Adherence to the Class-Based Component of a Tai Chi Exercise Intervention for People Living with Dementia and Their Informal Carers

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Abstract

Objective: The aim of this study was to understand the experiences of people living with dementia and their informal carers' taking part together (in dyads) in Tai Chi classes and the aspects influencing their adherence.

Methods: Dyads' experiences of taking part in Tai Chi classes for 20 weeks within the TACIT Trial were explored through class observations (n = 22 dyads), home-interviews (n = 15 dyads) and feedback. Data was inductively coded following thematic analysis.

Results: Tai Chi classes designed for people with dementia and their informal carers were enjoyable and its movements, easy to learn. Facilitators of their adherence were the socializing component and their enjoyment of the classes, whereas unexpected health problems were the main barrier.

Discussion: Finding the optimal level of challenge in the class setting might be crucial for people with dementia to feel satisfied about their progression over sessions and enable their continued participation.

Keywords

Falls; Barriers; Facilitators; Qualitative research; Self-determination theory.

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Introduction

Dementia is estimated to affect 50 million people around the globe with prospects pointing towards 131.5 million people living with dementia by 2050 (Alzheimer's Disease International, 2015). Its prevalence, the impact on the person with the diagnosis, their relatives, the strains on the social and healthcare systems, and the lack of a cure have made dementia a public health priority (Department of Health, 2015; WHO, 2018). Similarly, falls have also been identified as a global problem among older people due to its higher prevalence in this population and associated risk of mortality (WHO, 2007). Among older adults, people living with dementia are more likely to experience falls than their peers as well as experience more severe consequences after a fall, including increased dependence and death (Allan, Ballard, Rowan, & Kenny, 2009; Fernando, Fraser, Hendriksen, Kim, & Muir-Hunter, 2017; Shaw, 2003). Hence, the development of interventions to prevent falls and people living with dementia's adherence to these is key to improving their own and their carers' quality of life.

Exercise is an effective intervention to prevent falls, particularly those exercises challenging balance, such as Tai Chi (Nyman, 2020; Sherrington et al., 2019). However, adherence to exercise and falls prevention interventions has been reported as a limitation for older people living with dementia to get the benefits of these interventions (Burton et al., 2015). Previous research has highlighted characteristics of the exercise intervention that would facilitate people living with dementia's adherence to exercise classes (i.e., including a socializing component, tailoring exercise to individual needs, and memory aids such as attendance reminders) (Dal Bello-Haas, O'Connell, Morgan,

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& Crossley, 2014; Frederiksen, Sobol, Beyer, Hasselbalch, & Waldemar, 2014; Pitkälä et al., 2013), of the instructor (i.e., charisma and expertise) (Dal Bello-Haas et al., 2014; Frederiksen et al., 2014; Pitkälä et al., 2013; Prick, de Lange, van 't Leven, & Pot, 2014), and participants (i.e., ability to sustain attention, expectations, perceived benefits and motivations) (Dal Bello-Haas et al., 2014; Frederiksen et al., 2014; Prick et al., 2014). Whereas factors that hinder their sustained participation in exercise classes include previous health conditions and frailty (Chong et al., 2014; McCurry et al., 2011), excessive content (or introduced in a speedy manner or not adapted to participants needs) (Chong et al., 2014; Frederiksen et al., 2014; McPhate et al., 2016), or adverse events (Frederiksen et al., 2014; Teri et al., 1998).

Despite the positive qualities attributed to Tai Chi for older people (i.e., in terms of physical and psychological improvements (Li et al., 2005; Sun et al., 2015; Voukelatos, Cumming, Lord, & Rissel, 2007)), previous exercise trials have tended to exclude people living with dementia. When people living with dementia have been invited to participate, studies have mainly focused on the effectiveness of the interventions to prevent falls and their experiences have not been explored (Yao, Giordani, Algase, You, & Alexander, 2012). Although Suttanon et al. (2012) examined qualitatively the motivators and barriers for participants with dementia for home-based exercise to date no falls prevention studies have explored the factors associated with adherence to class-based exercise in individuals with dementia and their family carers. One previous study focused on the acceptability of Tai Chi among people living with dementia, however, this was conducted in the context of a four week Pilot Intervention Phase (Barrado-Martín, Heward, Polman, & Nyman, 2019). Hence, there is the need to study long-term barriers and facilitators to their adherence to Tai Chi classes, and whether lessons learnt have an impact on a long-term adherence intervention. Likewise,

previous exercise research in people living with dementia have scarcely linked their findings to existing theory (Yu & Swartwood, 2012). Hence, there is a lack of understanding of what people living with dementia and their carers would need to facilitate attendance to exercise classes and potentially obtain its benefits.

Self-determination theory (SDT) seems particularly appropriate in the exercise context as it has been found useful to understand the motivational orientation to adopt and maintain exercise behaviour (Ingledew, Markland, & Medley, 1998). SDT postulates that individuals are driven by an innate tendency to discover their environment and satisfy three basic needs of autonomy, competence and relatedness. SDT suggests that individuals will be more likely to sustain behaviours that are self-determined, which are intrinsically enjoyable for the individual and fulfils their basic needs (Deci & Ryan, 2000).

The current study, embedded in the <BLINDED FOR REVIEW> Trial (Trial Registration: <BLINDED FOR REVIEW>) that was designed to explore Tai Chi's impact on people living with dementia's postural balance, aimed to understand what is influencing those living with dementia and their carers' participation in Tai Chi exercise classes. SDT was used jointly with previous research to discuss this study findings and its fit with SDT postulates regarding the relevance of the three basic needs and the self-determination required to sustain adherence to exercise practice.

Design and methods

Participants

Participants were recruited between April 2017 and July 2018. Recruitment sources included 3 National Health Service Trusts, and 15 General Practitioner surgeries, Join Dementia Research Website, the Alzheimer's Society and publicity (via flyers or face-to-face events attended by <BLINDED FOR REVIEW> Team) across three different

research sites in the <BLINDED FOR REVIEW>. A total of 359 participants were referred and screened by the <BLINDED FOR REVIEW> Team, amongst those 86 were randomized after being found eligible and willing to take part in the trial. Of these 86 dyads, 42 dyads were allocated to the intervention arm and were divided into 10 different groups.

This study sample represents participant dyads allocated to the intervention arm of the first 6 out of the 10 groups organized (n = 25). Dyads were formed of a person with dementia and their informal carer (non-professional, unpaid carer, like a family member or friend providing support). Demographic characteristics of participants included in the study are provided in Table 1 and inclusion and exclusion criteria are described in Table 2. Amongst recruited participants, three dyads did not attend any of the classes (one participant living with dementia changed her mind regarding participation in the study after randomisation and a second participant had health issues that impeded attendance to classes) or discontinued participation before being observed (one dyad due to competing commitments), and hence only 22 dyads were included in the analysis. Most participants observed during classes (n = 22) were later interviewed (n = 15) as reflected in Supplementary Material B.

[TABLE 1 HERE]

[TABLE 2 HERE]

Design and instruments

A qualitative approach was used to explore dyads' experiences of taking part in the <BLINDED FOR REVIEW> Trial. At baseline participants' demographic details were collected through a structured questionnaire (see Table 1). Semi-structured observation sheets were used during observations of classes, to help the researcher note their observations and collect feedback from instructors and participants at the end of the

classes in a systematic way. Likewise, a semi-structured schedule was used to guide dyadic interviews with dyads following their participation in the intervention (see Supplementary Material A). Data collection tools were developed based on previous research and the experiences of our Pilot Intervention Phase <BLINDED FOR PEER REVIEW>. Elements that could influence adherence as well as elements from self-determination theory such as the three basic needs were included in these sources of data collection. For instance, the interview topic guide included aspects about participants' feelings taking part in a group intervention and their willingness to sustain these relationships beyond their involvement in the study (relatedness) and how did they feel about the intensity or the level of difficulty of the classes (competence). Observation and feedback sheets, on the other side, had a box dedicated to comments made by participants during classes regarding their competence performing the moves and researcher's observations on their performance. Likewise, another box was dedicated to observations on relatedness or how participants reacted to practising with others (e.g. interacting with others, looking at others during the classes and non-verbal communication). Finally, another box was dedicated to autonomy need where participants' comments and observations on their independent and voluntary participation in the classes were captured.

Procedure

Participants in the intervention arm were invited to join weekly Tai Chi (Chen style) classes for 20 weeks (where 8 warm up patterns, and 5 tai chi forms pattern were taught), as well as practicing at home for 20 minutes a day. Each class consisted of 45 minutes of Tai Chi practice (warm-up, patterns and relaxation) with emphasis on posture and breathing plus up to 45 minutes for informal conversation with peers and Q&A with the instructor (for more detail see study protocol <BLINDED FOR

REVIEW>). New warm-ups and patterns were progressively introduced over classes. During classes, the new movements were taught through instructor demonstration and verbal cues. Each movement was repeated until participants were able to follow the instructor correctly, the instructor corrected participants' moves verbally and where required also physically. Likewise, as per protocol, throughout their participation in the study (from baseline up until the follow-up home visit), participants received weekly falls monitoring calls by first author (second author acted as cover when first author was unavailable) (<BLINDED FOR REVIEW>). The classes were led by two fully trained and experienced Tai Chi instructors. The classes' venues were chosen by the research team after assessing a series of accessibility, maintenance, and suitability criteria tested in the Pilot Intervention Phase of the <BLINDED FOR REVIEW> Trial (<BLINDED FOR REVIEW>).

Throughout the 20-week period a researcher observed a total of 23 classes, this was made up of between 2 and 5 classes from each Tai Chi group (less observations were made when the group was left with a single dyad attending until data saturation had been reached). Feedback from participants and instructors was collected at the end of each observed class (n = 23). Additionally, instructors' notes in the class registers were also incorporated in the analysis. Around week 16, 15 dyads were invited to take part in a dyadic interview at home. A purposive sampling strategy ensured a range of participants with differing adherence experiences were included, such as dyads that were able to attend all sessions and others who were not. All dyads invited to take part in an interview agreed to take part together at their home. These interviews were audio-recorded and professionally transcribed verbatim.

Researcher characteristics

Data was collected by first author who had a BSc (Hons) in Psychology, an MSc in Geropsychology and was working towards her PhD in Psychology when data was collected. She had previous clinical and research experience working with people living with dementia and their carers, but no expertise in exercise research. However, she was willing to learn about any intervention with a potential to have a positive impact on people living with dementia's lives. First author met participants over the phone at the time of their initial screening or soon after through weekly monitoring calls, which lasted throughout participants' involvement in the study. Participants knew the role of the first author within the study, and that she had never practised Tai Chi before. Participants were aware the role of the first author was to learn from their experiences and about the barriers and facilitators to their participation; and that their low or high adherence to the intervention was not the focus of first author's research, but their frank views to be able to further improve the Tai Chi intervention to meet their needs. She was interested in learning from participants' experiences, and perhaps because she was not used to exercise herself, thought people living with dementia and their carers would find difficulties in adhering to an exercise routine.

Ethical considerations

The trial was ethically approved by the West of Scotland Research Ethics Committee 4 (reference: <BLINDED FOR REVIEW>) and the Health Research Authority (IRAS project ID: <BLINDED FOR REVIEW>). Participants were provided with a participant information sheet by post and given a minimum of 48-hours to consider their participation. Written informed consent was obtained from both members of the dyad. Additionally, process consent was verbally attained at each interaction with participants (Dewing, 2008).

Data analysis

Field notes and interviews' transcriptions were incorporated to Nvivo.11 (QSR International Pty Ltd., Doncaster, Victoria, Australia) and thematically analysed together. Each interview was coded promptly to afford refinement of the interview probes for subsequent interviews until data saturation was reached. The 6 steps described by Braun and Clarke (2013) were used at this stage to get familiarized with the data, generate initial codes, search for themes and review those initial themes to finally write-up the report. Data was inductively coded by the first author and 10% of the data was double coded by the second author following a coding manual developed by the first author, reaching a strong level of agreement in the quotes being coded under the same codes (Kappa value: .90). Finally, resulting themes and codes were reviewed by all four authors. All three sources of data (qualitative observations, feedback, and dyadic interviews) were analysed together as no significant changes were appreciated between participants or participants and researchers accounts during data collection, which might reflect participants' comfort in reporting back to the researcher- However, the richest source of data, and particularly of quotes, were the interviews, hence most part of the quotes provided in Table 4 were extracted from those interviews. This publication presents findings related to participants' experiences of the classes, a separate publication (<BLINDED FOR REVIEW>) reports on their experiences to the home-based component.

Findings

Class attendance

Dyads' adherence to the classes varied widely among participants as shown in Supplementary Material B. Only three dyads attended 100% (20/20 class offered), one additional dyad attended all the classes offered since their recruitment (16 classes), and 10 dyads attended at least 50% of the classes. Overall, people living with dementia

attended an average of 11.4 (ranging 0-20) sessions and carers, 11.6 (ranging 0-20) sessions.

Class attendance is measured from the time participants were recruited into the study until the end of the study or, where applicable, the point that they withdrew from the study. Overall attendance to classes fluctuated over the course of the intervention as shown in Supplementary Material C. People living with dementia attended an average of 58.1% of the classes, whilst their carers attended 59.1% as reflected in Supplementary Material B. This difference was due to one of the participants living with dementia not being able to attend several sessions due to previous health issues (i.e., back pain), but the carer continued attending.

Reasons for participants or instructors' missing classes are provided in Table 3. A total of 14 sessions had to be cancelled and postponed, due to none of the participants (n=8) or the instructors (n=6) being able to attend, to ensure the delivery of 20 classes originally planned either.

[TABLE 3 HERE]

Qualitative findings

Within participants' classes experiences six subthemes were identified: the practicalities of the classes, instructors' characteristics, participants reactions to the intervention, class barriers, class facilitators and improvements suggested. Each theme is explained next and example quotes supporting those themes are provided in Table 4.

[TABLE 4 HERE]

Practicalities of the classes

The venues and timing were generally perceived as suitable. Two carers in a venue with a big mirror at the end of the class valued this element, whereas a participant living with dementia in a class without a mirror missed it after struggling with mirroring the

instructor and having practised in front of a mirror at home. When asked, Instructor 2 also thought that in an ideal situation, a mirror in the class would be helpful. As shown in Table 3, the duration of the classes (45 minutes, once a week), intensity, and level of challenge were adequate for all 15 dyads interviewed. The frequency of the classes was right for participants. Only two carers in the group taking part on Mondays (which clashed with several bank holidays) highlighted in their feedback that continuity would be preferable. They all seemed to agree that less frequent classes would not help their learning process or to create a routine and they would feel the Tai Chi would lose its impact.

Although, in some instances, dyads were provided with one-to-one tuition they preferred to practice in the company of others. When asked, participants pointed towards an ideal number of dyads per class being between four and eight, always depending on the size of the room and the instructor's ability to monitor the individuals in the group. Both instructors agreed that small groups were a challenge as the impact on dyads missing a class or withdrawing was greater on the other participants. Likewise, the socializing component of the classes was highly valued, and frequently perceived as one of the strengths of the intervention as it gave participants the opportunity to share time with other people 'in the same boat'. Participants positively described their relationships with other participants and the instructors and felt this socializing component was important for their well-being. This component was missed when not been fully implemented (e.g. when participants had competing demands after the class or their carpark ticket was about to expire by the end of the Tai Chi session) and participants suggested this could be promoted by:1) Allocating 10/15/20 minutes for socializing (in groups where this did not happen) and presenting it as part of the class

"*Well you have…you include that as a coffee break…um, and it seemed to…it…that's*

the hour. Instead of committing three quarters of an hour, you're there for an hour." (01022C-I); 2) Staying in the same room for socializing in the case of group 2 where they were required to move to another room on a different floor (however, another participant in this group thought this would have not been a difficulty) "*Well I think if we didn't have to move. (…) But the fact that we've all got to pack up and walk up to that room upstairs and then the kettle has to go on makes it all a bit time-consuming*." (01002C-I). and; 3) Choosing a different room environment inviting to socialize in a more natural way (as reported in group 3 and 5 where refreshments were offered in the same venue). "*I mean, the <Venue 3> Centre is not exactly designed for sitting around and having a chat is it (…) …it just wasn't as…you know, like a sit down and socialize sort of looking place*." (03008C-I).

Instructors' characteristics

Despite the attempts to deliver the classes in a similar way, instructors showed some differences in their teaching styles. For instance, whereas Instructor 1 seemed more concerned about participants performing the movements exactly as instructed (and used more direct correction), Instructor 2 delivered the classes in a professional but more relaxed way, including the use of jokes and personal anecdotes during the classes. Regardless of these differences, however, both instructors received positive feedback from the participants. Participants frequently pointed Instructor 1´s strengths were her patience, authenticity and her way to welcome the participants, as well as her attentive manner. Participants guided by Instructor 2 described him as an excellent instructor who created a failure free environment and explained the tales behind the movements which made the classes interesting.

Participants' reactions

Participants kept focused on the instructor during the classes and had little interaction with other participants or the instructor. Some participants tended to spontaneously comment more during the classes and were acknowledged by instructors with a reassuring response. Conversation between members of the dyad or with other participants during the classes was mostly non-existent except when one of the participants needed occasional carer's support in executing the movements or if there had been a joke between participants and the instructor.

Participants seemed to welcome both direct and indirect corrections. Two participants living with dementia expressed their willingness 'to do it [Tai Chi], the way it's got to be done' (01002P, 03003P). One carer felt physical support and corrections were crucial for the person living with dementia to learn the movements the right way and achieve the expected benefits. One carer and two people living with dementia reported some potentially negative feelings around corrections. However, these were only initial feelings that did not impact on their enjoyment of the classes or their impressions about Instructor 1.

Participants reported at the end of the classes their expectation that movement execution would get easier over time. Interviews confirmed this notion. Both people living with dementia and their carers appreciated that the more repetition, the more they could feel the flow when engaging in Tai Chi. Repetition provided feelings of improvement in their performance over sessions, which was supported by instructors.

Eight participants living with dementia and three carers perceived their ability to perform the movements was worse than others, that they struggled with some particular movement or part of their practice, or their ability had worsened after a experiencing a stroke or fall (unrelated to Tai Chi). Most participants were able to identify their own strengths and weaknesses during their practice and were confident their performance

could improve with further practice. This encouraged them to keep practicing Tai Chi and willing to continue with the classes as one of the dyads who joined Instructor 2's private lessons once their participation in the study finished (e.g. dyad 01012).

Three participants living with dementia described their learning process as a natural process, something they were learning from the instructor during the classes implicitly. One of the participants living with dementia who experienced two strokes during her participation in the study and had to discontinue her practice reported she was still capable of remembering the movements when back practicing. Similarly, another dyad was able to resume and catch up with the classes after missing several sessions when recovering from an accident.

Class barriers

None of the participants reported any reluctance to attend classes. On the contrary, the potential benefits were perceived to be more important than potential difficulties to attend (i.e., time of the classes) and that they would miss the Tai Chi classes once their participation in the study would be finished.

Only one dyad described Tai Chi as a 'boring' activity (01022), however, they admitted their previous exercise history might have impacted on their experience of Tai Chi, as both the person living with dementia and the carer were used to higher intensity exercises (i.e., personal trainer and cardio exercises). Their continued attendance to the classes was motivated by the chance of getting health benefits from Tai Chi and their commitment to the study. One additional carer perceived Tai Chi not to be a suitable activity for her in a dyadic setting as she did not feel able to relax. She might have continued for the benefit of her mother living with dementia but would have preferred to continue in a separate group (i.e., Tai Chi carers group). This was not the reason for

their withdrawal, however, this last dyad ended up withdrawing from the intervention after her new job clashed with the Tai Chi classes.

A limitation of Tai Chi pointed out by one person living with dementia was that it took them a while to familiarize themselves with the movements. This was probably increased in this dyad's case as they joined the intervention later and the person living with dementia struggled with getting used to the mirroring.

Twelve participants living with dementia reported a health issue that interfered with their class Tai Chi practice at some point (i.e., not allowing participants to copy the movements or feeling discomfort when doing it). Less than half of them had to sit for a little while during the classes because of diabetes, low blood pressure, feeling wobbly, dizzy spells, balance difficulties, back pain, or shoulder problems. They joined the class following a short break and this did not result in dyad's withdrawing from the intervention. Participants (ten of them) and instructors reported Tai Chi specific difficulties. These included left right differentiation, getting relaxed, copying the movements, remembering the movements, doing the footwork, mirroring, or practicing with little verbal guidance.

Class facilitators

Overall, participants reported that they enjoyed their participation in the classes, both people living with dementia and their carers were looking forward to attending the classes. It was observed and later confirmed in the interviews that a couple of participants living with dementia attending classes had difficulties recalling why they were at the venue before the start of the class. However, such difficulties expressed also by another two participants living with dementia did not impede them enjoying the classes. Three younger carers with an age gap with the person living with dementia (>10 years) expressed some surprise towards the person living with dementia's enjoyment of

Tai Chi, either for the way they positively reacted to it or the difficulties they faced to find an activity the person living with dementia was interested in.

Enjoyment and socializing opportunities were reported by all as two of the main factors associated with adherence. Two carers also liked the helpful environment and the instructors were also acknowledged for their motivational qualities by four dyads.

Dyads expressed the exercise itself, the potential benefits (i.e., helping to keep fit, feeling well afterwards), the habit of attending classes, the environment characteristics (i.e., failure free), and the enjoyment of specific parts of the session (such as the warm-ups or the integration between foot and arm work, when they felt were 'actually doing the Tai Chi') helped them to keep attending the classes.

An additional motivator was the fact that Tai Chi gave the participants the possibility of practicing exercise together, which for some participants was a must or an incentive (i.e., 'It's always nicer if you've got someone to go with.' 01009P). The Tai Chi was described as potentially beneficial for both members, though three carers verbalised the target of the Tai Chi classes were those living with dementia. Lastly, more altruistic motivations such as helping people living with dementia and a firm commitment to the study were also mentioned as facilitators of classes' attendance (by two carers and 3 dyads respectively).

Suggested improvements to the classes

Most dyads were happy with the classes. Ten dyads suggested the following improvements: a) Possibly increase the number of dyads per class, recruiting younger people living with dementia, or participants at earlier stages of dementia progression; b) Set up a morning class instead of late afternoon class as getting home when it is dark might be off-putting for older people; c) Offer another class for carers with less pausing or give the option for the person living with dementia to attend on their own so the carer

can take some respite; d) Offer an outside practice in the summer; e) Keep verbal guidance throughout the classes; and f) Enhance the socializing component (see Practicalities of the classes).

Discussion and implications

Adherence is often reported as a challenge in exercise research. To our knowledge, this is the first study that qualitatively explores the adherence of those living with mild-to-moderate dementia and their carers to a class-based Tai Chi intervention. It builds on a previous study that qualitatively explored the acceptability of such intervention limited to a small number of classes (Barrado-Martín et al., 2019), providing further understanding on long-term barriers and facilitators to their adherence. Such exploration is key to understand the barriers and facilitators to class attendance identified by dyads with different adherence levels (and different dyadic relationships) throughout a longer study period. Furthermore, this is one of few exercise studies to include the voices of people living with dementia and their informal carers by observing their experiences and using dyadic interviews. Hence, this study makes a unique contribution to the understanding of the needs of people living with dementia and their carers to sustain their participation in Tai Chi exercise classes that could contribute to their wellbeing. This study highlights the value of using qualitative methods alongside trials as changes implemented to the intervention (e.g. reducing the number of patterns to learn throughout the course) after the lessons learnt from Barrado-Martín et al. (2019), were not raised as a barrier in the longer intervention.

Adherence facilitators

Several aspects of the classes have contributed to participants' adherence to the 20-week class practice in line with previous research findings: a) The enjoyment of the classes (Frederiksen et al., 2014; McPhate et al., 2016; Jacqueline Wesson et al., 2013; Yu &

Swartwood, 2012); b) The group-based setting with its inherent socializing component with similar others (Burgener et al., 2008; Dal Bello-Haas et al., 2014; Frederiksen et al., 2014; Yao et al., 2012); c) The friendly and task-oriented environment of the classes where improvement resulted from repetition and effort, and where instructors invited participants to avoid comparing themselves with others (Barnes et al., 2015); d) Their dyadic participation (Yao et al., 2012); and e) The perceived benefits of Tai Chi (Logghe et al., 2011). Additionally, weekly monitoring calls were perceived by some individuals as an encouragement for their attendance to the classes. Despite not being the purpose of these calls, this could have acted as a facilitator in line with previous research findings (Frederiksen et al., 2014; Hawley-Hague, Horne, Skelton, & Todd, 2016; Lam et al., 2012). Likewise, the ability of people living with dementia to remember and perform the movements could have acted as a facilitator to their adherence to the Tai Chi classes. In addition, their progress in movement execution and their enhanced physical self-perceptions can help explain willingness to keep practicing.

Adherence barriers

Reasons for participants being unable to attend sessions are aligned to those reported in the literature. Amongst them, changes in health (including adverse events) or worsening health conditions affecting the person living with dementia or the carer (Chong et al., 2014; Farran et al., 2008; Prick et al., 2014; Suttanon, Hill, Said, Byrne, & Dodd, 2012; Wesson et al., 2013), competing commitments (Suttanon et al., 2012), or holiday periods (Wesson et al., 2013) were the most common. In our study health-related issues affecting the person living with dementia or the carer accounted for 81% of the sessions missed. This had an important impact on the overall adherence of people living with dementia and their carers (58.1-59.1% respectively) despite reporting no reluctance to attend classes. Consistent with previous research, in-class barriers such as occasional

dizziness or physical discomfort (i.e., back pain) (Teri et al., 1998) led to a brief interruption of the Tai Chi practice. Similarly, difficulties to remember the Tai Chi moves (i.e., when the instructor was standing with their back to the participants) previously found amongst older adults in the community (Logghe et al., 2011), triggered one of the dyads to drop out.

Self-determination theory (SDT)

Participants joined the study aspiring to get a health benefit from their participation in Tai Chi. According to SDT, taking part in exercise for health benefit is considered an external form of behavioural regulation. It is not uncommon that during the adoption phase of a more active lifestyle participants are more motivated by such external motives. However, following continued participation behaviour becomes more internalized and intrinsic motives (i.e. enjoyment) can come to dominate motivation for continued engagement in the activity (Ingledew et al., 1998). This process was facilitated by the class environment and the instructors' behaviour that generated a task-oriented motivational climate through the use of constructive and informative feedback and discouragement of comparisons (Eys et al., 2013; Farrance, Tsofliou, & Clark, 2016). At the same time, the dyad nature and the provision of socialization opportunities assisted in developing relatedness (Annesi, Unruh, Marti, Gorjala, & Tennant, 2011; Farrance et al., 2016). The satisfaction of competence and relatedness needs, together with the intrinsic enjoyment obtained through their practice would have assisted in participants' continued participation in the classes (Lee, Arthur, & Avis, 2008). The basic need of autonomy was not relevant in the context of group classes, as participants were there voluntary and nor carers or instructors forced their practice during the classes (e.g. were able to stop if they felt unwell, and were practicing on their own throughout classes).

Additionally, this study findings suggest the usefulness of social cognitive theory as well in that performance accomplishments (Neupert, Lachman, & Whitbourne, 2009), verbal persuasion from professional instructors (Burton, Shapiro, & German, 1999) and vicarious experiences (Lee, Avis, & Arthur, 2007) might have been relevant for participants' adherence to the classes. Over the sessions, participants perceived their own improvement and realized they were able to perform the movements they initially found challenging. This way participants experienced mastery and developed their physical self-efficacy beliefs. Importantly, this study demonstrates that people living with dementia were actively able to participate in Tai Chi and improve in their performance over time. Participants reported getting familiar and progressively learning the moves, despite possible initial difficulties, which enhance their perceptions physical self-efficacy. Overall, Tai Chi might be less suitable for those preferring more vigorous activity but challenging enough for those with less exercise experience. An optimal challenge appeared to be offered to the majority of participants in the <BLINDED FOR REVIEW> Trial as were able to develop their Tai Chi skill (Guadagnoli & Lee, 2004).

This study's strengths

An important strength of the current study was the use of field notes to collect '*in situ*' feedback from participants living with dementia, which enabled capturing comments from participants (i.e., describing the relaxed environment of the classes and encouraging themselves to give a go to Tai Chi). These details might or might not have come up in the context of the interview, which were generally scheduled within sessions (on average 3 days after the most recent session). Secondly, being in touch with participants to collect data for the <BLINDED FOR REVIEW> Trial contributed to a natural development of rapport with the first author which helped the participants open

up when she undertook the interviews. As well being involved in the collection of all data the first author gained an overview of the data set that enabled her to determine the consistency of the data collected during the classes and the interviews (enhancing credibility and dependability) and triangulate the findings. Finally, this study placed the person living with dementia at the centre and confirmed participants living with dementia's ability to contribute and be satisfied with their participation and input to the interviews, which supports future qualitative work with this group. The dyadic setting facilitated the data collection process as carers were able to make clarifications in a familiar environment.

This study's limitations

Because of slow recruitment into the trial, the groups observed, and dyads approached to participate in interviews were from the first six Tai Chi groups rather than representative of all 10 groups organized. Measures of in-class participation were not used, which does not allow a precise evaluation of their adherence (e.g., in terms of intensity) during the classes. In future studies this limitation could be overcome by video-recording the classes. Furthermore, participants who discontinued their participation were interviewed several weeks after having attended their last class as interviews were due around week 16 (i.e., 5 dyads had not attended classes for 6 consecutive weeks on average, ranging from 1 to 9, prior to the interview). Hence, future research might benefit from scheduling these visits as soon as possible after early discontinuation of the classes (i.e., if not immediately after the class, then the next day) to facilitate recall. Likewise, an exit interview with all participants who withdrew from the study would have been useful. The impact of small groups, withdrawal or discontinuation added to health issues and competing commitments (e.g. medical appointments) resulted in 27% of the sessions being run for one dyad only. Future

research would benefit from larger groups to promote the group approach. Similarly, the dyadic format of interviews might have impacted on dyads' willingness to share the weaknesses of taking part together in the intervention together to avoid upsetting the other person.

Implications for practice

Findings of this study suggest that community-based interventions for individuals with mild-to-moderate dementia can be successful when conducted with a significant other (dyadic approach) (Moon & Adams, 2013). However, giving people living with dementia the choice to join on their own could facilitate access, particularly to those living alone (Rollin-Sillaire et al., 2013). The provision of normalised exercise (i.e., Tai Chi, which is also practiced by people living without dementia or other conditions) (Nyman & Skelton, 2017) for a group of people living with the same diagnosis (i.e., dementia) in the community is preferred. A Tai Chi program could benefit from multiple sessions per week on similar days and times to contribute to adherence and learning. Exercise interventions for people living with dementia should include substantial repetition of movements to facilitate such learning (Fenney & Lee, 2010; van Halteren-van Tilborg, Scherder, & Hulstijn, 2007). It is also important to have instructors who create a task-oriented motivational climate through instruction and positive feedback. Providing opportunities for socialising post-exercise also enhances participants' enjoyment and likelihood of continued participation in the activity (Farran et al., 2008; Frederiksen et al., 2014; Hawley-Hague et al., 2016; Lam & Cheng, 2013). Finally, in light of this study findings and to ensure the viability of the program, groups should be larger to allow its continuity when participants living with dementia and their carers inevitably experience health issues or adverse events that impact on their adherence to the classes.

Conclusions

The findings of this study suggest the ability of people living with dementia to learn a new exercise and appreciate their progress over time. The provision of an optimal level of challenge to the group class, accompanied with a failure free environment which has a task-oriented focus, the use of repetition, and supportive and accessible instructors can facilitate dyads enjoyment of the classes. Additionally, the social component of the class might be an incentive to their sustained participation and a way of fulfilling their needs to relate to others outside their usual social networks. Overall, Tai Chi classes might provide people living with dementia with a normalized, accessible and enjoyable activity to share with their informal carers. Future research would need to explore participants' adherence to Tai Chi classes in larger groups which could facilitate their viability in community settings.

References

Allan, L. M., Ballard, C. G., Rowan, E. N., & Kenny, R. A. (2009). Incidence and prediction of falls in dementia: A prospective study in older people. *PLoS One, 4*(5), e5521. https://doi.org/10.1371/journal.pone.0005521

Alzheimer's Disease International. (2015). Dementia statistics. Retrieved from http://www.alz.co.uk/research/statistics

Annesi, J. J., Unruh, J. L., Marti, C. N., Gorjala, S., & Tennant, G. (2011). Effects of the coach approach intervention on adherence to exercise in obese women: Assessing mediation of social cognitive theory factors. *Research Quarterly for Exercise and Sport, 82*(1), 99-108. https://doi.org/10.1080/02701367.2011.10599726

Barnes, D. E., Mehling, W., Wu, E., Beristianos, M., Yaffe, K., Skultety, K., & Chesney, M. A. (2015). Preventing loss of independence through exercise

(PLIÉ): A pilot clinical trial in older adults with dementia. *Plos One, 10*(2), e0113367-e0113367. https://doi.org/10.1371/journal.pone.0113367

Barrado-Martín, Y., Heward, M., Polman, R., & Nyman, S. R. (2019). Acceptability of a Dyadic Tai Chi Intervention for Older People Living With Dementia and Their Informal Carers. *Journal of aging and physical activity*, 27(2), 166–183. https://doi.org/10.1123/japa.2017-0267 Burgener, S. C., APRN-BC, FAAN, Yang, Y., Gilbert, R., & Marsh-Yant, S. (2008). The effects of a multimodal intervention on outcomes of persons with early-stage dementia. *American Journal of Alzheimer's Disease and Other Dementias, 23*(4), 382-394. https://doi.org/10.1177/1533317508317527

Burton, E., Cavalheri, V., Adams, R., Browne, C. O., Bovery-Spencer, P., Fenton, A. M., . . . Hill, K. D. (2015). Effectiveness of exercise programs to reduce falls in older people with dementia living in the community: A systematic review and meta-analysis. *Clinical Interventions in Aging, 10*, 421-434. https://doi.org/10.2147/CIA.S71691

Burton, L. C., Shapiro, S., & German, P. S. (1999). Determinants of physical activity initiation and maintenance among community-dwelling older persons. *Preventive Medicine, 29*(5), 422-430. https://doi.org/10.1006/pmed.1999.0561

Chong, T. W. H., Doyle, C. J., Cyarto, E. V., Cox, K. L., Ellis, K. A., Ames, D., & Lautenschlager, N. T. (2014). Physical activity program preferences and perspectives of older adults with and without cognitive impairment. *Asia-Pacific Psychiatry: Official Journal of The Pacific Rim College of Psychiatrists, 6*(2), 179-190. https://doi.org/10.1111/appy.12015

Dal Bello-Haas, V. P. M., O'Connell, M. E., Morgan, D. G., & Crossley, M. (2014). Lessons learned: Feasibility and acceptability of a telehealth-delivered exercise

intervention for rural- dwelling individuals with dementia and their caregivers. *Rural and Remote Health, 14*(3), 2715. Retrieved from http://www.rrh.org.au/publishedarticles/article_print_2715.pdf

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Department of Health. (2015). *Prime Minister's Challenge on Dementia 2020.* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/414344/pm-dementia2020.pdf

Dewing, J. (2008). Process consent and research with older persons living with dementia. *Research Ethics Review, 4*(2), 59-64. https://doi.org/10.1177/174701610800400205

Eys, M. A., Jewitt, E., Evans, M. B., Wolf, S., Bruner, M. W., & Loughead, T. M. (2013). Coach-initiated motivational climate and cohesion in youth sport. *Research Quarterly for Exercise and Sport, 84*(3), 373-383. https://doi.org/10.1080/02701367.2013.814909

Farran, C. J., Staffileno, B. A., Gilley, D. W., McCann, J. J., Li, Y., Castro, C. M., & King, A. C. (2008). A lifestyle physical activity intervention for caregivers of persons with Alzheimer's disease. *American Journal of Alzheimer's Disease and Other Dementias, 23*(2), 132-142. https://doi.org/10.1177/1533317507312556

Farrance, C., Tsofliou, F., & Clark, C. (2016). Adherence to community based group exercise interventions for older people: A mixed-methods systematic review. *Preventive Medicine, 87*, 155-166. https://doi.org/10.1016/j.ypmed.2016.02.037

Fenney, A., & Lee, T. D. (2010). Exploring spared capacity in persons with dementia:

What WiiTM can learn. *Activities, Adaptation and Aging*, *34*(4), 303-313. https://doi.org/10.1080/01924788.2010.525736

Fernando, E., Fraser, M., Hendriksen, J., Kim, C. H., & Muir-Hunter, S. W. (2017). Risk factors associated with falls in older adults with dementia: A systematic review. *Physiotherapy Canada*, *69*(2), 161-170. https://doi.org/10.3138/ptc.2016-14

Frederiksen, K. S., Sobol, N., Beyer, N., Hasselbalch, S., & Waldemar, G. (2014). Moderate-to-high intensity aerobic exercise in patients with mild to moderate Alzheimer's disease: A pilot study. *International Journal of Geriatric Psychiatry*, *29*(12), 1242-1248. https://doi.org/10.1002/gps.4096

Guadagnoli, M. A., & Lee, T. D. (2004). Challenge point: A framework for conceptualizing the effects of various practice conditions in motor learning. *Journal of Motor Behavior*, *36*(2), 212. https://doi.org/10.3200/JMBR.36.2.212-224

Hawley-Hague, H., Horne, M., Skelton, D. A., & Todd, C. (2016). Older adults' uptake and adherence to exercise classes: Instructors' perspectives. *Journal of Aging and Physical Activity*, *24*(1), 119-128. https://doi.org/10.1123/japa.2014-0108

Hsieh, S., McGrory, S., Leslie, F., Dawson, K., Ahmed, S., Butler, C. R., . . . Hodges, J. R. (2015). The Mini-Addenbrooke's Cognitive Examination: A New Assessment Tool for Dementia. *Dementia and Geriatric Cognitive Disorders*, *39*(1-2), 1-11. https://doi.org/10.1159/000366040

Ingledew, D. K., Markland, D., & Medley, A. R. (1998). Exercise motives and stages of change. *Journal of Health Psychology*, *3*(4), 477-489. https://doi.org/10.1177/135910539800300403

Lam, L. C. W., Chau, R. C. M., Wong, B. M. L., Fung, A. W. T., Tam, C. W. C., Barrado-Martín, Y., Heward, M., Polman, R., & Nyman S. R. (in press). Adherence to the class-based component of a Tai Chi exercise intervention for people living with dementia and their informal carers. *Journal of Aging and Physical Activity*.

Leung, G. T. Y., . . . Chan, W. M. (2012). A 1-year randomized controlled trial comparing mind body exercise (Tai Chi) with stretching and toning exercise on cognitive function in older chinese adults at risk of cognitive decline. *Journal of the American Medical Directors Association, 13*(6), 515-520. https://doi.org/10.1016/j.jamda.2012.03.008

Lam, L. C. W., & Cheng, S. T. (2013). Maintaining long-term adherence to lifestyle interventions for cognitive health in late life. *International Psychogeriatrics, 25*(2), 171-173. https://doi.org/10.1017/S1041610212001603

Lee, L.-L., Arthur, A., & Avis, M. (2008). Using self-efficacy theory to develop interventions that help older people overcome psychological barriers to physical activity: A discussion paper. *International Journal of Nursing Studies*, 45(11), 1690-1699. https://doi.org/10.1016/j.ijnurstu.2008.02.012

Lee, L.-L., Avis, M., & Arthur, A. (2007). The role of self-efficacy in older people's decisions to initiate and maintain regular walking as exercise: Findings from a qualitative study. *Preventive Medicine, 45*(1), 62-65. https://doi.org/10.1016/j.ypmed.2007.04.011

Li, F., Harmer, P., Fisher, K. J., McAuley, E., Chaumeton, N., Eckstrom, E., & Wilson, N. L. (2005). Tai Chi and fall reductions in older adults: a randomized controlled trial. *The Journals of Gerontology Series A Biological Sciences and Medical Sciences, 60*(2), 187-194. https://doi.org/10.1093/gerona/60.2.187

Logghe, I. H. J., Verhagen, A. P., Rademaker, A. C. H. J., Zeeuwe, P. E. M., Bierma-Zeinstra, S. M. A., Van Rossum, E., . . . Koes, B. W. (2011). Explaining the ineffectiveness of a Tai Chi fall prevention training for community-living older people: A process evaluation alongside a randomized clinical trial (RCT). *Archives of Gerontology and Geriatrics, 52*(3), 357-362.

Barrado-Martín, Y., Heward, M., Polman, R., & Nyman S. R. (in press). Adherence to the class-based component of a Tai Chi exercise intervention for people living with dementia and their informal carers. *Journal of Aging and Physical Activity*.

https://doi.org/10.1016/j.archger.2010.05.013

McCurry, S. M., Pike, K. C., Vitiello, M. V., Logsdon, R. G., Larson, E. B., & Teri, L. (2011). Increasing Walking and Bright Light Exposure to Improve Sleep in Community-Dwelling Persons with Alzheimer's Disease: Results of a Randomized, Controlled Trial. *Journal of The American Geriatrics Society*, *59*(8), 1393-1402. https://doi.org/10.1111/j.1532-5415.2011.03519.x

McPhate, L., Simek, E. M., Haines, T. P., Hill, K. D., Finch, C. F., & Day, L. (2016). "Are your clients having fun?" The implications of respondents' preferences for the delivery of group exercise programs for falls prevention. *Journal of Aging and Physical Activity*, *24*(1), 129-138. https://doi.org/10.1123/japa.2014-0168

Moon, H., & Adams, K. B. (2013). The effectiveness of dyadic interventions for people with dementia and their caregivers. *Dementia*, *12*(6), 821-839. https://doi.org/10.1177/1471301212447026

Neupert, S. D., Lachman, M. E., & Whitbourne, S. B. (2009). Exercise self-efficacy and control beliefs: Effects on exercise behavior after an exercise intervention for older adults. *Journal of Aging and Physical Activity*, *17*(1), 1-16. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3740728/

Nyman, S. R. (2020). Tai Chi for the Prevention of Falls Among Older Adults: A Critical Analysis of the Evidence, *Journal of Aging and Physical Activity*, 1-10. Retrieved from https://journals.humankinetics.com/view/journals/japa/aop/article-10.1123-japa.2020-0155/article-10.1123-japa.2020-0155.xml

Nyman, S. R., & Skelton, D. (2017). The case for Tai Chi in the repertoire of strategies to prevent falls among older people. *Perspectives in Public Health*, *132*(2), 85-86. https://doi.org/10.1177/1757913916685642

Barrado-Martín, Y., Heward, M., Polman, R., & Nyman S. R. (in press). Adherence to the class-based component of a Tai Chi exercise intervention for people living with dementia and their informal carers. *Journal of Aging and Physical Activity*.

Pitkälä, K. H., Pöysti, M. M., Laakkonen, M.-L., Tilvis, R. S., Savikko, N., Kautiainen, H., & Strandberg, T. E. (2013). Effects of the Finnish Alzheimer disease exercise trial (FINALEX): A randomized controlled trial. *JAMA Internal Medicine, 173*(10), 894-901. https://doi.org/10.1001/jamainternmed.2013.359

Prick, A. E., de Lange, J., van 't Leven, N., & Pot, A. M. (2014). Process evaluation of a multicomponent dyadic intervention study with exercise and support for people with dementia and their family caregivers. *Trials, 15*(1), 401. https://doi.org/10.1186/1745-6215-15-401

Rollin-Sillaire, A., Breuilh, L., Salleron, J., Bombois, S., Cassagnaud, P., Deramecourt, V., . . . Pasquier, F. (2013). Reasons that prevent the inclusion of Alzheimer's disease patients in clinical trials. *British Journal of Clinical Pharmacology, 75*(4), 1089-1097. https://doi.org/10.1111/j.1365-2125.2012.04423.x

Shaw, F. E. (2003). Falls in older people with dementia. *Geriatrics and Aging, 6*(7), 37-40. Retrieved from https://www.healthplexus.net/files/content/2003/August/0607dementiafall.pdf

Sherrington C, Fairhall NJ, Wallbank GK, Tiedemann A, Michaleff ZA, Howard K, Clemson L, Hopewell S, Lamb SE. Exercise for preventing falls in older people living in the community. Cochrane Database of Systematic Reviews 2019, (1). https://doi.org/10.1002/14651858.CD012424.pub2

Sun, J., Kanagawa, K., Sasaki, J., Ooki, S., Xu, H. L., & Wang, L. (2015). Tai chi improves cognitive and physical function in the elderly: A randomized controlled trial. *Journal of Physical Therapy Science, 27*(5), 1467-1471. https://doi.org/10.1589/jpts.27.1467

Suttanon, P., Hill, K. D., Said, C. M., Byrne, K. N., & Dodd, K. J. (2012). Factors influencing commencement and adherence to a home-based balance exercise

program for reducing risk of falls: Perceptions of people with Alzheimer's disease and their caregivers. *International Psychogeriatrics, 24*(7), 1172-1182. https://doi.org/10.1017/S1041610211002729

Teri, L., McCurry, S. M., Buchner, D. M., Logsdon, R. G., LaCroix, A. Z., Kukull, W. A., . . . Larson, E. B. (1998). Exercise and activity level in Alzheimer's disease: A potential treatment focus. *Journal of Rehabilitation Research and Development, 35*(4), 411-419. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10220219

van Halteren-van Tilborg, I. A. D. A., Scherder, E. J. A., & Hulstijn, W. (2007). Motor-skill learning in alzheimer's disease: A review with an eye to the clinical practice. *Neuropsychology Review, 17*(3), 203-212. https://doi.org/10.1007/s11065-007-9030-1

van Halteren-van Tilborg, I. A. D. A., Scherder, E. J. A., & Hulstijn, W. (2007). Motor-skill learning in alzheimer's disease: A review with an eye to the clinical practice. *Neuropsychology Review, 17*(3), 203-212. https://doi.org/10.1007/s11065-007-9030-1

Wesson, J., Clemson, L., Brodaty, H., Lord, S., Taylor, M., Gitlin, L., & Close, J. (2013). A feasibility study and pilot randomised trial of a tailored prevention program to reduce falls in older people with mild dementia. *BMC Geriatrics, 13*, 89. https://doi.org/10.1186/1471-2318-13-89

WHO. (2007). *WHO global report on falls prevention in older age*. Retrieved from http://www.who.int/ageing/publications/Falls_prevention7March.pdf?ua=1

WHO. (2018). *Towards a dementia plan: A WHO guide*. Retrieved from http://apps.who.int/iris/bitstream/handle/10665/272642/9789241514132-eng.pdf?ua=1

Barrado-Martín, Y., Heward, M., Polman, R., & Nyman S. R. (in press). Adherence to the class-based component of a Tai Chi exercise intervention for people living with dementia and their informal carers. *Journal of Aging and Physical Activity*.

Yao, L., Giordani, B. J., Algase, D. L., You, M., & Alexander, N. B. (2012). Fall risk-relevant functional mobility outcomes in dementia following dyadic Tai Chi exercise. *Western Journal of Nursing Research, 35*(3), 281-296. https://doi.org/10.1177/0193945912443319

Yu, F., & Swartwood, R. M. (2012). Feasibility and perception of the impact from aerobic exercise in older adults with Alzheimer's disease. *American Journal of Alzheimer's Disease and Other Dementias, 27*(6), 397-405. https://doi.org/10.1177/1533317512453492

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