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# Moving Together: Developing and Testing the Impact of a Technology-Driven Intergenerational Intervention. A Pragmatic Evaluation.

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## Dedication

*To Ffion & Cari,*

*I hope, above and beyond anything else, I've inspired you to follow your dreams. I hope you can see that you can achieve whatever you want to achieve, be whatever you want to be, and that whatever exciting paths your futures take, I'll support you, like you've supported me.*

## Summary

The phenomenon of intergenerational contact and the ability it may have to facilitate benefits for both older adults and children, often attracts attention. However, it is an underexplored concept, primarily underpinned by anecdotal evidence. This thesis aimed to develop and investigate the potential impact of a familial intergenerational technology-driven intervention on physical activity levels, sedentary behaviour, health-related quality of life, and stereotypes of ageing in older adults, aged ≥ 60 years old, in a real-world setting. Through the rigorous application of the stages of an individualised, iterative, multi-stage process model, justification of approach was confirmed, a unique intervention designed and refined, the incorporated behaviour change techniques mapped out, and, the feasibility, acceptability, functionality, and useability of the intervention and approach established. The developed intervention interlinked several discrete elements to allow intergenerational dyads, comprised of older adults (aged ≥ 60 years), and children (aged 7-11 years), to work collaboratively, using activity trackers (Mi Band 2) to complete virtual walk route challenges via the World Walking platform. Despite the limitations imposed by the COVID-19 pandemic, it was clearly established that: i) Age stereotype-based interventions provide an encouraging approach to challenging the health-related behaviour of older adults; ii) Through the components of Contact Theory (Allport, 1954), intergenerational contact and technology already available within the public domain, can be innovatively entwined to formulate health behaviour change intervention strategies; iii) Intergenerational contact provides mutual benefits for older adults and children, and, iv) The intervention developed was acceptable, useable, and potentially a highly feasible way of empirically exploring the impact of intergenerational contact, challenging age stereotypes, and positively affecting physical activity levels, sedentary behaviour, and health-related quality of life. Indeed, where depictions of later life have historically been negative, intergenerational contact provides an avenue to challenge such beliefs and behaviours.

## Résumé

Le contact intergénérationnel connaît un intérêt grandissant pour ses bénéfices potentiels sur les personnes âgées et les enfants. Cependant, il s'agit d'un concept sous-exploré, dont les effets sont principalement étayés par des preuves anecdotiques. Cette thèse visait à développer une intervention intergénérationnelle familiale connectée, et d'étudier son impact sur les niveaux d'activité physique, le comportement sédentaire, la qualité de vie liée à la santé et les stéréotypes liés au vieillissement chez les personnes âgées de plus de 60 ans, en contexte de vie réelle. En s'appuyant sur l'application rigoureuse des étapes d'un modèle de processus individualisé, itératif et à plusieurs étapes, la justification de l'approche a été confirmée, une intervention unique conçue et affinée, les techniques de changement de comportement incorporées cartographiées, et, la faisabilité, l'acceptabilité, la fonctionnalité et l'utilisabilité de l'intervention et de l'approche établies. L'intervention développée reliait plusieurs éléments discrets pour permettre à des dyades intergénérationnelles, composées de personnes âgées (≥ 60 ans) et d'enfants (âgés de 7 à 11 ans), de travailler en collaboration, en utilisant des trackers d'activité (Mi Band 2) pour réaliser des défis de marches virtuelles via la plateforme World Walking. Malgré les limites imposées par la pandémie de COVID-19, il a été clairement établi que : i) les interventions basées sur les stéréotypes liés à l'âge constituent une approche encourageante pour remettre en question les comportements liés à la santé des personnes âgées ; ii) en s'appuyant sur les composantes de la théorie du contact (Allport, 1954), le contact intergénérationnel et la technologie déjà disponible dans le domaine public, peuvent être mêlés de manière innovante pour formuler des stratégies d'intervention visant à modifier les comportements liés à la santé ; iii) le contact intergénérationnel offre des avantages mutuels aux personnes âgées et aux enfants, et iv) l'intervention développée était acceptable, utilisable et potentiellement réalisable pour explorer empiriquement l'impact du contact intergénérationnel, remettre en question les stéréotypes liés à l'âge et affecter positivement les niveaux d'activité physique, le comportement sédentaire et la qualité de vie liée à la santé. En effet, si les représentations de l'âge avancé sont généralement négatives, le contact intergénérationnel offre une possibilité de remettre en question ces croyances et ces comportements.

## Declarations

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed..... [redacted] .....

Date..... 8th July 2021 .....

This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

Signed..... [redacted] .....

Date..... 8th July 2021 .....

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Date..... 8th July 2021 .....

The University's ethical procedures have been followed and, where appropriate, that ethical approval has been granted.

Signed..... [redacted] .....

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## Publications and Presentations

Knight, R.L., Chalabaev, A., McNarry, M.A., Mackintosh, K.A., & Hudson, J. (2021). Do age stereotype-based interventions affect health-related outcomes in older adults? A systematic review and future directions. *British Journal of Health Psychology.* Doi: 10.1111/bjhp.12548

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## Authorship Contribution Statement

The following people and institutions contributed to the publication of work undertaken as part of this thesis:

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**Paper 1:** *Do Age Stereotype-Based Interventions Affect Health-Related Outcomes in Older Adults? A Systematic Review and Future Directions.*

Located in Chapter 3

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Author 2 contributed: Conceptualization; Data curation; Writing – review & editing (7%)
Author 3 contributed: Conceptualization; Writing – review & editing (4%)
Author 4 contributed: Conceptualization; Data curation; Writing – review & editing (5%)

We the undersigned agree with the above stated "proportion of work undertaken" for each of the above published peer-reviewed manuscripts contributing to this thesis:

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## Abbreviations

| | |
|---|---|
| ACSM | American College of Sports Medicine |
| BCT | Behaviour change technique |
| BCW | Behaviour Change Wheel |
| GDPR | General Data Protection Regulation |
| MRC | Medical Research Council |
| MVPA | Moderate-to-vigorous intensity physical activity |
| ONS | Office for National Statistics |
| PRISMA | Preferred Reporting Items for Systematic reviews and Meta-Analysis |
| RCT | Randomised controlled trial |
| TDF | Theoretical Domains Framework |
| WHO | World Health Organisation |
| UK | United Kingdom |
| US | United States |

## Units and Symbols

| | |
|---|---|
| *d* | Cohen's measure of effect size |
| *p* | Probability |
| $\eta^2$ | Eta squared |
| *n* | Number |
| *SD* | Standard deviation |
| $\beta$ | Beta |
| *t* | t-test value |
| *F* | F-ratio |
| *M* | Mean |
| *r* | Pearson's correlation |
| SQRT | Square root |
| % | Percentage |

# Chapter 1

# Introduction

*This thesis explores the impact of facilitating familial intergenerational contact on physical activity, sedentary behaviour, health-related quality of life and stereotypes of ageing in older adults aged ≥ 60 years within 'real-world' settings. It establishes the current evidence base, proposes a theoretical logic model that examines the mediating influence between variables, and, describes the development, feasibility, and piloting of a new technology-driven intervention strategy. Whilst the primary focus of this thesis is older adults, during the development, feasibility, and piloting stages the potential impact and implications for their dyadic partners, children aged 7-11 years old, are also considered.*

*This chapter maps out the core processes, approaches and factors that have influenced and ultimately moulded the thesis. The intervention development process adopted is discussed and presented as an individualised Multi-stage Process Model. The underpinning methodological approach is described, detailing, the research paradigm, design, impact of COVID-19, and, ethical considerations. Finally, the research problem is operationalized, and, the overall purpose and structure of the thesis defined.*

## 1.1 Complex Intervention Development

### 1.1.1 Overview.

The development of complex interventions that positively influence or change health behaviours, their key components, and optimum strategies for their design, subsequent evaluation and implementation remains a topic of debate (O'Cathain et al., 2019a; Sheeran, Klein, & Rothman, 2017). Such interventions normally target several different outcomes, require a change in the behaviour of the recipient or deliverer, and, are comprised of a number of interacting components (Craig, et al., 2008). Multiple approaches and frameworks have been produced to assist and guide researchers with their endeavours. The difficulties associated with the generation of empirical evidence to identify which actions are specifically needed, means that such guidance is however primarily based only on expert opinion (O'Cathain et al., 2019a).

A recent systematic review led to the creation of a taxonomy of eight categories based on the type of approach taken: Partnership; Target Population Centred; Theory and Evidence Based; Implementation Based; Efficiency Based; Stepped or Phased; Intervention Specific; Combination, and, Pragmatic (O'Cathain et al., 2019b). Despite the variety of approaches identified, the most widely cited methods appear to be those driven by evidence and theory, namely: Intervention Mapping (Bartholomew, Parcel, & Kok, 1998); Medical Research Council Framework for developing and evaluating complex interventions (Craig et al., 2008)[1]; Behaviour Change Wheel (Michie, van Stralen, & West, 2011), and, the Theoretical Domains Framework (French et al., 2012). In broad terms, theory is an amassing of a priori assumptions and knowledge about what influences human behaviour and how. It has been more specifically defined as:

> "a set of concepts and/or statements with specification of how phenomena relate to each other. Theory provides an organising description of a system that accounts for what is known and explains and predicts phenomena." (Davis, Campbell, Hildon, Hobbs, & Michie, 2015, p. 327).

[1] It is pertinent to note, a new updated version of the Medical Research Council Framework for developing and evaluating complex interventions has been published (Skivington et al., 2021). However, as this was not available until after the work within this thesis had been completed, reference within the text is made to the revised version of Craig et al. (2008).

### 1.1.2 Theory or no theory?

The necessity of a theoretical underpinning is however one of the aforementioned contentious key components. It is unclear whether interventions developed based on existing theory result in superior levels of effectiveness over those that are not (Dalgetty, Miller, & Dombrowski, 2019). Nonetheless, concluding their review of reviews, Dalgetty et al. (2019), in line with others before them (Michie & Wood, 2015), suggest that given the potential issues with evidence base generation and the plethora of potential reasons for mixed findings (e.g., methodological quality, unclear risk of bias, suboptimal reporting of utilized theory), discounting the value of theoretically driven models is premature. Defining how and why an intervention works is deemed equally as important as establishing its effectiveness (Craig et al., 2008).

A fundamental reason the application of theory is considered an integral step of intervention development (Craig et al., 2008) is the potential opportunity it presents to understand the effect of the 'how' and 'why' or mediating factors/mechanisms of action, and, the 'when' or 'for whom' or moderating factors, on outcome variables of interest (Michie & Abraham, 2004). Mediators can potentially explain any relationship between variables, moderators can alter the strength or direction (Baron & Kelly, 1986). Understanding these relationships through the inclusion of a theoretical framework affords researchers the opportunity to gain an insight into how the causal chain, albeit successfully or not, has been influenced (Bleijenberg et al., 2018). Thus, any subsequent intervention amendments or refinements may have a greater chance of being effective (Davis et al., 2015). As identified by O'Cathain et al. (2019b), five frameworks underpin their approach with the integration of existing evidence and theory. Each has their own set of core components, benefits, limitations, and ideal situations for application.

#### *1.1.2.1 Intervention Mapping.*

An iterative yet also cumulative six step protocol, Intervention Mapping provides a framework with which to select and apply theory and implement change strategies (Bartholomew et al., 1998; Bartholomew et al., 2016). Advocating the use of multiple rather than a single theory, this approach aims to assist the solving of practical real-world problems (Kok, Schaalma, Ruiter, van Empelen, & Brug, 2004). Encompassing the stages of problem identification through to solution, the comprehensive step-wise

pathway uses the findings of one step as the basis for the next and involves: the construction of a logic model of the problem - including a needs assessment, context description and goal formation; identification of programme outcomes and objectives – including the creation of a logic model of change; programme design - including the selection of theoretically-based methods of change and an intervention delivery strategy; programme production – including structure refinement, material development and piloting; programme implementation planning – including identification of long-term users, and, evaluation planning (Bartholomew et al., 2016).

#### *1.1.2.2 Medical Research Council Framework.*

Cited as one of the most influential sets of guidelines (O'Cathain et al., 2019a), the Medical Research Council (MRC) guidance on developing and evaluating complex interventions, more specifically the revised version (Craig et al., 2008) proposes four key stages: Development; Feasibility/Piloting; Evaluation, and Implementation. Stage one – Development: split into three sub-components: establishment of the existing evidence base; identification of a theoretical underpinning, and, modelling the potential interactions between processes and outcomes with or without an economic evaluation, each component focuses on optimising intervention design. Stage two - Feasibility/Piloting: providing vital information on areas including acceptability, usability, functionality, recruitment and retention, effect and sample sizes, this stage is deemed crucial to guiding design and delivery modifications that could increase the probability of intervention success. Stage three – Evaluation: influenced by the results of prior stages, at this point researchers progress to assessing effectiveness and the impact on specific outcome measures through appropriately scaled experimental or non-experimental studies. Further considerations include the need for process evaluation to explore factors such as how and/or why the intervention was successful or not and whether it was fully delivered as intended. Stage four – Implementation: the final stage of this iterative process concludes with the reporting of results to stakeholders and where applicable, the long-term follow-up and monitoring of the measured outcomes to further establish effectiveness and the potential for translation into wider practices.

#### *1.1.2.3 Behaviour Change Wheel.*

The systematic synthesis of theory and evidence from 19 previously published intervention development frameworks culminated in the production of the Behaviour Change Wheel (BCW; Michie et al., 2011). Nine intervention functions: Education; Persuasion; Incentivisation; Coercion; Training; Restriction; Environmental restructuring; Modelling; Enablement, and, seven policy categories: Communication/marketing; Guidelines; Fiscal; Regulation; Legislation; Environmental/social planning; Service provision were identified. Central to the BCW is its own theoretical position, the COM-B model (Michie et al., 2011); its role being to facilitate the determination of what parameters need to be addressed to enable an individual to change the targeted behaviour. The COM-B postulates that at least one of three areas should be targeted: capability, opportunity, or motivation (Michie, Atkins, & West, 2014).

The BCW intervention design framework, an eight-step process, primarily parallels in greater detail, stage one of the MRC guidelines and steps two and three of Intervention Mapping (Michie et al., 2014). Steps one to four focus on the definition, selection, and specification of the target behaviour, collectively termed establishing a behavioural diagnosis. Having determined what needs to change, through steps five and six, researchers progress to identifying the most appropriate and potentially influential intervention functions and policy categories. Specific behaviour change techniques (BCTs) from a taxonomy of 93 (Michie et al., 2013: discussed further in Chapter 4, section 4.9) are mapped onto the intervention functions in step seven. Finally, step eight culminates with the determination of one or more appropriate modes of delivery (Michie et al., 2014). It is noted that the capacity to change policy may not always be possible and hence only the selection of intervention functions may be necessary.

#### *1.1.2.4 Theoretical Domains Framework.*

Using a multi-stage approach, an expert consensus group identified and synthesised 33 theories and 128 theoretical constructs into 12 distinct domains (Michie et al., 2005). This provided the format for the original Theoretical Domains Framework (TDF), developed to explore the influences on the implementation of evidence-based guidelines by health professionals (Atkins et al., 2017). In 2012, the TDF was refined,

producing a finalised framework containing 14 domains and 84 constructs. With the domains *Nature of behaviour removed*, *Optimism and Reinforcement added, and Motivations and goals split into separated Intentions and Goals domains*, the finalised framework consisted of: Knowledge; Skills; Memory, attention and decision processes; Behavioural regulation; Social influences; Environmental context and resources; Social/Professional role and identity; Beliefs about capabilities; Optimism; Beliefs about consequences; Intentions; Goals; Reinforcement, and, Emotions (Cane, Connor, & Michie., 2012). The use of the TDF has subsequently been extended and it is now primarily used within the intervention development phase to identify potential barriers and facilitators to change and enhance the tailoring and implementation of the intervention to the target population (Atkins et al., 2017).

In order to enhance the usability of the framework, Atkins et al. (2017) produced formal guidance on its optimal application. The authors detail a series of seven primarily qualitative methodological stages: selection and specification of the target behaviour(s); selection of the study design; development of study materials; sampling strategy; collection of data; data analysis, and, reporting of findings. Whilst the TDF can be used as a tool to direct researchers towards other frameworks and pertinent theories, it is frequently used in combination with the COM-B model as part of step four of the BCW, and, has more recently been integrated as an optional additional layer.

#### *1.1.2.5 Normalisation Process Theory.*

Taking a different approach to the use of theory, rather than advocating the selection of a specific theory or theories to facilitate change within the intervention development process, Murray et al. (2010) use Normalisation Process Theory (May et al., 2009; May & Finch, 2009) as the foundation for their framework. The authors recognise that there are often translational difficulties between laboratory work and the real-world. This framework advocates the consideration of implementation from the perspective of participants – both service users and those who would ultimately be delivering an intervention during a trial and long-term. From inception, the major focus of this approach is understanding what factors could, or would, potentially inhibit or promote the future implementation of experimentally successful interventions into

clinical or health promotion practices (Murray et al., 2010). The apparent overall aim being to embed interventions to the point that they become 'normal' practice.

Normalisation Process Theory contains four core components identified to assist with 'normalisation': Coherence; Cognitive participation; Collective action, and, Reflexive monitoring (May & Finch, 2009). The framework uses these components to ensure that at each stage of intervention development (defining context, designing, and analysing the intervention), and evaluation prior to proceeding to trialling (defining context and trial parameters, considering all groups likely to be affected, analysing trial parameters) a number of factors are considered. These are that everything makes sense, all participants (both service users and deliverers) are engaged and support the process, the work that participants will need to do and what needs to be done to support this has been considered, and, finally that the perceptions of benefit, an appraisal of the intervention and feedback systems are implemented and regularly reviewed (Murray et al., 2010).

### 1.1.3 Multi-stage Process Model.

Whilst no model, framework or indeed theory will provide a best fit for all situations or guarantee success, their incorporation provides users with a systematic approach that has previously been implemented and deemed useful (O'Cathain et al., 2019b). As all approaches ultimately target the same outcome, behaviour change, many do significantly overlap, containing the same or very similar principles and actions.

The intention of this thesis is to explore the interlinking of several discrete elements using an intervention approach supported by technology-based components readily available within the public domain. Accounting for this, the factors discussed above and the boundaries of the PhD, an individualised iterative Multi-stage Process Model was constructed. Focusing on the primary phases of development, feasibility and piloting, the framework, as detailed in Figure 1.1, is based on the first two phases of the MRC guidance (Craig et al., 2008), and, enhanced with additional elements proposed to enrich the efficacy and transparency of the developmental phase (Bleijenberg et al., 2018; O'Cathain et al., 2019a) namely: problem operationalization, needs determination, component mapping against the BCT taxonomy (Michie et al., 2013), and, intervention refinement.

| Stage | | Process |
|---|---|---|
| Development | 1 | Operationalize the problem |
| | 2 | Determine needs/context/environmental and external factors |
| | 3 | Review evidence base |
| | 4 | Primary theory identification |
| | 5 | Intervention design (Including mapping of BCTs) |
| | 6 | Confirmation of theoretical approach |
| | 7 | Modelling of process and outcomes |
| Feasibility & Piloting | 8 | Testing procedures |
| | 9 | Estimating recruitment and retention |
| | 10 | Refinement of the intervention |

*Figure 1.1.* Multi-stage Process Model

*Note*. BCTs = behaviour change techniques

Given the complexities of real-world research it would be naïve to ignore the potential impact of external factors on the effectiveness, acceptability, and long-term adoption of interventions. This could be on an individual level, that is, from potential participants, or a wider level, based on pre-defined research parameters or constraints (Craig, Di Ruggiero, Frohlich, Mykhalovskiy, & White, 2018). Moore and Evans (2017) suggest that interventions should not be viewed as discrete component packages without due consideration of context and environmental factors, sentiments echoed within the Normalisation Process Theory framework (Murray et al., 2010), therefore an assessment of these parameters has also been incorporated.

## 1.2 Methodology

### 1.2.1 Research paradigm.

The theoretical lens and philosophical position adopted by a researcher can have a fundamental impact on their research standpoint. Providing an insight into how reality is viewed, knowledge is deemed to be produced, and the impact that an individual's background could have on their observations, interpretations and relationships with

others is therefore vital (Gill, 2011; Guba & Lincoln, 1994). Having a clinical background as a physiotherapist, I am bestowed with a prior knowledge of physical activity intervention application with older adults in real-world settings. This experience potentially had an inherent, although not straightforward, impact on my underpinning paradigms and chosen research approach.

Driven by my prior experiences, personality traits that seek structure, and an underlying desire for the relative or definitive truths that historically direct evidence-based medicine, a post-positivistic epistemological position was taken throughout this research. However, this reality was viewed through a critical realist lens, acknowledging that the 'real-world' potentially sits behind subjective and social complexities that shape a truth (Madill, Jordan, & Shirley, 2000). Consequently, in reality, truth may involve error and modifications, and, can either never be an absolute certainty or, can only be explained within the specific context that it has been explored (Trochim & Donnelly, 2008).

### 1.2.2 Research design.

A sequential multi-method approach was adopted. The findings and results from each individual study were evaluated consecutively, not iteratively, and utilized to guide and optimise the succeeding research process and methodological choices. Where qualitative methods were employed, they have been underpinned by post-positivistic principles, structure, and a degree of objectivity. Thus, criteriological-based measures were implemented to limit the impact of researcher bias and subjectivity (Burke, 2017).

The validity of using or mixing different methodologies and methods to form effective research strategies has been extensively debated (for example, Lincoln, 2010; Whaley & Krane, 2011). Concerns regarding research becoming misinformed if epistemological and ontological assumptions are unclear or detached from methodologies are noted (Denzin, 2010). However, it is now acknowledged that researchers can choose to utilize a range of methods without changing their philosophical stance, as long as they remain mindful that not all combinations are compatible (Sparkes, 2015). When mixing methods, or using a multi-method approach, Sparkes (2015) infers that what should potentially be deemed of paramount importance is the coherence of the research, and the purpose and justification for the use of each

different method. The specific methods for each individual study within this thesis are outlined in detail within their corresponding Chapters, 3, 5, 6, and 7.

### 1.2.3 Impact of COVID-19.

Describing everyday life and the way that knowledge is presented or derived, is rarely straightforward, therefore it has been suggested that researchers (particularly using qualitative methods) have to accept complexity (Gubrium & Holstein, 1997) and adopt a degree of flexibility in their designs (Sparkes & Smith, 2014). Whilst not inherently advocated within the boundaries of quantitative methods, in unprecedented situations the external influence of the real-world can make an unforeseen change of methods within or between methodologies unavoidable and an absolute necessity if a study is to continue.

Within this thesis, the global health pandemic and essential imposed restrictions on daily life had a significant impact on the progression and viability of Study 3 at a crucial point during recruitment. The subsequent changes implemented were at no point viewed as a devaluation, rather they were positively embraced as a true reflection of critical realism, the complexities of real-world research and an opportunity to explore the application of alternative ways to answer the research question. Whilst some could argue this involves a degree of pragmatism, the researcher at all points maintained a post-positivistic stance, incorporating albeit partially retrospectively, the guidance of structured objectively driven implementation and analytic frameworks where available and appropriate.

### 1.2.4 Ethical considerations.

Approvals, where required, were obtained from the College of Engineering Research Ethics Committee, Swansea University. At all points during the research process due diligence was observed regarding the principles of non-maleficence, autonomy, beneficence, and justice. These principles were particularly pertinent given the unforeseen considerations relating to COVID-19. Additional ethical advice, guidance and approvals were requested when needed, and adhered to in line with the wider implemented University Policies, Local and National Government guidance.

## 1.3 Operationalization of the Problem

### 1.3.1 Physical activity, sedentary behaviour, health, and ageing.

The trajectory through life that determines healthy ageing is influenced by many factors. It is widely acknowledged that being physically active and engaging with exercise are effective strategies to increase longevity, decrease morbidity and help adults advancing through life both with and without chronic conditions, maintain the highest quality of life attainable (Chodzko-Zajko et al., 2009; Department of Health and Social Care, 2019; DiPietro et al., 2019). Multiple constructs potentially impact the acceptability of physical activity to older adults and their subsequent participation levels. Social interaction, ease of access, the need for enjoyment, personal - not necessarily health-related - intrinsic benefits and the diversity and range of observed physical function in older age all have demonstrated importance (Boulton, Horne, & Todd, 2018; Devereux-Fitzgerald, Powell, Dewhurst, & French, 2016; World Health Organisation [WHO], 2015).

More recently, sedentary behaviour has been identified as an additional, distinct risk to the health of older adults (De Rezende, Rodrigues Lopes, Rey- López, Matsudo, & Luiz, 2014). It is suggested that merely breaking up prolonged sedentary time periods (i.e., sitting) has the potential to provide benefits independent to those achievable through physical activity and exercise (Sardinha, Santos, Silva, Bapitista, & Owen, 2015). Intervention research within this field is in its relative infancy. Whilst targeting reductions in sedentary time has been deemed feasible, optimal dose-response, intervention approach (e.g., a specifically targeted approach versus aiming to reduce sedentary time through physical activity), and the long-term benefits are yet to be determined (Copeland et al., 2017; McCorry, Murphy, Bleakley, & Mair, 2018).

Whilst conventionally, sedentary time and physical activity were suggested to represent independent risk factors, more recent research has suggested that these factors may interact to determine all-cause mortality. Specifically, Ekelund et al. (2016) reported that high levels of physical activity (60-75 minutes/day) mitigated the risk of high sitting times, whilst Stamatakis et al. (2019) suggested that such extreme levels of physical activity were not required, reporting that meeting the physical activity guidelines was sufficient to attenuate, or potentially eliminate, the deleterious effects of prolonged sitting. This remains a contentious area, and, this research does not

specifically focus on the interactive effects in older adults, for whom it may be hypothesised that the relatively high time spent sedentary may make the level of physical activity required to compensate unlikely/infeasible.

When promoting health behaviours with older adults, the direct transference of albeit successful strategies and techniques employed with younger adults, may prove ineffective (French, Olander, Chisholm, & McSharry, 2014). Tailored, population-specific approaches are needed, and several promising concepts are actively being researched. These include challenging age stereotypes, the identification and application of age specific BCTs, the incorporation of technology, and, intergenerational contact. However, which intervention implementation method, or combination of components is the most effective, how to achieve consistent, sustained engagement patterns and behavioural changes, whilst embracing the often diverse and complex needs of older adults, remains undetermined (Drury, Abrams, & Swift, 2017).

### 1.3.2 Targeting change.

#### *1.3.2.1 Challenging stereotypes of ageing.*

Routinely presented as generalised assumptions and negative depictions of later life, for instance, ill health, increased dependency, decreased functional ability (Ory, Hoffman, Hawkins, Sanner, & Mockenhaupt, 2003), age stereotypes frequently inhibit opportunities for social interaction, influence attitudes towards, and the self-perceptions of, older adults (Popham & Hess, 2015; WHO, 2015). Moreover, studies have demonstrated an association between age stereotypes, physical and cognitive function (e.g., Barber, Mather, & Gatz, 2015; Chiviacowsky, Cardozo, & Chalabaev, 2018; Haslam, Morton, Haslam, Varnes, Graham, & Gamaz, 2012; Swift, Lamont, & Abrams, 2012), and overall long-term engagement with health behaviours (Levy & Myers, 2004).

For older adults, the impact of stereotypes is complex and potentially multifactorial. Émile et al. (2014) conducted a questionnaire-based study with 192 older adults (aged 60–93 years). They concluded that openness to experiences, attitudes towards their own ability to exercise and self-perceptions of ageing may be important factors in physical activity engagement, whilst Coudin and Alexopoulos (2010) suggest that negative stereotypes affect self-evaluation and function subsequently leading to increased dependency. It is proposed that older adults may attempt to avoid reaffirming

negative stereotypes by disengaging and removing themselves from potentially threatening activities and situations, subsequently leading to said increased dependency.

Whilst it may already be justifiable to conclude that negative age stereotypes and self-perceptions of ageing have extensive detrimental implications for the health and well-being of older adults, the impact of positively manipulating these stereotypes to enhance health behaviours remains unclear (Kotter- Grühn, 2015; Westerhof et al., 2014). The addition or incorporation of strategies that aim to reduce the impact of stereotype threat, and/or challenge views-on-ageing could therefore prove to be a vital component of successful behaviour change interventions.

#### *1.3.2.2 The potential role of technology and social support.*

Physical activity participation now often involves engaging with technology (e.g., activity monitors, exercise equipment). When this is the case, opinions on participation could be culturally and historically situated as well as individually interpreted, and, affected by the potential vast variability in human nature, past experiences and various external factors that could impact on behaviour and lifestyle choices. Indeed, it has been suggested that:

> "behaviour is often conditioned by people's social circumstances, the opportunities and choices available to them" (Hussey, 2013, p. 9).

Research indicates that multiple forms of technology-based interventions including web-based platforms, exercise gaming, wearable monitors, SMS text messaging and smartphone apps are in fact deemed to be both feasible and acceptable intervention methods for mid and older adults (Ammann, Vandelanotte, de Vries, & Mummery, 2013; King et al., 2013; Muller, Khoo, & Morris, 2016; Lyons, Swartz, Lewis, Martinez, & Jennings, 2017).

The participatory needs of older adults related to technology use were explored by De Angeli et al. (2016) using semi-structured interviews with 18 older adults (aged 60–102 years), 10 in Italy and 8 in the United Kingdom (UK). They reported that whilst the effects of ageing and increasing physical decline were identified as an important

concept, the ageing process was not necessarily negatively perceived, and, family members often influenced choices not only with regards to technology use but also choice of, and participation in, physical activities. They conclude that there is a need to design interventions that increase self-efficacy, are led by enjoyment, and foster independent active habits. Nevertheless, it is apparent that whilst technology-based interventions could provide the basis for effective strategies targeting physical activity, the inclusion of family members, or other intergenerational components, could increase their appeal and ultimately success.

#### *1.3.2.3 Intergenerational and intergroup contact.*

Familial or intergenerational contact, either informally within the boundaries of daily life or through structured interventions has been linked to positive health and well-being benefits for older adults (Kirchengast & Haslinger, 2015; Sakurai et al., 2016; Tsai, Motamed, & Rougemont, 2013). Merely having a greater frequency of contact with grandchildren every month has been shown to have a significant impact on health-related quality of life (Kirchengast & Haslinger, 2015). With regard to physical activity, benefits across generations are suggested to stem from the motivation that may evolve from social support and the given potential to set and work on joint goals (Granacher, Muehlbauer, Gollhofer, Kressig, & Zahner, 2011).

Traditionally, the effects of intergroup contact (Pettigrew, 1998) have been explored via direct face-to-face interactions. However, advances in technology allow the impact of alternative options to be considered. The facilitation of contact virtually via the internet (Amichai-Hamburger & McKenna, 2006), for example by email or Facebook, have resulted in positive effects on cultural prejudices (Schwab, Sagiogoglou, & Greitemeyer, 2018; Tavakoli, Hatami, & Thorngate, 2010). When systematically reviewing the effectiveness of intergenerational programmes, Canedo-García, García-Sánchez, and Pacheco-Sanz (2017) noted that virtual approaches present an under-represented and researched opportunity to improve efficacy and break down barriers to inclusion and communication.

#### *1.3.2.4 Age stereotypes, intergenerational contact, and technology.*

Prior research indicates a link between intergenerational contact and stereotypes of ageing for both older adults and children (Abrams et al., 2008; Popham & Hess, 2015). Effects are primarily thought to stem from the occurrence of reductions in stereotype threat and/or the concurrent activation of positive upward social comparison and stereotype boost that subsequently impact views-on-ageing (Lamont, Swift, & Abrams, 2015). In children, intergenerational contact may additionally assist with the prevention of stereotype embodiment, thus potentially leading to long-term influences on perceptions of ageing and health and well-being (Popham & Hess, 2015).

The impact of stereotype threat on maths performance relative to positive prior contact with grandchildren was explored in 51 older adults (aged 58-84 years) by Abrams et al. (2008). Their results indicate that both level of stereotype threat, and prior contact had significant effects on performance, with changes to anxiety levels having a separate mediating effect. Whilst acknowledging that in reality intergenerational contact is often difficult to achieve, they conclude that it could still prove to be highly effective. Using technology as a platform to facilitate the removal of barriers, and, increase opportunities for contact, may therefore present a viable solution.

Appropriate research endeavours are key to ensuring the development of health-related schemes, interventions and professional practices that effectively challenge the pervasive view that declines in physical and psychological function are an inevitable consequence of the ageing process (Ory et al., 2003). Understanding which age stereotype constructs and manipulations, BCTs and intervention delivery formats evoke and sustain the greatest changes in the health behaviours of older adults could prove to be of paramount importance, affording the question: How do we effectively target physical activity levels, sedentary behaviour, stereotypes of ageing and health-related quality of life in older adults, in real-world settings?

## 1.4 Purpose of the Thesis

### 1.4.1 Aim.

The overall aim of this research was to develop and explore the potential impact of a familial intergenerational technology-driven intervention on physical activity levels, sedentary behaviour, health-related quality of life, and stereotypes of ageing in older adults aged ≥ 60 years old, in a real-world setting.

### 1.4.2 Objectives.

Whilst each study within the thesis has its own specifically identified objectives, cumulatively it endeavours to address the following over-arching objectives:

1. To understand the current position of literature that assesses the effects of age stereotype-based interventions on health-related variables in older adults.
2. To identify how intergenerational contact, technology and challenging stereotypes of ageing could be interlinked to formulate an intervention strategy.
3. To develop an intergenerational technology-driven intervention underpinned by a theoretical framework and technology-based components that are readily available within the public domain.
4. To test the acceptability, useability, functionality, and study parameters of the intervention from the perspective of both the older adults aged ≥ 60 years old and their dyadic partners, familial children aged 7–11 years old, through progressive feasibility and piloting studies to refine the intervention.
5. To investigate, in adults aged ≥ 60 years old, what effects a familial intergenerational technology-driven physical activity intervention undertaken in a real-world setting has on physical activity (primary outcome), sedentary time/behaviour, health-related quality of life, and, stereotypes of ageing.
6. To explore the potential secondary effects of participating in a familial intergenerational technology-driven physical activity intervention on the physical activity levels and perceptions of ageing of children aged 7-11 years.

7. To examine in older adults if, a change in views-on-ageing, self-perceptions of ageing or stereotype threat could potentially influence the impact of the intervention on physical activity levels, or, conversely, whether a change in health status or health behaviour (health-related quality of life, physical activity, sedentarism) could influence change in stereotypes of ageing.

### 1.4.3 Thesis structure.

Following the stages of the constructed process model outlined in Figure 1.1, Chapter 2 presents an assessment of needs, a critique of existing literature related to health behaviours and/or factors associated with physical activity participation, sedentary behaviour, and stereotypes of ageing in older adults including: motivational influencers, technology, and intergenerational contact. The literature review element is further built on in Chapter 3, with the results of Study 1, a systematic review entitled: '*Do Age Stereotype-Based Interventions Affect Health-Related Outcomes in Older Adults? A Systematic Review and Future Directions.*'

Chapter 4 describes how the intervention was defined and designed including the identification of relevant theories, frameworks, models, and 'real-world' components, mapping of the incorporated BCTs, and modelling of the potential processes and outcomes. The testing and refinement of the intervention is presented in Chapters 5 (Study 2), 6 and 7 (Study 3). Chapter 6 additionally discusses the impact that COVID-19 had on the research, and, the merits of case studies as research. Study 3 subsequently concludes as a case study in Chapter 7. Finally, an overall discussion including the contribution to the knowledgebase, implications, limitations, and directions for future research is presented in Chapter 8, with a reflective epilogue of the PhD journey narrated in Chapter 9.

# Chapter 2

## Current Position

*The UK guidelines for older adults currently recommend at least 150 minutes per week of moderate-intensity physical activity and/or 75 minutes of vigorous-intensity physical activity, and that this should include multi-component strength and functional-balance training aimed at falls prevention on at least two days per week (Department of Health and Social Care, 2019). However, an update by the WHO (2020) recommends that all adults engage in at least 150 to 300 minutes of moderate-intensity physical activity, or 75 to 100 minutes of vigorous-intensity physical activity, or indeed an equivalent combination of moderate-to-vigorous physical activity (MVPA), throughout the week. Both guidelines now also include advice to minimise and break up periods of prolonged sedentary time (Department of Health and Social Care, 2019; WHO, 2020). This chapter commences with a determination of the need to explore and develop new intervention strategies that target physical activity and sedentary behaviour in the older adult population. Population ageing statistics are reviewed on both a global and national level, along with the associated trends for physical activity and sedentary behaviour. The subsequent impact on an individual and societal level are discussed. A comprehensive review of the literature, focused on the discrete elements being considered within this PhD, is then presented. Factors that influence physical activity and sedentary behaviour are discussed along with the potential impact of stereotypes of ageing on health-related outcomes. The concept, application, and potential role of intergenerational contact is outlined and the potential position for technology as an integral driver of the impending intervention development established.*

## 2.1 Determination of Need

### 2.1.1 Global ageing, health, physical activity, and sedentary behaviour.

The world's population is ageing. By 2030, it is predicted that approximately 25% - 30% of individuals will be at least 65 years old (Mamolo & Scherbov, 2009). Despite globally reported statistics indicating that average life expectancy is continuing to increase, between 10% and 13% of life years are still lived in poor health (WHO, 2019a). The consistent engagement of older adults with behaviours that are known to positively influence physical and mental health, such as physical activity, provides one of the biggest challenges of the modern world (Forberger et al., 2017). Indeed, older adults remain one of the least active segments of the population, with 60% of adults aged 65 years and older not reaching adequate physical activity levels worldwide and 55% of adults aged 60 years and older sitting for at least four hours per day (Hallal et al., 2012)[2].

Physical inactivity is the fourth leading risk factor for non-communicable diseases (WHO, 2019b) predicted to account for over five million preventable deaths per year (Ding et al., 2016). Higher levels of physical inactivity and sedentary behaviour are linked to poor health outcomes in older adults (with and without chronic health conditions), all-cause mortality, cardiovascular disease and cancer mortality, and incidence of cardiovascular disease, cancer, and type II diabetes (WHO, 2020). Evidence for the role of physical activity within both the primary and secondary prevention of such diseases has been deemed irrefutable (Warburton, Nicol, & Bredin, 2006). Moreover, relative to quality of life, being physically active is also related to improved bone health and therefore a lower risk of osteoporosis, decreased risk of falls, and a decreased risk of age-related loss of cognitive and physical function (Bauman et al., 2016). However, the global pattern of burden is complicated, whilst physical inactivity increases with age across all of the WHO classified regions, in South-East Asia, older adults were found to not only be more active than their age-matched compatriots but also younger adults (aged 15–29 years) from all other comparable regions (Hallal et al., 2012). Additionally, within-region variations can be substantial. For example, in Europe, where 12.5% of individuals aged 55 years or older, reportedly participate in no MVPA, prevalence ranges from 4.9% (Sweden) to 29% (Portugal; Gomes et al., 2017).

[2] Data from 122 countries for physical activity and 66 countries for sedentary behaviour

It is pertinent to note, there are currently no global estimates of sedentary behaviour for older adults aged 65 or above. Difficulties extrapolating data are cited due a lack of upper age limit in the majority of studies (WHO, 2020). Whilst research regarding the new risk to non-communicable diseases imposed by sedentary behaviour, specifically for older adults, is still in its relative infancy, associations have been reported between sitting time and all-cause mortality, metabolic syndrome, waist circumference (De Rezende et al., 2014) and the presence of biomarkers of ageing (Sjögren et al., 2014). In a randomised control trial (RCT), Sjögren et al. (2014) concluded that reductions in sitting time, not just increased physical activity, but could contribute to the lengthening of telomeres (components of blood cells associated with longevity), in sedentary, overweight older adults ($p = 0.02$, $\eta^2 = 0.28$), however their population sample was small ($n = 49$) increasing the risk that the finding occurred by chance.

### 2.1.2 National trends.

Within the UK, the overall population is continuing to grow ($n = 66.8$ million in 2019), the rate of growth is however, the slowest it has been for 15 years (Office for National Statistics [ONS], 2020). Between 2009 and 2019 the number of people aged 65 or over increased by 22.9% to 12.4 million, with those aged 85 or over increasing by 23% to 1.6 million (ONS, 2020). In Wales, circa 1.3% of the population is currently aged 60 or over, with the fastest growing segment of the population being aged 65 years or over (ONS, 2020). Of the four constituent UK Countries, it has the highest proportion of people aged ≥ 65 years, a figure predicted to raise to 26% of the total population by 2035 (ONS, 2012). The National Survey for Wales 2019-2020 (Welsh Government, 2020) reported that only 43% of adults aged ≥ 65 years were active at a moderate intensity for at least 150 minutes per week, moreover, of concern is that 42% were active at that level for *less than* 30 minutes per week, potentially indicating high amounts of sedentary time. No significant changes were observed in this data from that collated for the 2016-2017 time period.

### 2.1.3 Economic impact.

The estimated cost of physical inactivity has previously been conservatively estimated to cost health-care systems US$ 53.8 billion worldwide per annum, with an

additional predicted loss of 13.4 million daily adjusted life years (Ding et al., 2016). From the data used in this review, this cost was equated to £1.2 billion within the UK (British Heart Foundation, 2017), an increase of £0.3 billion from previous estimations (Scarborough et al., 2011). Whilst it is not possible to relate this data directly to older adults, given the aforementioned correlations between advancing age, physical activity and risk of having, or developing a chronic condition, the potential economic implications of effectively tackling physical inactivity could be substantial. For example, when reviewing population attributed risks, Lee et al. (2012) estimated that, on a global scale, if the entire population became physically active, 7% of the financial burden from type II diabetes, and 6% from coronary heart disease could be avoided. Given that for coronary heart disease the cost per annum to the UK economy is circa £7.8 billion, with £1.8 billion directly attributable to healthcare costs[3] (Wilkins et al., 2017), this alone could save the National Health Service approximately £108 million every year.

#### 2.1.4 Summary.

Physical inactivity and leading a sedentary life can have a range of negative health consequences. Changing trends in these behaviours, particularly for older adults, is therefore of paramount importance. The majority of data on physical activity and sedentary behaviour is self-report. Although this is a common and established method of collecting vast amounts of population-level information, it can be inherently problematic. Compared to objective measurements (i.e., accelerometry), the potential for over-reporting could be between 36% – 173% (Lee, Macfarlane, Lam, & Stewart, 2011). Indeed, this means that the trends identified could be worse than predicted.

## 2.2 Literature Review

### 2.2.1 Being active: What drives older adults?

Combatting physical inactivity and promoting health behaviours in older adults requires the development of behavioural interventions that can effectively promote healthy habits. One problem is that many behaviour change techniques that are commonly used for younger adults, such as goal setting, self-monitoring, planning, or

[3] Based on 2015 data

providing feedback, are not effective for older adults (for a review see French et al., 2014; discussed further Chapter 4, section 4.9). This is due, at least in part, to older adults having certain distinct, population-specific, motivational barriers. For example, in the physical domain, where factors such as cost, or conflicting priorities/time, may apply across the whole adult population (Franco et al., 2015; Sequeira, Cruz, Pinto, Santos, & Marques, 2011), older adults often report health or physical limitations, and fear of injury as specific barriers to physical activity (Baert, Gorus, Mets, Geerts, & Bautmans, 2011; Boulton et al., 2018; Devereux-Fitzgerald et al., 2016).

Rather than viewing physical activity as a distinct process, from the meta-synthesis of 10 qualitative studies that considered the acceptability of physical activity, it has been proposed that older adults often construe it as being undertaken as a by-product of other activities (McGowan, Devereux-Fitzgerald, Powell, & French, 2018). This leads to questions over its perceived purpose and relevance. The authors conclude that targeting reductions in sedentary behaviour, or increases in lower intensity physical activity, may therefore prove to be more effective than traditional MVPA approaches. Adopting these strategies could also limit the impact of any health or injury related barriers.

Broderick, MuCullagh, White, Savage, and Timmons (2015) recruited 29 frail older adults who were participating in a larger exercise intervention trial during an acute hospital admission and interviewed them to gain an understanding of factors that influenced their exercise behaviour. Thematic analysis identified a link between exercise being akin with purposeful activities, therefore function, rather than fitness, could also be a key driver for this population. Another core theme from this study was social support. However, interpretation of this finding is complex. Whilst in general, participants associated their family members with being motivational, others saw them as a barrier who limited household routines and sometimes actively discouraged exercise. Limited access to non-familial social contact was also a perceived barrier. The validity of these findings is enhanced by the reflexive approach to the research reported by the authors, and the implementation of strategies to decrease researcher bias.

The role of social support is a theme that threads through several other studies (Becofsky, Baruth, & Wilcox, 2014; Flogel et al., 2015; Gomes et al., 2017; Victor et al., 2016). At an 18-month follow-up, a subset of 24 older adults (mean age 65 years, *SD* =

8.79) shared their views of a previously completed four-month physical activity intervention, and factors that affected their ability to sustain any positive effects (Flogel et al., 2015). A mixed methods analysis revealed that during the intervention period, both those who remained active, and became inactive, valued the support provided from the mentor and peer group, and that those who managed to stay active, reported significantly more ongoing support from family and friends. Similarly, Victor et al. (2016) found that the majority of the participants (mean age 68 years, range 61-75), who increased their step-counts and time spent in MVPA during a 12-month walking intervention, participated as a couple, or had someone else to walk with, whereas non-improvers noted the limitations of a lack of social support.

Additional motivational facilitators were identified in a qualitative study that aimed to develop a socioecological approach to physical activity in older adults. Boulton et al. (2018) explored the views and experiences of 60 community-dwelling adults aged 50–87 years. From a series of semi-structured interviews and focus groups they concluded that a range of appealing, accessible, and appropriately targeted activities are needed that are enjoyable and have a social focus. These findings were comparable to those of a prior systematic review and meta-synthesis of 14 papers that had explored the physical activity experiences of older adults aged ≥ 65 years (Devereux-Fitzgerald et al., 2016). Also highlighted within this analysis is that participation could, to a degree, be driven by intrinsic benefits, but that this does not include potential health-related gains.

Evidence regarding the impact of interventions that target reductions in sedentary behaviour specifically in older adults is limited. However, there is some suggestion that explicitly focusing on endeavouring to reduce sitting time, could be both effective, and acceptable (Fitzsimons et al., 2013, Lewis et al., 2016, Rosenberg et al., 2015; White et al., 2017). With regard to motivational barriers, and indeed facilitators, preliminary studies suggest a remarkably similar pattern of factors to those that are known to influence physical activity. Physical health, environmental factors, being negatively stereotyped, and social perceptions of the need to rest, were identified as key barriers (Chastin, Fitzpatrick, Andrews, and DiCroce, 2014), as were a lack of motivation, financial constraints, and a lack of resources (McEwan, Tam-Seto, & Dogra, 2017). Subsequent work from McGowan, Powell, and French (2019) noted motivational

themes structured around enjoyment, feeling a sense of achievement, and opportunities to socialise. It is pertinent to note that the participant sample of McGowan et al. (2019), although targeting those with diverse socio-economic backgrounds, was predominantly British Caucasian, limiting generalisability, and that Chastin et al. (2014) failed to record and transcribe the interviews they conducted with 11 older women meaning that no data extracts were available. Whilst notes taken during the interviews were reviewed by the participants for accuracy, their results lack transparency.

Finally, it is important to consider the perceived negativity associated with labelling (Boulton et al., 2018). Parameters often imposed by society to define situations when individuals have entered older adulthood (i.e., over 60's swimming), are often viewed as engagement inhibitors, despite their underpinning goal being to increase opportunity. Indeed, it has been suggested that the motivational barriers of older adults may be partially subjective and result from the influence of *age stereotypes* (Levy, 2009), therefore, such well-meaning intentions could end up in some instances, being inherently detrimental.

### 2.2.2 Stereotypes of ageing: Health implications for older adults.

As previously defined in Chapter 1, age stereotypes are characteristics, generalisations, or assumptions about how a group of individuals are viewed and how they should behave (Ory et al., 2003). They are often negative depictions of later life (e.g., ill health, decreased functional ability, increased dependency). Importantly, longitudinal prospective studies show that age stereotypes are associated with older adults' physical and functional health (Levy, Slade, & Kasl, 2002; Wurm, Tomasik, & Tesch-Römer, 2010), and longevity (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009), notably, by negatively predicting their long-term engagement with health behaviours (Levy & Myers, 2004), or limiting declines in function (Sargent-Cox, Anstey, and Luszez, 2012). Indeed, such optimistic views regarding the overall ageing process (views-on-ageing) and on an individual/personal level (self-perceptions of ageing) have both demonstrated positive health benefits.

Levy and Myers (2004) found that in a subset of 241 participants (aged 50-80 years), from the Ohio Longitudinal Study of Ageing and Retirement, those with more positive self-perceptions of ageing at baseline (20 years prior) adopted more beneficial

health behaviours in later life (e.g., physical activity, healthy diet, compliance with medical prescriptions), than those with negative perceptions. Additionally, Sargent-Cox et al. (2012) when following 1,212 participants aged ≥ 65 years old, at five time-points over a 16-year period, found that more positive self-perceptions of ageing may also protect against declines in physical function in later years. In a further large-scale longitudinal study, Wurm et al. (2010) followed 4,034 middle-aged and older adults (aged 40–85 years) for six years. In the older adults, more positive views-on-ageing were associated with a greater frequency and volume of walking. Whilst the larger sample sizes do increase generalisability, all of these findings are observational, meaning that an association can be inferred, however causation cannot. Nonetheless, further support for these findings is provided from controlled experimental laboratory-based studies where inducing negative stereotypes has been shown to increase autonomic responses to stress (Levy, Hausdorff, Hencke, & Wei, 2000), inhibit cognitive function and memory (for example, Barber et al., 2015; Haslam et al., 2012), and reduce physical function (Chiviacowsky et al., 2018; Swift et al., 2012).

In what appears to be the only study to-date that has investigated the impact of an age stereotype construct on sedentary behaviour, Gale et al. (2018) explored the effect that attitudes towards ageing (views-on-ageing) had on time spent sedentary, daily step count, and number of sit-to-stand transitions. In comparison to the previously mentioned longitudinal studies (Levy & Myers, 2004; Sargent-Cox et al., 2012; Wurm et al., 2010) that relied on self-report data, the 304 participants (all aged 72 years at baseline), were objectively followed-up seven years later with seven-day accelerometry. However, in this study no significant predictive effects were found on any measured outcome variable. Where the strength of this study's findings lies with its use of an objective measurement of activity levels, only 271 participants were included in the final analysis, falling below the 300 identified as being needed in the sample size calculation, potentially underpowering the study and decreasing the probability of identifying true differences between the variables (Patel, Doku, & Tennakoon, 2003). Nevertheless, this study highlights the need for further studies that explore the association between age stereotype constructs and objectively measured behaviours.

Several mechanisms have been identified that seek to explain the effects of age stereotypes on older adults' health, including stereotype internalisation, stereotype

threat, and stereotype priming effects. The *stereotype embodiment theory* of Levy (2009) proposes that age stereotypes are internalised into self-perceptions of ageing in later life, which affect health behaviours, and in turn overall health outcomes. Indeed, merely having a positive outlook on ageing has been shown to enhance recovery from severe disability and acute myocardial infarction (Levy, Slade, May, & Caracciolo, 2006; Levy, Slade, Murphy, & Gill, 2012), protect against dementia (Levy, Slade, Pietrzak, & Ferrucci, 2018) and predict longevity (Levy, Slade, Kunkel, & Kasl, 2002). The *stereotype threat theory* of Steele and Aronson (1995) proposes that individuals underperform or disengage when they feel at risk of confirming negative views about their abilities. In a meta-analysis of 22 published and 10 unpublished studies, Lamont et al. (2015) found that age-based stereotype threat had a significant effect (mean $d$ = 0.32) on performance across health domains in older adults regardless of gender, age, or underlying health status. Finally, stereotypes may also influence health outcomes more directly, as proposed by the *ideomotor theory* applied to age stereotypes (Levy, 2009). This approach suggests that priming stereotypes (usually in an implicit manner) may directly affect behaviours, without being mediated by self-perceptions of ageing, or concerns of being negatively stereotyped. For example, positive age stereotypes presented subliminally have, in the short-term, improved older adults' physical function (Levy & Leifheit-Limson, 2009) and influenced their will to live (Levy, Ashman, & Dror, 1999-2000).

Laboratory-based studies investigating the short-term effects of experimentally manipulating stereotypes have primarily focused on outcomes within the cognitive health domain. In addition to demonstrating detrimental effects on memory (for example, Barber et al., 2015; Levy, 1996; Weiss, 2016), studies have shown that merely priming individuals with simple, negative, manipulations can significantly affect cognitive function (Barber et al., 2015; Fresson, Dardenne, Geurten, & Meulemans, 2017; Haslam et al., 2012; Mazerolle et al., 2017). To explore if placing older adults into situations that encourage them to see themselves as 'old' was more likely to lead to decrements in performance on the Addenbrooke's Cognitive Examination – Revised, commonly used to screen for dementia, 68 participants (mean age 65.1 years, $SD$ = 3.1) were randomly allocated into one of four groups (Haslam et al., 2012). Depending on allocation, individuals were verbally informed that they were either at the older, or

younger, end of the participant age range spectrum. Following this, again dependant on group allocation, they were then asked to read a brief article in which ageing was either deemed to be associated with a specific decline in memory, or, generalised cognitive decline. When categorised as older and led to expect ageing to be associated with generalised cognitive decline, the likelihood of being clinically classified as having dementia increased by 400%.

Within the physical domain, the findings are not as conclusive. Indeed, when the effect sizes within the review of Lamont et al. (2015) were presented for specific domains, whilst for cognition, the mean ($d$ = 0.57), was greater than that for overall performance ($d$ = 0.32), for the physical domain no specific result was reported due to the small number of included studies. Concerning stereotype threat, Swift et al. (2012) found that when increasing stereotype threat through a single, explicit, verbally delivered, age-related social comparison, immediately post-manipulation, hand grip strength performance was half that reported for the non-threat control group. Moreover, using a similar threat manipulation, but also including a positive prime group, Chiviacowsky et al. (2018) when looking at the immediate and delayed effects on the balance of 39 older women, found no reportable effect immediately post-manipulation. Whilst all groups increased their balance over repetitions, the negative prime group had a significantly shorter balance time at a 24-hour follow-up. The authors suggest that this observed delayed effect of threat may explain the lack of findings in other studies (i.e., Horton, Baker, Pearce, & Deakin, 2010, Marquet et al., 2018; Moriello, Cotter, Shook, Dodd-McCue, & Wellefore, 2013).

The potential effect when focus is instead placed on the nullification of threat or the boosting of self-perceptions or views-on-ageing, has been sparsely investigated (Emilé et al., 2017; Hausdorff, Levy, & Wei, 1999). Both studies report promising results, nonetheless, it is pertinent to note that in the early work of Hausdorff et al. (1999), where the implicit activation of positive age stereotypes increased gait speed by 9% ($p$ < 0.001) compared to a group that was primed subconsciously with negative age stereotypes, it is unclear how the sample of 47 participants were recruited or randomised. This presents the risk of selection and allocation bias, and, the risk of experimenter and reporting biases cannot be ruled out. Only the data for 30 participants

(15 from each group), was included in the reported gait analysis, and, whilst the participants were blinded to group allocation, it appears the researcher was not.

Overall, the drawing of specific conclusions on the effects of stereotype manipulations on physical function is limited by a lack of homogeneity between studies, particularly in relation to methodological differences. Even when prime approaches are similar, the length of prime exposure, method of delivery, timing of follow-up measurement, and measures of physical function often differ. Moreover, even when the same outcome measure, hand grip strength was utilised, as the only measure (Émile et al., 2017; Swift et al., 2012), or as part of a test-battery (Horton et al., 2010; Marquet et al., 2018), the testing protocols applied varied significantly.

The findings of the literature reviewed in this section indicate that age stereotypes could act as a barrier to older adults' engagement in health behaviours. However, further research is needed, particularly within the physical domain, to consolidate and/or facilitate interpretation of the findings. Despite the limitations identified above, developing interventions that endeavour to reduce the negative impact of stereotypes on health outcomes may offer a promising approach to promote healthy ageing. Indeed, it has been suggested that there is a need to explore the impact of age stereotypes in a wider range of settings, including within the context of indirect interventions (i.e., *intergenerational contact*), that may have the potential to ameliorate or decrease stereotype threat effects (Lamont et al., 2015). A systematic review of randomised and non-randomised field studies that have explored the effects of age stereotyped-based interventions on health-related outcomes in older adults, is presented separately, in Chapter 3.

### 2.2.3 Intergenerational contact: Challenging age stereotypes.

In principle, the term 'intergenerational', could refer to any interaction or occurrence between members of different generations from any age categories. However, it is more often used to describe ongoing contact between older adults and children, adolescents, or young adults, either through dyadic partnerships, or as part of group activities that endeavour to bring about benefits for all involved (Newman, Ward, & Smith, 1997). Relative to age stereotypes, there are two pertinent research streams. As well as the effects of intergenerational contact on the age-related stereotypical

concerns, or views of older adults, the potential impact on the attitudes of particularly children, but also adolescents and young adults, towards older adults and the ageing process, are also important to acknowledge.

In young adults, studies have shown that contact with older adults can positively influence ageing process expectations (Jarrott & Salva, 2016; Prior & Sargent-Cox, 2014) or attitudes towards older adults (Drury, Hutchinson, & Abrams., 2016). A sample of 457 undergraduate psychology students (mean age = 19.4 years, 74% female) completed an online survey comprised of items rating their empathy, ageing knowledge, ageing anxiety, and intergenerational contact (Jarrott & Salva, 2016). Less self-ambivalence, or conflicting reactions, beliefs, or feelings about ageing, were associated with higher ratings of intergenerational contact with older adults. It has also been reported that merely imaging positive contact with an older adult led to decreased anxiety about ageing and increased positive expectations of the ageing process; findings that were still present at a 4-week follow-up (Prior & Sargent-Cox, 2014). In this randomised control trial, 201 undergraduate students (mean age = 21.21 years, 61% female), were allocated to one of three groups: i) asked to imagine contact with a 75-year-old male; ii) asked to imagine contact with a 75-year-old female, or, iii) a control group asked to imagine a pleasant outdoor space. Interestingly, when analysed further, the favourable findings were only present in the male, not female participants.

Taking another different approach, Drury et al. (2016) explored the effects of extended contact, a hypothesis based on the principle that knowing peers of the same age have positive relationships with another stigmatized group, can lead to more positive attitudes towards this group (Wright, Aron, McLaughlin-Volpe, & Ropp, 1997). In this cross-sectional study, a convenience sample of university students (mean age = 21.16 years, 54% female), was approached on campus and invited to complete a questionnaire. In addition to examining the relationship between age-related attitudes and extended contact by asking participants to indicate how many of their close friends had positive relationships with older adults, frequency of contact with people aged 65 years or over, and the perceived quality of such contact, were also recorded. Correlations were identified between extended contact and quality of contact and attitudes towards older adults, but not with contact frequency. The results for extended contact remained even when the effects of direct contact (frequency and quality) were

controlled for. Whilst these findings infer that it could be possible to challenge ageism remotely, the non-experimental methodology and the sampling strategy decrease the external validity of the results, limiting their interpretation.

It is important to note that not all studies have presented purely positive findings. The effects of an intergenerational digital technology education programme on perceptions of older adults were evaluated in group of students that had conducted two guided conversations with an older adult about technology (Drury, Bobrowicz, Cameron, & Abrams, 2018). When compared to a control group that did not participate, post-intervention the students perceived older adults as more friendly, but also viewed them as less competent. This finding suggests that when facilitating intergenerational contact, it may be vital to consider not only the quality of contact (Drury et al., 2016), but also the context in which it is occurring, a factor identified as important for inclusion with the developed multi-stage process model (Chapter 1, section 1.1.3). Further potential technology-related contextual issues are discussed in the next section and in Chapter 4, section 4.4.

Contradictory findings have also been reported in studies exploring the impact of intergenerational contact on the attitudes of children towards older adults, the most commonly reported outcome in this type of research (Burnes et al., 2019). On one hand, it has been shown that contact can improve stereotypical attitudes (Aday, Aday, Arnold, & Bendix, 1996; Dunham & Casadonte, 2009; Heyman, Gutheil, & White-Ryan, 2011; Lynott & Merola, 2007). On the other hand, there are other studies that have reported no significant effects (Babcock, MaloneBeach, & Salmon, 2018; Klein, Council, & McGuire, 2005; Whiteland, 2016). The attitudes of a group of adolescents (aged 14–18 years) from one American high school that participated in a single session *Aging Fair*, were compared with a control group from another school that did not (Klein et al., 2005). During the fair, students spent 20 minutes at each of six booths, covering three different topics relating to ageing and older adults, additionally a further 20 minutes were spent meeting an ‘elder hero’. Examining pre- and post-test measures administered two-to-three weeks before, and after the fair, in 91 intervention and 103 control participants, no significant differences between-groups, or within the intervention group, were reported.

Using a pre-post study design, Babcock et al. (2018) evaluated the impact of a six-week intergenerational programme. Each weekly session was comprised of a lesson, an interview with an older family member, and group work (two older adults and four to five children). As part of wider scale programme implementation, the effect on the general attitudes of 23, fifth grade students, towards older adults, were measured via both implicit and explicit measures. While the implicit measures did reveal some degree of negative bias towards older adults, no significant changes were reported between pre- and post-measures. A number of factors could account for the differences reported including, small sample sizes and differences in methodological approaches, however, notable, is the potential influence of age. In three of the studies that reported positive changes to attitudes, all of the children were aged 10 years or less (Aday et al., 1996; Heyman et al., 2011; Lynott & Merola, 2007), and in the work of Dunham and Casadonte (2009), participants ranged in age from 6–13 years. It is possible that greater effects may be observed when interventions target earlier periods of childhood. Indeed, it is suggested that negative stereotypes become embodied at an early age, even before there is any notion of self-relevance (Bennet & Gaines, 2010), therefore, by the time adolescence begins, changing attitudes could become more difficult (Klein et al. 2005).

### 2.2.4 Intergenerational contact: The potential benefits for older adults.

Observational and qualitative studies have reported positive associations between intergenerational contact and health-related variables in older adults. In one study, focus groups aiming to discuss the benefits of interaction with youths, were held with 42 older adults randomly selected from individuals participating in a wider scale volunteer programme (Fees & Bradshaw, 2003). As well as a sense of generativity towards the younger generation, and feeling an affirmation about their life role, a greater sense of general well-being was reported. Moreover, in familiar settings, significant correlations have been found between frequency of contact per month with grandchildren and health-related quality of life (Kirchengast & Haslinger, 2015), and, being the provider of more childcare and enhanced psychological status, namely lower depression and loneliness levels (Tsai et al., 2013).

Three pertinent laboratory-based studies have examined the effect that interactions between intergenerational contact and age stereotypes had on cognition-

related outcomes (Abrams, Eller, & Bryant, 2006; Abrams et al., 2008; Kessler & Staudinger, 2007). In a seminal study, Abrams et al. (2006) recruited 97 retired adults (mean age = 74.81 years, *SD* = 7.43) to explore the impact of generating situations where older adults were placed under higher or lower levels of stereotype threat, on cognitive performance (measured as comprehension, recall, verbal facility, and digital span). Participants either received a brief, verbal, social comparison with younger adults or a neutral statement. Taking an additional measure of frequency and quality of positive intergroup contact with younger people, the authors predicted that in the high threat group, the negative effects would be eradicated by more positive contact. Indeed, their findings showed that stereotype threat had a large significant effect on performance in individuals who reported less positive contact, $\beta = -0.68$, $t(93) = 5.20$, $p < 0.001$, whereas the effect on those reporting more positive contact, was not significant, $\beta = -0.13$, $t(93) = 0.95$. Although not health-related, a mediating effect of test anxiety was also reported. Considering the targeted generations within this thesis, it is pertinent to note, that whilst their assessment of intergroup contact did refer to contact with grandchildren, it also included questions on contact with people under the age of 35 years, limiting the applicability of the results.

Exploring the effects of interactions been 90 older women (aged 70-74 years) and 90 adolescent girls (aged 14-15 years), Kessler and Staudinger (2007) predicted that positive contact would limit age-related performance deficits. The nonfamiliar participants were randomly assigned to one of three groups, where each dyad collaborated on one task defined by having a different level of contextual demand. In the intervention group, for dyads made up of different generations, a difficult life problem was expected to place expert status with the older adult, triggering positive age stereotypes. In the first of two control groups, the dyad partners were from different generations, but the task was a media problem designed to stress older adults' deficiencies and hence activate negative stereotypes. In the second, the dyads received the life problem, but were paired with a participant from the same generation. Immediately post task completion, cognitive performance was observed in the older adults via measures of word speed, word fluency, and logical reasoning. Partial support for their hypothesis was provided. Significant differences were found between the intervention and media problem control group for word fluency, $F(1,85) = 5.36$, $p \leq 0.05$,

$\eta^2$ = 0.059; for word speed, the result was not significant, but a small effect size was noted $F(1,85) = 3.19$, $p \leq 0.10$, $\eta^2 = 0.039$. However, no significant differences were observed when comparisons were made with the group comprised of dyads of two older adults, or between any groups for logical reasoning.

Building on their earlier work, Abrams et al. (2008) hypothesised that intergenerational contact would ameliorate the effect of stereotype threat, this time on an indirect measure of cognitive function, maths performance. Undertaking two separate experiments, the first explored the effects of prior contact with grandchildren, the second the impact of imagined contact. In study one, 51 participants (mean age 69.14 years, *SD* = 4.70) were randomly assigned to a high or low threat group that received the same manipulations used in Abrams et al. (2006). For people with less positive contact with grandchildren, the effect of threat on performance was significant, $\beta = -2.01$, $t(45) = 5.27$, $p < 0.001$, but again the effect on those reporting higher levels of positive contact was not significant, $\beta = -0.41$, $t(45) = 1.03$, $p < 0.307$, with test anxiety additionally mediating the results.

In study two, 84 participants (mean age 72.22 years, *SD* = 8.23) were recruited into three groups. The control group received the same neutral manipulation as study one. Two further groups received the threat manipulation, plus participants in one group were asked to imagine meeting a young stranger (contact) or an outdoor scene (no contact). Performance levels between the contact (*M* = 13.03, *SD* = 6.48) and control group (*M* = 16.14, *SD* = 5.35) did not significantly differ, however in the no contact group (*M* = 10.00, *SD* = 5.94) performance was significantly worse than both other groups. The authors conclude that these findings signal that even imagined contact can sustain performance in situations of stereotype threat.

Moving onto field-based studies, despite the magnitude of interest in intergenerational programmes and interventions, their supporting evidence-base is relatively small, and appears to be, at least partially, anecdotal. The majority of interventional studies conducted involving children and older adults have either been focused on social cohesion or community initiatives, or, arts, education, or culturally based programmes delivered in education facilities or supervised groups (for reviews, see Giraudeau & Bailly, 2019; Martins et al., 2019). Such programmes have historically been structured around the effects of volunteering on older adults, not

intergenerational contact *per se*, and where the health benefits have been reviewed and positively reported (Park, 2014), health-related components are often not the underpinning drivers of programmes or interventions.

In a RCT, Tan, Xue, Li, Carlson, and Fried (2006) via The Experience Corps® programme, placed 113 older adult volunteers (aged 59-86 years) into public elementary schools in Baltimore for 15 hours per week. The study was successfully designed to simultaneously increase physical activity levels in the older adults, and academic performance in the school children. However, generalisation of their results, particularly regarding the older adults, is limited due to the high percentage of female participants (94%) and the lack of ethnic diversity (96% African American). The lack of male participants could be particularly noteworthy as it is suggested that men may respond differently to intergenerational contact and therefore reported outcomes may be different (Prior & Sargent-Cox, 2014). Similarly, in a series of three studies undertaken in Brazil, older adults grouped with adolescents to participate in school-based reminiscence activities reported or demonstrated more positive perceptions of their overall health status post-intervention (De Souza, 2003, 2011; De Souza & Grundy, 2007). It is important to consider when interpreting the results of any study based on volunteering, that they may be inherently limited by the suggestion that participants are self-selected, and therefore more likely to be healthier, younger, and more active at baseline than the general older adult population (Park, 2014).

For physical activity, it has been proposed that the motivation generated from social support and the given potential to set and work on joint goals may be the driver of any benefits achieved (Granacher et al., 2011). Nonetheless, in the few instances where researchers have endeavoured to implement and analyse more rigorous methodologies to explore the impact of physical activity driven intergenerational interventions, they have encountered various challenges. In one study, a three-month intergenerational physical intervention was trialled by two groups, one comprised of 11 older adults (mean age 63.91 years, *SD* = 7.62) and 18 preschool children (mean age 4.85 years, *SD* = 0.38 years), the other 9 older adults (mean age 68.67 years, *SD* = 7.25) and 13 primary school children (mean age 7.17 years, *SD* = 0.38; Mouton, Renier, & Cloes, 2015). Once a week, the group members participated together in a school-based physical activity session. Whilst the intervention was generally well received, no

significant improvements were observed in the physical or mental health of the older adults, or the physical activity levels of the children. The only promising finding was for upper limb strength in the older adults. In total, 15 out of the 31 children initially included, had to drop out or be excluded from the study because parents failed to return their questionnaires, halving the data available for analysis. Also, the sample of older adult participants, as per the study of Tan et al. (2006), had a female bias (> 80% per group).

Taking a different approach, following co-design workshops with older adults, Leitiao and Reed (2015) piloted *IStep*, an intergenerational support intervention designed to encourage physical activity in grandparents and grandchildren outside of the school setting. Developed to motivate towards a common goal, dyads wore pedometers to complete a virtual week-long walk around their local city, aiming for 70,000 steps collaboratively. Recruitment occurred via children aged 7-8 years at a local Primary School. To engage with grandparents, a classroom event was organised, but attendance was poor. This resulted in only one grandparent being recruited, and the inclusion criteria being widened to include the children's parents.

Notwithstanding the addition of parents, participants proceeded to consent but then fail to sign up to and engage with the web-platform. This factor potentially links to an additional problem with a lack of data being entered. While this does present another separate difficulty, both could stem from reported problems with access to technology resources. These issues were encountered despite public involvement in the co-design process, signifying the level of complexity that surrounds developing intergenerational interventions. Although there is some indication that intergenerational approaches to targeting health-related behaviours in older adults could be promising (Moulton et al., 2015; Sakurai et al., 2016; Tan et al., 2006), further research that specifically investigates the impact of intergenerational contact and concludes with the collection of sufficient data to expand the evidence-base is crucially needed. However, it has been identified that facilitating optimal contact is, in practice, difficult to achieve (Abrams et al., 2008), and therefore, understandably difficult to research, thus exploring the use of *technology*, in the right context, could provide a viable solution.

### 2.2.5 Technology: A method of contact facilitation?

The European Commission (European Commission and the Economic Policy Committee, 2014) has previously made research into the development of technology-based interventions for health promotion in older European adults a priority. A number of systematic reviews and meta-analyses have explored and reported positive effects of different aspects of technology on physical activity and sedentary behaviour in older adults, including, digital behaviour change interventions (Muellmann et al., 2018) and physical activity monitors/trackers (Larsen, Christensen, Juhl, Andersen, & Langberg, 2019; Oliveira, Sherrington, Zheng, Rodrigues Franco, & Tiedemann, 2020).

In response to the COVID-19 pandemic, McGarrigle and Todd (2020) conducted a rapid review of reviews targeting evidence for the potential role of mobile health (mHealth) or eHealth technologies in promoting physical activity during periods of social distancing in adults aged 50 years or older. It was concluded that such approaches may indeed be effective in the short term, within interventions that are underpinned by theory, provide social or professional support, and embed appropriate BCTs within their design process. Interestingly, contradicting the previously highlighted findings of French et al. (2014), the inclusion of self-regulatory techniques (i.e., self-monitoring, goal setting) were deemed to be beneficial, thus suggesting that interventions delivered using different approaches, in different contexts, may in fact benefit from the inclusion of different BCTs (see Chapter 4, section 4.9, for further discussion). McGarrigle and Todd (2020) do however highlight that the overall quality of the evidence was low-to-moderate, and highlighted the practical issues associated with users who may have limited experience using such digital technologies.

Technology could play a pivotal role in facilitating opportunities not only for engagement with health-related behaviours but also social contact – already identified as a motivational driver for older adults (Becofsky et al., 2014; Flogel et al., 2015; Gomes et al., 2017; Victor et al., 2016). Nonetheless, it is important to consider other potential factors that could have an impact on the generation of successful outcomes, particularly the role of stereotypes. Exploring the differences between being randomly assigned to a familiar or unfamiliar touchscreen tablet-based task, Caspi, Daniel, and Kavé (2019) found that in a sample of 151 participants, aged 18–83 years, the oldest participants assigned to the unfamiliar task, increased their subjective age from baseline. It is

proposed that whilst no performance detriments were observed, the threat of being perceived as incompetent and lacking technological ability could have led to the reported findings. Similarly, the results of a longitudinal study, have subsequently shown an association between stereotype threat and level of computer use (Mariano, Marques, Ramos, Gerardo, & de Vries, 2020). It therefore appears that if technology is used to underpin interventions designed to challenge health behaviours, that it may be imperative to consider the parameters in which it is being used, or, implementing strategies to decrease threat.

### 2.2.6 Summary.

Fostering opportunities for intergenerational contact presents an array of potential benefits for both older adults and younger generations on a variety of levels. In the short term, for older adults, promising experimental findings in the cognitive domain (i.e., Abrams et al., 2006) indicates that reducing situational threat, or the stigma often associated with older adulthood, could positively influence health-related outcomes. For children and adolescents, even though findings are inconsistent, given the potential detrimental effects of negative age stereotypes in later life, overlooking the potential gains from seeking out or utilising opportunities to instil more positive perceptions from a young age, could be premature. Intergenerational contact could provide a highly effective way to target not only outcomes and behaviours across health domains, but also cross-generational age stereotypes.

# Chapter 3

## Do Age Stereotype-Based Interventions Affect Health-Related Outcomes in Older Adults? A Systematic Review and Future Directions.

*Developing interventions that target population-specific motivational barriers to promote health behaviours is crucial, especially for older adults who are confronted with negative age stereotypes. Whilst previous reviews have investigated how manipulating age stereotypes affects health outcomes, these only included laboratory-based studies (see Armstrong, Gallant, Lingqian, Patel, & Wong, 2017; Lamont et al., 2015). This chapter presents a systematic review that evaluates randomised and non-randomised field studies that tested the effects of age stereotype-based interventions on health outcomes, in adults aged 50 years and over.*

*The current review initially aimed to investigate this question in community dwelling older adults aged ≥ 60 years. It is acknowledged that older adults are defined by WHO (2015) as aged ≥ 65 years. However, initial literature scoping identified that previous research has not used a consistent age range to define someone as an 'older adult'. Definitions of 'older adult' ranged from 50 years of age upwards. To ensure that a comprehensive overview of all relevant studies targeting 'older adults' was achieved, at the screening phase, the age range criterion was defined as any study in which participants were aged ≥ 50 years. A detailed outline of the methodology is provided along with a narrative synthesis of the results, discussion of the findings, and recommended directions for future research.*

## 3.1 Aim

The overall aim of this study was to: i) identify field interventions targeting age stereotypes and/or their mechanisms of influence, in community dwelling older adults aged ≥ 50 years, and, ii) examine the intervention effects compared with any alternative intervention, control group, or pre-post intervention design, on health-related outcomes and age stereotype constructs**.**

## 3.2 Research Question

This study was designed to address the question:

What effects do field interventions targeting age stereotypes have on health-related outcomes in community dwelling older adults aged ≥ 50 years?

## 3.3 Methods

This review was designed and conducted in line with the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA, Liberati et al., 2009) and registered with PROSPERO; registration number CRD42018094006 available at: https://www.crd.york.ac.uk/prospero/.

### 3.3.1 Article selection criteria.

A full breakdown of article inclusion/exclusion criteria is provided in Table 3.1. Although older adults are defined by WHO (2015) as aged ≥ 65 years, initial literature scoping identified that previous research has used an inconsistent age range to define someone as an "older adult", varying from 50 years of age upwards. To ensure a comprehensive overview of all relevant studies targeting "older adults", the age range criterion was defined as any study including participants aged ≥ 50 years. Studies meeting this criterion, but which also included participants under 50 years, were excluded.

Table 3.1

*Study inclusion/exclusion criteria*

| Variable | Inclusion criteria | Exclusion criteria |
|---|---|---|
| Population, or participants and condition or interest | Older adults – Aged ≥ 50 years<br>Any gender<br>Not restricted to the UK | Studies with participants aged 50 and over, that also included participants under 50 years of age |
| Intervention or exposures | Interventions that incorporate or are based on processes that either promote positive, or suppress negative, views-on-ageing and/or self-perceptions of ageing, or reduce the impact of stereotype threat, and were designed to elicit positive effects on either health-related variables and behaviours, or any age stereotype construct | Laboratory-based studies that only induced and reported the immediate or very short-term effects of a single stereotype priming session (e.g., the next day, Chiviacowsky et al., 2018) |
| Comparisons or control groups | No restrictions were placed on the alternative intervention, control group or pre/post intervention outcome measurement | |
| Outcomes of interest | A change in any health-related outcome (i.e., cognitive function, PA) or measured age stereotype construct (i.e., attitudes towards own ageing) from baseline to any available follow-up, with no restriction on intervention length or type, measurement tool or minimum length of follow-up period | Studies that do not have at least 1 outcome measure that can be directly or indirectly associated with participant health, their age stereotypes or views-on-ageing |
| Setting | Any community or research facility setting | Hospital/inpatient settings |
| Study designs | Any intervention-based study design (RCT, non-randomised control trials, cohort, intervention comparison, controlled before-and-after intervention studies | Observational studies where no intervention or manipulation occurs<br>Studies not providing original results such as systematic reviews, meta-analysis, general reviews or editorials |

*Note*. PA = physical activity; RCT = randomised control trial; UK = United Kingdom

### 3.3.2 Data sources, searches, and study selection.

Electronic databases (EBSCOhost MEDLINE, EBSCOhost SPORTDiscus, Scopus, Web of Science Core Collection and EBSCOhost PsychINFO), limited to academic journals published in English from 1995 – April 2018, were searched by RLK. Database alerts were set, and new citations screened, until May 2019. Search terms were verified by a subject librarian and agreed by the review team. The Boolean terms used included, but were not limited to, ("older adul*" OR "senio*" OR "elderly") AND ("age stereotyp*" OR "ageism" OR "positive priming" OR "stereotype prejudice") AND ("memory" OR "physical activity" OR "quality of life" OR "views-on-ageing"). Additionally: Google Scholar and Ethos were searched for grey literature; full text articles retrieved were hand searched via reference checking and forward and backwards citation screening/snowballing, and members of the Society for Personality and Social Psychology group were contacted to identify any additional studies.

All database and secondary searches were conducted by the author who, following the removal of duplicates via Endnote X8 (Clarivate Analytics, US), screened the titles and abstracts of potentially eligible articles, coding "yes", "no", or "maybe". A screening tool developed by the author, based on the inclusion criteria, was piloted on 5% of the articles; a second reviewer (thesis supervisor, JH) independently reviewed the screened titles for discrepancies to ensure there was no discordance between reviewers, or with regards to inclusion/exclusion criteria application. On completion of the screening process, a further 5% of studies and all articles coded "maybe" were reviewed by the thesis supervisor. The two reviewers independently reviewed all articles retrieved in full text against the pre-defined inclusion/exclusion criteria. Disagreements regarding eligibility of articles were resolved by discussion with a third reviewer (second thesis supervisor, AC; initially $k$ = 0.75, following discussion $k$ = 1). Details of database specific restrictions, and an example of the full search terms applied are outlined in Appendix A.

### 3.3.3 Data extraction.

A form based on a Cochrane Collaboration template (Higgins et al., 2019), was used to extract data by the author, including: authors; publication year; study design, setting, aim, hypothesis and methodology; sample size, participant demographics and

baseline characteristics; outcome measure(s); exposure and follow-up time-point measurement; empirical results, and, risk-of-bias assessment information. Where applicable, the Behaviour Change Technique Taxonomy V1 (Michie et al., 2013), a nomenclature that classifies intervention components into 93 different BCTs, was used independently by two appropriately trained reviewers (the author and thesis supervisor) to characterise the 'active' elements of interventions. A third unblinded reviewer (third thesis supervisor, MM) independently reviewed all extracted data. No discrepancies were identified, therefore inter-rater reliability was not calculated.

### 3.3.4 Quality assessment.

Two reviewers (author and second thesis supervisor, or third thesis supervisor) independently assessed risk-of-bias and study quality for each reported outcome measure using the ROB 2.0 tool for randomised studies (Sterne et al., 2019) and the ROBINS-I tool for non-randomised studies (Sterne et al., 2016). In line with guidance, algorithms were followed to obtain a judgement for each assessed domain using the published article and available supplementary material. Studies with at least one domain scored as *high* risk-of-bias or with four or more domains of *some concerns,* were subsequently classified overall as high risk-of-bias. Studies were classified overall as *low* risk-of-bias only if all domains achieved this criterion (Sterne et al., 2019). Disagreements were resolved through discussion. No studies were excluded due to low quality or risk-of-bias, rather, all issues were considered when interpreting the results.

### 3.3.5 Data synthesis.

Using the framework outlined in the Centre for Reviews and Dissemination (2009) and The Cochrane Collaboration Handbook (Higgins et al., 2019), the following elements have been considered for data analysis and synthesis: development of theories on how the interventions work, why and for whom; development of a preliminary synthesis of findings of included studies; exploration of relationships within and between studies, and, an assessment of the robustness of the synthesis.

A descriptive summary and explanation of evidence robustness for each study is presented as a lack of homogeneity between studies in terms of design, interventions and outcome measures precludes a meta-analysis from being conducted. Themes focus

on the effect of different intervention types on specific outcome domains. Findings are collated in a tabulated summary, grouped, and synthesised according to study design and characteristics.

## 3.4 Results

Electronic database searching identified 14,236 articles, with a further 21 identified from secondary searches. Following removal of duplicates, 9,742 articles were screened, with 9,655 that did not meet the inclusion criteria excluded. The remaining 87 articles were retrieved in full text and assessed for eligibility, with 10 articles retained for the final analysis. A flow chart of the full process, including a breakdown of reasons for full text exclusions, is displayed in Figure 3.1. An overlap between four articles was identified[4], indicating the 10 articles represented the results of eight independently conducted studies. For clarity, the characteristics, results, and risk-of-bias for each individual article are presented separately, but, where appropriate, findings between those linked are discussed together.

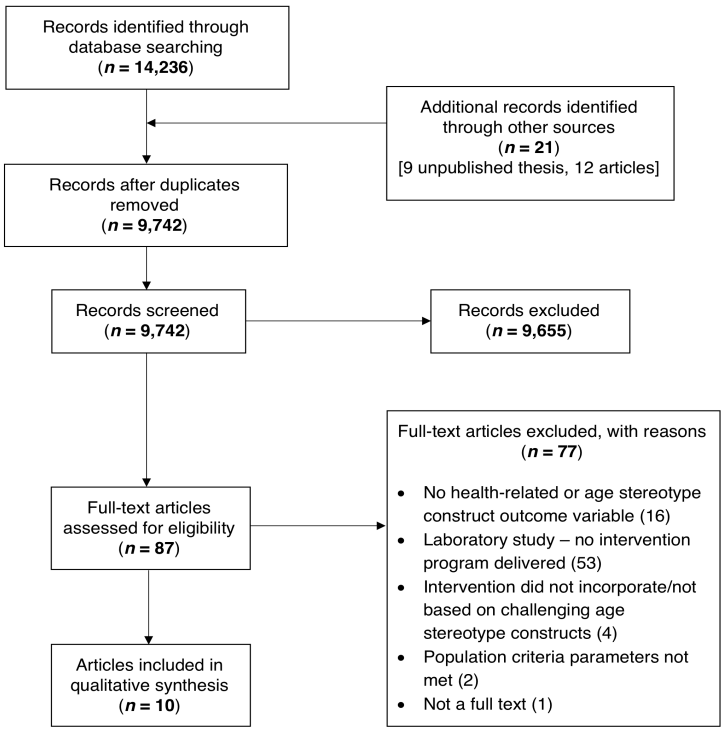


*Figure 3.1* PRISMA flow diagram

[4] Fujiwara et al. (2009) and Sakurai et al. (2016), and Warner et al. (2016) and Wolff et al. (2014) present different outcome data components and/or time-points from the same overall studies

### 3.4.1 Study characteristics and participants.

All articles included in the review were published in English between 2009 and 2019, six were RCTs and four were non-randomised. The summation of participant data was deemed inappropriate due to the potential overlap between articles (Fujiwara et al., 2009 *with* Sakurai et al., 2016; Warner, Wolff, Ziegelmann, Schwarzer, & Wurm, 2016 *with* Wolff, Warner, Ziegelmann, & Wurm, 2014). Individual data for each article is presented with the study characteristics in Table 3.2. The REPRINTS study (Fujiwara et al., 2009; Sakurai et al., 2016) and AgingPlus Program (Brothers & Diehl, 2017) included some participants aged < 65 years old, however, normal distribution analysis showed at least 94% and 83% of participants, respectively, were aged > 64 years old. Although all studies provided demographic information on participant age and sex, only some provided further details, such as ethnicity (Belgrave, 2011; Brothers & Diehl, 2017; Levy, Pilver, Chung, & Slade, 2014) or health status (Brothers and Diehl, 2017; Warner et al., 2016; Wolff et al., 2014).

Intervention structure (content, duration, session frequency) and where utilised, control group parameters, varied substantially between the eight independent studies (see Table 3.2). Follow-up periods ranged from two-weeks to seven years. Concerning content, two independent studies reviewed the impact of providing positive experiences through intergenerational contact (Belgrave, 2011; Fujiwara et al., 2009; Sakurai et al., 2016), a concept that it has been proposed could challenge age stereotypes, leading to positive health gains, through the provision of positive experiences and reductions in stereotype threat and negative attitudes (Abrahms et al., 2008; Pettigrew & Tropp, 2006). One study reviewed the impact of implicit and explicit priming of positive age stereotypes (Levy et al., 2014), one the impact of inducing positive views-on-ageing coupled with non-age-specific BCTs (Warner et al., 2016; Wolff et al., 2014) and four based their intervention around exercise provision. Whilst in Klusmann, Evers, Schwarzer, and Heuser (2012) exploring the implicit impact of exercise was the only intervention strategy, others targeted an additional component – perceptions of participants' own ageing (Beyer, Wolff, Freiberger, & Wurm, 2019), suppressing negative attitudes and general thoughts about ageing (Brothers & Diehl, 2017; Émile et al., 2014). Health-related outcomes from three domains were identified:

physical, psychological/psychosocial well-being and quality of life/subjective health, with age stereotype domain outcomes additionally categorised.

Six independent studies stated or implied their intervention was theoretically underpinned by a stereotype model. All relied on the stereotype internalisation process proposed by Levy (2009) within stereotype embodiment theory. Specifically, Beyer et al. (2019); Brothers and Diehl (2017); Émile et al. (2014); Klusmann et al. (2012); Levy et al. (2014); Warner et al. (2016), and Wolff et al. (2014), based their studies on this theory.

### 3.4.2 Risk-of-bias.

The risk-of-bias summaries for the six RCTs and four non-randomised articles are presented in Figures 3.2 and 3.3, respectively. Despite multiple domain assessments of *some concerns* indicating that the overall article risk-of-bias should be considered *high*, following discussion between authors, Warner et al. (2016) and Wolff et al. (2014) were instead deemed to have an overall risk-of-bias of *some concerns*. This classification was based on the level of identifiable concern within each domain and partial provision of evidential support between the articles and within the study, that decreased, but did not nullify, these concerns. Appendix B presents the supporting justification for each study's individual outcomes.

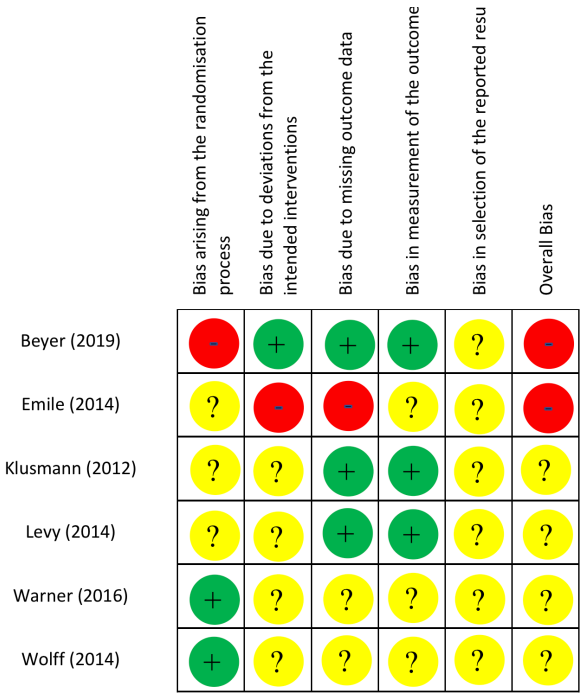


*Figure 3.2* Risk-of-bias summary for each included randomised study

*Note.* Low risk-of-bias (+), Some Concerns (?), High risk-of-bias (-)

Table 3.2

*Study characteristics*

| Author (Location) | Design | Participants | Intervention description | Intervention length | Control group (s) | Stereotype prime | Target stereotype construct | BCTs intervention group | BCTs control group |
|---|---|---|---|---|---|---|---|---|---|
| Belgrave (2011) (USA) | CBA | *n* = 27<br>Age range not reported<br>Mean age = 84.75 years<br>*SD* not reported<br>Female = 88.89% | Intergenerational music therapy - dyadic pairings (not the same every week) with children from local school. Activities included singing, structured conversations, instrument playing, moving to music | 10-weeks<br>10 x 30 min sessions<br>1x week over 12-week period<br>(2-week vacation) | Passive control group - Maintained ordinary routine & attended other normal non-intergenerational activities at their living facility | Implicit | N/A | 12.2 Restructuring the social environment (++) | None |
| Beyer et al. (2019) (Germany) | RCT | *n* = 89<br>Age range 65-88 years<br>Mean age = 76.54 years<br>S*D* = 5.4<br>Females = 34.8% | Group exercise training sessions<br>targeting improving balance, strength, endurance, flexibility & reducing fear of falling<br>+ 4x 20-30 min psychological intervention, aimed at changing<br>SPA, embedded in the second half of the exercise sessions at weeks 2, 5, 8 & 11 | 12-weeks<br>60 min sessions<br>1x week | Active control group - Exercise only | Explicit | SPA | 3.1 Social support (unspecified) (+)<br>4.1 Instruction on how to perform a behaviour (+)<br>6.1 Demonstration of behaviour (+)<br>8.1 Behavioral practice/rehearsal (+)<br>13.2 Framing/Reframing (++)<br>5.1 Information about health consequences (+)<br>3.3 Social support (emotional) (++) | 4.1 Instruction on how to perform a behaviour (+)<br>6.1 Demonstration of behaviour (+)<br>8.1 Behavioural practice/rehearsal (+) |
| Brothers & Diehl (2017) (USA) | Case Series | *n* = 62<br>Age range 52-82 years<br>Mean age = 65.26 years<br>*SD* = 6.62<br>Females = 83.9% | Multi-component program targeting NVoA<br>Educational component (weeks 1-4) - attitudinal & motivational pieces for enacting behaviour change<br>Experiential component (weeks 5-8) - worked towards personalised PA goal & completed daily PA logs | 8-weeks<br>Weeks 1-4: 4x 120 min education sessions 1x week<br>Weeks 5-8: 4x 10-15 min semi-structured interview + telephone support 1x week | N/A | Explicit | VoA | 1.2 Problem solving (++)<br>1.3 Goal setting (outcome) (++)<br>2.3 Self-monitoring of behaviour (++)<br>3.1 Social support unspecified (+)<br>5.3 Information about social and environmental consequences (+)<br>13.2 Framing/Reframing (++) | N/A |

Table 3.2

*Study characteristics continued*

| Author (Location) | Design | Participants | Intervention description | Intervention length | Control group (s) | Stereotype prime | Target stereotype construct | BCTs intervention group | BCTs control group |
|---|---|---|---|---|---|---|---|---|---|
| Émile et al. (2014) (France) | RCT | *n* = 52<br>Age range 67-97 years<br>Mean age = 78.54<br>*SD* = 7.37<br>Females = 100% | Individualised non-standardised supervised walking program & education component that incorporated strategies to suppress negative age stereotypes & activate positive ones | 12-weeks<br>40-60 min sessions<br>2x week | Passive control group - Maintained normal daily routine | Implicit & Explicit | VoA | 1.3 Goal setting outcome (+)<br>2.4 Self-monitoring of outcome(s) of behaviour (+)<br>3.3 Social support (emotional) (++)<br>5.3 Information about social and environmental consequences (+) | N/A |
| Fujiwara et al. (2009) (Japan) | NRCT | *n* = 143<br>Age range not reported<br>Mean age = 68.46 years<br>*SD* = 5.3<br>Females = 62.23% | Intensive training sessions followed by group activity sessions with school children. Activities included pre-group meeting to share information, playing hand games & with toys, picture book reading, additional monthly meetings with area wide group/time to engage with further training | | Passive control group – Maintained normal daily routine | Implicit | N/A | 12.2 Restructuring the social environment (++) | None |
| Klusmann et al. (2012) (Germany) | RCT | *n* = 259<br>Age range 70-93 years<br>Mean age = 73.6 years<br>*SD* = 4.2<br>Females = 100% | Intensive multi-faceted group exercise targeting aerobic, strength & flexibility training | 6-months<br>90 min sessions<br>3x week | Passive control group - Maintained normal daily routine<br>Active control group - computer course designed for seniors dealing with common software | N/A | SPA | 3.1 Social support unspecified (+)<br>4.1 Instruction on how to perform a behaviour (+)<br>6.1 Demonstration of behaviour (+)<br>8.1 Behavioural practice/rehearsal (+) | Active control group<br>3.1 Social support unspecified (+) |

Table 3.2

*Study characteristics continued*

| Author (Location) | Design | Participants | Intervention description | Intervention length | Control group (s) | Stereotype prime | Target stereotype construct | BCTs intervention group | BCTs control group |
|---|---|---|---|---|---|---|---|---|---|
| Levy et al. (2014) (USA) | RCT | *n* = 100<br>Age range 61-99 years<br>Mean age = 81 years<br>*SD* = 10<br>Females = 78% | Group 1 - Implicit subliminal priming via computer with words depicting positive stereotypes of ageing plus Explicit neutral – asked to imagine neutral topics<br>Group 2 - Explicit positive asked to "imagine a senior citizen who is mentally and physically healthy" (one of 3 versions) plus Implicit neutral – primed via same method as implicit prime but with random series of letters<br>Group 3 - Exposed to both implicit and explicit positive interventions | 4-weeks<br>4x sessions<br>1x week over 8-week period<br>(Weeks 2, 3, 4 & 5) | Neutral control group - Implicit neutral – primed via same method as implicit prime but with random series of letters, plus Explicit neutral – asked to imaging neutral topics | Implicit & Explicit | VoA & SPA | N/A | N/A |
| Sakurai et al. (2016) (Japan) | NRCT | *n* = 349<br>Age range not reported<br>Mean age = 67.7 years<br>*SD* = 5.7<br>Females = 82.8% | Intensive training sessions followed by group activity sessions with school children. Activities included pre-group meeting to share information, playing hand games & with toys, picture book reading, additional monthly meetings with area wise group/time to engage with further training | 12-week intensive training<br>Unspecified x 30 min sessions<br>1x every 1-2 weeks<br>Unspecified x 120mins meetings/additional training<br>1x week | Passive control group - maintained normal daily routine but 38% were involved in volunteering activities i.e., at welfare facility every week & 42% a few times a month (Mean time per week 1.5hours, *SD* = 1.7) | Implicit | N/A | 12.2 Restructuring the social environment (++) | None |

Table 3.2

*Study characteristics continued*

| Author (Location) | Design | Participants | Intervention description | Intervention length | Control group (s) | Stereotype prime | Target stereotype construct | BCTs intervention group | BCTs control group |
|---|---|---|---|---|---|---|---|---|---|
| Warner et al. (2016) (Germany) | RCT | *n* = 310<br>Age range 64-92 years<br>Mean age = 70.34 years<br>*SD* = 4.89<br>Females = 75.2%<br>NB. *n* = 153 randomly selected to wear an accelerometer at baseline and week 11 | <u>Intervention group 1</u><br>All BCTs targeted to change PA +VoA component - information about positive aspects of ageing, raising & correcting false beliefs or misconceptions of ageing + prompting positive VoA by presenting findings on association between positive VoA & health, longevity & health behaviours<br>Plus, technique taught to empower identification of automatic, unconscious negative thoughts on ageing & as a second step replace them with neutral or positive<br><u>Intervention group 2</u><br>All BCTs targeted to change PA substituting the VoA component with an additional planning sheet | 1-week<br>1x short session<br>5-weeks after baseline | Passive control group - maintained normal daily routine<br>Active control group - parallel session with techniques targeted to change volunteering | Explicit | VoA | All intervention groups as self-listed by authors<br>5.1 Health Consequences (+)<br>15.3 Focus on past success (++)<br>6.1 Demonstration of behaviour (++)<br>16.3 Vicarious enforcement (++)<br>1.3 Goal setting (outcome) (+)<br>1.1 Goal setting (behaviour) (+)<br>1.4 Action planning (including implementation intentions) (+)<br>1.5 Review behaviour goal(s) (+)<br>2.3 Self-monitoring of behaviour (++)<br>12.2. Restructuring of the social environment (++)<br><u>Additional BCTs for VoA group</u><br>3.3 Social support emotional (++)<br>5.1 Health consequences (+) (extra)<br>13.2 Framing/Reframing (++) | None |

Table 3.2

*Study characteristics continued*

| Author (Location) | Design | Participants | Intervention description | Intervention length | Control group (s) | Stereotype prime | Target stereotype construct | BCTs intervention group | BCTs control group |
|---|---|---|---|---|---|---|---|---|---|
| Wolff et al. (2014) (Germany) | RCT | *n* = 234<br>Age range not reported<br>Mean age = 70.34 years<br>*SD* = 4.9<br>Females = 75% | <u>Intervention group 1</u><br>All BCTs targeted to change PA +VoA component - information about positive aspects of ageing, raising & correcting false beliefs or misconceptions of ageing + prompting positive VoA by presenting findings on association between positive VoA & health, longevity & health behaviours<br>Plus, technique taught to empower identification of automatic, unconscious negative thoughts on ageing & as a second step replace them with neutral or positive<br><u>Intervention group 2</u><br>All BCTs targeted to change PA substituting the VoA component with an additional planning sheet | 1-week<br>1x short session<br>5-weeks after baseline | Passive control group – not included in study analysis<br>Active control group - parallel session with techniques targeted to change volunteering | Explicit | VoA | All intervention groups as self-listed by authors<br>5.1 Health consequences (+)<br>15.3 Focus on past success (++)<br>6.1 Demonstration of behaviour (++)<br>16.3 Vicarious enforcement (++)<br>1.3 Goal setting (outcome) (+)<br>1.1 Goal setting (behaviour) (+)<br>1.4 Action planning (including implementation intentions) (+)<br>1.5 Review behaviour goal(s) (+)<br>2.3 Self-monitoring of behaviour (++)<br>12.2. Restructuring of the social environment (++)<br><u>Additional BCTs for VoA group</u><br>3.3 Social support emotional (++)<br>5.1 Health consequences (+) (extra)<br>13.2 Framing/Reframing (++) | None |

*Note*. BCT(s) = behaviour change technique(s); CBA = controlled before and after; min = minutes; n = number; N/A = not applicable; NVoA = negative views-on-ageing; PA = physical activity; RCT = randomised control trial; *SD* = standard deviation; SPA = self-perceptions of ageing; VoA = views-on-ageing; (+) = BCT present in all probability; (++) = BCT present beyond all reasonable doubt

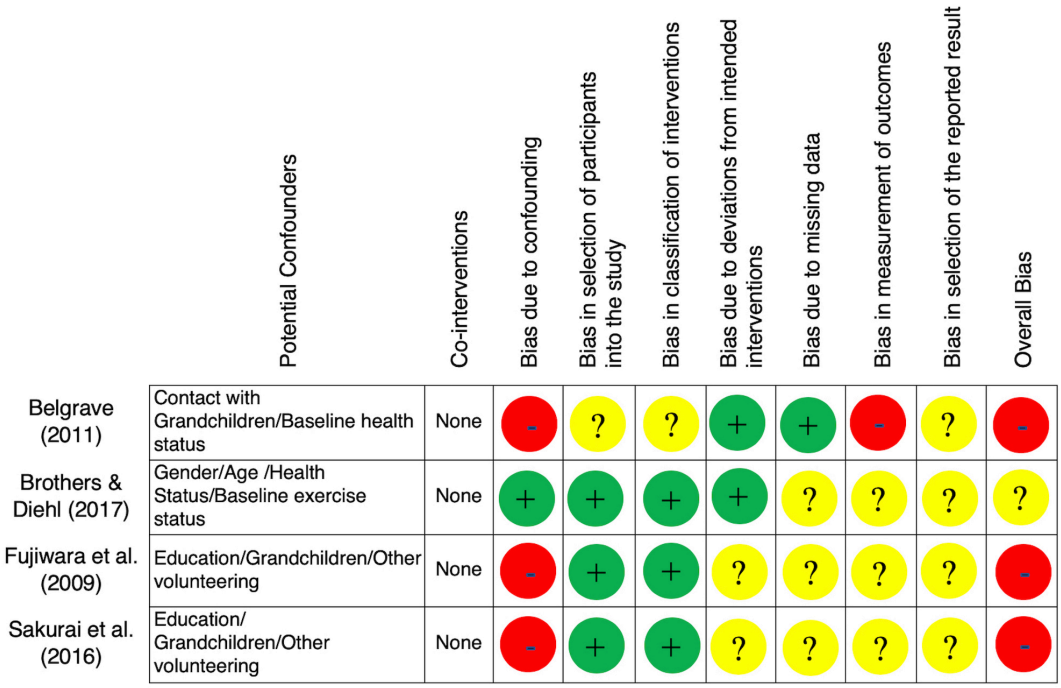


*Figure 3.3* Risk-of-bias summary for each included non-randomised study

*Note.* Low risk-of-bias (+), Moderate risk-of-bias (?), Serious risk-of-bias (-)

### 3.4.3 Study descriptions.

#### *3.4.3.1 Non-randomised studies.*

Four articles presenting three independent studies used non-randomised designs. Belgrave (2011) measured generativity and self-esteem in older adults following participation in an intergenerational music therapy intervention, compared with a usual-routine control group. During 10 sessions over a 12-week period, participants formed dyads with different children (mean age 9.5 years). Fujiwara et al. (2009) and Sakurai et al. (2016) also explored the effects of intergenerational contact during the REPRINTS study. Usual walk speed, hand-grip strength and self-rated health were measured nine months from baseline, with maximal walk speed, functional reach, one-leg stand, depression level and self-esteem additionally measured at a seven-year follow-up. Intervention group participants volunteered at Education or Child Care facilities once every one or two weeks. The control group continued life as usual.

Participants who withdrew or changed groups/engaged in associated activities were excluded from analysis.

Conversely, Brothers and Diehl (2017) used a case-series design to establish the preliminary effects of an eight-week multi-component experimental personalised goal achievement programme. The intervention, based on the Health Action Process Approach (Schwarzer, 2008), aimed to challenge negative views-on-ageing, operationalised as a composite of awareness of age-related change, age stereotypes, expectations regarding one's own ageing, and subjective age. Views-on-ageing, self-perceptions of ageing, and self-reported physical activity levels were measured four-weeks post-intervention. Additional measurements of views-on-ageing and self-perceptions of ageing were taken at week four. The moderation of age on training effect was also examined.

#### *3.4.3.2 RCTs.*

Six articles, including five independent studies, used randomised designs. Beyer et al. (2019) embedded a psychological intervention into an exercise session for older adults. Information targeting self-perceptions of ageing in losses and gains domains was provided once a week for 12 weeks. Differences in physical function and depression level were measured at baseline and at a four-week follow-up and compared to an exercise-only control group. Effects on self-perceptions of ageing were measured at baseline, mid-intervention, post-intervention and at a four-week follow-up. Similarly, Émile et al. (2014) examined the effects of providing counter-stereotypical information to sedentary older women during a twice weekly individualised, supervised walking programme. Post-intervention, quality of life, self-reported physical activity (supported by a six-minute walk test, classified by the authors as measures of physical capacity), and views-on-ageing were measured and compared with non-intervention controls.

Klusmann et al. (2012), as part of a wider cognitive ageing study, evaluated how an exercise-only intervention, delivered three times a week for six months, affected self-perceptions of ageing and age dissatisfaction in females. Comparisons were made with an active control group undertaking an equal length computer course and a passive non-intervention control group. The authors also tested whether direct approach (defined

as the most emotionally gratifying orientation by Mees & Schmitt, 2008) mediated the relationship between exercise and age stereotypes.

Taking a different approach, Levy et al. (2014) investigated whether subliminally presenting positive age stereotypes four times over an eight-week period could: improve physical function, strengthen positive and decrease negative views-on-ageing, and, increase positive and decrease negative self-perceptions of ageing. Comparisons were made with a group that received an explicit-positive prime only and a control group that received neutral versions of both priming techniques. No data or results are presented for an additionally stated implicit-positive plus explicit-positive prime group, however the study used a 2x2 design, and the findings presented address the three study hypotheses.

Warner et al. (2016) and Wolff et al. (2014) developed a brief single session intervention based on a battery of BCTs underpinned by the Health Action Research Approach (Schwarzer, 2008). Aiming to induce positive views-on-ageing, five weeks after baseline assessment, intervention group participants received additional information about positive aspects of ageing and the association between positive views-on-ageing and health outcomes. Change in self-reported physical activity levels (supplemented by accelerometery data in Warner et al., 2016) was compared with an alternate intervention group that received an additional planning sheet of comparable length, an active control group targeting volunteering and a passive control group. Wolff et al. (2014) additionally measured attitudes towards older adults as a participant outcome but did not present data for any outcome measure for the passive control group. Details of reported outcome measures, their associated follow-up periods, and presented statistical results for the non-randomised studies and RCTs are displayed at the end of this chapter in Tables 3.3 and 3.4, respectively.

### 3.4.4 Study findings.

#### *3.4.4.1 Physical domain.*

Within this domain, results are split between two separate constructs: physical function and physical activity.

*3.4.4.1.1 Physical activity.* A significant direct effect on physical activity was reported by two studies; one RCT (Émile et al., 2014) and one case-series design

(Brothers & Diehl, 2017). In Émile and colleagues' study (2014), both self-reported physical activity, and capacity for physical activity significantly improved from baseline to three-month follow-up in the intervention group, in comparison to the control group, where they remained stable. A positive correlation was identified between stereotypes of the perceived benefits of exercise for older adults and physical activity score and a negative correlation between stereotypes of the perceived exercise risks for older adults and physical activity score.

Brothers and Diehl (2017) also found a significant trend for increased physical activity throughout their study. Participants doubled their mean weekly minutes of physical activity from baseline ($M$ = 84.95; $SD$ = 91.17) to a four-week follow-up ($M$ = 171.55; $SD$ = 97.26). However, using a much briefer intervention, an RCT reported by Warner et al. (2016) and Wolff et al. (2016) found no significant direct group effects on physical activity for the main intervention plus views-on-ageing group. The only significant effect evident in the two intervention groups was at a 14-month follow-up, in favour of the intervention plus planning group.

Wolff et al. (2014) also explored the indirect effect of different components of attitudes towards older adults (measured by the German Semantic Differential) on changes in physical activity. Despite an overall non-significant effect, they identified a marginally significant indirect effect to change physical activity from the intervention plus views-on-ageing (versus active control) via changes in integrity. For mean change in integrity, physical activity levels were predicted to increase by 42 minutes per week.

*3.4.4.1.2 Physical function.* Two out of three studies, one RCT (Levy et al., 2014) and one non-randomised control trial (Fujiwara et al., 2009; Sakurai et al., 2016), found a notable effect on any measure of physical function. Although Beyer et al. (2019) reported a significant latent change from baseline to a four-week follow-up across their whole sample, embedding a positive self-perceptions of ageing component into an exercise intervention did not lead to physical function changes between baseline and at four-week follow-up or the intercept at mid-intervention.

Levy et al. (2014) reported that only the implicit-positive intervention had a significant strengthening effect. Improved physical function at week eight was predicted by level of positive self-perceptions at week six. Additionally, the implicit intervention

had a direct impact on physical function in the predicted direction. The only significant group effect found by the REPRINTS study (Sakurai et al., 2016) was on functional reach at a seven-year follow-up, with observed decline in reach distance significantly less in the intervention group.

#### *3.4.4.2 Quality of life/subjective health.*

A single RCT by Émile et al. (2014) found a trend for group effect between the exercise plus counter-stereotypical information and non-intervention control group in the WHOQoL-26 domains of physical health, and psychological health. Additionally, a positive correlation was identified between stereotypes of the perceived benefits of exercise for older adults and psychological health. The main effect of group in a non-randomised intergenerational contact versus usual-routine control study found no reportable effect on mean subjective self-rated health at nine-month or seven-year follow-up (Fujiwara et al., 2009; Sakurai et al., 2016).

#### *3.4.4.3 Psychological/psychosocial well-being.*

In Beyer et al. (2019), the group variable significantly predicted the change between baseline and four-week follow-up; only participants randomised to the exercise plus self-perceptions of ageing intervention demonstrated a decrease in mean depression level. The group variable also significantly predicted the intercept at a four-week follow-up. Conversely, depression and self-esteem level at seven-year follow-up did not change significantly between groups in a study where participants were given the option to join the intergenerational intervention or usual-routine control group (Sakurai et al., 2016). These findings mirrored those of Belgrave (2011) in a prior non-randomised 12-week intergenerational study. Differences between post-intervention scores for generativity and self-esteem were not significant.

#### *3.4.4.4 Age stereotypes.*

Within this domain, results are split between two separate constructs: self-perceptions of ageing and views-on-ageing. While self-perceptions of ageing refer to people's satisfaction with their own ageing; this is not the case for views-on-ageing, which refer to individuals' general beliefs about older adults. The latter was included in

the review as a manipulation check indicating whether the intervention has been effective in changing age stereotypes.

*3.4.4.4.1 Self-perceptions of ageing*. Significant effects were reported by three RCTs (Beyer et al., 2019; Klusmann et al., 2012; Levy et al., 2014) and one-case series design (Brothers & Diehl, 2017). Implicit priming with positive stereotypes significantly strengthened positive, and weakened negative, self-perceptions of ageing, when compared with the neutrally primed control group (Levy et al., 2014). Using a completely different intervention strategy, Klusmann et al. (2012) found that dissatisfaction with ageing was lower immediately following a six-month exercise intervention compared to both the passive and active control groups. The authors additionally concluded the significant effect on exercise was mediated through direct approach, and that age had a significant partial effect on age dissatisfaction.

The positive self-perceptions of ageing component embedded by Beyer et al. (2019) into their exercise intervention, again, had a significant effect on measured self-perceptions of ageing from baseline to intervention completion for ongoing development (i.e., ageing as a time of growth) and physical losses (i.e., ageing as a time of decline). Nevertheless, this effect was not fully sustained four weeks later, decreasing but remaining significant for ongoing development factors and no longer maintaining the group effect for physical losses. Brothers and Diehl (2017) observed a similar effect pattern when utilising strategies designed to target the suppression of negative attitudes and general thoughts about ageing. Whilst significant improvements in self-perceptions of ageing were observed during the intervention period, a significant decline in sustained effect was observed at a 12-week follow-up.

*3.4.4.4.2 Views-on-ageing.* Some significant effects were presented by four studies; three RCTs (Émile et al., 2014; Levy et al., 2014; Wolff et al., 2014) and one case-series design (Brothers & Diehl, 2017). A significant intervention effect was observed on attitudes toward older adults, and more particularly the integrity scale of the German Semantic Differential (Wolff et al., 2014). From baseline to six-week follow-up study participants who received the additional views-on-ageing component had more positive attitudes towards older adults at the end of the intervention compared to the active

control group. The group effect significantly increased perceived benefits of exercise for older adults, and decreased perceived risks of exercise for older adults, when views-on-ageing and exercise were targeted via a three-month supervised walking programme (Émile et al., 2014). No group effect was reported for the psychological barriers' component of views-on-ageing.

Brothers and Diehl (2017) reported a significant effect of the intervention for all views-on-ageing measures: age stereotypes/views-on-ageing scale, awareness of age-related change (gains), and awareness of age-related change (losses). However, age stereotypes and gains-related factors demonstrated a significant decline between the end of the formal education component and a four-week follow-up. Implicit priming with positive stereotypes also significantly strengthened positive, and weakened negative, views-on-ageing when compared with a neutrally primed control group (Levy et al., 2014). Whilst the explicit-positive intervention also strengthened positive views, the effect of the implicit intervention was reported to be 30% greater.

## 3.5 Discussion

This systematic review examined the effects of interventions that have targeted age stereotypes on health outcomes in community-dwelling older adults. Six of the eight independent studies focused on health outcomes within the physical domain (Beyer et al., 2019; Brothers & Diehl, 2017; Émile et al., 2014; Fujiwara et al., 2009; Levy et al., 2014; Sakurai et al., 2016; Warner et al., 2016; Wolff et al., 2014), five of which reported significant (Brothers & Diehl, 2017; Émile et al., 2014; Fujiwara et al., 2009; Levy et al., 2014), or marginal (Wolff et al., 2014), improvements in physical function or physical activity due to the intervention. However, only three studies (Brothers & Diehl, 2017; Levy et al., 2014; Wolff et al., 2014) did not present an overall high risk-of-bias. As such, although the results are generally consistent, they should be interpreted with caution given the low number of studies and the varied risk-of-bias.

Other health outcomes investigated relate to psychological well-being. Half of the independent studies examined at least one dimension of this domain: quality of life (Émile et al., 2014), subjective health (Fujiwara et al., 2009), generativity (Belgrave, 2011), depression (Beyer et al., 2019; Sakurai et al., 2016), and self-esteem (Belgrave,

2011; Sakurai et al., 2016). Results consistently demonstrated no impact by the interventions (with the exception of depression in Beyer et al., 2019).

It is noteworthy that most independent studies (six out of eight) were theoretically underpinned (Beyer et al., 2019; Brothers & Diehl, 2017; Émile et al., 2014; Klusmann et al., 2012; Levy et al., 2014; Warner et al., 2016; Wolff et al., 2014). These studies focused exclusively on one specific mechanism of stereotype influence: the internalisation of stereotypes into self-perceptions of ageing (stereotype embodiment theory; Levy, 2009). All seven studies found significant effects on either age stereotype endorsement or self-perceptions of ageing, providing support to stereotype embodiment theory (Levy, 2009). Although these results are promising, two studies had a high overall risk-of-bias (Beyer et al., 2019; Émile et al., 2014), thus their results need to be considered with caution. Additionally, interpretation is limited by the fact that studies have used different operationalisations of stereotype internalisation. They examined intervention effects on self-perceptions of ageing (Beyer et al., 2019; Klusmann et al., 2012), on endorsement of age stereotypes (Wolff et al., 2014; Émile et al., 2014), or on both (Brothers & Diehl, 2017; Levy et al., 2014), whilst mostly using the same terminology of *views-on-ageing*.

### 3.6 Future Directions

The present review reveals consistent effects of age stereotype-based interventions on health outcomes in the physical domain. These results are promising, and more research is needed to better understand when, and how, such interventions may be effective. First, although the physical health domain is important, other health outcomes, (e.g., cognitive abilities), deserve further investigation. Interestingly, cognitive outcomes have been the main focus in laboratory-based studies investigating the effects of experimental manipulations of stereotypes (for a review see Lamont et al., 2015). The generalisability of these laboratory-based findings to real-life settings remains to be elucidated.

Second, age stereotype-based intervention effects have mostly been examined on self-perceptions of ageing, within the stereotype internalisation hypothesis. More research is needed to investigate whether such interventions may also affect stereotypic concerns, as per stereotype threat theory (Steele & Aronson, 1995). Again, this question

has only been investigated in laboratory-based studies. Addressing this unknown is important, as intervening on stereotypic concerns might require different techniques to intervening on self-perceptions of ageing. Indeed, suppressing the endorsement of negative age stereotypes, as is typically done in stereotype internalisation-based interventions, might not be effective on stereotypic concerns. Susceptibility to stereotype threat effects may occur simply because individuals are aware of the existence of negative stereotypes about their group, even if they do not endorse them (Steele, 1997). Techniques that help individuals to adopt a malleable conception of their competence (e.g., Émile et al., 2017) or that stimulate intergenerational contact (e.g., Abrams et al., 2008), may represent a promising approach to reduce stereotypical concerns, but these need to be tested further in real-world settings.

Third, concerning the stereotype internalisation hypothesis, given that studies have used different operationalisations of this concept, future research should endeavour to disentangle the constructs of interest. Intervening on older adults' age stereotypes (i.e., the underlying cause) may have different implications than intervening on their self-perceptions of ageing (i.e., the proximal mechanism). Adopting a mechanistic approach towards the influence of stereotypes could therefore be useful, by testing the mediating role of self-perceptions of ageing in the effect of a stereotype-based intervention on health outcomes. The study of Levy et al. (2014) demonstrates promise in this regard, however more research is needed to further support the mediating role of self-perceptions of ageing.

Finally, other potential avenues for future research include investigating whether: i) age-specific BCTs are more effective than non-age-specific techniques. Only one RCT has examined this question (Warner et al., 2016; Wolff et al., 2014); ii) some components of stereotype-based interventions are more effective than others. Studies have used different ones (i.e., exercising, challenging negative stereotypes, presenting positive stereotypes, avoiding negative thoughts and attitudes about one's own ageing, or a combination of these); iii) interventions are equally effective irrespective of sex. A significant proportion of participants in previous studies were female (75% - 100%), and, iv) the effects of stereotype-based interventions depend on intervention duration, and if these effects are sustained over longer time-periods. Indeed, the preliminary work of Brothers and Diehl (2017) suggests this may not be the case.

## 3.7 Limitations

A rigorous, systematic approach, following a pre-defined protocol and using validated risk-of-bias tools, was employed within this review. Whilst every effort was made to identify all relevant articles during the screening process, a lack of standardisation within the nomenclature of terms used by authors when describing age stereotype constructs, and the diversity of potential 'health-related' outcomes, may have resulted in some studies not being captured. It is also important to acknowledge, only studies published in English were included. The moderate-to-high risk-of-bias within studies, heterogeneous nature of the interventions, and inclusion of some studies that involved participants < 65 years old, limited the interpretation of findings, and strength of conclusions that could be drawn.

## 3.8 Conclusion

Age stereotypes are detrimental to older adults' health. Whilst some positive effects were identified on components of physical function or physical activity, and self-perceptions of ageing, this review highlights a paucity of high-quality research on the use of real-world interventions that endeavour to positively impact health outcomes by directly or indirectly targeting stereotypes of ageing. Nevertheless, the potential for impact should not be dismissed as the range and robustness of available studies is limited. Given that more subtle strategies, implemented over longer time-periods may be needed (Brothers & Diehl, 2017; Émile et al., 2014; Levy et al., 2014), the role of intergenerational contact should not be overlooked on the basis of the reported null findings (Belgrave, 2011; Fujiwara et al., 2009; Sakurai et al., 2016). Increasing life expectancy and the current lack of consensus on how to effectively influence healthy ageing indicates taking a pragmatic approach towards intervention development, and, that research in real-world settings could be vital.

Table 3.3

*Outcome data and results of non-randomised studies*

| Author | Outcome domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Belgrave (2011) | Psychosocial Well-being | Loyola generativity scale | Intergenerational | 36.71 (10.83) | 39.29 (6.45) | _ | _ | _ | Difference between post intervention scores non-significant $U(14,12) = 68$, $p > 0.05$ | Baseline T1 = post intervention (week 13) |
| | | | Control | 36 (8.21) | 35.33 (10.14) | _ | _ | _ | | |
| | | Rosenberg self-esteem scale | Intergenerational | 22.14 (3.74) | 24.71 (4.23) | _ | _ | _ | Difference between post intervention scores non-significant $U(14,12) = 68$, $p > 0.05$ | |
| | | | Control | 24.92 (3.4) | 23.25 (4.25) | _ | _ | _ | | |
| Brothers & Diehl (2017) | Age Stereotypes | AARC - Gains (VoA) | NVoA | 17.67 (2.83) | 20.58 (2.46) | 19.21 (3.47) | _ | _ | Significant increase over intervention period, $F(2,102) = 24.32$, $p < 0.001$, $n^2_p = 0.32$ Significant improvement weeks 0 - 4 & weeks 0 - 12 ($p < 0.05$) but significant decline weeks 4 -12 ($p < 0.05$) | Baseline T1 = week 4 T2 = 4 weeks after intervention finished/week 12 |
| | | AARC - Losses (VoA) | NVoA | 11.08 (3.45) | 10.83 (2.46) | 10.02 (3.76) | _ | _ | Significant decrease over intervention period, $F(2,102) = 3.73$, $p < 0.028$, $n^2_p = 0.07$ Significant improvement weeks 0 - 12 ($p < 0.05$) | |
| | | Expectations regarding ageing | NVoA | 50.18 (16.58) | 64.05 (16.39) | 60.04 (18.2) | _ | _ | Significant improvement over intervention period, $F(2,102) = 26.15$, $p < 0.001$, $n^2_p = 0.34$ Significant improvement weeks 0 - 4 & weeks 0 - 12 ($p < 0.05$) but significant decline weeks 4 - 12 ($p < 0.05$) | |
| | | VoA Scale | NVoA | 40.85 (7.14) | 47.7 (7.64) | 43.5 (7.3) | _ | _ | Significantly more positive over intervention period, $F(2,102) = 22.70$, $p < 0.001$, $n^2_p = 0.31$ Significant improvement weeks 0 - 4 ($p < 0.05$) but significant decline weeks 4 -12 ($p < 0.05$) | |
| | Physical Activity | Self-report (mean mins /week) | NVoA | 84.95 (91.17) | _ | 171.55 (97.26) | _ | _ | Result only for $n = 50$ Significant increase over intervention period, $F(2,98) = 24.70$, $p < 0.001$, $n^2_p = 0.34$ | |

Table 3.3

*Outcome data and results of non-randomised studies*

| Author | Outcome domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Fujiwara et al. (2009) | Physical Function | Usual walk speed (m/min) | Intergenerational | 86.9 (12.3) | 92.1 (15.3) | _ | _ | _ | Main effect of group non-significant | Baseline T1 = 9 months |
| | | | Control | 81 (11.8) | 88.2 (15.6) | _ | _ | _ | | |
| | | Hand grip strength (kg) | Intergenerational | 25.7 (6.8) | 25.4 (6.4) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 26.6 (5.9) | 25.1 (6.7) | _ | _ | _ | | |
| | Subjective Health | Self-rated health | Intergenerational | 1.9 (0.6) | 2.1 (0.7) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 2.1 (0.5) | 2 (0.6) | _ | _ | _ | | |

Table 3.3

*Outcome data and results non-randomised studies continued*

| Author | Outcome domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Sakurai et al. (2016) | Psychological Well-being | Geriatric Depression Scale | Intergenerational | 2.5 (2.1) | 2.3 (2.2) | _ | _ | _ | Main effect of group non-significant | Baseline T1 = 7 years |
| | | | Control | 3 (2.4) | 2.9 (2.9) | _ | _ | _ | | |
| | | Rosenberg self-esteem scale | Intergenerational | 4.1 (1.5) | 4.4 (1.5) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 4 (1.6) | 4.3 (1.6) | _ | _ | _ | | |
| | Physical Function (*n* = 147) | Hand grip strength (kg) | Intergenerational | 24.7 (6.6) | 22.9 (6.1) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 26.2 (6.8) | 23 (6.5) | _ | _ | _ | | |
| | | Usual walk speed (m /min) | Intergenerational | 88.5 (12.3) | 88.8 (17) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 86.6 (11.8) | 89.9 (14.2) | _ | _ | _ | | |
| | | Maximum walk speed (m/min) | Intergenerational | 133.4 (20.3) | 134.1 (22.1) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 129.9 (17.1) | 131.9 (22.4) | _ | _ | _ | | |
| | | One leg stand (seconds) | Intergenerational | 51.7 (16.9) | 45.4 (19.7) | _ | _ | _ | Main effect of group non-significant | |
| | | | Control | 50.8 (17.6) | 46.4 (19.7) | _ | _ | _ | | |
| | | Functional reach (cm) | Intergenerational | 38.9 (6.7) | 37.4 (6.7) | _ | _ | _ | Significant effect for group at follow-up ($p < 0.01$) | |
| | | | Control | 38.5 (5.7) | 34.7 (6.2) | _ | _ | _ | | |

*Note:* AARC = awareness of age-related change; cm = centimetres; kg = kilograms; *M* = mean; m = metres; min = minutes; n = number; NVoA = negative view-on-ageing; *SD* = standard deviation; SPA = self-perceptions of ageing; VoA = views-on-ageing

Table 3.4

*Outcome data and results of RCTs*

| Author | Outcome domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Beyer et al. (2019) | Physical Function | SPPB | Exercise +SPA | 8.66 (1.7) | _ | _ | 10.32 (1.42) | _ | Significant latent change from baseline to T3 across whole sample *B* = 1.31, SE = 0.26, *p* < 0.01. Group variable did not predict change between baseline & T3, *B* = 0.02, SE = 0.19, *p* = 0.92. Group variable did not predict intercept at T1, *B* = -0.04, SE = 0.17, *p* < 0.01 | Baseline (3 weeks before intervention started)<br>T1 = week 6 (mid intervention/week 8)<br>T2 = week 12 (end of intervention/week 14)<br>T3 = 4 weeks after intervention finished /week 18 |
| | | | Exercise Only | 8.76 (1.63) | _ | _ | 10.04 (1.78) | _ | | |
| | Psychological Well-being | CES-D | Exercise +SPA | 1.64 (0.3) | _ | _ | 1.54 (0.37) | _ | Group variable significantly predicted change between baseline and T3, *B* = -0.38, SE = 0.14, *p* < 0.01. Group variable significantly predicted intercept at T3, *B* = 0.31, SE = 0.11, *p* < 0.01 | |
| | | | Exercise Only | 1.67 (0.42) | _ | _ | 1.71 (0.3) | _ | | |
| | Age Stereotypes | Adapted AgeCog Battery (SPA) - Ongoing Development | Exercise +SPA | 2.22 (0.48) | 2.31 (0.36) | 2.39 (0.5) | 2.28 (0.41) | _ | Group significantly predicted change from baseline - T2, *B* = 0.35, SE = 0.14, *p* = 0.01. Group variable significantly predicted intercept at T2, *B* = 0.27, SE = 0.13, *p* = 0.03 Significant effect T1 - T2, *B* = 0.34, SE = 0.13, *p* = 0.01 not baseline - T1, *B* = 0.04, SE = 0.18, *p* = 0.85. Group effect decreased but still significant T2 - T3, *B* = -0.37, SE = 0.16, *p* = 0.02 | |
| | | | Exercise Only | 2.29 (0.57) | 2.32 (0.56) | 2.23 (0.48) | 2.23 (0.56) | _ | | |
| | | Adapted AgeCog Battery (SPA) - Physical Losses | Exercise +SPA | 3.06 (0.33) | 2.92 (0.32) | 2.83 (0.28) | 2.86 (0.37) | _ | Group variable significantly predicted change from baseline to T2, *B* = -0.29, SE = 0.14, *p* = 0.03. Group variable did not predict intercept at T2, *B* = 0.06, SE = 0.17, *p* = 0.74<br>Significant effect occurred between T1 & T2, *B* = -0.34, SE = 0.14, *p* = 0.02 not baseline to T1, *B* = -0.01, SE = 0.16, *p* = 0.96. Significant effect not maintained between T2 & T3 | |
| | | | Exercise Only | 2.9 (0.47) | 2.81 (0.42) | 2.85 (0.44) | 2.85 (0.43) | _ | | |

Table 3.4

*Outcome data and results of RCTs continued*

| Author | Outcome domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Émile et al. (2014) | Age Stereotypes | ASES - Psychological barriers (VoA) | Exercise +CSI | 4.63 (1.09) | 5.07 (1.42) | _ | _ | _ | No reported group effect | Baseline T1 = 3 months |
| | | | Control | 4.7 (0.99) | 4.61 (0.77) | _ | _ | _ | | |
| | | ASES - Perceived Benefits (VoA) | Exercise +CSI | 5.98 (1.12) | 6.52 (0.56) | _ | _ | _ | Significant group effect, $F(1,49) = 28.08$, $p < 0.01$, $n^2 = 0.36$ | |
| | | | Control | 5.79 (0.87) | 5.71 (0.76) | _ | _ | _ | | |
| | | ASES - Perceived risks (VoA) | Exercise +CSI | 3.73 (1.36) | 2.86 (1.48) | _ | _ | _ | Significant group effect, $F(1,49) = 11.29$, $p < 0.01$, $n^2 = 0.19$ | |
| | | | Control | 3.34 (0.93) | 3.71 (1) | _ | _ | _ | | |
| | Quality of Life | WHO-QoL26 Physical Health | Exercise +CSI | 3.96 (0.66) | 4.25 (0.79) | _ | _ | _ | Trend for group effect, $F(1,49) = 3.56$, $p = 0.06$, $n^2 = 0.07$ | |
| | | | Control | 4.16 (0.89) | 4.03 (0.85) | _ | _ | _ | | |
| | | WHO-QoL26 Psychological Health | Exercise +CSI | 4.36 (0.86) | 4.68 (0.79) | _ | _ | _ | Trend for group effect, $F(1,49) = 3.28$, $p = 0.07$, $n^2 = 0.06$ | |
| | | | Control | 4.12 (1.15) | 4.22 (1.1) | _ | _ | _ | | |
| | Physical Activity | 6MWT (m) | Exercise +CSI | 183.97 (54.55) | 203.82 (55.47) | _ | _ | _ | Significant group effect, $F(1,49) = 58.26$, $p < 0.001$, $n^2 = 0.54$ | |
| | | | Control | 185.83 (42.09) | 180.83 (41.52) | _ | _ | _ | | |
| | | Physical Activity Score | Exercise +CSI | 10.56 (3.33) | 12.5 (3.53) | _ | _ | _ | Significant group effect, $F(1,49) = 71.85$, $p < 0.001$, $n^2 = 0.59$ | |
| | | | Control | 12.5 (3.53) | 12.39 (3.91) | _ | _ | _ | | |

Table 3.4

*Outcome data and results RCTs continued*

| Author | Outcome Domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Klusmann et al. (2012) | Age Stereotypes | Age Dissatisfaction Questionnaire (SPA) | Exercise | no data | 14.64 (4.32) | _ | _ | _ | Significant main effect for group, $F(2,225) = 5.39$, $n^2_p = 0.05$, $p = 0.05$<br>Change significantly lower in exercise group compared to passive control group ($B = -1.67$, SE = 0.52, 95% CI [-2.70 to -0.64], $n^2_p = 0.04$) and active control group ($B = -1.11$, SE = 0.50, 95% CI [-2.10 to -0.12], $n^2_p = 0.02$) | Baseline<br>T1 = 6 months |
| | | | Active Control | no data | 15.95 (4.57) | _ | _ | _ | | |
| | | | Passive Control | no data | 15.51 (4.3) | _ | _ | _ | | |
| Levy et al. (2014)[a] | Age Stereotypes | Images of ageing (Positive VoA) | Implicit Positive | 55.62 (1.52) | 63.36 (1.86) | 61.2 (2.05) | 61.56 (2.05) | _ | Implicit positive intervention significantly strengthened positive VoA, $F(1,164) = 7.42$, $n^2_p = 0.065$, 95% CI [0.009 - 0.16], $p = 0.004$<br>Explicit positive intervention strengthened positive VoA, $F(1,162) = 6.09$, $n^2_p = 0.05$, 95% CI [0.010 - 0.120], $p = 0.01$<br>Even though both effects significant, influence of implicit intervention 30% greater. | Baseline (week 1)<br>T1 = week 5<br>T2 = week 6<br>T3 = week 8 |
| | | | Control | 54.54 (1.41) | 54.9 (1.49) | 55.44 (1.55) | 55.8 (1.66) | _ | | |
| | | Images of ageing (Negative VoA) | Implicit Positive | 29.88 (1.13) | 26.28 (1.55) | 28.44 (1.61) | 27.63 (1.51) | _ | Implicit positive intervention significantly weakened negative VoA, $F(1,162) = 3.30$, $n^2_p = 0.04$, 95% CI [0.008 - 0.113], $p = 0.04$ | |
| | | | Control | 31.68 (1.22) | 32.04 (1.04) | 30.51 (1.41) | 30.69 (1.22) | _ | | |
| | | Images of ageing (Positive SPA) | Implicit Positive | 76.32 (1.96) | 80.1 (2.2) | 79.74 (1.88) | 81.54 (1.91) | _ | Implicit positive intervention significantly strengthened positive SPA, $F(1,164) = 6.01$, $n^2_p = 0.051$, 95% CI [0.005 - 0.142], $p = 0.008$. No significant reported effect of the explicit intervention | |
| | | | Control | 74.88 (1.85) | 75.42 (2.14) | 73.44 (2.01) | 74.34 (2.23) | _ | | |
| | | Images of ageing (Negative SPA) | Implicit Positive | 16.65 (1.34) | 15.57 (1.38) | 15.93 (1.23) | 14.22 (1.25) | _ | Implicit positive intervention significantly weakened negative SPA, $F(1,162) = 3.65$, $n^2_p = 0.03$, 95% CI [0.001 - 0.111], $p = 0.03$ | |
| | | | Control | 18.54 (1.28) | 18.99 (1.52) | 19.17 (1.26) | 18.72 (1.41) | _ | | |
| | Physical Function | SPPB | Implicit Positive | 6.94 (0.47) | 7.61 (0.54) | 7.81 (0.49) | 8.28 (0.46) | _ | Implicit positive intervention significantly strengthened physical function, $F(1,164) = 5.93$, $n^2_p = 0.08$, 95% CI [0.023 - 0.118], $p = 0.008$. No significant reported effect of the explicit intervention | |
| | | | Control | 7 (0.56) | 7.15 (0.55) | 7.12 (0.52) | 7.09 (0.55) | _ | | |

Table 3.4

*Outcome data and results RCTs continued*

| Author | Outcome Domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Warner et al. (2016) | Physical Activity | Priscus PA Questionnaire (weekly mins) | Intervention +VoA | 219.09 (31.83) | 218.84 (29.44) | 219.29 (32.69) | 208.26 (21.33) | 213.91 (27.73) | Only significant difference in self report PA between the 2 intervention groups in favour of Intervention +Planning group between baseline & T4, $B$ = 0.24, SE = 0.10, $p$ = 0.01, $n^2$ = 0.058 | Baseline (intervention 5 weeks after baseline)<br>T1 = 7 weeks after baseline<br>T2 = 11 weeks after baseline<br>T3 = 10 months after baseline<br>T4 = 14 months after baseline |
| | | | Intervention +Planning | 214.82 (28.81) | 210.03 (22.06) | 215.2 (19.58) | 213.61 (30.29) | 229.04 (33.55) | | |
| | | | Active Control Group | 222.57 (27.16) | 223.13 (31.49) | 220.98 (31.23) | 213.41 (28.53) | 218.9 (24.2) | | |
| | | | Passive Control Group | 214.25 (29.21) | 214.14 (27.22) | 215.21 (29.03) | 208.49 (29.45) | 213.57 (30.35) | | |
| | | MVPA/week via accelerometery (only for n = 153) | Intervention +VoA | 43.82 (68.76) | _ | 40.32 (53.56) | _ | _ | Main effect of group non-significant | |
| | | | Intervention +Planning | 60.9 (64.71) | _ | 77.3 (54.41) | _ | _ | | |
| | | | Active Control Group | 66.84 (70.83) | _ | 63.68 (74.21) | _ | _ | | |
| | | | Passive Control Group | 59.1 (77.77) | _ | 49.95 (67.04) | _ | _ | | |

Table 3.4

*Outcome data and results RCTs continued*

| Author | Outcome Domain | Outcome measure | Group | Baseline *M (SD)* | T1 *M (SD)* | T2 *M (SD)* | T3 *M (SD)* | T4 *M (SD)* | Analysis of results | Time points reported |
|---|---|---|---|---|---|---|---|---|---|---|
| Wolff et al. (2014) | Physical Activity | Priscus PA Questionnaire (MET mins/week) | Intervention +VoA | 16.86 (8.05) | 16.36 (9.46) | 16.86 (8.59) | 16.85 (8.52) | _ | Indirect effect from Intervention +VoA (vs control) to change in PA via change in integrity marginally significant, *B* = 0.03, 90% CI [0.01 - 0.07], *p* = 0.7; for mean change in integrity (*b* = 0.41), physical activity levels are predicted to increase by 0.7 h per week | Baseline (intervention 5 weeks after baseline)<br>T1 = 7 weeks after baseline<br>T2 = 11 weeks after baseline<br>T3 = 10 months after baseline<br>T4 = 14 months after baseline |
| | | | Intervention +Planning | 12.54 (7.2) | 14.32 (6.54) | 16.67 (6.17) | 17.03 (10.11) | _ | | |
| | | | Active Control | 15.76 (6.18) | 13.44 8.08 | 17.35 9.65 | 15.56 8.67 | _ | | |
| | Age Stereotypes | GSD - Integrity (VoA) | Intervention +VoA | 4.12 (1.2) | 4.08 1.26 | 4.26 1.29 | 4.33 1.26 | _ | Significant intervention effect for Control group vs Intervention +VoA on integrity scale at T2 (week 11) *B* = -0.14, SE = 0.07, *p* = 0.3; significant intervention effect for Intervention +Planning vs Intervention +VoA on integrity scale, T2 (week 11) *B* = -0.1, SE = 0.04, *p* = 0.3; Intervention +VoA had more positive attitudes towards older adults (on the integrity scale) at end of intervention compared to control from baseline to T2, *B* = 0.17, *p* = 0.1; change in physical activity from baseline to T2 did not predict change in integrity from T2 to T3, *B* = 0.05, *p* = 0.53; change in integrity (baseline to T3) predicted change in physical activity from T2 to T3 (week 11 to 10 months) *B* = 0.2, *p* = 0.01 | |
| | | | Intervention +Planning | 4.07 (0.76 | 3.98 1.04 | 4.15 1.15 | 4.07 0.9 | _ | | |
| | | | Active Control | 4.23 (1.43) | 4.06 1.07 | 4.13 1.25 | 4.44 1.21 | _ | | |
| | | GSD - Autonomy (VoA) | Intervention +VoA | 4.12 (1.2) | 4.15 1.3 | 4.06 1.26 | 4.21 1.25 | _ | | |
| | | | Intervention +Planning | 4.07 (0.76) | 4.14 1 | 4.06 1.1 | 3.99 0.95 | _ | | |
| | | | Active Control | 4.2 (1.33) | 4.23 1.03 | 4.1 1.22 | 4.34 1.21 | _ | | |
| | | GSD - Acceptability (VoA) | Intervention +VoA | 4.04 (1.19) | 3.97 1.2 | 4.04 1.24 | 4.24 1.22 | _ | | |
| | | | Intervention +Planning | 4.22 (0.99) | 4.15 1.07 | 4.28 0.8 | 4.07 0.88 | _ | | |
| | | | Active Control | 4.05 (1.17) | 4.06 1.02 | 4.02 1.12 | 4.33 1.16 | _ | | |
| | | GSD - Instrumentability (VoA) | Intervention +VoA | 4.17 (1.15) | 4.33 1.12 | 4.33 1.2 | 4.3 1.19 | _ | | |
| | | | Intervention +Planning | 4.12 (0.91) | 3.98 (1.16) | 4.09 (0.97) | 4.04 (0.86) | _ | | |
| | | | Active Control | 4.38 (1.2) | 4.36 (0.99) | 4.21 (1.03) | 4.4 (1.18) | _ | | |

*Note:* ASES = age stereotype and exercise scale; CES-D = Center for Epidemiologic Studies Depression Scale; CI = confidence interval; cm = centimetres; CSI = counter-stereotypical information; GSD = German Semantic Differential; kg = kilograms; m = metres; min = minutes; MET = metabolic equivalent; MVPA = moderate-to-vigorous physical activity; *n* = number; PA = physical activity; QoL = quality of life; SE = standard error; SPA = self-perceptions of ageing; SPPB = short physical performance battery; VoA = views-on-ageing; WHO = World Health Organization; 6MWT = six minute walk test. [a]Levy et al. 2014 figure in parenthesis = SE not SD, no mean data presented for the explicit-positive prime group, no mean data or results presented for implicit-positive plus explicit-positive prime group.

# Chapter 4

# Defining and Designing the Intervention

*Commencing with clarification of the identified research gap, the content of this chapter concludes with the developmental stages of the Multi-stage Process Model outlined in Chapter 1. The merits of underpinning the overall intervention design with evidence and theory have already been reviewed, therefore this chapter identifies relevant theories, frameworks, and models, and discusses how these may facilitate intervention development. Having narrowed these down, a logic model is presented that has been used to hypothesise how each component of the model may interlink, and ultimately achieve changes in the targeted outcomes. Based on this model, and, with due consideration of additionally identified environmental and contextual factors that could facilitate or provide barriers to success, an intervention was developed.*

*From the outset of this research, it was the researcher's aim to 'site' this intervention within the 'real-world' utilising technological components already available within the public domain. The rationale behind this approach, the systematic processes undertaken to identify appropriate components, the issues that arose, and, how these were overcome are subsequently discussed. To conclude, the finalised intervention structure is presented along with the recommended breakdown of incorporated BCTs (Michie et al., 2013). Due to the use of readily available technology, a significant proportion of the included techniques were pre-defined, and, therefore not specifically identified as optimal, tied to, or driven by a particular theory of behaviour change. The implications of this factor are considered.*

## 4.1 Determining the Research Gap

The findings of the literature and systematic reviews indicate that stereotypes of ageing can have a detrimental impact on health-related outcomes and behaviours in older adults (i.e., Levy & Myers, 2004; Wurm et al., 2010). However, the processes and mechanisms at work are complex. For example, although within certain domains, the negative effects of inducing stereotype threat have been consistently demonstrated (i.e., cognition and memory, for a review see Armstrong et al., 2017), within the physical domain the results are not as clear. Not only are the short-term effects on physical function inconclusive (see Chapter 2, section 2.2.2), so are the results of preliminary work that has looked at underpinning physical activity interventions with strategies to promote positive or challenge negative stereotype constructs (see Chapter 3).

Intergenerational contact and the utilisation of '*programmes*' driven by this construct have, to a degree, been successfully implemented as a way to improve children's attitudes towards older adults (Drury et al., 2016; Dunham & Casadonte, 2009); whether comparable effects are achievable on older adults' views-on-ageing and/or self-perceptions of ageing has not been determined. Intergenerational contact also presents an under-explored opportunity to promote active ageing and facilitate engagement in positive health behaviours (Martins et al., 2019).

Within this genre of research, there are two identifiable streams of approach. First, that led by researchers whose primary interest is the manipulation of age stereotypes, for example experimental laboratory-based work that looks at the immediate short-term effects of intergenerational contact on manipulations of stereotype threat (i.e., Abrams et al., 2006; Abrams et al., 2008; Drury et al., 2018). Second, that led by researchers whose primary focus is the impact that intergenerational programmes delivered in real-world settings have on intergroup attitudes and targeted outcomes. These often have an educational or arts-based focus (for a review see Martins et al., 2019), and where health-related outcomes have been measured it is as a by-product, not as the driving focus of the intervention (e.g., Fujiwara et al., 2009; Sakurai et al., 2016).

It is proposed that the exploration of utilising an intergenerational intervention specifically designed to target physical activity behaviour is warranted. There is also a need to review which age stereotype construct intergenerational contact has the

greatest effect on, and whether any observed effect could be responsible for mediating the magnitude of any change in physical activity level.

## 4.2 Theory Identification

Despite the increasing popularity of intergenerational practices, reported developments often lack the use of theory, a strong conceptual framework, and an outcome driven evidence-base (Jarrott, 2011; Jarrott, Stremmel, & Naar, 2019). It is however suggested, that to ensure effectiveness, where theory is going to be incorporated within intervention or programme development, it should be underpinned by intergenerational principles, and, that alternative theories, for example educational (or indeed potentially stereotype or behavioural focused) are just used to reinforce 'why' intergenerational contact should be promoted, as they do not address 'how' it should be implemented to obtain the greatest effects (Jarrott & Smith, 2011). Applying theory that specifically targets intergenerational principles could therefore not only enhance understanding of the mechanisms at work, but also our ability to optimally facilitate behaviour change.

Kuehne and Melville (2014) reviewed all intergenerational programme literature available between 2003 and 2014, regardless of methodology, to establish which theories are most commonly used, why, how they were applied, and any associated issues. From 56 articles, excluding those where contact was familial, the authors classified theories and frameworks as those that focused exclusively on individual development ($n$ = 3), and those that focused on both individuals and groups within interactive contexts ($n$ = 8). For a summary see Box 4.1. The most frequently cited theoretical underpinnings were Contact Theory (Allport, 1954) and the work of Erikson (1963) based on the notion of generativity. From their findings, the authors suggest several different theoretical approaches to intergenerational research that could warrant further exploration to gain a greater understanding of how the effects of intergenerational practices occur, and therefore can be optimised. These include proposing, the need to develop a new unique theory, the blending together of more than one theory, or the use of a grounded theory-based approach.

Box 4.1 *Classification of theories (adapted from Kuehne & Melville, 2014)*

**Individual Development**

Human Development Theory (primarily based on the generativity versus stagnation stage of psychosocial development; Erikson, 1963)

Theory of Personhood (Kitewood, 1997)

Conceptually based programme evaluations (primarily atheoretical, but with evidence of an individualised design or evaluation model/framework)

**Individuals and Groups**

Contact Theory (Allport, 1954)

Social Capital Theory (Coleman, 1988)

Social Organisation Perspective, Community Capacity Framework (Jarrott et al., 2011)

Situated Learning Theory (Lave & Wenger, 1991; Wenger, 1998)

Relational Theory (Miller, 1976)

Intergenerational Communication Theory (Ryan, Hummert, & Boich, 1995)

Empowerment Theory (Lawrence-Jacobson, 2006)

Vygotskian Theory (Vygotsky, 1986)

In a more recent systematic review, Martins et al. (2019) used this classification to analyse intergenerational programme research published between 2008 and 2016. Narrowing their focus, only studies of interventions that involved older adults (aged ≥ 50 years) and young people (aged ≤ 30 years) and reported measures of outcome effectiveness were included. In this instance, only five of the original pertinent theories from the classification outlined by Kuehne and Melville (2014) were identified; Empowerment Theory (Zimmerman, 2000), Situated Learning Theory (Lave & Wenger, 1991), Social Capital Theory (Coleman, 1988), Contact Theory (Allport, 1954), and Human Development Theory, with Personality Theory[5] additionally identified within the individual development category. Whilst each of these theories has been associated with effect generation, the environments, and contexts in which they may prove the most beneficial differ.

[5] As no further details were supplied pertaining to which specific personality theory this refers to, and this could not be established through reviewing the two articles cited by the authors, this has been excluded from any further discussion.

### 4.2.1 Empowerment Theory.

Where Empowerment Theory (Zimmermann, 2000) has underpinned success, it has been situated within local community initiatives targeting group involvement (i.e., Lawrence-Jacobson, 2006). The major driver behind this theory is to provide marginalised individuals with equal access to, and control of, resources. Therefore, for empowerment to be effective within an intergenerational context, there needs to be a clearly identified issue which is deemed equally important and/or will generate mutual benefits for both generations (Lawrence-Jacobson, 2006). To successfully target this concept of shared responsibility at an individual level, Zimmerman (2000) outlines three core dimensions: (1) critical awareness of the environment must be gained – *interactional dimension*, (2) a sense of individual control needs to be achieved – *intrapersonal dimension*, and (3) actions need to be exerted that allow individuals to take control over their environment - *behavioural dimension*.

### 4.2.2 Situated Learning Theory.

Primarily focused on education, this theory again was developed for application within community settings. Learning is viewed as a social process, that should be delivered in the same place that it is used. Lave and Wenger (1991) set out four key facilitators: learning should be delivered via an apprentice style approach; the context of application should be realistic; primary learning should be through observation and guided work, and only when confidence has been built should the mentor start to gradually relinquish responsibilities.

### 4.2.3 Social Capital Theory.

Facilitated learning through the pursuit of joint goals sits at the centre of this theoretical approach. It is suggested that positive social capital can be gained within intergenerational practices through the generation of communication networks, trust and improved social norms (Boström, 2003; 2009). The ethos of social capital is that it consists of an element of social structuring, and that it is a productive process that leads to the achievement of goals or outcomes that would otherwise not be possible (Coleman, 1988). To be effective there must be a degree of trustworthiness in the social

environment, an understanding of obligations and expectations, and appropriate social organisation.

### 4.2.4 Contact Theory.

The most frequently cited theory across research with an intergenerational focus (for reviews, see Kuehne & Melville, 2014; Martins et al., 2019), Contact Theory, originally developed by Allport (1954) supports the benefits of social contact between different groups. Often associated with reductions in prejudices, prior research both within and outside of laboratory settings has focused on its ability to change negative attitudes and reduce the impact or threat of stigma. Comparable outcomes have been reported where contact is structured or unstructured (Pettigrew & Tropp, 2006). However, Allport (1954) suggests that we are inherently more sensitive to factors that conform to our negative perceptions and stereotypes, and that casual contact can be superficial and therefore a potential source of increased, not decreased prejudices. Indeed, it is suggested that "true acquaintance" (Allport, 1954, p. 264) is needed if stereotypes are to be effectively challenged.

As one of the more detailed theories, four core conditions are outlined to optimise the effects of contact, a component that Jarrott and Smith (2010) postulate is often neglected in the application of other theories to intergenerational practices. These components are equal group status, between group cooperation, seeking to achieve common goals, and support from appropriate social and institutional authorities (i.e., policy makers, local councils, family units). To-date the majority of intergenerational research based on the components of Contact Theory (Allport, 1954), has been heavily facilitated by the researcher(s) or third parties and driven either by volunteering within educational facilities, or educational-based activities in other settings. Indeed, all five studies identified by Martins et al. (2019) adopted these approaches. In these studies, the measured outcomes aligned with Allport's beliefs regarding the ability of contact to change stereotypical attitudes.

A number of extensions or alternative approaches to facilitate effects have been suggested. Where Pettigrew (1998) suggests the addition of a fifth condition for success, cross-group friendships, others suggest that when opportunities for positive contact through direct, face-to-face contact are limited, different variations of indirect contact,

may be beneficial. Merely having knowledge that a member of your ingroup has a positive relationship with an outgroup member is proposed to improve attitudes through the concept of extended contact (Wright et al., 1997). Indeed, it is also proposed that actually experiencing any form of contact may not be necessary, and that simply imagining contact may be sufficient (Crisp & Turner, 2009). The most recent addition is virtual contact, where technological interfaces could be used to enable interaction, for example via the internet or messaging platforms (Amichai-Hamburger & McKenna, 2017).

It is postulated that the conceptual principles of this theory could potentially, either directly, or indirectly through changes in attitudes and reductions in stereotype threat, be an effective method to target health-related variables in older adults. The experimental laboratory-based studies conducted by Abrams and colleagues (previously identified in section 4.1), bear reference to the extended version outlined by Pettigrew (1998), Intergroup Contact Theory. The authors found that in older adults, positive contact was associated with the suppression of stereotype threat and greater cognitive performance (Abrams et al., 2006; Abrams et al., 2008).

#### 4.2.5 Human Development Theory.

Generativity, or the process of 'giving' to other or future generations, as identified by Erikson (1963) as the seventh stage of psychosocial development, is often a prominent citation in any discussions about intergenerational practices (Kuehne & Melville, 2014). Supporters of this approach suggested that the utilisation of intergenerational contact provides a unique opportunity for generational synergy that can subsequently target the needs of different generations at the same time (Giraudeau & Bailly, 2019). This theory underpinned the work of Fujiwara et al. (2009). A volunteering intervention was implemented under the premise that improvements in health-related variables for older adults could be indirectly achieved through the facilitation of situations where they contributed to the development of children through educational activities and the sharing of cultural values.

### 4.2.6 Theoretical approach.

Deciding which theory is used to underpin the development of an intervention should ultimately be led by the aims and targeted outcomes. The key criteria used to select the most appropriate theory are outlined and mapped against each of the theories discussed in Table 4.1. In this instance, the parameters of Contact Theory (Allport, 1954) provide the most optimal structure. Whilst it focuses on and was established to pursue a reduction in prejudice, within this research it is being used under the premise that: (A) it may have a direct effect on age stereotypes, (B) the direct effect of reducing associated prejudices may facilitate and/or mediate a change in health-related behaviour, and, (C) from previous research it is unclear which stereotype mechanism (if any) may be responsible for any associated changes, therefore any observed change could be a direct consequence of contact. It is also proposed that Contact Theory (Allport, 1954) could provide an alternative direct route to facilitating behaviour change in older adults, independent of any change in stereotype constructs.

Table 4.1

*Outline of key criteria used to select the optimal theory*

| Criteria for theory selection | Theory |
|---|---|
| Potential to affect age stereotypes | Contact Theory (Allport, 1954) |
| Potential to target specific health-related outcomes | Contact Theory (Allport, 1954)<br>Human Development Theory (Erikson, 1963) |
| Potential to specifically target intergenerational principles/contact | Contact Theory (Allport, 1954)<br>Empowerment Theory (Lawrence-Jacobson, 2006)<br>Situated Learning Theory (Lave & Wenger, 1991; Wenger, 1998)<br>Social Capital Theory (Coleman, 1988)<br>Human Development Theory (Erikson, 1963) |
| Focuses on both the individual the group/dyad within an interactive context | Contact Theory (Allport, 1954)<br>Empowerment Theory (Lawrence-Jacobson, 2006)<br>Situated Learning Theory (Lave & Wenger, 1991; Wenger, 1998)<br>Social Capital Theory (Coleman, 1988) |
| Pursuit of joint goals/an issue that will generate mutual benefits | Contact Theory (Allport, 1954)<br>Empowerment Theory (Lawrence-Jacobson, 2006)<br>Social Capital Theory (Coleman, 1988)<br>Human Development Theory (Erikson, 1963) |

## 4.3 Logic Model

Figure 4.1 outlines the preliminary logic model developed to illustrate the concepts discussed, their potential roles, and the proposed interactions.

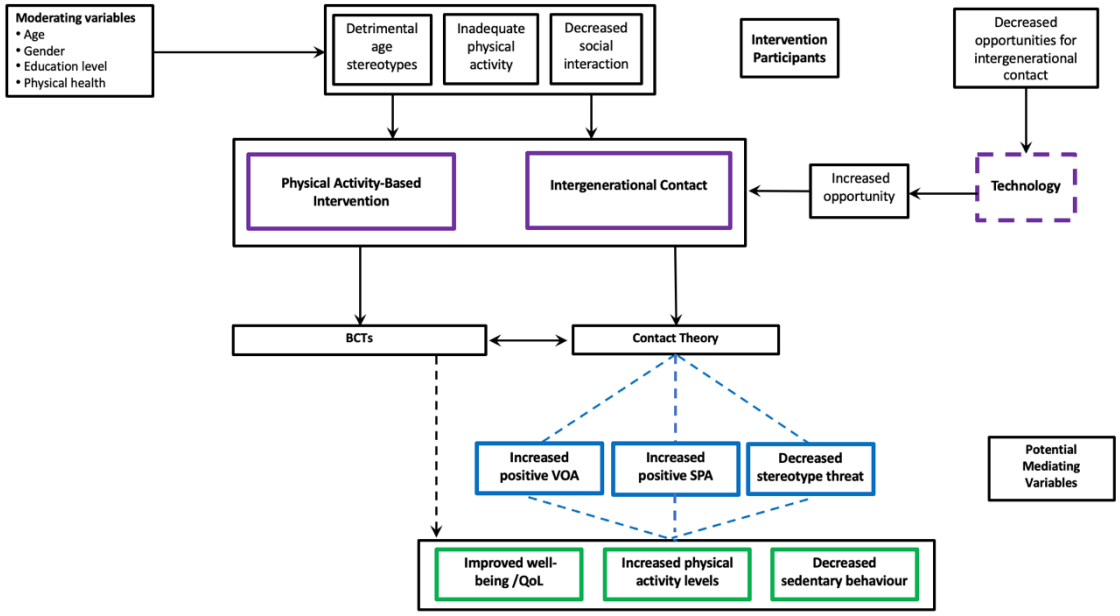


*Figure 4.1.* Preliminary conceptual logic model of technology-driven intergenerational physical activity intervention

*Note:* BCTs = behaviour change techniques; QoL = quality of life; SPA = self-perceptions of ageing; VOA = views-on-ageing

## 4.4 Environmental and Context Assessment

An issue regularly raised within the research community is how to successfully translate and implement interventions that have demonstrated '*experimental*' promise into the '*real-world*' and everyday life (e.g., Ziemann et al., 2019). This issue could, in part, be attributable to a lack of sustainability (Rapport et al., 2018), therefore, the focus here was to develop an intervention based on components and strategies that would require minimal (if any) translational adaptations and could be easily accessible to the target population even when the research ended. Where interventions are developed from specifically allocated, time constrained budgets, when the research concludes and funding ends, often so do the resources to maintain, for example, the specialist website platforms that were constructed.

Being able to effectively address, manipulate or control many environmental or contextual factors is beyond the scope of a novice researcher (i.e., political, historical,

funding streams; Ziemann et al., 2019). From the outset, the parameters of this PhD funding defined that the following key components that had to be considered; physical activity levels in older adults had to be targeted via an intervention that incorporated technology and intergenerational contact (where the second generation was defined as children), and, consideration had been given to the role of age stereotypes. However, within the boundaries of these core components there are specific factors that warranted due consideration.

One such factor is the pre-known characteristics of the target population. Prior research has indicated that cost, ease of access, and transportation issues are often presented as barriers to older adults' engagement with physical activity and exercise (Boulton et al., 2018). Additionally, people in this age group do not want constraints placed on their time or current daily routines (Boulton et al., 2018), or to engage with activities that they do not perceive to be purposeful, functional (McGowen et al., 2018) and enjoyable (Devereux-Fitzgerald et al., 2016). These factors alone present a population where wide scale variability may be present and the need for individual choice vital.

When developing an intergenerational programme or intervention an important consideration is how to ensure its appropriateness, suitability, and meaning for both members of any potential partnership (Giraudeau & Bailly, 2019; Salari, 2002). The work of Salari (2002) indicates that intergenerational programme developers need to be mindful that the type of intervention utilised, and its structure needs to be equally amenable to both generations involved. Any sense of infantilization could have negative connotations for the older adults and lead to disengagement. The author also recommends that it should be ensured that the participation (of all parties involved) is voluntary.

Giraudeau and Bailly (2019) additionally identify the lack of knowledge about a co-participant as a potential barrier to success. Apprehension, particularly in relation to children, could be caused by a lack of familiarity between participants (Varma et al., 2004). Whilst some studies have endeavoured to overcome this by providing information about each participant to their allocated partner (Dunham & Casadonte, 2009; Lynott & Merola, 2007), using familial partnerships could also eliminate this issue. It is pertinent to note however, that it has been suggested that greater gains may be

observable when programmes or interventions include non-familiar pairings of non-adjacent generations (Martins et al., 2019), and, that the effects on change in attitudes towards older adults may not be as significant with related participants (Whiteland, 2016). Within the context of this research, the incorporation of technology further complicates the ability to address all of these factors and generate viable solutions.

When any technology is developed, it is presumed that it is done so following extensive research into the target market, and, hence constructed containing features and usability parameters specific to the target population. Unfortunately, there is currently a lack of mobile health technology products, particularly physical activity related, that target healthy ageing rather than the management of decline in the older adult population (Centre for Ageing Better, 2019). Web platforms, Apps, and the associated products and devices are often not designed to consider the needs of older adults, for example, potential eyesight or musculoskeletal limitations (Wildenbos, Peute, & Jaspers, 2018). Given that it is already established that cost can be a barrier to participation, the price of purchase, plus any associated additional costs (smart phone, internet connection) may limit the ability to make such technologies widely accessible (Carroll et al., 2017). Positively, within the UK, engagement with technology via internet usage in older adults is increasing. In 2020, 86% of 65- to-74-year-olds and 54% of adults aged > 75 years old were recent internet users (increasing from 61% and 29%, respectively in 2013), however, 11% of adults aged 65- to -74 years-old and 39% of adults > 75 years old have still never used the internet (ONS, 2021).

## 4.5 Defining the Intergenerational Partnership

In line with the definition provided by the WHO (2015), the intervention was developed to target older adults chronologically aged ≥ 65 years. Keeping within the PhD remit of utilising intergenerational contact with children to underpin the intervention structure, it was rationalised that dyads should be formed with children aged 7-11 years. Erickson's theory of Psychosocial Development (Erickson, 1963) postulates it is between the ages of 5-12 years, that children gain the ability to demonstrate competence, set and achieve goals, seek positive assessments of their behaviour, and intrinsically take pride in their behaviour. This range was subsequently narrowed on the premise of recruitment facilitation to coincide with UK Junior School years three to six.

Martins et al. (2019) concluded that intergenerational programmes were more likely to be effective if the pairings were unfamiliar with each other[6]. Options to allow this were explored, for example, through the inclusion of a parent, or the facilitation of indirect or imagined contact whereby participants could be blindly matched to work towards a collaborative challenge, receiving bi-weekly feedback on their dyad progress. However, the decision regarding whether non-familiar or familiar pairings would be pursued ultimately became an ethical issue. From an early point within the development process informal discussions were had with the Chair of the College of Engineering Research Ethics Committee regarding the nature of the research, particularly regarding the outlined age ranges of participants, and the use of technology to facilitate contact. Given that contact would potentially be unsupervised, and, participant led, even if indirect, the complexities surrounding this led to an agreement being reached where familial dyads would be targeted. However, the definition of familial was expanded to include not only family members, but also older adults 'familiar' to the child, if explicit consent to the pairing was obtained from the parent of the child.

## 4.6 Key Intervention Design Considerations

The prior sections of this chapter, coupled with the findings of the evidence review (Chapter 2) and systematic review (Chapter 3), raise a number of key design consideration factors. These are presented in Table 4.2 along with any additional pertinent points. From these, the decision was made to explore: (1) the options available to develop an intervention that could utilise a web-based platform or App to provide dyads with a collaborative physical activity challenge; (2) technology to facilitate the collection of activity data, and (3) ways that dyads could potentially work together remotely through virtual contact without the need to commit to and attend specifically outlined sessions or alter pre-established routines.

[6] It is pertinent to note all of the studies in the systematic review of Martin et al. (2019) that included children, were education, arts or culturally based, and set either within supervised group or education facilities.

Table 4.2

*Outline of key factors considered when determining the intervention plan*

| Factor | Consideration |
|---|---|
| Technological components | Available within the public domain<br>Low/no associated costs<br>Age appropriate<br>Avoidance of infantilization<br>Compliance with GDPR<br>Facilitation of intergenerational contact<br>Facilitate the completion of a physical activity driven collaborative task<br>Potential suitability and acceptability of activity monitors<br>Compatible with/available on both Android and iOS technology platforms<br>Technological literacy requirements |
| Activity type | Low specific commitment<br>Avoidance of need to travel to specific venues or locations<br>Flexible around pre-existing routines<br>Accommodates individual choice<br>Accommodates different abilities<br>Affords the participants equal status |
| Participants | Familial pairing<br>Older adults aged ≥ 65 years<br>Children aged 7-11 years<br>Parental oversight<br>Child protection |

*Note:* GDPR = General Data Protection Regulation (European Parliament and Council of European Union, 2016)

## 4.7 Identification of Options for the Technological Components

### 4.7.1 Web platforms and Apps.

In recent years there has been a sharp rise in the number of Apps and internet platforms designed to facilitate or help individuals monitor health-related behaviours, particularly physical activity, and exercise. The primary task within this section was to systematically identify and establish the viability and suitably of available options with due consideration as to how they: (1) align to aims the research; (2) align to the parameters of Contact Theory (Allport, 1954) and, (3) address the key factors outlined in Table 4.1. Following extensive searching and trialling during September 2018[7], four possibilities, *Muuvit, Big Team Challenge, World Walking, and Kiplin*, were deemed suitable for further exploration, and contact was made with each developer/company. In-depth discussions ensued and all available information was scrutinised. A summary is presented in Table 4.3.

### 4.7.2 Activity trackers.

All four identified web platforms/Apps were driven by the recording of daily activity in the format of step counts. The current market of available wearable activity trackers was therefore reviewed during October 2018. Three brands that manufactured devices suitable for use with adults and/or children were discovered, reviewed, and where appropriate tested for compatibility and usability - *Garmin*, *Fit Bit*, and *Mi Band*. A summary of the findings is presented in Table 4.4.

[7] All available physical activity/exercise/step tracker related Internet platforms or Apps on Android, iOS or Google were reviewed and if deemed potentially suitable trialed. Exact numbers were not recorded but it is estimated in excess of 150 different options were identified, with approximately 15-20 explored in greater depth.

Table 4.3

*Summary breakdown of the scrutinised physical activity driven web platforms and Apps*

| Platform | Operating System | Target Audience | Cost | Automatic Sync | Privacy Policy | Features | Barriers to use |
|---|---|---|---|---|---|---|---|
| Muuvit | Android, iOS, Web | School Children /Families | Estimated in excess of £10K for specific set up & usability amendment costs | No<br>Manual data input or sync via health kit on smartphone | Aged 4+ | Interactive around the world map challenge<br>Ability to work in pairs<br>Combined step totals<br>Ability to put multiplier in to alter time to complete<br>Set overall reward/daily step goal<br>Can be controlled by the researcher<br>Participants do not need email accounts to have access | Manual data input only<br>Lack of sync ability with wearables<br>Potential cost implications<br>Groups cannot set their own routes<br>Rewards are linked to 'classroom' type task completion<br><br>https://www.muuvit.com/uk |
| Big Team Challenge | Android, iOS, Web | Adults – Workplace teams | Cost per participant £8.00 | Fit Bit via App | Aged 16+ | Multiple route options visible on map & Google maps<br>Team challenge, each team can see others' results<br>Individualised platform<br>Ability for researcher to see how much contact with platform has been made<br>Participants need email account to operate | Privacy policy<br>Open access to other teams' data<br>Competitive rather than collaborative<br><br>https://www.bigteamchallenge.com |

Table 4.3 continued

*Summary breakdown of the scrutinised physical activity driven web platforms and Apps*

| Platform | Operating system | Target audience | Cost | Automatic sync | Privacy policy | Features | Barriers to use |
|---|---|---|---|---|---|---|---|
| World Walking | Android, iOS, Web | Any individual or group, originally geared towards aged 60+ | Free<br>Charity run | Fit Bit via App<br>Manual data entry via App or web | Aged 16+ | Multiple route options and lengths visible on map & Google maps<br>Can be closed participation/private groups<br>Use of display name to maintain anonymity<br>Researcher could be non-participatory member of each team so can view data<br>Rewards with medals and milestones<br>Need email account | Privacy policy<br>Adult would have to set up and have control of account<br>Only syncs with Fitbit<br>Unable to set specific daily goal targets within the platform<br>Would need to ask participants not to upload photos to maintain anonymity<br>Total step data summed with other groups<br>Developer may be able to manually count contacts<br><br>https://worldwalking.org/ |
| Kiplin | Web | Groups<br>Geared towards aged 18–65 years | Free for feasibility study<br><br>Minimum of 200 users<br>€6000 | Via Web login<br>Potentially could be used with multiple different tracker brands<br>App in development | Aged 13+ (for allowance of sync) | If longer than one month can complete different challenges<br>Basic map of route<br>Combined steps not competition<br>Need email account | Not orientated towards children<br>No option for manual data entry<br>Only solution would be for children to 'wear'/carry smart phone<br><br><br>https://movebox.kiplin.com/login |

Table 4.4

*Summary breakdown of the scrutinised wearable activity tracker devices and associated Apps*

| Brand | Operating system | Target audience | Available watches & cost | Associated App for syncing | Privacy policy | Key features | Overall comments |
|---|---|---|---|---|---|---|---|
| Garmin | Android, iOS, Windows | Adults | Vivo smart - £69.99 - £119.00<br>Fore Runner - £129.99<br>Others - £+++ | Garmin Connect | GDPR compliant | *ViVosmart:* Multiple versions, 7-day battery, HR monitor, vibration alerts, oxygen monitor<br>*Forerunner:* 5-day battery, GPS, smart alerts, calorie counting | Garmin contacted – unable to sync data from Garmin ViVofitjr App to third party platform<br>Cost implications<br>Content of different Apps would add different BCTs for adult & child<br>ViVofitjr App must be linked to Garmin Connect account |
| | | Children | ViVofit Jr2 - £79.99 | ViVofitjr | Age 4+<br>Parental led | 1-year battery life, waterproof<br>Themed activity challenges if 60-minute daily step goal met (linked to watch type (e.g., Star Wars)<br>Virtual rewards<br>Family leader board | |
| Fit Bit | Android, iOS, Windows | Adults | Fit Bit Alta – £99.99<br>Fit Bit Charge 2 - £109.99<br>Flex 2 - £49.99 | Fit Bit | GDPR compliant | *Fit Bit Alta:* Splash proof, 5-day battery, HR monitor, built in feedback, step count display<br>*Fit Bit Charge 2:* Splash proof, 5-day battery, step count display, built in feedback<br>*Flex 2:* Waterproof but no visible step count, 5 days battery | Fit Bit contacted – unable to sync data from Fit Bit child account to 3rd party platform as child account only available through family account<br>Cost implications<br>App content different for the adult & child |
| | | Children | Fit Bit Ace - £49.99 | Fit Bit | Aged 8+<br>Parental led | Splash proof, 5-day battery<br>Goal setting, rewards, and badges, step count display, reminders to move | |

Table 4.4 continued

*Summary breakdown of the scrutinised wearable activity tracker devices and associated Apps*

| Brand | Operating system | Target audience | Available watches & cost | Associated App for syncing | Privacy policy | Key features | Overall comments |
|---|---|---|---|---|---|---|---|
| Mi (Xiaomi) | Android, iOS | Adults | Mi Band 2 - £19.99<br>Mi Band 3 - £25.00 | Mi Fit | GDPR compliant | *Mi Band 2:* 20-day battery, HR monitor, step count, calories, splash proof<br>Idle alerts – vibrate<br>Simple one button activation<br>*Mi Band 3:* 20-day battery, HR monitor, step count, calories, waterproof<br>Idle alerts – vibrate<br>Improved screen visibility but difficult to operate touch screen | Unable to make contact with company<br>Uncommon within the UK market but widely used in Asia and the Middle East<br>Mi Band 3 not showing on Xiaomi site<br>HR monitor possibly unreliable<br>Research reports available for Mi Band 2 |
| | | Children | Mi Band 2 - £19.99<br>Mi Band 3 - £25.00 | Mi Fit | Age 4+ | As above for adult | Under 13 years must have parental permission, gained via email<br>Children can use pseudonyms |

*Note:* BCTs = behaviour change techniques; GDPR = General Data Protection Regulation (European Parliament and Council of European Union, 2016); HR = heart rate

Several other Apps compatible with multiple devices were reviewed where terms of use did not allow use with children - Polar Flow, TomTom, Nike+ Run Club, Nokia Health Mate, Run Keeper, Runtastic, Any Under Armour App, Misfit, iHeal

### 4.7.3 Component selection and justification.

The selection of suitable components that focused on the parameters of the research and gave due consideration to the factors outlined in Table 4.1 proved to be significantly more difficult than already anticipated. It quickly became apparent that the issues, in part, mirrored those stated by the Centre for Ageing Better (2019). Additionally, difficulties arose finding technology that either did not overly infantilise the processes, prevent usage with the targeted age range of children, require substantial parental involvement, or have significant cost implications. Whilst no identified components, or combination of components, presented the optimum solution, taking all available information into consideration the decision was made to focus on the web and App based platform *World Walking* and the activity tracker *Mi Band 2* and its associated *Mi Fit* App.

#### *4.7.3.1 World Walking.*

*World Walking*[8] is an interactive platform created with older adults and ease of usage in mind, by an individual initially looking to support and motivate local people in Inverclyde to continue being active after completing Cardiac Rehabilitation. The concept allows individuals, teams, or groups, to collate their daily step count data and use it to complete pre-developed virtual walk routes of their choice across the globe. Each route, designed to include a number of target landmark milestones, states the total completion distance in steps. As steps are added to the walk (via any of the methods identified in Table 4.2) the associated map route is updated to outline the percentage completed. When each milestone is reached, information of interest about the location is revealed to the user. The routes are also linked to Google Street View, therefore at any point users can see exactly where in the world they would be if walking in reality. Unfortunately, due to privacy and user restrictions, only adults can have account login access.

[8] https://worldwalking.org

#### *4.7.3.2 Mi Band 2 and Mi Fit App.*

The *Mi Band 2*[9] wearable pedometer-based activity tracker is part of the Xiaomi group, whilst the brand does not dominate the Western market its functionally has been deemed comparable to other more well-known products (Ricchio, Lyter, & Palao, 2018; Xie et al., 2018). One of its major advantages is its competitively low cost. The watch is also simply designed, with one touch button on an organic light-emitting diode display allowing alternation between the time, daily steps, heart rate and battery life. The associated App, downloadable onto any smart device, allows users to control which features are displayed and utilised on the watch. For example, whilst nudges can be included through idle alerts, these would provide an inappropriate distraction to children during school lessons, therefore this feature, although potentially useful for the older adults, was disabled. As with all wearable devices (apart from basic pedometers), to work correctly, users have to be able to download and synchronise the watch to the associated App, in this instance, *Mi Fit*. The synchronisation allows the App to store and chart up to six months of data, preventing the need for manual recording. Users also have the ability to set an individualised daily step goal target. Only the features of the App relevant to the research were explored, additional options (i.e., sleep pattern analysis) were not used.

## 4.8 Mapping the Intervention to the Theory

The work of Allport (1954) identified four core components deemed necessary for the successful application of Contact Theory. Table 4.5 outlines how each parameter is addressed within the development of this intervention.

[9] https://www.mi.com/global/miband2/

Table 4.5

*Contact Theory (Allport, 1954) intervention components*

| Condition | Application within the intervention |
|---|---|
| Equal status | Each member of the dyad is afforded an equal role in their pursuit of their goal, using the same wearable devices, collecting the same data, over the same time periods. |
| Cooperation | The physical activity intervention requires participants to work together, not in competition. |
| Common goals | The focus of World Walking is the achievement of a shared common goal that relies on both dyad members' contribution. |
| Support from social and institutional authorities | Support for the contact will be provided by the relevant personnel within the place of recruitment (i.e., school headteacher) and the parent of the child. |

## 4.9 Mapping the Intervention to BCTs and Mechanisms of Action

When designing interventions that directly or indirectly target one or more health-related outcome or behaviour, it is vital to use the most appropriate BCTs to facilitate change in the defined population (Morgan & Tan, 2018), in this instance, older adults. Even though this intervention is driven by a theoretical approach not identified in a compendium of 83 theories of behaviour change (Michie, West, Campbell, Brown, & Gainforth, 2014), the transparent identification and presentation of the specific BCTs included (rather than the broader theoretical concept they may be tied to; Morgan & Tan, 2018) remains of paramount importance. Without this process, the active components and potential mechanisms of action within successful (or unsuccessful) research, cannot ultimately be reproduced or likewise excluded, from future endeavours.

In order to facilitate this pursuit of clarity and transparency, Michie and colleagues, with the support of the MRC, followed a rigorous system of testing and refining, to develop the internationally agreed and accepted Behaviour Change Technique Taxonomy v1 (Michie et al., 2013). A structured nomenclature of 93 BCTs, split into 16 groups, the taxonomy classifies the smallest intervention components that, whether on their own or in combination, can lead to positive behavioural changes when

conditions are favourable (Michie et al., 2013). Overall, it affords researchers and policy makers a greater depth and consistency of understanding regarding the most successful intervention components for specific populations, in specific situations, hence allowing for optimised transferability.

Conducting research and developing an intervention within real-world parameters that uses pre-constructed technology means that to an extent, regardless of any findings from prior research, the BCTs included from these components are pre-defined. This factor was not deemed to be an issue as the ethos of this research was to explore the use of widely available technology within its *natural* environment. Table 4.6 displays the core components of the developed intervention, the associated identified and/or incorporated BCTs (as per the Behaviour Change Technique Taxonomy v1; Michie et al., 2013) and subsequent modes of facilitation and delivery.

It is acknowledged that to effectively challenge different health behaviours, different approaches and therefore BCTs may be needed, for example, when targeting physical activity and/or sedentary behaviour (see Chapter 1, section 1.3.1). Whilst exploring the effects on both are identified outcomes within the overall objectives of this research, focus was placed on establishing which BCTs could optimally facilitate physical activity as the primary intervention driver and health-related outcome of interest.

Given the heterogeneity of 'old-age', and the number of vast, varied, and often complex factors that can influence behaviour, it is not surprising that reviews attempting to summate research and draw conclusions on which BCTs can effectively lead to physical activity gains in older adults vary. One such example relates to the BCT *Feedback*. Where O'Brien et al. (2015) concluded that self-regulation through feedback was the only BCT that demonstrated effectiveness in interventions targeting physical activity in older adults, French et al. (2014) surmised that self-regulatory techniques, including *Feedback on performance*, may indeed be discouraging and hence less effective and acceptable. Translating these findings is complicated by the differences in the imposed review parameters, for example, participant age ranges and targeted stages of change (preparation/action versus maintenance; Prochaska & DiClemente, 1984).

Table 4.6

*Components of the intervention and their associated BCTs and modes of delivery*

| Intervention component | BCTs | Mode of delivery |
|---|---|---|
| World Walking | Goal setting (outcome) (1.3) | Targeted completion of a virtual walk route and attainment of interim milestones |
| | Restructuring the physical environment (12.1) | Access to and engagement with the platform and/or App |
| Mi Band 2 & Mi Fit App | Goal setting (behaviour) (1.1) & Action planning (1.4) | Individual setting of specific daily step goal target |
| | Self-monitoring of behaviour (2.3) | Observing and engaging with record of daily steps, providing feedback on own behaviour |
| | Adding objects to the environment (12.5) | Provision of the wearable device, facilitation of use of the App |
| Intergenerational contact | Restructuring the social environment (12.2) | Social environment changed through the formation of the dyadic partnerships to facilitate social support and the targeted behaviour |

*Note:* BCTs = behaviour change techniques

Numbers in parentheses relate to Behaviour Change Technique Taxonomy v1 (Michie et al., 2013)

In the earlier of the reviews, based on the findings of prior reviews that had highlighted the importance of self-efficacy in the general adult population, French et al. (2014) focused on the identification of BCTs that targeted physical activity and self-efficacy in older adults aged 60 years or above. From the meta-analysis of 24 studies that reported a change in self-efficacy immediately following the completion of an intervention designed to target physical activity, the authors reported an overall increase in self-efficacy ($d$ = 0.37) and physical activity frequency or duration ($d$ = 0.14) independent of which BCTs were used. However, during moderator analysis to compare techniques associated with changes in both self-efficacy and physical activity, six BCTs were associated with smaller effects on both outcomes: *Providing normative information about others' behaviour; Goal setting (behaviour); Prompt self-monitoring*

*of behaviour; Provide feedback on performance; Plan social support/social change, and Relapse prevention/Coping planning*. It is suggested that older adults may find these predominantly self-regulatory techniques more cognitively challenging, and generally less acceptable due to differing drivers of motivation and/or participation. However, French et al. (2014) do recommend caution when interpreting their findings for reasons including the impact of potential confounding variables such as population characteristics. For example, 76% of the total participants included in the overall analysis were female.

In contrast, O'Brien et al. (2015) focused their review and meta-analysis on the BCTs that specifically targeted the long-term effectiveness of physical activity interventions that had at least a 12-month follow-up period, in older adults aged 55–70 years old. From 19 eligible studies, when compared with minimal/non-intervention groups, an overall positive effect on physical activity was observed ($d$ = 0.29). Whilst *Goal setting* was identified as the most commonly used BCT, moderator analysis revealed that *Feedback* could be the most effective BCT. It is pertinent to note that in all of the interventions that used *Feedback*, it was not used in isolation, and was always combined with at least one more self-regulatory based technique. Thus, the authors conclude that the effectiveness of BCTs, may, at least in part, be dependent on concurrent interactions and potentially combined effects.

As previously suggested by French et al. (2014), more recent qualitative explorations of the motivational drivers of physical activity participation and acceptability in older adults (for example Boulton et al., 2018; Devereux-Fitzgerald et al., 2016; as discussed in Chapter 2, section 2.1.2) indicate an observable association with the effectiveness of BCTs implemented within interventions. Indeed, given that participation for health reasons has been identified as a potentially ineffective stimulus with older adults (Morgan & Tan, 2018), the additional prior finding of O'Brien et al. (2015), that utilizing the BCT *Provision of information on consequence of behaviour* was ineffective, is therefore not surprising. Likewise, Warner et al. (2016) concluded that a lack of positive impact within their study could be related to the ineffectiveness of overreliance on *Planning.* This factor was corroborated by the findings of Boulton et al. (2018). Adopting a person-centred, approach that is flexible, does not place constraints

on life and allows for individual choice, may be of paramount importance within the intervention development process.

An additional area where different behaviour change theories and research findings agree, is regarding the link between physical activity and self-efficacy (e.g., Health Action Process Approach, Schwarzer, 2008; Social Cognitive Theory, Bandura, 1986; Transtheoretical Model, Prochaska & DiClemente, 1984; French et al., 2014; van Stralen et al., 2009). Regardless of the situation, individuals need to believe that they have the capability or competence to participate, otherwise they will either not engage at all, or motivation to continue could wane (Deci & Ryan, 2008). This pertinent point reinforces the importance of optimal *Goal setting*, considering how *Restructuring the physical and social environment* is approached, and the need to use components that do not require a high level of technological literacy.

Based on all of the points discussed it is proposed that when developing intergenerational interventions, and identifying potential BCTs, wider consideration should be given to the known contextual views and opinions of the target population, and the situation in which they will be employed. In relation to self-regulatory techniques, discarding these from use with older adults may be premature. They may well not be effective in isolation, or where significant cognitive processing is needed to engage with complex planning and goal setting strategies. However, within this intervention they are framed within an environment and context where enjoyment, social interaction/support (both identified as important facilitators by older adults; see Boulton et al., 2018; Franco et al., 2015) and collaborative goals are the driving force. Self-regulation in this situation is not being used as the central component.

## 4.10 Summary

Throughout the design and development process it became increasingly apparent that the range of 'on the market technologies' available, especially in relation to web platforms and Apps suitable for, or targeting, older adults is very limited. There is also a distinct lack of age and/or General Data Protection Regulation (GDPR; European Parliament and Council of European Union, 2016) compliant options for those looking to facilitate affordable cross-generational behaviour engagement, whether this is between older adults and children, or within immediate family units. Privacy policy age

restrictions actually mean that the vast majority of products are indeed not legally valid for use with children. Despite the challenges encountered, and the vast number of factors that needed to be considered, a dyadic intergenerational intervention underpinned by Contact Theory (Allport, 1954) was developed. The finalised concept model incorporating the theoretical parameters and associated BCTs is detailed in Figure 4.2.

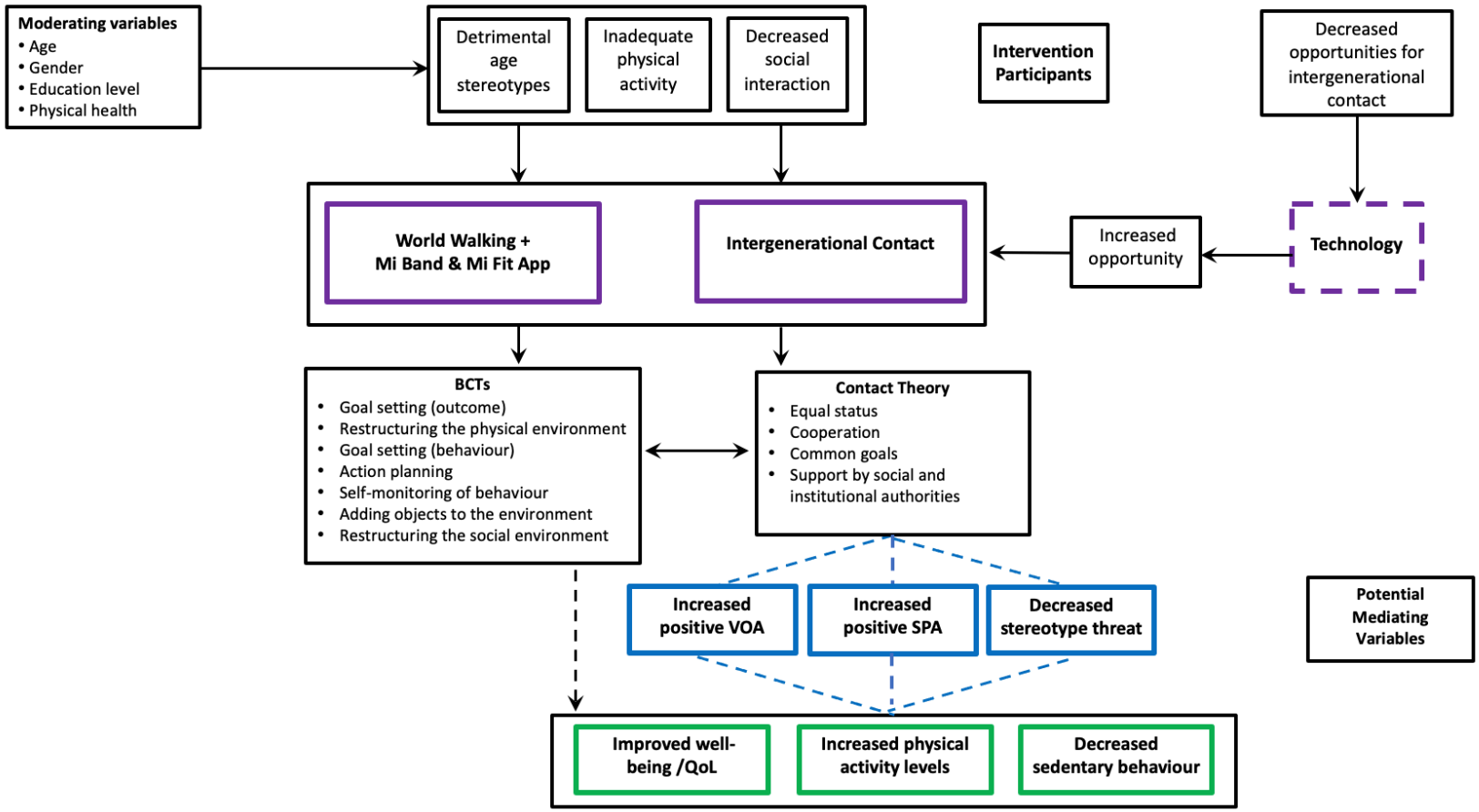


*Figure 4.2* Conceptual model of technology-driven intergenerational physical activity intervention

*Note:* BCTs = behaviour change techniques; QoL = quality of life; SPA = self-perceptions of ageing; VoA = views-on-ageing

# Chapter 5

# Feasibility Study

*In Chapter 2, the negative effects of age stereotypes on the health and well-being of older adults and their mechanisms of action were discussed. The impact of utilising age stereotype-based interventions to challenge these effects was then systematically reviewed in Chapter 3, with directions for future research, including the need for further exploration of the role of intergenerational contact identified. It was highlighted that the role of age stereotypes does not have to be negative. In many cultures, older adults are perceived as knowledgeable and wise, therefore themselves providing a wealth of often untapped support and experience (Diongi, 2015). It has been pertinently suggested that internalization or embodiment of potentially detrimental negative age stereotypes can begin at an early age (Kwong See & Nicoladis, 2010). Therefore, it is proposed that a multifaceted intergenerational technology-based approach to targeting physical activity and/or sedentary behaviour, that encompasses the need for choice and individuality, could, positively influence the outlook and opinions of not only older adults, but also those of children, towards the ageing process (Diongi, 2015).*

*In the preceding chapter, the design and construction of a 'real-world' intergenerational technology-driven intervention was discussed. The current chapter presents a crucial stage in the development process, establishing acceptability, testing functionality and useability, and identifying any potential issues with recruitment and retention. Using these pre-established aims as themes of interest, thematic analysis was used to iteratively explore data collected from post-participation focus groups. Identified within stages 8-10 of the individualised, iterative, Multi-stage Process Model (as outlined in Chapter 1), establishing the feasibility of any proposed intervention, from the perspective of all involved parties, is a key step in the development process, if fundamental problems in future implementation stages are to be avoided (O'Cathain et al., 2015). Interest in the concept through response rates, willingness to participate, and adherence was established, whilst practical issues regarding the suitability and functionality of key components were evaluated (Arain, Campbell, Cooper, & Lancaster, 2010). These findings were used to guide subsequent intervention refinements. Whilst*

*primarily exploring the potential impact and implications for both the members of the dyadic partnership, this study additionally considers the views of parents/guardians.*

## 5.1 Aim

The overall aim of this study was to explore the acceptability and usability of a technology-driven intergenerational intervention designed to impact age stereotypes and physical activity levels in older adults and children following a trial period of up to four weeks.

## 5.2 Research Question

This study was designed to address the question:

How do familiar older adults aged ≥ 65 years old and children aged 7-11 years old, engage with and view a collaborative intergenerational technology-driven intervention designed to target physical activity engagement and stereotypes of ageing?

## 5.3 Specific Objectives

1. To establish the optimum methods to approach, retain and engage participants and confirm what resources and time commitments will be needed for recruitment.
2. To ascertain the acceptability, usability, and any potential issues with the chosen commercially available technology platform and wearable activity tracker.
3. To test the intervention and explore the impact of intergenerational contact on physical activity engagement in older adults and children.

## 5.4 Methods

### 5.4.1 Research design.

This study employed a multi-methods design. Using this approach, a trial period of the proposed intervention by familial intergenerational dyads (as described in Chapter 4), of up to four weeks, was combined with qualitative post-participation analysis via focus groups with the children and older adults, parental/guardian evaluation questionnaires, and, the exploration of reasons for non-participation via an additional focus group with parents who had identified participants that met the inclusion criteria, but did not proceed to enrolment. Due to the nature of the study being

to test the feasibility of progression to a larger scale trial, no baseline or outcome measures were taken. Basic metrics regarding recruitment, retention, and, participant demographics were collated to aid the overall analysis.

### 5.4.2 Ethics.

Ethical approval for this study was granted by the College of Engineering Research Ethics Committee, Swansea University (approval numbers 2018-103 and 2018-103A; Appendix C). Written, signed, informed consent was obtained from the parent/guardian of each participating child, the co-participating older adult, and, any separately non-participating parent. Written, signed, informed assent was obtained from each participating child (Appendix D). All participants were health screened by the primary researcher prior to enrolment. All participants aged ≥ 65 years old completed a health screening questionnaire based on American College of Sports Medicine (ASCM) guidelines (Magal & Riebe, 2016) prior to enrolment (Appendix E). For all participants aged 7-11 years, a modified version of the health screening questionnaire was completed by their parent/guardian (Appendix E). Where screening triggered the ACSM algorithm, participants were asked to gain written medical clearance from their General Practitioner or Hospital Consultant Team, or to sign a medical disclaimer where appropriate, if they still wished to participate in the study (Appendix F).

### 5.4.3 Participant sampling and recruitment.

In an endeavour to ensure that as far as possible, the samples were representative across age ranges and sex for both the children and older adults, and non-participatory parents respectively, participants were recruited via purposive sampling from a local Primary School in Swansea, South Wales.

#### *5.4.3.1 Intergenerational dyads.*

This study targeted the recruitment of 10 dyads, formed of one older adult aged ≥ 65 years old and one child aged 7-11 years old. Participants could be male or female. The older adult could either be a family member of the child, or, an older adult that the child had a 'familiar' link with, and, with whom the parent/guardian of the child provided explicit consent for their child to be paired.

Following formally obtaining permission to recruit dyads via pupils aged 7-11 years old from the Headteacher[10], recruitment packs were sent to all appropriately aged children in school years two to six. Each pack contained three information sheets, one for the child, one for their parent/guardian, one for their potential co-participating older adult, a written parental consent form, an older adult consent form, a child assent form, a child health medical declaration, and health screening questionnaire for the older adult[11]. Additionally, recruitment posters were placed within school grounds and sent out by the Headteacher via the schools' electronic message platform. Six interested parties returned their consent forms to the school. Those who met the inclusion criteria were subsequently contacted by the primary researcher to establish a convenient time for enrolment and induction. In total, four dyads (four children and four older adults) with age ranges of 7-8 years and 66-71 years respectively were recruited. Basic demographic and participation data are presented in Table 5.1.

*5.4.3.1.1 Inclusion criteria.* To be included in the study, participants must have:

- been a dyad pairing of a child aged 7-11 years with parental consent and child assent with a co-participating and consenting older adult aged ≥ 65 years
- been able to write and converse in English
- been willing to discuss their experiences in focus groups
- access to a smart phone, computer or tablet device, and Wi-Fi/internet access

*5.4.3.1.2 Exclusion criteria.* Participants were excluded from the study if they:

- did not have a co-consenting participant within the required age range
- did not have written parent/guardian informed consent (for children)
- had not provided informed assent in the case of the child, or informed consent in the case of the older adult
- were not aged 7-11 years old or ≥ 65 years old
- felt uncomfortable sharing their experiences of the study intervention with fellow participants

[10] For a copy of the letter see Appendix G.
[11] For copies of all documents included in the recruitment packs see Appendices D, E, and H.

- were not able to cooperate with the research team for the full duration of the project
- were unable to understand, write and converse in fluent English
- did not have access to a computer, smart phone, or tablet device
- provided any answers from the health questionnaire that were contraindications to participation

Table 5.1

*Demographic and participation data of the intervention dyads*[12]

| Identifier | Gender | Age (years) | Intervention days completed |
|---|---|---|---|
| FG1 | F = 3, M = 1 | 66-71 | 23-28 (Mean = 26.75, *SD* 2.17) |
| FG2 | F = 3, M = 1 | 7-8 | 19-28 (Mean = 24.75, *SD* 3.70) |

*Note*: F = female; FG = focus group; M = male, SD = standard deviation

#### *5.4.3.2 Non-participant parents.*

The study targeted the recruitment of 5 to 10 parental/guardian participants who had informed the researcher that they were able to identify participants who met the criteria for the intergenerational dyads, but who subsequently did not gain consent to participate. Participants could be male or female. Following the completion of the intervention phase, all potential parental/guardian participants were contacted. For those who agreed to take part, a mutually convenient day and time was organised, again at the Primary School. Four individuals initially agreed to participate; however, one withdrew on the day of the focus group. This resulted in the recruitment of three participants to the final focus group (2 female, 1 male; aged 38-47 years). Each reported at least one older adult within the age range 65-73 years old, and, a child aged 8-11 years old who would have been eligible to participate in the study.

*5.4.3.2.1 Inclusion criteria.* To be included in the study, participants must have:

- been a parent who had identified participants who met the criteria for the

[12] Due to the small participant numbers in each focus group, to ensure anonymity, a breakdown of individual participant data has not been provided

intergenerational dyads of the study but did not participate

- been able to write and converse in English
- been willing to discuss their experiences in focus groups

*5.4.3.2.2 Exclusion criteria.* Participants were excluded from the study if they:

- did not provide informed consent
- felt uncomfortable sharing their experiences of the study intervention with fellow participants
- were not able to cooperate with the research team for the full duration of the project
- were unable to understand, write and converse in fluent English

**5.4.4 Intervention trial phase procedure.**

Prior to commencing the intervention all eligible, consented dyads, and, a parent/guardian for each child attended an enrolment and induction session with the primary researcher at the Primary School. At this point, consent and health screening was reviewed and demographic data collected. Both members of the intergenerational dyad were supplied with a '*Mi Band 2*' activity tracker, and, assisted to download and set up the associated '*Mi Fit App*' on the smart device of their choice. For the children, this was governed by their parent. For the older adults, access to the '*World Walking*' platform, a step count based, open access, online platform, accessible via a computer, or additional downloaded App was also established. For up to the next four weeks, working collaboratively, the dyads combined their daily step counts to complete a virtual walk route, in this instance a route through Wales (see Figure 5.1). No individual exercise prescription occurred during the study, rather participants were only encouraged to engage with and trial the concept of the intervention.

Only the older adult could be provided with access to the World Walking platform due to GDPR (European Parliament and Council of European Union, 2016) access restrictions. Therefore, the child separately recorded their step data and liaised with their co-participant for it to be added manually to their collaborative totals. The

child was supplied with an A3 copy of the map/walk route the dyad were completing (see Figure 5.1), stickers and marker pens, to allow them to additionally chart their collaborative progress. To allow for personal preference, each older adult was also supplied with a printed step record sheet, to record their daily steps, instead of referring to the Mi Fit App. Copies of the step record charts are presented in Appendix I. During weeks one to three of the study, each older adult participant and the parent/guardian of each child were briefly contacted via their communication method of choice to discuss any issues or concerns.


*Figure 5.1* Walk route and map (World Walking route reproduced with permission)

## 5.5 Data Collection

### 5.5.1 Focus groups.

The interaction afforded by group-based discussions, recommended as an integral part of intervention development (Craig et al., 2008), provides a platform to encompass a broad range of perspectives and generate ideas that might not be disclosed in semi-structured individual interviews (Kitzinger, 1995). Thus, they allow participants

to share, debate and reflect on their own experiences (Kitzinger, 2005), explore as a group issues identified as individually important, and, highlight concerns and priorities for action. Before each session commenced, participants were briefed on the purpose and structure of the focus group, reminded that they could withdraw from the study at any time without having to provide a reason, that all data would be stored securely, and, that all identifying markers would be removed and pseudonyms applied.

All groups were conducted with due consideration for current focus group recommendations. It is acknowledged that ideally for children, optimal group size is four to six participants, and for adults four to eight (Heary & Hennessey, 2002; Kitzinger, 1995), however group size was ultimately determined by the boundaries imposed by recruitment numbers. All focus groups, ranging in duration from 20 to 75 minutes, were held at the Primary School used for recruitment, audio and video recorded (Phillips Digital Voice Recorder; Sony HandyCam), and, transcribed verbatim from the audio recordings. Video recordings were only used for clarification purposes when it was unclear to whom a data extract should be allocated. Where the focus group involved children, an additional member of staff identified by the school was also in attendance.

#### *5.5.1.1 Intergenerational dyad participants.*

Following the completion of the trial phase, dyad participants were invited to attend a focus group, with separate focus groups held for the children and the older adults. Each focus group was designed to obtain information about the participants' experiences of using and interacting with the fitness tracker and technology platform, and their overall experiences of collaborating and working intergenerationally, to inform future recommendations for implementation within a larger scale trial. With regard to the older adults, the participants' opinions concerning the impact of the intergenerational collaboration on their views-on-ageing, and age stereotypes in general were also explored. Box 5.1 provides an outline of the key open questions and topics covered with the older adults, but, as the groups were used to prompt conversation between participants, the exact order and phrasing of questions was not identified a priori.

Box 5.1

*Focus group topic guide, older adults*

**Introduction**

Participants will be reminded that:

- Whilst the session will be recorded, and the researcher will take notes as needed, the recordings will be destroyed following full data analysis.
- Everything they discuss will remain anonymous, they can contribute when they choose to do so, and, that there are no right or wrong answers, different people might have different views on the intervention, and we are interested in finding out everyone's experience of the intervention.

They will then be given an opportunity to ask questions before the focus group begins.

**Main Questions**

- What did you think of taking part in the intervention?
  Did you enjoy it, dislike it, like it, find it helpful or unhelpful in any way?
- What did you think about having to pair up with the child?
  Do you think it made any difference? Did you like it, dislike it? How did it make you feel?
- Did taking part encourage you to be more active?
- How did taking part make you feel and think about being an older person?
- How did you find using the technology practically?
  Do you feel that you had the right skills to use technology?
  Did you have any issues accessing the web page/App relating to Wi-Fi/internet access?
  Think about the watch - Was it easy to use? Any difficulties?
  Think about the website/App – Was it easy to use? Any difficulties?
- Would they use/recommend using this type of intervention in future?
  Why? Why not? What alternatives would you suggest?

**Summary**

- Reminder that if participants want to withdraw their data from the study, they just need to contact the main Researcher without offering a reason.
- Participants thanked for their time and given the opportunity to ask questions about the study within the group or privately.

Comparable questions were used for the children. The wording and language were simplified accordingly, and, as per guidance, brief, more closed questions were used to help initiate the conversation and build up trust, with follow-up questions, prompts, and open questions used to encourage further detail (Gibson, 2012).

Additionally, prior to commencing the focus group with the children, in an endeavour to engage participants and break down potential communication barriers 'Ice Breaker Bingo' was played. Box 5.2 provides an outline of the key questions and topics covered with the children. All question schedules were reviewed and agreed by a supervisor experienced in qualitative research (JH) prior to their use.

Box 5.2

*Focus group topic guide, children*

**Introduction**

Participants will be reminded that:

- Whilst the session will be recorded, and the researcher will write notes as needed, the recordings will be deleted once they have been used.
- Everything they discuss will remain confidential, they can answer when they want to, there are no right or wrong answers, different people might give different answers, but we are interested in finding out everyone's experience and opinion.

They will then be given an opportunity to ask questions before the focus group begins.

**Main Questions**

- Have you liked taking part in the activity over the last few weeks?

  If yes.... Could you tell me a little bit more? Did you enjoy it? What did you enjoy?

  If no..... Could you tell me a little bit more? What did you dislike?
- Do you think taking part made you be more active?

  What did you find helpful/unhelpful?
- How did you find using the watch and having to wear it?

  Was it easy to use? Any difficulties?
- Did you enjoy using your map?

  What did you do? How did you find out how far you had gone?
- What did you think about having to pair up with an adult/your grandparent?

  Do you think it made any difference? Did you like it, dislike it? How did it make you feel?
- What did you think about the adult taking part?
- Would you like to do something like this again?

  Why/why not? What could we do to make it better?

**Summary**

- Reminder that if they decide they don't want what they have said included in the study, they just need to get their parent to contact the main Researcher.
- Participants thanked for taking part and given the opportunity to ask questions.

#### *5.5.1.2 Non-participant parents.*

A single researcher-led focus group was undertaken to discuss participant recruitment issues/limitations, the overall intervention concept, opinions, and potential solutions. For this group, written information was provided, and written consent and basic demographic data obtained immediately prior to the session. An outline of the key open questions and topics covered is provided in Appendix J.

### 5.5.2 Parental evaluation questionnaires.

One parent/guardian of each participating child was also sent an evaluation questionnaire via their preferred communication method. The questionnaire (Appendix K) was designed to explore their satisfaction with their child's participation and the level of parental involvement that was required to enable the child to engage with the technology.

## 5.6 Data Analysis

### 5.6.1 Thematic analysis.

Following the meticulous verbatim transcription and anonymisation of each audio recording, qualitative data analysis of the three focus groups and questionnaire responses was undertaken in accordance with the six-stage thematic analysis process outlined by Braun and Clarke (2006). Using this iterative structured approach, the use of which is not restricted to specific methodologies, codes and ultimately themes, were identified, tracked, and revised through:

1. Familiarisation and immersion within the data content through reading, re-reading and accuracy checking against the audio recordings.
2. Initial generation of codes, where the coding process was deductively driven by the pre-defined, study aim-specific, individually constructed thematic framework. Under the headings: acceptability; functionality; useability, and, recruitment and retention, codes were allowed to emerge inductively from observations within the data. Only the semantic meaning of the data, as presented by the participants, was explored (Braun & Clarke, 2013).
3. Searching for sub-themes through the broader categorisation and organisation

of similar, linked or overlapping codes, and, the triangulation of data from each different source.

4. Reviewing and refining the candidate sub-themes in line with the research question and study objectives, with subsequent presentation of these within a hierarchical thematic coding table.
5. Defining and naming the sub-themes according to data representation. This information has been presented using a pen profile, defined as a way to clearly present analysis outcomes for researchers with both qualitative and quantitative backgrounds (Sharp et al., 2020).
6. Finalising the analysis and interpretation of the data to produce the final report illustrated with verbatim quotations.

Exhibits from each stage of the process are provided within the coding audit trail detailed in Appendix L. All coding was initially carried out manually, with subsequent categorisation, organisation, re-checking and refinement carried out within Microsoft Word (Office 365). During stages two to five codes were challenged and checked back against the original transcripts to ensure data fit, removed and/or rearranged within themes and sub-themes to ensure accurate data representation, and, assessed for duplication. Sub-theme names and the thematic coding table were reviewed and amended accordingly. These processes were, for transparency, credibility, quality control and rigor (Smith & McGannon, 2018), completed in collaboration with a 'critical friend' (thesis supervisor) who additionally blindly crossmatched 10% of the data extracts against the generated codes to ensure consistency in approach and that the data had been coded appropriately. Eight discrepancies were discussed and reviewed back to the original data set until agreement was reached.

### 5.6.2 Reflexivity for trustworthiness.

Within the current study, it is pertinent to note that the research was undertaken in a location where the PhD candidate was known to some of the participants and the wider Primary School community. Consideration therefore needs to be given to the way in which this might have affected interaction and responses. This particularly related to the non-participant parental group, who all had a priori knowledge of the candidate and their professional background. At all times during data collection impartiality was strived

for. As the aim of the research was to establish feasibility, the common codes and sub-themes triangulated from different perspectives across all data sets were afforded equal importance (Nowell, Norris, White, & Moules, 2017).

## 5.7 Results

Through the deductive application of the four pre-defined over-arching framework themes that targeted the parameters of the study objectives, eight core themes emerged: Engagement; Provision of a Positive Experience; Participant Stimuli; Generated Outcomes; Operationality; Limitations; Mediators; Facilitators, and, Perceptions. These are presented visually with associated quotations using a pen profile (see Figure 5.2). The pseudonyms Morgan, Francis, Pat and Viv relate to the older adults; Jesse, Alex, Casey and Taylor to the children; Blake, Charlie, and Sam to the non-participant parents, and PQ1-PQ4 to the responses from the parental evaluation questionnaires.

### 5.7.1 Acceptability.

#### *5.7.1.1 Theme 1: Engagement.*

Overall acceptability of the intervention was supported by the level of engagement with the core concepts and components. With regards to the technology, whilst the primary focus was interaction with the step count features, and the ability of these features to facilitate the use of World Walking, participants also reported accessing additional features of the watch and App: *"I liked it because you got to count your steps and you knew your heartbeat" (Alex).*

> *Pat: "I found it quite addictive using the watch actually"*
> *Morgan: "Yes"*
> *Pat: "Um not just for the steps but for the sleep patterns as well, we were having a chat about that earlier on um (.) I found that quite fascinating I'm tempted to buy one to keep it going"*

Both groups of participants, and the parents of the children, thought that World Walking was interesting: "*I think the map was the main thing it was the interest really in seeing how far we were getting it was good for us and good for the children as well" (Pat)*, and,

that the children in particular enjoyed charting their progress: *"Ooo Ooo I liked it because I keep getting putting stickers on my umm map" (Casey)*. However, frequency of engagement varied. Where some checked their steps and progress every day, others, more specifically the parents assisting the children, synced the watch and updated their progress a few times per week.

An important observation is the impact that engagement had on the participants' insight into their activity levels. For the older adults, engagement appeared to have a constructive effect. Participants demonstrated a change in their awareness of how active they are, when, and, what factors positively and negatively affect their behaviour.

> *Morgan: "It has been um it's definitely shown me when I'm active and when I'm not um (.) I look after my [grandchild] a little one two days a week sometimes three and <u>then</u> my steps are really down because I've got [them]"*

> *Viv: "I have found myself more aware of exercise um (.) like I walk around the bathroom cleaning my teeth now ((laughter)) and when vacuuming the carpet instead of standing on the spot and going like this ((demonstrates)) I go striding down the hallway and striding back up again ((laughter)) so it's made me more conscious then"*

However, with the children, whilst their parents felt they were, in general, more aware, and active: *"[they were] very good at self-checking and realising if [they] had a good moving day or a bad day" (PQ2),* the children did not, at least knowingly, appear to make this association:

> *Interviewer: "So (.) by doing more steps did you feel that you were moving a little bit more than you normally do? Did it make you think that Ooo I haven't done any steps perhaps I should try and do a bit more?"*
> *((Shaking of heads))*
> *Interviewer: "No? you were just interested to see how many"*
> *Alex: ((In overlap)) "You do"*

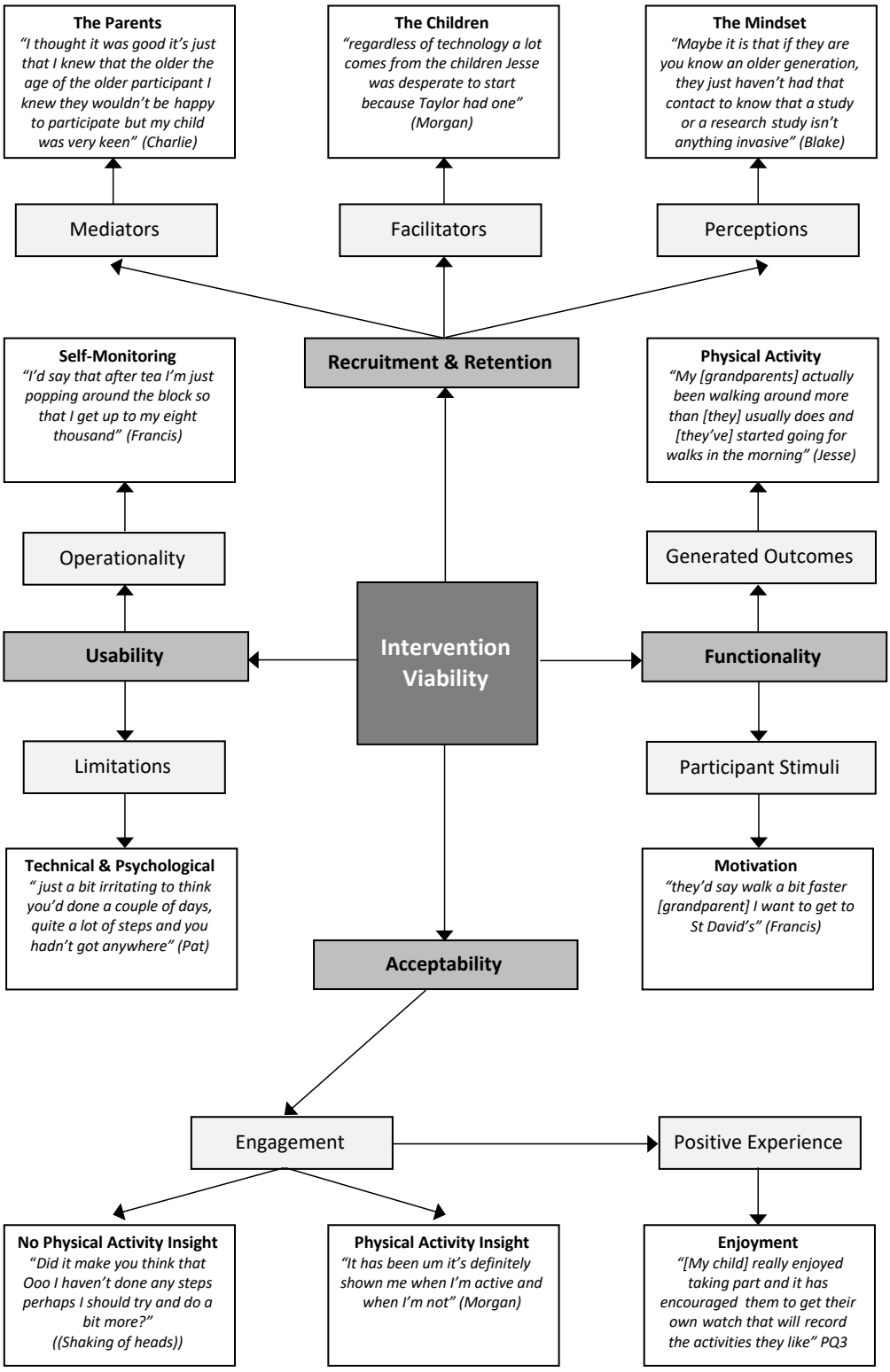


*Figure 5.2* Pen profile of core feasibility themes related to participant engagement with and views of a collaborative intergenerational technology-driven intervention

#### *5.7.1.2 Theme 2: Provision of a positive experience.*

Taking part in the trial and engaging with the intervention process was considered a positive and enjoyable experience by all involved: *"Yeah and I've quite enjoyed doing that and it made me feel fitter and better for doing it" (Francis), "I didn't dislike anything really" (Viv).* All of the dyads were composed of grandparents and grandchildren. The older adults specifically, recognised not only an influence on their fitness levels, but, also on their relationships and contact with their grandchildren. The opportunity afforded to them to consolidate and explore this intergenerational relationship was deemed to be a good thing.

> *Pat: "I thought it was good because um ((pause)) I think you have a different relationship with your grandchildren to your children to some extent and so it was although we see a lot of ours it was just a nice thing to do"*

As well as the short-term intervention specific gains, wider benefits, and, the potential for longer term engagement were identified. Some participants found the watch *"addictive",* whilst others were considering purchasing their own.

> *PQ3: "[My child] really enjoyed taking part and it has encouraged them to get their own watch that will record the activities they like – swimming etc. I think this is a good activity for family members and extended family to participate in together"*

The potential to instigate wider reaching gains and changes in behaviour not just directly for the dyad members, but also indirectly for other family members was also discussed. Children reported being more active with other family members: *"I liked it because um I because I we got to do a lot more walks and now, I get to know a few more birds because we've gone out for lots more walks" (Taylor),* and, plans had been made to form larger familial teams to complete longer challenges in the future: *"when this trial is over we are going to carry on the four of us no five ..... and target walking to the moon" (Morgan).*

### 5.7.2 Functionality.

#### *5.7.2.1 Theme 3: Participant stimuli.*

From the basic principle of knowing they were measuring activity, to the satisfaction gained from observing higher daily step count levels, and, the encouragement received from their co-participant: *"they'd say walk a bit faster [grandparent] I want to get to St David's" (Francis)*, the motivation provided was repeatedly drawn upon.

> *Morgan: "It's good in that way in that it's made me more aware of it (.) it made me more conscious of it and made me think and basically as you say rather than sit down and think aw I'll do something later I'll do it now you know so it does it's a good"*
> *Viv: "Motivator"*
> *Morgan: "It is a good motivator there's no doubt about that, for me anyway"*

World Walking and the underpinning principles of the intervention trialled are based on the premise that collaboration, rather than competition, is a key driver for success. With the dyads' accumulated step counts being used to complete the walk, the notion of 'working together' was received positively. For example, *"If I was doing it on my own, I wouldn't have got very far but when we when me and my [grandparent] were working as a team we got quite far" (Taylor), and "Jesse had the map and of course [they were] following it as well and saying, 'come on [grandparent] you need to do more'...." (Morgan).* However, despite not being targeted within the intervention design process, it was clear that the participants also enjoyed competing with each other: *"I like it because I keep beating my [grandparent]" (Casey)*. It is pertinent to note that this competition was not viewed negatively: *"when we say was competitive it was just a bit of fun isn't it really" (Pat)*, and, in fact it provided an additional source of motivation.

> *Francis: "It does make you more competitive I think I mean obviously if I spoke to Alex on the phone and they'd say, 'how many steps you done?' and if I'd done more than them they'd tell me 'talk to [parent]'"*

Where endeavouring to achieve the collaborative goal was important, also important was individualisation. It appeared that for the older adults particularly, setting goals that are achievable and realistic, could be of paramount importance.

> *Morgan: "I didn't realise that you need to do you know 10,000 steps is not far off 5 miles a day for me which is quite a lot to do you know when they say you should be doing 10,000 steps a day there's no way I could do that I don't think"*
> *Viv: "Yes if you'd set ours at ten thousand steps a day, I don't think …."*
> *Pat: "Yeah we wouldn't have bothered"*

Indeed, it was suggested that failing to acknowledge these factors could stimulate the formation of detrimental barriers to success: *"I think the important thing is if you do think about setting targets for people is, they have got to be achievable otherwise you get that demotivating factor coming in" (Pat).*

#### *5.7.2.2 Theme 4: Generated outcomes.*

Participation in the trial period was generally felt to have had a positive impact on the primary targeted behaviour, physical activity. Through seeing it as an opportunity to make time: *"I've always enjoyed doing it when I've had the time but what this has made me do is (.) make time" (Morgan)***,** and, just finding ways to incorporate more activity and make active choices within existing daily routines, encouraging outcomes and effects were ultimately discussed.

> *Viv: "sometimes if it was a nice day I would walk the long way around I'd come right up to the [Club] and come around to the school that way which backfired one morning because they had locked the gate couldn't get in there was a crowd there so I just sort of circled round to clock up some steps"*

For some individuals, somewhat surprisingly, they actually enjoyed engaging and finding the time. Parents reported observing an overall increase in their children's activity levels, whilst some of the children noticed changes in the behaviour of their co-participants: *"Well my [grandparents] actually been walking around more than [they] usually does and [they've] started going for walks in the morning around [place] where [they live]" (Jesse).*

Not substantially altered, was the level of contact between the dyad members. The majority of co-participants were already in regular contact with each other at least once a week: *"I see them nearly every day anyway apart from Saturdays and Sundays so just saw [them] the same" (Viv)*. Although, some extra contact via phone calls was instigated by a few of the children, and, happily welcomed and appreciated by the older adults: *"Taylor rang me and [they don't] normally ring me and was quite chatty on the phone talking about this and it was quite nice from that point of view, but we do see [them] regularly anyway" (Pat).*

### 5.7.3 Usability.

#### *5.7.3.1 Theme 5: Operationality.*

The multi-component nature of the intervention inherently left it open and susceptible to user/interface issues, but overall, this was not the case: *"We found the watch and the app easy to use" (PQ4).* Only one participant identified a potential synchronisation issue between the watch and the App; however, this was counteracted by changing to manually noting daily step counts at the end of each day until the issue could be resolved. It is apparent, that in situations where technology-driven approaches are used, clear explanations supported by the provision of concise supporting secondary guidance are imperative.

> *Pat: "I found it a bit baffling the day we came in and you explained it all to us but once I you know you explained it well we set things up together I went home and read through the guidelines and then it was okay after that I didn't have any problems at all to be honest"*

All participants engaged with the technology to self-monitor their daily step progress: *"I got I got to 12,000 the other day" (Alex).* For the children, again, this did not appear to knowingly translate into purposeful changes or increases to their physical activity engagement. For the older adults, a more direct association is plausible: *"If you have a day when you don't do much like when you're looking after one of the grandchildren you think oh tomorrow, I've gotta do some extra" (Pat), "Yeah I think oh I'll just pop-up town now you know I won't get that tomorrow I'll get that now and then I'll get up my steps today" (Francis).*

There was an observed need for parental involvement for a number of reasons. Whilst some of the dyads liaised directly with each other to transfer data and discuss their process: *"I'd phone up and tell [them] you can stick a sticker on Bangor" (Viv),* others relied on parental facilitation: *"My [person]-in-law [they were] on the phone most nights you know saying what are your steps" (Morgan)*. The children also needed reminding to record their steps and put their watches back on when removed, and, help to chart their progress on their maps. However, the amount of time needed was minimal, with an average parental time of five and half minutes per day spent assisting their child.

#### *5.7.3.2 Theme 6: Limitations.*

Despite the overall positivity afforded to the intervention concept, limitations of both a technological and psychological nature were uncovered: *"I thought it would motivate me to get the bike out the back of the garage and go on a cycle ride with Casey you see but no it was all about walking" (Viv*). Disappointment that certain activities did not count towards daily step totals, for instance cycling, swimming, team sports requiring watch removal, was apparent: *"Jesse often said oh I did this, and I did that, but I had to take my watch off" (Morgan).*

Another negative factor raised was the distance between the milestones on World Walking. It was felt to be disheartening and *"just a bit irritating to think you'd done a couple of days, quite a lot of steps and you hadn't got anywhere" (Pat) and* seemed to be "*stuck*" for days at a certain location: *"I'd check it every night and go what I haven't moved I'm still in Portmerion" (Viv).* This was consequently thought to be demotivating. Uncertainty regarding a feature of World Walking that allocates medals was also mentioned.

The issue of compliance raised interesting points. The necessity for the removal of the watch by children for participation in water-based, and, certain other, activities leading to them forgetting to put it back on, was to a degree, not unexpected: *"I've left this in the toilet (laughter), and I left it in the (bed) 'cos it's not waterproof that's why I took it off" (Casey).* However, prior consideration had not been given to the issue of parents intermittently wearing the watches for the children: *"My [parent] wears mine*

*so [they] actually does the steps for me for a bit" (Jesse), "I go swimming for an hour, so I got my [parent] to wear the watch" (Alex).*

### 5.7.4 Recruitment and retention.

#### *5.7.4.1 Theme 7: Facilitators.*

Engaging individuals with research, particularly older adults, can be difficult. Three ways to potentially enhance recruitment levels were identified. First, it was thought that the strategy implemented, targeting recruitment via the children, was the right approach, and, if anything a stronger emphasis on this should be employed.

> *Morgan: "Right I'd have thought a lot of it would've come from the children um I'm in it because Jesse wanted to do it you know if she had come home and said oh, they've got this thing, or this letter and I don't really wanna do it Mum and I don't really wanna do it Dad then that would be the end of it"*

Indeed, not only could it be the reason that older adults choose to participate, but it could also have a domino effect on stimulating interest amongst other children: *"regardless of technology a lot comes from the children Jesse was desperate to start because Taylor had one" (Morgan), "Once one is doing it, it makes other ones want to get involved" (Francis)*.

Second, alternative options to the familial dyad were discussed. Thoughts were mixed on changing the structure to include the 'middle generation'. Where some felt it could work: *"I don't know why it wouldn't work obviously every family is different" (Pat),* others felt it could change the unique dynamic of the dyad: *"because it's Jesse and me and we're competing then I think that's a better motivator if that's what you're after is motivation" (Morgan).* Regardless of the additional technological support it could add, whether this would actually encourage already sceptical older adults to become involved was debatable. Finally, it was suggested that exploring the use of incentives to boost interest and uptake, a method that often affords success in other situations should be considered: *"a couple of um surveys I've done you get ten pounds for them each" (Sam).*

#### *5.7.4.2 Theme 8: Mediators.*

Where some factors could directly facilitate uptake and participation rates, others could mediate strategy effectiveness. Often the first point of contact, the provision of sufficient study information to all concerned parties, is crucial. Where the volume is too large, it could be *"information overload for some elderly people" (Blake),* and that could ultimately disengage people: "*it was a big folder wasn't it bit scary wasn't it you know what I mean" (Sam).* This provides a dilemma for researchers undertaking multi-participant work. Getting this wrong may hinder progress.

Despite the overall focus of the intervention concept being to encourage people to move more, albeit through reducing sedentary time or increasing physical activity, these were not identifiable as reasons for engagement. The level of initial and sustainable interest in these and other core elements, could inherently be limitations. Indeed, some individuals may have a distinct lack of interest in being active: *"[They] don't like doing anything [they're] a typical teenager even though [they're] eleven but [they are] a teenager [they'll] sit there watching TV or read, read, read" (Sam)*. Others, particularly older adults, whilst potentially having the capabilities to use different technologies, either may not have any interest in using it, choose not to, or, are uncertain of the terminology that surrounds it: "*My [in-law] was instantly um 'what I've got to wear something?' and we were like 'yeah it's a watch'….. and 'but I wear a watch already' I was like 'yes' …. 'what it tracks me?'...." (Blake).* However, the opportunity afforded to seemingly help someone else, appeared to be important: *"I hoped that they'd see that it's not just helping them it's helping their grandchild" (Blake).*

> *"I felt kind of happy because sometimes some days when we didn't go out for a walk I'd only do something like 2,000 when my [grandparent] would be out doing lots of steps so [they] kinda helped me when [they] didn't do lots of steps I did when I didn't do lots of steps [they] helped me do lots of steps" (Taylor)*

Even when engagement has been achieved and acceptability established, it is apparent that there is an underlying risk that adherence and long-term participation could be hindered by the potential novelty factor. Within the relatively short time period that the intervention was trialled, activity levels were felt to have "*waned*" from those

initially achieved: *"The first couple of days I walked down to town instead of taking the car but the novelty of that soon wore off" (Pat),* with the children additionally sometimes showing more interest in other aesthetical features and components of the technology: *"I liked it because I could see the time" (Alex).*

The final mediator recognised, is one that has the potential to detrimentally impact recruitment within any intergenerational research where the target populations include older adults and children; the dynamics present with families. Through their own pre-established opinions and subsequent actions, parents may consciously or subconsciously, impede: *"I thought it was good it's just that I knew that the older the age of the older participant I knew they wouldn't be happy to participate but my child was very keen" (Charlie),* or, facilitate recruitment: *"They see obviously me and [my spouse] wear them and you just yeah [they] couldn't wait to wear one" (Blake).* It was also believed that the prevalent pattern of an increasingly smaller age gap between generations within western societies would limit the ability to form dyads constructed of an older adult and child within the required age ranges: *"people having children earlier in life you're not going to get a grandparent in that right bracket" (Pat).*

#### *5.7.4.3 Theme 9: Perceptions.*

It is clear that perceptions have a complex and varied role within the research recruitment process. The intervention was well perceived: "*I thought it was lovely I had children who wanted to take part and were keen to take part" (Blake).* Nevertheless, this did not equate to the desired recruitment numbers. Perceptions of the technology, the time required to engage with being more active, and, the research process in general, were all described as limitations: *"Maybe it is that if they are you know an older generation, they just haven't had that contact to know that a study or a research study isn't anything invasive" (Blake).*

Unfortunately, a number of negative perceptions regarding ageing and the ageing process were weaved throughout the focus group discussions. Some of these views were presented as likely self-perceptions:

*"They're often in the mindset like with mine well my [parent] goes 'well I'm seventy-two I'm not going to lose weight now am I I'm not going to' and I'm like well you could actually you could get fitter you could move more but [they are] you know 'I've had a good life' and 'I'm seventy something' 'I'm gonna keep as I'm going'....." (Blake).*

Moreover, older adults were viewed by others as being too set in their ways to embrace a new challenge that would potentially interfere with their daily routines: *"I think it's an age thing as well they're all set in their own ways of what they will do at certain times and they've got routines and I think that is what is the main problem" (Charlie).* Technophobia and the ability of older adults to use the required technology was also questioned: *"I would actually wonder about if it's the technology that put older people off a little bit because not everyone over sixty-five is conversant with modern technology" (Viv).*

## 5.8 Discussion

### 5.8.1 Intergenerational physical activity: A positive approach?

All participants successfully engaged with the intervention for the whole duration of the trial period indicating acceptability, and, the provision of a potential platform to generate positive behavioural changes and health outcomes. Participants signalled that they enjoyed taking part. Enjoyment, particularly when considering or undertaking more physical activity has been deemed an important motivational factor for both older adults (Boulton et al., 2018; Devereux-Fitzgerald et al., 2016) and children (Mackintosh, Knowles, Ridgers, & Fairclough, 2011). However, it is pertinent to note that the reasons for impact, and therefore the underpinning mechanisms at work, may be different for dyad members within each targeted age range, in this instance older adults aged ≥ 65 years old and children aged 7-11 years old.

It was observed that where the older adults appeared to draw direct and explicit associations between daily monitored step counts, self-determined goal progress and success, for children, the effects could be more subtle and implicit. In this situation, the children's benefits appear to have arisen from their desire to 'beat' their co-participant and complete the walk. The application of behaviour change models to one population age group, just because they have demonstrated success with another, has already been

questioned (French et al., 2014), therefore, the different mechanisms of change and effect, are not unexpected.

Intergenerational contact provides both children and older adults with the opportunity for generativity, a concept identified as potentially being an important driving force in successful partnerships and outcomes (Fujiwara et al., 2009; Kessler & Staudinger, 2007), and, within this study, a recruitment facilitator. Whilst classically presented as an opportunity to guide and help the next generation (Erickson, 1950, reprinted 1993), through its ability to determine self-worth in later life (Kotre, 1984), it appears that in pre-pubescent years, children may also be able to identify and attach comparable benefit to the perceived ability to help others.

### 5.8.2 Is the stereotype cliché getting old?

Intergenerational contact has been proposed as a way to target the detrimental effects and limit the impact of negative stereotypes of ageing across generations (Abrams et al., 2006; Oh, Bailenson, Weisz, & Zaki, 2016; Prior & Sargent-Cox, 2014). The work of Abrams et al. (2006) reported that the effects of stereotype threat on older adults aged 59-89 years, were notably supressed when prior contact with young people had been more positive. Comparison with outgroup members significantly impaired cognitive performance in individuals who experienced less contact, with those who had experienced higher levels of contact relatively unaffected. Ironically, within this feasibility study, negative stereotypes of ageing, both self-perceived and views-on-ageing, particularly relating to the abilities of older adults to engage with technology and be physically active, were evident. Additional strategies to challenge such stereotypes may need to be an integral part of recruitment processes.

### 5.8.3 Family: friend or foe?

Where associations have been made between levels of social support, and physical inactivity in older adults (Broderick et al., 2015; Floegel et al., 2015) the role of the family unit, its structural make-up, and hierarchy within in it, is undoubtedly complex. Important observations were raised regarding the targeted age range inclusion criteria, and the impact this could have on the availability (i.e., due to the generational age gap), and accessibility (i.e., due to the pre-conceived views of the wider family), of

the corresponding generations. Allowing 'younger' older adults to participate was a suggested solution. Whilst this would potentially change the boundaries of any conclusions that could be drawn, it has been suggested that age stereotypes may actually become less threatening with advancing age (Eich, Murayama, Castel, & Knowlton, 2014), and, that salience to stereotype threat in particular, is indeed greater, during the transition into older adulthood (Hess, Hinson, & Hodges, 2009). Therefore, intergenerational interventions that target 'early' older adulthood could be more effective.

When designing and ultimately endeavouring to implement intergenerational interventions or programmes, how members of the wider family will view and engage with the concept also needs to be considered. Strategies to challenge their beliefs and pre-conceived opinions may be essential. Particularly with familial older adults and children, the parental 'gatekeeper' who may end up mediating participation, could, albeit unintentionally, considerably help or hinder success (Mody et al., 2008). However, the extent of any impact may not always be initially apparent.

### 5.8.4 How do we solve the problem of recruitment?

Perhaps the biggest challenge facing intergenerational research, particularly where the target populations are older adults and children, is how to effectively recruit sufficient participant numbers. Addressing this issue is of paramount importance, as at present, the evidence-base surrounding this concept and its ability to positively affect health outcomes in older adults is at best, anecdotal. In line with the encountered limitations, prior studies have experienced similar issues. For instance, the *iStep* project initially aimed to explore the effects of a pedometer-based intergenerational social innovation on obesity levels in older adults through the formation of grandparent/grandchild partnerships. Unsuccessful recruitment led to the formation of pupil/teacher, and pupil/parent partnerships instead (Grindell, Mawson, Gerrish, Parker, & Bissell, 2019; Leitiao & Reed, 2015). Regardless of the level of potential afforded to an intervention concept or behavioural change strategy, or, how accurately it is constructed, a failure to recruit limits the ability to explore engagement, the magnitude of any observed change, and, the wider generalizability of results (McHenry et al., 2015).

There is an apparent need to address the divide between how the research process is presented and subsequently viewed. Targeted, population specific, innovative recruitment strategies may need to be devised that evoke interest, demonstrate a positive benefit to burden ratio, and, where necessary, subtly challenge the perceptions and opinions of not only potential participants, but also their wider circle of often influential family and friends (Mody et al., 2008). Additionally, specific to interventions utilising technology, consideration needs to be given as to how terminology is used, and, the connotations that could arise from different interpretations of seemingly standardised wording, for example, 'activity tracker'.

Reporting the lessons learnt from recruiting 777 older adult participants, aged ≥ 65 years with a high risk of mobility disability into a 12-month multicentre RCT, Withall et al. (2020) adopted a variety of different recruitment strategies. The most effective strategy appeared to be mail invites via General Practitioners. Face-to-face recruitment via liaison with and presentations at third-sector organizations (i.e., shelter housing) provided minimal uptake. However, it is pertinent to note their recommendation that to gain a representative sample, and therefore increase generalizability, such relationship building methods may still be essential with minority groups.

#### 5.8.5 What are the key considerations for future work?

For older adults, when designing behaviour change interventions, be they intergenerational or not, the findings of this study suggest it may be pertinent to consider whether they allow for flexibility within pre-established routines, individual choice, and a potential lack of interest in and engagement with, rigidly imposed structures, where being 'active' is permitted to be a by-product of participation in other activities (McGowan et al., 2018). It is however noted that the effectiveness of self-regulatory techniques with older adults is questionable (French et al., 2014; O'Brien et al., 2015; Warner et al., 2016). Within this study, attainable achievement was also perceived as being important, where the distance between some of the milestones within World Walking was deemed to be too far, motivation waned.

Another key 'gripe', that could have been a contributary factor in the issue that arose whereby some parents were wearing their children's watches, was the inability to record steps for other sports and activities undertaken. Consideration needs to be given

to how this issue can be addressed. One possibility could be the provision of activity-to-step conversion charts, thus allowing the accumulation and addition of equivalent step data. Less despondence from the children, could remove the need for parents to feel compelled to help. Some purposefully constructed, study specific, web-platforms have utilised more sophisticated built-in step calculators (Patel et al., 2017), however, within real-world research, options are restricted.

## 5.9 Strengths and Limitations

Within this study, 75% of focus group participants and 100% of parental responses were female. Positively, each focus group did have one male representative. This is important as it has been noted that gender disparities within such research are common (Park, 2014), and, that males and females could have different outcome responses to intergenerational interventions and activities (Prior & Sargent-Cox, 2014). Criticism may also be drawn towards the small convenience sample obtained from only one local school and hence the limited scope for generalizability of the results. However, given the identified recruitment complexities, and failure of other studies to recruit any of their targeted sample (Grindell et al., 2019; Leitiao & Reed, 2015) this work still provides some valuable insight. Additionally, the strategies employed within the interview schedules with the children appeared to be affective. Given the young age of the participants, and their developing linguistic ability (Gibson, 2012), the use of monosyllabic responses was minimal, and the volume of data obtained deemed sufficient.

The dyads only experienced a relatively short trial period. It is therefore difficult to truly understand the implications of any novelty factor or longer-term adherence issues. Additionally, a degree of despondence was reported towards certain elements of the intervention components. These potential limitations will need to be given due consideration in subsequent pilot work.

It is pertinent to note that the researcher/PhD candidate was a parent at the participating school, and, the only focus group moderator. Whilst professional and ethical boundaries were observed at all times, an impact on recruitment, and, the subsequent results, albeit positive or negative, cannot be ruled out. To minimise bias,

within the focus groups, outline interview question schedules were specified a priori, and, within the data analysis, emergent codes and themes were critiqued and challenged by a critical friend to ensure that the personality, experiences, and, beliefs of the researcher, and, goals of the research did not bias the analysis and reporting.

## 5.10 Intervention Refinement

An essential component of the intervention development process is the utilisation of findings from preliminary work, where possible, to enhance the potential effectiveness and success of any prospective future studies, and, the ultimately targeted implementation phase. Within this feasibility study, three key addressable limitations were identified:

- Potential recruitment impediment secondary to the older adult age range parameters.
- The lack of ability to accumulate steps for non-step-based activities.
- Walk route set up and the achievability of incorporated milestones.

### 5.10.1 Older adult inclusion criteria.

Given the suggestions of Eich et al. (2014) and Hess et al. (2009), and the important observations raised by the focus group participants (see section 5.8.3), in an endeavour to facilitate and enhance potential recruitment, in future work lowering the age range of the older adult participants to aged ≥ 60 years old was deemed appropriate.

### 5.10.2 Activity minute-to-step conversion charts.

To assist with limiting discourse and improving compliance with the parameters of the study, an activity minute-to-step conversion chart, freely available online was sourced (Earlham College, 2019), and, condensed to include the potential activities that participants in future studies may undertake. For example, if a participant swam leisurely for 30 minutes, the equivalent step count is 133 steps per minute, therefore, 133 x 30 = 3990 steps[13]. As the calculation and self-monitoring of daily step counts within this research was only a facilitatory behaviour change technique, and, not a reported

[13] For a copy of the complete conversion chart see Appendix M.

outcome measure, validation of the absolute accuracy of the conversion chart was not deemed necessary.

### 5.10.3 Collaborative walk route design.

The third addressable issue identified, related to the motivational limitations imposed by the method of route construction within the chosen walk, specifically, the distance between some of the pre-determined milestones. Following discussions with the World Walking platform provider, it was agreed that a series of new study specific walk routes could be developed. To facilitate this, two collaborative processes were completed. The first involved the platform provider and the researcher co-designing a new walk route that mirrored the Coastal Path of Wales.

In the feasibility study, the route through Wales was 301 miles long, had nine milestones, and, the average distance between each milestone was 33.5 miles. The newly developed Coastal Path of Wales route was constructed to be 564 miles long, with 37 milestones, and, an average distance between each milestone of 15.2 miles. Allowing for fluctuations in daily step counts, and, that the older adult participants in the feasibility study clearly deemed routinely achieving the daily recommended 10,000 steps to be unachievable, this was equated to a targeted average of 8,000 steps per day, per team member. Over a 12-week period (as required to establish true efficacy of behaviour change interventions; Lally, van Jaarsveld, Potts, & Wardle, 2010), the average weekly distance target per dyad, would therefore be 47 miles (3.36 miles/8,181 steps each per day). Based on these calculations, dyads would therefore hypothetically reach a new milestone at least every two to three days, and, be able to complete the walk within the intervention period. Figure 5.3 provides an image of the new route.

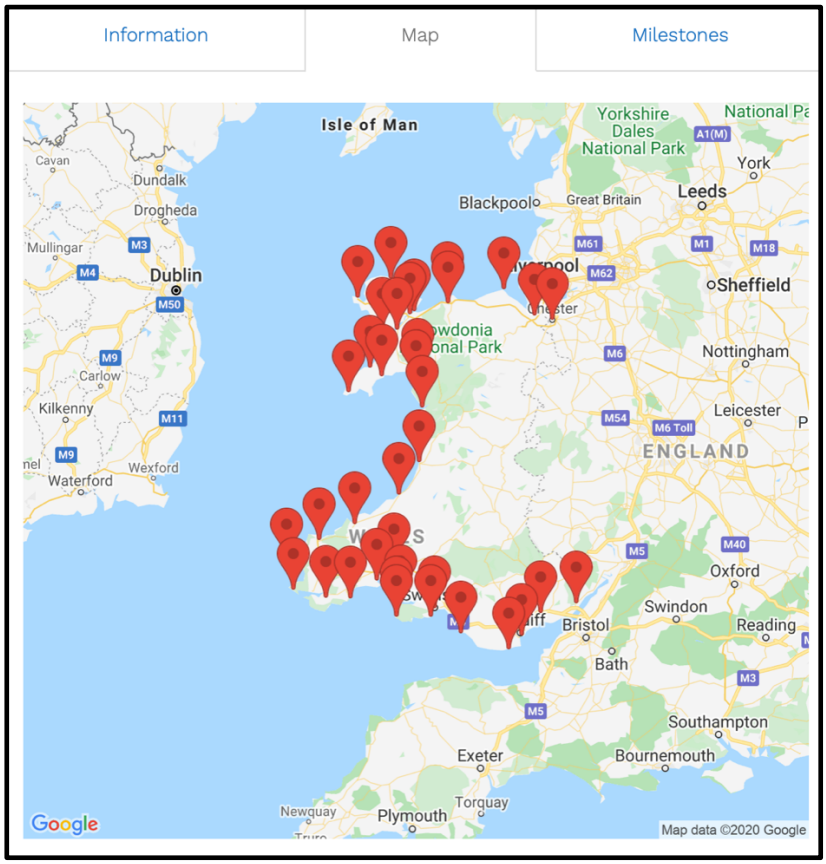


*Figure 5.3* Collaboratively constructed Wales Coast Path route/Llwybr Arfordir Cymru

The second process involved the facilitation of a co-design workshop where the participants who completed the feasibility study were invited to help design outline routes for new walks around Swansea, Gower, and the surrounding area. The routes were developed based on milestone suggestions provided by the wider child population of the participating primary school. An outline of the aims and processes undertaken is provided in Box 5.3.

Box 5.3

*Outline plan for the co-design process of new World Walking routes around Swansea, Gower, and the surrounding area*

| **Target Location: Swansea, Gower & surrounding area** | |
|---|---|
| Aims: | To create 1 or 2 local walks that incorporate key local points of interest/landmarks, and in recognition of Swansea University's Centenary celebrations both University campuses.<br><br>To include information on the area, each milestone, and reason why the location was picked. |
| Stage 1: | Every child was sent home a pre-printed sheet to complete that asked them to identify 1 or 2 places in the Swansea or surrounding area that they would like to see included in the walk. This could be sent home or completed in class.<br><br>They were asked to include:<br>• The name of the place.<br>• Any facts or information they know about it (if they could).<br>• Why they chose that particular place. |
| Stage 2: | Information to be returned to school and collated by the researcher. |
| Stage 3: | Co-design workshop made up of the researcher and participants from the feasibility study held to review all the received suggestions, create the outline walk route(s), and, choose information and comments to be including within the milestone information. |
| Stage 4: | Researcher collation of additional information on each milestone and completion of the design process with World Walking. |
| Stage 5: | Final version to be reviewed and agreed by researcher and headteacher prior to publication for public use on the website. |

From this collaboration, two additional shorter routes were constructed. The Swansea University Centenary Walk (75,022 steps) and, the Primary Schools North Gower and Beyond Adventure (62,362 steps). They incorporated the favourite places of the school children, additional landmarks considered important by the workshop participants, and were illustrated where possible with photographs provided by a local

photographer. Printed maps of the area, to facilitate the use of these routes in future work, were sourced and supplied by the local council tourism department. Examples from the finalised versions are presented in Figure 5.4.

## 5.11 Conclusion

This study provides a limited yet encouraging and constructive insight into the effects of an innovative approach to targeting physical activity engagement and stereotypes of ageing, and considerations for future work. Broaching physical inactivity and sedentarism through technology-driven intergenerational contact provides a viable option for further controlled exploration. Where motivational drivers and the level of direct impact may differ between dyad members this should not be viewed negatively, especially if interventions are designed with a primary emphasis on the health outcomes of one half of the dyad (i.e., the older adults). It may need to be accepted that, whilst secondary gains are still there to be made (i.e., for the children), they may not be as significant.

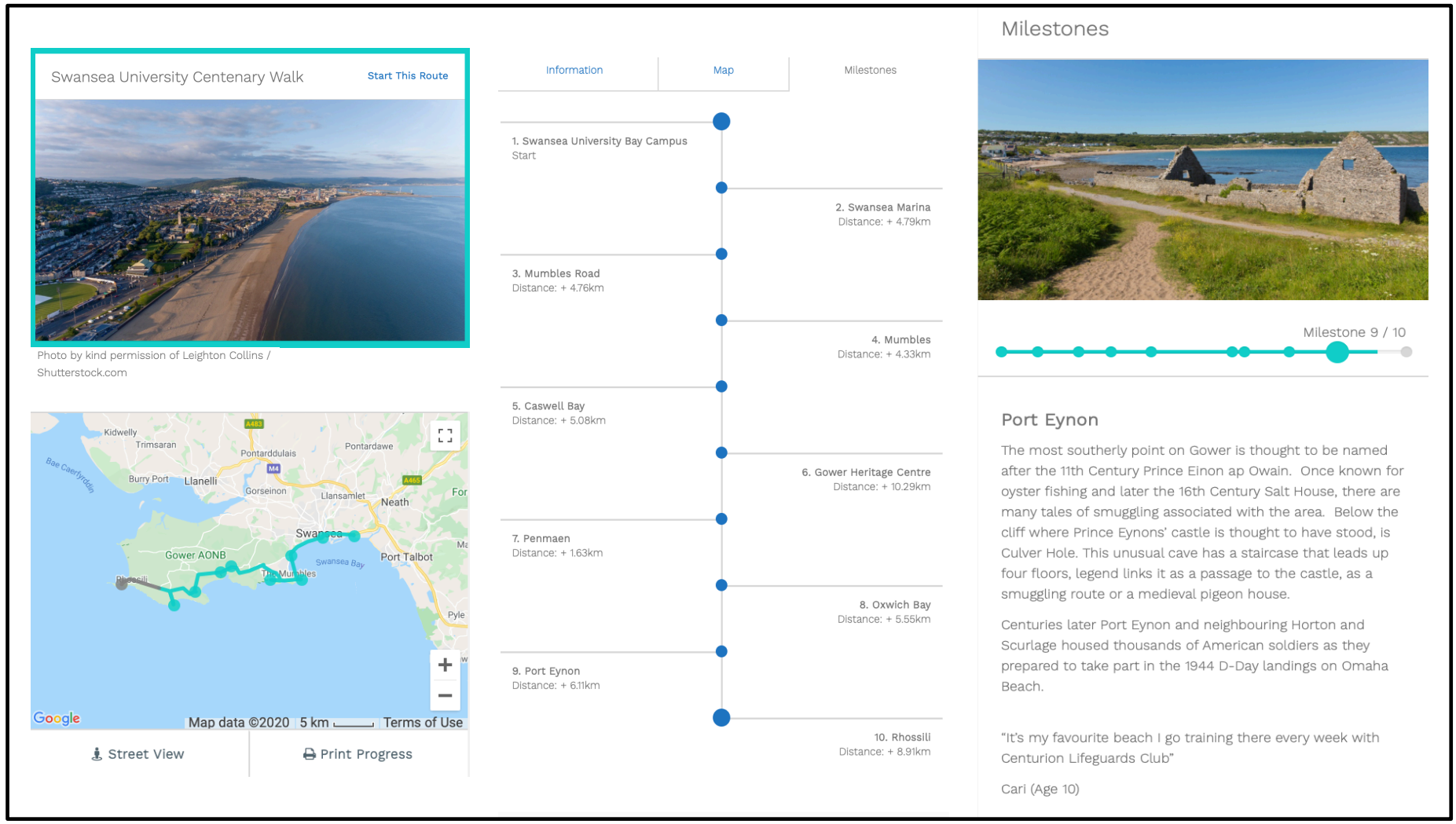


*Figure 5.4* Sections of the co-designed walk routes from World Walking (reproduced with permission)

# Chapter 6

## Intended Pilot Study and COVID-19 Modifications

*Within the MRC intervention development guidance (Craig et al., 2008), it is advised that a series of studies may be necessary to progressively refine and define an intervention before progression to a wider scale evaluation. Interventions that have failed to implement this approach may not just be ineffective, but could inadvertently cause harm, and waste resources (Faggiano et al., 2014). Where feasibility studies help focus the parameters of a study, establish the willingness of individuals to participate, and, endeavour to identify any problems with the overall intervention design and individual components (O'Cathain et al., 2015), pilot studies provide the opportunity to implement a more rigorous methodology, trial a smaller version of the ultimately targeted study, and, collect data on the outcomes of interest, but, without specific hypothesis testing unless a powered sample size is attainable (Arain et al., 2010).*

*The primary focus of this thesis is the impact of the developed intervention on parameters associated with older adults. Given the potential to generate secondary effects for children it is therefore essential to also test, and, where possible, measure viable outcomes in both participant groups. The gains from one group, however promising, cannot lead to detriments for the other. Indeed, research has a duty at all times to ensure the principle of non-maleficence. Following the establishment of feasibility and refinement of the intervention in Chapter 5 (Study 2) this chapter presents the primary stages of Study 3. In response to findings from the feasibility study, it is pertinent to recall that the age range criteria for older adult participants in this work, was lowered accordingly to aged ≥ 60 years, activity-to-step conversion charts were sourced to assist compliance, and new, study specific walk routes were constructed to address identified motivational limitations. Additionally, recruitment procedures were amended to streamline the volume of information provided in the preliminary stages.*

*Initially designed as a proof-of-concept study to enable a preliminary exploration of the potential interactions and mediations between intergenerational contact, parameters of health (physical activity, sedentary time, health and well-being), and age stereotype constructs (self-perceptions of ageing, views-on-ageing, stereotype threat),*

*the progression of this work was impacted by the essential restrictions imposed on society to control COVID-19. Therefore, this chapter outlines the structure of the intended pilot study and provides details of the processes completed up to the point that the established data collection methods and recruitment had to cease. Finally, ethical amendments, implemented changes and the proceeding way forward are discussed.*

## 6.1 Aim

The aim of this research was to pragmatically explore the impact of intergenerational contact on physical activity, sedentary time, and stereotypes of ageing in children aged 7-11 years old and older adults aged 60 years or over. Additionally, the influence on health-related quality of life was also to be explored in the older adult participants.

## 6.2 Research Questions

1. In adults aged 60 years or older, what are the potential effects of the addition of intergenerational contact to a technology driven physical activity intervention undertaken in a real-world setting, on physical activity levels (primary outcome), sedentary time, health-related quality of life and stereotypes of ageing (secondary outcomes) when compared with the intervention alone?
2. What are the potential effects of an intergenerational technology driven physical activity intervention undertaken in a real-world setting on physical activity levels (primary outcome), sedentary time and perceptions of ageing (secondary outcomes) in children aged 7-11 years old compared with a non-intervention control group?
3. In adults aged 60 years or over, do changes in views-on-ageing, self-perceptions of ageing or stereotype threat influence the role of an intergenerational physical activity intervention on physical activity levels?

## 6.3 Specific Objectives

1. To explore the impact of an intergenerational contact-driven intervention on physical activity engagement, sedentary time, and stereotypes of ageing in older adults and children over the optimum trial period (12-weeks).
2. To ascertain the appropriateness of the employed outcome measures.
3. To examine intervention adherence and the practicalities of sustaining participation rates.

## 6.4 Methods

### 6.4.1 Research design.

This study employed a quasi-experimental design. Using a non-randomised approach, participants were recruited separately into an intergenerational dyadic group who engaged with the intervention together, an older adult only control group who engaged with the intervention independently, and a child only control group who maintained their usual routine. Following the completion of a baseline week, each group engaged with the study period for a further 12-weeks. Baseline (week 0), mid-intervention (week 6) and post-intervention (week 12) outcome measures of physical activity, and stereotypes of ageing were taken, with health-related quality of life also measured in the older adults. At baseline, along with demographic data, for the older adults only, additional measures of education level, marital status, self-related health, subjective age, and frequency and quality of contact with any grandchildren were also recorded. These measures, that would have allowed the impact of potential confounders to be explored during data analysis, are outlined in Box 6.1.

Box 6.1

*Outline of additional older adult only baseline measures*

**Education level**
Highest attained qualification and number of years in education

**Frequency of contact with grandchildren during the last year**
1 = never, 2 = once a year, 3 = A few times a year, 4 = Once a month, 5 = Once a week, 6 = A few times a week, 7 = Everyday (Abrams et al., 2008)

**Quality of contact with grandchildren**
1 = very negative, 2 = negative, 3 = fairly negative, 4 = neutral, 5 = fairly positive, 6 = positive, 7 = very positive

**Self-rated health**
1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = very good (WHO, 2002)

**Subjective age**
Single item measure asking, "how old do you tend to feel?" (Kastenbaum, Derbin, Sabatini, & Artt, 1972) Proportion score calculated ([subjective age - chronological age]/chronological age), a negative score will indicate feeling younger than their chronological age – i.e., scoring -0.20 would mean individual felt 20% younger than their actual age (Rubin & Berntsen, 2006).

### 6.4.2 Ethics.

Ethical approval for this study was granted by the College of Engineering Research Ethics Committee, Swansea University, as an amendment to approval obtained for Study 2 (Chapter 5; approval numbers 2018-103 and 2018-103A). Identical processes were followed as outlined in Chapter 5, Section 5.4.2. Study and group specific consent, assent and information sheets were constructed giving due consideration to points raised within the feasibility study (see Appendices N and O).

### 6.4.3 Participant sampling and recruitment.

Separate convenience samples were recruited from different locations between September 2019 and March 2020. This approach was used in an endeavour to facilitate recruitment and prevent cross contamination between the different participant groups. The control groups were not made aware of the study aims at enrolment but were fully debriefed at the end of their study period. The intergenerational intervention group and child only control group were recruited from two different local Primary schools in Swansea, South Wales. The first school recruited was allocated to the control group, the second to the intergenerational group. An email targeting the recruitment of participants for the intergenerational group was also sent out via the Swansea University College of Engineering Staff mailing list. The older adult only group was recruited through attending and presenting information to local groups, for example, a male voice choir, and placing flyers in local community venues. A snowballing approach to recruitment was adopted.

#### *6.4.3.1 Intervention group.*

This study arm targeted the recruitment of 10-20 familial intergenerational dyads, formed of one older adult aged ≥ 60 years old, and, one child aged 7-11 years old. Participants could be male or female. As per the feasibility study, the older adult could either be a family member of the child, or an older adult with whom the child had a 'familiar' link, and, with whom the parent/guardian of the child provided explicit consent for their child to be paired.

Following formally obtaining permission to recruit dyads via pupils aged 7-11 years old from the Deputy Headteacher of the participating school[14], information was presented by the researcher to the children in school years three to six during a scheduled School Assembly. Initial recruitment packs containing an information letter, recruitment flyer, frequently asked questions sheet, and expression of interest form[15] were then sent home with each child. Only when completed expression of interest forms were returned to the researcher via the school, were the specific information, consent, assent, and health screening forms individually sent out[16].

*6.4.3.1.1 Inclusion criteria.* To be included in the study, participants must have:

- been a dyad pairing of a child aged 7-11 years with parental consent and child assent, with a co-participating and consenting older adult aged ≥ 60 years
- had access to a smart phone/tablet device, an active email address and Wi-Fi/internet access

*6.4.3.1.2 Exclusion criteria.* Participants were excluded from the study if they:

- did not have a co-consenting participant within the required age range
- had not provided written informed assent (child), informed consent (older adult) or parent/guardian informed consent
- were not aged 7-11 years old or were < 60 years old
- were unable to cooperate with the research team for the full duration of the project
- were unable to understand, write and converse in fluent English
- identified any participation contraindications on the health screening questionnaire

***6.4.3.2 Older adult control group.***

This arm of the study targeted the recruitment of 10-20 older adults aged ≥ 60

[14] See Appendix P for a copy of an example gatekeeper letter.
[15] For copies of all documents included in the recruitment packs see Appendix Q.
[16] Copies of the parental/guardian, co-participating older adult, child information sheets, consent/assent forms, health screening questionnaires and data protection information can be found in Appendices E, N, O, and R.

years old. Participants could be male or female. All interested participants were supplied with an information sheet, consent form, health screening questionnaire and data protection information[17]. Those who met the inclusion criteria were contacted by the primary researcher to initiate enrolment.

*6.4.3.2.1 Inclusion criteria.* To be included in the study, participants must have:

- been aged ≥ 60 years
- had access to a smart phone or tablet device, an active email address and Wi-Fi/internet access

*6.4.3.2.2 Exclusion criteria.* Participants were excluded from the study if they:

- did not provided informed consent
- were aged < 60 years old
- were unable to cooperate with the research team for the full duration of the project
- were unable to understand, write and converse in fluent English
- identified any participation contraindications on the health screening questionnaire

***6.4.3.3 Child control group.***

This arm of the study targeted the recruitment of 10-20 children aged 7-11 years old. Participants could be male or female. Permission to recruit pupils was obtained from the participating school Headteacher, who selected a sample of 60 pupils across school years three to six to be approached. Recruitment packs containing parental/guardian and child information sheets, a parental consent form, child assent form, child health screening questionnaire and data protection information were supplied to each identified child[18]**.** Completed consent forms were returned to the researcher via the school.

[17] See Appendices E, N, O, and R.
[18] For copies of all documents included in the recruitment packs see Appendices E, N, O, and R.

*6.4.3.3.1 Inclusion criteria.* To be included in the study, participants must have:

- been aged 7-11 years with parental consent and child assent

*6.4.3.3.2 Exclusion criteria.* Participants were excluded from the study if they:

- did not provide written informed assent and parent/guardian informed consent
- were aged < 7 or > 11 years
- were unable to cooperate with the research team for the full duration of the project
- were unable to understand, write and converse in fluent English
- identified any participation contraindications on the health screening questionnaire

### 6.4.4 Intervention procedures.

#### *6.4.4.1 Intergenerational dyads and older adult only control group.*

Prior to commencing the intervention all eligible, consenting dyads and a parent/guardian for each child, attended two enrolment and induction sessions with the primary researcher, at least one week apart, at a time and location convenient to them. This could have been at either of their homes or at Swansea University. A breakdown of the enrolment and follow-up session structure with a description of tasks completed at each time-point is detailed in Table 6.1. For the children the downloading and access to the '*Mi App*' was governed by their parent. Once the enrolment and induction processes were completed the dyads were set up to commence the intervention the following day.

For the next 12-weeks, working collaboratively, the dyads combined their daily step counts to complete virtual walk routes. In the first instance this was the specifically constructed Coastal Path of Wales route (see Chapter 5, Figure 5.3). If participants completed this route before the end of the study, they were free to either complete the Swansea routes or independently choose their own routes from those available on World Walking. No individual exercise prescription occurred during the study, rather, participants were only encouraged to engage with the concept of the intervention.

Table 6.1

*Enrolment/follow-up schedule: Intergenerational and older adult only groups*

| Meeting | Tasks completed | Average time |
|---|---|---|
| Week 0 | Review of consent forms and health screening<br>Completion of outcome measure questionnaires<br>Supply with accelerometer (7-day recordings)<br>Download of Mi Fit App on smart device | 45 mins |
| Week 1<br>(Start of study) | Return accelerometer<br>Complete set up and familiarisation with World Walking<br>Supply with Mi Band 2 Watch and complete set up and sync with App | 45 mins |
| Week 6 | Supply of accelerometer and repeat outcome measure questionnaires | 10 mins |
| Week 7 | Return accelerometer | 5 mins |
| Week 12 | Supply of accelerometer and repeat outcome measure questionnaires | 5 mins |
| Week 13 | Collect all equipment and questionnaires<br>Study debriefing | 20 mins |

Again, as the children could not be provided with access to the World Walking platform due to GDPR (European Parliament and Council of European Union, 2016) access restrictions, they separately recorded their step data and had the option to chart the dyad's collaborative progress for the initial walk route on an A3 printed map of Wales. As per the feasibility study, to allow for personal preference, each older adult was also given the option to record their daily steps manually, instead of referring to the Mi App. If the older adult was not comfortable leading on the input of information into World Walking, then this task, if they were in agreement, could be completed by the parent of the child. Both dyad members were additionally supplied with an activity to step conversion chart to allow step allocation for activities when the watch had to be removed, for example, swimming, printed or electronic instructions on how to use the Mi Band 2, World Walking and the accelerometers, and a sheet to record any periods

when the accelerometer was removed[19]. For the older adult only control group, the participants followed exactly the same processes and meeting structure as the intergenerational dyad participants, but independently.

#### *6.4.4.2 Child only control group.*

As it was impossible to provide the children with independent access to World Walking, a comparable child only 'intervention' comparison group could not be included. Therefore, the participants completed the same outcome measures, following the same time-point schedule as the other two groups[20], but instead continued with their usual daily routines and activities. All of the children who had returned appropriately completed parental consent and child assent forms to the school, prior to the first session, were invited to take part. All enrolment and follow-up sessions took place at the recruited Primary school, during school hours, following a time and date schedule previously agreed with the Headteacher. During the first enrolment session (week 0), the researcher was assisted by a volunteer Sport and Exercise Science Undergraduate student. When a second person was not available, all contact with the children was undertaken in an open space with a member of school staff present within the immediate vicinity.

### 6.4.5 Outcome measures.[21]

The following section presents the outcome measures that would have been analysed if the study had been completed as initially planned.

#### *6.4.5.1 Physical activity.*

ActiGraph GT9X Link accelerometers were to be used to record 7-day physical activity levels with all study participants as per the schedule outlined in Table 6.1. The intention was to assess minutes spent in MVPA, counts·min$^{-1}$, and daily sedentary time. Additionally, the Godin Leisure Time Questionnaire (Godin & Shepherd, 1985), a four-

[19]Copies of all provided guidance and the activity to step conversion chart are provided in Appendices M, S, T, and U.
[20]As per Table 6.1, but the average session times for 'week 0' and 'week 1' were reduced to 20 minutes and 5 minutes, respectively.
[21]Copies of all of the questionnaires used can be found in Appendix V.

item self-administered measure of mild, moderate, and strenuous physical activity over a typical 7-day period, was to be completed by the older adults only. Self-report physical activity measures are noted to be inherently problematic and susceptible to recall error when used with young people (Biddle, Gorely, Pearson, & Bull, 2011). A correlation of $r = 0.24$, $p < 0.01$ has been demonstrated between total reported leisure activity and maximal aerobic power percentile, with this increasing to $r = 0.38$, $p < 0.001$ for the strenuous exercise only condition. The obtained results could have either been presented as a relative ranking, or, used to classify individuals as active, moderately active or insufficiently active (Godin, 2011).

#### *6.4.5.2 Age stereotypes.*

*6.3.5.2.1 Older adults.* Measures of age stereotypes were identified to assess each of the three main constructs - stereotype threat, views-on-ageing, and self-perceptions of ageing.

Stereotype threat/Stigma consciousness

Data from a modified version of the Stigma Consciousness Questionnaire developed by Pinel (1999) was intended to be used to establish how concerned the older adults were regarding age stereotypes and the extent to which they expected to be stereotyped. Although the original scale was constructed and validated for gender and sexual orientation stigmas (Pinel, 1999), a study by Hess et al. (2009) adapted and used the modified version with an older adult population, reporting internal consistency via Cronbach's alpha to be reasonable at 0.71. Participants are asked to respond to 10 statements, for example, *'Most young people have a problem with viewing older adults as equals'*, using a 7-point Likert scale from 0 *'strongly disagree'* to 6 *'strongly agree'*. The higher the overall reported score the greater the stigma consciousness/perceived level of stereotype threat.

Views-on-ageing

Attitudes towards the overall process of ageing, from the perspective of the older adults, including both the potential associated losses and gains were to be assessed using the 24-item Attitudes to Ageing Questionnaire (Laidlaw, Power, &

Schmidt, 2007). Consisting of three subscales, each with eight statements, it reviews psychosocial loss, physical change, and psychological growth. Each statement, for example, *'I feel excluded from things because of my age'* is scored on a five-point scale from 1 *'strongly disagree'* to 5 *'strongly agree'*. The total calculated scores for each domain (ranging from 8 to 40) give an indication of attitudes to ageing, with higher scores on the physical change and psychological growth subscales indicating a more positive outlook towards the ageing process. On the psychosocial loss subscale, higher scores, or a stronger endorsement of the domain items, indicate a more negative appraisal of ageing. Internal consistency via Cronbach's alpha for psychosocial loss, physical change and psychological growth are reported as reasonable, at 0.81, 0.81 and 0.74, respectively (Laidlaw et al., 2007).

Self-perceptions of ageing

The Attitude Toward Own Ageing subscale, based on items from the Philadelphia Geriatric Center Morale Scale (Lawton, 1975; Liang & Bollen, 1983), was to be used to assess participants' self-perceptions of ageing. The five-point subscale consists of the following statements: '*Things keep getting worse as I get older'*, '*I have as much pep as I did last year*', '*As you get older, you are less useful*', '*I am as happy now as I was when I was younger*', and '*As I get older, things are (better, worse, or the same) than I thought they would be*'. This questionnaire would have been scored using the method described by Levy, Slade, Kunkel, and Kasl (2002). For the first four statements, participants who respond with a '*no*', score 0, and with a '*yes*', score 1, with the scores for statements one and three being reversed to make all scores reflect positive self-perceptions. As statement five has the responses '*better*', '*worse*', or '*the same'*, to make the scoring system comparable, the responses '*the same'* and '*worse*' are combined (scoring 0) and *'better'* responses are scored 1. A total score ranging from 0 to 5 is subsequently recorded. The higher the score, the more positive the reported self-perceptions of ageing.

*6.4.5.2.2 Children.* The Child-Age Implicit Association Test (Babcock et al., 2016) was the measure identified to explore children's potential implicit ageism. Babcock et al. (2016) propose that even at a young age, children, because of social norms and the fear

of being viewed negatively, may not be willing to openly express their true attitudes towards older adults. Therefore, an implicit measure should provide a more accurate overview of any underlying biases. A series of Items are presented as paired categories. Items correctly identified as consistent with a bias (good/young) versus when they are inconsistent with a bias (bad/old) are compared. Bias scores are calculated as a product of the square root of the difference in the two scores: (X/Y)*SQRT(X-Y), where X is the greater of the two scores and Y is the smaller. If the bias-inconsistent score is greater than the bias-consistent score, this figure would be multiplied by -1. A score greater than '0' would indicate bias. Internal consistency reliability analyses demonstrated a Cronbach's alpha of 0.94.

#### *6.4.5.3 Health and well-being (older adults only).*

The WHOQOL-BREF (WHO Mental Health Division, 1996), a globally recognised questionnaire comprised of 26 self-report items, was to be used to establish how the older adult participants only felt about their health-related quality of life levels over the preceding two weeks. The first two items rate overall quality of life and satisfaction with general health. The remaining 24 cover four domains: physical health; psychological health; social relationships, and, environment. Participants were asked to assess how they feel about each question, and to score their responses using a 5-point Likert scale ranging from 1 '*not at all',* to 5 '*completely*'. A raw score for each domain is calculated and the greater the score, the higher the quality of life experienced (WHO Mental Health Division, 1996).

## 6.5 Proposed Data Analysis

Depending on sample size, adherence, and data normality, appropriate statistical tests would have been selected to explore the influence of, and interaction between, intergenerational contact and the dependent variables (MVPA, sedentary time, health-related quality of life, age stereotype constructs).

## 6.6 Study Status at Data Collection Cessation due to COVID-19 Restrictions

At the point recruitment had to cease, 10 expressions of interest for the intergenerational intervention group had been returned (9 via the school, 1 via University email). Two dyads who met the inclusion criteria had proceeded to consent to participate, with one progressing through baseline data collection, enrolment, and induction processes to commence the intervention. Unfortunately, the other dyad was unable to fully complete the baseline measures and enrolment process prior to the enforcement of lockdown restrictions, and no further contact with the other interested parties was permissible due to these restrictions.

Data collection for the child only control group had been completed. A total of 23 sets of consent forms were initially returned. Five parental consent forms were incomplete, and one pupil withdrew for medical reasons before data collection commenced, leaving a final sample of 17 children. Of these, 16 participants, with a mean age of 8.7 years (*SD* 1.27) completed the study, with one further participant withdrawing at baseline due to being unable to tolerate wearing the accelerometer. For the older adult only group, 11 participants, with a mean age of 62.2 years (*SD* 2.85; range 60-70) had been recruited. Nine had fully completed all data collection points, whereas two were unable to complete the final 12-week follow-up due to COVID-19 restrictions. This additionally prevented the recruitment of two further potential recruits who had expressed an interest in participating.

## 6.7 Identifying the Way Forward

When life as we knew it stood still, it was unclear when and how restrictions would be lifted, and what 'normal' life would therefore look like for the foreseeable future. Discussions and deliberations ensued, regarding whether:

1. To pause recruitment and data collection and wait to see whether restarting at a future time point would be viable.
2. To cease the study completely.
3. Any analysis of the older adult control group data as a pre-post intervention study could address any of the pre-defined study objectives.
4. To explore if, the one dyad already enrolled, would consent and be happy to

continue to participate with remote follow-up and data collection via alternative methods.

Following consideration of all of the information available at the time, the enthusiasm and consent of the remaining dyad, and, obtaining ethical approval, the decision was made to transform the research approach and present an intergenerational intervention case study. It was accepted that all of the data already collected for the older adult and child control groups would become obsolete, and, that this new approach would not be able to address the specific research questions and objectives of the pilot study. It was however, deemed through its potential to provide a rich data set that could enhance and build upon the findings of the first two studies, to be the most appropriate and viable approach, given the overall thesis aim and objectives, and the unpredictability of the situation.

## 6.8 Case Studies as Research

Often a misunderstood mode of research injury (Yin, 2018), case studies afford researchers the unique opportunity to holistically explore in depth a specific, often complex phenomenon, bounded by place and time, in a pragmatic real-world context (Schwandt, 1997). The 'case' can be a person, group, event, or community, whose situation and collated data is used to help explain 'how' and 'why' the phenomena of interest may work (Stake, 2005). Within the context of this research, this refers to intergenerational contact, and its potential role as a strategic approach to challenge stereotypes of ageing, and positively influence health behaviours. Within the context of COVID-19, this refers to the unusual and previously unaccounted for situational status that inherently imposed restrictions on physical activity and opportunities for social contact. Case studies have successfully been undertaken as viable alternatives in situations where practical or ethical issues, participant accessibility, and logistical constraints have prohibited or restricted other options (Hodge & Sharp, 2019).

### 6.8.1 Types of case study.

A number of approaches to case study research can be undertaken depending on the targeted knowledge generation and type of 'case' being pursued. Three core

types were identified by Stake (2005) as intrinsic, instrumental, and collective, with crucial cases previously detailed by Gerring (2004). An *intrinsic* case relates to a specific interest, for example, an individual or occurrence of a particular event, that is not tied to an overarching concept or theoretical construct. Kirby and Kluge (2013) used this approach to gain a greater understanding of women's experiences as part of 65+ volleyball team. Conversely, an *instrumental* case pertains more specifically to the generation of a wider understanding about the phenomena behind the case of interest. For example, the health information seeking behaviours of cancer patients and their relatives, with the wider goal of reproducing services on different technological platforms (Papadakos et al., 2017). Within health-related contexts, case studies are deemed to be an under-utilised resource, particularly when an enhanced understanding of the mechanisms behind a phenomenon that underpin any observed effects, could indeed be vital to the success of long-term implementation strategies (Paparini et al., 2020).

Where multiple cases are reviewed concurrently the term *collective* case is used. This approach encompasses data collected from several instrumental cases, often with the aim of strengthening theoretical construction and/or the generalisation of findings. Combining the data sources from five individual male children with cerebral palsy, Wright, White, and Gaebler-Spira (2004) explored the effects of using an established method of teaching physical activity within an adapted martial arts setting. The final, and least accepted type of case study is the *crucial* approach (Gerring, 2004). These cases are often deliberately selected because they are unique or represent a specific target of interest. Hodge and Sharp (2019) raise concerns regarding the definition of what constitutes the most 'crucial' element of a particular concept of interest. Such cases often explore deviants, negative examples (i.e., a failure of effect, selection for a team) or closely align to a theoretical perspective.

### 6.8.2 The positivistic or post-positivistic approach.

Whilst potentially not the view of all, Yin (2018) believes that a researcher's epistemological and ontological position does not preclude their use of case study research. Indeed, they view it from a predominately realist perspective, indicating that it is in fact possible to use this approach whilst still leaning towards the notion of one

reality and undertaking a deductive approach to analysis (Shanks, 2002; Yin, 1994). Shanks (2002) postulates that this format can be useful where explicit control or manipulation of variables has not occurred and the phenomenon of interest, theoretical position, and where empirical testing will occur, the hypothesis, have been pre-defined.

When approaching case study research from this perspective, Shanks (2002) proposes that researchers should ensure that four core parameters are met. First, any underpinning theory and the boundaries of its application should be clearly outlined and defined. Second, case study sites should be carefully selected. Third, it should always be acknowledged that the principle of generalisation from case studies is inherently different from that of experimental research, and finally, the appropriateness of a post-positivistic approach should be embraced when a researcher standpoint recognises that theoretical propositions may have a level of uncertainty surrounding them regarding what can actually be 'known'.

## 6.9 Summary

Even outside of this unprecedented set of circumstances, it is not uncommon for the path of a research study to change course. Adaptability, acceptance of the parameters of the issue, and an appreciation of albeit different, but equally valid, methodological approaches and how they can be appropriately integrated, has in this instance proved to be vital. The pre-established parameters of this research, namely the overall thesis aim of pragmatically exploring the potential impact of an intervention driven by the phenomenon that is intergenerational contact, on physical activity levels, sedentary behaviour, health-related quality of life, and stereotypes of ageing, in a real-world setting, lends itself to the application of an instrumental case study approach. Whilst it will not provide the initially strived for empirical evidence, it will allow the underpinning mechanisms behind any observed effects to be explored.

To facilitate the case study construction and completion, data collection method amendments were necessary. The completion of the previously outlined outcome measures would either not have been possible due to imposed restrictions, or individually would not have provided meaningful data for empirical analysis. With only one intergenerational dyad, there would be no comparable data, and the within-participant changes would potentially be negligible. Therefore, individual interviews

were conducted with each dyad participant at the mid-point (week 6) and post-intervention (week 13) follow-ups via the Zoom internet platform. Further methodological details including specific objectives and outline interview schedules are discussed and presented in Chapter 7.

# Chapter 7

# Interventional Case Study

*Chapter 6 outlined the pilot study proposal and the changes that had to be made in response to the COVID-19 pandemic. This Chapter details the parameters of the amended methodological approach, the case study. Formatted from the dyad who were able to continue participation, a single, holistic, instrumental case study was undertaken. The case study was designed and constructed to support the overall aim of the thesis; thus, this Chapter focuses on the phenomenon of intergenerational contact, the experiential views of the dyad regarding this phenomenon, and the potential for impact on health-related variables, namely physical activity, and sedentary behaviour. It is pertinent to recall that the primary focus of this thesis remains the impact of the developed intervention on parameters associated with older adults. However, as per the intended pilot study, given the potential to generate secondary effects for the children it was deemed essential to also explore their views and experiences.*

*Between the approaches of Stake (2005) and Yin (2018) a number of key case study components are discussed. One such component, a primary conceptual logic model, described by Baxter and Jack (2008) as the anchor of such studies, has previously been outlined and discussed in Chapter 5. Therefore, this Chapter presents the overall aim of the case study, defines the 'case' through a specific research question and study propositions, outlines the research design to include binding the boundaries of the case, and details the utilised data collection methods. Finally, the results of the triangulated thematic analysis are presented and deliberated with due consideration for the unique, unforeseen, contextual situation that the participants found themselves encapsulated within, and the exploration of rival explanations.*

## 7.1 Aim

The aim of this case study was to explore the experiential effects of the phenomenon of intergenerational contact on health-related variables and stereotypes of ageing from the perspective of a single dyadic partnership both during and following the completion of a real-world technology-driven intervention.

## 7.2 Research Questions

This study was designed to address the questions:

1. What value and meaning do older adults and children place on the concept of intergenerational contact?
2. How does participating in an intergenerational intervention stimulate and facilitate health behaviour changes and challenge stereotypes of ageing?

## 7.3 Study Propositions

1. Intergenerational contact will provide a mutually beneficial experience for both the older adult and child.
2. Through the constructs of Contact Theory (Allport, 1954), intergenerational contact provides a platform to challenge age stereotype constructs in older adults, and attitudes towards older adults in children.
3. A technology-driven physical activity-based intergenerational contact intervention can facilitate an increased awareness of physical activity levels and sedentary behaviour, subsequently leading to changes in behaviour in both the older adult as the primary target, and child as the secondary target, in a situation where opportunities for social contact are restricted.

## 7.4 Methods

### 7.4.1 Research design.

This study employed a single holistic/instrumental case study design. From the sampling and recruitment procedures, and inclusion/exclusion criteria outlined in Chapter 6, one dyad consisting of a 61-year-old female, and 9-year-old male child were recruited and retained within the study and continued to collaboratively engage with the developed intervention. The older adult was married, self-employed, self-rated their health status as very good, and had a positive relationship with her grandchildren, who were normally seen a few times per week. The child had no underlying health issues and reported normally being active at a moderate intensity, for 30 minutes, at least three times per week. The relationship between the dyad was step-grandparent and grandchild.

Following the completion of a baseline week[22,] the dyad engaged with the study period, as planned, for a further 12-weeks. However, from week two onwards, a government enforced national lockdown, implemented in response to the COVID-19 pandemic, placed restrictions on opportunities for social contact, closed all non-essential facilities, and engagement in exercise outside of the home was limited to one hour per day. Only one amendment was made to the intervention procedures outlined in Chapter 6, section 6.4.3.1, mid-intervention (week 6) and one-week post-intervention (week 13) semi-structured interviews were conducted individually with each participant instead of repeating accelerometery and questionnaire measurements. Even though the intervention period was only 12-weeks, the decision was made to adhere to the original follow-up schedule, and hence conduct two interviews with each participant. Additionally, from a pragmatic perspective, given the fluidity of the situation, it was felt that useful data could be collected at 6-weeks to potentially mitigate the unknown effects of COVID-19 on the dyad. A breakdown of the amended enrolment and follow-up session structure with a description of tasks completed at each time-point is provided in Table 7.1.

[22]Data collected as per outcome and baseline measures outlined in Chapter 6, prior to lockdown restrictions.

Table 7.1

*Amended enrolment/follow-up schedule: Intergenerational dyad*

| Meeting | Tasks completed | Average time |
|---|---|---|
| Week 0 | Review of consent forms and health screening<br>Completion of outcome measure questionnaires<br>Supply with accelerometer (7-day recordings)<br>Download of Mi App on smart device | 45 mins |
| Week 1<br>(Start of study) | Return accelerometer<br>Complete set up and familiarisation with World Walking<br>Supply with Mi Band 2 Watch and complete set up and synchronise with App | 45 mins |
| Week 6 | Individual semi-structured interviews | 30-45 mins |
| Week 13 | Individual semi-structured interviews<br>Study debriefing | 30-45 mins |

### 7.4.2 Binding the parameters of the case.

In addition to the inclusion/exclusion criteria applied to the participant sample selection, in case study research it is important to narrow down the focus, depth and breadth of the case, establishing not just what it will be, but conversely what it will not (Baxter & Jack, 2008). For clarity purposes, the boundaries imposed on this case study, in relation to each identified parameter, are provided in Table 7.2.

Table 7.2

*Case study boundaries*

| Parameter | Definition |
|---|---|
| Intergenerational contact | Between the dyad, relative to their participation in the intervention and the wider social situation<br>No restrictions or guidance were imposed on how, when, or how often contact should occur |
| Health-related variables | Physical activity<br>Sedentary behaviour<br>Psychological well-being |
| Age stereotype constructs | Older adult: views-on-ageing, self-perceptions of ageing, stereotype threat<br>Child: attitudes towards ageing |
| Older adult | Aged ≥ 60 years old |
| Child | Middle childhood (approximately 7-12 years old) |
| Intervention | 12-week collaborative technology-driven physical activity-based intervention |
| Intervention location | Local South Wales community |

#### 7.4.3 Ethics.

Ethical approval for this study was granted by the College of Engineering Research Ethics Committee, Swansea University, as an addition to the amendment to approval obtained for the pilot study (approval numbers 2018-103 and 2018-103A). Identical processes were followed as outlined in Chapter 5, section 5.4.2. Amended information sheets were provided prior to the interviews, detailing the changes to the outcome measure collection methods and processes. An example is provided in Appendix W.

## 7.5 Data Collection

#### 7.5.1 Semi-structured interviews.

Through the facilitation of a conversation, semi-structured interviews allow specific topics to be explored with a sufficient degree of flexibility for interviewees to

express their own opinions and thoughts (Sparkes & Smith, 2014). Thus, allowing the deeper meaning of the generated data to be considered. Although not without its limitations, the ability to conduct such interviews via synchronous online methods, in this instance, allowed the research to be conducted in a situation where the physical presence of the researcher was prohibited (Salmons, 2015).

At the mid-intervention point (week 6) and post intervention completion (week 13), separate semi-structured interviews were conducted with each dyad participant. Each interview was designed to explore the participant's experiences of the intervention in relation to intergenerational contact, any associated perceived value, benefits, and/or limitations. The impact of social isolation and activity restrictions were also explored. Box 7.1 provides an outline of the core topics and open questions covered with the older adult that were identified for discussion prior to the interview; Box 7.2 provides the comparable questions used with the child. For the child, the wording and language were simplified accordingly, and, as per guidance, brief, more closed questions were used to help initiate the conversation and build up trust, with follow-up questions, prompts, and open questions used to encourage further detail (Gibson, 2012). All question schedules were reviewed and agreed by a supervisor experienced in qualitative research (JH) prior to their use.

Before each interview, participants were briefed on the purpose of the interviews, reminded that they could withdraw from the study at any time without having to provide a reason, that all data would be stored securely, and, that all identifying markers would be removed and pseudonyms applied. All interviews, ranging in duration from 13 to 43 minutes, were conducted remotely via the Zoom Inc. platform, audio and video recorded (Zoom record function; Phillips Digital Voice Recorder), and transcribed verbatim from the audio files, utilizing the video files where necessary to gain clarity. For the interviews with the child, one of the child's parents remained in the room or within the immediate vicinity whilst the interviews were being conducted.

Box 7.1

*Interview topic and question guide, older adult*

**Introduction**

The interviewee will be reminded that:

- Whilst the session will be recorded, and the researcher will take notes as needed, the recordings will be destroyed following full data analysis.
- Everything discussed will remain anonymous, and, that there are no right or wrong answers.
- They will then be given an opportunity to ask questions before the interview begins.

**Main Questions**

1. What do you think of taking part in the project?
   Are you enjoying it, disliking it, like it, find it helpful or unhelpful in any way?
2. What did you think about having to pair up with a child?
   Do you think it has made any difference? Do you like it, dislike it? How does it make you feel?
3. Has taking part changed the way you think about physical activity for yourself? For <<your partner>>?
4. Are you managing to stay active? How are you doing this?
5. Has taking part encouraged you to be/remain more active?
   What are you doing now compared to before?
   Do you think participating in the project has changed or had any influence on how you are approaching physical activity at the moment? Do you think it has helped you adapt?
6. Do you think it offers you any benefits during these changed circumstances? (If participant continuing to exercise and stay physically active)
7. Are you still managing to work with and keep in contact with <<your partner>>?
   Has the project changed the way you interact with/your relationship with <<partner>>?
   Has having to socially isolate had an impact on your ability to maintain contact?
8. How does having to socially isolate make you feel?
9. How does taking part make you feel and think about being an older person?
   Given the current situation have your thoughts or feelings changed at all?
10. How are you finding using the technology practically?
    Do you feel that you have the right skills to use technology?
    Have you had any issues accessing the web page/App relating to Wi-Fi or internet access?
    Think about the watch/website - Are they easy to use? Any difficulties?
11. How do you feel about continuing the project for another 6 weeks? (6 weeks only)
12. How did you feel at different points within the intervention (start/middle/end)? (12 weeks only)
13. Did your engagement with the intervention change at any point? (12 weeks only)
14. Would you use/recommend using this type of intervention in the future?
    Is there anything that you will miss now that it's finished? Why? Why not? What alternatives would you suggest? (12 weeks only)

Box 7.2

*Interview topic and question guide, child*

**Introduction**

The interviewee will be reminded that:

- Whilst the session will be recorded, and the researcher will take notes as needed, the recordings will be destroyed following full data analysis.
- Everything discussed will remain confidential, and, that there are no right or wrong answers.
- They will then be given an opportunity to ask questions before the interview begins.

**Main Questions**

1. What do you think of taking part in the project?
   What are you enjoying /disliking/finding helpful or unhelpful in any way?
2. What did you think about having to pair up with an older adult?
   Do you think it has made any difference? Do you like it, dislike it? How does it make you feel?
   What did you think about an older adult taking part?
3. Has taking part made you think more about being active?
4. Are you managing to stay active? How are you doing this?
5. Has taking part encouraged you to be/remain more active?
   What are you doing now compared to before?
   Do you think taking part in the project has changed what you would be doing now, because you can't go out? Do you think it has helped you adapt?
6. Are you still managing to work with and keep in contact with <<your partner>>?
7. How does having to stay in and away from other people make you feel?
8. How are you finding using the watch and having to wear it?
   Is it easy to use? Any difficulties?
9. Are you enjoying using your map?
   What have you done? How have you been finding out how far you have gone?
10. How do you feel about continuing the project for another 6 weeks? (6 weeks only)
11. Do you feel any different now about the activity/project compared to at the start or in the middle? (12 weeks only)
12. Think about the watch, has how much you've used it, and charted your steps, change at any point? (12 weeks only)
13. Would you like to do something like this again?
    Is there anything that you will miss now that it's finished?
    What could we do to make it better? (12 weeks only)

## 7.6 Data Analysis

### 7.6.1 Thematic analysis.

Following the verbatim transcription of each audio recording, qualitative data analysis of the four interviews was undertaken following the six-stage process of Braun and Clarke (2006), as outlined in Chapter 5, section 5.6.1. A comparable iterative approach was undertaken to identify, track, and revise codes and themes, namely: (1) familiarisation and immersion within the data; (2) initial generation of codes; (3) searching for themes; (4) reviewing and refining the candidate themes; (5) defining and naming themes according to data representation, and (6) finalising the analysis and interpretation. However, whilst the coding process remained deductively driven by the study aim, research questions, and propositions (specifically regarding the phenomenon of intergenerational contact and its experiential effects on health-related variables and stereotypes of ageing), codes were subsequently allowed to emerge inductively from observations within the data, in this instance, both the semantic and latent meanings of the data were explored (Braun & Clarke, 2013). Exhibits from each process stage are provided within the coding audit trail detailed in Appendix X.

In line with the systems employed in Chapter 5, following manual coding, subsequent categorisation, organisation, re-checking and refinement of codes, themes, and sub-themes, was carried out within Microsoft Word (Office 365). These processes were completed in collaboration with a 'critical friend' (thesis supervisor), who additionally blindly crossmatched 10% of the data extracts against the generated codes, to ensure data had been coded appropriately. One discrepancy was identified, discussed, and reviewed back to the original data set until agreement was reached.

### 7.6.2 Reflexivity for trustworthiness.

This research was undertaken during a period of time that placed both the participants and researcher in the same, underlying, unique, set of circumstances and rules. This position made it, at times, difficult for the researcher to maintain an objective, neutral position within the interviews. Without intent, the dialect sometimes became a two-way discussion. Despite this, it is not felt that this in anyway influenced responses or hindered the process, indeed, having that common ground, could have inadvertently improved the fluidity of the interview.

## 7.7 Results

Through the semantic and latent analysis and interpretation of the data in line with the study aim, research question, and propositions, four core themes emerged: *Reciprocal Encounter; Opportunity for Reflection and Re-evaluation; Platform for Change,* and *COVID-19*. These are outlined along with their associated sub-themes in Figure 7.1. All themes and sub-themes were present across both the 6- and 12-week time-points. However, the strength of some sub-themes within the theme *Platform for Change,* namely those relating to age stereotype constructs, was greater at week 12. These are highlighted in Figure 7.1. Within the preceding section, the pseudonyms Older Adult (OA) '1' or '2', and Child (CH) '1' or '2', have been used to distinguish between each participant, and interview number.

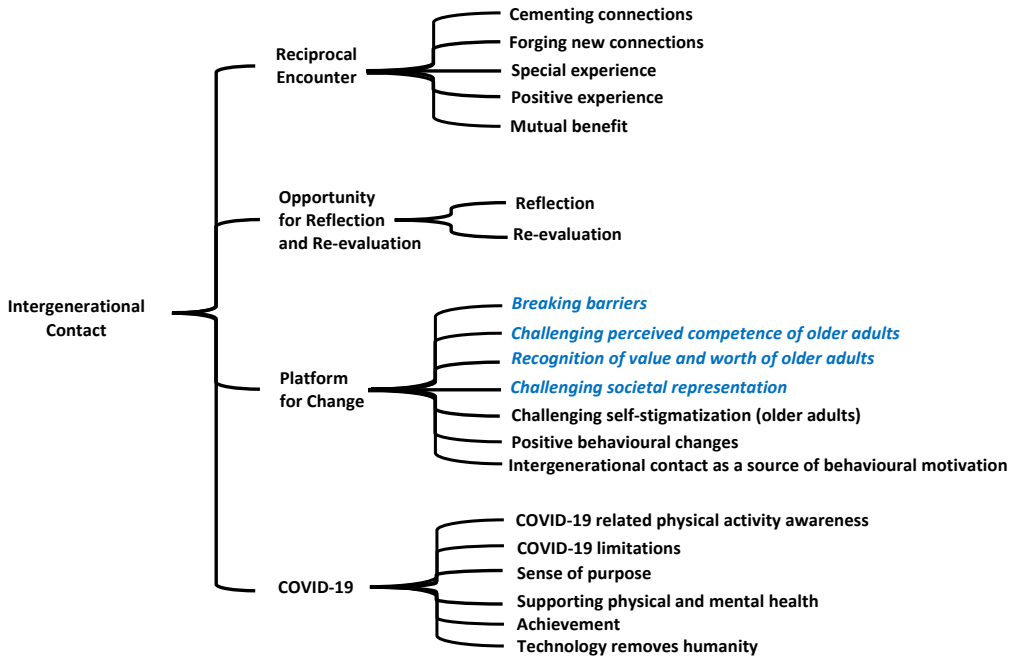


*Figure 7.1* Model of the core themes and sub-themes related to the experiential effects of the phenomenon intergenerational contact

*Note:* Highlighted sub-themes presented greater strength at 12-week follow-up

### 7.7.1 Themes

#### *7.7.1.1 Theme 1: Reciprocal encounter.*

Mutual benefits of intergenerational contact were revealed. In addition to stimulating physical activity in both dyad members through the processes of collaborative goal planning: "*The plan was for [partner] to do ten so hopefully [they] done ten yesterday.....and for me to do twenty 'cos all we needed was thirty thousand steps more*" *(CH1),* several relationship related sub-themes emerged.

The dyad was provided with an avenue to forge new, and, cement existing connections through a special, positive experience. For the child, a potential opportunity was identified to connect with older relatives: *"If you choose someone who, your older relative who you haven't connected for well, it will be good just to connect with them because you're working with them" (CH2),* and to personalise their picture of their older adult partner through being able to: "*learn more about them and stuff" (CH2).* For the older adult, it was a chance to build a relationship with a child new to their family: *"I saw it as an ideal opportunity where I had that sort of special connection with [them] to hopefully develop the relationship as well you know" (OA1).* It also sparked a wider involvement in the child's life, confirming to them their worth to the child:

> *"[They] had a project to do for school, part of [their] schoolwork, and [they] were like oh come and see this, come and do this you know, and I don't know whether that is specifically as a result of the project. I think that would have helped. Or whether it's the circumstances or whether, well you don't know where it can lead you, you know. It's got to be positive" (OA2)*

The concept was perceived to have provided the dyad with a "*common bond*" *(OA2)* and a unique opportunity: "*this was a real chance for me and [them], just the two of us to do something together" (OA2).* This left the older adult dyad member in particular, with hope that this relationship would continue into the future: *"I just hope that from [child's] point of view [they] would be able to ask me to do other things as well*" *(OA2).*

Overall, both dyad members found the experience to be positive and enjoyable. From being "*a good thing"* and *"really fun" (CH2),* to *"absolutely great"* and *"a real feel-good factor" (OA2)*, participating stimulated positive emotions: *"I was chuffed to bits*

*that [child] even considered asking me*" *(OA2).* The intervention and intergenerational concept were also deemed to be an effective way to target the specified outcomes: *"It's worked. It's worked and it's worked really well" (OA2).*

#### *7.7.1.2 Theme 2: Opportunity for reflection and re-evaluation.*

Life priorities, and how these impact and influence decisions made, and the choices adopted, were evaluated, and reflected upon by the older adult. Self-perceived as the "*sandwich generation*", whereby carer responsibilities extend to both generations above and below, such priorities negatively conflicted with being able to maintain adequate levels of physical activity: "*I have been aware that when the pressure is on the first thing that goes, is exercise" (OA1)*. However, it is a balancing act between the time implications, and appreciating and embracing the life that you have: *"It is the time constraints on everything you know .....you've got to weigh it up if I didn't have the children around but is that the life I want to lead?" (OA1)*. Subsequent concerns about not being able to find a balance and being able to: *"keep this up after you know after the project ends and after all this" (OA1)*, were counteracted by a heightened awareness of previous positive habits: *"I used to swim before work, and I got out of the habit of doing it....you gotta get it part of your daily living" (OA1)*, and, where there are already unused opportunities for physical activity within pre-existing routines: *"I think it's about using my time more constructively sometimes you know 'cos I do tend to get up quite early in the morning and then sit around for a couple of hours coming to" (OA1)*.

Engagement with the intergenerational contact intervention also led to reflection on both an individual level about how their perceptions affect themselves: *"It has given me time to reflect on things I knew, but I couldn't really do a lot about as well" (OA1)*, and as a consequence of raised awareness of the impact of modern life on sedentary behaviour in children:

> *"I'm very conscious that again I spent my childhood out and this this times the number of times I've been out walking and thinking that this reminds me of my childhood. No cars. No, hardly any people, sort of freedom as well but it's a different lifestyle for some of these kids you know, ..... long periods of time on laptops and goodness knows what" (OA1).*

#### *7.7.1.3 Theme 3: Platform for change.*

The phenomenon of intergenerational contact was also viewed as being an ideal way to break barriers and challenge age stereotype-based views and perceptions. For the older adult, it allowed the opportunity to positively change their own self-perceptions of ageing: *"I think it's made me realise that yeah, I can, I still can compete with [child] if needs be. I can keep going" (OA2).* For the child, it provided a platform to challenge the perceived competence of older adults, and, societal representations.

Whilst the capability of older adults to use technology was raised, *"[they] can work some stuff on the computer but other stuff [they] can't" (CH2),* technology was still viewed as being useful to older adults, and a modality that they could, and potentially would, use more. Indeed, it was perceived that older adults can still learn new things, they just need to be taught: *"I think if there was like an online class actually got old people, people who are not used to using Skype or anything, used to using Skype more technology stuff, I think they would get better at it" (CH2).* However, for physical activity, it was perceived that children were much more active than older adults: *"we would probably have like sixty thousand steps if I did it with one of my friends, a day" (CH1).* Although, almost surprisingly to the child, older adults were viewed to be *"actually pretty fun" (CH2),* and their partner was seen to be someone that it was possible to have shared views with: *"there's one thing that I actually was talking to [partner] about I actually agree with her computers should get rid of spell check" (CH2).*

From the perspective of both dyad members, it also stimulated recognition of the value and worth of older adults. It was acknowledged by the child that, in general, children do not talk to older adults enough, and, that they provide an opportunity to connect with the past: *"it's basically a good time when you're talking to them to ask them what it was like in their generation, to actually learn more about the history of this world" (CH2).* Although conflicting with their perception that children were the more active population, older adults were still viewed as being a good option as a co-participant as, unlike children, they are not 'slaves to their computers': *"If I was doing it with my friends, I wouldn't, I wouldn't know who to choose because all my friends will obviously spend their day on the computer" (CH2).* Conversely, there was a sense of realisation that, as an older adult, they were not only in a position to be a positive role

model, but that intergenerational contact generates teachable moments and situations in which to transfer knowledge:

> *"I love the water, so I walk in the pool, and I walk a mile, I do sixty four lengths and I said to [child] I've done eight thousand and odd steps today in the pool 'how do you know that' [they] said, well I said, I counted one and I times it by sixty four and that gave me the answer, and you know, absolutely amazed that you like because I couldn't wear my watch in the pool, that I couldn't count the steps as well you know I mean it's we're just old school" (OA1).*

Pertaining to changes in health-related behaviour, although potentially more relevant to the older adult, it emerged that within this context, intergenerational contact acted as a source of behaviour motivation. Overall engagement and participation was facilitated by teamwork: *"I think it's working together it's working as part of a team" (OA1)*; not wanting to disappoint the child: *"It's not wanting to let [child] down as well you know and I think no I gotta do it you know, I can't let [them] down" (OA1)*; reciprocal encouragement: *"I don't think that's competitiveness. I think it's more of a sort of trying to egg each other on" (OA2)*, and, co-monitoring of progress and participation: *"I've been having less steps [partner's] been having more steps" (CH2)*; and, *"they certainly know that I'm doing it and they [child] knows I'll be on [their] back as well if [they] don't do it as well" (OA1)*. Additionally, the intervention as a whole acted as a direct driver of behaviour for the older adult:

> *"I don't know whether I would have been driven to get out and do it every day you know or perhaps if I was having a bit of a bad day or if it was a bit wet or of it was this or that" (OA1)*.

Finally, positive effects on behaviour were identified. Both dyad members reported increased levels of physical activity: *"I've continued getting out there walking. I've certainly upped my steps considerably. Some days I've even got up to about eighteen, nineteen thousand" (OA2),* and, *"I am finding it helpful because it gets me walking more is does it does get me walking" (CH1).* The effects of increased self-awareness of behaviour, and understanding what should be targeted, were also noted:

> *"Well, the weather wasn't particularly good yesterday, but I was up to about eight and a half thousand. And when [Husband] got back from work we had to go to deliver a birthday card to his son and it was picking to rain and I said no, these steps are too low drop me. So easily it was up to nearly twelve thousand you know. Which I feel more comfortable doing now. So, it does make you really aware. It has made me really aware" (OA2).*

As was the potential to stimulate longer-term physical activity goals and aspirations: *"After the rainbow run, I want to do the whole entire world" (CH1)*.

#### *7.7.1.4 Theme 4: COVID-19.*

Several sub-themes emerged that interlinked with the COVID-19 pandemic, stay-at-home order, and implemented social restrictions. These factors contributed to the observed heightened awareness of physical activity behaviour. The child identified not only the limitations that restrictions were having on both their own and their partner's ability to keep active: *"[They do] go out a lot but just because we are in this isolation thing [they] can't go out that much" (CH1*), but also an awareness that without the restrictions, their partner could be more active: "*If it wasn't for this [they] would probably hit thirty thousand a day [they] probably would if we weren't in this" (CH1)*. A loss of opportunity was identified from changes to their routine: *"I would have done my thirty thousand steps I tell you why err I'd probably be going down the park with [family member] erm probably get a load of steps in school" (CH1)*, a factor also related to the importance normally placed on the social element of physical activity: *"when [friend] comes back from [their] school, we go down the park...we would probably be outside" (CH2)*. For the older adult, there was an awareness of the benefits of physical activity during the period of restrictions: *"Under the current regime, I'm just so glad they've allowed us to continue exercising" (OA1)*.

Participation in the intervention through a major segment of the first COVID-19 pandemic 'lockdown', provided the dyad with a number of valuable benefits. It was perceived to have provided a source of "*focus*" *(OA1),* and an overall sense of "*purpose*" *(OA1)*, even when motivation was waning:

> *"I think it's given me more of a purpose as well it's made me more determined you know (.) oh I can't be bothered to go out for a walk, yes I am because I need to do this, so I think it's it's influenced that as well" (OA1).*

On a basic level, it provided "*something to do in the day*" *(CH2),* a conscious reason to be active, and made physical activity a source of entertainment: *"It would be boring.... now I actually get challenges to do" (CH1)*. These factors translated into positive achievements for both the child: *"since we've been isolating, I've hit thirty thousand steps" (CH1)*, and, the older adult: *"I think during the circumstances it has given me something to think well yeah, I've done something really positive during that very, very, difficult time" (OA2)*. Furthermore, participation supported not just the physical, but also mental health, of the older adult providing a form of escape, and an avenue to *"forget what's going on in the real world" (OA2)*.

The major driver underpinning the delivery of the intergenerational intervention was technology. Despite its positive application, during the restrictions, virtual, technology-driven contact methods were not viewed as a substitute for face-to-face contact. "*Just not seeing actual people*" *(CH1),* stimulated feelings of sadness, and a lack of humanity: *"this is okay, but it only gives me part of the full experience really. I would much rather see you in person" (OA2)*. With regard to the intervention, it was not deemed to have made maintaining intergenerational contact any easier:

> *"it's a little bit haphazard at the minute and we're just hoping that when we you know we're out hopefully we're out of lockdown and things will ease off a bit then we can have more in depth discussions on exactly what we are doing" (OA1).*

Other limitations to the success of the intervention were also linked to COVID-19. The lack of ability to maintain intergenerational contact due to a change in housing situation, was perceived to have led to a lack of ongoing participation and degree of disengagement and loss of initial benefits (for the child) between weeks 6-12: *"I have noticed a reluctance from [child] to walk and stuff since [their] back" (OA2)*.

## 7.8 Discussion

### 7.8.1 Intergenerational contact: More than meets the eye?

The targeted outcomes of the developed intervention focused on its ability to positively affect health behaviours (physical activity, sedentary behaviour, health-related quality of life), and challenge stereotypes of ageing. An increased awareness of physical activity, and indeed inactivity was observed, along with questioning of existing perceptions, views, and attitudes towards and about older adulthood, with the latter appearing to gain more traction as time progressed. However, it has become apparent that intergenerational contact has the potential to facilitate other important benefits. The boundaries of modern families, and the variety of different dynamics and compositions that may be present can often complicate and inhibit certain bonds from being established (Buchanan & Rotkirch, 2018). For the dyad within this case study, participation offered a unique opportunity to build and nurture relationships.

In Western societies, older adults, and moreover grandparents, are not always as revered or valued in the same way as they are within other cultures (Hossain, Eisberg, & Shwalb, 2018). Children are losing out on the opportunity to learn from the experience, wisdom, and knowledge that older adults have to share (Diongi, 2015). The logistics of establishing the level of confidence and trust needed in another individual to create adequate bonds, and appreciate such privilege, could be facilitated by technology, more specifically virtual methods. However, in some situations, this may not be the most appropriate, or preferred choice. This could be secondary to both individual perceptions of the removal of humanity, and knowledge gained from prior research that higher quality contact may bring about greater gains (Drury et al., 2016).

### 7.8.2 Older adulthood: The balancing act.

Where later life was once thought to represent a fixed point of retirement, with less personal and financial responsibilities, for some, this is now not the case. For many, it is a time of conflicting priorities, including the need to remain employed and with increased caring responsibilities. In the UK, 10% of people aged over 65 years are estimated to still work (British Medical Association, 2016), whilst in England and Wales, almost 1.3 million people aged 65 over are long-term carers, a figure that rose 11% between 2001 and 2019 (Carers UK, 2019). All of these factors may limit opportunities

to remain active and engage with lifestyle choices that facilitate health and well-being. It has previously been suggested that caregivers may feel that exercising takes away the energy needed for other activities (King & Brassington, 1997). Moreover, it has more recently been reported that older adults who gave help to others within the previous 12 months were, in fact, 2.8 times *less* likely to be physically inactive (Gomes et al., 2017).

As grandparents, care provision often extends to grandchildren, namely the 'school-age' generation. Interactions associated with the provision of this care have been linked with positive health-related gains, including enhanced psychological status (Tsai et al., 2013) and a better quality of life (Kirchengast, & Haslinger, 2015). Designing interventions that are flexible, allow for incorporation into pre-established daily routines, but also embrace and utilise streams of intergenerational contact that already exist, could provide older adults fulfilling these roles with a way to interlink such responsibilities, removing barriers to engagement and participation.

#### 7.8.3 Moving together: A coping mechanism during COVID-19.

Globally, the restrictions on life as we knew it, had a negative impact on both physical activity and sedentary behaviour (for a review, see Stockwell et al., 2021). Another significant issue identified was the correlated implications for mental health (for a review, see Caputo & Reichert, 2020). The bi-directional relationship between mental health, either as the overall concept, or a specifically defined condition (i.e., depression), and physical activity and/or sedentary behaviour is well established (WHO, 2019c). Engaging in more sedentary behaviour and being less active can negatively impact mental health, whilst poor mental status can subsequently lead to being less active and more sedentary (WHO, 2019c). Within this case study, maintaining intergenerational contact, and engagement with the intervention not only had a direct impact on particularly awareness of physical activity and sedentary behaviour, but also provided a strategy to cope with, and occasionally escape from, the realities of the situation.

### 7.9 Strengths, Limitations, and Rival Explanations

This research successfully implemented methods to remotely collect data pertaining to the phenomenon intergenerational contact during a period of time when

social contact, and the continuation of established research was extremely limited. However, the data only being generated from the views and opinions of one intergenerational dyad, restricts the wider implications that can be drawn from the presented results. It is also pertinent to note potential alternative or rival explanations. The impact of changing social boundaries clouds the picture that can be presented. During the first two weeks of participation, there were no social restrictions in place, only growing concern and unease over the developing situation. For the remaining 10 weeks, only one hour of exercise away from home was permitted, and, this had to start, and finish, at home. Also, during weeks 6-12, there were changes to the child's home situation that altered the pattern of engagement, and intergenerational contact. The observed changes in behaviour, particularly for the older adult, could have been secondary to changes in their routine, namely not being able to work, provide childcare, or socialise with friends and family. These changes provided more time and freedom to engage with the intervention. Indeed, it has been found that during the pandemic, despite restrictions, some older adults did maintain (Richardson, Duncan, Clarke, Myers, & Tallis, 2020) or increase (Suzuki, Maeda, Hirado, Shirakawa, & Urabe, 2020), pre-lockdown levels of physical activity. It is also important to acknowledge that the interviews at week six, could inherently be viewed as an additional intervention component that *may* have had an influence over the behaviour of the dyad participants during weeks 6-12.

## 7.10 Conclusion

This case study presents the findings of a unique data set, that, whilst not replicable, represent a situation that many community-dwelling older adults can routinely find themselves in, social isolation, a situation that can, in some people, increase the risk of loneliness (Yildrem, & Kocabiyik, 2010). Facilitating intergenerational contact, through virtual methods, although not always the optimal choice, provides a way to not just challenge age stereotypes, and target health behaviours, but also to counteract the detrimental health and well-being implications of loneliness (i.e., decreased longevity; Holt-Lunstad, Smith, Baker, Harris, &, Stephenson, 2015), and, establish connections that could bring far great gains.

# Chapter 8

# Discussion

*This thesis set out to investigate the impact of facilitating familial intergenerational contact on physical activity, sedentary behaviour, health-related quality of life and stereotypes of ageing in older adults (primary outcome) and children (secondary outcome) within 'real-world' settings. The processes of an individualised, iterative, Multi-stage Process Model based on components of pre-existing complex intervention development guidance (Bleijenberg et al., 2018; Craig et al., 2008; Michie et al., 2013; O'Cathain et al., 2019a), were rigorously followed. The completion of stages 1-7 operationalized the problem; determined need; reviewed the current position of the evidence base* (*where significant promise, but also gaps, within the literature and findings of prior research across the key proposed intervention constructs were identified); proposed a theoretical logic model to hypothesise the potential mediating influence between variables, and, cumulated with the interlinking of several discrete elements to design a unique intervention. Driven by technology, the developed intervention allowed intergenerational dyads, comprised of older adults (aged ≥ 60 years), and children (aged 7-11 years), to work collaboratively, using activity trackers (Mi Band 2) to complete virtual walk route challenges via the World Walking platform. Through stages 8-10, the feasibility, acceptability, functionality, and useability of the intervention were established, recruitment and retention explored, and, the intervention structure, where necessary, refined. This chapter outlines and summarizes the findings generated from the developmental processes completed, and subsequent studies undertaken, relative to the core thesis aims and objectives. Contributions to the knowledgebase are discussed, along with implications and directions for future research, and any identified limitations. The points outlined, pave a pathway, to Chapter 9 where further analysis, evaluation, and reflection are presented within a reflective epilogue.*

## 8.1 Contributions to the Knowledge

### 8.1.1 Addressing the objectives.

Through the developmental journey and findings of the thesis, it has been clearly established that:

i) Age stereotype-based real-world interventions provide an encouraging approach to challenging the behaviour of older adults within health-related domains. Nevertheless, the optimum approach remains to be elucidated.

ii) Through the components of Contact Theory (Allport, 1954), intergenerational contact and technology can be innovatively interlinked to formulate intervention strategies designed to challenge age stereotypes, and, target physical activity, sedentary behaviour, and health-related quality of life in real-world settings. This was a previously unresearched combination.

iii) It is possible to construct a technology-driven intergenerational intervention from components readily available within the public domain without excessive expense or presented complexity for those involved.

iv) Intergenerational contact provides mutual benefits for older adults and children. Indeed, these benefits can be wider than just those primarily targeted.

v) The intervention developed was acceptable, useable, and potentially a highly feasible way of empirically exploring the impact of intergenerational contact, challenging age stereotypes, and positively affecting health-related outcomes.

vi) The anecdotal position of intergenerational contact as a 'real-world' solution to tackling negative health behaviours and stereotypes of ageing needs to be further challenged and firmly established.

Unfortunately, the limitations imposed by the COVID-19 pandemic restrictions prevented the full exploration of the direct impact of the developed intervention on the targeted dyad participants, and the examination of any potential influencing factors.

## 8.2 Theoretical and Practical Implications

### 8.2.1 Challenging age stereotypes as an intervention approach.

The novel systematic review of the effects of age stereotype-based interventions on health-related outcomes in older adults aged 50 and over (Chapter 3), established that there may be enhanced benefits achievable when strategies to challenge specific age stereotype constructs are embedded within interventions that target health behaviours. These findings were particularly pertinent for physical function or physical activity (Brothers & Diehl, 2017; Émile et al., 2014; Fujiwara et al., 2009; Levy et al., 2014; Wolff et al., 2014), and self-perceptions of ageing (Beyer et al., 2019; Brothers & Diehl, 2017; Klusmann et al., 2012; Levy et al., 2014). The negative impact of stereotypes across genres has been extensively documented since the pioneering work of Allport (1954). For age stereotypes, one of the first and seminal studies regarding the effects on health in older adults was published in the mid-nineties by Levy et al. (1996). It is therefore interesting that in the years since this, whilst the negative effects on numerous health-related outcomes have been repeatedly established (Chapter 2), there is such a sparsity of studies that have translated and explored these insights as interventional strategies.

The work of Levy et al. (2014) found that both implicit and explicit stereotype manipulations led to increased physical function in older adults, however implicit strategies achieved effects that were 30% greater. Intergenerational contact could be viewed as an implicit stereotype manipulation, where, through applying the theoretical components of control theory (Allport, 1954), self-perceptions of ageing, and views-on-ageing in older adults, and attitudes towards ageing in children, are subtly challenged in line with the principles of stereotype embodiment theory (Levy, 2009). Indeed, although preliminary, the findings of the feasibility work and case study indicate that this is a viable proposition. Alternatively, positive changes could be the result of the construction of an optimum situation and environment, that is context-specific, and again, underpinned by the parameters of Control Theory (Allport, 1954), leading to reductions in perceived stereotype threat (Steele & Aronson, 1995).

As discussed previously (Chapter 2, section 2.2.4), laboratory-based studies that have focused on the impact of actual or imagined intergenerational contact, lend support for this rival explanation (Abrams et al., 2006; Abrams et al., 2008).

Interestingly, when reviewing the impact of negative threat on the performance of older adults across various domains, Lamont et al. (2015) found that the mean effect for control groups that implemented a nullification approach i.e., counter-stereotypical information, was smaller (mean *d* = 0.25) than for neutral control groups (mean *d* = 0.37). Indeed, it has been suggested that overly positive views-on-ageing, may, for some older adults be unrealistic, and their presentation could actually end up reinforcing negative views-on-ageing (Andrews, 1999, Kotter-Grühn & Hess, 2012). Alternatively, only people who are amenable to change may benefit from, or respond to, attempts to change views-on-ageing (Émile et al., 2017), hence potentially limiting the effect of any strategies implemented to counteract them. The use of more subtle strategies, that focus on reducing age-related stigma, may therefore ultimately be more effective, and responsible for mediating changes in health behaviours. Unfortunately, further exploration of this proposition relating to intergenerational contact, from the findings of this thesis, was prevented by the COVID-19 pandemic restrictions that impacted data collection.

### 8.2.2 Defining and designing a complex behaviour change intervention.

Importantly, it has been established that intergenerational contact can be facilitated, and health behaviour targeted, by repurposing technology readily available in the public domain. Thus, this type of interventional structure is immediately translational, and, not time-limited within the boundaries of a research study. Indeed, given the ongoing impact that limitations to *opportunity* (COM-B model; Michie et al., 2011) had on the general adult population's physical activity levels during the essential pandemic restrictions (see Appendix Y), and the potential negative impact this has had on the socioeconomic health gap, developing alternative, accessible, affordable options to encourage individuals to be active, is imperative.

Despite endeavours to identify the most relevant theory and BCTs from the literature, that should, for older adults, when framed within the optimum context and environment, bring about the greatest health-related gains, constructing the intervention from readily available technological components, precluded their complete incorporation (Chapter 4). However, for translational research, it could be argued that this is not an issue, and actually, presents a more accurate reflection of what is

pragmatically achievable. Indeed, it removes the element of laboratory or clinical trial-based success bias that can often unfortunately be partially lost in translation, hence not resulting in comparable benefits (Heneghan, Goldacre, & Mahtani, 2017). It is not being suggested that adopting this position, or that the ongoing 'theory versus no theory' debate (Dalgetty et al., 2019) and conflicting evidence regarding which BCTs have the greatest effect for older adults (for reviews see, French et al., 2014; O'Brien et al., 2015), means that endeavouring to underpin interventions with these components should be discarded. Rather, an alternative direction, as taken within this thesis, could be, in parallel to the vital research which continues to explore the specific, controlled, application of theory and/or BCTs, to explore the effects of pre-constructed intervention components. Such components, may, or may not, have been underpinned by theory, the a priori application of BCTs, or indeed, specific research findings. Ultimately, these are what are 'contained' within the devices, Apps, and web-platforms that individuals will have the greatest access to and therefore, will be more likely to engage with.

It is acknowledged that the undertaking of Process Evaluation during complex, pragmatic trials is of paramount importance (Moore et al., 2015). The breadth and depth of the data collected within the completed studies precludes a detailed analysis of the potential role of technology and/or the BCTs from being undertaken. However, the findings from the collated qualitative data can still be used to improve understanding of complex models and pathways, in this instance through the identification of the most likely mechanisms of action; findings that could subsequently be used to optimise the design of future intergenerational intervention studies targeting health behaviour change.

The key findings from Chapter 5 (Study 2) and Chapter 7 (Study 3) suggest that from the BCTs identified as present within the intervention (Chapter 4, Section 4.9, Table 4.6), self-monitoring of behaviour - Mi Band and Mi Fit App, goal setting (outcome) and restructuring the physical environment - World Walking, and, restructuring the social environment – intergenerational contact, may indeed, within the context of the developed intervention, have been the most effective BCTs. Whilst other BCTs may remain present within any readily available technology used, i.e., action planning and goal setting (behaviour), or merely present as part of the process of provided access to equipment (adding objects to the environment), the role of these in the observed

behaviour change processes appeared to be less important. A revised logic model that represents these findings is presented at the end of this Chapter in Figure 8.1.

As discovered in Chapter 4, utilising 'market ready' products with older adults and children, for researchers, is not straightforward. Finding a balance between those that are too complex, over infantilised (for older adults), age-appropriate (for children) and financially viable is difficult, and could, without due diligence and attention to detail, limit intervention success. A recent report highlighted similar older adult-based concerns (Centre for Ageing Better, 2019). Whilst within this thesis, an optimised solution was established, there is a significant gap in a market where interest is rapidly evolving. This gap also presents an opportunity for future research to develop technology-driven applications that target multiple generations simultaneously, apply more context-specific theoretical parameters, and incorporate BCTs known to facilitate change. The ultimate aim being to then introduce such developments into the public domain. Additionally, models of research development should be adopted that, where possible, are user led, and therefore include, in this instance older adults, within such technology design processes (Centre for Ageing Better, 2019; Heneghan et al., 2017).

### 8.2.3 Technology-driven intergenerational contact.

Where the endeavours of prior studies to specifically explore the impact of technology-driven intergenerational contact between older adults and children on health-related behaviour have been unsuccessful (i.e., Leitiao & Reed, 2015), the feasibility and pilot work presented in Chapters 5-7, recruited participants, including multiple intergenerational dyads. This provides a unique insight into the impact of intergenerational contact, and allowed the acceptability, functionality, and useability of the intervention parameters to be explored, evaluated, and ultimately established. Specific factors relating to recruitment and retention are discussed and reflected upon in Chapter 9, section 9.4.

Positively, the intervention and phenomenon of intergenerational contact were widely accepted by all of the dyads involved. Participants successfully engaged with the concept and intervention components and enjoyed the process. Important observations have been made regarding the need to consider that when applying intergenerational-based interventions, the facilitated effects, although mutual, may stem from different

mechanisms of action. For the older adults these may be more explicit and direct, for the children, at least within the age range included in this work (7-11 years old), these may be more subtle, with changes being made implicitly, without them being aware of, or being able to knowingly make, formal associations. Therefore, if as in this thesis, the outcomes for one member of the dyad, rather than the other, are the primary focus and driver of the included BCTs, it may need to be accepted, that such mutual benefits may not be of comparable magnitude.

It has been identified that the phenomenon of familial intergenerational contact, as postulated from the interlinking of the findings of prior research (i.e., Abrams et al., 2006, Abrams et al., 2008; Drury et al., 2016; Martins et al., 2019), provided dyad participants with a platform to challenge age stereotype-related stigmas, perceptions, and views, and, to facilitate positive behavioural changes, including participation in greater levels of physical activity. Moreover, the effects of such a platform may be strengthened by the deeper-rooted reciprocated benefits generated through the confirmation and/or establishment of relationships. Indeed, the ramifications of this observation may be far wider, and important, than the parameters this thesis was able to explore.

The COVID-19 pandemic has led to a dramatic increase in interest into the utilisation and scope-of-benefit of virtual intergenerational interactions. Programmes, for example, Lifting Hearts with the Arts (2021) used such approaches to facilitate contact in an endeavour to limit social isolation. The provision of contact, via virtual methods, was previously identified as an underexplored opportunity by Amichai-Hamburger and McKenna, (2017). Nonetheless, adopting this approach, when other options to facilitate contact are not limited, may indeed, not be preferable.

#### 8.2.4 COVID-19: The unexpected findings.

It is undoubtable that COVID-19 had an impact on the completion of this thesis. Nevertheless, it provided a unique opportunity to gain an insight into how intergenerational interventions and indeed, purely having intergenerational contact, could be used, even in part, to limit the effects of the social restrictions. The intervention provided an unexpected coping mechanism, becoming a source of purpose, focus and escape. However, interestingly, technology, although becoming many people's lifeline

during the stay-at-home order, was clearly not viewed as a substitute for face-to-face contact within the case study, with the removal of 'humanity' being difficult for both the older adult and the child to manage. Relative to intergenerational contact, this supports the findings of prior work that the quality of contact, at least for young people, is more important than the frequency (Drury et al., 2016). When developing technology-driven interventions, how much contact is required via this, or other modalities, warrants consideration so that the potential benefits are not outweighed by more frequent poor-quality contact.

## 8.3 Strengths and Limitations

It is acknowledged that the findings of the feasibility and case study reported within this thesis are based on a small number of participants therefore limiting generalisability, however, positively, at each stage, representation across genders was achieved. The primary limit relates to the inability to complete the pilot study and collect the empirical data targeted to fully answer all of the outlined thesis objectives. This was secondary to an unprecedented situation, that could not have been pre-empted, or controlled for, the global COVID-19 health pandemic. Nonetheless, a series of small ethical adaptations enabled data collection to continue and additional different, yet equally insightful knowledge to be gained.

Since the completion of the work within this thesis, an updated version of the MRC guidance on developing and evaluating complex interventions, the major driver of the individualised, iterative Multi-stage Process Model developed and utilised, have been published (Skivington et al., 2021). Positively, additional elements deemed important to enrich the processes outlined by Craig et al. (2008), and therefore incorporated within the model, have subsequently been highlighted within the update. Namely: understanding context interactions; identification of key uncertainties; economic factors (value and resource needs); theory application; intervention refinement, and, the use of iterative rather than sequential processes, thus, reinforcing the appropriateness of the approach adopted.

## 8.4 Recommendations for Future Research

The following propositions suggest directions for future research:

i. Interventional studies specifically targeting the effects of age stereotypes on health-related outcomes need to investigate whether such interventions also affect stereotypic concerns, as per stereotype threat theory (Steele & Aronson, 1995).

ii. Interventional age stereotype research needs to adopt a mechanistic approach towards the influence of stereotypes, thus endeavouring to disentangle the constructs of interest and establish the mediating effects on health outcomes.

iii. Research proposals including older adults need to include strategies that facilitate overall recruitment (i.e., that challenge age stereotypes and perceptions of research – Chapter 9, section 9.3), and where necessary, tailor such strategies and the intervention structure towards increasing the uptake of male participants. Consideration should be given to utilising targeted mailings, particularly from an individual's General Practitioner - although potentially costly, and, with some older adult populations (i.e., ethnic minorities and the less affluent) face-to-face engagement, as methods to increase participation rates (Withall et al., 2020).

iv. In the absence of opportunities to collect empirical data, alternative opportunities to explore the impact of intergenerational contact could be pursued to strengthen the evidence-base (i.e., participatory action research).

v. Research needs to explore gender-based intergenerational preferences and influences. It is suggested that there may be gender differences, with males and females potentially having different outcome responses (Prior & Sargent-Cox, 2014), and grandfathers' but not grandmothers' sedentary behaviour recently associated with that of their grandchildren (Zovko, Djuric, Sember, & Jurak, 2021).

vi. Further studies are needed that utilise objective measures to explore the impact of age stereotypes, and indeed intergenerational contact interventions, on physical activity and sedentary behaviour. To-date, no studies have presented findings for either low-intensity physical activity or

sedentary behaviour. Given the recent move towards 24-hour Movement Guidelines (Ross et al., 2020), this presents a significant gap in the knowledgebase.

## 8.5 Conclusion

Is ageism socially engrained? (WHO, 2015). Is the view that decreased physical activity and health-related quality of life are inevitable consequences of the ageing process (Ory et al., 2003) embedded too strongly within societal beliefs? Hopefully not. Moreover, even if elements of such negative depictions have been historically embraced, this does not mean that they should just be accepted, or, that endeavours to positively change perceptions and/or behaviours should stop. This thesis demonstrates that the phenomenon of intergenerational contact provides an underutilised avenue to challenge such beliefs and behaviours in older adults and children. An absence of sufficient evidence does not indicate evidence of effect absence (Altman & Bland, 1995).

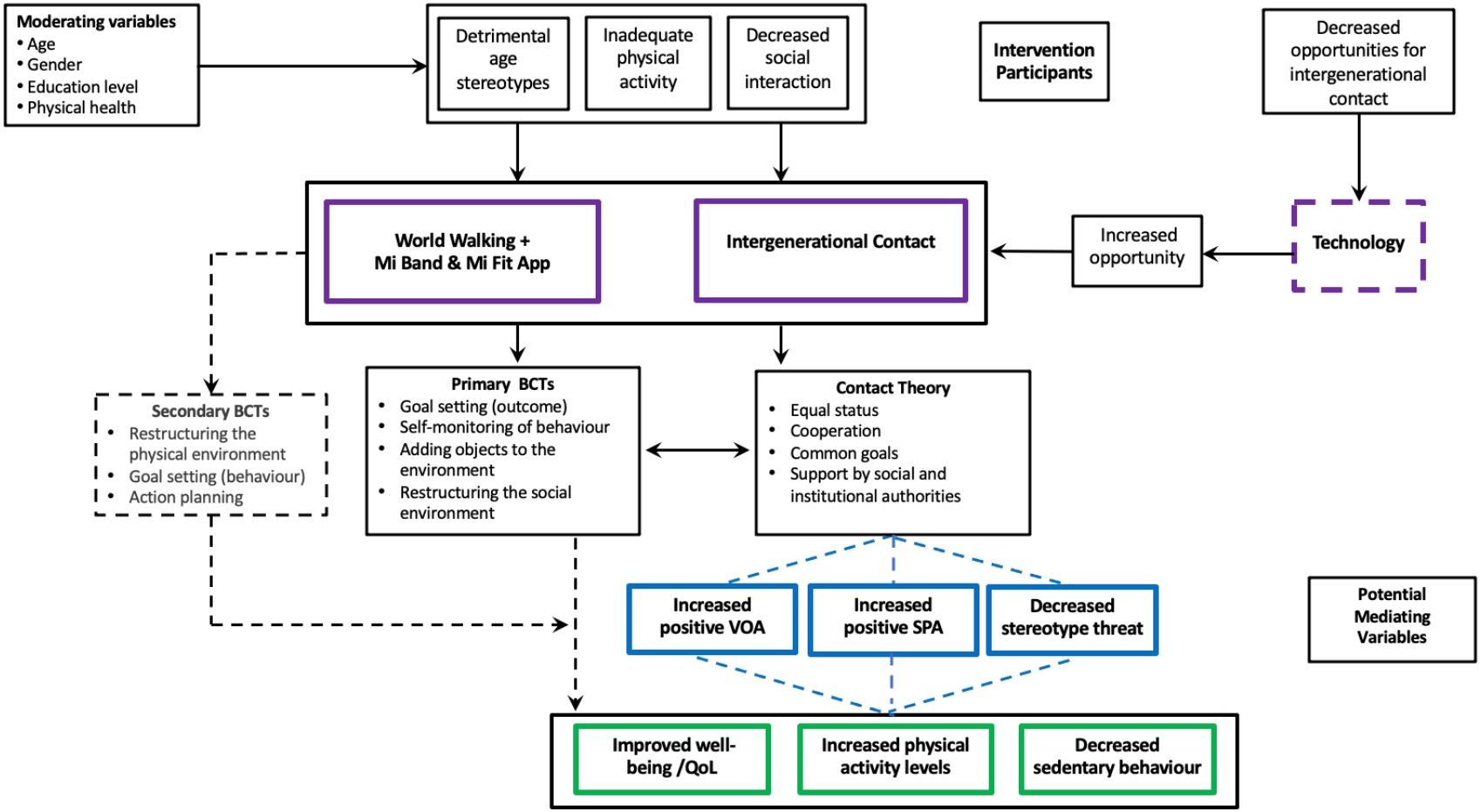


*Figure 8.1* Revised conceptual model of technology-driven intergenerational physical activity intervention

*Note:* BCTs = behaviour change techniques; QoL = quality of life; SPA = self-perceptions of ageing; VoA = views-on-ageing

# Chapter 9

# Reflective Epilogue

*This final chapter summarises my personal perspective of my research journey. My feelings, experiences, thoughts, and overall analysis are presented through reflection on the positives, negatives, challenges, findings, and aspirations for future work.*

## 9.1 Description

As a neophyte researcher, I undertook a PhD that endeavoured to explore the concepts of intergenerational contact and stereotypes of ageing in older adults and children. The ultimate goal being to design, develop, and refine a real-world intervention that simultaneously targeted physical activity engagement in older adults (as the primary outcome) and children (as a secondary outcome) using a technology-driven approach. It was also planned to review the effects on sedentary behaviour and changes to age stereotype constructs.

Physical inactivity has been identified as the fourth leading cause of mortality worldwide, as well as a primary risk factor for a plethora of chronic health conditions (WHO, 2019b). It is known, that for older adults, age stereotypes can routinely supress opportunities for social interaction, influence society's attitudes and perceptions, and inadvertently generate misconceptions about perceived physical activity capabilities (Popham & Hess, 2015; WHO, 2015). Indeed, declines in physical activity are often incorrectly viewed as an inevitable consequence of the ageing process (Ory et al., 2003). Conversely, intergenerational contact (structured or informal), has been linked to positive health and well-being, and positive effects on age stereotypes in older adults (Kirchengast & Haslinger, 2015; Lamont et al., 2015). In children, as well as the anticipated immediate effect on physical activity levels, a multitude of long-term benefits could be gained through the suppression of stereotype embodiment (Popham & Hess, 2015).

Within clinical practice, I have repeatedly struggled to find ways to encourage individuals to instigate and sustain behaviour change. With a lack of time and financial resources, opportunities for social interaction, ease of access, the need for enjoyment,

personally driven intrinsic benefits and the diversity and range of observed physical function in older age repeatedly identified as potentially significant factors (Boulton, et al., 2018; Devereux-Fitzgerald et al*.,* 2016; WHO, 2015), effectively targeting change is difficult. I therefore proposed that increases in physical activity across generations could be targeted through the motivation attached to the social support, the potential to set and work on joint goals and the predicted positive mediating impact on views-on-ageing (Granacher et al., 2011). The use of technology provided a platform to remove certain barriers and increase opportunities for intergenerational contact.

To enable me to develop the proposed intervention, fully explore its feasibility, and potential effects on the targeted outcomes, I completed a series of steps as outlined in Chapter 1. Familiar intergenerational dyads were initially recruited to trial the technology and concept, and to feedback their thoughts and experiences via focus groups. This information was triangulated with data from questionnaires completed by a parent/guardian of each participating child, and the opinions generated from an additional focus group of parents who identified an age-appropriate child and/or older adult who subsequently declined to participate. My primary aim focused on ascertaining the acceptability, usability, and any potential issues with the chosen commercially available technology platform and wearable activity tracker whilst additionally establishing the optimum methods to approach, retain and engage participants in any preceding interventional study.

Secondary to the establishment of feasibility, refinement of the intervention ensued through collaborations that led to the designing and production of local, study specific elements (see Chapter 5). These developments were fed, along with the findings of the feasibility study, into further pilot work. Within my personal pursuit of developing the optimum intervention and research strategy possible within the boundaries of my PhD, I endeavoured to ultimately combine my professional experience and tacit knowledge with the subjectivity of the qualitative feasibility study to improve the objectivity of any subsequent quantitative work. For reasons outside of my control (the COVID-19 pandemic), the opportunity to pursue this approach was prevented, and additional qualitative approaches were adopted instead.

## 9.2 Feelings

Apprehension. Undoubtedly my overriding and predominant feeling prior to commencing the feasibility study recruitment phase. Being an eternal pessimist does not go hand in hand with being a researcher. I found the realisation that the 'fate' of my studies and to an extent the direction of my PhD, had become to a degree, out of my control, extremely difficult. Would anyone respond? Would anyone consent and commit to participating?

Purely getting to the point of being able to commence recruitment at each stage felt like a mammoth task in itself. Everyone is busy, everyone has their own priorities, participating in research, however much we try and limit it, adds extra work, not just for those participating, but for those whose support is crucial. In this instance primarily school staff and parents. Gaining support is key. Additionally, ethical approval is a fundamentally essential process, this does not however make it any less stressful. I found myself periodically questioning why I had decided combining two populations potentially categorised as vulnerable, a technological interface accessed via the internet and physical activity was a good idea. This feeling was compacted by slow response rates and the final sample obtained for the formative feasibility study being below that, for once, optimistically anticipated.

It was difficult not to allow myself to conclude that this, at least in part, was due to a developmental error. Had I misunderstood the literature? Was my interpretation and proposed application of the concept flawed? Despite these mixed emotions I continued to feel strongly about the potential role of intergenerational contact. Recruitment involving human participants is historically difficult. If human behaviour was not complex and multifaceted there would be no justifiable reasons to utilise research to explore it. Accepting I was not alone in my quest nevertheless provided little comfort.

My confidence in my own abilities and the primary structure of the feasibility study was boosted by the eventual enrolment of four dyads. There was an evidential general interest in the concept and project parameters. I just had to accept that striving for perfection is theoretically impossible and was in fact having a negative impact on my own developmental experience and acquisition of new knowledge and skills. I realised that I had the opportunity to not only critically challenge some of my own personal

habitual traits but to use my tacit knowledge and professional experience to optimise the quality of my results (Anderson, Knowles, & Gilbourne, 2004).

With the impending need to moderate the focus groups my crisis of confidence returned, particularly with regards to working with the children. My predominant fear was – What if they do not speak? I am able to process that there is a degree of irrationality on my part regarding this, but it did not stop the unease festering. Additionally, within the context of the focus groups I was mindful of the role and impact that I as the researcher could impart within the inductive processes of qualitative research. Any loss of objectivity, overbearing or shift in power balance could influence the data obtained. I knew that I needed to make a concerted effort not to allow my own ontological and epistemological position, professional knowledge, or personal opinions, bias the outcome data.

My initial apprehension and lack of confidence was followed by unexpected enjoyment and an overwhelming sense of pride in what I was able to achieve through collaborative work within the community, of which a substantial part was intergenerational. A blog post written for World Walking, the online platform that underpinned the intervention, and one of the aforementioned collaborators, regarding the process and generated outputs from the walk route co-design processes, sums up my feelings perfectly (see Figure 9.1). It was also interesting to observe and gain an understanding into how people view the area in which they live, and what is individually important. The older adults really embraced the task at hand and took it very seriously.

I took the opportunity to channel my newly found positivity into the next steps of the outlined Multi-stage Process Model, specifically, when targeting recruitment into the non-randomised pilot work control groups. However, whilst this carried me though the pre-empted difficulties and allowed me to embrace the challenges rather than panic, COVID-19 was an unforeseen hurdle. The feeling of uncertainty on both a personal and professional level, was compacted by a sense of initial despair over the potential loss of ability to continue with my planned study path. This was quickly followed by the realisation that the data already collected was now to an extent, obsolete.

Intergenerational Working at its Best!

September 21st, 2019 Posted in: 2019

Intergenerational Working at its Best!

It started with one person, one PhD idea and one phone call.

It progressed into an exciting shared vision, many emails and a fantastic collaboration between the wonderful children of Pengelli Primary School, a few enthusiastic, knowledgeable grandparents and local residents, me, and of course World Walking!

It ended with the creation of two amazing new walk routes that now allow World Walkers to explore the natural beauty and hidden treasures of Swansea and the Gower Peninsula.

Intergenerational contact and its potential benefits for all involved is an area currently receiving a lot of attention. We think we have shown here that it is a concept that should definitely be embraced more often!

The whole co-design team hope that you will join us in celebrating Swansea University's Centenary year, Pengelli Primary's favourite places and intergenerational working at its best!!

Thank you to all involved for not only making this possible but such an easy and enjoyable task to complete.

Rachel L Knight

Doctoral Scholar, Joint Research Degree Swansea University & Communauté Université Grenoble Alpes

*Figure 9.1* Intergenerational Working at its Best – World Walking Blog

It was hard to accept that the significant volume of planning and work that had gone into successfully collecting the targeted amount of control group data, and the effort and perseverance required just to engage further points of access to intergenerational dyads, was ultimately for nothing. What did I do now? With a little time and rationality, came clarity within a surreal situation that could not have been accounted for with any amount of contingency planning. The feelings of frustration were gradually replaced with a sense of gratitude for what I had been able to achieve to that point, and for the fluidity of the changes I was able to implement to make the most of the situation - embracing change and alternative, equally valid approaches. The irony of my drive for translational research, set in the real-world, and my previous highlighting of the importance and potential impact of environmental and contextual factors, has not been lost on me.

## 9.3 Evaluation

The completion of the feasibility study proved to be a thought-evoking and intrinsically rewarding experience, nonetheless, finishing it was a great relief. From establishing that the concept as a whole was well received, to embracing the complexity of recruitment and realising that whilst people's opinions of technology use and its potential dual role as both a barrier and facilitator to participation vary, there were thankfully no major glitches or concerns raised.

Despite my initial panic, the focus groups proved in my opinion, to be an engaging, insightful process. Whilst they did provide a challenge to impartially yet effectively moderate, I feel completing the process was not only an imperative part of optimising and finalising the structure of the proposed main interventional pilot study but also a seminal part of my own academic development and PhD journey. However, I think that the fundamental elements of my personal gradient of learning came not from successfully achieving all of the study aims but from the knowledge-in-action gained from three specific themes:

- The impact and role of the parent
- The global understanding and perception of research by the general public

- The insight into behaviour and the general public's perceptions of physical activity from a non-clinical perspective.

I naively underestimated the power of the parent. Regardless of the potential views of a particular child or older adult during the recruitment phase, the parent ultimately mediates the process. Their own particular opinions on whether 'x' or 'y' would be interested, too busy, too unwell, too technophobic, or too old to take part appeared to often dictate and hinder enrolment. In some cases, this could have ultimately led to interested parties being vetoed without ever being given the chance to make their own informed decision. I find it ironic, that with regards to the older adult population, stereotypes of ageing, a primary element of my PhD, could have inadvertently ended up hindering my progress.

Parents also have the potential to significantly impact the outcomes of research and unfortunately bias results. I was very surprised to find children reporting that their parents had indeed periodically worn their activity trackers for them in order to increase their step counts. I accept that to a degree this was secondary to frustration on the part of the child. For all of the children, there were periods of time where the activities they were doing required them to remove the watch, maybe their parent felt they were losing vital step data.

During formative work for the development of the Families Reporting Every Step to Health Project, Guagliano et al. (2019), through talk out loud sessions with $n$ = 7 children and $n$ = 2 families, also identified not being able to capture certain activities (i.e., swimming) with pedometers, as discouraging. They endeavoured to address this issue through the provision of a step conversion calculator. This was an idea that I subsequently explored and embedded into the proceeding pilot work.

Within any of the data collection I have undertaken, daily step count was not intended to be an objective measurement of physical activity. It does beg the question though: Has this factor been an unmeasured confounder in other studies? Potentially contaminating presented results and leading to the generation of inflated effect sizes. I made sure that within the pilot work I was able to undertake, that it was clearly stated that the watch should not be worn by anyone else, although I personally fail to comprehend why this fact would not be obvious.

Another objective of the feasibility study was to clarify the time commitment implications not only for the child and older adult, but for the supporting parent. I endeavoured from the outset to keep this to a minimum. Through pure coincidence, whilst I was completing data collection for my study, my own children participated in a different research project. This provided me with an unexpected insight into elements of what I was asking of others. In short, I concluded that the potential commitment could always be greater than anticipated, particularly where the child is engaged for a prolonged period of time. Without the full co-operation of the parent, there is a significant risk of attrition or incomplete outcome data.

Despite my children being old enough to self-manage devices and daily data recording they still required repeated reminders, a process that often ended with me completing the records for them. Parents are busy, research is not their priority. I needed a high level of diligence to get the researcher the most complete data set possible, if I did not understand the critical value of this, as a busy parent with other conflicting priorities would I have made this effort? Probably not.

As an aspiring academic and researcher who already has additional experience applying research to practice, I became aware that perhaps I had previously failed to fully acknowledge that not everyone has had the same encounters with the research process. Regardless of the level of interest in the concept, it became apparent that just the word 'research' has the potential to elicit fear, and that this is a fear of the unknown and the perception of what research entails, particularly within the older adult population. Would activity trackers allow us to know where they were? And what they were doing? What if we found something wrong with them? The emergence of COVID-19 during the preliminary stages of recruiting dyads to the pilot study, only exacerbated concerns, understandably adding risk of cross-infection to their fears.

I strived to provide the clearest explanation of my study through the provided information sheets, but I was targeting a generation who have lived through the evolvement of research to the process that we now know and trust. Their primitive experiences are those of a post war era where researchers like Ancel Keys in The Minnesota Starvation Study employed strategies that would in present day almost certainly be deemed unethical, and an apparently safe anti-nausea medication, thalidomide, ended up causing significant birth defects (Kalm & Semba, 2005; Kim &

Scialli, 2011). Whilst the concerns raised to me did not pose the same ethical gravity, for the individuals concerned they were intrinsically of equal importance.

I feel fortunate to have had the opportunity to view physical activity and to an extent sedentary behaviour, through a different lens and gain an insight, however brief, that beyond the remit of my PhD will only serve to have a positive impact on any future return to professional practice. Currently within the UK healthcare system, particularly with regards to physical activity, there is momentum behind the concept of brief interventions, signposting and making every contact count (Health Education England, 2019). I have however now begun to question the efficacy of these models in relation to behaviour change theory. Is brief advice enough to increase or stimulate self-efficacy or to move someone through a stage of change? (Bandura, 1998; Prochaska & DiClemente, 1983). Is there actually a sufficient body of supporting evidence? (Lamming et al., 2017). I honestly cannot provide a definitive answer, but my limited experience with a small sample suggests that even if people are aware of current guidelines, they still fail to embrace, translate, and practically apply this knowledge.

Associated with the above concerns, in some related work, I systematically explored the complexity of physical activity and sedentary behaviour during the COVID-19 pandemic, and the correlates that influenced the behaviour of the adult population (see Appendix Y). The findings suggest that during this time of social and freedom of movement restrictions, different socioecological constructs may have had a greater impact on behaviour in different population groups. Subsequently, different mechanisms of behaviour change (in this instance identified from the COM-B model; Michie et al., 2011) may need to be targeted. Can such complexities be addressed with generic brief advice?

## 9.4 Analysis

Apart from COVID-19, the most significant challenge I faced was the recruitment of participants. This is an issue I am sure has hindered many researchers before me and will continue to frustrate those that follow. In a study that utilised a similar concept, Leitiao and Reed (2015) following co-design workshops with older adults, piloted *iStep*, an intergenerational support intervention designed to encourage physical activity in grandparents and grandchildren.

Developed to motivate towards a common goal, dyads wore pedometers to complete a virtual week-long walk around their local city, aiming for 70,000 steps collaboratively. Recruitment occurred via children aged 7-8 years old at a local Primary School. To engage with grandparents, a classroom event was organised, but attendance was poor. This resulted in only one grandparent being recruited, and the inclusion criteria being widened to include the children's parents. Notwithstanding the addition of parents, participants proceeded to consent but then still failed to sign up to and engage with the web-platform.

Widening the target population to form triads that included an additional generation (the parent of the child), was an option discussed within the focus groups, however it was felt that this would negatively change the dynamic of the relationship and contact between the child and the older adult. An opinion also informally apparent from the case study participants. Given the findings of Leitiao and Reed (2015) it appears that it potentially would not be an effective strategy to optimize uptake rates anyway. Despite the level of complexity that surrounds the development of intergenerational interventions there are other key findings that could be employed to enhance interest.

Generating enthusiasm within the targeted child population could significantly influence both the chance of agreement to enrol by their familiar older adult and the recruitment of other dyads through peer power. It appears that older adults may be more likely to participate for the benefit of the child than for their own personal gain or perception of the need to improve their health. Indeed, this finding relates back to many other studies (for example, Boulton et al., 2018; Devereux-Fitzgerald et al., 2016). Whilst I failed to process this fact prior to commencing the feasibility study and had limited opportunity to utilise this strategy within the pilot study, it could prove to be a vital avenue to target in future work.

I still find the lack of conception that it is necessary, and more than likely possible to actually make time for physical activity fascinating. Time, from numerous angles was repeatedly presented as a barrier to participation in older adults. This is not a new revelation to me or indeed to the wider research community, but scepticism about the amount of commitment needed and anticipated changes to rigid routines almost certainly heightened anxiety levels. I may have provoked these reactions with the sheer volume of preparatory information provided, a percentage of which was compulsory

and outside of my control. I could have inadvertently ended up making people unnecessarily overwhelmed and uneasy.

Concerns were raised by impartial observers that I was also potentially hindering recruitment by failing to acknowledge that the lower limit of the age range for the older adults (initially 65 years old or above, later lowered to 60 years old or above) may in fact be too high. This in turn was deemed to be presenting a 'generation' issue whereby the majority of the grandparents of the targeted child cohort (7-11 years old) would not be old enough to participate. These observations are difficult to quantify but could be arguably contradicted by the fact that the average age of first-time parents is reportedly continuing to rise, in 2017, 55% of mothers and 69% of fathers were aged 30 years or over (ONS, 2019).

Whilst aged 65 years or older was chosen in line with the World Health Organisation definition of an older adult (WHO, 2015), evidence suggests that stereotypes of ageing are increasingly prevalent, the most salient, and therefore the most likely to be detrimental to health, in the transition period into perceived old age, rather than when individuals have become accustomed to it (Hess & Hinson, 2006; Eich et al., 2014). Decreasing the age limit for older adults in subsequent work was therefore justifiable or in fact could have been imperative.

## 9.5 Action Planning for the Future

In relation to intergenerational research, I feel that further exploration and deliberation of key points that with hindsight, even after adjustments following the feasibility study, should have been considered in greater detail, could prove to be vital. I would make sure that I had a detailed and comprehensive recruitment strategy that incorporates a range of different yet realistic approaches including focusing on engagement of the children (and their parents) and ensuring the allocation of optimal time and resources. This would hopefully eliminate the elements of disappointment and frustration I experienced when I did not manage to enrol the optimum dyad numbers. I would also explore further whether ethically, alternative approaches to the provision of participant information are possible to try and reduce the risk of information overload and inhibit the impact of research 'fear'.

In relation to conducting research in general, I am beginning to think that it bears a remarkable similarity to running a business. The need to forward plan, expect the unexpected and pre-empt potential limits to success, are all strategies that directly correlate to research. Stutley (2012) describes starting a business as being about the entire journey and the plan that gets you to the desired outcome, I think this statement could equally be applied to the research process. Furthermore, if marketing is an exchange relationship where value is created, communicated, and supplied through the building of strong customer relations that generate a return, then I think recruitment almost certainly requires a marketing strategy (American Marketing Association, 2013; Kotler, Armstrong, Harries, & Piercy, 2013).

## 9.6 Conclusions

Ultimately, I feel that even though I encountered some challenging aspects, I successfully engaged with and embraced my PhD journey. With time, I learnt to accept at a deeper level, a concept that I really already knew: that one study and one individual cannot change the world. There is however an element of self-gratification in thinking that any study however small, may have had a positive impact on the behaviour and hence potentially life, of even one individual. This could be related to the targeted health behaviour outcome, or an additional unexpected impact: Enabling children to feel like '*little scientists*' and play a small part in facilitating a broader understanding and insight into where education could lead them.

A researcher's philosophical position, coupled with their personality traits and life experience undoubtedly influences their mindset, interpretation, and approach towards academia. Comparing $n = 296$ healthcare professionals to $n = 54{,}646$ individuals with other occupations, Richardson, Lounsbury, Bhaskar, Gibson, and Drost (2009) reported a significantly higher mean score for conscientiousness ($p < 0.05$) in the healthcare workers. The work of Bandura (1998) suggests that obstacles to achievement in conscientious individuals with high levels of self-efficacy, often stimulate even greater levels of effort. Theoretically, the more challenges I encounter, the more effort I should make.

I often struggle with my philosophical position. I think I would class myself as a critical realist with a post-positivist worldview. I do have a newfound appreciation for qualitative research and indeed can now see the value of both this paradigm and empirical work. However, qualitative work is messy, and you never quite know where it will take you. Whilst a degree of preparatory planning is essential before a focus group or an interview, I learnt that adopting a more flexible stance particularly during groups is vital, but for me this was not an easy skill to master and one that requires more thought and practice. Is my epistemological position therefore subconsciously driven by my preference for the neater, controllable approach that can be applied to quantitative work?

There are multiple possible realities that could be explored within physical activity research. To build an evidence-base for practice and 'buy-in' from stakeholders to change policies, the scientific community still currently requires the presentation of statistically quantifiable results. However, the findings of experimentally controlled trials lack the subjectivity of the real-world, the effects of which are now inherently more prominent than ever before. For me, this makes translational research of paramount importance if we are to gain a greater practical insight into workable solutions to the global issue that is physical inactivity. For older adults and children, a technology driven intergenerational approach that implicitly targets stereotypes of ageing could just be part of that workable solution.

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# Appendices

## Appendix A

Example systematic review search strategy and database specific restrictions

**SPORTDiscus**

TI "older adul*" OR AB "older adul*" OR TI "elderly" OR AB "elderly" OR TI "aged" OR AB "aged" OR TI "retired" OR AB "retired" OR TI "geriatric" OR AB "geriatric" OR TI "older peopl*" OR AB "older peopl*" OR TI "older populatio*" OR AB "older populatio*" OR TI "older perso*" OR AB "older perso*" OR TI "older wom?n" OR AB "older wom?*" OR TI "older men" OR AB "older men*" OR TI "mature" OR AB "mature" OR TI "senio*" OR AB "senio*"

AND

TI "age stereotyp*" OR AB "age stereotyp*" OR TI "aging stereotyp*" OR AB "aging stereotyp*" OR TI "ageing stereotyp*" OR AB "ageing stereotyp*" OR TI "ageism" OR AB "ageism" OR TI "agism" OR AB "agism" OR TI "priming" OR AB "priming" OR TI "positive priming" OR AB "positive priming" OR TI "negative priming" OR AB "negative priming" OR TI "implicit priming" OR AB "implicit priming" OR TI "explicit priming" OR AB "explicit priming" OR TI "positive stereotyp*" OR AB "positive stereotyp*" OR TI "negative stereotyp*" OR AB "negative stereotyp*" OR TI "implicit stereotyp*" OR AB "implicit stereotyp*" OR TI "counterstereotyp*" OR AB "counterstereotyp*" OR TI "counter stereotyp*" OR AB "counter stereotyp*" OR TI "counter-stereotyp*" OR AB "counter-stereotyp*" OR TI "self regula*" OR AB "self regula*" OR TI "self-regula*" OR AB "self-regula*" OR TI "views on aging" OR AB "views on aging" OR TI "views on ageing" OR AB "views on ageing" OR TI "stereotype boost" OR AB "stereotype boost" OR TI "stereotype threat" OR AB "stereotype threat" OR TI "stereotype embodiment" OR AB "stereotype embodiment" OR TI "stereotype internali?ation" OR AB "stereotype internali?ation" OR TI "positive vie*" OR AB "positive vie*" OR TI "negative vie*" OR AB "negative vie*" OR TI "imagery" OR AB "imagery" OR TI "imagined contact" OR AB "imagined contact" OR TI "intergenerational contact" OR AB "intergenerational contact" OR TI "intergroup contact" OR AB "intergroup contact" OR TI "self perceptio* of aging" OR AB "self perceptio* of aging" OR TI "self perceptio* of ageing" OR AB "self perceptio* of ageing" OR TI "self-perceptio* of aging" OR AB "self-perceptio* of aging" OR TI "self-perceptio* of ageing" OR AB "self-perceptio* of ageing" OR TI "subjective aging" OR AB "subjective aging" OR TI "subjective ageing" OR AB "subjective ageing" OR TI "stereotype prejudice" OR AB "stereotype prejudice" OR TI "stereotype discrimination" OR AB "stereotype discrimination" OR TI "social interactio*" OR AB "social interactio*" OR TI "social support" OR AB "social support"

AND

TI "physical activity" OR AB "physical activity" OR TI "exercise" OR AB "exercise" OR TI "physical function" OR AB "physical function" OR TI "physical performance" OR AB "physical performance" OR TI "motor performance" OR AB "motor performance" OR TI "motor learning" OR AB "motor learning" OR TI "well-being" OR AB "well-being" OR TI "wellbeing" OR AB "wellbeing" OR TI "well being" OR AB "well being" OR TI "quality of life" OR AB "quality of life" OR TI "cognition" OR AB "cognition" OR TI "cognitive functio*" OR AB "cognitive functio*" OR TI "memory" OR AB "memory" OR TI "functional capacity" OR AB "functional capacity" OR TI "health related variabl*" OR AB "health related variabl*" OR TI "health-related variabl*" OR AB "health-related variabl*" OR TI "self-worth" OR AB "self-worth" OR TI "self worth" OR AB "self worth" OR TI "anxiety" OR AB "anxiety" OR TI "physical recovery" OR AB "physical recovery" OR TI "self related health" OR AB "self related health" OR TI "self-related health" OR AB "self-related health" OR TI "self esteem" OR AB "self esteem" OR TI "self-esteem" OR AB "self-esteem" OR TI "self efficacy" OR AB "self efficacy" OR TI "self-efficacy" OR AB "self-efficacy" OR TI "motivation" OR AB "motivation" OR TI "obesity" OR AB "obesity" OR TI "subjective aging" OR AB "subjective aging" OR TI "subjective ageing" OR AB "subjective ageing" OR TI "age stereotyp*" OR AB "age stereotyp*" OR TI "aging stereotyp*" OR AB "aging stereotyp*" OR TI "ageing stereotyp*" OR AB "ageing steretyp*" OR TI "views on aging" OR AB "views on aging" OR TI "views on ageing" OR AB "views on ageing" OR TI "self perceptio* of aging" OR AB "self perceptio* of aging" OR TI "self perceptio* of ageing" OR AB "self perceptio* of ageing" OR TI "self-perceptio* of aging" OR AB "self-perceptio* of aging" OR TI "self-perceptio* of ageing" OR AB "self-perceptio* of ageing" OR TI "perceptio* of aging" OR AB "perceptio* of aging" OR TI "perceptio* of ageing" OR AB "perceptio* of ageing"

**Database specific restrictions**

Scopus – Subject headings – Medicine, Nursing, Psychology, Social Sciences, Health Professions, Undefined.
MEDLINE – MeSH terms and keyword searches were explored during preliminary searches, however, due to the quality of citations generated and the number of specific terms not covered by MeSH, a combined keyword and MeSH term search was run.

## Appendix B

Information to support systematic review risk-of-bias assessments

Non-randomised articles

| | Outcome Domain | Potential Confounders | Bias due to confounding | Bias in selection of participants | Bias in classification of interventions | Bias due to deviations from intended interventions | Bias due to missing data | Bias in measurement of the outcome | Bias in selection of the reported result | OVERALL JUDGEMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Belgrave (2011) | Psychosocial Well-Being | Contact with Grandchildren<br>Baseline health status | Non-equivalent CG - potential differences in health status, cognition and contact with grandchildren<br>Recruitment method<br>No evidence of control of any potential confounders but did do baseline comparisons | Experimental and control groups were from different residential facilities<br>Only 1 x 10-week intervention period<br>Cannot rule out bias completely as unclear when participants allocated to groups - could be low but methods not comparable to randomised trial | No serious concerns but not exactly comparable to a randomised trial | No indication of any deviations beyond what would be expected in usual practice | At least 95% available details of 1 x participant that deceased noted<br>No serious concerns but not exactly comparable to a randomised trial | Researcher assessed and delivered sessions, self-report outcome measure | Only pre-post measures taken or one outcome measure | Serious risk of bias from confounding, no adjustment and lack of blinding |
| Brothers & Diehl (2017) | Physical Activity<br>Age Stereotypes | Gender<br>Age<br>Health Status<br>Baseline exercise status | No comparator group but does not appear to be any | No concerns | No concerns | No concerns | Data for 11 participants not included | Measure could have been influenced as measure is self-report | No information on multiple outcome measurements but no indication of multiple analyses | Based on multiple scores of moderate risk |
| Fujiwara et al. (2009) | Physical Function<br>Subjective Health | Education<br>Grandchildren<br>Other volunteering | Potential from contact with grandchildren, other volunteering activities only education controlled for in analysis | No concerns | No concerns | Participants changed from control to intervention group but not likely to have affected the outcome as excluded from analysis | Data from multiple withdrawals not included but even though there are exclusions they have been identified | Outcome measures could not have been influenced by knowledge of intervention received but no information on whether outcome assessors aware of participant allocation | Lack of information | Based on confounder control plus multiple scores of moderate risk |
| Sakurai et al. (2016) | Physical Function | Education<br>Grandchildren<br>Other volunteering | Potential from contact with grandchildren, other volunteering activities. Only education controlled for in analysis | No concerns | No concerns | Participants changed from control to intervention group but not likely to have affected the outcome as excluded from analysis | Data from multiple withdrawals not included but even though there are exclusions they have been identified | Multiple participant led outcomes | Lack of information | Based on confounder control plus multiple scores of moderate risk |

## Randomised articles

| | Outcome Domain | Risk arising from randomisation process | Risk due to deviations from the intended interventions | Risk due to missing outcome data | Risk in measurement of the outcome | Risk in selection of the reported result | OVERALL JUDGEMENT |
|---|---|---|---|---|---|---|---|
| Beyer et al. (2019) | Physical Function | Participants were randomly assigned to the IG or the CG using the software R (R Development Core Team, 2015) via the function 'sample' of the R 'base' package with predefined sizes for both groups. However, an additional non-randomised group was added at a later date | Participants aware of assigned interventions. The self-perceptions of aging intervention were delivered by a separate psychologist who did not have contact with the control group. Appropriate analysis used to estimate effect of assignment to the intervention | No apparent missing data | No information on whether outcome assessors aware of the intervention received | No information on analysis plan but results for all time points reported | Based on outcome of risk arising from the randomisation process |
| | Psychological Well-Being | | | Missing data is described for the questionnaire but unclear if it refers to this measure | Participant led outcome and participants blinded | | |
| | Age Stereotypes | | | No apparent missing data | Participant led outcome and participants blinded | | |
| Émile et al. (2014) | Quality of Life | Participants randomly divided into two groups, but any further methods unclear | Participants aware of intervention, not possible to hide allocation from a non-intervention control group. Concerns over failure to analyse participants in their allocated groups - 34 randomly divided into two groups but total results only reported for n = 52 | Potentially 18% data missing, with no explanation | Participant led outcome and participant aware of intervention | Insufficient information, appears all outcome measurements reported, but unclear about volume of analyses | Based on two high risk domains |
| Émile et al. (2014) | Physical Activity | | | | Appears that the intervention and the outcome assessment are delivered by the same person. Judged to be some concerns not high risk as unclear as influence of intervention knowledge could be different for the objective and subjective measures | | |
| Émile et al. (2014) | Psychological Well-Being | | | | Participant led outcome and participant aware of intervention | | |
| Klusmann et al. (2012) | Age Stereotypes | 259 women met the eligibility criteria, were included in the baseline assessment, and then were randomised. Of these, 247 women were allocated to one of three study groups, that is, a physical exercise course, an active control (i.e., a computer course), or a passive control group - no information on method of randomisation. Not enough information on baseline data | Participants probably unaware of intervention allocation as debriefed at end of study but intervention deliverers probably aware. Intention to treat analysis used. No information to judge deviation from intended intervention | > 95% of sample reported | Participants are outcome assessors, and it is likely they knew their allocation but not aware of actual reason for study as debriefed at end | No indication analysis planned in advance but no concerns over lack of measurement reporting or multiple data analysis | Based on average risk of some concerns |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Levy et al. (2014) | Age Stereotypes | Statement on lack of differences between baseline measures in intervention groups, but no details on method of randomisation | Participants unaware of the hypotheses and to which group they had been assigned<br><br>Three experimenters, two unaware of the hypotheses (tested 90% of participants) and the nature of condition assignment; the pattern of significant results did not differ between the three experimenters. No information to conclude if appropriate analysis. No concerns that any participant changed groups or were lost to follow up | No apparent missing data | Participants are outcome assessors and it is likely they knew their allocation but not aware of actual reason for study as debriefed at end | No indication analysis planned in advance but no concerns over lack of measurement reporting or multiple data analysis | Based on average risk of some concerns |
| Levy et al. (2014) | Physical Function | | | No apparent missing data | Comparable timepoints (see Table 1) and assessors<br><br>Three experimenters, two unaware of the hypotheses (tested 90% of participants) and the nature of condition assignment; the pattern of significant results did not differ between the three experimenters.<br><br>Assessment consists of physical participant led measures | No information on analysis plan on measure of physical activity but whilst data for all groups are not reported, a 2x2 design has been utilized and data presented relative to all noted hypotheses | Based on average risk of some concerns |
| Warner et al. (2016) | Physical Activity | The software R (http://cran.r-project.org) via the function 'sample' of the R package 'base' was used to randomize participants into three groups using pre-defined group sizes for the intervention group. Successful randomisation<br><br>to these four groups supported by analyses of variance and chi-square tests. No differences occurred between the groups for any demographic variables, and accelerometer-assessed PA, Functional Comorbidity Index or disadvice to be active from a physician at baseline | Minimal information to make judgements. Due to the nature of the intervention those delivering would know who was in the group<br><br>Reasons for dropouts and Attrition analyses undertaken but no information as to whether ITT or mITT carried out | Unclear, not all reasons for drop out stated (Figure 1 p. 1149, Warner, 2016)<br><br>Figure 1 reasons for attrition varied – see consort diagram, multiple dropouts due to health-related outcomes | Participant reported and objective measure through accelerometer. No indication that assessment of the outcome influenced by knowledge of the intervention | No information on analysis plan but results for all time points reported, multiple different covariates etc. but non-significant results reported | Judged as some concerns not high-risk following reviewer discussion |
| Wolff et al. (2014) | Physical Activity | The software R (http://cran.r-project.org) via the function 'sample' of the R package 'base' was used to randomize participants into three groups using pre-defined group sizes for the intervention group | Minimal information to make judgements. Due to the nature of the intervention those delivering would know who was in the group<br><br>Reasons for dropouts and Attrition analyses undertaken but no information as to whether ITT or mITT carried out | Unclear, not all reasons for drop out stated<br>See supplementary data; reasons for attrition varied – see consort diagram, multiple dropouts due to health-related outcomes | Participant led outcome and participant aware of intervention | No information on analysis plan but results for all time points reported, multiple different covariates etc. but non-significant results reported. Data for passive control group not reported but this is not what the question is asking | Judged as some concerns not high-risk following reviewer discussion |
| Wolff et al. (2014) | Age Stereotypes | | | | | | |

## Appendix C
Ethical approvals

**Bevan N.E.**
Ethics Approval - Knight 2018-103
To: KNIGHT R. [redacted] Cc: Bloodworth [redacted], Hudson [redacted]

21 February 2019 at 16:27
Details
BN

Dear Rachel,

This is to confirm that the Ethics application **'Moving Together: Determining the feasibility, acceptability and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study'** has been approved.

The approval number is 2018-103 and the date of approval is February 19th, 2019.

Please keep this information safe as you may need it in the future.

Best wishes,

Nicola

**RE: Further ethics amendments**

BN
**Bevan N.E.**
**To:** Bloodworth [redacted] KNIGHT R [redacted]

Thursday, 4 April 2019 at 14:12

Hi both,

Updated number is 2018-103A to reflect the amendment.

Best wishes,

Nicola

**Appendix D**

Feasibility study consent and assent forms

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARTICIPANT CONSENT FORM (OLDER ADULT)

**(Version 1.1, Date: 21/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

**Please initial box**

1) I confirm that I have read and understood the information sheet dated 21/01/2019 (version number 1.1) for the above study and have had the opportunity to ask questions. ☐

2) I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

3) I understand that sections of any of data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to these records. ☐

4) I understand that data I provide may be used in reports and academic publications in anonymous fashion. ☐

5) I agree that digital / video images obtained during the study can be used during the dissemination of the results. ☐

6) I have no known cardiovascular (e.g., heart), metabolic (e.g., diabetes or pre-diabetes) or renal (e.g., kidney) disease. ☐

7) As far as I am aware I have not experienced any signs or symptoms of cardiovascular (e.g., heart), metabolic (e.g., diabetes or pre-diabetes) or renal (e.g., kidney) disease. ☐

8) I agree to take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

# PARTICIPANT ASSENT FORM (CHILD)

**(Version 1.1, Date:21/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and joanne.hudson@swansea.ac.uk

Please initial box

1. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without my medical care or legal rights being affected. ☐
3. I understand that sections of any of the data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to these records. ☐
4. I agree that pictures and video images taken during the study can be used during presentations and when the research team are sharing the results with other people. ☐
5. I think I am fit and well enough to take part in the above study. ☐
6. I agree to take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARENTAL CONSENT FORM

**(Version 1.1, Date: 15/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

Please initial box

1. I confirm that I have read and understood the information sheet dated 21/01/2019 (version number 1.1) for the above study and have had the opportunity to ask questions ☐

2. I understand that my child's participation is voluntary and that they are free to withdraw at any time, without giving any reason, without their medical care or legal rights being affected. ☐

3. I understand that sections of any of the data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my child taking part in the research. I give permission for these individuals to have access to these records. ☐

4. I agree that digital / video images obtained during the study can be used during the presentation and dissemination of the results. ☐

5. I confirm that to the best of my knowledge my child does not have any medical reasons why they should not participate in the study. ☐

6. I confirm that I consent to my child: _____ (please enter name of child) participating with _____ (please enter name of Older Adult) and that I, not Swansea University take responsibility for having an oversight of any interactions between the named participants that may occur. ☐

7. I agree that my child may take part in the above study. ☐

8. I consent to being sent a parental study evaluation questionnaire to be completed at the end of the study. ☐

   I would prefer to complete the questionnaire electronically ☐

   I would prefer to receive a paper copy of the questionnaire ☐

| _____ | _____ | _____ |
|---|---|---|
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

# PARTICIPANT CONSENT FORM (NON-PARTICIPANT PARENT)

**(Version 1.1, Date: 22/03/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

**Please initial box**

1. I confirm that I have read and understood the information sheet dated 22/03/2019 (version number 1.1) for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐
3. I understand that sections of any of data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to these records. ☐
4. I understand that data I provide may be used in reports and academic publications in anonymous fashion. ☐
5. I agree to take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

## Appendix E

Health screening questionnaires

### PRE-PARTICIPATION HEALTH SCREENING QUESTIONNAIRE

**Please mark all TRUE statements**

**Step 1**

**SYMPTOMS**

Do you experience:

____ chest discomfort with exertion
____ fainting /dizziness /blackouts
____ unreasonable breathlessness
____ ankle swelling
____ unpleasant awareness of a forceful, rapid or irregular heart rate
____ burning or cramping sensations in your legs when walking a short distance

**Step 2**

**CURRENT ACTIVITY**

Do you currently perform planned, structured physical activity of at least 30 minutes at moderate intensity on at least 3 days per week and have you done so for the last 3 months?

YES ☐ NO ☐

**Step 3**

**MEDICAL CONDITIONS**

Do you currently have, or have you ever had:

____ a heart attack
____ heart surgery or cardiac angiogram or insertion of stents
____ angina
____ a pacemaker or implantable cardiac defibrillator (ICD)
____ rhythm disturbance (irregular or fast heart rate)
____ heart valve disease
____ heart failure
____ heart transplantation
____ congenital heart disease
____ high blood pressure
____ diabetes
____ renal disease
____ asthma or any other lung condition
____ any musculoskeletal (joint or muscle) problems that may limit your physical activity

Do you currently take any prescription medications? YES ☐ NO ☐

*(Based on: Exercise preparticipation health screening questionnaire for exercise professionals; Magal & Riebe, 2016)*

**I confirm that to the best of my knowledge the information provided above is correct.** I take full personal responsibility and liability for my participation and will inform the researcher immediately of any change in my medical status.

_____ _____ _____

Name of Participant Date Completed Signature

## PRE-PARTICIPATION HEALTH SCREENING QUESTIONNAIRE

**Please mark all TRUE statements**

**Step 1**

**CURRENT ACTIVITY**

Does your child currently perform planned, structured physical activity of at least 30 minutes at moderate intensity on at least 3 days per week and have they done so for the last 3 months?

YES ☐ NO ☐

**Step 2**

**MEDICAL CONDITIONS**

Does your child currently have, or have they ever been diagnosed with:

____ a heart condition
____ diabetes
____ renal disease
____ asthma or any other lung condition
____ any musculoskeletal (joint or muscle) problems that may limit their physical activity

Does your child currently take any prescription medications? YES ☐ NO ☐

*(Based on: Exercise preparticipation health screening questionnaire for exercise professionals; Magal & Riebe, 2016)*

I confirm that to the best of my knowledge the information provided above is correct.

I take full personal responsibility and liability for my Childs participation and will inform the researcher immediately of any change in their medical status.

_____ _____
Name of Participant Date form completed

_____ _____ _____
Name of Person completing form Signature Relationship to Child

**Appendix F**
Medical disclaimer form

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# MEDICAL DISCLAIMER FORM

**(Version 1.1, Date: 18/02/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

**Please initial box**

1. I have obtained written medical clearance to participate (please see attached) ☐

OR

2. I declare to the best of my knowledge that:
   a. any medical condition(s) I have identified in the Health Screening Questionnaire are controlled and stable, and will not pose any detrimental risk to my health through my choice to participate in the study ☐

   b. I have never been advised that my medical condition(s) prohibits or limits my participation in physical activity ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

**Appendix G**

Feasibility study example gate keeper communication

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

Date: DD/MM/YY

Dear [XXXXX]

We are researchers from Swansea, Grenoble, and Cardiff Universities, with expertise in Physical Activity & Health. On behalf of our research team, I am contacting you to see if you would be willing for us to approach pupils (aged 7 – 11 years old) within your School to take part in a study designed to explore the feasibility and usability of a technology-supported intergenerational intervention aimed at improving age stereotypes and physical activity participation in children and older adults. Each child would form a dyadic pairing with an older adult (aged ≥65 years old), either a family member or an older adult familiar to the child, to work collaboratively towards physical activity goals.

The study would involve the dyads testing wearable trackers and a supporting technology platform for a 4-week period. Participants will also be asked to attend a pre-study enrolment /familiarisation session and a post-study focus group. The researcher would also hold a weekly trouble shooting meeting at the end of weeks 1 – 3 to allow any potential technical issues to be addressed.

If you are willing to allow us to approach your pupils to take part, we would ideally like to send home written information to all eligible pupils in each year group via the School system (please see attached). If possible, with a message to parents or copy of the parent information sheet additionally being sent out via the school's electronic communication method of choice informing them about the study. Interested participants would return their consent forms to the school and contact would then be made accordingly to arrange enrolment and commencement of the study.

Participants are free to withdraw from the study at any time and their data and responses will be confidential to the research team and anonymously reported in any publications or presentations. The study has received ethical approval from the College Research Ethics Committee. If you would like to discuss this process or raise any ethical concerns about the study, please contact Dr Andrew Bloodworth, Chair of the College Research Ethics Committee, on [redacted] or [redacted]

Thank you for taking the time to consider this request. If you would be happy for the school and the pupils to take part in the study, please could you confirm via any of the contact details provided below.

Please do not hesitate to contact me if you would like to discuss any element of the study further.

**Appendix H**

Feasibility study participant information sheets

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARTICIPANT INFORMATION SHEET (OLDER ADULT)

**(Version 1.1, Date: 21/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 1) Invitation Paragraph

We would like to invite you to take part in a research study that we are conducting with our colleagues at Swansea University, Cardiff University and Communauté Université Grenoble Alpes. Please take the time to read this information sheet carefully as it will provide you with the details of our study and hopefully all the information you will require to help you decide if you want to participate. It is important to say at this point that the decision to take part is entirely up to you, and that even if you decide to do so, you can withdraw your consent at any point during or after completion of the study, as long as it is before the data has been analyzed, either in person, in writing or by e-mail.

## 2. What is the purpose of the study?

We have developed an intervention that aims to change views about ageing and physical activity in children (aged 7-11 years old) and older adults (aged ≥ 65 years old). We would like you to experience this intervention and provide us with information and feedback on how suitable and useable you found it. You will be required to form a partnership with a child that is either a family member, or a child that is familiar to you and has requested to be paired with you. Using watches that record your activity levels (similar to a fit-bit), linked to a web-based program on a device of your choice that you already have available (smart phone, tablet, computer) you will work together for 4 weeks to complete physical activity challenges, for example, virtual walking routes.

## 3. Why have I been chosen?

You have been chosen as you are either a family member or are well-known to a child at Pengelli Primary School and have been identified as a suitable potential partner by the child and their parent/guardian.

## 4. What will happen to me if I take part?

You will need to return your completed Consent Form and Health Screening Form via your co-participating child to their School. If indicated, you will be contacted by the researcher to

further discuss any health conditions. You will be invited to attend an enrolment session with your partnering child at Pengelli Primary School which will last approximately 1 hour. At this session we will familiarise you with the intervention, explain how to use the activity tracker watch and how to access the web page. You will need to wear the watch day and night for 4 weeks. At the end of the study, the watch will be returned, and you will be invited to attend a feedback discussion group with 5 – 10 other adults who have also participated that will last approximately 1.5 hours.

The group will be held at a time that is mutually convenient for all the participants at Pengelli Primary School and will be audio and video recorded. The full recordings will only be viewed by the lead researcher, and only used to fully write up the discussion and accurately allocate comments to the correct person. If you are willing, sections of the video recording will be kept by the research team for use within the presentation and distribution of the study results. If you do not wish for this to happen, we will ensure that no images in which you are present will be kept. Once this process has been completed the remaining recordings will be erased.

During weeks 1-3 of the study you will also receive a weekly telephone call from the researcher to trouble shoot any issues or concerns.

### 5. What are the possible disadvantages of taking part?

You might feel mild discomfort in a discussion with others. However, you can refuse to answer any questions that you do not feel comfortable answering and remove any data that you do not want to be used.

There will be minimal physical risk through participation in the study as we are only looking to characterise your normal daily activities. The aim is to work within the limits of your current health status and ability. Any concerns regarding this or any health conditions that feel may influence your participation can be discussed with the researcher either at enrolment or by contacting Rachel Knight by email at [redacted] or telephone [redacted]

### 6. What are the possible benefits of taking part?

You can benefit from taking part in the study by potentially being more aware of your activity levels and enjoying taking part. You could also gain health benefits. We are also interested in finding out what you feel the benefits of the intervention are and so do not want to suggest what we feel they will be.

### 7. Will my taking part in the study be kept confidential?

Any information you provide will be kept strictly confidential. Participants' names will not be given in any reports of the findings, and personal information will not be linked in any way to your data. Quotations that are used within the write up of the discussion groups will be kept anonymous by giving each participant a code name.

**Data Protection and Confidentiality**

Your data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly confidential. Your data will only be viewed by the researcher/research team.

All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet in a locked office at Swansea University. Your consent information will be kept separately from your responses to minimize risk in the event of a data breach.

Please note that the data we will collect for our study will be made anonymous, at the end of the data collection period, thus it will not be possible to identify and remove your data at a later date, should you decide to withdraw from the study. Therefore, if at the end of participating in this research study you decide to have your data withdrawn, please let us know immediately.

Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information.

**Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent to participate in this study by completing the consent form that has been provided to you.

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public interest justification is approved by the College of Engineering Research Ethics Committee, Swansea University.

The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

**How long will your information be held?**

We will hold any personal data and special categories of data for a maximum period of 5 years (following Swansea University requirements) after the awarding of the researcher's degree as required by Research Councils.

**What are your rights?**

You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information.

Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)
Vice-Chancellor's Office
Swansea University
Singleton Park
Swansea
SA2 8PP
Email: dataprotection@swansea.ac.uk

**How to make a complaint**
If you are unhappy with the way in which your personal data has been processed, you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied, then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,
Wycliffe House,
Water Lane,
Wilmslow,
Cheshire,
SK9 5AF
www.ico.org.uk

## 8. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via post or email. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: A.J.Bloodworth@swansea.ac.uk.

# PARTICIPANT INFORMATION SHEET (CHILD)

**(Version 1.2, Date: 21/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight ([redacted] Tel: [redacted]

## 1. Invitation Paragraph

*You are being invited to take part in a research study. It is up to you if you want to take part and the information below will help you decide.*

*You can change your mind and stop taking part at any time if you wish, you will still be able to take part in future studies, even if you decide you do not want to take part in this one. Taking part will not change how you are treated at school.*

## 2. What is the purpose of the study?

*To look at if working together with an older adult who you know very well (maybe a grandparent) can make you and your partner move more which is good for how you feel.*

## 3. Why have I been chosen?

*Your school has agreed that all children in Years 3,4,5 and 6 can be asked to take part.*

## 4. What will happen to me if I take part?

- *You will meet with a researcher who will tell you more about the study.*
- *You will then work with your partner to complete an around the world walking challenge. You will wear a watch all day every day, even when you're sleeping for 4 weeks that counts how many steps you take.*
- *At the end of the study, you will meet up with other children in your school who took part to talk about what you thought of the watch, the app and working with your partner.*

- *We will record the meeting and if you and your parent / guardian are happy, we will keep some of these recordings to use when we talk to other people about the study results.*

### 5. What are the possible disadvantages of taking part?

- *You should not feel any different because we are only looking at your normal everyday activities, but you may be more aware of being more active.*
- *You may get a little embarrassed when talking in a group in front of other children, but the researcher will always explain everything to you and you do not have to answer any questions that you do not want to.*

### 6. What are the possible benefits of taking part?

- *Being more active, a little bit healthier and enjoying taking part.*
- *Helping us to understand if there is anything, we could do to make the study better.*

### 7. Will my taking part in the study be kept confidential?

*All information collected about you will be kept private, only members of the research team will have access to it. A number that will be used instead of your name and any information shared within the team about you will only have this number on it, not your name.*

### 8. What if I have any questions?

*If you have questions about the study, either now or in the future, you can get in touch with us (or can ask your parents or teachers to) by using the contact details at the start of this form.*

# PARENTAL INFORMATION SHEET

**(Version 1.1, Date:21/01/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 1. Invitation Paragraph

Your child is being invited to take part in a research project. Please take the time to read this information sheet as it will provide you with the details of our study and hopefully provide you with the information you require to help you decide if you want your child to participate. It is important to say at this point that the decision about whether your child takes part is entirely up to you, and that your child will not be disadvantaged in the future with regard to other studies or at school should you decide you do not want them to participate. Taking part is voluntary and you and your child have the right to withdraw at any time before the data has been analysed if you wish.

## 2. What is the purpose of the study?

We have developed an intervention that aims to change views of aging and physical activity levels in children (aged 7-11 years old) and older adults (aged ≥ 65 years old). Within this study, your child would form a pairing with an older adult that is either a family member, or an older adult that is familiar to you and your child. Using watches that record their activity levels (similar to a fit-bit), linked via the internet to a web-based program on a smart phone, tablet or computer (this will depend on your preference and what you have available for your child to use) they will work together for 4 weeks to complete physical activity tasks/challenges, for example, virtual walking routes. In this study, we would like your child to experience this intervention and provide us with information and feedback on how suitable and useable they found it.

## 3. Why has my child been chosen?

Your child has been chosen to take part as their school has agreed that any child in Years 3, 4, 5 & 6 can be invited to take part in the study.

The participation of your child will also depend on whether you are able to identify an older adult who both you and your child consent to being their partner, and the consent to participate from the older adult.

### 4. What will happen to my child if they take part?

Firstly, you will need to ensure all consent and health screening forms are fully completed and returned to School with your child. They will then be invited to attend a pre-study enrolment session which will last approximately 60 minutes and will be held at Pengelli Primary School where we will familiarise them with the intervention and the technology. They will attend with their partnering older adult, you are also welcome to attend. If you are not able to attend, we will provide your child with login/enrolment details to bring home. They will be provided with an activity monitor watch to wear all day every day including when asleep that links to the app or web page for a 4-week period.

At the end of the study, the watch will be returned, and they will be invited to attend a feedback discussion group that will last approximately 45 minutes with 4 – 6 other children who have also taken part. The group will be held at the end of the school day at Pengelli Primary School and will be audio and video recorded. The full recordings will only be viewed by the lead researcher, and only used to fully write up the discussion and accurately allocate comments to the correct child. If you and your child are willing, sections of the video recording will be kept by the research team for use in future presentations. If you do not wish for this to happen, we will ensure that no images that contain your child are kept. Once this process has been completed the recordings will be erased. During weeks 1-3 of the study the researcher will also briefly meet with your child on a weekly basis to trouble shoot any issues or concerns. The researcher will also be available via telephone or email for you to contact should you have any additional issues or concerns

### 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking to characterise your child's normal daily activities. Children may get a little embarrassed when talking in a group in front of other children. They will be reassured that they do not have to answer any questions that they do not want to. A full explanation of the procedures at all stages will be made.

### 6. What are the possible benefits of taking part?

Your child can benefit from taking part in the study by being more aware of their activity levels and enjoying taking part. They could also gain health benefits. Your child would also be helping us to understand if there is anything, we could do to improve the intervention.

### 7. Completion of a Parental Study Evaluation Questionnaire

In addition to your child's participation in the study we would like to request your additional permission to send you a short questionnaire at the end of the study regarding your views on your child's participation in the study and the level of input required from you to allow your child to interact with the technology.

### 8. Will my child's taking part in the study be kept confidential?

All personal information collected about your child will be kept strictly confidential and stored securely, only members of the research team will have access to it. Any information that is distributed amongst the research team will only be identifiable by number and not

name. Each participant be given a code name will be used during the write up of the focus groups.

**Data Protection and Confidentiality**
Your child's data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about your child will be kept strictly confidential. Your child's data will only be viewed by the researcher/research team.

All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet in a locked office at Swansea University. Consent information will be kept separately from your child's and your responses to minimize risk in the event of a data breach.

Please note that the data we will collect for our study will be made anonymous, at the end of the data collection period, thus it will not be possible to identify and remove your child's data at a later date, should your child decide to withdraw from the study. Therefore, if at the end of participating in this research study you or they decide to have their data withdrawn, please let us know immediately.

Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information.

**Data Protection Privacy Notice**
The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data and can be contacted at the Vice Chancellors Office.

Your child's and your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent for your child to participate in this study by completing the consent form that has been provided to you.

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public interest justification is approved by the College of Engineering Research Ethics Committee, Swansea University.

The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

**How long will your information be held?**
We will hold any personal data and special categories of data for a maximum period of 5 years (following Swansea University requirements) after the awarding of the researcher's degree as required by Research Councils.

**What are your rights?**
You have a right to access your child's and your personal information, to object to the processing of your child's and your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)
Vice-Chancellor's Office
Swansea University
Singleton Park
Swansea
SA2 8PP
Email: dataprotection@swansea.ac.uk

**How to make a complaint**
If you are unhappy with the way in which your child's or your personal data has been processed, you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied, then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,
Wycliffe House,
Water Lane,
Wilmslow,
Cheshire,
SK9 5AF
www.ico.org.uk

## 9. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via any of the details at the top of the form. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

# PARTICIPANT INFORMATION SHEET (NON-PARTICIPATING PARENT)

**(Version 1.1, Date: 22/03/2019)**

**Project Title:** Moving Together: Determining the feasibility, acceptability, and usability of a technology-based physical activity intervention in Older Adults & Children. A Mixed Methods Feasibility Study.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 2) Invitation Paragraph

We would like to invite you to take part in a research study that we are conducting with our colleagues at Swansea University, Cardiff University and Communauté Université Grenoble Alpes. Please take the time to read this information sheet carefully as it will provide you with the details of our study and hopefully all the information you will require to help you decide if you want to participate. It is important to say at this point that the decision to take part is entirely up to you, and that even if you decide to do so, you can withdraw your consent at any point during or after completion of the study, as long as it is before the data has been analyzed, either in person, in writing or by e-mail.

## 2. What is the purpose of the study?

Following on to our recent participant recruitment call to the Moving Together Feasibility Study we would like to explore potential recruitment limitations and barriers, the reasons behind these and potential solutions.

## 3. Why have I been chosen?

You have been chosen as you have indicated that you were able to identify potential participants for the Feasibility Study, but they did not progress on to participate.

## 4. What will happen to me if I take part?

If you wish to take part, please either contact the researcher directly via the details on this information sheet or return the completed consent form to Pengelli Primary School. You will then be contacted by the researcher to organise a mutually convenient time and place to participate. You will be asked to attend a single focus group session that will last approximately 1 hour

The focus group will be audio and video recorded. The full recordings will only be viewed by the lead researcher, and only used to accurately write up the discussion. Once this process has been completed the recording will be erased.

## 5. What are the possible disadvantages of taking part?

You might feel mild discomfort in a discussion with others. However, you can refuse to answer any questions that you do not feel comfortable answering and remove any data

that you do not want to be used.

### 6. What are the possible benefits of taking part?

You can benefit from taking part in the study by potentially becoming aware of different views of aging and the benefits of and physical activity recommendations for both children and older adults. We are also interested in finding out what you feel the benefits of the intervention are and so do not want to suggest what we feel they will be.

### 7. Will my taking part in the study be kept confidential?

Any information you provide will be kept strictly confidential. Participants' names will not be given in any reports of the findings, and personal information will not be linked in any way to your data. Quotations that are used within the write up of the interviews will be kept anonymous by giving each participant a code name.

**Data Protection and Confidentiality**

Your data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly confidential. Your data will only be viewed by the researcher/research team.

All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet in a locked office at Swansea University. Your consent information will be kept separately from your responses to minimize risk in the event of a data breach.

Please note that the data we will collect for our study will be made anonymous, at the end of the data collection period, thus it will not be possible to identify and remove your data at a later date, should you decide to withdraw from the study. Therefore, if at the end of participating in this research study you decide to have your data withdrawn, please let us know immediately. Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information.

**Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent to participate in this study by completing the consent form that has been provided to you.

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public interest justification is approved by the College of Engineering Research Ethics Committee, Swansea University. The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

**How long will your information be held?**
We will hold any personal data and special categories of data for a maximum period of 5 years (following Swansea University requirements) after the awarding of the researcher's degree as required by Research Councils.

**What are your rights?**
You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)
Vice-Chancellor's Office
Swansea University
Singleton Park
Swansea
SA2 8PP
Email: dataprotection@swansea.ac.uk

**How to make a complaint**
If you are unhappy with the way in which your personal data has been processed, you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied, then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -
Information Commissioner's Office,
Wycliffe House,
Water Lane,
Wilmslow,
Cheshire,
SK9 5AF
www.ico.org.uk

## 8. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via post or email. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: A.J.Bloodworth@swansea.ac.uk.

**Appendix I**
Step record charts

Swansea University
Prifysgol Abertawe

# Daily Steps

UNIVERSITÉ Grenoble Alpes

| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|
| **WEEK 1** Write in your number of steps | | | | | | | |
| |  | | | | | | |

Colour the footprints or add a sticker to mark off each time your steps are added to World Walking

| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|
| **WEEK 2** Write in your number of steps | | | | | | | |
| |  | | | | | | |

Colour the footprints or add a sticker to mark off each time your steps are added to World Walking

# Step Log Sheet

| | Daily Goal | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|---|
| Week 1 | | | | | | | | |
| Week 2 | | | | | | | | |
| Week 3 | | | | | | | | |
| Week 4 | | | | | | | | |

| | Week 1 | Week 2 | Week 3 | Week 4 |
|---|---|---|---|---|
| Comments | | | | |

**Appendix J**

Non–participating parents focus group schedule

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

Prior to each focus group, participants will be reminded that whilst the session will be recorded, and the researcher will take notes as needed, the recording will be destroyed following full data analysis They will also be reminded that everything they discuss will remain anonymous and they can contribute when they choose to do so. They will also be reminded that there are no right or wrong answers, that different people might have different views on the intervention, and we are interested in finding out everyone's experience of the intervention. They will then be given an opportunity to ask questions before the focus group begins.

**Introductory Questions**

These questions are intended to put the participants at ease and encourage them to discuss their experiences over the past few weeks whilst completing the study. They will focus on topics such as:

Who they are, and, general information about themselves.

**Main Questions**

1) What are your overall opinions of the study intervention that was proposed?
2) What did you think about your child and an older adult pairing up to work together? Good idea? Bad idea? Why? What did you child think?
3) Were you comfortable approaching the adult(s) about their potential participation? What stopped you asking? Why were you uncomfortable?
4) You all identified that your child in theory had an older adult of the right age who could have participated, why do you think they did not want to?
5) What are your thoughts /beliefs/opinions on older adults being physically active and exercising? Why?
6) Do you know how much exercise your child / older adults should be trying to do? Are you surprised? What do you think about these guidelines?
7) Do you have any thoughts or ideas on what we could do to improve uptake to similar studies or physical activity interventions?

**Summary**

The focus group will be concluded with a reminder that if participants want to withdraw their data from the study, they only need to contact the Researcher without offering a reason.

Participants will be thanked for their time and given the opportunity to ask questions about the study within the group or in private after the group.

**Appendix K**
Parental evaluation questionnaire

## PARENTAL EVALUATION QUESTIONNAIRE

Below is a list of statements relating to the *Moving Together* feasibility study.

Please **tick** the most relevant response for **each statement.**

| | Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| My child found the watch easy to use | | | | | |
| My child needed to be reminded to record their daily steps | | | | | |
| My child enjoyed taking part in the study | | | | | |
| My child enjoyed working with their partnering older adult | | | | | |
| My child had more contact than they normally would with their partnering older adult | | | | | |
| My child enjoyed charting their joint progress on the map | | | | | |
| My child needed my help to chart their progress on the map | | | | | |
| The intervention was suitable for my child | | | | | |
| Taking part encouraged my child to be more active | | | | | |
| My child was more interested in being physically active than they are normally | | | | | |
| I would allow my child to continue to use the watch if it was available to them | | | | | |
| I would allow my child to continue to complete other walks with their partner | | | | | |
| I would consider continuing to use World Walking with my child | | | | | |

**1)** If you needed to help your child with recording their steps or using the map, how much time did you need to spend helping your child:

Per day _____ minutes  Per week _____ minutes

**2)** Did you have any difficulties using the Mi Fit app?

Yes ☐  No ☐

**If Yes, please comment:**

_____
_____
_____
_____

**3)** How often on average did you sync the watch with the app?

Weekly ☐  A few times per week ☐
Daily ☐  A few times a day ☐

I did not sync the watch with the app ☐

**4)** Please provide any additional comments. For example, these could be general comments or related to specific questions, issues or improvements you think could be made. Please also comment on any additional support you needed to provide your child that has not been discussed above.

_____
_____
_____
_____
_____
_____
_____
_____
_____

**5)** Are you:  Male ☐  Female ☐

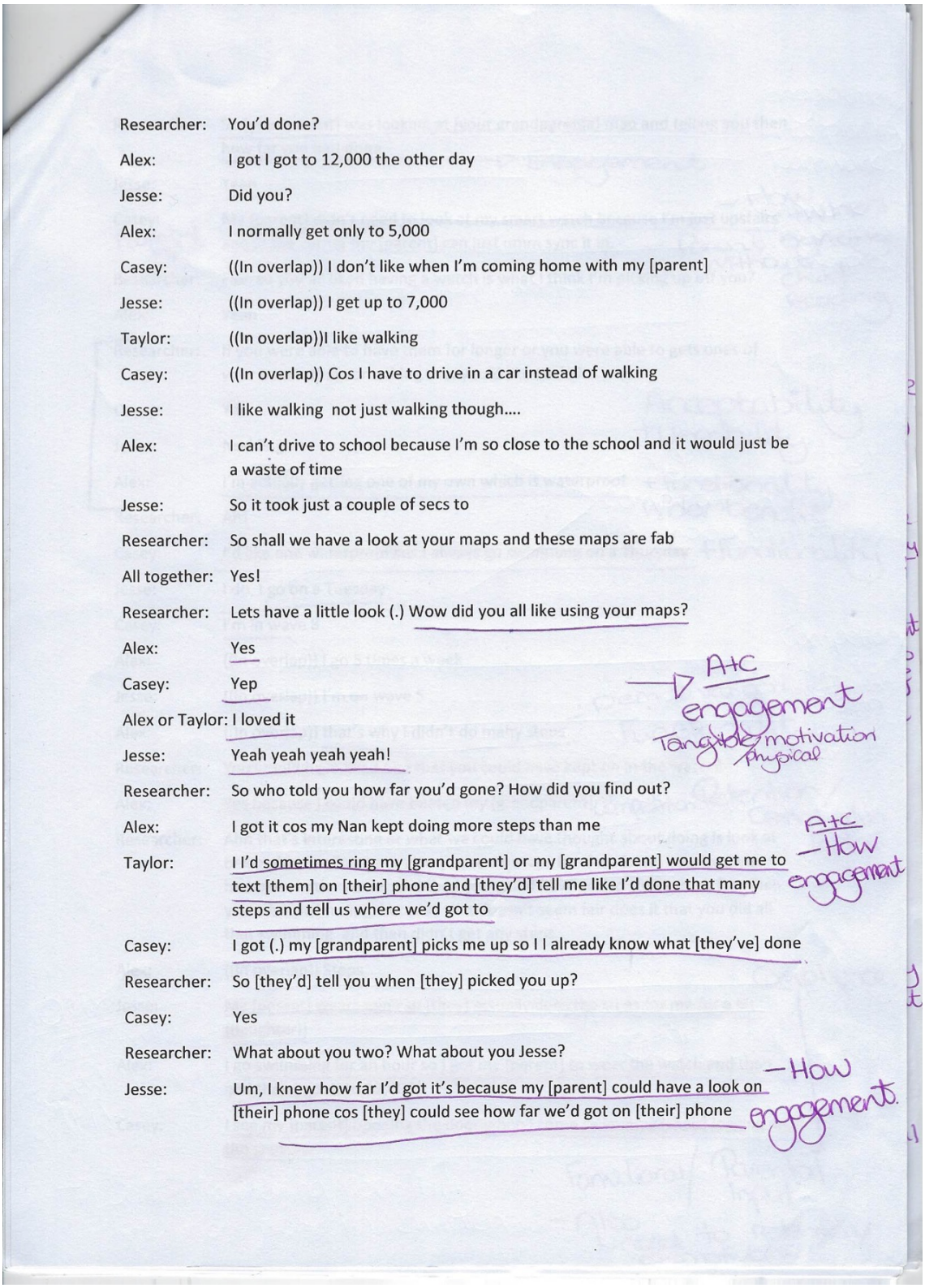
**6)** Relationship to participating child: _____

**7)** Age of participating child: _____ years

**Thankyou for taking the time to complete this questionnaire**

**Appendix L**
Feasibility study coding audit trail

Example of initial manual coding



| | |
|---|---|
| Researcher: | You'd done? |
| Alex: | I got I got to 12,000 the other day |
| Jesse: | Did you? |
| Alex: | I normally get only to 5,000 |
| Casey: | ((In overlap)) I don't like when I'm coming home with my [parent] |
| Jesse: | ((In overlap)) I get up to 7,000 |
| Taylor: | ((In overlap))I like walking |
| Casey: | ((In overlap)) Cos I have to drive in a car instead of walking |
| Jesse: | I like walking not just walking though.... |
| Alex: | I can't drive to school because I'm so close to the school and it would just be a waste of time |
| Jesse: | So it took just a couple of secs to |
| Researcher: | So shall we have a look at your maps and these maps are fab |
| All together: | Yes! |
| Researcher: | Lets have a little look (.) Wow did you all like using your maps? |
| Alex: | Yes |
| Casey: | Yep |
| Alex or Taylor: | I loved it |
| Jesse: | Yeah yeah yeah yeah! |
| Researcher: | So who told you how far you'd gone? How did you find out? |
| Alex: | I got it cos my Nan kept doing more steps than me |
| Taylor: | I I'd sometimes ring my [grandparent] or my [grandparent] would get me to text [them] on [their] phone and [they'd] tell me like I'd done that many steps and tell us where we'd got to |
| Casey: | I got (.) my [grandparent] picks me up so I I already know what [they've] done |
| Researcher: | So [they'd] tell you when [they] picked you up? |
| Casey: | Yes |
| Researcher: | What about you two? What about you Jesse? |
| Jesse: | Um, I knew how far I'd got it's because my [parent] could have a look on [their] phone cos [they] could see how far we'd got on [their] phone |

Researcher: So [your parent] was looking at [your grandparents] map and telling you then how far you had done → Engagement.

Jesse: Yeah

Casey: My [parent] didn't need to look at my smart watch because I'm just upstairs and in the corner my [parent] can just umm sync it in. Parental input — How +When — Parent syncing without child reading

Researcher: Fab, so you all liked having a watch is what I think I'm picking up off you?

Alex: Yeah

Researcher: If you were able to have them for longer or you were able to gets ones of your own is that something that you'd like to do? Acceptability + Useability

Casey: Yes

Jesse: Nodding

Alex: I'm actually getting one of my own which is waterproof + Functionality. Wider benefit

Researcher: Ah!

Casey: I'd like one waterproof cos I always go swimming on a Thursday + Functionality

Jesse: I do, I go on a Tuesday

Casey: I'm in wave 8

Alex: ((In overlap)) I go 5 times a week

Jesse: ((In overlap)) I'm on wave 5

Alex: ((In overlap)) that's why I didn't do many steps — Demotivation. Functionality.

Researcher: You would have liked one that you could have kept on in the water?

Alex: Yes because I could have beated my [grandparent] Competition. Retention/ Demotivation factor.

Researcher: Ahh that's interesting or what we could have thought about doing is look at being able to allocate or give you some steps for if we knew how long you had been in the water, and then you could have added some steps for when you were swimming, because that doesn't seem fair does it that you did all that swimming and then didn't get any steps

Alex: ((In overlap)) Steps

Jesse: My [parent] wears mine so [they] actually does the steps for me for a bit ((laughter)) Compliance.

Alex: I go swimming for an hour so I got my [parent] to wear the watch and then and then I got it to 12,000

Casey: I see my [parent] opening the door when I come swimming [their] jogging on the spot

Familiaral/ Parental input.

— Also linked to retention/ demotivation.

Example of data extraction

| | Code | Data Extract |
|---|---|---|
| **Usability** | Parents wearing watches for children | <u>*Focus group 2 – Children*</u><br>*Jesse (p5):* My [parent] wears mine so [they] actually does the steps for me for a bit ((laughter))<br>*Alex (p8):* I go swimming for an hour, so I got my [parent] to wear the watch and then and then I got it to 12,000<br>*Casey (p7):* I see my [parent] opening the door when I come swimming [their] jogging on the spot |
| **Usability** | Compliance | <u>*Focus group 1 – Older Adults*</u><br>*Viv (p3):* But sometimes [they] went out to [place] and forgot to put [their] watch on<br><br><u>*Focus group 2 – Children*</u><br>*Case (p7)y*: Well I did leave it somewhere, but I tried to get more steps up (.)<br><br>*Jesse (p5):* My [parent] wears mine so [they] actually does the steps for me for a bit ((laughter))<br>*Alex (p8):* I go swimming for an hour so I got my [parent] to wear the watch and then and then I got it to 12,000<br>*Casey (p7):* I see my [parent] opening the door when I come swimming [their] jogging on the spot<br><br>*Casey (p7):* Have you ever left you fit bit somewhere like me<br><br>*Jesse (p5):* That's mine I was trying really hard but I took it off for like 2 hours of the day<br>*Case (p7)y:* I'm still here even though I've left this in the toilet (laughter) and I left it in the (bed) cos it's not waterproof that's why I took it off<br><br><u>*Parental Questionnaires*</u><br>*PQ1 (p12):* Some nights my [child] didn't want to wear the watch to bed or they would take it off without me realising so there were occasions when they spent time not wearing it |
| **Usability** | Technological limitations World Walking | <u>*Focus group 1 – Older Adults*</u><br>*Viv (p3):* .....there was such a long gap between er I was stuck in Portmerion for ever because there was no base at Aberystwyth or anywhere<br><br>*Pat (p2):* I think there was there are some issues with that where it stops at a certain point like a junction on a road and nothing seems to happen until you've done a certain number more steps and then suddenly it jumps forward<br><br>*Viv (p3):* My main gripe was the distance between Portmerion to Fishguard or St David's<br><br>*Viv (p3):* Also, if your taking about thee um actual website there were medals that you were supposed to get (.) none of my medals were given<br>*Francis:* I had a walking the penguin one, march of the penguins or something<br>*Pat (p2):* Did you? I didn't get any either<br>*Viv (p3):* And er on the first day if you remember when we were setting the watches Casey already clocked up the solo walk one and then we got another one of the symbols it clicked in and then after that nothing<br><br>*Viv (p3):* I check it every night and go <u>what</u> I haven't moved I'm still in Portmerion<br><br>*Viv (p3):* Did you ever go on the street view on it as well?<br>*Pat (p2):* By accident<br>*Viv (p3):* If you clicked on street view you were sometimes stuck on a round about<br>*Francis:* or a bend in the road or something |

| | | |
|---|---|---|
| **Usability** | Psychological / motivational limitations from Activity Monitor | <u>*Focus group 1 – Older Adults*</u><br>*Morgan: (p1)* Right right the other thing I found a bit unnerving on a poor day it would say (here) ahead of nine percent of users and I'd think oh god I'm in trouble<br><br>*Francis (p4):* I think Alex was disappointed because [they] do a lot of swimming and obviously it's not waterproof<br><br>*Interviewer:* we could provide a sheet and there are some out there already that give calculations and we could give them some information on for example if you swam for thirty minutes you can allocate yourself 'x' amount of steps or a formula where if you did gymnastics for an hour allocate yourself um a certain number of steps<br>*Morgan (p1):* Yeah<br>*Viv (p3):* [Name] goes swimming as well<br>*Morgan (p1):* That would encourage them then I think they'd be more into it because Jesse often said oh I did this and I did that but I had to take my watch off<br><br><u>*Focus group 2 – Children*</u><br>*Alex (p8):* ((In overlap)) that's why I didn't do many steps<br>Interviewer: You would have liked one that you could have kept on in the water?<br>*Alex (p8):* Yes because I could have beated my [grandparent] |
| **Usability** | Technological limitations Activity Monitor | <u>*Focus group 1 – Older Adults*</u><br>*Francis (p4):* [they] does a lot of swimming so a lot of [theirs] don't count<br><br>*Morgan (p1):* I did what I was finding was well there was one day where it just logged me out completely I don't know and then thankfully you logged me back in but um what I also found was that I'd go to bed at night check how much I'd done but the next morning it was different so what I started to do was I've got a stepper as well there was one day where (.) there we are it was in the second week on the Tuesday in the night (.) before I went to bed right I had done six thousand three hundred and fifty five the next morning I had done fifty-eight..... what I started doing was I'd take a note every night then of what I'd done and then that is the figure I would put on the sheet the next morning not what the watch shows what my phone shows<br><br>*Francis (p4):* I think Alex was disappointed because [they] do a lot of swimming and obviously it's not waterproof<br>*Morgan (p1):* Yes, Jesse found that and [they do] gymnastics as well and of course they can't keep wear them for gymnastics<br><br>*Pat (p2):* It didn't seem to matter what I did it never registered me as doing anything strenuous<br><br>*Morgan (p1):* I think the concept is positive I've had issues with my phone and the watch a little bit<br>*Francis (p4):* I couldn't wear it at night I didn't like it on my wrist at night<br><br><u>*Focus group 2 - Children*</u><br>*Alex (p8):* I'm actually getting one of my own which is waterproof<br>*Interviewer:* Ah<br>*Casey (p7):* I'd like one waterproof cos I always go swimming on a Thursday<br>*Jesse (p5):* I do, I go on a Tuesday<br>*Casey (p7):* I'm in wave 8<br>*Alex (p8):* ((In overlap)) I go 5 times a week<br>*Jesse (p5):* ((In overlap)) I'm on wave 5<br>*Alex (p8):* ((In overlap)) that's why I didn't do many steps<br><br>*Casey (p7):* I'm still here even though I've left this in the toilet (laughter) and I left it in the (bed) cos it's not waterproof that's why I took it off<br><br><u>*Parental Questionnaires*</u><br>*PQ1 (12):* When [they] rode [their] bike, no steps were recorded<br><br>*PQ1 (12):* [They] went swimming twice a week and had to make sure that [they] put the watch back on |

Example of sub-theme refinement process

| Acceptability | Usability | Functionality | Recruitment & Retention | Additional |
|---|---|---|---|---|
| ***Engagement*** | ***Technological Limitations*** | ***Participation Stimuli*** | ***Perceptions*** | |
| Engagement lead to insight into / awareness of activity levels | Technological limitations Activity Monitor | Competition | Perceived time for PA as a potential recruitment limitation | Perceptions of PA & guidelines |
| Engagement did not lead to insight into / awareness of activity levels | Technological limitations World Walking | Collaboration | Perceived ability to use technology | Barriers to physical activity |
| Engagement with the activity monitor – additional features | Parents wearing watches for children | Importance of Individualisation & Goal Achievability | Perceptions of research as a recruitment limitation | Facilitators of physical activity |
| Engagement with the activity monitor – step counts | Compliance | Motivator | Perceived Technophobia | |
| Engagement with app features | ***Psychological Limitations*** | | Perceptions of technology as a potential recruitment limitation | |
| Frequency of engagement with technology | Psychological / motivational limitations from Activity Monitor | ***Outcomes*** | Self-Perceptions of Ageing | |
| Engagement with World Walking / Maps | Psychological / motivational limitations from World Walking | Positive impact on PA levels | Views-on-ageing: older adults are set in their ways | |
| ***Conceptual Limitations*** | ***Operationality*** | Positive experience - Found time for physical activity | *Perception of the intervention concept | |
| Impact of Terminology | Self-Monitoring | **Incorporation into daily routine | ***Mediators*** | |
| Potential novelty factor | Ease of usage - positive | Changes to contact between the dyad | Mediating effect of parents on recruitment + Family dynamics as a recruitment limitation = *Family Dynamics* | |
| ***Positive Experience*** | Ease of usage - negative | | (Lack of) Interest in physical activity | |
| Wider Benefit | Need for Parental Involvement | | Information overload | |
| Positive engagement / experience with technology | How information was transferred between the dyad | | Reason for Participation | |
| Participation provided an overall positive experience | | | (Lack of) Access to technology | |
| Potential for longer term participation | | | (Lack of) Interest in technology | |
| | | | ***Facilitators*** | |
| *Perception of the intervention concept | | | Recruitment via children | |
| **Incorporation into daily routine | | | Use of incentives in increase recruitment | |
| | | | Opinions on alternative partnership options | |
| | | | Generativity | |

| Acceptability | Usability | Functionality | Recruitment & Retention | Additional |
|---|---|---|---|---|
| ***Engagement*** | ***Technological Limitations*** | ***Participation Stimuli*** | ***Perceptions*** | |
| Engagement lead to insight into / awareness of activity levels | Technological limitations World Walking | ***Motivator*** | Perceived time for PA as a potential recruitment limitation | Perceptions of PA & guidelines |
| Engagement did not lead to insight into / awareness of activity levels | ***Technological limitations Activity Monitor*** | ***Individualisation & Goal Achievability*** | *Perception of the intervention concept | Barriers to physical activity |
| Engagement with World Walking / Maps | Parents wearing watches for children | Importance of Goal Achievability | Perceptions of research as a recruitment limitation | Facilitators of physical activity |
| Frequency of engagement with technology | Compliance | Importance of Individualisation & Goal Achievability | Perceptions of technology as a potential recruitment limitation | |
| ***Engagement with the activity monitor & app*** | ***Psychological Limitations*** | ***Competition v's Collaboration*** | ***Age Stereotypes*** | |
| Engagement with the activity monitor – additional features | Psychological / motivational limitations from Activity Monitor | Competition | Perceived ability to use technology | |
| Engagement with the activity monitor – step counts | Psychological / motivational limitations from World Walking | Collaboration | Perceived Technophobia | |
| Engagement with app features | ***Operationality*** | ***Generated Outcomes*** | Self-Perceptions of Ageing | |
| | Self-Monitoring | Positive impact on PA levels | Views-on-ageing: Older adults are set in their ways | |
| ***Conceptual Limitations*** | Ease of usage - positive | Positive experience - Found time for physical activity | ***Mediators*** | |
| Impact of Terminology | Ease of usage - negative | **Incorporation into daily routine | ***Information overload*** | |
| Potential novelty factor | Need for Parental Involvement | Changes to contact between the dyad | ***Participatory Reasons*** | |
| | How information was transferred between the dyad | | Generativity | (Lack of) Access to technology? **should be removed only one vague reference to this** |
| ***Positive Experience*** | Frequency of engagement with technology | | To be more active | |
| Wider Benefit | | | ***Family Dynamics*** | |
| Positive engagement / experience with technology | | | Mediating effect of parents on recruitment | |
| Participation provided an overall enjoyable experience | | | Family dynamics as a recruitment limitation | |
| Potential for longer term participation | | | ***Level of interest*** | |
| | | | Level of interest in physical activity | |
| *Perception of the intervention concept | | | Level of interest in technology | |
| **Incorporation into daily routine | | | ***Facilitators*** | |
| | | | Recruitment via children | |
| | | | Use of incentives | |
| | | | Potential alternative partnership options | |

Final coding by theme, sub-theme, and codes

| Framework Theme | Theme | Sub Theme | Code |
|---|---|---|---|
| Acceptability | Engagement | Insight | Engagement led to insight into / awareness of activity levels |
| | | | Engagement did not lead to insight into / awareness of activity levels |
| | | Engagement with technology | Engagement with the activity monitor – additional features |
| | | | Engagement with the activity monitor – step counts |
| | | | Engagement with app features |
| | | | Engagement with World Walking / Maps |
| | | | Frequency of engagement with technology |
| Acceptability | Positive Experience | | Wider Benefit |
| | | | Participation provided an overall enjoyable experience |
| | | | Positive engagement / experience with technology |
| | | | Potential for longer term engagement |
| Usability | Limitations | Technological limitations | Technological limitations World Walking |
| | | | Compliance |
| | | | Parents wearing watches for children |
| | | | Technological limitations from the activity monitor |
| | | Psychological / Motivational limitations | Psychological / motivational limitations from Activity Monitor |
| | | | Psychological / motivational limitations from World Walking |
| Usability | Operationality | Ease of Usage | Ease of usage - negative |
| | | | Ease of usage - positive |
| | | | How information was transferred between the dyad |
| | | | Need for Parental Involvement |
| | | | Self-Monitoring |

| Framework Theme | Theme | Sub Theme | Code |
|---|---|---|---|
| **Functionality** | **Participant Stimuli** | Motivator | Motivator |
| | | Individualisation | Importance of Individualisation |
| | | | Importance of Goal Achievability |
| | | Competition versus Collaboration | Competition |
| | | | Collaboration |
| **Functionality** | **Generated Outcomes** | | Positive experience - Found time for physical activity |
| | | | Changes to contact between the dyad |
| | | | Positive impact on PA levels |
| | | | Incorporation into daily routine |
| **Recruitment & Retention** | **Facilitators** | | Recruitment via children |
| | | | Use of incentives |
| | | | Potential alternative partnership options |
| **Recruitment & Retention** | **Perceptions** | Perceptions of Ageing | Perceived ability to use technology |
| | | | Perceived Technophobia |
| | | | Self-Perceptions of Ageing |
| | | | Views-on-ageing: Older adults are set in their ways |
| | | | Perceptions of research as a recruitment limitation |
| | | | Perceived time for PA as a potential recruitment limitation |
| | | | Perceptions of technology as a potential recruitment limitation |
| | | | Perception of the intervention concept |
| **Recruitment & Retention** | **Mediators** | Family Dynamics | Family dynamics as a recruitment limitation |
| | | | Mediating effect of parents on recruitment |
| | | Reasons for Participation | Reason for participation – To be more active |
| | | | Reason for participation - Generativity |
| | | Level of Interest | Level of Interest in physical activity |
| | | | Level of interest in technology |
| | | Information overload | Information overload |
| | | Conceptual Limitations | Impact of Terminology |
| | | | Potential novelty factor |

**Appendix M**

Activity minute to step conversion chart

# Convert your Activity Minutes into Steps

- If you have had to take your watch off during any activities, you can use this chart to give yourself some steps for these activities and add them to your daily total.
- You need to multiply the number of minutes you did the activity by the number in the chart that is next to the activity you did.
- For example: If you participate in Leisurely Swimming for 30 minutes that would equal 133 x 30 = 3990 steps

| Physical Activity | Number Multiplied by Minutes Spent |
|---|---|
| Aerobics (Low Impact) | 146 |
| Aerobics (Moderate/High Impact) | 217 |
| Badminton (Recreational) | 99 |
| Badminton (Competitive) | 141 |
| Basketball (Recreational) | 171 |
| Basketball (Competitive) | 250 |
| Cycling (Leisurely, 10-11.9 mph) | 170 |
| Cycling (Moderate, 12-13.9 mph) | 228 |
| Cycling (Vigorous, 14-15.9 mph) | 294 |
| Bowling | 87 |
| Canoeing | 177 |
| Circuit Training | 242 |
| Dance (Slow) | 87 |
| Dance (Fast) | 154 |
| Football (Casual) | 207 |
| Football (Competitive) | 293 |
| Gymnastics | 160 |
| Hockey | 243 |
| Horseback Riding (Trotting) | 102 |
| Ice Skate (Leisurely) | 90 |
| Jogging | 209 |
| Kayaking | 296 |
| Kickboxing/Karate/Judo | 270 |

| Physical Activity | Number Multiplied by Minutes Spent |
|---|---|
| Pilates | 113 |
| Roller Skate | 214 |
| Roller Blade | 316 |
| Rowing (Leisurely) | 93 |
| Rowing (Moderate/Heavy) | 217 |
| Rugby (Flag/Touch) | 275 |
| Rugby (Competitive) | 309 |
| Skateboard | 172 |
| Skipping (Slow) | 242 |
| Skipping (Moderate) | 278 |
| Swimming (Treading Water) | 90 |
| Swimming (Leisurely) | 133 |
| Swimming (Moderate) | 174 |
| Swimming (Vigorous) | 222 |
| Tae Kwon Do | 290 |
| Tai Chi | 8 |
| Tennis (Doubles) | 160 |
| Tennis (Singles) | 338 |
| Trampoline | 106 |
| Water Aerobics | 123 |
| Yoga (Moderate) | 86 |
| Yoga (Vigorous) | 160 |
| Zumba | 152 |

(Please note conversions are estimates)

Adapted from: https://earlham.edu/media/3049229/activityconversionchart.pdf

**Appendix N**

Pilot study consent and assent forms

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARTICIPANT CONSENT FORM (OLDER ADULT)

**(Version 1.2, Date: 07/07/2019)**

**Project Title:**

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

**Please initial box**

9) I confirm that I have read and understood the information sheet dated 07/07/2019 (version number 1.2) for the above study and have had the opportunity to ask questions. ☐

10) I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

11) I understand that sections of any of data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to these records. ☐

12) I understand that data I provide may be used in reports and academic publications in anonymous fashion. ☐

13) I have no known cardiovascular (e.g., heart), metabolic (e.g., diabetes or pre-diabetes) or renal (e.g., kidney) disease. ☐

14) As far as I am aware I have not experienced any signs or symptoms of cardiovascular (e.g., heart), metabolic (e.g., diabetes or pre-diabetes) or renal (e.g., kidney) disease. ☐

15) I agree to take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARTICIPANT ASSENT FORM (CHILD)

**(Version 1.2, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

Please initial box

7. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions. ☐

8. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without my medical care or legal rights being affected. ☐

9. I understand that sections of any of the data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to these records. ☐

10. I think I am fit and well enough to take part in the above study. ☐

11. I agree to take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARENTAL CONSENT FORM

**(Version 1.2, Date: 07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson

Contact emails: [redacted] and [redacted]

Please initial box

9. I confirm that I have read and understood the information sheet dated 07/07/2019 (version number 1.2) for the above study and have had the opportunity to ask questions ☐

10. I understand that my child's participation is voluntary and that they are free to withdraw at any time, without giving any reason, without their medical care or legal rights being affected. ☐

11. I understand that sections of any of the data obtained may be looked at by responsible individuals from the Swansea University or from regulatory authorities where it is relevant to my child taking part in the research. I give permission for these individuals to have access to these records. ☐

12. I confirm that to the best of my knowledge my child does not have any medical reasons why they should not participate in the study. ☐

13. I confirm that I consent to my child: _____ (please enter name of child) participating with _____ (please enter name of Older Adult) and that I, not Swansea University take responsibility for having an oversight of any interactions between the named participants that may occur. ☐

14. I agree that my child may take part in the above study. ☐

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Name of Participant | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

**Appendix O**

Pilot study participant information sheets

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

## PARTICIPANT INFORMATION SHEET (OLDER ADULT DYAD)

**(Version 1.1, Date: 05/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]
Contact emails: [redacted] and [redacted]

### 3) Invitation Paragraph

We would like to invite you to take part in a research study that we are conducting with our colleagues at Swansea University, Cardiff University and Communauté Université Grenoble Alpes. Please take the time to read this information sheet carefully as it will provide you with the details of our study and hopefully all the information you will require to help you decide if you want to participate. It is important to say at this point that the decision to take part is entirely up to you, and that even if you decide to do so, you can withdraw your consent at any point during or after completion of the study, as long as it is before the data has been analyzed, either in person, in writing or by e-mail.

### 2. What is the purpose of the study?

Keeping active is good for health and well-being. The purpose of this study is to see if children (aged 7-11 years old) and adults (aged ≥ 60 years old) working together towards joint physical activity goals has an effect on their views on ageing, physical activity levels and general well-being. You will be required to form a partnership with a child that is either a family member, or a child that is familiar to you and has requested to be paired with you. Using watches that show you your daily steps taken (similar to a fit-bit), linked to a web-based program on a device of your choice that you already have available (smart phone, tablet,) you will work together for 12 weeks to complete virtual walking routes around cities of the world.

### 3. Why have I been chosen?

You have been chosen as you are aged ≥ 60 years old and either a family member or are well-known to a child at (Insert Location) and have been identified as a suitable potential partner by the child and their parent/guardian.

### 4. What will happen to me if I take part?

- You will need to return your completed Consent Form and Health Screening Form either via your co-participating child to their (Location) or directly to the researcher.
- The researcher will contact you to, if necessary, discuss the study further, any health conditions and to arrange a time for enrolment with your partnering child.
- You will be supplied with a watch that records your daily step count to wear all day every day for 12 weeks. You will add your step data and that of your partnering child to the program to complete your chosen walk routes.
- In addition to the activity watches we will also ask you to wear an additional physical activity monitor all day every day for 7 days at three separate times and to complete 2 questionnaires.
- The researcher will need to meet with you 6 times over the 12 weeks (see table on next page) at a location the most convenient for you this could potentially be at (insert name) school, at your home or at the School of Sport, Swansea University. Some of the meetings will be very brief and are just to allow the research to supply and then collect the monitor.
- All meetings will be done on an individual basis, apart from Week 1, where we will arrange to jointly meet with you, your partnering child and their parent/guardian.

### 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking for you to work within the limits of your current health status and ability. You may feel some slight discomfort if increase your physical activity levels. Any concerns regarding this or any health conditions that feel may influence your participation can be discussed with the researcher either at enrolment or by contacting Rachel Knight by email at [redacted] or telephone [redacted]

| Meeting Number | Tasks to be completed | Average time |
|---|---|---|
| Week 0 | Completion of questionnaires<br>Supply activity monitor<br>Start set up of World Walking and step counter watch | 45 mins |
| Week 1<br>(Start of study) | *Joint meeting with partnering child and their parent / guardian*<br>Return Activity monitor<br>Complete Set up and familiarisation with World Walking and step counter watch | 45 mins |
| Week 6 | Supply of Activity Monitor and repeat questionnaires | 10 mins |
| Week 7 | Return Activity Monitor | 5 mins |
| Week 11 | Supply of Activity Monitor | 5 mins |
| Week 12 | Repeat questionnaires<br>Return all watches | 20 mins |

## 6. What are the possible benefits of taking part?

You can benefit from taking part in the study by potentially being more aware of your activity levels and enjoying taking part. You could also gain health benefits.

## 7. Will my taking part in the study be kept confidential?

Any information you provide will be kept strictly confidential. Participants' names will not be given in any reports of the findings, and personal information will not be linked in any way to your data. Quotations that are used within the write up of the discussion groups will be kept anonymous by giving each participant a code name.

## 8. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via telephone, post or email. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

# PARTICIPANT INFORMATION SHEET (CHILD DYAD)

**(Version 1.1, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight ([redacted] Tel: [redacted]

## 1. Invitation Paragraph

*You are being invited to take part in a research study. It is up to you if you want to take part and the information below will help you decide.*

*You can change your mind and stop taking part at any time if you wish, you will still be able to take part in future studies, even if you decide you do not want to take part in this one. Taking part will not change how you are treated at school.*

## 2. What is the purpose of the study?

*To look at if working together with an older adult who you know very well (maybe a grandparent) can make you and your partner move more which is good for your health and how you feel.*

## 3. Why have I been chosen?

*Your school has agreed that all children aged 7,8,9,10 or 11 can be asked to take part.*

## 4. What will happen to me if I take part?

- *You will meet with a researcher who will tell you more about the study and answer any questions.*
- *For 12 weeks you will work with your partner to complete around the world walking challenges. You will wear a watch all day every day, even when you're sleeping that counts how many steps you take (picture 1), you will write down these steps and use them with your partners steps to complete the walks.*
- *Three times during the study we will ask you to wear an extra special monitor either on your wrist or your waist all day every day for 1 week that tells us how active you have been (Picture 2) and answer a questionnaire.*

*Picture 1*


*Picture 2*


## 5. What are the possible disadvantages of taking part?

- *You may be more aware of being more active and working a little bit harder*

## 6. What are the possible benefits of taking part?

- *Being more active, a little bit healthier and enjoying taking part.*
- *Helping your partner to be a little bit more active which could be good for their health.*

## 7. Will my taking part in the study be kept a secret?

*All information collected about you will be kept secret, only members of the research team will be able to see it. You will be given a special number that will be used instead of your name so that no one knows who your results belong to.*

## 8. What if I have any questions?

*If you have questions about the study, either now or in the future, you can get an adult to ask us touch with us by using the contact details at the start of this form or ask us when we meet with you.*

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARENTAL INFORMATION SHEET (DYAD)

**(Version 1.1, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 1. Invitation Paragraph

Your child is being invited to take part in a research project. Please take the time to read this information sheet as it will provide you with the details of our study and hopefully provide you with the information you require to help you decide if you want your child to participate. It is important to say at this point that the decision about whether your child takes part is entirely up to you, and that your child will not be disadvantaged in the future with regard to other studies or at school should you decide you do not want them to participate. Taking part is voluntary and you and your child have the right to withdraw at any time before the data has been analysed if you wish.

## 2. What is the purpose of the study?

Keeping active is good for health and well-being. The purpose of this study is to see if children (aged 7-11 years old) and adults (aged ≥ 60 years old) working together towards joint physical activity goals has an effect on their views on ageing, physical activity levels and general well-being. Within this study your child will be required to form a partnership with an older adult that is either a family member, or an older adult that is familiar to you and your child. has requested to be paired with you. Using watches that record their daily steps taken (similar to a fit-bit), linked to an app on a device of your choice that you already have available (smart phone or tablet) they will work together for 12 weeks to complete virtual walking routes around cities of the world.

## 3. Why has my child been chosen?

Your child has been chosen to take part as their school has agreed that any child in Years 3, 4, 5 & 6 / aged 7 – 11 years old can be invited to take part in the study. The participation of your child will also depend on whether you are able to identify an older adult who both you and your child consent to being their partner, and the consent to participate from the older adult.

## 4. What will happen to my child if they take part?

- You will need to ensure all completed Consent and Health Screening Forms are returned either via your child to their (Location) or directly to the researcher. The researcher will then contact you to discuss the study further, any identified health conditions and to arrange a time for enrolment.
- The researcher will need to meet with your child 6 times over the 12 weeks (please see table below) at a location the most convenient for you and your child, this could potentially be at (insert location of school or troop), at your home or at the School of Sport, Swansea University. Some of the meetings will be very brief and are just to allow the researcher to supply and then collect the monitor.
- All meetings will be done on an individual basis, apart from Week 1, where we will arrange to jointly meet with you, your child and their co-partnering older adult. If you are not able to attend, we can either provide you with the set-up instructions for the watch electronically or provide copies that can be brought home with your child.
- Your child will be provided with a watch to wear all day every day, even when sleeping that counts how many steps they have taken. They will then write down these steps and use them with their partners steps to complete the walks.
- We will also ask your child to wear an additional physical activity monitor for 7 days at three separate times and to complete 3 questionnaires.

| Meeting Number | Tasks to be completed | Average time |
|---|---|---|
| Week 0 | Completion of questionnaire<br>Supply activity monitor<br>Start set up of World Walking and step counter watch | 45 mins |
| Week 1<br>(Start of study) | *Joint meeting with partnering child and their parent / guardian*<br>Return Activity monitor<br>Complete Set up and familiarisation with World Walking and step counter watch | 45 mins |
| Week 6 | Supply of Activity Monitor and repeat questionnaire | 10 mins |
| Week 7 | Return Activity Monitor | 5 mins |
| Week 11 | Supply of Activity Monitor | 5 mins |
| Week 12 | Repeat questionnaire<br>Return all watches | 20 mins |

The researcher will be available via telephone or email for you to contact should you have any additional issues or concerns throughout the study.

## 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking for your child to be active within the limits of their current health status and ability. They may feel some slight discomfort if they increase their physical activity levels. Any concerns regarding this or any health conditions that feel may influence their participation can be discussed with the researcher either at enrolment or by contacting Rachel Knight by email at [redacted] or telephone [redacted]

## 6. What are the possible benefits of taking part?

Your child can benefit from taking part in the study by being more aware of their activity levels and enjoying taking part. They could also gain health benefits.

## 8. Will my child's taking part in the study be kept confidential?

All personal information collected about your child will be kept strictly confidential and stored securely, only members of the research team will have access to it. Any information that is distributed amongst the research team will only be identifiable by number and not name. Each participant be given a code name will be used during the write up of the focus groups.

## 9. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via any of the details at the top of the form. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

# PARTICIPANT INFORMATION SHEET (OLDER ADULT CONTROL)

**(Version 1.1, Date: 05/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]
Contact emails: [redacted] and [redacted]

## 4) Invitation Paragraph

We would like to invite you to take part in a research study that we are conducting with our colleagues at Swansea University, Cardiff University and Communauté Université Grenoble Alpes. Please take the time to read this information sheet carefully as it will provide you with the details of our study and hopefully all the information you will require to help you decide if you want to participate. It is important to say at this point that the decision to take part is entirely up to you, and that even if you decide to do so, you can withdraw your consent at any point during or after completion of the study, as long as it is before the data has been analyzed, either in person, in writing or by e-mail.

## 2. What is the purpose of the study?

Keeping active is good for health and well-being. The purpose of this study is to explore the effects of a technology-driven intervention on views on ageing and physical activity. Using watches that show you your daily steps taken (similar to a fit-bit), linked to a web-based program on a device of your choice that you already have available (smart phone, tablet) you will spend 12 weeks completing virtual walking routes around cities of the world.

## 3. Why have I been chosen?

You have been chosen as you are aged ≥ 60 years old.

## 4. What will happen to me if I take part?

- You will need to return your completed Consent Form and Health Screening Form to the researcher. The researcher will contact you to if necessary, discuss the study further, any health conditions and to arrange a time for enrolment.
- You will be supplied with a watch that records your daily step count to wear all day every day for 12 weeks. You will add your step data to the program to complete your chosen walk routes.
- In addition to the activity watches we will also ask you to wear an additional physical activity monitor all day every day for 7 days at three separate times and to complete a few questionnaires.
- The researcher will need to meet with you 6 times over the 12 weeks (see table on next page) at a location the most convenient for you this could potentially be at (insert organisation name), at your home or at the School of Sport, Swansea University. Some of the meetings will be very brief and are just to allow the research to supply and then collect the monitor.

| Meeting Number | Tasks to be completed | Average time |
|---|---|---|
| Week 0 | Completion of questionnaires<br>Supply activity monitor<br>Start set up of World Walking and step counter watch | 45 mins |
| Week 1<br>(Start of study) | Return Activity monitor<br>Complete Set up and familiarisation with World Walking and step counter watch | 45 mins |
| Week 6 | Supply of Activity Monitor and repeat questionnaires | 10 mins |
| Week 7 | Return Activity Monitor | 5 mins |
| Week 11 | Supply of Activity Monitor | 5 mins |
| Week 12 | Repeat questionnaires<br>Return all watches | 20 mins |

## 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking for you to work within the limits of your current health status and ability. You may feel some slight discomfort if increase your physical activity levels. Any concerns regarding this or any health conditions that feel may influence your participation can be discussed with the researcher either at enrolment or by contacting Rachel Knight by email at [redacted] or telephone [redacted]

## 6. What are the possible benefits of taking part?

You can benefit from taking part in the study by potentially being more aware of your activity levels and enjoying taking part. You could also gain health benefits.

## 7. Will my taking part in the study be kept confidential?

Any information you provide will be kept strictly confidential. Participants' names will not be given in any reports of the findings, and personal information will not be linked in any way to your data. Quotations that are used within the write up of the discussion groups will be kept anonymous by giving each participant a code name.

## 8. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via telephone, post, or email. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

# PARTICIPANT INFORMATION SHEET (CHILD CONTROL)

**(Version 1.1, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 1. Invitation Paragraph

*You are being invited to take part in a research study. It is up to you if you want to take part and the information below will help you decide.*

*You can change your mind and stop taking part at any time if you wish, you will still be able to take part in future studies, even if you decide you do not want to take part in this one. Taking part will not change how you are treated at school.*

## 2. What is the purpose of the study?

*Moving around and being active is good for your health. We want to know a bit more about how much you move about and what you think about getting older.*

## 3. Why have I been chosen?

*Your school has agreed that all children aged 7,8,9,10 or 11 can be asked to take part.*

## 4. What will happen to me if I take part?

- *You will meet with a researcher who will tell you more about the study and answer any questions.*
- *Three times during the study we will ask you to wear a special monitor either on your wrist or your waist all day everyday even when your asleep for 1 week that tells us how active you have been (Picture 1) and answer a questionnaire.*

*Picture 1*


## 5. What are the possible disadvantages of taking part?

- *You may be more aware of being more active and working a little bit harder*

## 6. What are the possible benefits of taking part?

- *Finding out if you are being active enough, what you should be aiming to try and do and how you could do it.*

## 7. Will my taking part in the study be kept a secret?

*All information collected about you will be kept secret, only members of the research team will be able to see it. You will be given a special number that will be used instead of your name so that no one knows who your results belong to.*

## 8. What if I have any questions?

*If you have questions about the study, either now or in the future, you can get an adult to ask us touch with us by using the contact details at the start of this form or ask us when we meet with you.*

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARENTAL INFORMATION SHEET (CONTROL)

**(Version 1.1, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]

Contact emails: [redacted] and [redacted]

## 1. Invitation Paragraph

Your child is being invited to take part in a research project. Please take the time to read this information sheet as it will provide you with the details of our study and hopefully provide you with the information you require to help you decide if you want your child to participate. It is important to say at this point that the decision about whether your child takes part is entirely up to you, and that your child will not be disadvantaged in the future with regard to other studies or at school should you decide you do not want them to participate. Taking part is voluntary and you and your child have the right to withdraw at any time before the data has been analysed if you wish.

## 2. What is the purpose of the study?

Keeping active is good for health and well-being. The purpose of this study is to see how much children are being physically active and what they think about getting older.

## 3. Why has my child been chosen?

Your child has been chosen to take part as their school has agreed that any child in Years 3, 4, 5 & 6 / aged 7 – 11 years old can be invited to take part in the study.

## 4. What will happen to my child if they take part?

- You will need to ensure all completed Consent and Health Screening Forms are returned either via your child to their (Location) or directly to the researcher.
- The researcher will need to meet with your child 6 times over the 12 weeks (please see table below). This will occur during school hours / troop sessions at (insert location of school or troop). Some of the meetings will be very brief and are just to allow the researcher to supply and then collect the monitor.
- Three times during the study we will ask your child to wear a special activity monitor either on their wrist or their waist all day everyday even when they are asleep for 7 days that tells us how active they have been and answer a questionnaire.

| Meeting Number | Tasks to be completed | Average time |
|---|---|---|
| Week 0 | Completion of questionnaire<br>Supply activity monitor | 20 mins |
| Week 1<br>(Start of study) | Return Activity monitor | 5 mins |
| Week 6 | Supply of Activity Monitor and repeat questionnaire | 10 mins |
| Week 7 | Return Activity Monitor | 5 mins |
| Week 11 | Supply of Activity Monitor | 5 mins |
| Week 12 | Repeat questionnaire<br>Return all watches | 20 mins |

The researcher will be available via telephone or email for you to contact should you have any additional issues or concerns throughout the study.

## 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking for your child to be active within the limits of their current health status and ability. They may feel some slight discomfort if they increase their physical activity levels. Any concerns regarding this or any health conditions that feel may influence their participation can be discussed with the researcher either at enrolment or by contacting

Rachel Knight by email at [redacted] or telephone [redacted]

## 6. What are the possible benefits of taking part?

Your child can benefit from taking part in the study by being more aware of their activity levels and enjoying taking part. They could also learn more why it is important to be active.

## 8. Will my child's taking part in the study be kept confidential?

All personal information collected about your child will be kept strictly confidential and stored securely, only members of the research team will have access to it. Any information that is distributed amongst the research team will only be identifiable by number and not name. Each participant be given a code name will be used during the write up of the focus groups.

## 9. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via any of the details at the top of the form. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

**Appendix P**

Pilot study example gate keeper communication

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

Dear [XXXXX]

1st September 2019

We are researchers from Swansea, Grenoble, and Cardiff Universities, with expertise in Physical Activity & Health. On behalf of our research team, I am contacting you to see if you would be willing for us to approach pupils (aged 7 – 11 years old) within your School to take part in a study designed to explore the effect of a technology-driven intergenerational intervention aimed at improving age stereotypes and physical activity participation in children and older adults. The school would be recruited to one of two study arms.

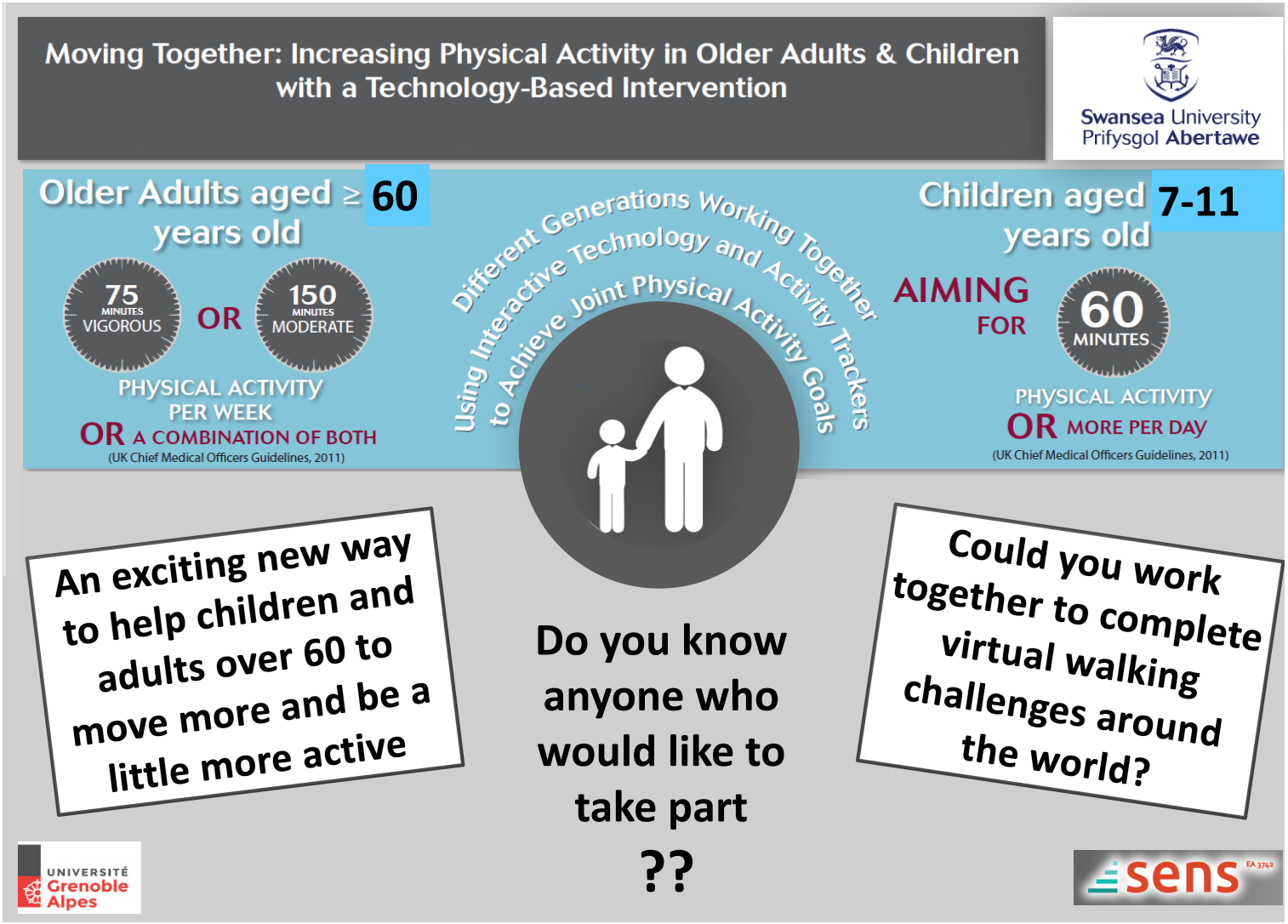
*Intervention Arm*: Each child would form a dyadic pairing with an older adult (aged ≥60 years old), either a family member or an older adult familiar to the child, to work collaboratively towards physical activity goals. The study would involve the dyads wearing activity monitors and using a supporting technology platform for a 12-week period. Participants will also be asked to complete a pre-study baseline measurements session, mid study and post-study evaluation, which will include the wearing of an additional monitor for 7 days during each of the three data collection periods.
*Control Arm*: Each child will be asked to complete a pre-study baseline measurements session, mid study and post-study evaluation which will include the wearing of an additional monitor for 7 days during each of the three data collection periods. In between data collection points participants will just continue with their normal daily activities.

If you are willing to allow us to approach your pupils to take part, we would ideally like to either present a short video or pitch to children, followed by sending home a recruitment information leaflet to all eligible pupils via the School system (please see attached). If possible, with a message to parents or copy of the parent information sheet additionally being sent out via the school's electronic communication method of choice informing them about the study. Interested participants would either return their expression of interest / consent forms to the school or contact the researcher directly. Contact would then be made accordingly to arrange enrolment and commencement of the study.

Participants are free to withdraw from the study at any time and their data and responses will be confidential to the research team and anonymously reported in any publications or presentations. The study has received ethical approval from the College Research Ethics Committee. If you would like to discuss this process or raise any ethical concerns about the study, please contact Dr Andrew Bloodworth, Chair of the College Research Ethics Committee, on [redacted] or [redacted]

Thank you for taking the time to consider this request. If you would be happy for the school and the pupils to take part in the study, please could you confirm via any of the contact details provided below. Please do not hesitate to contact me if you would like to discuss any element of the study further. Yours faithfully

**Appendix Q –** Dyad recruitment pack



## FREQUENTLY ASKED QUESTIONS

**What is an activity tracker?**

In this study it is just a watch that counts how many steps you have done each day.

**Will it tell you where I am and what I'm doing?**

At no point during the study will we know where you are or what anyone taking part in the is doing. Only participants themselves or in the case of the child, their parent / guardian will have access to the App that links to the watch.

**How often will it need to be worn?**

All day every day for 12 weeks even when you're sleeping.

**I'm worried I do not have the skills to use the technology**

Please don't worry! It is all very easy to use; we will set everything up, explain it all to you, provide additional instruction sheets and can be contacted at any point if you get stuck.

**Do I need to have access to anything specific to take part?**

You do need to have access to a device that can download an app (i.e. a smart phone or tablet) and access to the internet. Children do not need to have their own device; the app can go onto a device of the parents / guardian's choice.

**Will I have to do a certain type of activity?**

No, the benefit of this study design is that you can do whatever you want or are able to do, although the watch is not waterproof, so it does have to be taken off to go swimming.

**Can parents take part as well?**

Unfortunately, no. We are only looking for pairs made up of 1 child aged 7 – 11 years old and one adult aged ≥ 60 years old. The participants do not have to be related but they do need to know each other, and a parent / guardian of the child will have to provide written consent.

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# DYAD RECRUITMENT LETTER

**(Version 1.1, Date:07/07/2019)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

## Contact Details:

Rachel Knight
Email: [redacted]
Telephone Contact: [redacted]

Associate Professor Joanne Hudson
Email: [redacted]
Telephone Contact: [redacted]

1st September 2019

We would like your help with a research study. We are a group or researchers from Swansea, Grenoble, and Cardiff Universities, with expertise in Physical Activity & Health. We are doing a research study looking at the effects on physical activity and views on ageing of a technology-based intervention that gets children aged 7–11 years old and adults aged ≥ 60 years old to work together.

Your child has been chosen to take part as their school has agreed that any child in Years 3, 4, 5 & 6 / aged 7 – 11 years old can be invited to take part in the study.

Each child needs to form a pairing with an older adult, either a family member or an older adult familiar to the child. The study will involve the pairs wearing activity monitors and using World Walking an online virtual walk route platform for 12 weeks. We are doing this research because being physically active is good for everyone's health and well-being. The enclosed leaflet tells you a bit more about the study.

Please look over the enclosed information carefully. If you think you are able to identify a pair of participants who would like to take part and / or would like to receive more information, please either contact the researcher directly via the details above or complete the expression of interest form and return it to your child's school.

Thank you for your help

Yours sincerely

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Please complete as appropriate**

We would like to further information on the study to be sent home ☐

Name of Child: _____

Class: _____

We would like a member of the research team to contact us ☐

Contact Details

| | |
|---|---|
| Name: | |
| Relationship to child | |
| Preferred Contact Method: | Address:<br><br>Telephone:<br><br>Email: |

Contact Details

| | |
|---|---|
| Name: | |
| Relationship to child | |
| Preferred Contact Method: | Address:<br><br>Telephone:<br><br>Email: |

**Appendix R**

Pilot study data protection information


**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# DATA PROTECTION AND CONFIDENTIALITY

**(Version 1.1, Date: 05/07/2019)**

## Data Protection and Confidentiality

Your data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly confidential. Your data will only be viewed by the researcher/research team.

All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet in a locked office at Swansea University. Your consent information will be kept separately from your responses to minimize risk in the event of a data breach.

Please note that the data we will collect for our study will be made anonymous, at the end of the data collection period, thus it will not be possible to identify and remove your data at a later date, should you decide to withdraw from the study. Therefore, if at the end of participating in this research study you decide to have your data withdrawn, please let us know immediately.

Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information.

## Data Protection Privacy Notice

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet.
Standard ethical procedures will involve you providing your consent to participate in this study by completing the consent form that has been provided to you.

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public

interest justification is approved by the College of Engineering Research Ethics Committee, Swansea University.

The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

## How long will your information be held?

We will hold any personal data and special categories of data for a maximum period of 5 years (following Swansea University requirements) after the awarding of the researcher's degree as required by Research Councils.

## What are your rights?

You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)
Vice-Chancellor's Office
Swansea University
Singleton Park
Swansea
SA2 8PP
Email: dataprotection@swansea.ac.uk

## How to make a complaint

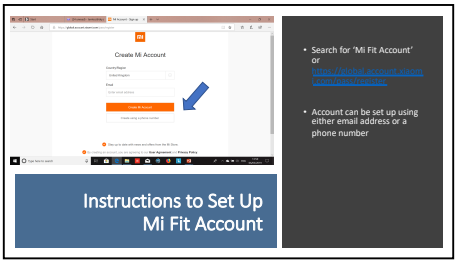
If you are unhappy with the way in which your personal data has been processed, you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied, then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,
Wycliffe House,
Water Lane,
Wilmslow,
Cheshire,
SK9 5AF
www.ico.org.uk

## Appendix S

Mi Fit App instructions

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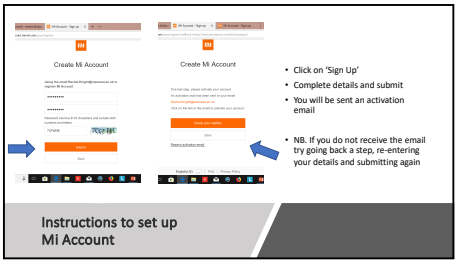


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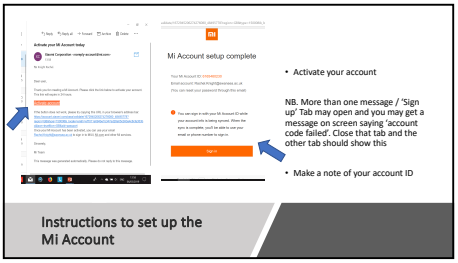


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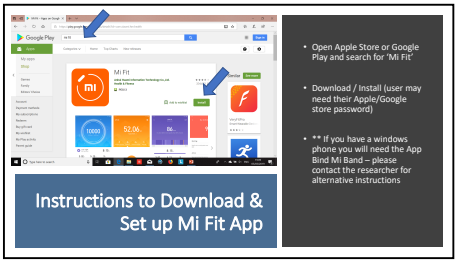


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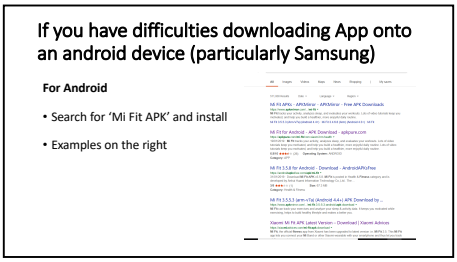


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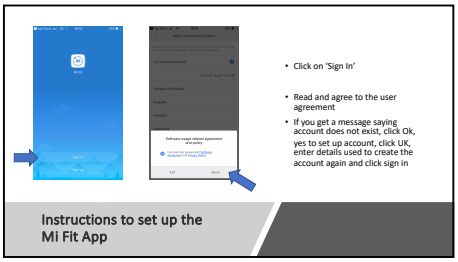


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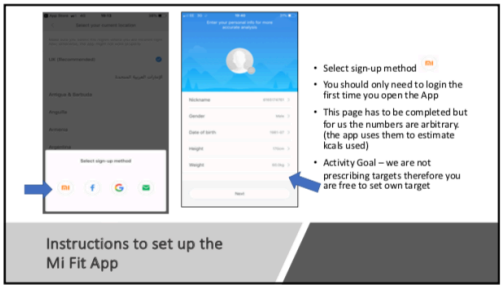
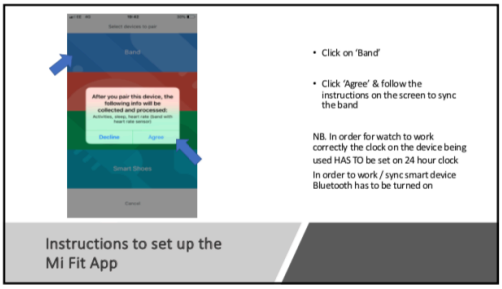
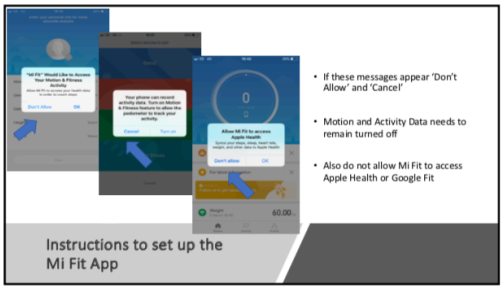

Select sign-up method
Nickname
Gender
Date of birth
Height
Weight
Next
• Select sign-up method
• You should only need to login the first time you open the App
• This page has to be completed but for us the numbers are arbitrary. (the app uses them to estimate kcals used)
• Activity Goal – we are not prescribing targets therefore you are free to set own target
Instructions to set up the Mi Fit App

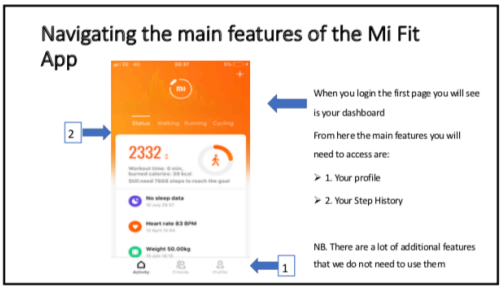
7


Band
After you pair this device, the following info will be collected and processed:
Decline
Agree
Smart Shoes
Cancel
• Click on 'Band'
• Click 'Agree' & follow the instructions on the screen to sync the band
NB. In order for watch to work correctly the clock on the device being used HAS TO be set on 24 hour clock
In order to work / sync smart device Bluetooth has to be turned on
Instructions to set up the Mi Fit App

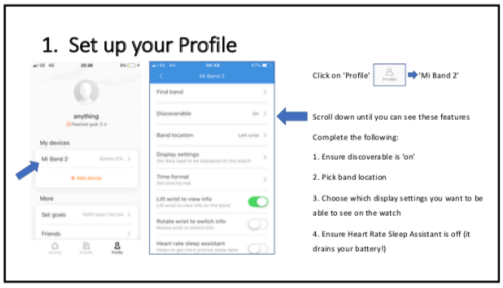
8


"Mi Fit" Would Like to Access Your Motion & Fitness Activity
Don't Allow
OK
Your phone can record activity data. Turn on Motion & Fitness feature to allow this application to track your activity.
Cancel
Turn on
Allow Mi Fit to access Apple Health
Don't allow
OK
60.00
• If these messages appear 'Don't Allow' and 'Cancel'
• Motion and Activity Data needs to remain turned off
• Also do not allow Mi Fit to access Apple Health or Google Fit
Instructions to set up the Mi Fit App

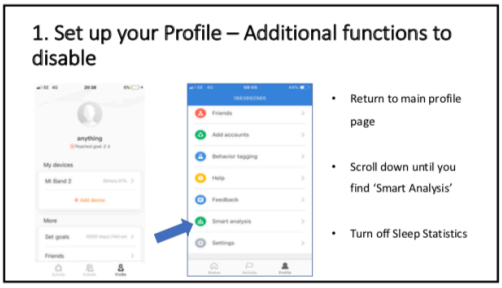
9


Navigating the main features of the Mi Fit App
2
1
2332
No sleep data
Heart rate 83 BPM
Weight 50.00kg
When you login the first page you will see is your dashboard
From here the main features you will need to access are:
➢ 1. Your profile
➢ 2. Your Step History
NB. There are a lot of additional features that we do not need to use them

10

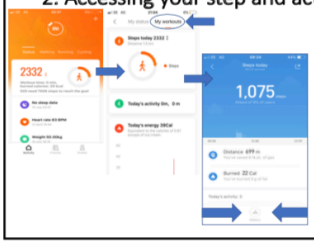

1. Set up your Profile
anything
My devices
Mi Band 2
+ Add device
More
Set goals
Friends
Mi Band 2
Find band
Discoverable
Band location
Display settings
Time format
Lift wrist to view info
Rotate wrist to switch info
Heart rate sleep assistant
Click on 'Profile' 'Mi Band 2'
Scroll down until you can see these features
Complete the following:
1. Ensure discoverable is 'on'
2. Pick band location
3. Choose which display settings you want to be able to see on the watch
4. Ensure Heart Rate Sleep Assistant is off (it drains your battery!)

11


1. Set up your Profile – Additional functions to disable
anything
My devices
Mi Band 2
+ Add device
More
Set goals
Friends
Friends
Add accounts
Behavior tagging
Help
Feedback
Smart analysis
Settings
• Return to main profile page
• Scroll down until you find 'Smart Analysis'
• Turn off Sleep Statistics

12

## 2. Accessing your step and activity data



- The page shows the step and goal data for the current day
- Clicking on the reveals more detailed daily stats
- Click on again and you can then access an important feature on this page **History**

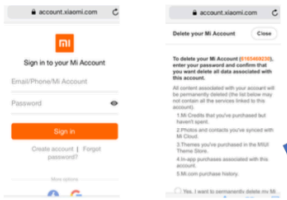
13

## 2. Accessing your step and activity data

- Clicking History allows you to scroll back over at least the last month and check you daily step totals.
- This is particularly useful if you have forgotten to make a note of or transfer your steps

14

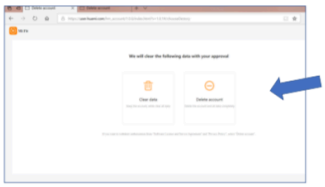
## 3. Deleting Account at the end of the study



- PLEASE UNPAIR THE WATCH FROM YOUR PHONE AND /OR TABLET FIRST
- https://account.xiaomi.com/pass/del
- Login with account details
- A delete account POP UP will come up
- Follow the instructions

15

## 3. Deleting Account at the end of the study

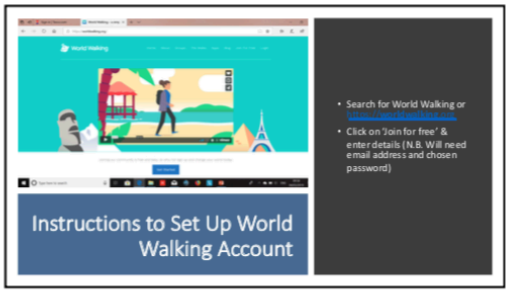


- Follow the instructions to delete your account

16

**Appendix T**

World Walking instructions

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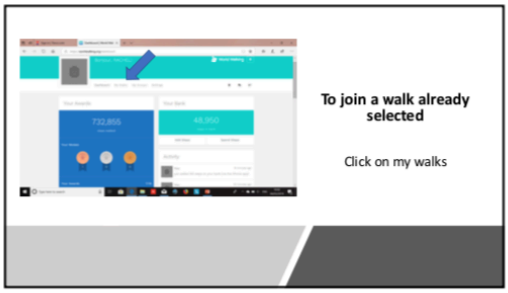


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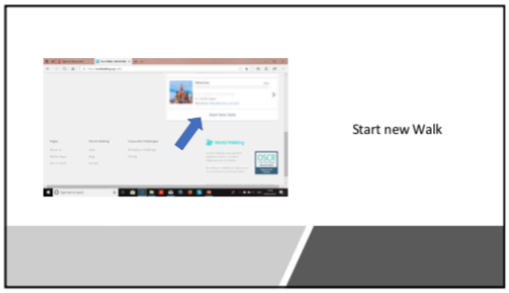


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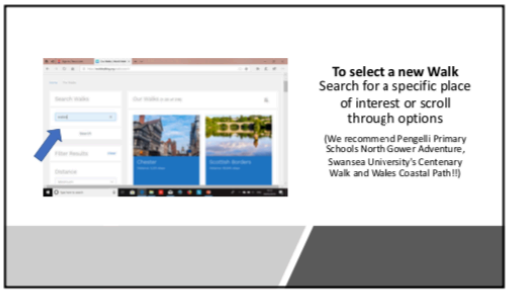


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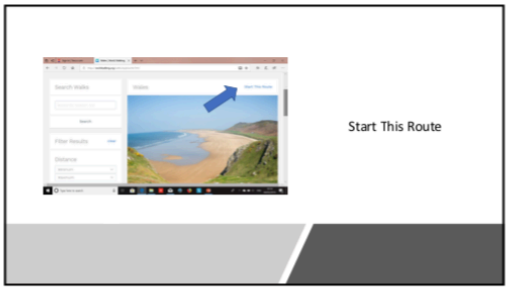


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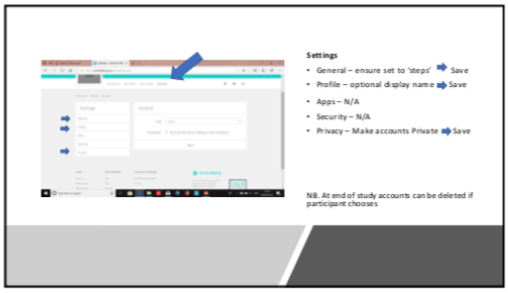
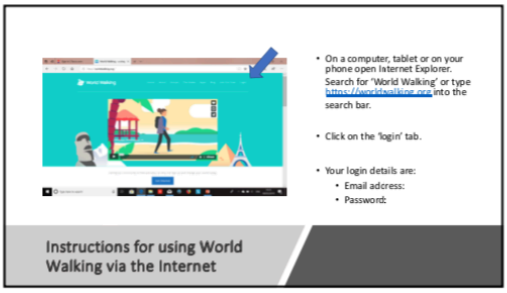

Settings
• General – ensure set to 'steps' ➡ Save
• Profile – optional display name ➡ Save
• Apps – N/A
• Security – N/A
• Privacy – Make accounts Private ➡ Save
NB. At end of study accounts can be deleted if participant chooses

7


• On a computer, tablet or on your phone open Internet Explorer. Search for 'World Walking' or type https://worldwalking.org into the search bar.
• Click on the 'login' tab.
• Your login details are:
• Email adcress:
• Password:
Instructions for using World Walking via the Internet

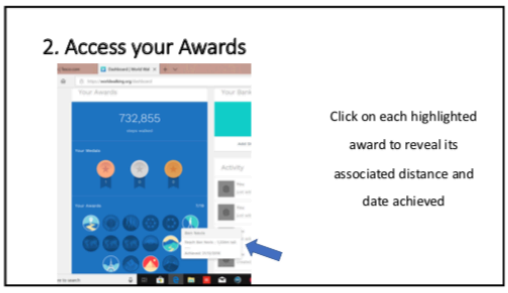
8


Navigating World Walking via the Internet
When you login the first page you will see is your dashboard
From here you can access:
➢ 1. Your Walks
➢ 2. Click on Your Awards – as you achieve certain distances these will become highlighted
➢ 3. Add & Spend steps towards completing your Wales walk

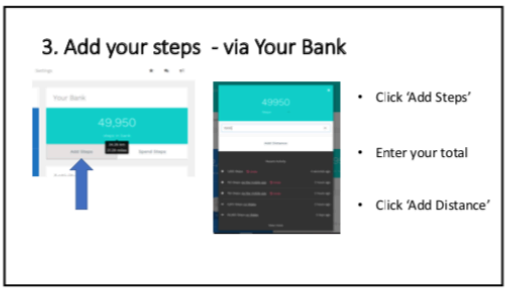
9


1. Accessing your walk
Under 'Your Walks' ➡ Click on 'Wales'
From here you can:
1. See your overall progress
2. See you progress on the route map and access street view
3. Access information about the milestones you have passed

10

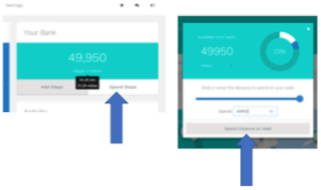

2. Access your Awards
Click on each highlighted award to reveal its associated distance and date achieved

11


3. Add your steps - via Your Bank
• Click 'Add Steps'
• Enter your total
• Click 'Add Distance'

12

## 3. Spend your steps - via Your Bank



- To allocate your steps to your walk you need to 'Spend your Steps'
- Click 'Spend Steps'
- Choose Wales Walk
- Slide or enter the distance / steps you want to add
- Click 'Spend Distance on Walk'

13

- Open Apple Store or Google Play and search for "World Walking"
- Download / Install (user may need their Apple/Google store password)

Instructions to download World Walking App

14

- Login using the same details as the World Walking website

Email:

Password:

- You should only need to login the first time you open the App
- Click on settings wheel ➡ Apps Ensure that Health Kit is disabled

Instructions to download World Walking App

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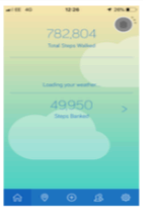
## If you have difficulties downloading App onto an iPad

**For iOS (iPad)**

- Open App Store
- Click on filters
- Select Supports ➡ iPhone Only
- Search for 'World Walking' and install
- OR try searching for 'World Walking' for Apple via the internet

16



- When you open the app you will see this home screen
- You can return to this screen by clicking on:
- The 2 other symbols you will need to access are:

and

Instructions for using World Walking via the App

17

## 1. Accessing your walk

Click and then on 'Wales'

From here you can:

- See your overall progress
- See your progress on the route map
- Access street view
- Access information about the milestones you have passed

18

## 2a. Add your steps


- Click on
- Enter Steps
- On an iPad/iPhone - Re-Click on to close the key pad
  On any other tablet – Click 'done'
- Click 'Add' to complete the process

19

## 2b. Spend your steps on your walk


To allocate your steps to your walk you need to 'Spend your Steps'

- Click on
- Make sure the walk is set to Wales
- Slide the circle to enter the distance / steps you want to add
- Click 'Add' to complete the process

20


If you are having any issues or have any queries you can:

**Either**
Contact the research team

**Or**
Scroll to the bottom of the Web Page and access the HELP section

**Troubleshooting and Frequently Asked Questions**

21


This section contains various articles that answer the most commonly asked queries

i.e. Virtual Walking

22

**Appendix U**
Instructions on how to use the accelerometers and removal record sheet

Swansea University
Prifysgol Abertawe

Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)
College of Engineering

# Instructions on How to Use the Monitors (Parental/Guardian)

**Version 1.1 Date: 10/07/2019**

This is a Physical Activity Tracker, also known as an accelerometer. It works by reading and recording the acceleration and rotational forces when you move. We will use this equipment to tell exactly how active your child really is.

## Key Points:

- **(Unlike the Mi Band,) All monitors are fully waterproof and can be worn at all times, including when sleeping, showering and doing water-based activities.**
- **Your child does not need to change anything about their week; we just want to know their usual activity level.**
- **The screen doesn't display anything but that doesn't mean that it's not working.**
- **It will not need to be charged.**

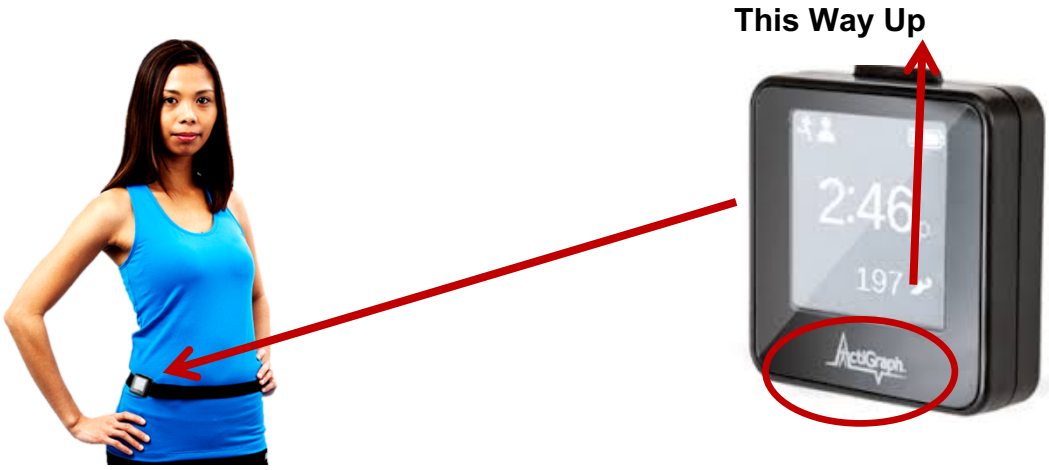
## Option 1. Wrist Monitor

Your child can wear the monitor on their wrist just like a watch. The most important thing is to make sure that it's tight enough that it doesn't move around on their wrist, but not too tight that it's uncomfortable.

**Option 2. Hip Monitor**

Your child should wear the monitor attached to the belt around their waist, just above their **right** hipbone. They can wear it either underneath or on top of their clothing. At first the belt may feel slightly awkward, but after a few hours they will probably get used to it and forget about it. Your child should wear the monitor so that the writing is facing the right way up (see picture below). The monitor should be snug against their body. If they need to adjust it, they can tighten it by pulling the end of the strap, or, to loosen it, push the strap more through the loop. **Please check that the belt is tight enough that the monitor does not move when they are being active**.

The monitor is fully waterproof, but they may still want to remove it if they are going swimming of showering/bathing so that the belt doesn't get wet. Please make sure that they put it straight on as soon as they can and record when they took it off on the log sheet provided.



**Please remind your child to wear the monitor every day (including on the weekend and when sleeping) for the next week. If they do take them off for any reason, please remind them to put them back on as soon as possible.**

**Don't forget it's important to keep a track of why they have taken them off and for how long on the log sheet provided.**

**Do NOT let anyone else wear their monitors.**

We kindly ask that your child takes care of the monitors. Each one broken or damaged cost us the equivalent of a new iPad to replace.

If you have any questions or if something happens to your monitor, please contact:

Rachel Knight
[redacted]

Alternatively, you can contact
[redacted]

# Accelerometer Removal Record Sheet

Version 1.1 Date: 10/07/2019

| | Day / Date | Time taken off | Time put back on | Reason taken off |
|---|---|---|---|---|
| Day 1 | | | | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

## Appendix V

Outcome measure questionnaires

### The Godin Leisure Time Exercise Questionnaire

INSTRUCTIONS
In this excerpt from the Godin Leisure-Time Exercise Questionnaire, the individual is asked to complete a self-explanatory, brief four-item query of usual leisure-time exercise habits.

CALCULATIONS
For the first question, weekly frequencies of strenuous, moderate, and light activities are multiplied by nine, five, and three, respectively. Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components, as shown in the following formula:

Weekly leisure activity score = (9 × Strenuous) + (5 × Moderate) + (3 × Light)

The second question is used to calculate the frequency of weekly leisure-time activities pursued "long enough to work up a sweat" (see questionnaire).

EXAMPLE: Strenuous = 3 times/wk + Moderate = 6 times/wk + Light = 14 times/wk

Total leisure activity score = (9 × 3) + (5 × 6) + (3 × 14) = 27 + 30 + 42 = 99

1. During a typical **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

Times Per Week

a) **STRENUOUS EXERCISE**
**(HEART BEATS RAPIDLY)** _____
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

b) **MODERATE EXERCISE**
**(NOT EXHAUSTING)** _____
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

c) **MILD EXERCISE**
**(MINIMAL EFFORT** _____
(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-moiling, easy walking)

2. During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

| OFTEN | SOMETIMES | NEVER/RARELY |
|---|---|---|
| 1. ☐ | 2. ☐ | 3. ☐ |

# Modified Stigma Consciousness Questionnaire

**INSTRUCTIONS**: Please indicate the extent to which you agree or disagree with the following statements using the scale below.

| | **Strongly Disagree** | | | **Neither Agree nor Disagree** | | | **Strongly Agree** |
|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| Stereotypes about older adults have not affected me personally. (R) | | | | | | | |
| I never worry that my behaviours will be viewed as stereotypical of an older adult. (R) | | | | | | | |
| When interacting with young people I feel like they interpret all of my behaviours in terms of the fact that I am an older adult. | | | | | | | |
| Most young people do not judge adult older adults on the basis of their age. (R) | | | | | | | |
| My being an older adult does not influence how young people act with me. (R) | | | | | | | |
| I almost never think about the fact that I am an older adult when I interact with young people. (R) | | | | | | | |
| My being an older adult does not influence how people act with me. (R) | | | | | | | |
| Most young people have a lot more ageist thoughts than they actually express. | | | | | | | |
| I think young people are unfairly accused of being ageist. (R) | | | | | | | |
| Most young people have a problem with viewing older adults as equals. | | | | | | | |

(R) = reversed score

# Attitudes to Ageing Questionnaire

(Laidlaw et al., 2007)

**INSTRUCTIONS:** Please indicate the extent to which you agree or disagree with the following statements using the scale below.

| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Old age is a time of loneliness | | | | | |
| Old age is a depressing time of life | | | | | |
| I find it more difficult to talk about my feelings as I get older | | | | | |
| I see old age mainly as a time of loss | | | | | |
| I am losing my physical independence as I get older | | | | | |
| As I get older, I find it more difficult to make new friends | | | | | |
| I don't feel involved in society now that I am older | | | | | |
| I feel excluded from things because of my age | | | | | |
| | | | | | |
| It is important to exercise at any age | | | | | |
| Growing older has been easier than I thought | | | | | |
| I don't feel old | | | | | |
| My identity is not defined by my age | | | | | |
| I have more energy now than I expected for my age | | | | | |
| Problems with my physical health do not hold me back from doing what I want | | | | | |
| My health is better than I expected for my age | | | | | |
| I keep as fit and active as possible by exercising | | | | | |
| | | | | | |
| As people get older they are more able to cope with life | | | | | |
| It is a privilege to grow old | | | | | |
| Wisdom comes with age | | | | | |
| There are many pleasant things about growing older | | | | | |
| I am more accepting of myself as I have grown older | | | | | |
| It is very important to pass on the benefits of my experiences to younger people | | | | | |
| I believe my life has made a difference | | | | | |
| I want to give a good example to younger people | | | | | |

# Attitudes Toward Own Ageing Questionnaire

(Lawton, 1975; Liang & Bollen, 1983)

**INSTRUCTIONS:** Please mark one answer for each question

**1.** Things keep getting worse as I get older.

Yes _____ No _____ (R)

**2.** I have as much pep as I had last year.

Yes _____ No _____

**3.** As you get older you are less useful.

Yes _____ No _____ (R)

**4.** As I get older, things are (better/worse/the same) as I thought they would be?

Better _____ Worse_____ Same_____

**5.** I am as happy now as I was when I was younger.

Yes _____ No _____

(R) = reversed score

Child-Age Implicit Association Test

(Babcock et al., 2016)

## Instruction

In this task, you will decide which group different pictures belong to. In the first part, you will decide which pictures show insects and which show flowers.
Here you can see which pictures belong to the insect group and which belong to the flower group.

**Insects**

**Flowers**

At first you will notice that there is one group on each side. For every picture that shows an insect (bugs, wasp, mosquito, or roach) you will put a check in the left circle. For every picture that shows a flower (daffodil, daisy, tulip, or violet) you will put a check in the right circle.

| Insects | | Flowers |
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As you can see here, wasp goes in the insects' group, which is on the left side, and violet goes in the flowers group, which is on the right side.

Do you have any questions?

So when I say GO classify the pictures as fast as you can. Try not to make mistakes. But, if you do make a mistake, don't stop to correct it, just keep going. It is important not to skip any pictures - you have to go in order, and just make a quick check through the circle (don't waste time carefully filling it in).

You have 20 seconds to complete as many pictures as you can and I'll let you know when to start and stop.

Begin at the top of the list and work your way down; if you finish the first column begin the second column. Very few people complete the first column. So please don't feel frustrated, if you cannot finish!

GUIDELINES

- Go fast
- Try not to make mistakes
- Don't correct mistakes
- Don't skip any picture
- Quick check through the circle

Do you have any questions?
Please turn the page now and look carefully at the pictures and the groups they belong to.

**Insects**

**Flowers**

*OK, please turn the page now and GO!*

**STOP – DO NOT TURN THE PAGE**

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| Insects | | Flowers |
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*Stop! (after 20 seconds)  Turn the page!*

Now the instructions are the same except that there are two new groups.

For every picture that shows something bad (wolf, witch, skull, or injury) you will put a check in the left circle.
For every picture that shows something good (butterfly, heart, ice cream, or present) you will put a check in the right circle.

| Bad | | Good |
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Do you have any questions?

Please turn the page now and look carefully at the pictures and the groups they belong to.

**Bad**

**Good**

*OK, please turn the page now and GO!*

**STOP – DO NOT TURN THE PAGE**

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*Stop! (after 20 seconds)  Turn the page!*

Now you will notice that there are 2 groups on each side. For every picture that shows an insect or that shows something bad you will put a check in the left circle.

For every picture that shows a flower or that shows something good you will put a check in the right circle.

Remember that there are 4 groups so you are not deciding if you think insects and flowers are good or bad, you are just putting insects into the insects group, flowers into the flowers group, pictures that show something good in the good group and pictures that show something bad in the bad group.

| **Insects Bad** | | **Flowers Good** |
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As you can see here, witch goes in the bad group and roach goes in the insects group, which are both on the left side. Daffodil goes in the flowers group, and heart goes in the good group, which are both on the right side.

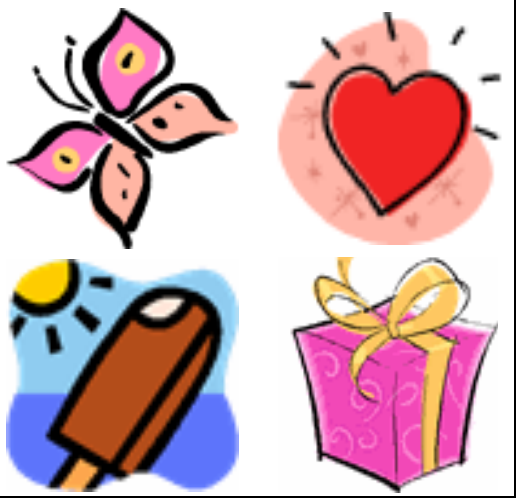
Do you have any questions?
Please turn the page now and look carefully at the pictures and the columns they belong to.

**Insects**

**Flowers**

**Bad**

**Good**



*OK, please turn the page now and GO!*

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| Insects Bad | | Flowers Good |
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*Stop! (after 20 seconds)  Turn the page!*

OK, now the instructions are still the same except that there is only one group on each side again, but they have switched sides.

Notice that now flowers are on the left side and insects are on the right side.

| Flowers | | Insects |
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Remember - go as fast as you can and make as few mistakes as possible.

Please turn the page now and look carefully at the pictures and the groups they belong to and remember that the groups have switched sides.

**Flowers**

**Insects**

*OK, please turn the page now and GO!*

**STOP – DO NOT TURN THE PAGE**

| Flowers | | Insects |
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*Stop! (after 20 seconds)  Turn the page!*

Now we have 2 groups on each side again.

Notice that now flowers and bad things are on the left side and insects and good things are on the right side.

| Flowers Bad | | Insects Good |
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So here, heart goes in the good column on the right and skull goes in the bad column on the left. Daisy goes in the flower's column on the left and roach goes in the insect's column on the right.

Do you have any questions?

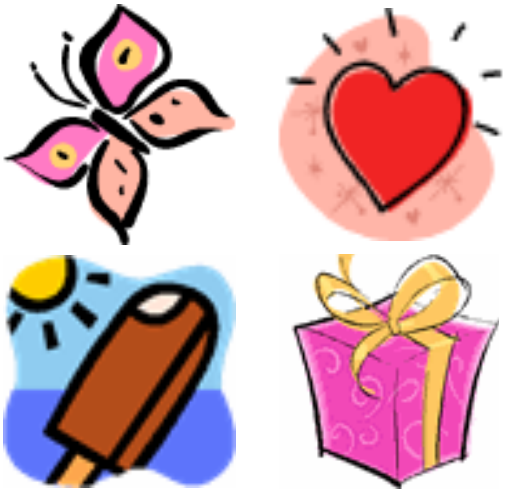
Please turn the page now and look carefully at the pictures and the groups they belong to.

## Flowers

## Insects

## Bad

## Good



*OK, please turn the page now and GO!*

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| Flowers Bad | | Insects Good |
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*Stop! (after 20 seconds)  Turn the page!*

Ok, now we will start with the second part.

The instructions are still the same except that there are two new groups.

Now you will decide which pictures show old people and which show young people.

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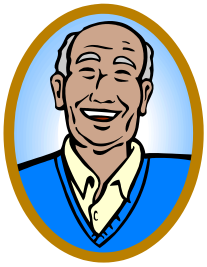
As you can see here, the old woman goes in the old group, which is on the left side, and the young girl goes in the young group, which is on the right side.

Please turn the page now and look carefully at the pictures and the columns they belong to.

## Old



## Young



*OK, please turn the page now and GO!*

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*Stop! (after 20 seconds)  Turn the page!*

Now there are the good and bad groups again, which you already know.

Please turn the page now and look carefully at the pictures and the columns they belong to.

For every picture that shows something bad (wolf, witch, skull, or injury) you will put a check in the left circle.
For every picture that shows something good (butterfly, heart, ice cream, or present) you will put a check in the right circle.

**Bad**

**Good**

*OK, please turn the page now and GO!*

**STOP – DO NOT TURN THE PAGE**

*Stop! (after 20 seconds)  Turn the page!*

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Now you will notice that there are 2 groups on each side again.

For every picture that shows and old person or that shows something bad you will put a check in the left circle.
For every picture that shows a young person or that shows something good you will put a check in the right circle.

Remember that there are 4 groups so you are not deciding if you think old and young people are good or bad, you are just putting old people into the old group, young people into the young group, pictures that show something good in the good group and pictures that show something bad in the bad group.

| Old<br>Bad | | Young<br>Good |
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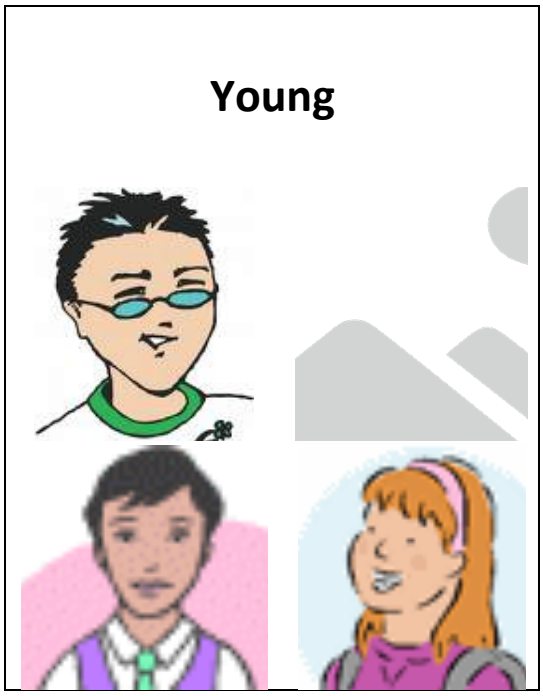
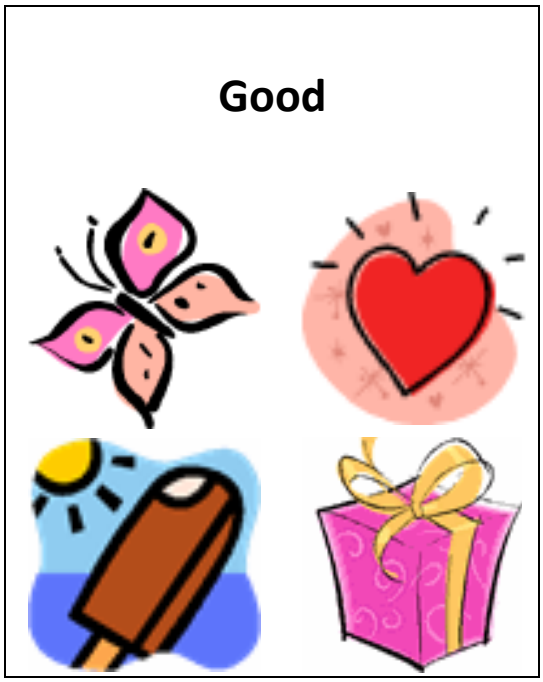
As you can see here, the old man goes in the old group, and the injury goes in the bad group, which are both on the left side. The young girl goes in the young group, and the heart goes in the good group, which are both on the right side.

Please turn the page now and look carefully at the pictures and the groups they belong to.






*OK, please turn the page now and GO!*

**STOP – DO NOT TURN THE PAGE**

*Stop! (after 20 seconds)  Turn the page!*

| Old Bad | | Young Good |
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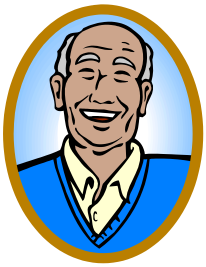
OK, now the instructions are still the same except that there is only one group on each side again, but they have switched sides.

Please turn the page now and look carefully at the pictures and the columns they belong to.

Notice that now young people are on the left side and old people are on the right.

**Young**

**Old**



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Now we have 2 groups on each side again.

Notice that now young people and bad pictures are on the left side and old people and good pictures are on the right side.

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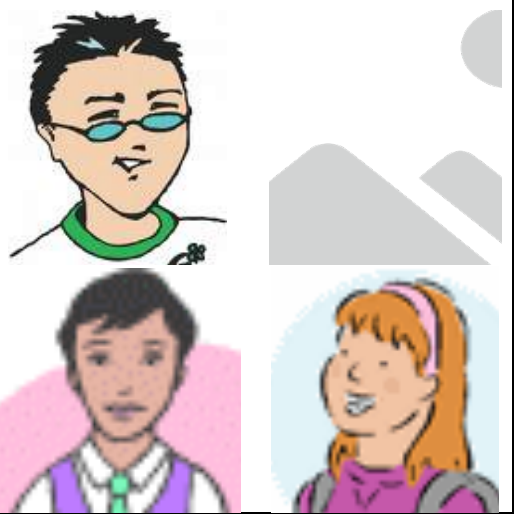
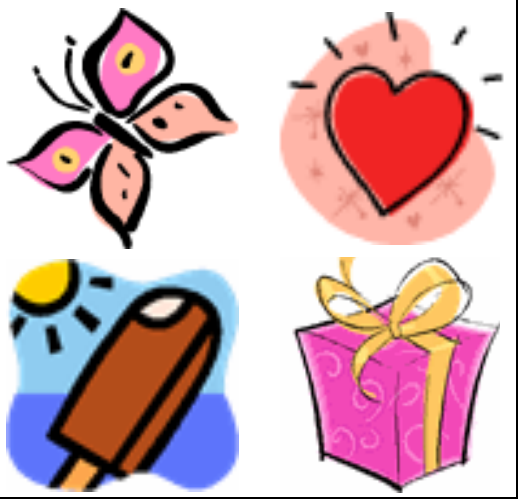
**Young**



**Old**

**Bad**

**Good**



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# WHOQOL-BREF

PROGRAMME ON MENTAL HEALTH

WORLD HEALTH ORGANIZATION GENEVA

For office use only

| | Equations for computing domain scores | Raw score | Transformed scores* | |
|---|---|---|---|---|
| | | | **4-20** | **0-100** |
| **Domain 1** | (6-Q3) + (6-Q4) + Q10 + Q15 + Q16 + Q17 + Q18<br>☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐ | = | | |
| **Domain 2** | Q5 + Q6 + Q7 + Q11 + Q19 + (6-Q26)<br>☐ + ☐ + ☐ + ☐ + ☐ + ☐ | = | | |
| **Domain 3** | Q20 + Q21 + Q22<br>☐ + ☐ + ☐ | = | | |
| **Domain 4** | Q8 + Q9 + Q12 + Q13 + Q14 + Q23 + Q24 + Q25<br>☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐ | = | | |

* Please see Table 4 on page 10 of the manual, for converting raw scores to transformed scores.

I.D. number

| | | | |
|---|---|---|---|
| | | | |

ABOUT YOU

Before you begin we would like to ask you to answer a few general questions about yourself: by circling the correct answer or by filling in the space provided.

What is your **gender**? Male Female

What is your **date of birth**? _____ / _____ / _____

Day / Month / Year

What is the highest **education** you received?

None at all
Primary school
Secondary school
Tertiary

What is your **marital status**?

Single Separated
Married Divorced
Living as married Widowed

Are you currently **ill**? Yes No

If something is wrong with your health what do you think it is? _____ illness/ problem

Instructions

This assessment asks how you feel about your quality of life, health, or other areas of your life. **Please answer all the questions.** If you are unsure about which response to give to a question, **please choose the one** that appears most appropriate. This can often be your first response.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life **in the last two weeks.** For example, thinking about the last two weeks, a question might ask:

| | | | | | | |
|---|---|---|---|---|---|---|
| | Do you get the kind of support from others that you need? | Not at all 1 | Not much 2 | Moderately 3 | A great deal 4 | Completely 5 |

You should circle the number that best fits how much support you got from others over the last two weeks. So you would circle the number 4 if you got a great deal of support from others as follows.

| | | | | | | |
|---|---|---|---|---|---|---|
| | Do you get the kind of support from others that you need? | Not at all 1 | Not much 2 | Moderately 3 | A great deal 4 | Completely 5 |

You would circle number 1 if you did not get any of the support that you needed from others in the last two weeks.

**Please read each question, assess your feelings, and put a cross next to the number on the scale for each question that gives the best answer for you.**

| | | Very poor | Poor | Neither poor nor good | Good | Very good |
|---|---|---|---|---|---|---|
| 1(G1) | How would you rate your quality of life? | 1 | 2 | 3 | 4 | 5 |

| | | Very Dissatisfied | Dissatisfied | Neither satisfied nor dissatisfied | Satisfied | Very satisfied |
|---|---|---|---|---|---|---|
| 2 (G4) | How satisfied are you with your health? | 1 | 2 | 3 | 4 | 5 |

The following questions ask about **how much** you have experienced certain things in the last two weeks.

| | | Not at all | A little | A moderate amount | Very much | An extreme amount |
|---|---|---|---|---|---|---|
| 3 (F1.4) | To what extent do you feel that physical pain prevents you from doing what you need to do? | 1 | 2 | 3 | 4 | 5 |
| 4(F11.3) | How much do you need any medical treatment to function in your daily life? | 1 | 2 | 3 | 4 | 5 |
| 5(F4.1) | How much do you enjoy life? | 1 | 2 | 3 | 4 | 5 |
| 6(F24.2) | To what extent do you feel your life to be meaningful? | 1 | 2 | 3 | 4 | 5 |

| | | Not at all | A little | A moderate amount | Very much | Extremely |
|---|---|---|---|---|---|---|
| 7(F5.3) | How well are you able to concentrate? | 1 | 2 | 3 | 4 | 5 |
| 8 (F16.1) | How safe do you feel in your daily life? | 1 | 2 | 3 | 4 | 5 |
| 9 (F22.1) | How healthy is your physical environment? | 1 | 2 | 3 | 4 | 5 |

The following questions ask about **how completely** you experience or were able to do certain things in the last two weeks.

| | | Not at all | A little | Moderately | Mostly | Completely |
|---|---|---|---|---|---|---|
| 10 (F2.1) | Do you have enough energy for everyday life? | 1 | 2 | 3 | 4 | 5 |
| 11 (F7.1) | Are you able to accept your bodily appearance? | 1 | 2 | 3 | 4 | 5 |
| 12 (F18.1) | Have you enough money to meet your needs? | 1 | 2 | 3 | 4 | 5 |
| 13 (F20.1) | How available to you is the information that you need in your day-to-day life? | 1 | 2 | 3 | 4 | 5 |
| 14 (F21.1) | To what extent do you have the opportunity for leisure activities? | 1 | 2 | 3 | 4 | 5 |

| | | Very Poor | Poor | Neither poor nor good | Good | Very Good |
|---|---|---|---|---|---|---|
| 15 (F9.1) | How well are you able to get around? | 1 | 2 | 3 | 4 | 5 |

The following questions ask you to say how **good or satisfied** you have felt about various aspects of your life over the last two weeks.

| | | Very dissatisfied | Dissatisfied | Neither satisfied nor dissatisfied | Satisfied | Very satisfied |
|---|---|---|---|---|---|---|
| 16 (F3.3) | How satisfied are you with your sleep? | 1 | 2 | 3 | 4 | 5 |
| 17 (F10.3) | How satisfied are you with your ability to perform your daily living activities? | 1 | 2 | 3 | 4 | 5 |
| 18(F12.4) | How satisfied are you with your capacity for work? | 1 | 2 | 3 | 4 | 5 |
| 19 (F6.3) | How satisfied are you with yourself? | 1 | 2 | 3 | 4 | 5 |
| 20(F13.3) | How satisfied are you with your personal relationships? | 1 | 2 | 3 | 4 | 5 |
| 21(F15.3) | How satisfied are you with your sex life? | 1 | 2 | 3 | 4 | 5 |
| 22(F14.4) | How satisfied are you with the support you get from your friends? | 1 | 2 | 3 | 4 | 5 |
| 23(F17.3) | How satisfied are you with the conditions of your living place? | 1 | 2 | 3 | 4 | 5 |
| 24(F19.3) | How satisfied are you with your access to health services? | 1 | 2 | 3 | 4 | 5 |
| 25(F23.3) | How satisfied are you with your transport? | 1 | 2 | 3 | 4 | 5 |

The following question refers to **how often** you have felt or experienced certain things in the last two weeks.

| | | Never | Seldom | Quite often | Very often | Always |
|---|---|---|---|---|---|---|
| 26 (F8.1) | How often do you have negative feelings such as blue mood, despair, anxiety, depression? | 1 | 2 | 3 | 4 | 5 |

Did someone help you to fill out this form?.....

How long did it take to fill this form out?.....

**Do you have any comments about the assessment?**

.....

.....

**THANK YOU FOR YOUR HELP**

**Appendix W**
Participant information sheet – example COVID-19 amendments

Swansea University
Prifysgol Abertawe

**Applied Sports Technology Exercise and Medicine Research Centre (A-STEM)**
College of Engineering

# PARTICIPANT INFORMATION SHEET (OLDER ADULT)

**(Version 1.2, Date: 10/04/2020)**

**Project Title:** Moving Together: Intergenerational Contact, Physical Activity and Views on Ageing in Older Adults and Children. A Pragmatic Evaluation.

**Contact Details:** Rachel Knight and Joanne Hudson **Telephone Contact:** [redacted]
Contact emails: [redacted] and [redacted]

## 5) Invitation Paragraph

We would like to invite you to take part in a research study that we are conducting with our colleagues at Swansea University, Cardiff University and Communauté Université Grenoble Alpes. Please take the time to read this information sheet carefully as it will provide you with the details of our study and hopefully all the information you will require to help you decide if you want to participate. It is important to say at this point that the decision to take part is entirely up to you, and that even if you decide to do so, you can withdraw your consent at any point during or after completion of the study, as long as it is before the data has been analyzed, either in person, in writing or by e-mail.

## 2. What is the purpose of the study?

Keeping active is good for health and well-being. The purpose of this study is to see if children (aged 7-11 years old) and adults (aged ≥ 60 years old) working together towards joint physical activity goals has an effect on their views on ageing, physical activity levels and general well-being. You will be required to form a partnership with a child that is either a family member, or a child that is familiar to you and has requested to be paired with you. Using watches that show you your daily steps taken (similar to a fit-bit), linked to a web-based program on a device of your choice that you already have available (smart phone, tablet,) you will work together for 12 weeks to complete virtual walking routes around cities of the world.

### 3. Why have I been chosen?

You have been chosen as you are aged ≥ 60 years old and either a family member or are well-known to a child at _____and have been identified as a suitable potential partner by the child and their parent/guardian.

### 4. What will happen to me if I take part?

- You will need to return your completed Consent Form and Health Screening Form either via your co-participating child to their_____ or directly to the researcher.
- The researcher will contact you to, if necessary, discuss the study further, any health conditions and to arrange a time for enrolment with your partnering child.
- You will be supplied with a watch that records your daily step count to wear all day every day for 12 weeks. You will add your step data and that of your partnering child to the program to complete your chosen walk routes.
- In addition to the activity watches we will also ask you to wear an additional physical activity monitor all day every day for 7 days at three separate times and to complete 2 questionnaires.
- The researcher will need to meet with you 6 times over the 12 weeks (see table on next page) at a location the most convenient for you this could potentially be at (insert name) school, at your home or at the School of Sport, Swansea University. Some of the meetings will be very brief and are just to allow the research to supply and then collect the monitor.
- All meetings will be done on an individual basis, apart from Week 1, where we will arrange to jointly meet with you, your partnering child, and their parent/guardian.
- **At week 6 and at the end of the study, we would also like to interview you to discuss for example, how you are getting on, what you think of the watch, app and working with your partner.**
- **These interviews will be held either face-to-face or remotely vis the internet, for example skype, or via the telephone, at a time that is mutually convenient for you, and will be audio and/or video recorded. The full recordings will only be viewed by the lead researcher, and only used to fully and accurately write**

**up the discussion Once this process has been completed the recordings will be erased.**

## 5. What are the possible disadvantages of taking part?

There will be minimal physical risk through participation in the study as we are only looking for you to work within the limits of your current health status and ability. You may feel some slight discomfort if increase your physical activity levels. Any concerns regarding this or any health conditions that feel may influence your participation can be discussed with the researcher either at enrolment or by contacting Rachel Knight by email at [redacted] or telephone [redacted]

**You might feel mild discomfort in a discussion with the researcher. However, you can refuse to answer any questions that you do not feel comfortable answering and remove any data that you do not want to be used.**

| Meeting Number | Tasks to be completed | Average time |
|---|---|---|
| Week 0 | Completion of questionnaires<br>Supply activity monitor<br>Start set up of World Walking and step counter watch | 45 mins |
| Week 1<br>(Start of study) | *Joint meeting with partnering child and their parent / guardian*<br>Return Activity monitor<br>Complete Set up and familiarisation with World Walking and step counter watch | 45 mins |
| Week 6 | Supply of Activity Monitor and repeat questionnaires<br>**Interview** | 10 mins<br>**30 – 45 mins** |
| Week 7 | Return Activity Monitor | 5 mins |
| Week 11 | Supply of Activity Monitor | 5 mins |
| Week 12 | Repeat questionnaires<br>Return all watches<br>**Interview** | 20 mins<br><br>**30 – 45 mins** |

## 6. What are the possible benefits of taking part?

You can benefit from taking part in the study by potentially being more aware of your

activity levels and enjoying taking part. You could also gain health benefits.

### 7. Will my taking part in the study be kept confidential?

Any information you provide will be kept strictly confidential. Participants' names will not be given in any reports of the findings, and personal information will not be linked in any way to your data. **Quotations that are used within the write up of the interviews will be kept anonymous by giving each participant a code name.**

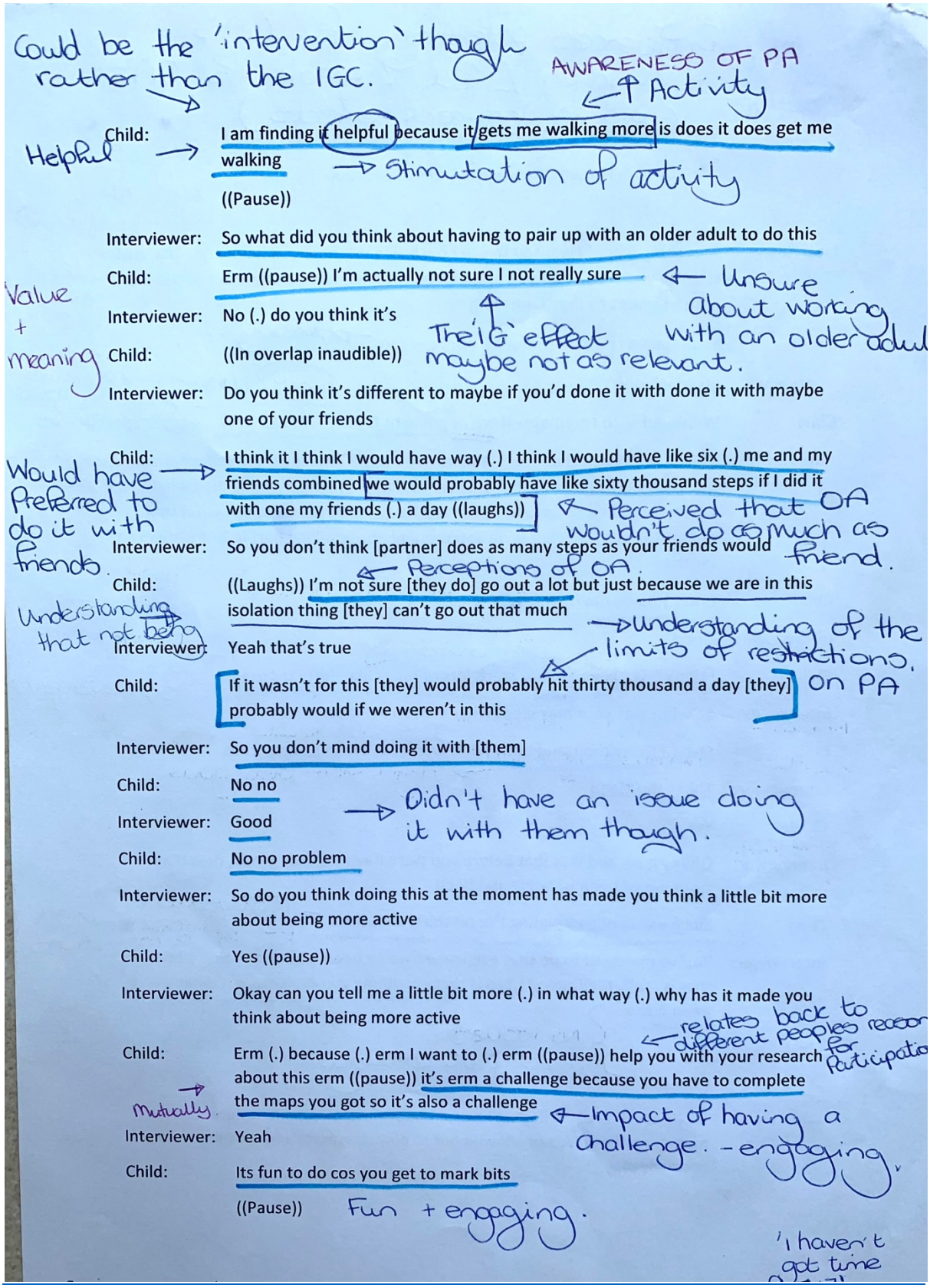
### 8. What if I have any questions?

If you would like to know any more about the research project, then you can contact the main researcher via telephone, post or email. The research has been approved by the College of Engineering Research Ethics Committee at Swansea University. If you have further questions or have concerns/complaints please contact Dr Andrew Bloodworth, Chair of the College of Engineering Research Ethics Committee, Swansea University: [redacted]

**Appendix X**

Case study coding audit trail

Example of initial manual coding



Example of data extraction

| | | CODE | SUPPORTING TEXT |
|---|---|---|---|
| **Reciprocal Encounter** | **Relationship building** | IGC exercise intervention as a way to connect & establish relationships | I think if you're exercising with one of your older relatives (.) if you choose someone who (.) your older relative who you haven't connected for well it will be good just to connect with them because you're working with them (.) won't it (.) by working with them (.) you're like you connect with your relatives (.) like you haven't been able to connect with them much [Ch2] |
| | | IGC intervention as an opportunity to establish (new) relationships | the child I'm involved with is relatively new in my life you know it's been a sort of couple of years and I saw it in un un ideal opportunity where I had that sort of special connection with him to hopefully develop the relationship as well you know [OA1] |
| | | IGC intervention provided wider, deeper rooted and unaccounted for benefits than just those targeted (relationship building) | I was hoping that it it was not only with the exercise but looking at relationship building that's what I had in my mind and I was absolutely thrilled when he actually asked me would I do it you know erm he's got grandparents I mean we are step and and all this you know and the other so I was chuffed to bits that he actually asked me would I do it and would I participate with him you know so I I think there is more meets the eye sometimes as well [OA1] |
| | | IGC as a way to learn about partner, and build relationships | But even like with [Child] I know reasonably well but I know little about in many ways either [OA2] |
| | | Impact of strengthening IG relationship is wider (repercussions) that the impact on the targeted outcomes | I was down there in the week, and I don't know whether you noticed it more or whether, but he had a project to do for school, part of his schoolwork. And he was like oh come and see this, come and do this you know. And I don't know whether that is specifically as a result of the project. I think that would have helped. Or whether it's the circumstances or whether, well you don't know where it can lead you you know. It's got to be positive. [OA2] |
| | | IGC intervention provided a common bond | we do pop down we don't go in there but we do pop down to see them and he says and I go 'how many have you done today' and we've got that sort of common bond [OA1] |
| | | IGC intervention provides a unique relationship building opportunity | it's the sort of relationship building for me with [child] in particular you know. It's, you know, families are not the sort of traditional families I grew up in. We've got all these different things coming into the mix. And this was a real chance for me and him, just the two of us to do something together [OA2] |
| | | Hoping that experience / impact of intervention on relationship continues into the future | And I just hope that from [Child's] point of view he would be able to ask me to do other things as well. [OA2] |
| | | IGC intervention as a way to break barriers | there's been lots around intergenerational and barrier breaking and what have you. I think it's been ideal you know [OA2] |
| | | Intervention stimulated positive emotions | And as I said at the start, I mean I was chuffed to bits that [child] even considered asking me. [OA2] |

Example of sub-theme refinement process

| ***Reciprocal Encounter*** | ***Platform for Change*** | ***Stimulation of Awareness*** | ***COVID-19*** |
|---|---|---|---|
| ***Relationship building**** | ***Challenging perceived competence*** | ***Opportunity for self-reflection (older adult)*** | ***Emergent Limitations*** |
| IGC exercise intervention as a way to connect & establish relationships | Perception that OA partner has limited capability with technology | Perceived time as a barrier to PA | Emotional impact of social restrictions |
| IGC intervention as an opportunity to establish (new) relationships | Older adults don't have the experience using technology | Awareness that achieving PA targets and decreasing SB does not have to be complicated | Lack of IGC lead to a lack of ongoing participation |
| IGC intervention provided wider, deeper rooted and unaccounted for benefits than just those targeted | Challenging stereotypes – OA can still learn new things they just need to be taught | Impact of the changing boundaries of older adulthood | Fears associated with lockdown |
| IGC as a way to learn about partner, and build relationships | Technology viewed as being potentially useful to older adults | Perception that cutting or losing opportunities for PA wasn't something that has any control over | Social restrictions impacted opportunities for IGC during the intervention |
| Impact of strengthening IG relationship is wider (repercussions) that the impact on the targeted outcomes | OA don't know how to use technology, but they could | Negative impact of conflicting priorities on PA | Opportunity to connect with OA's limits IGC and chances to gain more positive views of older adults |
| IGC intervention provided a common bond | Perception that children more active than older adults | Raised awareness of previous positive PA behaviour habits | Decreased engagement with the intervention between weeks 6 & 12 |
| IGC intervention provides a unique relationship building opportunity | Perceptions of the ageing and OA's not having been taught to use technology | Awareness of where there are already opportunities for PA | Initial benefits decreased during weeks 6-12 (child) |
| Hoping that experience / impact of intervention on relationship continues into the future | ***Challenging societal representation*** | Concern won't be able to maintain gains/changes | ***Intervention as a Coping Mechanism*** |
| IGC intervention as a way to break barriers | OA as an additional positive role model | ***Lack of awareness (for child)*** | Positive effect of IGC intervention during period of social restrictions |
| IGC stimulated positive emotions for older adult | IGC intervention provided opportunity for child to learn more about partner | Lack of understanding that it's good to get others with high SB levels involved or perception that need to partner with someone who is already active | PA as a form of escape (from COVID) |
| ***Positive experience*** | Older adults perceived as knowledgeable and a source of information | Completing less steps than partner does not stimulate more PA in the child | PA as a source of entertainment during COVID-19 |
| Intervention provided the child with a fun experience | Older adults perceived as fun | Less steps than partner associated with failing competition not less PA | Intervention provided a sense of purpose during COVID |
| Enjoyed participating | Positive IGC - Agreeing with OA views seem unusual to child (changing attitudes) | Perception you need partner who is already active because the challenges not the potential PA impact for themselves or others is the most important | Intervention provided something to do during the pandemic, conscious reason to be active |
| Positive experience | Older adults as a source of knowledge, IGC provides opportunities for education/teachable moments | ***Awareness of others behaviour**** | Intervention provided a sense of purpose |
| Intervention viewed as a good thing | Children possibly don't talk to OA's enough - generally IGC is insufficient | Engagement with IGC led to increased Awareness of impact of modern life on SB in children | Intervention as a focus (during COVID) |
| Intervention stimulated of positive emotions/ psychological well-being | Children have a lack of understanding of OAs | Intervention viewed as a way to provide awareness of physical inactivity and SB in children | Intervention provided a source of focus |
| Intervention perceived as a beneficial way to target PA | ***Challenging self-stigmatization (older adult)*** | Co-monitoring of progress and participation | Intervention provided a motivator to exercise |

| ***Importance of Dyad Composition*** | Self -Perception of not having the skills for the technology | Awareness of negative effects of technology and sedentary behaviour | Intervention as a way to help manage the impact of social restrictions |
|---|---|---|---|
| Perceived less risk of negative emotions and outcomes with IGC over partnership with another adult | Positive changes to self-perceptions of ageing and older adulthood | Technology facilitated an awareness of PA, and wider awareness of how others could use technology positively | During social restrictions, IGC intervention provided a challenge for the child & facilitated PA |
| Dynamic between the dyad could influence success | Older age perceived as a time of negativity | Awareness of positive and negative effects of technology (on SB) | Intervention perceived as a positive experience during social restrictions |
| Support for 'familial' IGC | ***Changing Behaviour*** | Awareness of exercise benefits (for others) | Positive achievement during a difficult time (COVID) |
| Dynamic of IGC provided a very positive experience | Facilitation of increased PA in older adults | Impact of intervention on behaviour of wider family members | ***Technology not a substitute for face-to-face contact*** |
| Extending dyad would not work as well | Positive change in behaviour of older adult | Perceived benefit to child co-participant | Technology not a substitute for face-to-face interactions |
| Widening the group could achieve a greater distance but could dilute the of impact and benefit of IGC | Facilitation of more PA in child | ***Awareness from intervention components*** | Technology removes humanity, doesn't provide the full experience |
| | IGC used as a platform to motivate positive behaviour/PA | Increased awareness of PA through self-monitoring (child) | Technology not viewed as a substitute for face-to-face IGC |
| | Increased positive awareness of PA/ step levels | The challenge of the technology-driven intervention facilitated more PA (child) | Technology not a substitute for face-to-face contact |
| | Embedding PA into daily activities | Increased awareness of PA – frustration when not allocated steps achieved (older adult) | Technology is not a substitute for face-to-face contact for child |
| | facilitator of long-term PA goal in child | ***General awareness*** | ***COVID-19 related raised awareness*** |
| | IGC perceived as being a way to target other avenues/outcomes | Increased awareness of PA | Awareness of impact of changes to routine of child's PA |
| | Intervention as a driver of behaviour change | | Awareness of the limitations on partners PA from restrictions |
| | ***Intrinsic facilitator*** | | Awareness that without COVID-19 restrictions OA could be more active |
| | IGC – not letting the child down, as a motivator | | Awareness of benefits of PA during social restrictions |
| | IGC – participating for the child, not to let him down | | Importance of social element of PA, awareness of when and where would normally be active |
| | Keeping going for the child stimulated PA for older adult | | Awareness of loss of PA opportunity during COVID |

| ***Unused codes*** | ***Different driving factors for participation*** | ***Older adults view of technology*** | **CONTROL THEORY COMPONENTS** |
|---|---|---|---|
| Child not opposed to working with OA | - For adult it's about the steps and watch | Only reluctance necessity to use IT | Shared achievement between the dyad |
| Importance of outdoor space and the social element of PA | No association in child between step counts and PA | Individual choice, not everyone is interested in technology | Collaboration to set and achieve new common goals & next challenge |
| Attitude influences actions / past experiences mould future attitudes | Completing the challenges not as important to the OA | Using technology is a personal choice, for some it's only used out of necessity | IGC stimulating PA in both dyad members through collaborative/joint goal planning |
| Value of IGC unclear to the child | Importance of PA being fun to child | Only engages with technology if needs to | Intergenerational teamwork extends to how the overall task is managed not just completing the challenges |
| | Importance of variety, individual choice, and opportunity of PA for child | Not interested in technology | |

Final coding by theme, sub-theme and codes

| THEME | SUB THEME | CODE |
|---|---|---|
| **Reciprocal Encounter** | **Cementing Connections** | Connect & establish relationships |
| | | Confirming connection and worth to the child |
| | **Forging new connections** | Establish (new) relationships |
| | | Learn about partner |
| | | "Person"alising the Older Adult |
| | | Sparks wider involvement in child's life |
| | **Special experience** | Common bond |
| | | IGC intervention provides a unique relationship building opportunities |
| | | Hoping that experience / impact of intervention on relationship continues into the future |
| | **Positive experience** | Intervention provided the child with a fun experience |
| | | Enjoyed participating |
| | | Positive experience for older adult |
| | | Intervention viewed as a good thing |
| | | Intervention stimulated positive emotions/ psychological well-being |
| | | Intervention perceived as a beneficial way to target PA |
| | | Dynamic of IGC provided a very positive experience |
| | | Intervention stimulated positive emotions |
| | Mutual benefit | IGC stimulating PA in both dyad members through collaborative/joint goal planning |
| **Platform for change** | **Breaking barriers** | IGC intervention as a way to break barriers |
| | | Perception that OA partner has limited capability with technology |
| | | Challenging stereotypes – OA can still learn new things they just need to be taught |

| | | |
|---|---|---|
| | **Challenging perceived competence of older adults** | Technology viewed as being potentially useful to older adults |
| | | OA don't know how to use technology, but they could |
| | | Perception that children more active than older adults |
| | **Recognition of value and worth of OA** | OA as an additional positive role model |
| | | Opportunity to connect with the past |
| | | Children don't talk to OA's enough |
| | | Older adults not "slaves to their computers" |
| | | Older adults as a source of knowledge, IGC provides opportunities for education/teachable moments and knowledge transfer |
| | **Challenging societal representation** | Older adults perceived as fun |
| | | Recognising common/shared views |
| | | Children have a lack of understanding of OAs |
| **Platform for change** | **Challenging self-stigmatization (older adults)** | Positive changes to self-perceptions of ageing and older adulthood |
| | **Positive Behavioural Changes** | Facilitation of increased PA in older adults |
| | | Positive change in behaviour of older adult |
| | | Facilitation of more PA in child |
| | | Increased self - awareness of PA |
| | | IGC technology intervention as a facilitator of long-term PA goal in child |
| | | Through raised awareness of own behaviour |
| | **IGC as Source of Behaviour Motivation** | Participating for the child, not to let them down |
| | | Co-monitoring of progress and participation |
| | | Intervention as a driver of behaviour change |
| | | IGC used as a platform to motivate positive behaviour through reciprocal encouragement |

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|---|---|---|
| | | Teamwork |
| **Opportunity for reflection and re-evaluation** | **Re-evaluation** | Perceived time |
| | | Concern that won't be able to maintain gains/changes |
| | | Negative impact of conflicting priorities on PA |
| | | Of priorities |
| | | Awareness of where there are already opportunities for PA |
| | | Raised awareness of previous positive PA behaviour habits |
| | **Reflection** | Reflection on perceptions for themselves |
| | | Engagement with IGC led to increased awareness of impact of modern life on SB in children |
| **COVID-19** | **COVID-19 related PA awareness** | Awareness of the limitations on partners PA from COVID-19 restrictions |
| | | Awareness that without COVID-19 restrictions OA could be more active |
| | | Awareness of impact of changes to routine of child's PA |
| | | Awareness of loss of opportunity for PA during COVID |
| | | Importance of social element of PA, awareness of when and where would normally be active |
| | | Awareness of benefits of PA during social restrictions |
| | **COVID-19 Limitations** | Emotional impact of social restrictions |
| | | Lack of IGC lead to a lack of ongoing participation |
| | | Decreased engagement with the intervention between weeks 6 & 12 |
| | | Fears associated with lockdown |
| | | Social restrictions impacted opportunities for IGC during the intervention |
| | | Initial benefits decreased during weeks 6-12 (child) |
| | **Sense of purpose** | Intervention provided a source of focus (during COVID19) |
| | | Intervention provided a sense of purpose during COVID |
| | | During social restrictions, IGC intervention provided a challenge for the child & facilitated PA |

| | | |
|---|---|---|
| | | Intervention provided something to do during the pandemic, conscious reason to be active |
| | | PA as a source of entertainment during COVID-19 |
| | **Supporting physical and mental health** | Intervention perceived as a positive experience during social restrictions |
| | | PA as a form of escape |
| | | Intervention as a way to help manage the impact of social restrictions |
| | **Achievement** | Positive effect of IGC intervention during period of social restrictions |
| | | Positive achievement during a difficult time (COVID) |
| | **Technology removes humanity** | Technology not a substitute for face-to-face contact |
| | | Technology is not a substitute for face-to-face contact for child |
| | | Technology not viewed as a substitute for face-to-face IGC |
| | | Technology removes humanity, doesn't provide the full experience |

**Appendix Y**

Pre-submission draft publication – *"Moving Forward: Understanding Correlates of Physical Activity and Sedentary Behaviour during COVID-19 - An Integrative Review and Socioecological Approach."*

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**Conflicts of Interest:** All authors declare they have no conflicts of interest

**Ethics Approval**: No ethical approval was needed as all data were available in the scientific literature

**Availability of data and material:** The data that support the findings of this study are available from the corresponding author upon reasonable request

**Consent for publication:** Not Applicable

**Code Availability:** Not Applicable

**Abstract**

**Introduction –** Population-level estimations of physical activity and sedentary time/behaviour represent a significant public health issue, which have been exacerbated by the restrictions enforced to control COVID-19. This integrative review interrogated available literature to advance our understanding of the pandemic's impact on correlates of physical activity and sedentary time/behaviour in adults aged over 18 years.

**Methods -** MEDLINE, SPORTDiscus, SCOPUS, CINAHL plus and Web of Science were systematically searched in January 2021. Data extracted from 64 articles were assessed for risk-of-bias using the Mixed Methods Assessment Tool. Via thematic analysis, correlates were identified, coded, and themed under the headings: *Individual*; *Social*; *Environmental*, and *Policy.* A socioecological model of physical activity during the pandemic was conceptualised and mapped to the COM-B model of behaviour change mechanisms.

**Results -** For physical activity, the model illustrates influences over five levels: *Individual* (biological) – general health; *Individual* (psychological) – mental health, cognition, motivation, behaviour; *Social* – domestic situation, sociodemographic factors, support, lifestyle choices; *Environmental* - resources, area of residence, and *Policy* – COVID-19-related rules. For sedentary time/behaviour, the most important correlates may be individual level factors, namely general and mental health. Unlike pre-COVID-19, during the restrictions neither age nor sex presented a clear correlation with either behaviour.

**Conclusions –** As we transition into a new normal, understanding which behaviour mechanisms could effectively challenge physical inactivity and sedentary time/behaviour is essential. Whereas targeting *capability* on a psychological level may facilitate both physical activity and limit sedentary time/behaviour, on a physical level, maximising *opportunities* to enact physical activity behaviours could be crucial.



**Keywords:** COM-B; Adults; Pandemic; Restrictions

## 1. INTRODUCTION

Physical activity (PA) is well evidenced to benefit the general population [1], with small increases being positively associated with a decreased risk of premature all-cause mortality [1]. As one of the leading risk factors for non-communicable diseases, including cardiovascular disease, cancer and type II diabetes, physical inactivity is predicted to be responsible for over five million preventable deaths per year [2]. Despite this, one in four adults, globally, do not meet PA recommendations [1]. Sedentary behaviour, defined as any waking behaviour characterised by an energy expenditure ≤1.5 metabolic equivalents (METs) while in a sitting or reclining posture [3], is an independent risk factor for mortality, even among individuals meeting the PA guidelines [4]. In the absence of measuring posture, sedentary time has been utilised, aligned with an energy expenditure ≤1.5 METs. Previous estimates suggest that adults spend approximately 60% of their waking time engaged in sedentary pursuits, equating to more than eight hours a day [5]. These estimates of population-level PA and sedentary behaviour represent a significant challenge for public health. Indeed, PA, and reduced sedentary time/behaviour, may be even more important with the emergence of the novel Coronavirus disease 2019 (COVID-19), not least as being physically active is associated with a lower risk of community-acquired infections, including COVID-19 [6].



First described in December 2019, COVID-19, caused by being infected with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic by the World Health Organization (WHO) on 11th March 2020. As of 8th June 2021, there have been over 172 million confirmed cases and 3.7 million deaths associated with COVID-19 in 218 countries, areas or territories worldwide [7]. In response to the emergence and transmission of COVID-19, the WHO issued advice for

all countries to identify, manage, and care for new cases of COVID-19 [8]. Whilst the response was not heterogeneous globally, national responses included the introduction of social distancing, restrictions on travel, the cancellation of mass participation events, changes to work practices and the introduction of self-isolation and quarantine to slow further spread, avoid overwhelming health systems and to prevent infection among those at higher risk of severe outcomes [8]. Given the rarity of pandemics and the different approaches taken in response to the COVID-19 pandemic, our understanding of the effects of these restrictions on individual's lifestyles and health is limited.

Physical activity is a complex and multi-faceted behaviour; in order to fully understand the impact of the COVID-19 pandemic it is necessary to explore the interactions between the individual, their social and physical environments, and relevant policies, consistent with a socioecological approach [9]. Socioecological models incorporate a broad range of variables that are expected to influence behaviour and they can be used alongside other complementary theoretically based models, such as the capability, opportunity, motivation, and behaviour (COM-B) model [10], to determine which conditions need to be met to facilitate behavioural change at an individual, and ultimately population, level [11]. The COM-B model outlines three potential mechanisms of behaviour change, each made up of two aspects: *capability* (physical and psychological), *opportunity* (physical and social environment), and *motivation* (reflective and automatic) [10]. The COM-B is the behavioural system positioned at the centre of the Behaviour Change Wheel (BCW), a framework that provides a structure to identify which aspects of behaviour provide suitable targets for interventions and which intervention functions are therefore most likely to be effective [11]. Assessing the impact of the COVID-19 pandemic on the correlates of PA and sedentary behaviour is essential to inform the response of policy makers and intervention designers seeking to

increase PA and reduce sedentary behaviour to improve population health as we transition to, and establish, a new normal.

The aims of the integrative review were therefore to: i) interrogate the available literature to establish the impact of the COVID-19 pandemic on correlates of PA and sedentary behaviour conceptualised within a socioecological model; and ii) use the COM-B model to identify mechanisms of behaviour change directly mapped from the developed socioecological model to make recommendations to inform future PA intervention strategies and policy following the COVID-19 pandemic.

## 2. METHODS

### 2.1 Literature Review Methodology

To inform the conceptualisation of the socioecological model, an integrative review of both quantitative and qualitative literature relating to PA, sedentary time/behaviour and COVID-19 was conducted in line with published guidance [12]. Electronic databases (EBSCOhost Medline, CINAHL plus, EBSCOhost SPORTDiscus, SCOPUS, Web of Science) were used to search key terms on 16th January 2021. Boolean and MeSH terms developed following librarian guidance were used to search for the following terms and variations of each term; *"physical activity", "exercise", "sport", "recreation", "active travel", "physical performance", "physical function", "sedentary time" "sedentary behaviour", "sedentary lifestyle", "physical inactivity", "prolonged sitting",* and *"coronavirus", "COVID-19", "SARSCov2", "n-CoV" and "novel coronavirus".* Original studies, published in English, which assessed correlates of PA and sedentary time/behaviour in adults aged 18 years or over during the COVID-19 pandemic were included. A full breakdown of article inclusion/exclusion criteria is provided in Table 1.

Two authors (RLK and AWR) independently reviewed all generated citations

and abstracts to select eligible studies using Rayyan (QCRI, Qatar), coding articles as either "included" or "excluded". Subsequently, all "included" articles at this stage were obtained as full-text articles and reviewed against the pre-defined inclusion/exclusion criteria independently by the two authors. Three disagreements regarding eligibility were resolved by discussion with a third reviewer (LS). For an example of the full search terms and a detailed outline of the study selection and data extraction procedures, see online Supplementary Material 1.

*<< Insert Table 1 here >>*



**2.2 Quality Assessment**

Whilst a critical appraisal of the literature has not always been a core component of the integrative review process [13], it is now deemed crucial [12]. Therefore, the Mixed Methods Assessment Tool (MMAT) [14], suitable for assessing different study designs (mixed methods, qualitative, quantitative – descriptive, and randomised and non-randomised trials), was used to appraise the quality of included studies. Depending on research design, one author (RLK) independently rated five domain criteria as 'Yes', 'No', or 'Unclear', with a second author (AWR) randomly checking 25% of the ratings to ensure consistency. No discrepancies were identified. Each study was subsequently attributed an overall quality score[23]. No studies were excluded due to low quality.

**2.3 Data Analysis and Model Development**

[23] Ranging from 1* where 20% of the quality criteria have been met, to 5* where 100% of the quality criteria have been met [15]

Using the six-stage process of thematic analysis outlined by Braun and Clarke [16], one author (RLK) reviewed the data extracted from the retrieved literature to identify correlates of PA and sedentary time/behaviour during the COVID-19 pandemic. The initial coding process was deductively driven by the socioecological model of Sallis et al. [9], with codes allowed to emerge inductively from the semantic meaning of the data under the headings: *Individual*; *Social*; *Environmental*; and *Policy*. Generated codes were categorised into sub-themes, named, and defined to accurately represent the data. During these stages, codes and themes were independently challenged by a 'critical friend' (LS), checked back in reverse to the original data extracts, and, where necessary, refined to ensure congruity.

Utilising the generated sub-themes, the first author (RLK) completed a two-step process: (i) conceptualisation of the socioecological model consistent with Sallis *et al.* [9]; and (ii) mapping of the developed context-specific model to the components of the COM-B [11]. To enhance transparency, credibility, quality control and rigour [17], following the completion of each step, the 'critical friend' additionally blindly cross-matched 10% of the studies against the generated model to ensure consistency in approach and that the data had been mapped appropriately. All discrepancies were discussed and reviewed in reverse, from the model to the original studies, until a consensus was reached.



## 3. RESULTS

A total of 3,996 articles were identified from electronic database searches, with a further two identified from secondary searches. Following the removal of duplicates, 1,979 articles were screened, with 1,838 excluded, and 141 retrieved for full-text eligibility screening. As outlined in Figure 1, 64 articles were retained and included in

the final analysis. The remaining articles encompass data from 155,313 adults aged 18 years or over [18-81], from 25 different countries, spanning six continents. All articles included > 100 participants, who were living under some degree of restrictions imposed to limit the spread of COVID-19 and presented data on correlates of PA, except for Kaur et al. [44] and Karuc et al. [42] which included 22 and 91 participants respectively. Only 19 out of 64 (30%) provided details of correlates relating to components of sedentary behaviour, namely taking active breaks, screen time, sitting time or total sedentary time. An illustrative summary of study details is provided in Table 2. For a full breakdown of individual study characteristics and MMAT quality assessments, see online Supplementary Materials 2 and 3.

A narrative synthesis of the findings, discussed in line with the dimensions of the socioecological framework of Sallis *et al.* [9], are outlined in the following section. Whilst these primarily relate to PA, where inferences to sedentary time/behaviour were possible these are also noted. To help frame the impact, the findings from the analysis of the PA data were conceptualised into a socioecological model, Figure 2, that allows variables from different domains and the potential dynamic between individuals and wider influencing factors to be portrayed [9]. Due to the lack of robustness, consistency, and breath of data available relating to sedentary time/behaviour, the creation of a second, or combined, model was not deemed appropriate.



*<< Insert Figure 1 here >>*

### 3.1 Individual – Biological Factors

#### 3.1.1 Age and Sex

For *age*, discrepancies in the definitions adopted to differentiate between and describe 'younger', 'middle-aged', and 'older' adults limits the conclusions that can be drawn. Nonetheless, where younger adults aged < 30 years were found to be more likely to increase their PA levels [25], those aged 18-25 years were more likely to be less active than those aged > 25 years [65]. Furthermore, people aged 18-34 years or 35-54 years were more likely than 'older adults' aged 55-74 years to be in a higher exercise category [33]. Whilst middle-aged adults (aged 40-64 years) were 1.2 times more likely to meet MVPA guidelines than their younger counterparts (aged 18-39 years) [43], those aged 43 years and over presented greater reductions in global guideline achievement [52]. Conversely, being aged 65 years or greater was also associated with maintaining sufficient [75], or higher [41], levels of PA. These findings are further complicated by reports that, in general, older individuals are more likely to exercise more frequently than younger (no age category specified) adults [30], and that age had no effect on either the change in PA levels [37] or behaviours [70].



There is little consensus in the literature as to the influence of *sex* on PA levels during the first wave of the COVID-19 pandemic. Specifically, where sex differences in PA levels were observed, females were reported to be more likely to be more active [38, 75], to increase their PA levels [28, 47, 72], or to have smaller reductions in PA levels [28, 52]. In contrast, others reported sex differences that favoured males [43, 51, 61, 66, 70], whilst some found no sex differences [18, 30, 37, 42, 57]. Additionally, in one instance, the difference between males and females was only apparent for light PA and not moderate, vigorous, or moderate-to-vigorous PA (MVPA) [26].

Similar variations in findings were observed for sedentary time/behaviour. Age may play a part in this complex depiction; indeed, screen time habits declined with increasing age [32]. Nevertheless, being a younger adult was associated with being more likely to increase overall sitting time [28, 65] but also a decrease in screen time obtained from watching television [19]. Regarding sex differences, where overall sitting time [28], and, conversely, having more active breaks [66], were both reported to be higher in men, sitting time also increased irrespective of sex [66, 72]. However, further findings indicated that sitting time was higher in females [26, 65]. For screen time, there were contradictory findings reported with both males [19] and females [32] being the most likely to increase time spent watching television. There is some suggestion though that such differences may be attributed to the type of screen time engaged with or reported. Where television time (and internet use) was higher in females, more males reported an increase in video-game use [32].



### 3.1.2 General health

Multiple variables associated with *general health* present as factors that positively or negatively influenced PA and sedentary time/behaviour. Lower perceived overall general or physical health has been related with being significantly less active [63, 65, 69]. More specifically, negative associations were identified between PA and body mass [66, 69], physical and general fatigue [24], sleep quality [40, 80], and having a chronic or high-risk health condition [36, 43, 69, 70], whilst not meeting guidelines for light-intensity PA [26] and spending less time per week being physically active [72], were linked with body mass index (BMI). Positive associations were found with higher perceived general and/or physical health and PA [18, 24, 31], and outdoor versus indoor exercise [32]. It is, however, pertinent to note research that highlighted no association between BMI and change in PA levels [37], and significantly higher levels of physical

inactivity among individuals without, compared to those with, a chronic disease [65]. Similar findings were also observed in sitting time [65, 72]. Negative associations were also found between sleep quality, television/computer/tablet use [80], and sitting time [54], perceived health and sitting time [79], BMI and screen time [19], and physical fatigue and sitting time [24]. Positive associations were observed between physical health and sitting time [18, 65], and general health and screen time [32], with an inverse association reported between body mass and taking active breaks [66].

### 3.2 Individual - Psychological Factors

#### 3.2.1 Mental health

Multiple associations were identified between components of *mental health and well-being* and PA. Although some of the evidence within this theme is of lower quality [31, 56, 57, 59, 60, 71, 73, 74], it remains clear that having a better overall mental health status is associated with being more physically active. This is demonstrated with relation to walking [18], total volume of PA [18], light-intensity PA [24], moderate-intensity PA [21], vigorous-intensity PA [21], MVPA [26, 41], general PA levels [49, 57, 59, 61, 63, 69, 73, 78], and outdoor PA [49]. It is also pertinent to note that the correlation between overall mental well-being and PA may be stronger in females than males [57].



Correlations were identified with anxiety, depression/mood, and emotions. *Anxiety*: higher levels were associated with decreased or less PA [23, 35, 41, 56, 61, 71, 74, 80] and outdoor activity [49], whilst lower levels were associated with participating in physical exercise [48, 74] and achieving recommended PA guidelines [53]. Further, non-directional, significant interactions were also reported [26, 63]. However, not all results supported these findings, with non-significant differences observed for generalised anxiety between active and inactive individuals [49], and severe anxiety

having a stronger association with higher MVPA than moderate anxiety [61]. *Depression/mood:* positive associations were observed between lower depression/mood levels and engaging in physical exercise [46, 74], the volume of MVPA [51], maintaining or slightly increasing pre-COVID-19 PA levels [40], meeting PA guidelines [53], moderate- (over vigorous-) intensity PA [29]. Higher levels of depression were linked to changes in pregnancy exercise routines [39], whilst having high levels of both depression and anxiety almost doubled the likelihood of being less physically active [71]. Further non-directional associations were also reported [26, 34, 63, 68]. *Emotions:* Relationships between higher stress levels and decreased [35, 47, 59], less [59, 60] or non-participation in [74] PA were reported. Additionally, poorer overall emotional well-being [61], feelings of sadness [80], loneliness [59, 80] and distress [57] were all reported to be detrimental to levels of PA.



With regard to sedentary time/behaviour, correlations were identified with components of mental health. Sedentary time [21] and screen time [21, 59] were negatively associated with overall mental health. Higher levels of depression were associated with increased screen time [59] and sitting time [59, 72], higher levels of anxiety with increased screen time [80] and sitting [72], and emotions, incorporating loneliness [59, 80], sadness [80] and higher levels of stress [59], with increased screen time. However, additional findings showed no association between any emotional states and sitting time [59], or parameters of mental health (self-perceived, depression) and sitting time [51, 59]. Nonetheless, interactions were observed between mental health, PA, and sedentary time/behaviour, with better mental health status and higher levels of PA associated with daily sitting time [18] and lower increases in screen time [32].

### 3.2.2 Personality traits

Minimal evidence, mostly of low quality [77], infers that overall [77], or components of, *personality* may have influenced PA levels and sitting time. Higher levels of neuroticism were associated with being less active [67,77] and sitting more [77], whilst being more extrovert (including activity-extraversion), conscientious [67,77] and/or agreeable [77] were related to higher mean levels of PA and decreased sitting time. Being more open was related to being more active, but unrelated to sitting time [77].

### 3.2.3 Motivation

Stemming from multiple different conceptual elements, during the COVID-19 pandemic, *motivation* also presented as a strong correlate of PA. On an intrinsic level, autonomous motivation was related to being more active [49, 61, 76]. Emotional and psychological well-being [20], perceived benefit [49, 61], maintaining good health [20], feeling better about oneself [20], affective judgements [67] - particularly enjoyment [20, 49, 61]), the level of interest [33], desire to participate, and importance placed on PA [20], were all identified as potential influential PA motives. Additionally, where positive affect was positively related to MVPA [26, 55], and in some instances moderate-intensity PA [26], negative affect was negatively related to MVPA [55]. On an extrinsic level, external regulation [49], striving to achieve goals [67], and introjected factors, for example, forcing oneself or viewing PA as a drudgery task, were associated with PA regulation [20, 61]. Conversely, being amotivated [49], or having a general lack of motivation, was related to being less active [44, 47].



### 3.2.4 Cognition

Physical activity modulation has been linked to *cognitive* characteristics. In adults, correlations were observed between confidence [49, 61], identity [67], perceived

capability [76], resilience factors (locus of control/self-efficacy/optimism) [26,27], knowledge [43, 56], and PA levels. However, no association between knowledge and behaviour was reported [76]. It is unclear whether specific COVID-19 concerns impacted engagement; whilst a fear of contamination was a reported concern [33], it served as both a PA driver and inhibitor [25].

### 3.2.5 Behaviour

Actions and responses, or *behaviour* factors, had important repercussions for PA during the COVID-19 pandemic. Higher levels of pre-restriction PA were linked to having a higher probability of maintaining, increasing, or having sufficient levels during the restrictions [30, 75], but also related to having the greatest declines [28, 37, 42, 57, 78]. Larger reductions in PA were observed in adults who previously attended the gym [37], exercised with friends [33], or engaged with a sports club [33, 42]. Merely participating/being previously active, and therefore having an established habit, had positive effects on PA levels [23, 30, 31, 42, 67], including time spent engaging in outdoor activity [49], and led to being more likely to achieve PA guidelines [38]. Although, trends were observed whereby adults classified as 'less active' before COVID-19 actually also increased the time they spent being physically active during the period of restrictions [28, 57].



Whilst an association with *behaviour* is apparent, the mechanisms of effect are potentially complex. Relationships were reported between behavioural intention and PA levels [72, 81]. However, additionally, associations were reported between prior PA habits, intention, and autonomous motivation during the pandemic [31], with such social cognition constructs (autonomous motivation, perceived behaviour control, attitudes, subjective norms) potentially mediating the relationship between past behaviour and subsequent intention [45]. Similarly, associations were observed between

behavioural planning and PA levels [61, 67], with planning also identified as a potential mediator between past behaviour and intentions [45].

### 3.3 Social Level Factors

#### 3.3.1 Sociodemographics

Several factors reporting a relationship with PA levels were themed as *sociodemographic* factors. A general association with income was observed [41, 67], with higher income related to a higher exercise frequency [30], achieving sufficient [75] or increased levels of PA [37], and being more likely to change to more intense PA [70]. Conversely, having a lower income was related to lower PA levels [69], with COVID-19 related changes to income associated with a higher risk of greater declines in PA [37] and changes to pregnancy exercise routines [39]. Being food secure, potentially related to income, was also negatively related with sitting behaviour [79]. However, being from a higher socioeconomic status family was found to be a predictor of both physical inactivity and sedentary time (sitting) [65].



Adults with a higher level of education were less likely to decrease their PA levels [25, 33, 52], with education being positively correlated to MVPA [67]. However, these findings are counterbalanced by reports of no significant association [30,43] and physical inactivity being significantly higher among those educated to graduate level or above [65]. Furthermore, being a student was, in general, related to being less active in comparison to pre-COVID-19 [40], significant decreases in MVPA [42], decreases across all PA intensity levels [28], and, higher levels of physical inactivity [65] and sitting time [65, 72]. No association was found between student living environment (university residence, shared apartment, with family) and sitting time [72].

Regarding employment status, where in some instances a general association was observed [67] and employed individuals showed significantly lower reductions in

PA levels [52], being unemployed was equivocally related to decreased [37], insufficient [43], or higher levels of PA [41]. Where those who transitioned to working at home during the pandemic increased their PA, those who did not, or were already working from home, experienced a decline [37].

Whilst ethnicity may be related to variations in parameters of PA [34, 69, 79], and sitting time [79], the breadth of data on which to draw inferences is limited.

### 3.3.2 Support

The theme of *support* from both social and structured sources was identified. Having better social relationships was related to higher levels of moderate- and vigorous-intensity PA [50], whilst lower perceived social well-being was associated with engagement in less PA [61]. Access to less social support was related to being less active [49, 59, 61], with this suggested to be particularly pertinent in adults who were already classed as inactive [49]. However, no link was found between social opportunity and different PA modalities (i.e., for transport, at work, in the neighbourhood) [76]. A lack of access to structured support, from instructors [44], organised activities, friends/companions, and the competitive aspects of exercise [33] were all deemed detrimental. Indeed, a degree of association was also observed between being able to engage in PA with others and mental health [49], an already noted potentially important correlate.



### 3.3.3 Domestic Situation

Parameters of an adult's home life, or *domestic situation*, were thematically highlighted as potential PA facilitators and barriers. Living alone was associated with greater decreases [37] or starting to do less intense PA [70], whereas although some reported no effect of having dependents at home [37], others reported that having children was associated with greater increases in PA [47, 67] or starting to do more

intense PA [70]. Furthermore, although the volume of PA increased as the number of children per household increased [79], the reverse was observed for the number of grandchildren [23]. Having a partner or family to exercise with [33] (particularly for females [22]), a dog [62, 67], being married [41], a housewife [65] or living with a nuclear, not joint family [65], were all related to higher PA levels, as opposed to being single which was associated to higher levels of physical inactivity [65]. However, living with a nuclear family predicted higher levels of sedentary behaviour (sitting time) [65]. For women, having stable childcare provision positively impacted opportunities for PA, whilst increasing childcare demands were linked to decreases in confidence, and more difficulty engaging in PA [61].

### 3.3.4 Lifestyle Choices



Associations were identified between choices regarding other health-related behaviours and PA, specifically diet. Reducing food intake was associated with increases in PA [25], a negative correlation was observed with pre-prepared food or snack intake [60], a positive correlation with general changes to diet [40], and significant differences (direction unspecified) with not eating a Mediterranean diet [72]. For sedentary behaviour related outcomes, alcohol consumption, eating a Mediterranean diet and/or being a non-smoker were related to increased sitting time [72], whilst taking active breaks afforded some protection over poor dietary choices [66]. Significant correlations were noted between PA and sedentary time/behaviour. Being less sedentary was related to being more active [33], and vice versa [54, 65, 79], with adults who were more active pre-restrictions potentially being more likely to report the highest increases in sitting time [28]. However, no specific correlation was identified between stage of change (PA) and sitting time, with increases observed with groups in the contemplation, preparation, action and maintenance stages [72].

### 3.4 Environmental Factors

#### 3.4.1 Area of Residence

Whilst acknowledged as one of the weaker themes identified, a potential association was identified between factors relating to an adult's *area of residence* and PA levels. Living in an urban or metro area was related to undertaking less PA [65], being less likely to meet MVPA guidelines during the pandemic [43], being more likely to report pregnancy exercise routine changes [39] and increased sitting time [65]. Additionally, not having access to outdoor space was linked to starting to do less intense PA [70]. However, with other reports of no significant effects of any neighbourhood environment variables on PA [67], the magnitude of importance of area of residence remains unclear.



#### 3.4.2 Resources

With the enforcement of restrictions came a loss or change in access to *resources*, including facilities and equipment. Access to sports clubs [33], gyms [44, 54], and suitable (gym) equipment [51], represented a major obstacle to engaging in PA. Having access to equipment at home was related to being more active [67], and predicted greater levels of PA, planning and autonomous motivation [45]. Purchasing home equipment also attenuated declines, or led to increases in, PA [37]. The effects of having access to cardiovascular and/or strength training equipment were potentially mediated by, and correlated with, autonomous motivation [45], with autonomous motivation and components of the theory of planned behaviour (attitudes, subjective norms, perceived behavioural control) also potentially mediating the relationship between equipment availability and PA intention and/or habit [45]. Engagement with alternative resources, specifically technology-driven, virtually delivered fitness platforms, (i.e., exergaming, online classes), led to increases in [37], or higher levels of,

total PA [33] (compared to those who did not), or the maintenance of PA routines [44, 56]. Additionally, the use of a specific PA app, and its gamification features, was related to more positive changes in PA but not sedentary behaviour (sitting time) [81].

### 3.5 COVID-19 Related Rules

Whilst the country-specific *COVID-19 related rules* and regulations that were implemented to curtail the spread of the virus may have had overarching, more indirect, negative effects on adult's PA (as identified in the previous themes), the direct effects were variable. Whilst in some instances social distancing measures had a negative effect on MVPA [67], in others, no specific effects of lockdown policy or COVID-19 restrictions were observed [43,49], or the restrictions presented barriers to PA for females but not males [61]. Similarly, being furloughed was associated with greater declines in PA [37], transitioning to working from home with increased PA [37] and changes to work status (working from home or lost job) had no effect [58, 61]. Conversely, such changes were related to higher sitting time (working from home or lost job) and screen time (lost job) [58].



Other changes to routines also had varying effects. Whilst some found that more time was available which facilitated PA opportunities [33, 47, 54], others found reductions in time to be a barrier [33, 54]. Not being able to continue and missing usual exercise regimes was related to less PA [33, 61], whereas those who were able to adapt their routines were able to limit their PA declines [37, 56]. The specific limitations through a perceived lack of opportunity to be active also had negative connotations for PA [49, 61, 76].

### 3.6. Discussion

This review sought to explore the correlates of PA and sedentary time/behaviour in adults aged 18 years or over during the unique period of enforced lifestyle restrictions

during the COVID-19 pandemic. A recent systematic review found that in the vast majority of included studies PA decreased and sedentary behaviour increased in both adults and children [82]. Enhancing our understanding of the multilevel influences on PA, and where possible sedentary time/behaviour, is therefore urgently needed to effectively guide future public health initiatives and policies.

<< *Insert Figure 2 here* >>

For PA, the model illustrates potential influences over all five levels: Individual (biological); Individual (psychological); Social; Environmental, and Policy. For sedentary time/behaviour, the findings provide some indication that individual level factors, namely general and mental health may be the primary correlates of importance. Indeed, it is already established that the relationship between mental health, as the overall concept or as specifically defined conditions (i.e., depression, anxiety), and PA/sedentary behaviour is bi-directional [83]. Specifically, poor mental health status often leads to being less physically active and more sedentary, whilst being less active and engaging in more sedentary behaviours can have negative implications for mental health [83]. Several studies have reported this to be a significant issue during the first stage of lockdown restrictions (for a review, see Caputo & Reichet, [84]). Nonetheless, more detailed discussions of this correlate are precluded by the lack appropriate available evidence, and indeed robustness, during the COVID-19 restrictions.



Prior behaviour, and more specifically habits, were associated with PA engagement during the periods of restrictions [23, 28, 30, 31, 37, 42, 67, 57, 75, 78]. It is, however, apparent that relationships and interactions between factors from different levels of the socioecological model, and the magnitude of effect that these may have at

an individual level, may, at least in part, explain some of the variations in the behaviour observed. The ability to maintain habits was, for some, directly influenced by a loss of access to resources and facilities [33, 37, 42]. For individuals who participated in team sports [33, 42] or utilised gyms [37] or other sporting facilities (e.g., swimming pools) to keep active, pre-COVID-19 participation and habit could have become irrelevant given that the opportunity had been removed. In contrast, such impact on habits were less manifest for those who engaged in outdoor physical activities, such as running. Whilst it could be argued that being physically active and less sedentary does not have to be dependent on equipment, establishing new habits may be challenging if sociodemographic situations [37, 39, 43, 69], support structures [33, 44, 49, 59, 61] and/or local infrastructure [65, 70] are not optimal. Notwithstanding these factors, individuals may also need to draw on, and maintain, their personal motivation, on an intrinsic [20, 26, 33, 49, 55, 61, 67, 76] and/or extrinsic level [20, 61, 49, 67], and believe in their own capability [26, 27, 43, 56,49, 61, 67, 76].



Interestingly, unlike pre-COVID-19 [85, 86], during the pandemic restrictions neither age or sex presented a clear correlation with either PA or sedentary time/behaviour. It is, however, pertinent to acknowledge other factors that may have influenced these findings. As outlined in Table 2, the countries in which the studies were undertaken and the level of restrictions imposed, even sometimes within countries, varied significantly. Additionally, seasonal differences, which are already known to impact both PA and sedentary time/behaviour [87] have not been accounted for. Individuals surveyed who resided in countries where the weather facilitated outdoor activity, may not have been as severely impacted by any imposed restrictions. Finally, studies predominately report levels of MVPA. Where light-intensity PA was reported, sex differences were found, with females being more likely to engage in sufficient

levels, in comparison to males [26]. Given that even small increases in PA can have positive benefits [1], with a move towards 24-hour movement guidelines [88], this finding warrants further exploration.

It is apparent that there may be differences in the level of impact different correlates have for different age or sex groups, such as mental health having a greater impact on PA in women [57], with age-related differences in the type of screen time that needs to be challenged [32]. However, there were insufficient group-specific data, which precluded futher interpretation. Such differences, however, are theoretically not unexpected. If pre-COVID-19, different populations (i.e., older adults) had different motivators and barriers to PA [89, 90] that require different batteries of behaviour change techniques to facilitate change [91], then it stands to reason that the correlates of their behaviour during these periods of 'unknown' could be different. Only three studies specifically surveyed adults aged ≥ 60 years [28, 68, 78].



### 3.7. Recommendations for policy: Mapping to the COM-B

Understanding which mechanisms of behaviour need to be targeted to develop effective interventions or strategies to facilitate PA is essential. Mapping the identified correlate themes for PA to the components of the COM-B [11] (Table 3), highlights that, to some degree, changes to all behavioural components could be needed. However, when considered in context with the strength of evidence supporting each theme, as previously discussed, and the frequency of component identification, *capability* (psychological) and *opportunity* (physical) become the core focus for attention. Whilst it is clear that the removal of physical opportunity had a significant impact on PA levels during the initial pandemic control restrictions, future policies need to not only consider

this but that the application of strategies that promote psychological well-being may be vital, both of which are not mutually exclusive.

During the easing of restrictions, particularly within the United Kingdom, sports and leisure facilities were amongst the last to re-open. Moreover, some have not yet re-opened at all, with others having a significantly reduced capacity. The benefits of PA for health and well-being have been deemed irrefutable [92]. Therefore, if measures are not taken to facilitate at least a return to access at pre-COVID-19 levels, or improve access to alternative options (i.e., outdoor gyms, cycle tracks), then especially in more rural areas where opportunity is already limited, the negative repercussions not just immediately, but for future generations, could be extensive. Moreover, given the observed correlations with sociodemographic-related factors, limiting access to affordable PA options will only serve to widen the current socioeconomic health gap.



*<< Insert Table 3 here >>*

### 3.8. Strengths and limitations

Despite the rigorous, systematic approach adopted, underpinned by published guidance and the use of validated tools, this review is not without limitations. In all epidemiological research, the results will always be partially dependent on who chooses to participate and the variables that the studies chose to explore. The data included in this analysis are cross-sectional. Therefore, even where a direction of effect has been stated, this only infers correlation, not causation. The majority of data were collected via self-report measures, with retrospective recall of pre-COVID behaviour patterns. During the unprecedented COVID-19 situation, it does however have to be accepted that these online methods, even with their potential accuracy and generalisability

limitations [93], ultimately provided the most appropriate approach. It is also important to note that i) 17 studies used unvalidated measures of PA or sedentary time/behaviour [19, 25, 30, 33, 35, 39, 40, 41, 46, 59, 64, 71, 73-75, 77, 80]; ii) only studies published in English were included; and, iii) the participant samples are not representative of the target population, being biased towards female, higher-educated and younger adults, whilst also lacking ethnical diversity.

## 4. CONCLUSION

The vital restrictions enforced in an endeavour to control the devastating effects of COVID-19 had a profound impact on PA and sedentary time/behaviour across the world [82]. The factors underpinning these effects are complex and multi-faceted. However, for adults, as we transition into a new normal, during any future periods of restrictions, or as part of focused behaviour change interventions, targeting *capability* on a psychological level may be essential to both facilitate PA and limit sedentary time/behaviour. For PA, whilst factors such as social support and motivation may also be important, limiting restrictions to *opportunity* on a physical level could be crucial.



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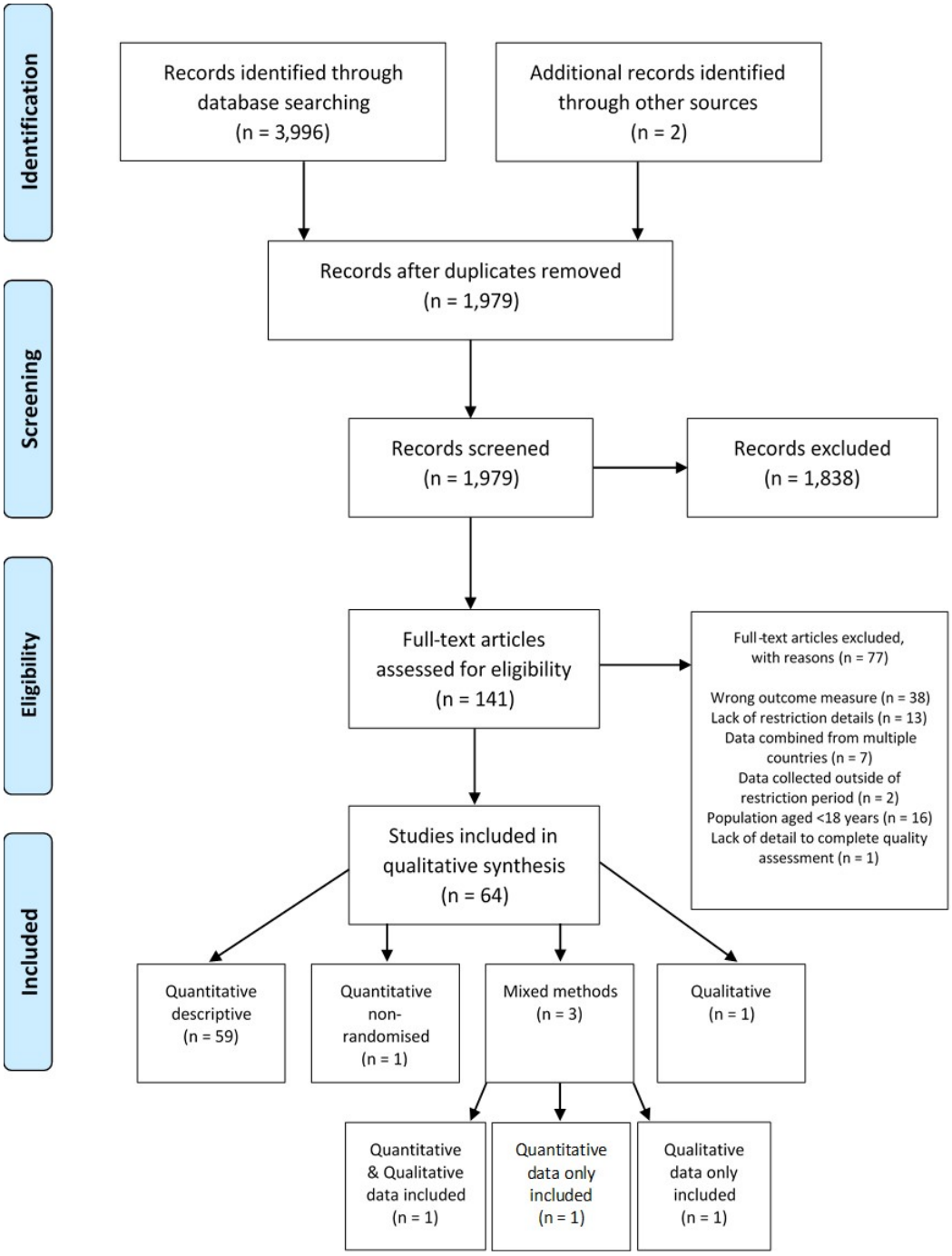


**Figure 1**. Schematic flow diagram of the integrative review process


**Figure 2.** Socioeconomic model of correlates of physical activity during the COVID-19 restrictions

**Table 1.** Study inclusion/exclusion criteria

| Variable | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Population, or participants and condition or interest | Adults aged 18 years or older<br>Any sex/gender<br>Not restricted to the UK | Studies including children and adolescents (aged less than 18 years) |
| Intervention or exposures | Exposure to the COVID-19 pandemic, containment and mitigation strategies | Studies that involve non-COVID-19 related pandemics, such as SARS or MERS |
| Comparison or control groups | No restrictions | |
| Outcomes of interest | Data/information, qualitative or quantitative, relating to correlates of PA and/or sedentary time/behaviour during the COVID-19 pandemic | No data relating to the pandemic phase or restrictions in place available<br>Studies only including empirical data on volume of or changes in volume of PA or sedentary time/behaviour<br>Data pooled from multiple different countries |
| Setting | Any community setting | |
| Study designs | Any providing original results | Studies not providing original results, such as systematic reviews, meta-analysis, general reviews or editorials |



*Note*. COVID-19 = novel coronavirus disease 2019; PA = physical activity; MERS = Middle East Respiratory-System related coronavirus SARS = Severe Acute Respiratory Syndrome; UK = United Kingdom

**Table 2.** Illustrative summary of study characteristics and overall study quality

| | | Number of studies |
|---|---|---|
| Country of study | Australia | 1 [62] |
| | Austria | 1 [64] |
| | Bangladesh | 2 [46,65] |
| | Belgium | 1 [33] |
| | Brazil | 3 [56,74,80] |
| | Canada | 5 [32,48,49,61,67] |
| | Chile | 1 [66] |
| | China | 1 [51] |
| | Croatia | 1 [42] |
| | France | 1 [73] |
| | Ghana | 1 [21] |
| | Hungary | 1 [18] |
| | Japan | 2 [60,78] |
| | Jordan | 1 [19] |
| | KSA | 1 [22] |
| | India | 1 [44] |
| | Italy | 5 [25,31,38,54,57] |
| | Northern Cyprus | 1 [23] |
| | Spain | 8 [20,26-29,52,53,72] |
| | Taiwan | 1 [30] |
| | Thailand | 1 [43] |
| | Turkey | 1 [63] |
| | United Kingdom | 9 [24,36,40,41,68,69,70,75,76] |
| | Ukraine | 1 [71] |
| | USA | 13 [34,35,37,39,45,47,50,55,58,59,77,79,81] |
| Study design | Observational | |
| | Cross-sectional | 59 [18-28,30-38,40-43,45-54,56-71,73-81] |
| | Longitudinal | 4 [29,39,55,72] |
| | Phenomenological | 1 [44] |
| Correlated behaviour | Physical activity | 64 [18-81] |
| | Sedentary behaviour | |
| | Active breaks | 1 [66] |
| | Screen time | 5 [19,32,58,59,80] |
| | Sitting time | 11 [18,24,26,28,51,54,58,59,65,68,72,77,79] |
| | Sedentary time | 2 [21,81] |
| Primary COVID-19 restrictions | Stay-at-home order | 47 [18-29,31,34-36,38,40-46,51-57,60, 62-65,68-76,78,80] |
| | Social distancing | 4 [30,58,59,66] |
| | Varied by state/region | 12 [32,37,39,47-50,61,67,77,79,81] |
| | Lockdown light | 1 [33] |
| Overall study quality | * | 1 [77] |
| | ** | 10 [31,55,56,57,59,60,71,73-75] |
| | *** | 29 [19,21,22,24,25,27,29,30,32,33,35,37,39,40,41,43,46,58, 61,63-66,68,70,72,76,79,81] |
| | **** | 21 [18,20,23,26,28,34,38,42,45,47-54,67,69,78,80] |
| | ***** | 3 [36,44,62] |

*Note:* COVID-19 = novel coronavirus disease 2019; KSA = Kingdom of Saudi Arabia; USA = United States of America

**Table 3.** Physical activity socioecological model themes mapped to the COM-B components

| Framework theme | Theme | COM-B component |
|---|---|---|
| Individual (biological) | General health | Capability (Physical) |
| Individual (psychological) | Mental health | Capability (Psychological) |
| Individual (psychological) | Motivation | Motivation (Automatic) |
| Individual (psychological) | Cognitions | Capability (Psychological) |
| Individual (psychological) | Behaviour | Motivation (Reflexive) |
| Social | Sociodemographic factors | Opportunity (Physical) |
| Social | Support | Opportunity (Social) |
| Social | Domestic situation | Opportunity (Social) |
| Social | Lifestyle choices | Capability (Psychological) |
| Environment | Resources | Opportunity (Physical) |
| Environment | Area of residence | Opportunity (Physical) |
| Policy | COVID-19 related factors | Opportunity (Physical) |

*Note:* COVID-19 = novel coronavirus disease 2019