A Qualitative Exploration of Perceptions of a Digital Intervention to Promote Physical Activity in Older Adults

**Abstract**

**Purpose:** This study explored participant views of a web-based physical activity intervention for older adults and examined how they resonate with the key principles which guided intervention development. **Methods:** Qualitative interviews were carried out with 52 older adults. A deductive qualitative analysis approach was taken, based around the intervention’s key principles. **Results:** Participants expressed mostly positive views of the intervention features, broadly confirming the appropriateness of the key principles, which were to: 1. Encourage intrinsic motivation for physical activity; 2. Minimise risk of users receiving activity suggestions that are inappropriate or unsafe; 3. Offer users choice regarding activities they engage with and build confidence to undertake more activity; 4. Minimise cognitive load and need to engage with the intervention website. The findings also identified ways in which content could be improved to further increase acceptability. **Conclusion:** This study illustrates how using the Person-based approach has enabled the identification and implementation of features that older adults appreciate.

*Keywords:* digital physical activity intervention, behaviour change, acceptability

Evidence shows that an active lifestyle has a range of benefits for cognitive, physical, and psychological health including improved cardiovascular and respiratory health, enhanced insulin sensitivity, heightened bone and muscle strength, improved positive affect and cognitive function, and increased resistance to type 2 diabetes, cancers, and depression (Corder, Ogilvie, & van Sluijs, 2009; H. W. Kohl et al., 2012; Powell, Paluch, & Blair, 2011). The UK Chief Medical Officers’ Physical Activity Guidelines advise that older adults engage in at least 150 minutes of moderate intensity aerobic activity per week, perform strength and balance exercises twice a week and reduce the amount of sedentary time (Department of Health and Social Care, 2019).

Whilst many interventions have been developed to increase rates of physical activity in older adults, evidence suggests there has been little increase in physical activity levels of the global older adult population (Antonucci et al., 2012; Clarke, Norris, & Schiller, 2017; H. W. Kohl et al., 2012; Lachman, Lipsitz, Lubben, Castaneda-Sceppa, & Jette, 2018). Indeed, in the UK, current estimates suggest that 35% of older adults aged 65-74, 52% aged 75-84 and 74% aged 85 or above do not meet the aerobic recommendations. Moreover, only 16% of older adults aged 65-74 and 8% aged 75 or above are thought to meet the strength recommendations (Health and Social Care Information Centre, 2017). Many physical activity interventions require users to follow a formal exercise regime, often setting aside time to go to a gym or use specialist equipment (Lachman et al., 2018), or expect daily engagement with the intervention. Such interventions are often difficult to implement on a sufficient scale to influence changes in physical activity at national levels (Koorts et al., 2018). A potentially more effective alternate approach, involving encouraging users to integrate physical activity into their daily routines based on personalised goals and interests, has been suggested by the National Institute on Aging Go4Life Program (National Institute on Aging, 2019).

A potential way to overcome the problem of scaling is to utilise digital behaviour change interventions (DBCI). These are remotely delivered using technologies such as websites and mobile applications (Stockwell et al., 2019). Using these technologies allows for the creation of ‘persuasive systems’ (Oinas-Kukkonen & Harjumaa, 2008), which utilise features of the technology to support behaviour change via methods such as primary task support (e.g. tailoring & self-monitoring), dialogue support (e.g. praise & reminders), system credibility support (e.g. trustworthiness & expertise) and social support (e.g. social facilitation & co-operation) (Oinas-Kukkonen & Harjumaa, 2009). Further to this, delivering interventions via the internet overcomes restrictions introduced by the physical location of both the user and intervention resources, overcoming geographic boundaries and enabling widespread, cost effective dissemination (Bennett & Glasgow, 2009). In the UK, older adults are the fastest growing group of internet users: internet usage in those aged 65-74 rose from 52% in 2011 to 83% in 2019; in those aged 75+ usage rose from 20% in 2011 to 47% in 2019 (Office for National Statistics, 2019). Whilst it must be acknowledged that DBCIs are not suitable for everyone, such as those who may not have access to the internet, by using this approach to deliver effective interventions at scale very cheaply, existing resources can be freed up to reach those without digital access in other ways (e.g. through face-to-face programmes).

Indeed, using digital approaches to deliver interventions has been demonstrated as an effective way to promote increased physical activity (L. F. Kohl, Crutzen, & de Vries, 2013). There are numerous commercial websites and apps available to the general population, but these are often focused on younger, physically active adults with higher levels of technological literacy, and often depend on smartphone technology (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012). However, there is also increasing evidence that digital physical activity interventions can be acceptable and effective amongst an older population (Ammann, Vandelanotte, de Vries, & Mummery, 2013; Muellmann et al., 2016; Stockwell et al., 2019). Although such web-based interventions have been demonstrated to provide short term improvements in physical activity, there is limited evidence as to their long-term benefits (Muellmann et al., 2016; Stockwell et al., 2019). Furthermore, there remains uncertainty as to which intervention features are most likely to be acceptable and effective in an older adult population (Zubala et al., 2017), with calls for future research to identify what is acceptable and unacceptable to older adults about interventions to increase physical activity (French, Olander, Chisholm, & Mc Sharry, 2014). This research therefore sought to understand in detail which aspects of a DBCI to promote physical activity (Active Lives) were likely to be acceptable to older adults. In addition, this allowed for the identification of any ways in which these might need to be adapted as part of the iterative development process (O’Cathain et al., 2019). An intervention being acceptable to the intended user population is a key factor in intervention engagement (Corbett et al., 2018b; Madkins et al., 2019; Sekhon, Cartwright & Francis, 2017), and therefore potential effectiveness in terms of an intervention’s targeted behaviour changes when used over a longer period of time.

‘Active Lives’, a novel web-based intervention, was developed with the aim of promoting long term increases in physical activity and, by extension, delaying or preventing cognitive decline (Buchman et al., 2012; Norton, Matthews, Barnes, Yaffe, & Brayne, 2014), in older adults with and without existing age-related cognitive decline. The Active Lives intervention was developed using an evidence-, theory- and Person-Based Approach (Morrison, Muller, Yardley, & Bradbury, 2018; Yardley et al., 2015), which uses in-depth qualitative research in an iterative process to obtain an understanding of user views, context and experiences. This is then used to adapt and optimise the intervention to ensure it is maximally meaningful, feasible and engaging for the target population. As part of this iterative development process (Moore et al., 2015), qualitative research was conducted to explore user perceptions and experiences of the intervention, whose provisional content was underpinned by the theory and evidence-based ‘guiding principles’, which aim to briefly summarise the key intervention features designed to promote behaviour change (Yardley, Morrison, Bradbury, & Muller, 2015). Understandings of users’ preferences and experiences helped to refine the intervention’s underpinning guiding principles and identified which aspects of the intervention older adults found either acceptable or unacceptable.

Using a combination of think-aloud (Charters, 2003) and semi-structured retrospective interviews (Fylan, 2005) this work sought to explore older adults’ perceptions of the key intervention features of Active Lives in order to understand more about whether they were implemented in a way that would be acceptable to users. In this context we considered acceptable to mean that the content and design of the intervention (e.g. the overall message, format, functionality, navigation and wording) is easily understandable, engaging (in that users are inclined to continue using it) and persuades the user to engage in the suggested behaviours. This approach presented an opportunity to understand how the proposed mechanisms through which the intervention was expected to work were viewed by prospective users, and therefore to identify ways in which the intervention could be improved specifically for the target population as part of an iterative design process to increase the likelihood of effective behaviour change (O’Cathain et al., 2019). This work was conducted as part of the intervention development phase of a larger body of research into the ‘Active Brains’ intervention, of which Active Lives forms a key component. Active Brains aims to prevent and reduce cognitive decline in older adults through increased physical activity (Active Lives), online brain training, and healthy eating.

**Methods**

**Design**

After ethical approval for the study was obtained from [name of the committee and ID numbers removed], data collection was carried out in two phases. Firstly, think-aloud interviews were conducted on preliminary intervention materials, which informed the iterative development of intervention content and the completion of a full prototype of the website. Following this, a qualitative feasibility evaluation of the intervention was conducted, which involved participants having access to the intervention for three weeks and then providing feedback in semi-structured interviews. This formed a brief part of the development phase study intended to collect perceptions and views on different aspects of the intervention. Each of these phases was intended to provide complementary data regarding participants’ experiences of using the intervention in order to provide a potentially broader insight into their perceptions of it. Think aloud interviews generate immediate reactions to the content, but require the presence of a researcher which may influence responses. In contrast retrospective interviews allow participants to use the intervention in their own environment, which can highlight additional issues with the intervention (such as with navigation and usability) as well as barriers to behaviour which can’t be identified during think aloud interviews.

**Participants**

Fifty-two participants were recruited from two routes: invitation through Join Dementia Research (JDR, a public facing web portal for matching UK-based patients and public to relevant studies) and searches of GP databases.

To be eligible for inclusion participants had to meet the following criteria:

* Be retired and aged between 60 and 85 years old
* Not in receipt of terminal/palliative care
* Not having severe mental health problems (including an existing diagnosis of dementia) and/or major uncontrolled depression/schizophrenia
* Not already meeting Department of Health and Social Care’s (DHSC) weekly physical activity recommendations (150 minutes of moderate exercise, or 75 minutes of vigorous exercise)
* Eligible participants provided informed consent by completing an online consent form and answered some brief online eligibility screening questionnaires. The screening questionnaires comprised the Baddeley Grammatical reasoning task (Baddeley, 1968) and the International Physical Activity Questionnaire Short (IPAQ-SF) (Craig et al., 2003). Eligible participants were assigned to one of two groups based on the results of cognitive assessments: participants scoring 1 SD below the norm for the Baddeley reasoning test task (Baddeley, 1968) were assigned to the lower cognitive score group, whilst participants who scored above this criterion were assigned to the higher cognitive score group. Cognitive assessment scores were collected due to this study being part of a wider body of research for which Active Lives was developed. In this context we were interested in finding out if Active Lives is suitable for people with mild cognitive impairment, and whether their views of the intervention differ.

**Guiding Principles**

A key part of the Person-Based Approach is the development of guiding principles, which specify the intervention’s core design objectives (what the intervention is trying to achieve) and the key intervention features that will support achievement of those design objectives within the user context. The design objectives specify what the intervention must do in order to address the needs of the target user and enhance engagement with the intervention. The guiding principles offer a succinct summary of the crucial ways in which the intervention is intended to support behaviour change by improving engagement with the intervention content.

To draft provisional guiding principles, an understanding of target users was obtained from scoping reviews and the research team, including PPI members, and combined with previous research evidence and the application of theory. The development of Active Lives drew on three key theories; self-determination theory (SDT) (Deci & Ryan, 1985; Ryan & Deci, 2000), social cognitive theory (SCT) (Bandura, 1986, 1991) and habit formation (Aarts, Paulussen, & Schaalma, 1997; Lally & Gardner, 2013).

* **Self-determination theory** proposes that more self-determined/higher quality motivation and continued engagement in a behaviour is underpinned by conditions that support the three basic psychological needs: the need for autonomy, the need for competence, and the need for relatedness.
* **Social cognitive theory** presents a three-way model in which personal factors, including sense of agency, self-regulation and self-efficacy, environmental influences, and behaviour continually interact. This theory also highlights the importance of outcome expectations, which are subjective estimates of how likely a behaviour will result in a particular outcome.
* **Habit formation** relates to the idea that physical activity behaviours are capable of being automatically evoked without the need of significant intentional effort or extensive planning when incorporated in existing lifestyles.

The resulting guiding principles (Table 1) identified four key design objectives needed to ensure that Active Lives would meet older adults’ behavioural needs in order for them to successfully increase physical activity:

1. Older adults may not be sufficiently motivated to increase activity. To build intrinsic motivationActive Lives therefore presents novel content that is appealing to older adults such as strength and balance training, breaks from sitting (to reduce sedentariness) and activities which easily fit within older adults’ lifestyles. The rationale for increasing activity draws on benefits which older adults have reported as salient and motivating, such as enjoyment, social interaction, maintenance of independence and improvement in symptoms (Devereux-Fitzgerald, Powell, Dewhurst & French, 2016).
2. The need to cater for a heterogeneous population of older adults with varying capabilities/preferences. Therefore, Active Lives aims to minimise risk of users receiving activity suggestions that are too advanced/unsafe or too basic to increase capacity. A choice of activities, designed to be carried out independently and suit different abilities/preferences are presented. Content is tailored to participants’ reported capability and preferences, to ensure it is beneficial and safe (e.g. in the strength and balance section videos of simple chair-based exercises are presented to those who report problems with strength/balance, these slowly increase in intensity working up to standing exercises over time). Participants choose the section of Active Lives they would like to begin with (guidance steers people towards what is most beneficial/safe), as activity levels and confidence increase, the intervention encourages use of all sections.
3. Many older adults have concerns about increasing activity(Devereux-Fitzgerald et al., 2016), Active Lives therefore aims to build confidence to undertake more activity by addressing common concerns, providing reassurance, encouragement and techniques for overcoming barriers. Graded activity employs very gradual increases from participants’ baseline. Participant stories model how similar individuals overcame concerns/barriers.
4. As nearly 20% of older adults will have some age associated cognitive decline/mild cognitive impairment(Petersen, 2016), Active Lives aims to minimise cognitive load and dependence on the intervention website to ensure behaviour can be maintained. Techniques used include examples of how to create new physical activity habits, including making small changes which fit within everyday routines, support with setting-up prompts to behaviour in the physical/social environment and signposting to offline resources such as local activity classes. Goal setting and reviewing (with tailored feedback to support motivation), plus pedometers facilitate self-monitoring and self-regulation. Emails provide additional prompts to behaviour and contain behaviour change techniques designed to sustain motivation for being active.

These guiding principles were used alongside the theoretical and empirical understandings of physical activity behaviour in this population to decide on:

1. appropriate features and functions of the intervention likely to increase in physical activity behaviours and;
2. the most appropriate behaviour change techniques to deliver these functions, such as; goal setting, action planning, restructuring the physical and social environment, instruction on how to perform a behaviour and habit formation (Michie et al., 2013).

Using this approach allows for the development of interventions that are more likely to be acceptable to the target population (Yardley, Ainsworth, Arden-Close & Muller, 2015), and as such increases the likelihood of effectiveness.

**Active Lives**

Active Lives contains three sub-modules that users are directed to differentially depending on which is deemed to be most beneficial for them. Whilst tailored recommendations are made about which sub-module users may find most helpful, participants have access to all three sub-modules at any point.

* The ‘Getting Active’ sub-module provides support and ideas about activities to try to increase individuals’ overall levels of lifestyle physical activity (e.g. doing more walking, activities at home and involving friends and family).
* The ‘Strength and Balance Training’ sub-module provides video demonstrations of simple strength and balance exercises and suggestions about how these can be built into daily activities and offers the opportunity to create an exercise plan. The level of exercise difficulty is tailored to the user and their progress.
* The ‘Breaks from Sitting’ sub-module supports individuals in reducing sedentary behaviour by suggesting simple changes that can be made to daily routines.

 Active Lives was designed to promote both initial engagement with, and long-term adherence to, new physical activities. It aimed to do this by firstly introducing users to new activity suggestions and encouraging goal setting and self-monitoring, and later by offering ideas for users to build these into daily routines to promote habit formation over the longer term. Active Lives was designed to support those with limited time and resources, as well as those with lower literacy skills. Content was written in easily accessible language and focused on simple ways of increasing physical activity that can be readily integrated into daily routines, without the purchase of additional equipment (to minimise costs, users are offered a free step counter as part of the intervention). A logic model for the intervention has been included (see Appendix A), as well as an overview of the intervention content (see Appendix B). A detailed account of the intervention development is available elsewhere (Essery et al., 2020).

**Procedure**

The procedure for each phase is outlined below.

**Think-aloud Interviews.** These were the initial phase of interviews and took place face-to-face at either participants’ homes or in a private room at the University of Southampton. The purpose of these interviews was to elicit users’ views on preliminary intervention materials and directly observe their use of, and interaction with, them to inform any necessary modifications. Participants were asked to work through a prototype of the Active Lives website with a researcher sitting beside them at the computer, whilst speaking their thoughts on content, structure and presentation out loud in real time.

**Retrospective Interviews.** These retrospective interviews were conducted following the completion of the initial think aloud interviews. Participants were invited to use the prototype intervention at home for three weeks, keeping a diary of their experiences. These diaries were not included within the analysed data; participants were instead encouraged to use them to prompt recall of their experiences during the interview. Semi-structured interviews were conducted after this time, either face-to-face, or via telephone, in order to understand users’ experiences of the intervention and recommended activities, and to identify further ways in which the intervention could be improved. The interview schedule was informed by the preceding phase of work, with a focus on participants’ general views of the website and the activities it recommended.

All participants were offered a £10 high street voucher before each phase of the research they participated in.

**Analysis**

Interview recordings were transcribed verbatim, added to QSR International's NVivo 12 qualitative data analysis software, and analysed using thematic analysis (Braun & Clarke, 2006). As the purpose of this research was not to construct a new theory, but rather to establish whether participant experiences of using the Active Lives program matched those predicted by the guiding principles, a deductive qualitative analysis approach (Crabtree & Miller, 1999; Gilgun, 2013) was taken. This was conducted in six stages:

1. The first two authors read the transcripts several times in order to familiarise themselves with the data and produced an a priori template of codes (Crabtree & Miller, 1999) in the form of an initial coding manual based around the guiding principles for the Active Lives intervention.
2. This coding manual was used to guide the identification of relevant extracts from both phases of data collection. Through this phase the coding manual was continually updated and refined through discussion between the researchers, with a broad ‘other’ code used for additional open coding to allow identification of experiences and understandings that could not be explained by the intervention’s guiding principles.
3. Following this the collated codes were explored to determine how well they fitted within the deductive framework of the coding manual, as well as to look for similarities or differences in the codes between the two data sets collected during each phase to allow for triangulation of this data. During this stage it was found that the single coding manual could be effectively applied to both data sets, and as such the data from both was collated.
4. Themes were then reviewed and refined by the research team. At this stage differences in responses between subgroups were also examined by identifying instances where there was a notable difference in the number of voiced opinions between subgroups (age, gender, cognitive score). Other subgroup comparisons based on educational level and frequency of internet use were not carried out as participants were unequally distributed across several subgroups, resulting in small numbers of participants within most subgroups.
5. The names attributed to both themes and sub-themes were then refined to present a clear and concise reflection of the data, as well as being clearly relatable to the guiding principles.
6. Finally, the results were written up in order to present a concise and coherent account of the findings in relation to the guiding principles.

**Results**

**Participant Characteristics**

In total, 52 participants were interviewed, with 34 taking part in think-aloud interviews, 11 in retrospective interviews, and 7 taking part in both (Table 2). The mean length of think aloud interviews was 95 min (SD = 17), with a median of 92 min, and a range between 64 and 131 min. The mean length of retrospective interviews was 30 min (SD = 19), with a median of 26 min, and a range between 10 and 91 min.

The findings are organised in four sections, discussing the extent to which participants’ perceptions reflected each of the four guiding principles’ key design objectives and associated intervention features.

**Design Objective: Encourage Engagement with and Intrinsic Motivation for Physical Activity**

**Key intervention feature: Offer novel activities that are compatible with users’ lifestyles and identities: lifestyle activity, strength and balance training, breaks from sitting.** Many users of both genders had positive reactions to the suggested activities, often commenting on how accessible they are, describing them as easy, useful and practical. Men were however more likely than women to express positive views about the activities. Many expressed feeling encouraged to try them. “I’m gonna do the walking bit, I’m gonna play golf, that’ll be a good start, won’t it?” (P0118, male, 70, lower cognitive score, think-aloud interview).

Some participants liked the idea of being encouraged to engage in everyday activities they enjoy instead of traditional exercise, explaining that because of this it was more likely that users of the intervention would follow the suggestions. Some also spoke appreciatively about being able to fit the suggested activities in their daily routines. “If you can build something into your life through something you like and make an exercise of it, it's better for you because you don't notice that you're exercising, if you understand me?” (P0130, female, 75, lower cognitive score, think-aloud interview).

Some people thought that the suggested activities were not relevant to them, mainly because they felt that they were already sufficiently physically active. Some, however, mentioned that using the intervention reminded them about the importance of being physically active, validating the activities they were already engaged in. “It’s confirming what I have in my mind and I do try to do” (P0245, male, 66, lower cognitive score, think-aloud interview).

**Key intervention feature: Rather than framing activities in terms of reducing risk of health conditions, highlight benefits that have immediately evident and noticeable outcomes and are known to be valued by the intended user group.** Many participants valued being given information about the benefits of physical activity, often mentioning that they appreciated being presented with supporting research evidence. Some expressed increased motivation to become more physically active as a result. “‘Taking a short two minute walk every half hour improves people’s blood sugar levels.’ Oh, I’ve got terrible problems with blood sugars. Right. Good. Now I know what to do about it” (J0101, female, 62, higher cognitive score, think-aloud interview).

Without commenting on specific features of the intervention, a few participants discussed motivation and discipline being prerequisites to being physically active.

So I think that’s the thing to be, have to be determined and to motivate yourself, ‘cause (…) I think it possibly is too easy, you know, being retired, oh it’s nice and cosy inside so I’ll sit inside and think about it, perhaps do it mañana as they say, tomorrow. (P0112, female, 68, lower cognitive score, think-aloud interview)

**Design Objective: Minimise Risk of Users Receiving Activity Suggestions That Are Too Advanced and Unsafe or Too Basic and Which Do Not Increase Capacity; Steer Users Towards Those Activities That Seem Most Personally Suitable/Beneficial; Offer Users Choice and Autonomy Regarding Content and Activities They Engage With (Within Those Suitable)**

**Key intervention feature: Advice tailored based on current activity levels and perceptions of current strength and balance skills.** A few participants had positive reactions to being presented with different difficulty levels for strength and balance activities.

Yeah, I think you need to do that. (…) say if it didn’t and it told me that I’d got to, you know, do this four times a day, I’d just get bored. And I wouldn’t move on, or, you know, or I’d want to jump a load of it and get further on. So, I think tailoring it early on in the active bit is, yeah, it’s essential. (J0104, male, 65, higher cognitive score, think aloud interview)

**Key intervention feature: Offer a variety of activities to suit different levels of ability.** Many people spoke positively about the fact that there are activities to suit everyone, allowing people with a wide range of abilities to start being more active. Some were pleased by the fact that the suggested activities seemed achievable by older adults. Participants with higher cognitive scores were more likely to voice this opinion than those with lower cognitive scores. Some speculated that proposing unreachable goals would likely put people off. “If you give people tasks that are just beyond, you know, just too unreasonable, you're switching them off and they won't bother doing it, totally” (P0111, male, 67, higher cognitive score, think-aloud interview).

**Design Objective: Build Confidence to Undertake More Activity**

**Key intervention feature: Provide reassurance, encouragement, techniques and strategies to reduce concerns and barriers: ‘Common Concerns’ pages.** Some participants had positive reactions to concerns about being physically active being discussed by the intervention. Some also valued seeing concerns about the safety aspects of engaging in physical activity being addressed, with some mentioning it would help with choosing and engaging in activities that are safe.

I think it gives you a bit of confidence to do it at your own pace (…) in a safe environment without sort of doing these things in an environment where you might not be safe if things go wrong. So, I think it sort of puts the perspective in your mind of what you should be expecting to do. (P0130, female, 75, lower cognitive score, think-aloud interview)

**Key intervention feature: Provide reassurance, encouragement, techniques and strategies to reduce concerns and barriers: provision of graded activities with gradual increases from low activity baseline.** Some users described the importance of being able to choose their own activities and goals in order to start slowly and to progressively increase amounts of physical activity over time.

You are making your own plan. The thing is to get you into the game and then, as the game goes on, then, 'Oh, I could do ten easy', then I'll up it or, yes, no, that's good because you are in control. (P0211, male, 73, lower cognitive score, think-aloud interview)

**Key intervention feature: Provide reassurance, encouragement, techniques and strategies to reduce concerns and barriers: stories from similar others about their successes with building up activities.** A majority of participants expressed liking the ‘success stories’, specifically commenting on the fact that they were relatable, and helped with seeing how others have successfully increased their physical activity levels from a similar starting point. Participants in their sixties were more likely to comment on this than those in their seventies and eighties.

In both cases, you’ve chosen someone who’s probably less active with Jo, and then someone who in the past was a little bit more active with Elsie, but is now finding that – which is a bit like me with my knees, I just find it’s hard to run, really. (J0104, male, 65, higher cognitive score, think-aloud interview)

A few people had more ambivalent feelings about the ‘success stories’, explaining that they are not interested in them, or that they wouldn’t help them with choosing activities.

I'm not really keen on the stories, to be honest. I mean, it might help people… I don't know. I think if you want to do something you will do it anyway. You don't really need other people to say how you can manage it. If you wanna do something, you will do it. (J0112, female, 61, higher cognitive score, think-aloud interview)

**Key intervention feature: Provide reassurance, encouragement, techniques and strategies to reduce concerns and barriers: access to a trained supporter to support engagement.** Participants in this study did not have access to a trained supporter (a feature of the planned larger trial), but a few liked the idea of having access to one (by either telephone or email) to help them start engaging with the suggested activities.

Oh, well, it’s lovely when someone takes an interest in how you’re getting on. And it helps to motivate you. A, because you want to have good news to tell them, and B, because the process of having to give the feed-back makes you more aware of what you’re slipping on and what you’re not slipping on. (…) if it was a bit more specific, you know, sort of “okay, what have you found have been the obstacles?”. So something to help you think through what would help you keep going on it, and what would improve it. Would be really useful, a bit of encouragement. (J0101, female, 62, higher cognitive score, think-aloud interview)

A small number of users didn’t feel the need for a support person, explaining that the intervention appeared sufficiently clear for them to engage with the intervention’s proposed activities independently, or that support is not something they would seek. “I'm quite a loner actually. I don't really look for support. I stick my heels in and get on with it. I don't look for that support from anyone in particular” (P0106, male, 76, lower cognitive score, think-aloud interview).

**Key intervention feature: Provide reassurance, encouragement, techniques and strategies to increase self-efficacy: graded goal setting and review.** Many people spoke positively about the intervention’s goal setting features and some discussed benefits such as helping with habit forming or avoiding participants drifting from their plans. A small number of participants commented on the fact that setting goals is a form of commitment, explaining that this would help them with keeping to their goals.

Yes, I think it's a good idea because it gives you an objective, doesn't it, to aim at. If you think, I'll have a walk this morning. You think, it's raining, I'll wait until tomorrow, but if you've got it there in black and white. You said you're going to do it then you should really try and do it. (P0106, male, 76, lower cognitive score, think-aloud interview)

Some participants had more negative feelings about setting goals, citing a variety of reasons: not liking lists; feeling like activities would become a chore; not liking the added pressure setting goals would apply; preferring to take each day as it comes; or not feeling sufficiently disciplined to achieve their goals.

Setting the goals is good, but you, kind of, forget about goals, anyhow, don't you? You say, I'll do that every time but, no, it never really quite works. I don't have the discipline to do it, every time I should do. (P0261, male, 62, higher cognitive score, retrospective interview)

Many users mentioned being pleased with being able to look back and review activity goals and progress. Some added that seeing improvements would give a sense of achievement and motivate them to continue.

Well, that does sound good that you can sort of see where you are and where you've got to and sort of think 'I couldn't do that so many weeks ago.' So it's nice that you can actually got something that you can go back and assess it by. (J0112, female, 61, higher cognitive score, think-aloud interview)

**Design Objective: Minimise Cognitive Load and Dependence on the Intervention Website**

**Key intervention feature: Suggestions and examples of how to create new physical activity habits.** A few participants discussed the importance of habit forming and were pleased with how the suggested ideas about incorporating physical activity into daily routines might help with this. For some this also inspired them to think about other ways in which they could incorporate more physically activity.

Then you’ll think, ‘oh yes, well… Instead of taking all the clean washing upstairs in one go, I’ll take it in two gos.’ And when I go up the stairs, I’ll go a bit slower, because that’s better exercise, go up it a bit slower. Or when I’m… well, you know, when I’m doing whatever, I’ll do a few more extra, you know, a few extras of this, or I’ll go a bit further. (P0112, female, 68, lower cognitive score, think-aloud interview)

**Key intervention feature: Suggestions and examples of how to make small changes to everyday physical and social environments to prompt activity.** A few people had positive reactions to the environmental restructuring suggestions, particularly those that involve placing everyday items away from usual locations.

I think putting the TV remote on the mantelpiece or next to the TV is a really good one 'cause I get so conscious some evenings that I'm sitting there on the sofa with the remote next to me and, actually, just to leave it by the telly, if I wanted to change channel, I think that's a really good one. (J0105, female, 65, higher cognitive score, think-aloud interview)

A few participants expressed not liking or wanting to follow the environmental restructuring suggestions, explaining they would find them impractical. “Because when I want to sit still I want to sit still, and I don’t want to get up to get the remote off the mantelpiece or to get the drink that I left further away, you know?” (P0105, female, 76, higher cognitive score, think-aloud interview).

Many users spoke about how involving others would make them more inclined to engage in physical activity, by increasing enjoyment, encouragement, and motivation. A few also mentioned that organising activities with others would likely help them keep to their plans.

If you agree to meet up with someone and do something, then it does make you think, well yes, I've got to do that because I said I'll meet them at such and such a time and I'll do something or they're coming around and we're going to do something. Whereas if you don't do that, it's easy to think, oh, I'll do it later and then not do it. (P0269, female, 64, lower cognitive score, retrospective interview)

Social support seemed to be a matter of personal preference as a few participants felt that they would be happy doing activities on their own and didn’t feel the need to involve others. “I'm quite happy with my own company” (P0129, female, 67, lower cognitive score, retrospective interview).

**Key intervention feature: Support for planning environmental prompting for each activity goal set (time of day, links to specific activities).** A few participants commented on this feature, describing valuing being able to specify a detailed plan for their goals, with some explaining that it would also increase the likelihood of doing their chosen activities.

Yes, well I think you must have a plan otherwise you're not going to stick to a routine, are you, and you're never going to do it properly. If you say you're going to do it for ten minutes or quarter of an hour at a certain time, and you do it every day like that, it's a good idea. Otherwise, it'll just fall by the wayside, I think, won't it? (P0106, male, 76, lower cognitive score, think-aloud interview)

**Key intervention feature: Exercise instructions/goals set/record sheets available as printouts.** Many people discussed the benefits of being able to print their goals, including using printouts as convenient visual reminders, avoiding the need to use their computer to access their goals.

And also, I mean, it’s, you know, if it’s there on a bit of paper, you can pin it up on the wall in the kitchen, and, ‘Oh yeah, I need to do that today,’ you know, rather than get the laptop out and go online or what have you. (J0114, male, 70, higher cognitive score, think-aloud interview)

**Key intervention feature: Signposting/links to offline resources to support activity.** A small number of participants commented on this feature, with positive reactions about being able to access further advice and information about additional activities and how to access them locally. “’Useful links.’ Oh, that’s good, ‘Information on walking groups.’ … And Tai Chi. So again, it’s good that you’ve got link—and I presume this will be somewhere to phone or a website” (P0142, female, 62, higher cognitive score, think-aloud interview).

**Discussion**

The main aim of this study was to explore older adults’ perceptions of Active Lives with regards to how acceptable they found its intervention features. In doing so, we also examined the extent to which participants’ experiences of using Active Lives resonated with the theory- and evidence-based guiding principles that informed the intervention content and format. Our findings are encouraging in that participants mainly expressed positive perceptions of the intervention’s key features. For the most part participant views were in accordance with the expected intervention mechanisms outlined in the guiding principles, the purpose of which aimed to maximise engagement and acceptability. Our findings also identified some features that were not appreciated by all participants and which should therefore be cautiously implemented as optional content, as well as identifying participants’ perceived need for additional content.

Participants valued the features derived from the intervention’s first guiding principle, which aimed to encourage intrinsic motivation for, and engagement with physical activity. The variety and accessibility of the suggested activities was appreciated by participants, and that these could be integrated into daily routines without difficulty. Our findings concur with existing literature about the type of activities that should be encouraged with this age group, as many older adults prefer to remain physically active through everyday activities, as opposed to engaging in physical activity as a purposeful activity within itself (McGowan, Devereux-Fitzgerald, Powell, & French, 2018). The fact that the activities suggested by Active Lives can be carried out close to home and do not involve significant costs may have further contributed to their appeal, as these are factors that have been found to positively affect the acceptability of physical activities by many older adults (Devereux-Fitzgerald et al., 2016).

Information about the immediate benefits of physical activity was also well received, with participants appreciating that this was accompanied by supporting research evidence. Our participants’ views align with previous literature about older adults appreciating present-oriented benefits (those in Active Lives included keeping mobile, maintaining independence, enjoyment, reducing pain, social connection, enhancing mood, maintaining general quality of life), as opposed to long-term health benefits (McGowan et al., 2018).

This study also allowed us to identify additional features that would be beneficial for encouraging intrinsic motivation for physical activity. A few participants discussed motivation as being something important to consider in itself, which suggests that including topics on ways to remain motivated would likely benefit users who may struggle with this. As many of the motivational techniques we had implemented were implicit in nature (for example, providing choice and using non-directive language, or presenting enjoyable activities and associated short-term benefits), this finding highlighted the need for more explicit motivational strategies to be included. As a result, supplementary content that discusses ways to remain motivated was subsequently implemented. This included additional pages and downloadable sheets addressing topics such as habit forming (Lally & Gardner, 2013), enjoyment and involving others (Devereux-Fitzgerald et al., 2016), remembering successes as a means to increase self-efficacy (Schutzer & Graves, 2004, Bandura 1977), and exploring personal reasons for being physically active, in order to help users identify intrinsic motivating factors (Deci & Ryan, 1985; Ryan & Deci, 2000). Further relating to our guiding principle to build intrinsic motivation for physical activity, some participants reported feeling that they were already sufficiently physically active, and explained that this limited the extent to which they thought they would find the intervention’s suggested activities engaging or motivating. To try and address this, suggestions were added for users to include their current activities when setting goals in order to build on activities they already did and enjoyed, as well as a message suggesting that no matter the activity level, it would be good to try and do a little bit more.

Features associated with the intervention’s second guiding principle - to ensure there was a wide range of activity suggestions to suit older adults of all levels of ability - were also valued by many of our participants. As older adults report doubts about their abilities to engage in physical activity (McGowan et al., 2018) and have concerns about falling and sustaining injuries during physical activity (Franco et al., 2015), our findings suggest that offering activities that cover a range of abilities is an acceptable way of minimising these barriers.

Our participants appreciated features resulting from the intervention’s third guiding principle - to build users’ confidence to engage with physical activity. Features to address this objective included ‘success stories’, which were positively commented on by a majority of participants. The ‘success stories’ included challenge commonly held perceptions by older adults that engaging in physical activity is not compatible with their self-identity (McGowan et al., 2018). Our participants’ positive comments about these ‘success stories’ may reflect recognition that this feature could help older adults reconsider their ability and confidence to try some of the recommended activities, and in doing so, could inspire a renewed sense of enthusiasm for physical activity. The individuals portrayed in the Active Lives ‘success stories’ are all older adults who have made small, manageable increases in physical activity, for instance doing a little more walking and using stairs instead of lifts, helping a less able friend with gardening, or standing up and stretching during TV adverts. As such, our participants’ views on these stories are consistent with research findings in the area of role modelling and physical activity in later years, which provide indications that for moderately or inactive older adults, the most effective role models may be peers who are slightly more physically active than them (Horton, Dionigi, & Bellamy, 2013), as opposed to highly physically active older adults or those with elite-athlete Masters status, whose achievements may be perceived as intimidating and unrealistic (Ory, Kinney Hoffman, Hawkins, Sanner, & Mockenhaupt, 2003; Horton, Baker, Cote, & Deakin, 2008; Horton et al., 2013). A few participants were however more ambivalent about this feature, explaining that they didn’t feel the need to read other’s stories to engage with the intervention or the suggested activities. This finding provided evidence for the need for ‘success stories’ to be included as optional content, as originally designed.

A further feature that aimed to build users’ confidence was goal setting and review. Goal setting and reviewing were amongst the most discussed features, with some participants commenting on how these would likely increase their motivation to engage in physical activity. Previous studies have reported mixed findings with regards to the use of self-regulatory techniques such as goal setting and reviewing with different age groups (French et al., 2014; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Williams & French, 2011). French et al. (2014) suggested that older adults may experience self-regulatory features such as goal setting and reviewing as burdensome tasks due to declining executive function (involved in forming and implementing intentions). This does not resonate with our participants’ experiences of these features, who infrequently expressed negative views about these features. These conflicting findings could be due, in part, to these features being implemented in a variety of ways across different interventions, with varying levels of success i.e. there may be implementation failure in some studies (Cargo et al., 2018). It may be that these features were more acceptable within Active Lives because they were designed to be accessible and easy to use, with many goal suggestions and planning features to select from in an attempt to reduce cognitive demands as much as possible. When participants did not like goal-related features there was no indication that this was due to difficulties with the required cognitive effort to use them, as our participants’ negative perceptions of these features included their dislike of lists, the unwanted added pressure of reaching goals, and not feeling sufficiently disciplined. Furthermore, the subgroup analysis did not show any substantial differences in views between people with lower and higher cognitive scores. This suggests that engagement with self-regulatory techniques may not be dependent on cognitive ability. Some of those who disliked these features provided rationales that suggest that these individuals may be averse to structure or to making plans, which may reflect an attachment to a more unconstrained lifestyle enjoyed in later years, when the need to plan around parental responsibilities or full-time work is often no longer required (French et al., 2014). As negative perceptions of goal-related features were infrequent, these features were retained in their original form; users are encouraged to try them the first time they encounter them, but they are presented as optional content in later sessions, since they are not suitable for all users, as illustrated by our findings.

Features related to the intervention’s fourth guiding principle - to minimise cognitive load and dependence on the intervention website - were also valued by our participants. They were particularly pleased with being able to use printouts of their goals as visual prompts, and in doing so avoiding having to use a device to access the intervention to remind themselves of their chosen activities and goals, further reducing the cognitive effort involved in following up on their goals. This extends the literature as we could not find any reports on user perspectives on goal printing features in the context of similar physical activity interventions for older adults. As such, this finding may be of use for the development of future digital physical activity interventions.

Another successful feature relating to the fourth guiding principle was intervention content encouraging the involvement of others. This was discussed by many participants, who mentioned important benefits such as increased enjoyment, encouragement, and motivation to engage in physical activity. This agrees with previous findings that older adults generally appreciate being physically active with others and value the motivation to persist this provides through enjoyment of social interactions (Devereux-Fitzgerald et al., 2016; Franco et al., 2015; McGowan et al., 2018). A few participants mentioned preferring to independently engage with the activities, which highlights the need for this feature to be optional and presented as a suggestion, which may help prevent potential disengagement from the intervention and its suggested activities by the minority of users who may not value being physically active with others.

Overall, our participants’ perceptions of the intervention components of Active Lives are encouraging and have allowed us to optimise the intervention content during its development. From a wider perspective, our participants’ positive views suggest that the overall approach to physical activity used by Active Lives has potential for being more successful than those that focus on prescriptive guidelines, disease prevention narratives, and framing physical activity solely as a means to transform an ageing body into a fit, more performant one. These strategies are associated with health policies resulting from the concept of *active ageing* (World Health Organisation, 2002). Active ageing was designed to counter the more prevalent *narrative of decline* (which portrays inevitable deterioration of ageing bodies) (Gullette, 1997). Active ageing has subsequently been criticised as contributing to a “war on old age” (Vincent, 2007), with those not living up to the standards of active (and successful) ageing implicitly failing, with negative consequences on their perceptions of self (Holstein & Minkler, 2007). Whilst Active Lives still aims to counter the narrative of decline, it does so by using a non-directive approach devoid of guidelines for minimum amounts of physical activity, and by instead suggesting activities accessible to most (including those with low incomes or limited time) that can be integrated into everyday routines. Active Lives provides a variety of ideas for increasing physical activity, and in doing so, implicitly acknowledges that older adults’ lives are diverse, encouraging users to make sense of how physical activity might fit within their current lifestyle and abilities. Active Lives focuses on the immediate benefits of physical activity (keeping mobile, maintaining independence, enjoyment, reducing pain, social connection, enhancing mood, maintaining general quality of life), with a view to enriching the lives of older adults, a more positive and engaging approach to implementing active ageing interventions, as put forward by Phoenix and Tulle (2017).

The intervention is being trialled in a feasibility study (in 2019-20) and a large trial (n=21,455) is being planned to evaluate Active Lives’ intended behavioural outcomes over a period of five years as part of the Active Brains web-based intervention. This trial will help to determine whether Active Lives is effective in increasing and maintaining older adults’ levels of physical activity over the long term.

**Limitations**

Using qualitative interviews enabled a detailed exploration of individual perceptions and experiences of the features of Active Lives through interactive and adaptable questioning. However, some participants may have been reluctant to express negative views to the interviewers (despite being encouraged to do so before and during interviews), due to acquiescence and social desirability biases (Bowling, 2014). It is also possible that the non-response bias (Bowling, 2014) may have played a role in shaping the sample, with those who chose to participate being more motivated than those who did not, although this is not always the case with this type of research e.g. Corbett et al. (2018a).

Our sample was large and diverse in terms of lower/higher cognitive scores and educational level. However, we did not capture participants’ ethnic backgrounds. Recruitment of participants was limited to the south coast of England and most participants appeared to be white British. It is therefore unclear whether findings are transferable to those from other ethnic groups. For this reason, as part of the planned nationwide trial, recruitment from GP practices covering areas that include a significant proportion of people who don’t identify as white will be purposefully increased. Recruitment from practices in areas with lower indices of multiple deprivation will also be increased in order to ensure a diverse sample in terms of socioeconomic status.

All participants in our sample already had access to the internet and a majority used it daily. It is therefore possible that views from inexperienced computer/internet users may vary from those expressed by our participants.

**Implications**

The present research has important implications for other developers of physical activity digital interventions for older adults. Our findings provide insights into this group’s particular needs in terms of their motivations, values, abilities, and concerns regarding physical activity. Amongst the features our participants appreciated the most, findings related to three of these merit greater attention, as they extend the literature and seem particularly relevant to this age group. The inclusion of goal setting and reviewing features has been the object of mixed findings as there have been suggestions that their use may be disliked or too burdensome for older adults. Our findings suggest such features may be useful and valued by many people in this age group, provided they are presented as optional content (as not appreciated by all), and implemented in such a way that minimises cognitive demands. Secondly, the portrayal of older individuals who have made small, manageable increments to their physical activity levels within the optional ‘success stories’ feature has been well received by a majority of participants. This provides further evidence that role modelling content consisting of peers who are slightly more active may be an effective strategy for engaging older adults who are not highly physically active. Thirdly, the ability for users to print their goals for offline access, a novel feature not previously discussed in the literature, was also appreciated by many participants This suggests that including this feature in the design of physical activity interventions destined for older adults may be useful, as in the context of Active Lives, participants spoke about how this would help them remember and act on their chosen goals.

**Conclusion**

Using the Person-Based Approach to develop a digital intervention to promote physical activity in older adults enabled us to identify and adopt design features that our target user group found broadly appealing. Our participants’ views were generally in agreement with the guiding principles which informed the intervention design, as well as with previous literature regarding factors that influence uptake of physical activity by older adults. Where they were not, this helped us to identify areas where additional features and techniques may enhance the acceptability of intervention content. These insights into the features and elements that older adults appreciated builds on the resources available to other digital intervention developers. Whilst our findings are promising, a fully powered five-year trial is being planned to investigate how effective Active Lives might be with increasing and maintaining engagement with physical activity in the longer term.

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