'Shall we dance'? Older adults' perspectives on the feasibility of a dance intervention for cognitive function

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Thøgersen-Ntoumani, C., PhD[1]*, Papathomas, A., PhD[2], Foster, J., PhD[1], Quested, E., PhD[1], & Ntoumanis, N., PhD[1]

[1]Curtin University
School of Psychology & Speech Pathology
GPO Box U1987
Perth
Western Australia 6845
Australia

[2]Loughborough University
School of Sport, Exercise & Health Sciences
National Centre for Sport & Exercise Medicine
Loughborough
Leicestershire
LE11 3TU
United Kingdom

Abstract

We explored perceptions of social dance as a possible intervention to improve cognitive functioning in older adults with subjective memory complaints. Thirty participants (19 female; *M* age = 72.6; *SD*=8.2) took part in the study. This included 21 participants who had self-reported subjective memory complaints and 9 spouses who noticed spousal memory loss. Semi-structured interviews were conducted and thematic analysis was used to analyze the data. Three main themes were constructed: 1) dance seen as a means of *promoting social interaction*; 2) *chronic illness as a barrier and facilitator* to participation; 3) social dance representing *nostalgic connections to the past*. Overall, the participants were positive about the potential attractiveness of social dance to improve cognitive and social functioning and other aspects of health. It is important in future research to examine the feasibility of a social dance intervention among older adults with subjective memory complaints.

Keywords

Physical activity, exercise, dementia, thematic analysis

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One of the primary factors prompting concerns over the global aging population is the rising prevalence of dementia and in particular Alzheimer’s Disease (AD; Prince et al., 2013). Dementia has been described as one of the largest disease burdens of the current era due to the aging demographic of Western societies (Wimo, Jönsson, Bond, Prince, & Winblad, 2013). Globally, it is estimated that 25-30% of adults aged 85 and older have dementia, with age representing one of the major risk factors for this disease (World Health Organization, 2011). Dementia is a debilitating condition for the individuals concerned as well as their significant others. Further, the public health costs associated with the treatment of dementia are prohibitive for most Western countries (Wimo et al., 2013; Wimo, Winblad, & Jönsson, 2007; Wimo & Winblad, 2001). Importantly, current medical treatment of dementia/AD is limited in effectiveness with widely available treatments addressing the signs and symptoms of the condition but not the fundamental causes of the disease (Waldemar, Phung, Burns, Georges, Ronholt Hansen, Iliffe, Marking et al., 2007). Further, dementia is difficult to diagnose, particularly in the early stages. Symptoms that may be indicative of early stages of dementia (such as memory problems) are often attributed to ‘benign’ features of aging. However, both clinically and economically, it is critical to capture early those people who are at risk of prodromal dementia, before they develop the first signs and symptoms of the disease (Leifer, 2003). One group of older adults that has been described as being at increased risk of dementia comprises individuals who experience age-related subjective memory complaints (Mitchell, Beaumont, Ferguson, Yadegarfar, & Stubbs, 2014). In the present study, we explored the views about a potential intervention involving physical activity (i.e. dance) that may help to reduce risks of dementia among a group of individuals

reporting subjective memory complaints. We aimed to explore the attraction to this potential program as well as perceived benefits and barriers.

A plethora of research evidence shows that physical activity can improve health (Marques, Baptista, Santos et al., 2014), daily functioning (Fiatarone Singh, 2002), well-being and quality of life (e.g., Park, Thøgersen-Ntoumani, Ntoumanis, Stenling, & Fenton, 2017) in older adults. Of particular relevance for the present study, evidence is also accumulating showing that physical activity (which includes structured exercise) can improve cognitive functioning and reduce the incidence of dementia (Ahlskog, Geda, Graff-Radford, & Petersen, 2011). A meta-analytic review of 29 randomized controlled trials with healthy (i.e. without cognitive deficits) adults showed that aerobic exercise training can improve various dimensions of cognitive function, including attention, speed of processing, executive functions and memory (although results for memory were less consistent; Smith et al., 2010). A review of prospective studies revealed that more physically active adults have a reduced risk of both age-related cognitive decline and incident dementia. A conservative estimate of effects suggested that physical activity was associated with an 18% reduced risk of dementia (Blondell, Hammersley-Mather, & Veerman, 2014). For older adults with existing dementia, a meta-analysis of randomized controlled trials found that exercise interventions (particularly those involving aerobic types of exercise) exert a positive effect on cognitive functions (Groot et al., 2016).

There has been recent interest in interventions that involve both cognitive and exercise components (e.g., Law, Barnett, Yau, & Gray, 2014). Law et al reviewed 8 RCTs of interventions lasting between 3-12 months. They found evidence to suggest that the combination of cognitive and physical exercise components is associated with beneficial effects on cognitive function. However, the review did not include interventions which

amalgamated within the same condition both cognitive and physical exercise components. However, some types of exercise by their inherent nature involve cognitive demands. One such example is social dance, which involves both cognitive demands (e.g., sequencing of steps) and aerobic exercise. It has been previously argued that dance may be a particularly effective activity (and superior to other types of physical activities) with respect to age-related cognitive benefits (Brown, Martinez, & Parsons, 2006). This is because dance is an activity with a range of sensorimotor complexity, including engagement of learning processes, memory, attention, co-ordination and rhythmic movement (Brown et al., 2006). The cognitive function benefits of dance are expected to occur as a result of the multisensory demands of the activity and not just the cardiovascular demands. It is possible that the cardiovascular demands would be lower during early stages of learning, which require slower movements and greater attention. However, later in the learning process when the dancing is quicker and cardiovascular demands increase, the activity would still require attention, memory, rhythmic movement, and social interaction, all anticipated to be important for improving and sustaining cognitive function (e.g., Eggenberger, Schumacher, Angst, Theill, & de Bruin, 2015; Fratiglione, Pallard-Borg & Winblad, 2004).

To the best of our knowledge, only one RCT has explored the role of dance to improve cognition in healthy older adults (Merom, Grunseit, Eramudugolla, Jefferis, Mcneill, & Anstey, 2016). Merom and colleagues compared the effects of dancing to walking on cognition, with results suggesting that dance participation resulted in slightly better benefits than walking in visuospatial learning, but not other components of cognition. However, the participants in this study were very physically active at baseline and, importantly, were cognitively healthy. It is possible that dance may be more effective for cognition in older adults with some subjective and/or objective memory complaints. Further, dance that involves an interpersonal element can promote social engagement, which in turn is associated

with better cognitive outcomes in older adults (Keyani et al., 2005). Finally, although dance is considered a popular pursuit among older middle-aged adults (Hunt et al., 2001), little is known about how this population might feel about social dance as a potential intervention modality. Indeed, it is vital to consider perceptions of acceptability, feasibility and usability of a proposed intervention by the target group in the development of health-related interventions (Craig et al., 2008; Moore et al., 2015). This has implications for how well older adults are likely to respond with regard to motivation and engagement and thus adherence to an intervention. The aim of this study was therefore to explore how older adults with subjective memory complaints view social dance as a potential intervention to improve cognitive functioning.

Methods

Participants and recruitment

On receiving institutional ethical clearance, 30 participants (19 female, mean age 72.6 years/SD = 8.2) were recruited via an advertisement broadcasted from a community radio station located at the University where the researchers were based. Interested participants were asked to phone the research team who then ascertained whether the participants were eligible. Specifically, interested participants were asked whether they currently experienced memory problems, what the nature of these memory problems were, and if and how they had experienced any changes to their memory over the past few years. A purposive sampling strategy was adopted whereby older adults with experience of subjective memory complaints were targeted. The exclusion criteria were if they had not experienced subjective memory complaints themselves, or if they had not noticed memory complaints in their spouse/partner. The majority of participants (n = 21) self-identified as having mild to moderate memory complaints, with the remainder noticing spousal cognitive decline. Participants expressed concerns such as “my memory has lost sharpness, people’s names and addresses, I have to

look them up now" or "I find it more difficult to remember my way around the roads". Most participants considered their memory issues to be a minor and anticipated nuisance (e.g. "I do believe it's a fairly common thing as we get older"); although some participants described more major concerns (e.g. "So sometimes I'm really questioning myself, you know, am I on the cusp of going down that path [Alzheimer's disease] or not?"). Participant socio-demographic characteristics, nature of their memory complaints and previous experience of dance are illustrated in Table 1.

Data collection

A semi-structured interview guide was designed to explore the perceived barriers, benefits and facilitators to a proposed program of social dancing to improve cognitive function. As the focus was on personal perspectives, participants were afforded the freedom to digress when responding to interview questions. Likewise, the interviewer was not obliged to ask all predetermined questions but rather was free to ask new and different questions as the conversation organically unfolded. This interactive interviewing style (see Ellis, Kiesinger, & Tillman-Healy, 1997) was adopted to better sensitize to each individual's story, thereby encouraging a more authentic construction of subjectivity. Prior to conducting the interviews, the interviewer had not previously interviewed members of this population. However, the interviewer had experience of conducting semi-structured interviews of older adults with Parkinson's Disease, as part of another project. Interviews took place in a location convenient to the participant which was invariably their place of residence (e.g. own home, residential care village or aged care facility). Before each interview began, the aims of the research were reiterated, an opportunity to ask any questions was provided and the informed consent form was signed. Interview duration ranged between 20 and 45 minutes with more than 9 hours of data collected in total. Interviews were recorded using a digital voice recorder and transcribed verbatim.

Data analysis

Interview transcripts were subject to a thematic analysis, a popular approach in psychology for interpreting qualitative data by identifying core patterns of meaning. We were guided by the form of thematic analysis described by Braun, Clarke and Weate (2016) because it provides a rigorous set of methodological steps, yet allows for flexibility in how these steps are fulfilled. The first phase involved *familiarization* with the data through repeated readings of the transcripts. Here, general annotations of possible areas of interest were made in an informal and unstructured way. Essentially, tentative insights were noted in the margins (e.g. "identity?" / "fear of failure?") with little concern for whether such insights were sufficiently representative of the data to influence the final analysis. The second phase was a more systematic *coding* of the data. Transcripts were trawled line by line and codes (brief content labels) assigned to segments of data in order to inductively capture their point of conceptual interest. For example, the code *"husband disinterest a barrier"* was attributed to the following data extract: "*a lot of women would like to do these things but the husbands are reluctant to do them.*" This is a form of semantic coding as it is descriptive of the original data. We also used latent coding which is more interpretive and thus reflective not of the surface meaning alone but also of what might underpin it theoretically. To illustrate, the code "rejecting an older identity" was applied to the following data extract: "There's a lot of pensioners that don't want to admit they're getting old…they don't like being lumped in with old people." In this example, although the participant does not directly reference identity as a construct, nor rejecting older identities, it was deemed reasonable to extrapolate this from the data given the content and the broader interview context. For phase 3, conceptually related codes were grouped into potential themes before being scrutinized for authenticity against the original transcripts (phase 4). In the penultimate phase 5, themes and subthemes, where relevant, were named according to meaning grounded in the data. Finally, the writing-up

process was considered the final phase of analysis, with subtle modifications made to all preceding stages as a result of a back and forth between the data, the literature and the manuscript.

Results and Discussion

Three main themes were constructed through our analysis; 1) promoting social interaction, 2) chronic illness as barrier and facilitator 3) nostalgic connections to the past. Each of these themes is supported by participant quotes and situated within the context of the extant literature. Pseudonyms have been used to preserve participant anonymity.

Theme 1: Promoting social interaction

The majority of participants explained that a dance class could provide an important opportunity for social interaction and that this would be an integral facilitator as well as a valued benefit. Participants focused on the benefits of social interaction and possible strategies to promote it. They acknowledged that there are a lot of lonely people within their age group and that initiatives to address this issue were important and necessary. For some participants, potential social benefits superseded improvements related to physical or cognitive health. For example, Mick, a 72 year old retired carpenter, suggested integrating a social element was vital as physical benefits for seniors would be secondary to increased social interactions:

> You set a good program, then it's fine, you know, if you've got a good hall where they can beat it a bit socially after that then, as well, where they could sit around, well, you know, you can have a coffee, and, and it's a social thing. Dancing for the seniors isn't dancing to get sort of super fit or anything like that. It's a social thing
>
> (Mick, 72)

By understating the value for seniors of becoming "super fit" in favor of a more socially oriented emphasis, Mick provided important insights into how a ballroom dance initiative might be structured. Mick's reference to sitting for coffee was echoed by the overwhelming majority of our sample, with many specifying "coffee and cake" or "tea and biscuits" as something that needs to be incorporated to exercise initiatives for older adults.

Aside from structuring tea and coffee time, a small number of participants suggested that efforts could be directed towards formally developing a group identity for the proposed ballroom dance sessions:

> you give little bags where they can put their dancing shoes in, with the logo on it. Then they'll remember to bring their dance shoes with the logo on, like the dance club, you know, and, and that gives them a little bit of a feeling of belonging then, rather than just walking up with a pair of old shoes on…you started something that they actually belong to.
>
> (Mick, 72)

There is merit to Mick's suggestions given the presence of a group identity has been associated with greater levels of physical activity (e.g. Grant Hogg, & Crano, 2015). Drawing on principles of group dynamics theory to promote physical activity may prove fruitful but there is little evidence as to which strategies (e.g. team logos) work best in trying to achieve this (Estabrooks, Harden, & Burke, 2012). Further, there may be tensions regarding the *type* of group identity constructed. For example, 69 year old Clare expressed a dislike for interacting with people older than her:

> We have haven't been to our so called Autumn Center, ever, because that's for old people…We've never been there. Because we've always thought,

> "oh, that's for old people". So we've never gone. There's a lot of pensioners that don't want to admit they're getting old and they don't like being lumped in with old people...
>
> (Claire, 69)

In specifying that she preferred not to be “lumped in with old people”, Claire explicitly rejected the idea of committing to a group identity with “older person” connotations. There is evidence to suggest that older aged adults often affiliate with younger identities (Westerhof, Barrett, & Steverink, 2003) and a younger “subjective age” has been associated with increased life satisfaction (Mirucka, Bielecka, & Kisielewska, 2016), better mental health (Keyes & Westerhof, 2012), and greater levels of physical activity (Caudroit, Stephan, Chalabaev, & Le Scanff, 2012). Interventionists who wish to develop group identity may therefore be better served by emphasizing the activity (e.g. dance) rather than the population (e.g. older adults) so as not to ostracize those with adaptive young age identities. Accommodating younger identities may be particularly pertinent for interventions designed to improve cognitive function, given recent suggestions that a lower subjective age may also play a role in slowing cognitive decline (see Stephan, Sutin, Caudroit, & Terracciano, 2015). One way to sensitize to these issues might be to narrow the targeted age-range in order to assimilate participants with a greater degree of experiential commonality and a more closely shared age identity.

The romantic connotations that traditionally imbue ballroom dancing were construed as both a potential positive and a possible negative in terms of promoting interaction amongst attendees. For example, 77 year old Lylia argued positively:

> People lining up across the room and, and you walk across and, or the gentlemen have to go and ask the ladies to dance like they used to do, you know. They just might

> interact pretty well then. By going to ask someone, they'll get used to dancing and interacting with everybody. And slowly, if people are turning up every week, or every other week, they will get used to chatting and talking and will want to go again. (Lylia, 77)

For Lylia, replicating old customs and fulfilling traditional gender roles of her youth was considered a feature that could breed a greater degree of interaction. Alternatively, some participants wondered whether the romantic undercurrents associated with dance might be a barrier to older aged individual's whose partners had died or whose partners (typically husbands) were not inclined to attend.

Theme 2: Chronic illness as barrier and facilitator

The presence of age-related chronic illness was perceived to be a potential barrier to participation in dance-based physical activity as well as a possible motivator. Two subthemes reflected these contrasting perspectives; *illness as debilitative* and *exercise as medicine*.

Illness as debilitative

Certain physical conditions were deemed as too debilitative to permit engagement in the more strenuous forms of dance. For example, Sylvia explained how here chronic bronchitis would prevent her engaging in her preferred jive dancing:

> the quick steps are quite good, I suppose I prefer jiving, but the thing is it's really quite strenuous and because I have a lung disease it does take its toll…your health can come in. I did mention that I've got like a, a lung disease, it's not going to kill me tomorrow, but I suppose it'll get me in the end, but it's like a chronic bronchitis (Sylvia, 71)

A similar experience was described by Beatrice, an 80 year old woman who also had problems breathing:

> At the moment I'm still suffering with bronchial asthma and having a nebulizer every night...I'm a bit breathless so I wouldn't be able at this time. I wouldn't be able to participate (in a ballroom dance class). I get breathless and I'm still coughing from the flu.
>
> (Beatrice, 80)

For Beatrice, like Sylvia, an existing chronic illness is considered a barrier to participating in exercise-related activity.

Exercise as medicine

Although illness can be a barrier to physical activity participation, it can also be construed as a facilitator and a benefit. As a facilitator, several participants expressed motivation to exercise in order to stave off the threat of physical and cognitive decline. For most participants, whether active or otherwise, physical activity was interpreted as a means to maintain health and therefore maintain independence. Clare, 68 years of age, articulated her own independence-related motivation:

> These days, if you are left on your own the children are all far too busy and they're too busy working, too busy running their own lives and with their own children. So, you have to go into a home because there's no-one to look after you if you need it. And, so, it's the loss of dignity, which is why so many people are trying so hard, to stay independent, on their own two feet, in their own home because they know what the alternative is. And things like this (dance class) can only benefit them.
>
> (Claire, 68)

For Claire, the prospect of losing her independence and duly losing the ability to live in her own home is a considerable exercise motivator and one that she argued is common amongst her peer group.

For some participants, exercise, specifically dance, represented an opportunity to prevent cognitive decline and more specifically to protect against dementia.

> I have been told or I have heard that dancing is probably one of the best things to do to try and ward off something like Alzheimer's…you do crosswords, and things like that, I did hear that dancing is actually the best because it incorporates the exercise and the brain activity of remembering certain steps and dances
>
> (Alice, 68)

A belief that the practice of learning and remembering dance sequences could help "ward off" Alzheimer's disease was shared by other participants, as illustrated by Molly in the following data extract:

> well apart from the exercise point of view, it's a good socializing thing, but it's also making you remember the sequences. That's what, that's what's worrying me. And that's why I rung you, because I thought, okay, if you're going to do something to do with that, then yes, that would be of benefit to me, and I can't be the only person that has trouble with this sort of thing.
>
> (Molly, 66)

Molly suggested that her worries regarding her memory would facilitate her participation in a proposed dance intervention for cognitive function. Claire, Alice and Molly readily linked exercise to physical and cognitive health suggesting that many older people are fully cognizant of the benefits to be gleaned from an active lifestyle. Learning a new dance

sequence provides a form of cognitive training; sets of steps are progressively added to develop an entire choreography, dance partners need to develop neuromuscular coordination to synchronise each other's movements and against the music tempo (Brown et al., 2006).

It was notable however that participants discussed exercise predominately as "preventative medicine" rather than as something that could improve symptoms associated with an existing condition. Even participants with arthritis – a chronic condition for which exercise is routinely recommended as an evidence-based management tool (Fernandes, Hagen, Bijlsma et al. 2013) – illness-related barriers were the focus rather than exercise-related benefits: e.g. "*I'd like to be more active. I'm less active than I'd like to be because I've got arthritis in my knees, and it's very, very hindering, you know*" (Abbey, 76). This is perhaps expected given the broader exercise is medicine movement is also heavily focused on the preventative qualities of exercise (see Sallis, 2014). It might be that more work is needed to encourage older adults living with chronic illness to engage with physical activity as a means to managing the symptoms of long-term conditions. This is a counterintuitive message given that exercise is often associated with physical strain and discomfort. As such, efforts to sell the medicinal properties of exercise to the chronically ill are unlikely to be straightforward. Alternatively, it may be that an exclusive emphasis on the health benefits of dance for older adults should not be the only approach. On this issue, one participant cautioned against overplaying the exercise as medicine narrative at the expense of more intrinsic motivators:

> If you get someone who's participating who doesn't want to dance and is just doing it just because, you know, they think that it's going to help (with cognitive function), but I think you, if a person already loves dancing, I think you're already halfway there. (Janice, 60)

In line with Janice's beliefs, there is a vast literature base supporting the benefits of more self-determined motivation for exercise (Edmunds, Ntoumanis, & Duda, 2007) and exercise that is enjoyed is usually exercise that is persisted with (Ekkekakis, 2009). Specifically, exercising to avoid ill health, perhaps at the bequest of a health professional, does not especially resonate with the autonomy that research suggests is associated with prolonged adherence (see Kinnafick, Thøgersen-Ntoumani, & Duda, 2014). The popular practice of foregrounding health benefits as part of an exercise promotion strategy may be effective short-term but not necessarily in the long run (Papathomas, Williams, Smith, 2015). Hence, both the health benefits and the fun aspect of social dancing should be highlighted in recruitment efforts.

Theme 3: Nostalgic connections to the past

Social dancing was described as a major feature of adolescence and young adulthood. Many participants spoke wistfully about their former dancing experiences, some of which may have been over 50 years prior. Sally, at 70 years old, recounted distant memories of dance:

> I love dancing, and certainly in my childhood and youth we used to go to, you know, the old time dancing. I lived in the country, so if there was a dance on, you know, all the kids would pile into the car and we all went to wherever the dance was. So from even preschool age, you know, we used to get up and dance with one another or dance with mom and dad or...I did a lot of dancing
>
> (Sally, 70)

For Lylia, the capacity for dance and music to rouse happy memories of youth was an important attraction for dance-based exercise interventions:

> You know, come along and hear your kind of music from when you were sweet sixteen, or whatever, you know (laughs). Happy twenty-one. You danced to a band,

> not to records, or taped music, or anything. It was a live band and men would come and ask you, "Please, may I have this dance?" And you got up and danced… (Lylia, 77)

Nostalgia is a primarily positive emotion associated with the recall of autobiographical memories (Batcho, 2007). It is an affective state often triggered by music, with more biographically salient music leading to stronger feelings of nostalgia (Barrett, Grimm, Robins, Wildschut, Sedikides, & Janata, 2010). These insights marry well with participants' perspectives and suggest that a dance-class intervention will likely be a nostalgic experience for many and therefore an enjoyable experience that promotes adherence. On a more general level, nostalgic reverie has been shown to lead to heightened health optimism compared to controls and this nostalgia induced optimism was associated with a range of positive health attitudes (Kersten, Cox, & Enkevort, 2016). Furthermore, in a follow-up study, individuals who engaged in nostalgic reflection engaged in significantly more independent physical activity than a control group. The authors suggest that this shows the potential for nostalgia to be used as a mechanism to promote exercise behaviour. Although future research is needed to substantiate this finding, it is encouraging from the perspective of a dance-class intervention for older adults. Further, an emerging body of evidence argues that regularly experiencing nostalgia enhances psychological functioning and wellbeing and supports successful aging (Routledge, Wildschut, Sedikides, & Juhl, 2013). Future research is needed to ascertain whether nostalgic experiences can directly support better cognitive performance.

Conclusions and Future Directions

The purpose of this study was to examine the appeal of social dance as a potential intervention approach to improve cognitive functioning in older adults with subjective memory complaints. The cognitive demands of learning a new choreography have beneficial

effects on the elderly's cognitive functioning and flexibility (Coubard, Duretz, Lefebvre, Lapalus, & Ferrufino, 2011). To this end, we interviewed 30 older adults who experienced cognitive decline in themselves or in their spouse. A thematic analysis identified three themes: 1) promoting social interaction, 2) chronic illness as barrier and facilitator 3) nostalgic connections to the past. Overall, the participants were positive about the potential attractiveness of a social dance class for a variety of motives, including improving social interaction, preserving cognitive and physical health, and "re-living" happy experiences of younger ages. Practical suggestions were offered in relation to the structuring of the classes so that they are appealing to a broad base of participants.

Future research should further test the feasibility of offering such a social dance class (e.g., ballroom dancing) to older adults (and their spouses where applicable) from community samples with subjective memory complaints. Information such as take-up rates, adherence, willingness to be randomized, and implementation challenges would be valuable in deciding whether there is a scope for a large scale RCT. Pilot information such as effect sizes, standard deviations of outcome measures and intraclass correlation coefficients would be helpful in informing a larger trial (see Eldridge et al., 2016). Given previous findings that physically inactive older adults are not a homogeneous group of individuals and that a range of strategies should be considered to make physical activity more appealing to them (Thøgersen, Ntoumanis, & Nikitaras, 2008), it is a worthwhile effort to examine the potential impact of a social dance intervention in inactive older adults using a range of cognitive (e.g., working memory, processing speed, attention), health (e.g., blood pressure, perceived health, fatigue) and social outcomes (e.g., perceived isolation). Such research could develop markers of cognitive function specifically connected to dance, for example, the number of choreographed sequences participants were able to perform at the beginning and the end of the dance intervention. It would be important before such an intervention is implemented that

prospective participants are interviewed to screen for indicators of low adherence to the program (e.g., perceptions of poor health, low interpersonal competence). Ensuring all stages of intervention planning are research-informed may support more efficacious physical activity promotion programmes and more efficient use of public health resources.

References

Ahlskog, J. E., Geda, Y. E., Graff-Radford, N. R., & Petersen, R. C. (2011). Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. *Mayo Clinic Proceedings, 86,* 876-884.

Barrett, F. S., Grimm, K. J., Robins, R. W., Wildschut, T., Sedikides, C., & Janata, P. (2010). Music-evoked nostalgia: affect, memory, and personality. *Emotion, 10,* 390-403. DOI: 10.1037/a0019006.

Batcho, K. I. (2007). Nostalgia and the emotional tone of song lyrics. *American Journal of Psychology, 120,* 361–381.

Blondell, S. J., Hammersley-Mather, R., & Veerman, J. L. (2014). Does physical activity prevent cognitive decline and dementia? A systematic review and meta-analysis of longitudinal studies. BMC Public Health, 14: 510. DOI: 10.1186/1471-2458-14-510.

Braun, V., Clarke, V., and Weate, P. (2016). Using thematic analysis in sport and exercise research. In B. Smith, & A. Sparkers (Eds.), *Routledhe handbook of qualitative research in sport and exercise* (pp. 191-205). London: Routledge.

Brown, S., Martinez, M. J., & Parsons, L. M. (2006). Neural basis of human dance. *Cereb. Cortex, 16,* 1157-1167. doi:10.1093/cercor/bhj057.

Caudroit, J., Stephan, Y., Chalabaev, A., & Le Scanff, C. (2012). Subjective age and social-cognitive determinants of physical activity in active older adults. *Journal of Aging and Physical Activity, 20,* 484-496. DOI: 10.1123/japa.20.4.484.

Coubard, O. A., Duretz, S., Lefebvre, V., Lapalus, P., & Ferrufino, L. (2011). Practice of contemporary dance improves cognitive flexibility in aging. *Frontiers in Aging Neuroscience, 3,* 13. http://doi.org/10.3389/fnagi.2011.00013.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Pettigrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *British Medical Journal, 337*, 7676. Doi: ARTNa165510.1136/bmj.a1655.

Edmunds, J., Ntoumanis, N., & Duda, J.L. (2007). Perceived autonomy support and psychological need satisfaction as key psychological constructs in the exercise domain. In M. Hagger & N.L.D. Chatzisarantis (Eds.) Self-determination in exercise and sport (pp. 35-51). Champaign, IL: Human Kinetics.Ekkekakis, P. (2009). Let Them Roam Free? *Sports Medicine, 39(10)*, 857-888.

Eggenberger P., Schumacher V., Angst V., Theill N., de Bruin E. D. (2015). Does multicomponent physical exercise with simultaneous cognitive training boost cognitive performance in older adults? A 6-month randomized controlled trial with a 1-year follow-up. *Clinical Intervention in Aging, 10*, 1335–1349. DOI: 10.2147/CIA.S87732.

Eldridge, S. M., Lancaster, G. A., Campbell, M. J., Thabane, L., Hopewell, S., Coleman, C. L., & Bond, C. M. (2016). Defining feasibility and pilot studies in preparation for randomised controlled trials: Development of a conceptual framework. *PLoS ONE* 11(3): e0150205. doi:10.1371/journal.pone.0150205.

Ellis, C. K., & Kiesinger, C. CE, & Tillman-Healy, CE (1997). Interactive Interviewing: Talking about emotional experience. *Reflexivity and Voice*, 119-149.

Estabrooks, P. A., Harden, S. M., & Burke, S. M. (2012). Group dynamics in physical activity promotion: what works? *Social and Personality Psychology Compass*, *6*(1), 18-40. DOI: 10.1111/j.1751-9004.2011.00409.x.

Fernandes, L., Hagen, K. B., Bijlsma, J. W., Andreassen, O., Christensen, P., Conaghan, P. G., ... & Lohmander, L. S. (2013). EULAR recommendations for the non-

pharmacological core management of hip and knee osteoarthritis. *Annals of the Rheumatic Diseases, 72(7),* 1125-1135.

Fiatarone Singh, M. A. (2002). Exercise to prevent and treat functional disability. *Clinics in Geriatric Medicine, 18,* 431-62.

Fratiglioni L., Pallard-Borg S., Winblad B. (2004). An active and socially integrated lifestyle in late life might protect against dementia. *Lancet Neurology, 3,* 343–356. DOI: 10.1016/S1474-4422(04)00767-7.

Grant, F., Hogg, M. A., & Crano, W. D. (2015). Yes, we can: physical activity and group identification among healthy adults. *Journal of Applied Social Psychology, 45,* 383-390. DOI: 10.1111/jasp.12305.

Groot C., Hooghiemstra, A. M., Raijmakers, P. G. H. M., van Berckel, B. N. M., Scheltens, P., Scherder, E. J. A., van der Flier, W. M., & Ossenkoppele, R. (2016). The effect of physical activity on cognitive function in patients with dementia: A meta-analysis of randomized control trials. *Aging Research Reviews, 25,* 13-23. DOI: 10.1016/j.arr.2015.11.005.

Hunt, K., Ford, G., & Mutrie, N. (2001). Is sport for all? Exercise and physical activity patterns in early and late middle age in the West of Scotland. *Health education, 101*(4), 151-158.

Kersten, M., Cox, C. R., & Van Enkevort, E. A. (2016). An exercise in nostalgia: Nostalgia promotes health optimism and physical activity. *Psychology & health, 31,* 1166-1181. DOI: 10.1080/08870446.2016.1185524.

Keyani, P., Hsieh, G., Mutlu, B., Easterday, M., and Forlizzi, J. (2005). *DanceAlong: Supporting Positive Social Exchange and Exercise for the Elderly Through Dance CHI*. Oregon: Human-Computer Interaction Institute, Carnegie Mellon University Portland.

Keyes, C. L., & Westerhof, G. J. (2012). Chronological and subjective age differences in flourishing mental health and major depressive episode. *Aging & Mental Health, 16(1),* 67-74. DOI: 10.1080/13607863.2011.596811.

Kinnafick, F. E., Thøgersen-Ntoumani, C., & Duda, J. L. (2014). Physical activity adoption to adherence, lapse, and dropout: A self-determination theory perspective. *Qualitative Health Research, 24(5),* 706-718. DOI: 10.1177/1049732314528811.

Law, L. L. F., Barnett, F., Yau, M. K., & Gray, M. A. (2014). Effects of combined cognitive and exercise interventions on cognition in older adults with and without cognitive impairment: A systematic review. *Ageing Research Reviews, 15*, 61-75. DOI: 10.1016/j.arr.2014.02.008.

Leifer, B. P. (2003). Early diagnosis of Alzheimer's Disease: Clinical and economic benefits. *Journal of the American Geriatrics Society, 51*, S281-S288. DOI: 10.1046/j.1532-5415.5153.x.

Marques, E. A., Baptista, F., Santos, D. A., Silva, A. M., Mota, J., & Sardinha, L. B. (2014). Risk for losing physical independence in older adults: The role of sedentary time, light, and moderate to vigorous physical activity. *Maturitas, 79*, 91-95. DOI: 10.1016/j.maturitas.2014.06.012.

Merom, D., Grunseit, A., Eramudugolla, R., Jefferis, B., Mcneille, J., & Anstey, K. J. (2016). Cognitive benefits of social dancing and walking in old age: The Dancing Mind randomized controlled trial. *Frontiers in Aging Neuroscience, 8*, 2-11. doi: 10.3389/fnagi.2016.00026.

Mirucka, B., Bielecka, U., & Kisielewska, M. (2016). Positive orientation, self-esteem, and satisfaction with life in the context of subjective age in older adults. *Personality and Individual Differences, 99,* 206-210. DOI: 10.1016/j.paid.2016.05.010.

Mitchell, A. J., Beaumont, H., Ferguson, D., Yadegarfar, M., & Stubbs, B. (2014). Risk of dementia and mild cognitive impairment in older people with subjective memory complaints: meta-analysis. *Acta Psychiatrica Scandinavica, 130*, 439-451. DOI: 10.1111/acps.12336.

Moore, G. F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W.…Baird, J. (2015). Process evaluation of complex interventions: Medical Research Council guidance. *British Medical Journal, 350*. Doi: ARTNh125810.1136/bmj.h1258.

Papathomas, A., Williams, T. L., & Smith, B. (2015). Understanding physical activity participation in spinal cord injured populations: Three narrative types for consideration. *International Journal of Qualitative Studies on Health and Well-Being, 10*:1, 27295. Doi: 10.3402/qhw.v10.27295.

Park, S., Thøgersen-Ntoumani, C., Ntoumanis N., Stenling, A., Fenton S.A.M.,. Veldhuijzen van Zanten, J.C.S. (2017). Profiles of physical function, physical activity, and sedentary behavior and their associations with mental health in residents of assisted living facilities. *Applied Psychology: Health and Well-Being, 9,* 60-80. doi:10.1111/aphw.12085.

Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. (2013). The global prevalence of dementia: a systematic review and meta-analysis. *Alzheimer's & Dementia, 9*, 63-75. DOI: 10.1016/j.jalz.2012.11.007.

Routledge, C., Wildschut, T., Sedikides, C., & Juhl, J. (2013). Nostalgia as a resource for psychological health and well-being. *Social and Personality Psychology Compass, 7*(*11*), 808-818. DOI: 10.1111/spc3.12070.

Sallis, R. (2014). Exercise is medicine: a call to action for physicians to assess and prescribe exercise. *The Physician and Sports Medicine, 43(1),* 22-26. DOI: 10.1080/00913847.2015.1001938.

Smith, P. J., Blumenthal, J. A., Hoffman, B. M., Cooper, H., Strauman, T. A., Welsh-Bohmer, K., Browndyke, J. N., & Sherwood, A. (2010), Aerobic exercise and neurocognitive performance: A meta-analytic review of randomized controlled trials. *Psychosomatic Medicine, 72,* 239-252. DOI: 10.1097/PSY.0b013e3181d14633.

Stephan, Y., Sutin, A. R., Caudroit, J., & Terracciano, A. (2015). Subjective age and changes in memory in older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 71,* 675-683. doi:10.1093/geronb/gbv010.

Tarr, B., Launay, J., Cohen, E., & Dunbar, R. (2015). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biology Letters, 11(10),* 20150767. DOI: 10.1098/rsbl.2015.0767.

Thøgersen, E.C., Ntoumanis, N., & Nikitaras, N. (2008). Typologies of Greek inactive older adults based on reasons for abstaining from exercise and conditions for change. *Journal of Sports Sciences, 26,* 1341-1350. DOI: 10.1080/02640410802165715.

Waldemar, G., Phung, K. T. T., Burns, A., Georges, J., Ronholt Hansen, F., Iliffe, S., Marking, C., Olde Rikkert, M., Selmes, J., Stoppe, G., & Sartorius, N. (2007). Access to diagnostic evaluation and treatment for dementia in Europe. *International Journal of Geriatric Psychiatry, 22,* 47-54. DOI: 10.1002/gps.1652.

Westerhof, G. J., Barrett, A. E., & Steverink, N. (2003). Forever young? A comparison of age identities in the United States and Germany. *Research on Aging, 25,* 366-383. DOI: 10.1177/0164027503025004002.

Wimo, A., Jönsson, L., Bond, J., Prince, M., & Winblad, B. (2013). The worldwide economic impact of dementia 2010. *Alzheimer's & Dementia, 9,* 1-11.e3. DOI: 10.1016/j.jalz.2012.11.006.

Wimo, A., & Winblad, B. (2001). Health economical aspects of Alzheimer's Disease and its treatment. *Psychogeriatrics, 1,* 189-193. DOI: 10.1111/j.1479-8301.2001.tb00047.x.

Wimo, A., Winblad, B., & Jönsson, L. (2007). An estimate of the total worldwide societal costs of dementia in 2005. *Alzheimer's & Dementia, 3,* 81-91. DOI: http://dx.doi.org/10.1016/j.jalz.2007.02.001.

World Health Organization (2011). Global health and aging. Retrieved from: http://www.who.int/ageing/publications/global_health.pdf.

Table 1

Characteristics of Participants

	Gender	Age	Memory complaint	Relationship status	Living situation	Working status	Dance experience
1	Female	71	Forgets tasks, cannot find objects	Single	Independent living	Retired	Lots of ballroom dancing until age 21
2	Female	77	Forgets names and addresses	Married	Independent living	Retired	Country, ballroom and jive throughout college years
3	Male	72	Significant other – forgets to do things, forgets tasks	Married	Independent living	Retired (carpenter)	Social dance until age 40
4	Female	68	Forgets names and addresses	Married	Independent living	Retired (home nursing carer)	None
5	Male	66	Significant other	Married	Independent living	Retired (manager motor tradesman)	None

6	Female	89	Significant other – forgets names	Married	Residential care village	Retired (school teacher)	Social ballroom dancing between aged 17-70
7	Male	93	Difficulty navigating places	Married	Residential care village	Retired (minister of religion)	Social ballroom dancing in the past
8	Female	65	Forgets names, memory is not sharp	Married	Independent living	(not reported)	Social dancing only when attending weddings
9	Female	71	Forgets names and places	Married	Independent living	Retired (Customer service officer)	Old Time and jive as a young adult
10	Male	70	Significant other	Married	Independent living	Retired (purchasing officer)	None
11	Female	83	Cognitively impaired	Single	Aged Care facility	(not reported)	Tango and waltz in the past
12	Female	80	Others tell her she is forgetful	Single	Aged Care facility	Retired (waitress)	None

13	Female	76	Forgets tasks	Single	Aged Care facility	Retired (advertising)	Disco and jive as young adult
14	Female	91	Cognitively impaired	Single	Aged Care facility	Retired (industrial work)	Musical theatre as young adult
15	Male	67	Cannot find objects	Married	Independent living	Working (locomotive)	Waltz and foxtrot during school years
16	Female	65	Significant other	Married	Independent living	Retired (kitchen wing cook)	Ballroom dancing during teenage years
17	Female	81	Cannot recall names	Single	Residential care village	Retired (nurse)	Waltz, foxtrot, ballroom only as young adult
18	Female	65	Forgets to do tasks	Married	Independent living	Retired (Community Development Officer)	Ballroom dance occasionally for the past couple of years

19	Male	68	Significant other	Married	Independent living	Retired (Chemical Engineering Consultant)	Ballroom dance occasionally for the past couple of years
20	Female	68	Forgets what happened in books and movies	Married	Independent living	Retired (Production Planner)	Jazz dancing and musical theatre as a young adult
21	Female	66	Cannot follow sequences	Married	Independent living	Retired (Office worker)	Social ballroom and barn dancing as a young adult
22	Male	71	Significant other	Married	Independent living	Retired (Accounts manager)	Old time dancing until age 40
23	Male	74	Significant other	Married	Independent living	Retired (building maintenance)	Rock and Roll, Jive, Two Step as a young adult
24	Male	67	Cannot find objects he has just put down	Married	Independent living	Retired (Butcher)	Ballroom dancing until age 60

25	Female	69	Forgets words during conversation, forgets tasks she is doing	Married	Independent living	Retired (aged care)	Ballroom dancing until age 60
26	Female	74	“Holes” in memory, cannot relay messages	Married	Independent living	House wife	Social ballroom only when attending weddings
27	Female	69	Relies increasingly on diary, memory not sharp	Married	Independent living	Working (Aged Care)	Waltz, foxtrot, quick step as a young adult
28	Female	60	Significant other	Married	Independent living	Working (owns motor business)	Occasional social dancing
29	Male	62	Forgets to do tasks, forgets which objects to use	Single	Independent living	Working (owns and runs motor business)	Occasional social dancing
30	Male	80	Struggles to hold conversations	Single	Independent living	Retired (Maintenance Surveyor)	Social ballroom, disco in the past

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