participants, however, disliked the technical limitations, difficulty of use and the paired work.

Participants filled in the worksheets with what they liked and disliked about each activity after doing them. The list of detailed likes and dislikes were compiled in Table 17.

Table 17. Detailed likes and dislikes

Likes	Calmness	Help participants to feel relaxed and calm Enable peacefulness between the mind and the body
	Mindfulness	Enhance attention and awareness through mindfulness Stay in the present moment Cognitive defusion to separate thoughts from self
	Enjoyable	Ensure activity is enjoyable
	Straightforward	Ensure it is straightforward and easy to understand.
	Giving & Receiving Kindness	Activity should encourage giving and receiving of kindness.
	Feeling Connected	Activity should help participants to feel connected with each other.

	Gratitude Thinking and Expressing Gratitude	Activities should provide opportunities for gratitude thinking and expression.
Dislikes	Technical Limitations	Alexa needs to be able to capture responses even if participants are too soft, mispronounce words, or have hoarse voices. Alexa needs to adapt appropriately if participants do not respond or respond incorrectly. Alexa needs to provide enough time for participants to think and respond, even as their condition fluctuates. Alexa needs to allow for more complex conversations and understanding of participant responses to facilitate deeper mindfulness. Alexa's name recognition needs to be improved. Alexa needs to prevent technical malfunctions.

	Unsuitable Lengths	Activity was too long or too short for different participants and needed to be personalised to each individual.
	External Distractions	External distractions should be managed before doing the activity.
	Difficult to Use	Activity should be easy for participants to practice well and understand what was needed. Some participants may find it difficult to visualise and contingencies should be made to cater to them. Terminology should not be used as they were difficult to understand.
	Sound was too Loud	Background sound should be peaceful and at an appropriate pace.
	Disliked paired work	Activities need to ensure that tasks are not too intimate. Alexa depends on both participant's responses and one participant can be affected because of the

		other's responses or lack thereof. Activities should have contingencies in such instances.
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5.4.2.7 Pre and Post Assessment Scores

Table 18. Pre and post assessment scores with changes

Caregiver	Midi Sense of Control Scale	Perceived Stress Scale	Penn State Worry Questionnaire	Unidimensional Relationship Closeness
C1 Before	30 Perceived Constraints, 21 Personal Mastery	35 Score	70 Score (Chronic worrier and in need	4.91666667 Score
C1 After	44 Perceived Constraints, 23 Personal Mastery	28 Score	65 Score (Currently have some	4.66666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Decreased scores, reduced relationship closeness
PwD				
D1 Before	31 Perceived Constraints, 25 Personal Mastery	16 Score	35 Score (Bothered by worries but	4.5 Score
D1 After	40 Perceived Constraints, 27 Personal Mastery	18 Score	40 Score (Bothered by worries but	4.91666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Increased scores, more bothered by stress	Increased scores, more bothered by worries	Increased scores, improved relationship closeness
Caregiver				
C2 Before	20 Perceived Constraints, 14 Personal Mastery	39 Score	80 (Chronic worrier and in need of	6.33333333 Score
C2 After	32 Perceived Constraints, 20 Personal Mastery	31 Score	74 (Chronic worrier and in need of	6.41666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Increased scores, improved relationship closeness
PwD				
D2 Before	44 Perceived Constraints, 18 Personal Mastery	26 Score	18 (Not anxious or a worrier)	5.58333333 Score
D2 After	27 Perceived Constraints, 15 Personal Mastery	24 Score	45 (Bothered by worries but below clinical range for worry)	5.16666667 Score
Result	Decreased perceived constraint scores Decreased personal mastery scores Feel less sense of control	Decreased scores, able to better manage stress	Increased scores, more bothered by worries	Decreased scores, reduced relationship closeness
Caregiver				
C3 Before	48 Perceived Constraints, 27 Personal Mastery	28 Score	73 (Chronic worrier and in need of	6.75 Score
C3 After	54 Perceived Constraints, 28 Personal Mastery	10 Score	36 (Bothered by worries but below	6.66666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Decreased scores, reduced relationship closeness
PwD				
D3 Before	36 Perceived Constraints, 23 Personal Mastery	23 Score	41 (Bothered by worries but below	7 Score
D3 After	30 Perceived Constraints, 18 Personal Mastery	23 Score	38 (Bothered by worries but below	7 Score
Result	Decreased perceived constraint scores Decreased personal mastery scores Feel less sense of control	No change in scores, constant stress levels	Decreased scores, able to better manage worries	No change in scores, constant relationship closeness
Caregiver				
C4 Before	40 Perceived Constraints, 21 Personal Mastery	16 Score	63 (Currently have some problems	6.91666667 Score
C4 After	48 Perceived Constraints, 25 Personal Mastery	18 Score	56 (Currently have some problems	6.91666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Increased scores, more bothered by stress	Decreased scores, able to better manage worries	No change in scores, constant relationship closeness
PwD				
D4 Before	22 Perceived Constraints, 14 Personal Mastery	30 Score	70 (Chronic worrier and in need of	5.75 Score
D4 After	33 Perceived Constraints, 15 Personal Mastery	27 Score	54 (Currently have some problems	6.83333333 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Increased scores, improved relationship closeness
Caregiver				
C5 Before	42 Perceived Constraints, 23 Personal Mastery	23 Score	41 (Bothered by worries but below	6.08333333 Score
C5 After	46 Perceived Constraints, 22 Personal Mastery	17 Score	33 (Bothered by worries but below	5.91666667 Score
Result	Increased perceived constraint scores Decreased personal mastery scores Feel more sense of control overall	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Decreased scores, reduced relationship closeness
PwD				
D5 Before	29 Perceived Constraints, 14 Personal Mastery	32 Score	52 (Bothered by worries but below	6.83333333 Score
D5 After	32 Perceived Constraints, 18 Personal Mastery	26 Score	48 (Bothered by worries but below	6.58333333 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Decreased scores, reduced relationship closeness
Caregiver				
C6 Before	44 Perceived Constraints, 27 Personal Mastery	12 Score	40 (Bothered by worries but below	6 Score
C6 After	52 Perceived Constraints, 28 Personal Mastery	6 Score	31 (Bothered by worries but below	6.16666667 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Increased scores, improved relationship closeness
PwD				
D6 Before	39 Perceived Constraints, 18 Personal Mastery	24 Score	29 (Not anxious or a worrier)	6.25 Score
D6 After	49 Perceived Constraints, 25 Personal Mastery	20 Score	27 (Not anxious or a worrier)	7 Score
Result	Increased perceived constraint scores Increased personal mastery scores Feel more sense of control	Decreased scores, able to better manage stress	Decreased scores, able to better manage worries	Increased scores, improved relationship closeness

After the study ended, all caregivers felt an improved sense of control and reduced worries. 5 caregivers had reduced perceived stress while 1 caregiver was more bothered by stress. However, only two caregivers experienced a marginal increase of closeness with their partner. Three caregivers had a marginally reduced score while one had no change in scores.

4 Pwds felt an improved sense of control, reduced perceived stress and worries. 2 Pwds had reduced sense of control and more worries, while 1 Pwd had more stress, and another 1 Pwd had no change in scores for stress. 3 Pwds felt increased closeness with their partners, while two Pwds had reduced relationship closeness and 1 Pwd had no change in scores.

5.5 Discussion

5.5.1 Principal Results

5.5.1.1. *Background*

The study requirements could have attracted spousal couples, as it needed participants who could participate daily and were most likely living together. There was a relatively equal mix of male and female participants, and although most participants were older, they could navigate digital technologies smoothly. Despite having varied educational backgrounds, dementia types and how long they had dementia, they did not seem to have difficulty using the intervention.

5.5.1.2. *Personalisation*

It was good that the use of CAs enabled personalisation to meet varying dyad's needs, and this would not have been possible in a group setting. Personalisation catered to individual needs, by having an easy-to-understand automated voice and accent, which was necessary for dyads to do the activities well. CAs enabled dyads to use it whenever they wanted, set, or cancel reminders as needed, which catered for higher levels of flexibility to ensure a more engaging experience with the intervention. Usage patterns at the end of the study revealed that activating Alexa at a participant's own time was preferred, because participants had varying routines, with some not having a fixed routine as well, reiterating the need for personalisation.

5.5.1.3. *Spaces*

Spaces chosen were based on where participants felt the most comfort and convenience to do the mindful activities. It had a space to seat, a connection source for power, and

allowed for Wi-Fi connection. Although spaces were meant to be quiet, to aid being mindful, some participants were distracted by phone calls and their pets. It did not matter whether participants were facing each other, as the activities gave them the option to close their eyes. But sitting near each other would be useful to facilitate closeness, as some activities gave them options to hold hands and say words of gratitude and kindness to each other. The spaces chosen were suitable as participants did not change the CA location during the study.

5.5.1.4. *Intervention Preferences*

Given that it was the dyad's first experience with the intervention, and the first experience with CAs for some participants, the CA experience was relatively smooth, with most finding it easy to engage with. As half of the participants had prior experience with Alexa, with 5 still using Alexa, and one participant had experience with Siri, this could have facilitated the mindfulness experience as they knew how to use CAs. The scores for ease of use of CAs before and after the study were marginally different and could have meant that it was easy to engage with for majority of the participants at the beginning and the end of the study. As the dementia condition deteriorates, and dyads may find the intervention more challenging, interventions need to cater to modified needs such as reduced cognitive abilities and lesser time availability. There might even be higher levels of negative emotions which mindfulness could reduce, or if hindered by technological barriers, might amplify.

Even though 4 participants have had prior experiences with mindful forms of exercises, the exercises they experienced differed from the ones in the intervention, except for breathing and gratitude. Also, this study incorporates a dyadic approach using CAs as a medium, where the mindfulness exercises were designed for a novel dyadic interaction. Most participants had a good first experience with the intervention and enjoyed mindfulness, doing it as a pair and also having CAs as a means of usage. More participants liked the intervention post study, revealing that the intervention was preferred more, even after extended usage. Almost all participants found the intervention useful, with only one caregiver disliking the paired experience, as the caregiver did not seem to have a sharing relationship with the PwD. Relationships between dyads for such interventions should be considered for future studies. Participants also brought up the need for interventions to provide individual usage for

caregivers as some participants had to help PwDs during the activities, and it caused them to feel stressed.

Future activities could provide personalised durations to cater to varying needs for different individuals, and for the same individual as their condition deteriorates. Regarding the number of activities, a large variety was unnecessary for engagement and benefits. A few simple and effective activities were enough to do so. The activities as they were designed could fit into participant's daily lives, which indicates that future interventions following this model may be useful for dyads. Also, as only one dyad did more than one activity a day on day 21 of the study, this reveals that a short mindfulness session is sufficient for the pair instead of lengthy mindfulness sessions done over extended periods of time. As mindfulness further translated into other aspects of participant's daily lives without the use of Alexa's guidance, this indicates that the usage transcended the study requirements, and the benefits encouraged them to apply the mindfulness activities in other contexts as needed. However, regarding the time frame needed for activities to translate to daily life, it varied greatly from 1 week to using it as a lifestyle. This reaffirms the need for such interventions to be more personalised to meet varying needs. Given that after the study ended, and almost all participants were willing to do the mindfulness exercises regularly—daily, 3 times a week and 1 time a week, with intention to do them as a lifestyle, this meant that the intervention was beneficial for dyads, and had the potential to aid forming of mindful habits. As all participants experienced benefits from using the intervention and most were likely to recommend it to others, this revealed that it is a useful tool for dyads. Although 2 PwDs mentioned not facing any challenges, their caregivers observed them having some difficulties using the device. Most of the other participants faced difficulties that were technical errors or necessary user improvements that needed to be addressed for future interventions.

5.5.1.5. Individual Activity Preferences

From participant usage patterns, dyads tried out different exercises at the beginning, but seemed to prefer MB overall as there was a proportionally larger usage of MB throughout the study, as compared to the other 3 activities. MB could be useful in helping dyads feel better especially during negative circumstances, as MB had the highest mean score as compared to the other three activities, although all three rated

highly as well. MB had consistently high likelihood of participants doing it again, with scores ranging from 4.0-5.0 throughout the study as compared to the other activities. Although scores fluctuated throughout the study, MS, GP, and KP had a relatively high likelihood of repeat usage scores as well. In terms of regular usage likelihood, MB had the highest scores and MS, GP, and KP had a lower likelihood of regular usage. MB was also the most well-liked activity, although the other three activities were highly rated as well. MS required metacognition, which was challenging. MB was more tangible and therefore easier to use, which could meet PwD needs as they decline. Thought-based activities like MS, that are useful for dyads could still be incorporated into future interventions for variety, but require modification to ensure appropriate usage. The high ease of understanding for all activities suggests that the CA content and interaction were accurately implemented to suit dyads' varying needs. This was likely due to the activity content and implementation methods designed to meet dyad's needs. Implementation methods considered the CA voice, intonation, speed, timed pauses for reflection and short activity time. The content was also designed with easy-to-understand language and appropriate cognitive load. All activities could be useful outside of the mindfulness study session, potentially without the help of Alexa, because activities were rated with moderately high mean scores when asked if they would translate to daily life. However, some dyads may still need Alexa to guide them.

5.5.1.6. Likes and Dislikes

The likes and dislikes varied for each activity, however calmness and mindfulness were themes that emerged across all activities. They were important, as they could have been beneficial in reducing stress and worries. As it cultivated calmness and mindfulness, it gave them a means to cope with stressful situations, providing them with a useful coping mechanism and increasing their sense of control during uncertain situations. Activities were also very enjoyable and straightforward, which made it easy for dyads to do. Relatedness was enhanced through GP and KP as the activities cultivated appreciation and empathy for oneself and others, facilitating closeness with each other. This seemed to be particularly important in promoting relatedness between dyads as the disease progresses and their relationship strains.

5.5.1.7. Technology Limitations

There were many limitations some of which could be improved through future iterations, however there were others that were limited by current technological capabilities, which means technology needs to advance further before such limitations can be addressed. Firstly, Alexa is not intelligent enough to capture responses out of its current scope. For instance, when a participant was too soft, mispronounced words or had hoarse voices, it could not continue with the activity. Alexa also needs to be adapted to the infinite multitude of possible responses, so that when participants do not respond or respond incorrectly which may be increasingly prevalent for persons with dementia as they deteriorate, Alexa could carry on with the rest of the activity in a meaningful and effective manner, not eliciting technology related frustrations. Secondly, for response time, dyads have a limited response time of 8 seconds before it repeats itself or shuts down. This is a limit set by Alexa, and as a result, prevents dyads, especially persons with dementia from having sufficient time to think and respond. This restricts them from diving deep into their thoughts and encourages one-word responses. It also causes frustration for persons with dementia, and this subsequently affects the caregiver as they have to troubleshoot and guide their partner. Alexa has to provide a seamless experience for both persons with dementia and their caregivers, troubleshooting in such instances. Thirdly, the intervention cannot comprehend complex answers from dyads, preventing deep thought and reflection, causing dyads to have shallow understanding and a yearning to dive deeper into their thoughts. As dyads get familiar with the intervention, and cultivate their awareness and attention, they get more proficient in mindfulness, which means that Alexa has to guide them towards deeper and more complex understandings, and this can only be done through more complex technology and comprehensive user design mapped out to meet variant user flows. Lastly, technology needs to be improved to facilitate accurate name recognition on all occasions, and technical malfunction where the intervention shuts down out of nowhere should be addressed.

5.5.1.8. Intervention Limitations

The intervention should be smart enough for dyads to have an optimal experience. User design should also remove some of these barriers where possible. Firstly, unsuitable length for each participant should be addressed where the activity is adapted based on each dyad's needs for the day. This need may be modified as the dyad progress with

improvement. It should also be adapted to meet needs as persons with dementia decline progressively, or if the condition fluctuates through the day. More personalisation, especially if automated, would be very beneficial in improving the user experience and promoting appropriate levels of mindfulness. More mindfulness may not necessarily be appropriate depending on each dyad's needs for the day. Secondly, external distractions can be reduced through pre-activity reminders. Thirdly, activities should also be easy to use, matching dyads needs in terms of comprehension, ability to respond, and time needed to respond. Fourthly, background sound should be peaceful, perhaps customisable depending on how dyads feel on that day. However, not too many options should be provided to prevent overwhelming dyads. Lastly, paired work may not be suitable for some dyads who do not have an intimate relationship. The level of intimacy could be adjusted for different relationships—spousal or parent-child, and how they would like it to progress. Individual practice is also essential for caregivers to have a breather of calmness without caregiving.

5.5.1.9. Pre-Post Assessments

Looking at pre and post assessment scores, although unidimensional relationship closeness scores decreased for 3 caregivers, the decrease was marginal, and qualitative feedback mentioned that dyads did not know why the scores decreased as they felt closer to their partners. Relationship closeness scores varied for Pwds, with 3 showing an improvement while two declined and one remained constant. The scores however had a more distinct change pre and post study with relationship closeness improvement showing a much larger change. On the other hand, there were assessment score improvements for sense of control, perceived stress and worries for almost all caregivers and majority of Pwds, revealing that the intervention was beneficial for them.

5.5.1.10. Guideline Integration

The successful integration of design guidelines into the dyadic mindfulness conversational agent prototype, followed by the validation through this chapter's empirical testing, underscores the efficacy and potential transferability of these guidelines within similar contexts. By adhering to the proposed design guidelines uncovered in the previous chapters, the resulting prototype serves as a tangible manifestation of their practical application. The subsequent positive outcomes observed

in this study further validate the relevance and effectiveness of the guidelines. This may also be applicable across different user populations and scenarios, that can be leveraged by other practitioners and researchers in the field, thereby contributing to the advancement of design practices and the optimization of dyadic mindfulness conversational agents aimed at enhancing the dyad's experiences and outcomes.

5.5.2 Limitations and Future Direction

Sample size for the study was small as recruitment was challenging. It was difficult to find participants with early-stage dementia, who lived together with a caregiver, and were open to navigating digital technology. Furthermore, the study required a 30-day period of practicing mindfulness together with assessments, surveys, and interviews, requiring significant time from the dyads. Future studies should involve a larger sample size.

During the study, some questions had to be asked multiple times to aid understanding for persons with dementia. There were also answers that did not make sense on some occasion and the researcher had to clarify it with the person with dementia. As a result, data may be affected because of the dementia condition. Future studies should use multiple tools and cross analysis, to aid accurate data collection and analysis.

The dementia condition fluctuates, and sometimes the caregiver had to provide assistance instead of doing the activities for themselves, thereby negatively affecting their experience. Separate activities on some days could be helpful for caregivers in future studies, or more in-depth implementation methods that take this need into consideration could be done.

As participants were given the freedom to decide which activity they wanted to do each day, activity usage varied daily for each activity type. This resulted in no data collected for some activities on different days.

Lastly, the intervention used was not perfect and had areas that could be improved upon. Technology also needs to progress further for human to CA conversations to be more fluid and human like. Future studies should develop and test more robust interventions to determine more accurate results.

5.6 Conclusion

In conclusion, participants liked the dyadic mindfulness experience using CAs as a medium. Dyads were favourable towards the intervention, finding it easy to use and understand. It was well liked, and it helped dyads to feel good after the activity. There were enough activities for the pair, and short activities done daily were sufficient, as opposed to lengthy mindfulness exercises. After the study ended, the activities were likely to be done again on a regular basis, revealing that the intervention which incorporated personalisation could potentially facilitate future usage, dependent and independent of Alexa. Majority of dyads had an improved sense of control, reduced stress and worries after the study. However, relatedness had varying results although qualitative responses were mostly positive. In essence, the intervention provided dyads with many benefits and mindfulness activities transcended the study requirements. This means that the guidelines used to design the intervention was useful and could be beneficial for future studies or product development to utilise. However, challenges need to be addressed for future interventions to better suit dyads' needs.

Chapter 6. Conclusion

This thesis enhanced the understanding of how dyadic mindfulness conversational agents can be designed, detailing user preferences and needs through the development and usage of a working prototype.

Although (1) mindfulness interventions for person with dementia or caregiver groups, and (2) dyadic mindfulness have had positive results, there were limitations as they were usually done in person, in a physical location, requiring more time commitment. Dyadic mindfulness using CAs as a medium had not yet been created. It was further explored as CAs could enhance (1) accessibility—allowing for guided usage anytime and anywhere, (2) scalability—allowing for people with low digital literacy levels to access, and it does not require a human guide, (3) integration—where it can be embedded in user's lives, and (4) personalisation—providing a plethora of choices to enhance the experience. From the literature, dyadic mindfulness conversational agents were novel, and may be beneficial, which led to the exploration of using CAs as a medium for dyadic mindfulness in this thesis.

Such interventions may be particularly important during circumstances like the COVID-19 pandemic, where digital technologies could enable usage of mindfulness. Guidelines were explored in the literature, however, only scant suggestions were provided by studies that focused on assessing effectiveness. This thesis revealed needs to consider when designing dyadic mindfulness conversational agents based on expert and user feedback. This enabled a better understanding of the needs of users for such interventions, which would be beneficial in aiding future intervention development.

Exploring the needs of dyads informed by a user centred design approach and experiencing an actual intervention was also essential. The process involved four iterations of understanding users, developing, and refining the prototype, as well as observing user's interactions with said prototype, which resulted in an enhanced understanding of user needs. This thesis enabled the development of a working prototype which was the first of its kind and was well received by dyads. It revealed the components of the intervention, and that the use of user feedback throughout the multiple iterations was beneficial. Further detailed needs were also identified by users and experts and could be taken into consideration for future designs.

After running a guideline assessment study for 30 days, we found that participants liked the dyadic mindfulness experience using CAs as a medium. The intervention was easy to use, easy to understand, and short activities on a daily basis were sufficient, needing just a few activities to choose from. They experienced many benefits—feeling good after the activity, reduced stress, reduced worries, and improved sense of control—which made them likely to continue using the intervention regularly after the study ended. Mindfulness activities also transcended the study requirements as participants used them outside of what was needed, independent and dependent of Alexa. However, there were challenges raised that need to be addressed for future interventions to better suit dyads' needs. This thesis shows that usage of the intervention over a longer period was feasible and that likes and dislikes were identified. This reveals that such future interventions can be created and could be useful for dyads, there are also guidelines that future developers can follow.

Challenges still need to be addressed and technology needs to improve for such interventions to seamlessly benefit dyads. Clinical trials on larger populations also need to be conducted to determine exact outcomes of such interventions. In conclusion, this thesis reveals a positive outlook on the novel intervention and more work needs to be done to ensure robustness to improve dyad's lives.

6.1 Discussion

6.1.1 Research Aims and Key Insights

Aim: Understand what had been done in previous studies that could be beneficial for dyads. Identify the gap in the literature.

Key insights: Based on the literature, mindfulness is a popular approach providing benefits for both persons with dementia and caregivers individually. Several studies have also investigated a dyadic mindfulness approach to meet the needs of both individuals simultaneously, showing preliminary benefits. Adopting a dyadic approach could potentially improve the relationships between the dyads, along with offering mindfulness benefits.

These studies, however, were conducted physically and had a fixed time to practice. CA approaches to mindfulness have yet to be implemented for dyads, and it could enhance accessibility, revealing a gap in the literature. The needs and preferences of such interventions were also not known as the intervention did not yet exist.

Aim: Understand the user needs pertaining to such interventions, based on the development and usage of a working prototype.

Key insights: The full list of user needs pertaining to such interventions were compiled across the chapters and can be referred to in section 6.2.

Aim: Create a working prototype through a user-centered design approach

Key insights: A working prototype of four activities were created after four iterative cycles of the user-centred design approach.

Aim: Understand if dyadic mindfulness conversational agents design guidelines were beneficial for dyads. Explore whether the intervention was easy to use and what user's preferences were. Understand how stress, worries, sense of control and relatedness were impacted.

Key insights: The intervention yielded numerous benefits for dyads, and mindfulness activities transcended the study requirements. Participants enjoyed the dyadic mindfulness experience facilitated by CAs, finding it to be uplifting post-activity. Dyads were favourable towards the intervention, finding it easy to use and understand. There were sufficient activities provided for the dyads and engaging in brief daily activities proved to be satisfactory, contrasting with longer mindfulness practices. There was a likelihood of participants continuing the activities regularly even after the study ended, indicating that the intervention, which integrated personalisation, has the potential to encourage future utilisation, whether reliant on Alexa or not. Majority of dyads had an improved sense of control, reduced stress and worries after the study. However, relatedness had varying results although qualitative responses were mostly positive. Overall, this underscores the effectiveness of the intervention's design guidelines, which could be valuable for future research or product development endeavors.

Aim: Understand the areas each mindfulness exercise should be improved on.

Key insights: In chapter 4, areas of improvements that can be made in the mindfulness activities for each stage of prototyping were provided with examples of how the guidelines were applied

to each activity. This not only enhanced the prototype with each revision, but also allows future researchers and product developers to learn from the examples.

Aim: Explore whether extended usage of the intervention was feasible, and if it encouraged future usage.

Key insights: The dyadic mindfulness conversational agent prototype demonstrated many positive results and responses during the extended duration of 30 days within the study. Many dyads also expressed their intention to continue using the intervention even after the study ends. Mindfulness using CAs became a part of the dyad's daily lives and they were experiencing benefits which encouraged continued regular usage.

6.1.2 Comprehensive User Needs

This section lists the compiled user needs of dyads for mindfulness conversational agents through the chapters.

Accessibility

1. Ensure activities are simple and easy to understand without complicated abstract concepts or metaphors - This ensures that users can easily access the activities, using simple visual aids, verbal instructions and providing written information for home-based self-help activities.
2. Simple and clear language used - Activities should have clear straightforward explanation that are not misleading, rephrase or clarify parts that could be misleading, no complex phrases or technical jargons, use simple instructions and literal description.
3. Easy to relate to – Name of activities and activity content.
4. Easy to engage with - activity should have a smooth flow, no lengthy sentences, remove repetitive content, do not provide too many examples or too much explanation just sufficient details will do. Visualisation exercises should be easy to focus on and perform.
5. Keep the same few terminologies throughout the exercises - keep it simple and standard for persons with dementia.
6. Meeting cognitive needs with appropriate cognitive load – Meet dyad's needs in terms of comprehension, ability to respond. For example, reduce the number of things to do within each activity, keeping the simple ones and repeating them for each activity.

Instead of asking users to think about and remember three things they are grateful for, try to limit it to one thing and provide repetition.

7. Provide shortened duration and increased number of sessions with reminders to encourage adherence - Shortened and regular activities with reminders help to promote ease of use and mindful habit formation, meeting the needs of persons with dementia who may have worsened memory and shorter attention spans. Suitable length of activities should be provided, not too long or short.
8. Hold live sessions on weekends to cater to working caregivers - Working caregivers may not have time or capacity to participate in mindfulness activities if they are held on the weekdays.
9. No pre-determined completion duration – Preventing pressure on reaching outcomes by a specific deadline, allowing users to use it whenever needed.
10. Provide mindfulness embedded into user's everyday life – providing more flexibility on where and when it can be done instead of using mindfulness in a fixed physical location at a fixed time. Allow for users to use activities when travelling for example, so that they are able to maintain the mindfulness habit and not be limited to the confines of the home environment.
11. Provide clear communication of steps - This enables users to differentiate transitions—start, transitions to next steps, and end of content.
12. Include only necessary details - Content provided should be sufficient, not containing too little or too many details. Although another study suggested for CAs to be wordy instead of taciturn, it may be beneficial to only include necessary details.
13. There should be more functions the CA can do to provide flexibility of use - CA allows users to tailor usage, where users could individualise content based on preferences.
14. Prevent fixed responses – Yes/No questions may elicit fixed responses. Remove phrases that are outcome based, provide flexibility in the guidance.
15. Ensure consistency across skills - This ensures coherence across skills and ease of use for users as compared to varying skill commands and sequences. Although another study suggested for CAs to provide variability in dialog structure and language, consistency should be applied instead.
16. Recognition instead of recalling - As users express difficulties memorising commands, it may be useful for users to hear and recognise commands instead of having to recall them.

17. Error prevention - Where commands are not captured or when users use CAs in ways it was not designed for, CAs should have means to allow users to correct the mistake and continue using the agent. For example, persons with dementia may not know what to do sometimes because of their condition, Alexa needs to be able to manage such circumstances. CAs should provide clear information with different but more detailed ways of presenting information with each clarifying user attempt.
18. More time for processing and response – It may be useful to provide more time to digest information and respond. Longer pauses can be integrated in between sentences or concepts for persons with dementia to understand and keep up. Pauses should also provide more time for visualisation.
19. Detail and repetition - Description of activities could incorporate more detail with some repetition if needed, to aid their understanding.
20. Same instructions over time - Having the same instructions over time as they decline can be useful, helping them to do the activity as it becomes muscle memory.
21. Pre-empt tasks – Pre-empt tasks to be done, or action to be taken prior to asking users to do something, so that they may be prepared to answer a question or voice an opinion.
22. Visualisation options – Some people may find it difficult to visualise, other options need to be provided in such cases.
23. Seated arrangement - Make it seated to cater to older population needs.

Activity mechanism

1. Address negativity - Certain topics may be too sensitive to share about during dyadic exercises, activities could avoid intense topics to prevent negative experiences. Another method could be to identify the best way of expressing negative thoughts each individual in the dyad face, as they may be concerned about each other. It may be beneficial to be comfortable with the negative experience instead of avoiding it through separate mindfulness interventions for each individual. Methods should be incorporated to aid coping with negativity should it arise during the exercise.
2. Has to be well designed to prevent unintended consequences – does not cause unintended stress, does not bring up pain in the body, unmanageable negative emotions and thoughts.

3. Cultivate positivity through thinking and expression for oneself and others – Focus on the positive, with activities that provide calm, loving kindness, gratitude, appreciation, empathy, and kindness for oneself and others.
4. Provide dyadic interaction – Allowing dyads to have more opportunities for paired interactions like holding each other's hands, enquiring about partner's needs, and acknowledging that needs have been met. However, Alexa depends on both participant's responses and one participant can be affected because of the other's responses or lack thereof. Activities should have contingencies in such instances.
5. Enhance relationship – Social connectedness was widely identified as a factor that should be incorporated into activities for dyads. In particular, social connectedness between the dyads was important. However, activities need to manage the level of closeness the tasks encourage, as some participants may have different types of relationships.
6. Strengthening emotions and feelings - It would be ideal to focus on strengthening emotions and feelings.
7. Encourage a mindful mindset shift - A mindful mindset shift may benefit the dyad through present moment awareness and attention, as well as having no attachment or aversions to experiences. Worries that come with a progressing illness could be mitigated through the effects of present moment activities where the hustle and bustle stop for a moment and there is a sense of calm, changing the relationship with experience to one of ease rather than one of struggle. Where pleasant or unpleasant feelings arise, thoughts should be allowed to come and go while being mindful—not reacting to or judging them. This means participants would be comfortable with discomfort, where a different way of being is okay. It may also be helpful to remove phrases that encourage comparisons, to provide for a more mindful mode of processing.
8. Practice cognitive defusion – To encourage dyads to separate their thoughts from self, allowing them to distance emotions tied to those thoughts, and to respond rather than to react.
9. Providing simplified tangible and thought-based activities – Activities for dyads could be tangible-based or thought-based. Tangible activities like deep breathing or body scan meditation focuses on the sensations one feels in the body to stay in the present moment. Thought-based activities utilised reflection, to help dyads generate insights about the self, bringing awareness of their thoughts, feelings, and sensations, enabling them to

prevent automatic rumination of thoughts, breaking the cycle of how fear-based thoughts affect unhealthy behaviour.

10. Has to be useful – Activities are encouraging, supportive, calming, relaxing, enabling peacefulness between the mind and body. They also provide clarity, reflection, more self-awareness, and keep movements in their bodies.
11. Coping mechanism – Provide coping mechanism for dyads to use during stressful situations, enabling them to reduce stress and worries, as well as to establish a stronger sense of control.
12. Provide an anchor – Have a grounding exercise that users can follow and stabilise the attention. This could include anchor points such as focusing on the breath, to help them get back to something more tangible like the body, when doing activities that are more thought based.
13. Guidance provided – Provide guidance allowing dyads to follow as some cannot do it without guidance.
14. Invitation to practice – Both at the beginning and at the end of every practice, it may be useful to further expand/amplify the intention at the beginning and then return to the intention again at the end with a further invitation.
15. Well-liked and enjoyable - Activities have to be well liked and enjoyable.
16. Detailed instructions given - Instead of leaving the instructions broad and open, as providing choices may confuse person with dementia (opposing previous recommendations by mindfulness experts), clear instructions are needed on what exactly to do.
17. Comprehensive user design – CAs need to have comprehensive user design, where activity flows are mapped out to meet variant user choices.

Personalisation

1. Understand individual needs and capabilities, catering to them - This enables personalised care for each individual, potentially enhancing quality of care. Take into consideration not only the cognitive capabilities that persons with dementia can employ as their condition deteriorates, but also the increasing time and resources limitations most caregivers face. For example, more time could be provided for reflection in sessions with repetition of concepts and written information to aid understanding. Allow for personalisation of activity usage, activity length, time needed for activities

to translate into something participants could do in their daily life without Alexa's guidance, or for participants to do as a lifestyle, or number of opportunities to express gratitude towards each other. Personalisation should cater to different individuals and the same individual as the condition deteriorates.

2. Advanced personalisation – Activity length should be adapted based on each dyad's needs for the day, as they progress with improvement, decline progressively because of dementia, or if the condition fluctuates through the day. Appropriate levels of mindfulness should also be provided as more mindfulness may not necessarily be suitable depending on each dyad's needs for the day. CAs should personalise the mindfulness content to allow for deeper immersion and progressive depth depending on participant needs. The level of closeness can also be adjusted for different relationships (spousal or parent-child), and how they would like it to progress.
3. Provide options for separate and dyadic use – Caregivers may be reluctant to share about their fears and may also be unable to fully focus on their own needs while worrying about the well-being of persons with dementia during a dyadic session. It may be useful for mindfulness programmes for dyads to provide options for separate use and dyadic use on different occasions.
4. Ensure both participants benefit - As mindfulness activities would be done for dyads with different cognitive abilities, activities need to meet both of their individual needs. It would be essential to have activities that cater to the needs of persons with dementia as they decline, while ensuring caregivers still benefit from the same activity.
5. Balanced flexibility - Although studies suggest providing more choices within activities, enabling personalisation, flexibility needs to be balanced, as too many choices when presented, may confuse persons with dementia.
6. Allow for personalised reminders – Set or cancel reminders as needed.
7. Allow for activating of mindfulness exercises through reminders and on command – reminders as they might forget to do it regularly, on command as they wanted control over when they would like to do it.

Positive content characteristics

1. Positive values embodied - CAs should come across as empathic with high empathic accuracy, caring, likeable, humorous, positive, welcoming, allowing and enjoyable.
2. Balance - Both positive and negative emotion language should be used. Some ideas prime them to focus on negative thoughts at the beginning, and need to be altered to

bring in both positive and negative aspects. Similarly, both social-oriented and task-oriented language should be used.

3. Trustworthy content - Content CAs use should be knowledgeable, and rely on trustworthy sources.

Enhance experience

1. Context awareness - Responses provided should be context aware.
2. Small talk - CAs should provide small talk.
3. Performance honesty - CAs should provide honesty about the CA's shortcomings in terms of performance.
4. Self-disclosure - CAs should provide a high level of self-disclosure.
5. Prevent triggering negative emotions - Thoughts may be perceived as facts to users and care needs to be taken to not trigger negative emotions, especially when dealing with negative thoughts.
6. Include calming background sounds - To aid visualisation, cannot be too distracting or loud. Should be peaceful, at an appropriate pace, and perhaps customisable. Some participants needed cues to know Alexa was still running and a soft background sound could provide cues.
7. Potential distractions that may interrupt activities should be addressed - distractions include (1) external noises (ringing phone, dogs walking by and air-conditioning sounds) (2) sleepiness, (3) instinctively opening one's eyes to answer questions asked by Alexa, (4) needing to use the restroom, (5) inability to focus, (6) questions from mindfulness activity itself. Reduce distractions through pre-activity reminders.
8. Sufficient activities to choose from – Provide a sufficient number of activities to choose from. However, a large variety was unnecessary for engagement and benefits. A few simple and effective activities were enough to do so.

CA characteristics

1. Trustworthy - CAs should use a stereotypically trustworthy voice or accent.
2. Similar to users - Culturally familiar communication styles are preferred, with a high similarity with users.
3. Voice options - A young female human voice could be used. There could also be options to choose the type, gender, speed, and intonation of the CA's voice.

4. Slow and calm - Regarding the speech rate and tone, a slower speech rate with a calm tone was preferred.
5. Polite ringtones - CAs should use polite ringtones for notifications.
6. Match between CA and real world - Ensure that CAs match users' language, timing for response, tone, and speed of dialogue rather than use system-oriented terms, especially for stress management contents like meditation. Voice must sound natural and not robotic.
7. Personify CAs - Personifying agents increase accessibility, satisfaction, and emotional connection. Provide different forms of personification based on individual needs.
8. First person perspective - CAs should use a first-person perspective.
9. Friend role - Socio-emotional dialogue should be used with relational language, assuming a friend role with small social distance.
10. Co-operation - CAs should provide cooperative behaviour.
11. Interested and appreciative - Incorporate phrasing that brings in attitudes of interest and appreciation.
12. Natural sounding - Using an artificial intelligence voice to perform the mindfulness activities may sound too robotic, and not embodied. Voice recording of a mindfulness expert or pacing the artificial intelligence voice to sound more natural may be useful.

Technical needs

1. Ensure 24/7 availability - Provide 24/7 access to CAs for users whenever they wish to use it.
2. Wi-Fi connection – Need to ensure there is Wi-Fi connection, especially in rural areas, or during power cuts, as that affects ability to use Alexa.
3. High quality performance - CAs should provide high quality performance, with the lack of application disruption. Technical malfunction where the intervention shuts down out of nowhere should be addressed.
4. High speed - CAs should have high speeds.
5. Strong system reliability - CAs should have improved system reliability to enable long-term usage.
6. Sound levels loud enough - Conversational agent sound levels need to be at an appropriate level to cater to the hearing issues of older generation.

7. Able to differentiate responses - Alexa needs to be able to differentiate when speakers pause to think before answering the question, instead of repeating the same section after assuming there is no response. Alexa needs to be able to differentiate right and wrong responses to the question asked, or the lack of responses, and respond accordingly. Alexa needs to be able to differentiate when speakers pause while talking, instead of moving to the next section before the speaker can finish responding. Alexa needs to be able to differentiate whether the person with dementia is talking, or caregiver is clarifying the question for the person with dementia as they did not understand, instead of moving to the next section. Alexa needs to be able to differentiate whether the caregiver is answering the question, or speaking to the researcher to clarify, instead of moving to the next section.
8. Accuracy of response capture - Alexa needs to be able to capture all responses accurately. Alexa needs to be able to capture responses when (1) speaker speaks softly, mispronounce words, have hoarse voices, or when (2) multiple people speak at the same time. It would be helpful for Alexa to know what activities speakers are requesting for, and activate them, even if speakers say the activation name incorrectly.
9. Name recognition – Technology needs to be improved to facilitate accurate name recognition on all occasions.
10. Better technology - Alexa needs to allow for more complex conversations and understanding of participant responses to facilitate deeper mindfulness, through deep thought and reflection.

Usage Requirements

1. Regular usage - Encourage using most activities again using Alexa, on a regular basis.
2. Fit into routines - Activities should fit into participants daily lives.
3. Activity translation - Activities could subsequently translate into something participants could use whenever they needed, without needing Alexa's guidance.

Space Requirements

1. Flexibility - Allows participants to place Alexa wherever they wish to.
2. Environment type - Use Alexa in a quiet, calming, comfortable and convenient space.

3. Space requirements - Space needs to have seats, a connection source for power and allowed for Wi-Fi connection.
4. Seating arrangement - Allow participants to choose the level of closeness they wish to feel. Participants can choose to seat near each other, or face each other if they wish to, helping them to feel closer.

Feedback

1. Provide opportunities for open discussions and feedback - This encourages feedback to be given, doubts to be clarified and learning to occur. As seniors with dementia may forget details, questions can be asked right after activities, to understand what they think.

6.1.3 Summary of Thesis Contribution

To summarise, the gap identified in the thesis opens up opportunities for future studies to explore using CAs for dyadic mindfulness. Secondly, with the user needs explored using a user centered design approach, this provided guidelines for other designers, developers and researchers to use when creating such interventions. Thirdly, the working prototype refined through multiple iterations also enable others to now be able to use them, and also provides examples of how the iterations were improved based on the guidelines. Lastly, with the benefits and challenges better understood over extended usage, it may encourage future clinical trials with better prototypes to further explore benefits.

6.1.4 Limitations and Future Work

Some of the study limitations include having a small population of participants, and future studies should involve larger populations and more accurately powered studies. With larger populations, more quantitative data can be collected as well, allowing for greater insights. Also, feedback from dyads and experts were provided separately, and it may be beneficial for future studies to obtain feedback through co-design workshops or interviews, where dyads and experts provide feedback together. With more resources, more workshops or interviews can be done with users and experts together instead of compressing them into one or two workshops. This would allow future researchers to go in depth, and at the same time, not overload participants.

There were also a few prototype limitations, and future studies could utilise better prototypes with more advanced technologies, and comprehensive user experience to provide a more seamless experience. Individual activities can also be provided as a complement to dyadic activities for future studies, as the researcher did not have enough time or resources to explore both dyadic and individual activities.

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Appendices

Appendix 1

Semi-structured Interview Questions for Dementia Experts

Introduction

“Hello! My name is Cassandra, and I am researching on how to create better mindfulness solutions for seniors with dementia and their caregivers. Thank you for participating in this study. I’d now like to ask you a few questions to better understand how to implement mindfulness activities and to learn from your many years of experiences. The whole interview should take about an hour. If now is a good time, shall we get started?” Would you be able to share with me about your work with people with dementia?

Exploring Current Problems and Mindfulness Interventions

A) Understanding Current Practices on Managing People with Dementia

1. What specific behaviour do you see from people with early dementia that you find hard to manage?

What approaches have you used to manage these behaviours in the past?

(Note: Need not be activities they do only during behavioural and psychological symptoms of Dementia (BPSD) episodes. It can also be activities that are done regularly to manage BPS

2. D)
3. Why do these approaches work?
4. Are these approaches done in groups or individually with people with dementia?

B) Understanding activities

Mindfulness is the practice of being aware of one’s physical, emotional, and mental state in the present moment in a non-judgmental way. Mindfulness-based stress reduction offers secular, intensive mindfulness training to assist people with stress, anxiety, depression and pain. Mindfulness-based cognitive therapy is an approach to psychotherapy that uses cognitive-behavioural therapy methods in collaboration with mindfulness meditative practices and similar psychological strategies.

5. Have you conducted any of these for people with dementia before? What were the responses?

How would you describe mindfulness activities to people with early dementia and carers who may have no knowledge of the subject?

6. t?
7. Most mindfulness interventions are held in groups with participants who have similar cognitive abilities. What can we do to ensure that all participants, with varying cognitive abilities, benefit from the same activity session?

C) Remote Delivery

8. Do you have recommendations for running mindfulness training activities digitally, like through conversational agents? Would these apply for online pre-recorded sessions?
9. What would be interesting and fun to introduce people to mindfulness through technologies like conversational agents?

D) Duration/ Format/ Sessions

10. How long should the sessions be? How often should it be done?

E) Social Factor

11. We are planning for the mindfulness activities to be done in pairs (people with dementia and carers) instead of larger groups. To what extent does group engagement contribute to the positive effects of the intervention and would doing the activities in pairs negatively affect the experience?

12. What can we do to mitigate negative effects if they are present?

Semi-structured Interview Questions for Mindfulness Experts

Introduction

“Hello! My name is Cassandra, and I am researching on how to create better mindfulness solutions for seniors with dementia and their caregivers. Thank you for participating in this study. I’d now like to ask you a few questions to better understand how to implement mindfulness activities and to learn from your many years of experiences. The whole interview should take about an hour. If now is a good time, shall we get started?” Would you be able to share with me about your work with mindfulness?

Understanding Mindfulness Intervention

D) A) Understanding activities

1. How would you describe mindfulness activities to people with early dementia and carers who may have no knowledge of the subject?

Most mindfulness interventions are held in groups with participants who have similar cognitive abilities. What can we do to ensure that all participants, with varying cognitive abilities, benefit from the same activity session?

2. n?
3. Could you briefly describe the type of activities you do, particularly those that might work better for people with Dementia?

When teaching to older adults who are new to mindfulness, would you focus on loving kindness, on breathing and being in the present, on understanding their thoughts, feelings, and behaviour better. Or on something else?

4. se?

What objects or materials do you consider most important in your teaching practice? Why?

5. hy?

B) Understanding motivations

6. Why are older people motivated to try mindfulness practices?
7. What **keeps** them motivated?

Do you think the motivations driving carers to mindfulness would be different to those of older people?

8. le?

Do you think motivations for people with dementia would be different to older people generally?

9. ly?

C) Remote Delivery

10. Do you have recommendations for running mindfulness training activities digitally, like through conversational agents? Would these apply for online pre-recorded sessions?

D) Duration/ Format/ Sessions

11. How long should the sessions be? How often should it be done?

E) Social Factor

12. We are planning for the mindfulness activities to be done in pairs (people with dementia and carers) instead of larger groups. To what extent does group engagement contribute to the positive effects of the intervention and would doing the activities in pairs negatively affect the

experience?

13. What can we do to mitigate negative effects if they are present?

Semi-structured Interview Questions for Caregivers of Persons with Dementia

Introduction

“Hello! My name is Cassandra, and I am researching on how to create better mindfulness solutions for people with dementia and their caregivers. Mindfulness is a type of meditation in which you focus on being intensely aware of what you're sensing and feeling in the moment, without interpretation or judgment. Thank you for participating in this study. I would like to ask you a few questions about yourself and what you think about some ideas we have.”

*Note that this is based on their experiences with early-stage dementia

Background

1. Can you tell me about yourself, in terms of your living situation? (This could include who you are living with and who comes to visit.)
2. Do you work full time? (Or when the person you cared for was in the early stage of dementia, did you work full time?)
3. Do you often feel stressed?
4. What do you currently do to manage stress?
5. What are your hobbies?
6. How do you usually spend your day?

Main Issues & Challenges

7. What are the main challenges you face when caring for someone in the early stages of dementia?
8. What are some of the bad memories you have experienced when caring for someone in the early stages of dementia?
9. What are some of the good memories on the other hand?

Use of Technology

10. Can you tell me about your use of technology? (What do you use?)

Conversational Agent Exploration

11. Have you had any experience using conversational agents like Alexa?
Use Alexa live to show example if they have not, explain what Alexa can do—perform tasks like setting alarms, playing music, searching the internet, and playing games or providing interesting facts.
12. What do you think about using conversational agents?
13. Do you think the conversational agent service should be provided on demand when it senses certain behaviours or when it is scheduled for a certain time?

Mindfulness Exploration

14. Have you had any experience with mindfulness?
Explain Mindfulness - Mindfulness is the basic human ability to be fully present, aware of where we are and what we are doing, and not overly reactive or overwhelmed by what is going on around us. Having mindful coping methods may enable one to better cope with difficult situations. Mindful methods could be deep breathing or meditation, for instance.

Try a present moment mindful exercise:

https://www.youtube.com/watch?v=SEfs5TJZ6Nk&ab_channel=MyLife

There is another aspect of mindfulness that focuses more on changing thought patterns, to change the way you feel. It requires reflection, changing of perspectives and thinking about your thoughts. https://www.youtube.com/watch?v=eCIs-mNb2V8&ab_channel=CassandraSeah

15. What do you think about mindfulness?
16. Which type of mindfulness activities - present moment or reflection-based mindfulness would be preferred? Present moment activities help you stay in the present moment, whereas for the other type, it is more cognitive, helping you to think about the thoughts you have and how to modify them.

Dyadic Mindfulness Conversational Agent Preferences

17. What do you think about practicing mindfulness with the person you care for?
18. Would it be better to conduct mindfulness activities for yourself together with the person you care for via live zoom sessions or through conversational agents? Why?
19. What factors are important to consider when designing for both you and the person you care for?
20. When would it be ideal to practice interventions like mindfulness? Would you use it when there are periods of agitation?

Semi-structured Interview Questions for Persons with Dementia

Introduction

“Hello! My name is Cassandra, and I am researching on how to create better mindfulness solutions for people with dementia and their caregivers. Mindfulness is a type of meditation in which you focus on being intensely aware of what you're sensing and feeling in the moment, without interpretation or judgment. Thank you for participating in this study. I would like to ask you a few questions about yourself and what you think about some ideas we have.”

*Note that this is based on their experiences with early-stage dementia

Background

1. Can you tell me about yourself, in terms of your living situation? (This could include who you are living with and who comes to visit.)

Do you work full time

2. e?
3. Do you often feel stressed?
4. What do you currently do to manage stress?
5. What are your hobbies?
6. How do you usually spend your day?

Main Issues & Challenges

7. What are the main challenges you faced by having early-stage dementia?
8. What are some of the bad memories you have experienced when faced with the disease?
9. What are some of the good memories on the other hand?

Use of Technology

10. Can you tell me about your use of technology? (What do you use?)

Conversational Agent Exploration

11. Have you had any experience using conversational agents like Alexa?
Use Alexa live to show example if they have not, explain what Alexa can do—perform tasks like setting alarms, playing music, searching the internet, and playing games or providing interesting facts.
12. What do you think about using conversational agents?
13. Do you think the conversational agent service should be provided on demand when it senses certain behaviours or when it is scheduled for a certain time?

Mindfulness Exploration

14. Have you had any experience with mindfulness?
Explain Mindfulness - Mindfulness is the basic human ability to be fully present, aware of where we are and what we are doing, and not overly reactive or overwhelmed by what is going on around us. Having mindful coping methods may enable one to better cope with difficult situations. Mindful methods could be deep breathing or meditation, for instance.

Try a present moment mindful exercise:

https://www.youtube.com/watch?v=SEfs5TJZ6Nk&ab_channel=MyLife

There is another aspect of mindfulness that focuses more on changing thought patterns, to change the way you feel. It requires reflection, changing of perspectives and thinking about your thoughts. https://www.youtube.com/watch?v=eCIs-mNb2V8&ab_channel=CassandraSeah

15. What do you think about mindfulness?
16. Which type of mindfulness activities - present moment or reflection-based mindfulness would be preferred? Present moment activities help you to stay in the present moment, whereas for the other type it is more cognitive, helping you to think about the thoughts you have and how to modify them.

Dyadic Mindfulness Conversational Agent Preferences

17. What do you think about practicing mindfulness with your loved one?
18. Would it be better to conduct mindfulness activities for yourself together with a loved one via live zoom sessions or through conversational agents? Why?
19. What factors are important to consider when designing for both you and your loved one?
20. When would it be ideal to practice interventions like mindfulness? Would you use it when there are periods of agitation?

Individual Mindfulness Exercise Survey

- 1. Play each activity on Alexa for users to try. Circle the activity tried.**

Mindful Breathing / Mindful Movement / Making Space / Gratitude Practice
/ Compassion Practice

- 2. On a scale of 1-5, how easy or difficult was the activity to understand?**

1 2 3 4 5

DifficultEasy

Why?

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to it) Why?

1 2 3 4 5
Not Likely Likely

Why?

- 4. Would you do this activity regularly (at least once a week)? (Assuming you had access to it)**

Yes/No

5. On a scale of 1-5, circle how much you liked or disliked the activity. Why?

1 2 3 4 5
Disliked Liked

Why?

- 6. What did you like about the activity?**

- 7. What did you dislike about the activity?**

Individual Mindfulness Exercise Survey

1. Play each activity on Alexa for users to try. Circle the activity tried.

Mindful Breathing / Mindful Movement / Making Space / Gratitude Practice
/ Compassion Practice

- 2. On a scale of 1-5, how easy or difficult was the activity to understand?**

1 2 3 4 5
Difficult Easy

Why?

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to it) Why?

1 2 3 4 5
Not Likely Likely

Why?

4. Would you do this activity regularly (at least once a week)? (Assuming you had access to it)

Yes/No

- 5. On a scale of 1-5, circle how much you liked or disliked the activity. Why?**

1 2 3 4 5
Disliked Liked

Why?

- 6. What did you like about the activity?**

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- 7. What did you dislike about the activity?**

--

Individual Mindfulness Exercise Survey

- 1. Play each activity on Alexa for users to try. Circle the activity tried.**

Mindful Breathing / Mindful Movement / Making Space / Gratitude Practice
/ Compassion Practice

- 2. On a scale of 1-5, how easy or difficult was the activity to understand?**

1	2	3	4	5
Difficult				Easy

Why?

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to it) Why?

1 2 3 4 5
Not Likely Likely

Why?

4. Would you do this activity regularly (at least once a week)? (Assuming you had access to it)

Yes/No

- 5. On a scale of 1-5, circle how much you liked or disliked the activity. Why?**

1 2 3 4 5
Disliked Liked

Why?

- 6. What did you like about the activity?**

--

- 7. What did you dislike about the activity?**

Individual Mindfulness Exercise Survey

- 1. Play each activity on Alexa for users to try. Circle the activity tried.**

Mindful Breathing / Mindful Movement / Making Space / Gratitude Practice
/ Compassion Practice

- 2. On a scale of 1-5, how easy or difficult was the activity to understand?**

1	2	3	4	5
Difficult				Easy

Why?

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to it) Why?

1 2 3 4 5
Not Likely Likely

Why?

[illegible]

4. Would you do this activity regularly (at least once a week)? (Assuming you had access to it)

Yes/No

- 5. On a scale of 1-5, circle how much you liked or disliked the activity. Why?**

1 2 3 4 5
Disliked Liked

Why?

- 6. What did you like about the activity?**

- 7. What did you dislike about the activity?**

Individual Mindfulness Exercise Survey

- 1. Play each activity on Alexa for users to try. Circle the activity tried.**

Mindful Breathing / Mindful Movement / Making Space / Gratitude Practice
/ Compassion Practice

- 2. On a scale of 1-5, how easy or difficult was the activity to understand?**

1	2	3	4	5
Difficult				Easy

Why?

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to it) Why?

1 2 3 4 5
Not Likely Likely

Why?

--

4. Would you do this activity regularly (at least once a week)? (Assuming you had access to it)

Yes/No

- 5. On a scale of 1-5, circle how much you liked or disliked the activity. Why?**

1 2 3 4 5
Disliked Liked

Why?

- 6. What did you like about the activity?**

- 7. What did you dislike about the activity?**

--

Mindfulness Feedback Semi Structured Interview

Mindfulness Questions

1. Is the voice/accent easy to understand?

Yes/No

If no, which accent would be easier to understand?

2. What did you think of the length of the activities?

Too long/ Just nice/ Too short

How long/short should it be, if not just nice?

3. How would you like to activate the mindfulness exercises? For instance, would you like to ask Alexa to start the activity before it guides you, or would you like it to activate at a set time each day?

4. Would you do these mindfulness exercises regularly (at least once a week)?
(Assuming you had access to it)

Yes/No

Why?

5. How often would you do these mindfulness activities?

Everyday/ 3x a week/ 1x a week/ 1x a month/ Seldom/ Never

6. Could these mindfulness exercises fit into your lives or habits?

Yes/No

How so?/ Why?

7. Would mindfulness exercises you learned through Alexa, translate to something you could practice whenever you need? For instance, as you go about your daily

life, and you feel that a mindfulness exercise is something you need, you would then do it on your own without Alexa guiding you?

Yes/No

Why?

- 8. How long would it take to translate into something you do in your daily life, without Alexa guiding you?**

As a lifestyle/ A year/ 6 months/ 3 months/ 1 month/ 1 week/ I don't need Alexa to guide me

Why?

Set Up Questions

9. Where would you place Alexa in your home?

10. What kind of space is it?

11. Is it a quiet space, without the possibility of being disturbed?

Yes/No

12. Is there space for the both of you to seat, to practice these mindfulness exercises?

Yes/No

13. Where would you seat? (Chair, bed, sofa?)

14. Would you sit near each other?

Yes/No

Why?

15. Would you sit facing each other?

Yes/No

Why?

16. Do you have any concerns with doing these mindfulness exercises that we need to take note of?

Appendix 3

Workbook Information for Participants

Please do one activity a day, it would take up to 15 minutes for each activity. You may choose to do more than one if you wish, but please remember to fill up a worksheet for each activity you complete. Do remember that keeping an open attitude towards mindfulness may benefit you the most.

How to start Alexa? Say “Alexa”, followed by the name of the activity, “mindful breathing”. Say “Alexa, mindful breathing” to start a breathing activity.

How to stop Alexa? Say “Alexa, stop.”

1. **Activity Command: “Alexa, mindful breathing.”**

Activity Description: Mindful breathing activity encourages you to stay in the present moment, focusing on sensations as you inhale and exhale.

2. **Activity Command: “Alexa, making space.”**

Activity Description: Making space activity encourages you to make space for thoughts, positive, negative, or neutral thoughts as they arrive in your mind. It encourages learning to be an observer of your thoughts, just watching them all go by and not latching onto certain thoughts.

3. **Activity Command: “Alexa, gratitude practice.”**

Activity Description: Gratitude practice encourages expressing gratitude towards the little things in life, and towards each other.

4. **Activity Command: “Alexa, compassion practice.”**

Activity Description: Compassion practice encourages sending and receiving compassion, to and from one another.

Things to note:

- Alexa waits for up to 8 seconds to capture what you said.
- If there is no user response, Alexa repeats the previous section.
- If you/someone else talks when Alexa requests for a response, Alexa would assume that is the response and move on to the next section.
- If you pause halfway when responding, Alexa will assume you are done, and move on to the next section.
- Alexa cannot capture responses when two people speak at one time.
- Only English names seem to be captured, speech recognition limitations.
- Words need to be enunciated clearly.

Appendix 4

Guideline Assessment Study Details

Welcoming

“Hello! My name is Cassandra, I am researching on how to create better mindfulness conversational agents for persons with dementia and caregivers. Thank you for participating in this study.”

“To start off, the aim of this study is to understand how mindfulness, when done as a pair, using Alexa, can benefit the both of you.”

“This study is expected to last one month, with mindfulness activities and accompanying worksheets, to be done for around 10-15 minutes each day. There will be an assessment done at the start and at the end of the study to see if there are any changes after doing the interventions. There is also a short survey at the start of the study and an interview to be done after the study is completed, to identify your thoughts and preferences.”

“I believe you would have read the participant information sheet and consent form sent to you earlier. Do you have questions on the study? If there are no questions, would the both of you be able to sign two copies of the consent form? One of which you will keep, and the other I would keep.”

Set Up

“I will now set up Alexa for you to be able to do the mindfulness activities. May I know where you would like it to be set up? I would need to test each activity to ensure that they are working fine, so that when you do the activities, you would not face any problems. This would take around 30 minutes, would that be alright?”

“Could you connect Alexa to a power source?”

“Could you also connect your Wi-Fi to the Alexa device?”

“Could you log into your Alexa app, as it would be connected to this Alexa device?”

Assessment

“Meanwhile, I would need each of you to fill in the assessment form. Could the both of you fill these forms up?”

Alignment

“Have you had any experience with mindfulness? If you have not, mindfulness is a therapeutic technique to help you focus on awareness of the present moment, being in the here and now. It involves acknowledging and accepting any and all thoughts, feelings and sensations one experiences, and to not be overly reactive or overwhelmed by what is going on around us. Mindfulness has many benefits, some of them include helping to relieve stress, improve quality of life and improved ability to manage difficult emotions and thoughts.”

“However, cultivating the healing power of mindfulness cannot be done by robotically following a set of instructions. It requires one’s mind to be open and receptive to learning and seeing things in a different light. Mindfulness cannot be forced, the more you force it, nothing will happen.”

“If you practice mindfulness with the mindset that it would not work, you probably will leave thinking that it is not helpful. The first instance you experience discomfort, you will probably say to yourself ‘see, I knew it wouldn’t go away’.”

“If you practice mindfulness thinking that it would immediately change your life, you probably will go away feeling disappointed. Mindfulness requires effort and consistency for there to be benefits and could not drastically change your life in a session or two. But it may help with stress relief, or even enable you to learn to cope with difficult situations more effectively, with practice over time.”

“It is important to maintain an open attitude while practicing mindfulness. You may have doubts, and that’s alright, you may say ‘I don’t know whether this will work, but I am willing to try my best and see what happens’”.

Demonstration & Introduction on Device

“To use Alexa, you would simply say ‘Alexa’ to this device, followed by the name of the activity, for instance ‘mindful breathing’. So, you would say ‘Alexa, mindful breathing’ to start the activity. When you start the activity, they would ask for your names to personalise the experience, please say the names in this order ‘Mary and Tony’ as the system only records names said in this manner. If you would like to stop the activity, say ‘Alexa, stop’ and the session will end. It is also important to note that Alexa waits for up to 8 seconds to capture what you said. If there is no user response, Alexa repeats the previous section. If you/someone else talks when Alexa requests for a response, Alexa would assume that is the response and move on to the next section. If you pause halfway when responding, Alexa will assume you are done, and move on to the next section. Alexa can’t capture responses when two people are speaking. Also, only English names seem to be captured, because of speech recognition limitations. Words also need to be enunciated clearly for Alexa to capture it. You can refer to the workbook if you need to, it has details on how to use Alexa, and also describes each activity briefly. There are 4 different activities that you can do, and the description as well as the name of the activity is written in the workbook.”

“The first activity is a mindful breathing activity, encouraging you to stay in the present moment, focusing on sensations as you inhale and exhale. The second activity is a making space activity, that encourages you to make space for all thoughts, positive, negative, or neutral thoughts as they arrive in your mind, learning to be an observer of your thoughts, just watching them all go by and not latching onto certain thoughts. The third activity is a gratitude practice that encourages expressing gratitude towards the little things in life, and towards each other. The fourth activity is a compassion practice that encourages sending and receiving compassion, to and from one another. Anytime you wish to do one of these exercises, simply say ‘Alexa’ before saying the exercise name, which can be found in the workbook.”

Activity 1

“Now, to start the study, would the two of you be able to try out one exercise on your own? I will sit here and provide help if you face any problems. You may pick any activity you would like to do.”

Dyads complete an activity.

“What do you think of the activity? Please fill in the questions in each of your workbook’s first worksheet. It’s important to remember that you would have to fill up a worksheet for

each activity you do.”

Dyads complete a worksheet.

“You may choose to do more than one activity if you prefer, although only one is required for each day. Please fill in a worksheet for any additional activities you do, for us to analyse them. Also, if you would like to receive daily reminders, please let me know your WhatsApp numbers and I will send you notifications each morning. You may also reach me at this number if you run into any problems or have any questions.”

Survey

“Now, I would like to ask you some questions about your needs and preferences.”

Reminder for Activity 2-30

“For the next 29 days, you may wish to do at least one activity each day, as a pair. Do remember to do each activity as a pair as they were created for both of you to do them together. You may do more than one if you prefer but remember to fill up each worksheet after each activity, as it only counts as an activity done if you fill it up. Do you have any other questions?”

After Day 30

“Thank you for completing the mindfulness interventions. I would now need each of you to take part in an assessment and interview, to find out more about your thoughts and preferences.”

Assessment

“Would each of you also be able to fill in the assessment forms to see if there are any changes from the start to the end of the study?”

Semi-structured Interview

“Would you be able to spend the next hour on an interview to find out about your experiences over the past month?”

Closing

“Do you have any other feedback on how we can improve?” (Note their feedback in the questionnaire, if not already present)

“I would need to collect the completed workbooks and Alexa.”

“Thank you for participating in the study, your feedback will be truly beneficial in helping us to understand how we can create dyadic mindfulness conversational agents for persons with dementia and caregivers. We would also like to reimburse you for your time with vouchers.”

Appendix 5

Pre-Study Assessments

MIDI Sense of Control Scale

For each statement please check the box corresponding to the answer that best represents your level of agreement with each statement as it applies to you.

	Strongly disagree	Somewhat disagree	Disagree a little	Don't know	Agree a little	Somewhat agree	Strongly agree
1. There is little I can do to change many of the important things in my life.	1	2	3	4	5	6	7
2. I often feel helpless in dealing with the problems of life.	1	2	3	4	5	6	7
3. I can do just about anything I really set my mind to do.	1	2	3	4	5	6	7
4. Other people determine most of what I can and cannot do.	1	2	3	4	5	6	7
5. What happens in my life is often beyond my control.	1	2	3	4	5	6	7
6. When I really want to do something, I usually find a way to succeed at it.	1	2	3	4	5	6	7
7. There are many things that interfere with what I want to do.	1	2	3	4	5	6	7
8. Whether or not I am able to get what I want is in my own hands.	1	2	3	4	5	6	7
9. I have little control over the things that happen to me.	1	2	3	4	5	6	7
10. There is really no way I can solve some of the problems I have.	1	2	3	4	5	6	7
11. Sometimes I feel that I am being pushed around in life.	1	2	3	4	5	6	7
12. What happens to me in the future mostly depends on me.	1	2	3	4	5	6	7

Perceived Stress Scale

For each question please check the box that best represents your answer.

	Never	Almost Never	Sometimes	Fairly Often	Very Often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you dealt successfully with irritating life hassles?	0	1	2	3	4
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	0	1	2	3	4
6. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
7. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
8. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
9. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
10. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
11. In the last month, how often have you been angered because of things that happened that were outside of your control?	0	1	2	3	4
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?	0	1	2	3	4
13. In the last month, how often have you been able to control the way you spend your time?	0	1	2	3	4
14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Penn State Worry Questionnaire

Choose the response that best describes how typical or characteristic each item is of you.

		Not at all typical	Rarely typical of me	Somewhat typical of me	Often typical of me	Very typical of me
1	If I don't have enough time to do everything, I don't worry about it.	5	4	3	2	1
2	My worries overwhelm me.	1	2	3	4	5
3	I do not tend to worry about things.	5	4	3	2	1
4	Many situations make me worry.	1	2	3	4	5
5	I know I shouldn't worry about things, but I just cannot help it.	1	2	3	4	5
6	When I am under pressure I worry a lot.	1	2	3	4	5
7	I am always worrying about something.	1	2	3	4	5
8	I find it easy to dismiss worrisome thoughts.	5	4	3	2	1
9	As soon as I finish one task, I start to worry about everything else I have to do.	1	2	3	4	5
10	I never worry about anything.	5	4	3	2	1
11	When there is nothing more I can do about a concern, I don't worry about it anymore.	5	4	3	2	1
12	I've been a worrier all my life.	1	2	3	4	5
13	I notice that I have been worrying about things.	1	2	3	4	5
14	Once I start worrying, I can't stop.	1	2	3	4	5
15	I worry all the time.	1	2	3	4	5
16	I worry about projects until they are done.	1	2	3	4	5

Unidimensional Relationship Closeness Scale

The following questions refer to your relationship with your loved one. Please think about your relationship with your partner when responding to the following questions.

1. My relationship with my loved one is close.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
2. When we are apart, I miss my loved one a great deal.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
3. My loved one and I disclose important personal things to each other.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
4. My loved one and I have a strong connection.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
5. My loved one and I want to spend time together.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
6. I'm sure of my relationship with my loved one.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
7. My loved one is a priority in my life.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
8. My loved one and I do a lot of things together.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
9. When I have free time I choose to spend it alone with my loved one.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
10. I think about my loved one a lot.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
11. My relationship with my loved one is important in my life.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
12. I consider my loved one when making important decisions.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Appendix 6

Pre-Study Survey

- 1. How loud should the volume be?**

25% / 50% / 75% / 100% Volume

- 2. Is the voice/accent easy to understand?**

Yes/No

If no, which accent would be easier to understand?

- 3. On a scale of 1-5, how easy or difficult was it to use the conversational agent (Alexa)?**

1	2	3	4	5
Difficult				Easy
Why?				

- 4. Would you like a reminder from Alexa to remind you to do mindfulness at a certain time each day?**

Yes/No

If yes, when and why? If no, why not?

- 5. Where did you place Alexa in your home?**

- 6. What kind of space is it?**

7. Is it a quiet space, without the possibility of being disturbed?

Yes/No

8. Where did you seat? (Chair, bed, sofa?)

9. Did you sit near each other?

Yes/No

Why?

10. Did you sit facing each other?

Yes/No

Why?

11. What is your relationship with your partner?

Spousal/ Parent-child/ Other: _____

12. Circle your gender.

Male/ Female

13. Circle your age.

<20, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, >89

14. Circle your education background.

Primary school, Secondary school, A level equivalent, Bachelors, Masters, PhD,
Others: _____

15. What type of dementia do you/your loved one have?

16. How long have you/your loved one had dementia? What stage?

<1 year, 1-2 years, 3-4 years, 5-6 years, 7-8 years, 9-10 years, >10 years

Stage: Early/ Moderate/ Severe

17. Have you had any experience with mindfulness prior to this study?

Yes/No

18. If yes, what type of mindfulness activities?

19. If yes, what did you use them for?

20. If yes, do you still practice mindfulness?

Yes/No

21. Have you had any experience with conversational agents like Alexa or equivalent, prior to the study?

Yes/No

22. If yes, what type of conversational agent?

23. If yes, what did you use them for?

24. If yes, do you still use conversational agents?

Yes/ No

25. On a scale of 1-5, how much did you like or dislike mindfulness activities?

1 2 3 4 5

Disliked

Liked

Why?

26. On a scale of 1-5 how much did you like or dislike a paired approach for mindfulness?

1 2 3 4 5
Disliked Liked

Why?

27. On a scale of 1-5 how much did you like or dislike using conversational agents (Alexa) to practice mindfulness with each other?

1 2 3 4 5
Disliked Liked

Why?

30 Day Study Daily Worksheets

Study Day No. _____ / Worksheet No. _____

1. Which activity did you do today? Circle the activity.

Mindful Breathing / Making Space / Gratitude Practice / Compassion Practice

2. On a scale of 1-5, how easy or difficult was the activity to understand?

	1	2	3	4	5
Difficult					Easy

3. On a scale of 1-5, circle how likely or not likely would you do this activity again, using Alexa. (Assuming you had access to Alexa)

1 2 3 4 5
Not Likely Likely

4. Would you do this activity regularly (at least once a week)? Assuming you had access to Alexa)

Yes/ No

5. On a scale of 1-5, circle how much you liked or disliked the activity.

1 2 3 4 5
Disliked Liked

6. What did you like about the activity?

7. What did you dislike about the activity?

8. Would this activity you learned through Alexa, translate to something you could practice whenever you need? For instance, as you go about your daily life, and you feel that this activity is something you need, you would then do it on your own without Alexa guiding you?

1 2 3 4 5
Not Likely Likely

9. On a scale of 1-5, circle how you feel after doing the activity.

1 2 3 4 5

Bad Good

Appendix 8

Post-Study Assessments

MIDI Sense of Control Scale

For each statement please check the box corresponding to the answer that best represents your level of agreement with each statement as it applies to you.

	Strongly disagree	Somewhat disagree	Disagree a little	Don't know	Agree a little	Somewhat agree	Strongly agree
1. There is little I can do to change many of the important things in my life.	1	2	3	4	5	6	7
2. I often feel helpless in dealing with the problems of life.	1	2	3	4	5	6	7
3. I can do just about anything I really set my mind to do.	1	2	3	4	5	6	7
4. Other people determine most of what I can and cannot do.	1	2	3	4	5	6	7
5. What happens in my life is often beyond my control.	1	2	3	4	5	6	7
6. When I really want to do something, I usually find a way to succeed at it.	1	2	3	4	5	6	7
7. There are many things that interfere with what I want to do.	1	2	3	4	5	6	7
8. Whether or not I am able to get what I want is in my own hands.	1	2	3	4	5	6	7
9. I have little control over the things that happen to me.	1	2	3	4	5	6	7
10. There is really no way I can solve some of the problems I have.	1	2	3	4	5	6	7
11. Sometimes I feel that I am being pushed around in life.	1	2	3	4	5	6	7
12. What happens to me in the future mostly depends on me.	1	2	3	4	5	6	7

As compared to your previous scores, was there an increase or decrease?

Increase/ Decrease

Why?

Perceived Stress Scale

For each question please check the box that best represents your answer.

	Never	Almost Never	Sometimes	Fairly Often	Very Often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you dealt successfully with irritating life hassles?	0	1	2	3	4
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	0	1	2	3	4
6. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
7. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
8. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
9. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
10. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
11. In the last month, how often have you been angered because of things that happened that were outside of your control?	0	1	2	3	4
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?	0	1	2	3	4
13. In the last month, how often have you been able to control the way you spend your time?	0	1	2	3	4
14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

As compared to your previous scores, was there an increase or decrease?

Increase/ Decrease

Why?

Penn State Worry Questionnaire

Choose the response that best describes how typical or characteristic each item is of you.

		Not at all typical	Rarely typical of me	Somewhat typical of me	Often typical of me	Very typical of me
1	If I don't have enough time to do everything, I don't worry about it.	5	4	3	2	1
2	My worries overwhelm me.	1	2	3	4	5
3	I do not tend to worry about things.	5	4	3	2	1
4	Many situations make me worry.	1	2	3	4	5
5	I know I shouldn't worry about things, but I just cannot help it.	1	2	3	4	5
6	When I am under pressure I worry a lot.	1	2	3	4	5
7	I am always worrying about something.	1	2	3	4	5
8	I find it easy to dismiss worrisome thoughts.	5	4	3	2	1
9	As soon as I finish one task, I start to worry about everything else I have to do.	1	2	3	4	5
10	I never worry about anything.	5	4	3	2	1
11	When there is nothing more I can do about a concern, I don't worry about it anymore.	5	4	3	2	1
12	I've been a worrier all my life.	1	2	3	4	5
13	I notice that I have been worrying about things.	1	2	3	4	5
14	Once I start worrying, I can't stop.	1	2	3	4	5
15	I worry all the time.	1	2	3	4	5
16	I worry about projects until they are done.	1	2	3	4	5

As compared to your previous scores, was there an increase or decrease?

Increase/ Decrease

Why?

Unidimensional Relationship Closeness Scale

The following questions refer to your relationship with your loved one. Please think about your relationship with your partner when responding to the following questions.

1. My relationship with my loved one is close.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
2. When we are apart, I miss my loved one a great deal.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
3. My loved one and I disclose important personal things to each other.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
4. My loved one and I have a strong connection.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
5. My loved one and I want to spend time together.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
6. I'm sure of my relationship with my loved one.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
7. My loved one is a priority in my life.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
8. My loved one and I do a lot of things together.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
9. When I have free time I choose to spend it alone with my loved one.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
10. I think about my loved one a lot.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
11. My relationship with my loved one is important in my life.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
12. I consider my loved one when making important decisions.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

As compared to your previous scores, was there an increase or decrease?

Increase/ Decrease

Why?

Appendix 9

Post-Study Interview

- 1. On a scale of 1-5, how much did you like or dislike mindfulness activities?**

1	2	3	4	5
Disliked				Liked
Why?				

- 2. On a scale of 1-5 how much did you like or dislike a paired approach for mindfulness?**

1	2	3	4	5
Disliked				Liked
Why?				

- 3. On a scale of 1-5 how much did you like or dislike using conversational agents (Alexa) to practice mindfulness with each other?**

1	2	3	4	5
Disliked				Liked
Why?				

- 4. Is the set up location the same from the start of the study?**

Yes/No
If no, what changed? Why?

5. On a scale of 1-5, how easy or difficult was it to use the conversational agent (Alexa)?

1	2	3	4	5
Difficult				Easy
Why?				

6. Do you think that it would be more challenging to use the intervention as dementia declines or as caregiving duties increase?

Yes/No

Why?

If yes, what can be done to mitigate this?

7. How did you activate the mindfulness exercises?

For instance, did you ask Alexa to start the activity before it guides you, or did you activate it through a reminder at a set time each day?

Why?

8. On a scale of 1-5, how useful or not useful did you find the activities?

1	2	3	4	5
Not useful				Very Useful
Why?				

9. What do you think about the length of the activities?

Too long/ Just nice/ Too short

How long/short should it be, if not just nice? Why?

--

10. How did you find tangible activities like Mindful Breathing, as compared to thought based activities like Making Space, was one more challenging than the other or were they both easy to use?

--

11. Were there sufficient activities for the both of you to do?

Yes/No
If no, why?

12. Were these mindfulness exercises able to fit into your lives or habits?

Yes/No

How so? / Why not?

13. Did mindfulness exercises you learned through Alexa, translate to something you practiced whenever you needed? For instance, as you go about your daily life, and felt that a mindfulness exercise was something you needed, you then did it on your own without Alexa guiding you?

Yes/No

Why?

14. How long did/ would it take to translate into something you do in your daily life, without Alexa guiding you?

As a lifestyle/ A year/ 6 months/ 3 months/ 1 month/ 1 week/ I don't need Alexa to guide me

Why?

15. Would you do these mindfulness exercises regularly after the study ends (at least once a week)? (Assuming you had access to it)

Yes/No

Why?

16. How often would you do these mindfulness activities after the study ends (Assuming you had access to it)?

Everyday/ 3x a week/ 1x a week/ 1x a month/ Seldom/ Never

17. How long would you do these mindfulness activities for, after the study ends (Assuming you had access to it)?

As a lifestyle/ A year/ 6 months/ 3 months/ 1 month/ 1 week/ Never

Why?

18. Did you find any benefits from doing the activities for the last month?

Yes/No

If yes, explain benefits.

19. Were there any challenges you faced in the last month?

Yes/No

If yes, explain challenges.

20. On a scale of 0 to 10, how likely is it that you would recommend this intervention to a friend or colleague?

0	1	2	3	4	5	6	7	8	9	10
Not at all										Extremely
Likely										Likely

21. Is there anything you would like to add?

Appendix 10

Image Use Permission



Danielle McEachern-Dugre



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Good afternoon,
Yes, you may use the images for your thesis.

Best wishes,
Dr. McEachern-Dugre

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