Examining dyadic processes in a person-centred intervention to increase outdoor walking after stroke

by

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Abstract

People with stroke are typically inactive. Dyadic interventions which involve two people working together to support change may increase activity. This study examines dyadic processes in a dyadic intervention for walking after stroke.

Single-arm observational pilot intervention study with qualitative process evaluation. Participants were people with stroke and their walking buddies. The 12-week intervention involved face-to-face and telephone sessions. Interview data and fieldnotes were thematically analyzed. 21 dyads were recruited. Ten dyads completed the intervention prior to COVID-19 restrictions. Eighteen dyads completed exit interviews. Four major themes were created: 'Communication' which helped to adapt to the environment, deepened relationships and promoted understanding; 'Motivation' which was increased by encouragement and improvement; 'Confidence' stemming from improved ability, comfort and independence; and 'Enjoyment' through reconnecting with the partner and the community. The dyadic structure of the intervention gave rise to several dyadic processes in relation to initiating and maintaining behaviour change.

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Dedication

To my Grandma, who always encouraged my pursuit in education, and whom without, it would not have been possible to attain. Though she passed before this thesis was complete, I know she is proud.

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List of Symbols, Nomenclature or Abbreviations

PA	Physical activity
BCT	Behaviour change techniques
UK	United Kingdom
PwS	Person with stroke
F	Facilitator
Bud	Walking buddy

Chapter 1: General Background

Causes and Consequences of Stroke

A stroke is caused by a restriction of blood flow to the brain (Heart and Stroke Foundation of Canada, 2021). The type of stroke is determined by how the blood flow is disrupted. An ischemic stroke is caused by a clot or blockage, often a result of plaque build-up on the inner wall of an artery. A hemorrhagic stroke is the rupture of a weakened artery wall, most commonly caused by high blood pressure (Heart and Stroke Foundation of Canada, 2021, Saunders et al., 2020). Furthermore, a transient ischemic attack (TIA) – also referred to as a warning or mini stroke – is a brief blockage caused by a small clot. Symptoms from a TIA are often short (usually less than an hour) and often a warning sign that a more serious stroke may occur in the near future (Heart and Stroke Foundation of Canada, 2021).

The impact following a stroke is unique to each individual, as the severity poststroke is determined by a combination of factors including: the type of stroke (i.e., ischemic or hemorrhagic), the hemisphere of the brain where the stroke occurred (right or left), which lobe or lobes of the brain were affected, the overall size of the damaged area in the brain, how much time the area received limited to no blood flow, and the time needed to get to a hospital (Heart and Stroke Foundation of Canada, 2021). These factors may change how a person with stroke thinks, feels, moves and behaves (Saunders et al., 2020). Some common disabilities observed six months poststroke include difficulty walking without aid, dependence with activities of daily living, aphasia, and depression (Roger et al., 2011). These disabilities may impact a

person living with stroke's ability to adhere to physical activity (PA) guidelines (Moore et al., 2013).

Physical Activity and Stroke

Globally, stroke is the leading cause of adult disability (Stroke Association, 2016). According to the United Kingdom's (UK) Stroke Association, people with stroke find the physical consequences of a stroke the most difficult to accept. Poststroke, 80% of people with stroke experience physical disability (Stroke Association, 2016) presented as a limitation or loss of functional abilities, movements or mobility (Saunders et al., 2020). PA helps rehabilitate and maintain recovery both mentally and physically in a person with stroke (Heart and Stroke Foundation of Canada, 2021; Morris et al., 2015).

PA encompasses structured and repetitive body movements resulting in expending energy and improved health, whereas sedentary behaviour involves inactivity and extended periods of sitting (Saunders et al., 2020; Morris et al., 2015). PA poststroke may reduce the risk of a stroke reoccurring and improve the individual's overall functioning, health and wellbeing (Lee et al., 2003). Additional outcomes of regular PA post-stroke include increased VO2 peak, muscle strength, bone density, functional mobility, balance, improved quality of life, walking speed and capacity, along with reduced fatigue, falls, fractures, and disability (Heart and Stroke Foundation of Canada, 2021; Saunders et al., 2020; Morris et al., 2015). However, people with stroke exhibit low levels of PA due to a variety of reasons including limitations and disabilities experienced poststroke (Morris et al., 2015; Morris et al., 2014; Fini et al., 2017;

Saunders et al., 2020; Moore et al., 2013; Vahlberg et al., 2018). Sedentary time is high, with patients spending an average of 23 hours per day sedentary immediately following a stroke (Moore et al., 2013).

The impact of physical disabilities after a stroke can be reduced through walking (Saunders et al., 2020; Fini et al., 2017). The Heart and Stroke Foundation of Canada recommends that people with stroke should attain a minimum of 150 minutes of moderate-to-vigorous intensity PA per week, equivalent to the general adult population (Heart and Stroke Foundation of Canada, 2021). Walking may be classified as moderate-intensity PA for people with stroke due to the higher energy costs poststroke (Fini et al., 2017). Although time spent sedentary poststroke decreases after three months, PA levels remain ~50% below these recommended guidelines (Moore et al., 2013). On average, people with stroke's daily step-count is half of what individuals are who are healthy and of the same age attain (Fini et al., 2017; Moore et al., 2013). Walking as a form of PA has been shown to improve people with stroke's cardiorespiratory health, fitness, balance and mobility (Saunders et al., 2020). Moreover, walking is one of the most attainable forms of PA post-stroke, as 95% of individuals are able to walk within 11 weeks following stroke (Jorgense et al., 1994). Therefore, walking is affordable and accessible for most people with stroke and is a viable target for intervention (Vahlberg et al., 2018).

Behaviour Change Theory and Physical Activity Interventions

Interventions aiming to support a behaviour change may benefit from integrating behaviour change theories into the development process (Michie &

Johnston., 2012). Behavioural theories identify and provide a scientific explanation for the key constructs and relationships within the process of behaviour and behaviour change (Michie et al., 2008). Many theories aim to describe why, when, and how change can occur which may aid in the understanding of how certain interventions succeed or fail (Michie et al., 2008). The use of theory-based behaviour change components allows for the integration of interventions based on a hypothesised causal pathway (Michie & Johnston, 2012). Effective mapping of theoretical causal pathways for behaviour change techniques (BCTs) requires the specification of theoretical framework, identifying techniques to change desired behaviour, and selecting the appropriate techniques to map differing determinants of behaviour (Michie & Johnston, 2012). Theory based behaviour change interventions can help promote the long-term maintenance of PA after stroke (Morris et al., 2014) and should be implemented into people with strokes' rehabilitation to inform interventions that address and overcome barriers specific to the individual (Morris et al., 2014).

A systematic review conducted by Morris et al., (2014) investigated the effects of 11 interventions – 11 randomized control trials – which promoted the long-term participation in PA for people with stroke. Within these 11 studies, six incorporated tailored counseling (with or without supervised exercise) and five were supervised exercise with general advice. Of the six tailored counseling studies, three showed an increase of attaining the recommended PA levels and continued participating in PA 12 months after the intervention ended. Two of the supervised exercise interventions showed a significant improvement in step count data at three months; however, the PA

levels were not maintained and declined three months after the intervention (Morris et al., 2014). The review concluded that findings suggest interventions aiming to maintain long-term participation of PA might benefit from incorporating PA-specific tailored counseling that is based on behavioural theory (Morris et al., 2014). Moreover, it has been suggested that current research on behaviour change interventions for people with stroke have not been studied thoroughly enough or on a large enough scale (Bakas et al., 2017).

Dyadic Intervention and Behaviour Change

Social support based behaviour change interventions can improve the long-term maintenance of PA poststroke (Morris et al., 2015). The inclusion of social support, such as a family member or a friend, is often referred to as a dyad when it includes two individuals, and may be incorporated into the intervention (Bakas et al., 2017). In the context of people with stroke, a dyadic intervention involves creating a shared target-oriented goal that the dyad, the person with stroke and family member or friend, aim to achieve.

Research shows PA with a partner may help keep an individual motivated and interested (The Heart and Stroke Foundation of Canada, 2021). A qualitative study examining the perceptions of PA following a stroke found people with stroke and their partner co-construct poststroke narratives and share recovery outcomes and future goals, which extend to the support of PA (Morris et al., 2015). Their findings suggest that carers are crucial in supporting PA following rehabilitation and have the potential

to support a person with stroke in meeting PA goals beneficial for improving health and subsequent stroke prevention (Morris et al., 2015).

Bakas et al. (2014) systematically reviewed 15 studies – 11 randomized control trials, three controlled clinical trials and one repeated measures design – all of which incorporated a dyadic intervention component for people with stroke. Of these, 14 of the 15 studies showed significant improvement in outcomes post intervention in people with stroke. Studies used a variety of different intervention approaches to supporting behaviour change. One study for example, examined if education and counselling after a stroke led to i) enhanced psychosocial and family functioning outcomes for stroke patients and their partners, and ii) improved functional and social outcomes for people with stroke (Clark & Rubenach, 2003). The study was a two-group randomized control trial comprised of an intervention group who received an information package and three visits from a social worker, and a control group. Data was collected during admission and discharge from rehabilitation and again six months later. The study reported the education and counselling provided to the intervention group led to improved social and functional outcomes for people with stroke and therefore aided patients and their partners in how to optimize living with stroke (Clark & Rubenach, 2003). Currently, studies analyzing dyadic interventions in stroke have focused on the short-term outcomes of the intervention but not the maintenance of PA (Bakas et al., 2014).

We Walk Study

We Walk is a dyadic behaviour change intervention targeted at helping people with stroke to increase uptake and maintenance of outdoor walking after stroke (Morris et al., 2022). We Walk was developed by a multidisciplinary research team led by Dr Jacqui Morris at the University of Dundee, Scotland. The We Walk project aimed to develop and test a person-centred theory-based dyadic intervention. The study reviews by the North of Scotland Research Ethics Committee (Reference: 19/NS/0077 protocol 1-022-19). We Walk was developed in two phases using person-centred principles and the Behaviour Change Wheel (Michie et al., 2011). The below section briefly introduces the person-centred principles and the Behaviour Change Wheel framework before describing the two phases of the intervention development process. For a full and detailed description of the development process see Morris et al., 2022.

Person-Centered Principles

We Walk adopted person-centred principles to aid in the development and delivery of the intervention (Morris et al., 2022). These principles were:

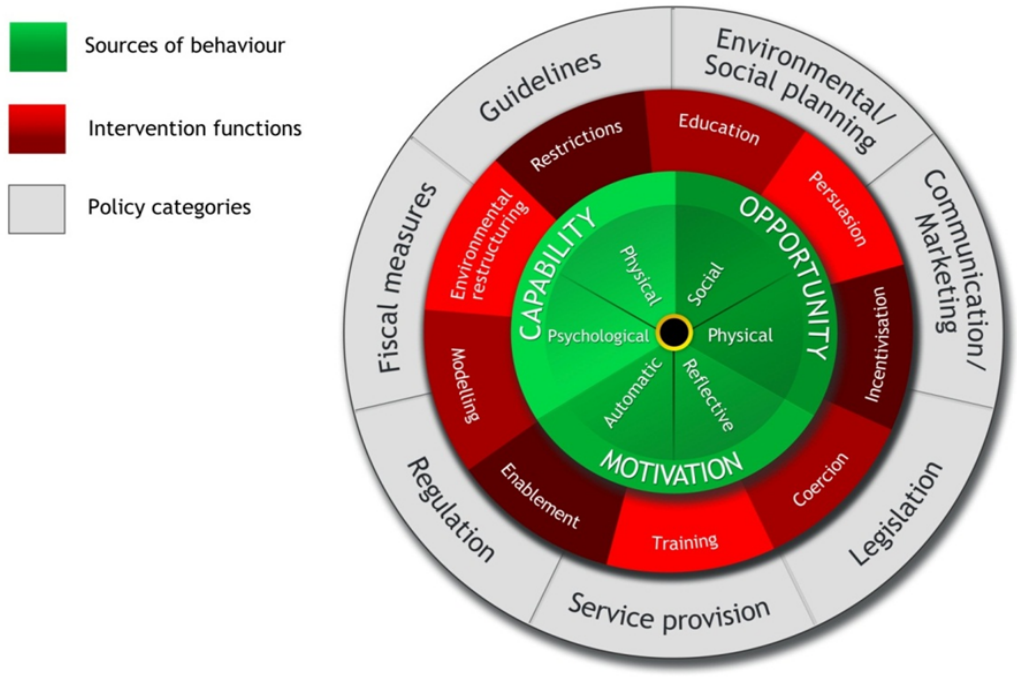
1) Take the person's values, perspective, social role and psychosocial context into account
2) Consider the values, future aspirations, experiences and concerns of the participant and their walking buddy to facilitate their involvement in decision-making
3) Understand their beliefs, values and experiences
4) Recognize the individual's uniqueness and maximize personally relevant resources by identifying significant goals and agendas in their lives
5) Pay attention to the person as a whole

The research team consistently assessed the language and the tone used in the written materials, interactions with stakeholders and how data was collected and analyzed throughout the development of the intervention to ensure person-centred principles were followed (Morris et al., 2022).

Behaviour Change Wheel

The Behaviour Change Wheel is a theoretically based system used for behaviour change intervention development (see Figure 1). This system classifies behaviour change interventions into nine intervention functions and seven policy categories that aid in identifying and using the most effective behaviour change techniques when developing an intervention (Michie et al., 2011). The centre of the wheel is comprised of a behaviour system, capability, opportunity, and motivation, referred to as COM-B system for the sources of behaviour. This is surrounded the nine intervention functions which aim to address the deficits in the intervention function (Michie et el., 2011). Lastly, are the seven policy categories which enables an intervention to occur. The Behaviour Change Wheel is based on a comprehensive causal analysis of behaviour and begins with asking what an individual needs in their social and physical environments to achieve a specified behavioural target (Michie et el., 2011).

Figure 1: The Behaviour Change Wheel (Michie et al., 2011)



Phased Intervention Development of We Walk

The intervention was developed in two consecutive phases each consisting of various steps outline below.

Phase 1. The initial phase of the intervention development process consisted of identifying existing evidence on the barriers and facilitators to PA after a stroke (*Step 1a)*. These were then mapped onto the intervention functions and policy categories in line with the Behaviour Change Wheel methods and incorporated into a logic model *(Step 1b)*.

Phase 2. A stakeholder consultation and intervention refinement was held to identify any concerns or suggestions for changes, which involved consulting with people with stroke, their companions and health professionals *(Step 2a)*. This was

followed by a review from experts in behaviour change intervention development who confirmed the theoretical coherence of the intervention *(Step 2b*). A review was conducted by patient and public engagement groups. These reviews aimed to confirm and identify any necessary changes to the intervention. A more detailed outline of the development in each phase is provided in Table 1. The intervention was designed with input from 6 focus groups comprised of 23 people with stroke, 16 survivor companions (e.g. family and friends), as well as 37 health and exercise professionals (22 physiotherapists, 8 occupational therapists, 5 stroke nurses and 2 exercise services coordinators).

Table 1: Development of phases in We Walk Study

Phase:	Development:
Phase 1a: Evaluation of existing evidence on barriers and facilitators to PA after stroke	• Barriers and facilitators to PA following a stroke were identified via a systematic search • Barriers and facilitators were then categorized into 12 themes (i.e. psychological, social, physical or environmental) • It was suggested the dyad should be referred to as "walking buddy"
Phase 1b: Evidence mapping/behavioural diagnosis	• Mapped the barriers and facilitators according to behaviour change theory following the methods of the behaviour change wheel • Behaviour change wheel identified 5 interventions that could be used to target increased walking behaviour change: education, persuasion, training, modelling and enablement • Developed logic model to help identify pathways between proposed intervention inputs, the process and outcomes for desired behaviour change

	• The structure of the intervention was created using the behavioural diagnosis and logic model
Phase 2a: Consultation with people with stroke, their companions and health professionals	• Stakeholder consultations were conducted with people with stroke, their companions and health professionals – all participants provided informed consent • Aimed to: confirm delivery format, identify any necessary changes, examine how dyads could work, and ensure person-centeredness was included throughout • Based on the findings: the draft intervention was refined prior to pilot testing • Researchers introduced the draft intervention to small groups • Next, separate focus groups for survivors, companions and health professionals were held for an in-depth analysis of each group's perspective
Phase 2b: Theoretical coherence of the intervention: Review by experts in behaviour change intervention development	• A group of international health psychology and PA research experts were contacted and requested to review the draft of the intervention • Data from previous phases were analyzed by the research team to confirm refinements on the delivery handbook and materials for testing in phase 2

We Walk was designed for the dyad and intervention facilitator to work as equal partners to set, plan, and achieve the goal of walking more following a stroke, rather than to tell people with stroke what to do or when to walk. It aimed to help people with stroke improve and maintain their recovery by using attainable and enjoyable walking within their own community (Morris et al., 2022). Researchers implemented the pilot study to allow fieldwork data to be collected in detail to help

refine the intervention if needed. The study aimed to test how acceptable and feasible the intervention is and receive feedback on how it can be improved and adapted for future use.

The pilot-test of We Walk identified three themes: 'acceptability evolves with experience', 'mutuality', and 'person-centredness with personally relevant tailoring' (Morris et al., 2023). The theme 'acceptability evolves with experience' expresses how dyads felt the intervention was acceptable and easier as their familiarity with the intervention grew. 'Mutuality' refers to how dyads who worked well together engaged in the intervention most successfully which led to social, physical and psychological benefits (Morris et al., 2023). The theme 'person-centredness with personally relevant tailoring' indicated the person-centred aspect allowed the persons with stroke the ability to adapt the intervention to their individual values, goals and capabilities and was a critical aspect to engaging in the intervention (Morris et al., 2023)

Process Evaluation

To help improve behaviour change interventions such as We Walk for future use, it is vital to understand and confirm the process of the dyadic intervention. This may be accomplished through the use of a process evaluation. Process evaluations are conducted using a systematic approach to identify key process questions and involves considering assumptions that are represented in the intervention (Moore et al., 2015). It aims to capture an intervention's fidelity, dose or reach to understand how specific effects occurred and how these can be replicated and optimised in the future versions of the intervention. When evaluating the effectiveness of an intervention, the main

focus of a process evaluation is to provide greater confidence in the conclusions that are drawn from the study and identify any new uncertainties that may have emerged following the pilot test (Moore et al., 2015).

Martinsen and colleagues (2021) conducted a process evaluation alongside a dialogue-based intervention which aimed to improve psychosocial support following a stroke in a randomized control trial. This process evaluation was embedded in the clinical trial and sought to deepen the understanding of the intervention processes (Martinsen et al., 2021). In eight focus group sessions the process evaluation assessed 22 intervention personnel's (18 registered nurses and 4 occupational therapists) experiences of conducting the intervention, and their thoughts on any weaknesses of the intervention and facilitators for future delivery.

The analysis identified two themes: 'developing a supportive relationship to facilitate the adjustment process following stroke' and 'developing professional skills in providing psychosocial support' (Martinsen et al., 2021). 'Developing a supportive relationship to facilitate the adjustment process following stroke' revealed aspects of how the nurses and occupational therapists perceived their relationship with the persons with stroke and any challenges or threats to them during the intervention. These aspects were explored in the subthemes 'getting personally involved', which referred to the gradual development of a trusting relationship between the intervention personnel and the person with stroke, and 'handling challenges', which referred to the challenge of keeping the relationship solely on a professional level.

'Developing professional skills in providing psychosocial support' showed the aspects of improvement the nurses and occupational therapists experienced in their professional skills when conducting dialogues with persons' with stroke (Martinsen et al., 2021). These were reflected in the subthemes 'becoming confident in conduction dialogues' which identified the intervention personnel found the intervention developed their professional and personal skills, and 'integrating psychosocial topics', which highlighted how intervention personnel found the intervention enhanced their awareness of the importance of health promotion in community stroke care. The results of the process evaluation found the persons' living with stroke felt the intervention was meaningful and increased their understanding of living with the consequences following a stroke (Martinsen et al., 2021).

A process evaluation may be conducted through the intervention development processes. This maximizes the research opportunities as it will present further research options (O'Cathain et al., 2015). Moreover, process evaluation can help identify additional research questions to report on findings. An important aspect of recognizing further research questions is highlighting key uncertainties the that study should address (O'Cathain et al., 2015). Members of the We Walk team determined a key uncertainty surrounds the question of, what the process of the dyadic intervention increases the effectiveness of the intervention was and how it can be used to improve the intervention, adapted or used in other contexts (e.g., heart attack, or delivered in a Canadian context). Currently, there is no in-depth analysis of the dyadic influence of walking poststroke using process intervention. The current study aims to fill this gap.

Chapter 2: Article

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Abstract

Background: People with stroke spend more than 80% of their waking hours inactive. Social support can influence the uptake and maintenance of PA. Dyadic interventions involve two people working together to support behaviour change.

Purpose: To examine dyadic processes in the We Walk intervention; a theory-based, person-centred 12-week dyadic behaviour change intervention targeting the promotion of outdoor walking in people with stroke.

Methods: A single-arm observational pilot study with qualitative process evaluation. Participants were community-dwelling people with stroke and their walking buddies. We Walk involved face-to-face and telephone sessions over 12 weeks. Semi-structured dyad interviews, fieldnotes and a facilitator interview were thematically analyzed.

Results: Overall, 21 dyads participated consisting of the person with stroke and their walking buddies, who were either family members (17) or volunteers (4). Four major themes were identified: 'Communication' which helped dyads to adapt to their physical and social environment, deepened relationships and promoted mutual understanding, 'Motivation' which was increased by encouragement, seeing improvement, obtaining mutual benefit and forming of routines, 'Confidence' stemming from improved ability, a sense of comfort and independence and 'Enjoyment' through reconnecting with the partner and the community.

Conclusion: The dyadic structure of We Walk gave rise to several dyadic processes perceived to be beneficial for initiating and maintaining behaviour change. Identified processes might be useful to help optimise future intervention content and delivery.

Introduction

A stroke is caused by a restriction of blood flow to the brain (Heart and Stroke Foundation of Canada, 2021). Globally, stroke is the leading cause of adult disability and people with stroke find the physical consequences of a stroke the most difficult to accept (Stroke Association, 2016). Physical disability is experienced by 80% of people with stroke (Stroke Association, 2016) and includes limitation or loss of functional abilities, movements or mobility (Saunders et al., 2020). Physical Activity (PA) is an important behaviour to help rehabilitate and maintain recovery after stroke, both mentally and physically (Heart and Stroke Foundation of Canada, 2021; Morris et al., 2015). Regular PA poststroke can reduce the risk of a stroke reoccurring and improve overall functioning, health and wellbeing (Lee et al., 2003). However, people with stroke have low levels of PA and spend approximately 23 hours being sedentary (Morris et al., 2015; Morris et al., 2014; Fini et al., 2017; Saunders et al., 2020; Moore et al., 2013; Vahlberg et al., 2018).

The impact of physical disabilities after a stroke can be reduced through walking (Saunders et al., 2020; Fini et al., 2017). The Heart and Stroke Foundation of Canada recommends people with stroke should attain a minimum of 150 minutes of moderate-to-vigorous intensity PA per week, equivalent to the general adult population. Walking can be classified as moderate-intensity PA for people with stroke due to the higher energy costs than prior to poststroke (Fini et al., 2017). Walking as a form of PA has been shown to improve people with stroke's cardiorespiratory health, fitness, balance and mobility (Saunders et al., 2020). Social support based behaviour change

interventions can improve the long-term maintenance of PA poststroke (Morris et al., 2015). The inclusion of social support, such as a family member or a friend, is often referred to as a dyad, and can be incorporated into an intervention (Bakas et al., 2017). In the context of stroke, a dyadic intervention involves creating a shared target-oriented goal that both dyads, the person with stroke and a family member, friend, or other supporting person, aim to achieve.

We Walk is a dyadic behaviour change intervention targeted at helping people with stroke to increase uptake and maintenance of outdoor walking after stroke (Morris et al., 2022). We Walk was designed for dyads and intervention facilitators to work as equal partners to set, plan and achieve the goal of walking more following a stroke, rather than to tell a person with stroke what to do or when to walk. It aimed to help improve and maintain recovery by using attainable and enjoyable walking within their own community (Morris et al., 2022). A pilot study examined the feasibility of recruiting dyads, assess the perception of the acceptability and experience of We Walk, and identify any refinements to the intervention, if needed, prior to progressing to a clinical trial (Morris et al., 2023).

To improve the We Walk intervention for future use, it is vital to understand and confirm the process of the dyadic intervention through a process evaluation (Moore et al., 2015). Process evaluations can provide greater confidence in the conclusions that are drawn from the study and identify any new issues that may have emerged following the pilot test (Moore et al., 2015). An important aspect of recognizing further research questions is highlighting key uncertainties the study

should address (O'Cathain et al., 2015). Currently, there are no in-depth process analyses of dyadic behaviour change interventions such as We Walk.

Purpose

The purpose of this study was to conduct a secondary analysis of data collected from the We Walk study to gain an understanding of the dyadic process in relation to increasing walking outside following a stroke. Specific objectives were to examine the perception of dyadic processes in: i) the person with stroke and their buddies and ii) the intervention facilitator.

Methods

Participants and recruitment

The We Walk study recruited 22 people with stroke, who could invite one family member or friend as their walking buddy (44 participants overall). A volunteer buddy was provided for participants who did not identify a walking buddy as part of their existing social networks (4). Inclusion criteria for a community dwelling person with stroke included having the ability to walk in outdoor environments (with or without aid), being over 18 years of age, able to provide informed consent, not having contraindications to increasing their walking, and being willing and able to provide critical feedback on their experience taking part in the study. The inclusion criteria for the walking buddies that were nominated by the person with stroke included the ability to provide informed consent, being over the age of 18 and being willing to work with the person with stroke as part of a dyad. Participants were recruited through

community rehabilitation therapists (n=10), stroke organisations (n=3) exercise classes (n=4), word of mouth (n=2) and via a press release (n=2).

Study procedures

The study was carried out from October 2019 through March 2020 when it was forced to end due to COVID 19 pandemic restrictions imposed by the UK government.

Intervention

We Walk was delivered for 12 weeks using a rolling recruitment, meaning dyads began the intervention as soon as they were recruited. Dyads were provided with an Omron 2.1 Step Counter pedometer and diary (example diary found in Appendix A) to monitor their progress. The pedometer provided a seven-day memory to allow dyads to look back on the week and document in their diaries if they desired. However, the steps were not accurate for most people with stroke, as they did not walk quickly enough for the pedometer to register. When this was the case, dyads used other methods to help track their improvement, such as time spent walking or distance.

People with stroke and their walking buddy took part in six intervention meetings overall including, four face-to-face sessions and two telephone sessions. These sessions ranged from one-two hours and were facilitated by a researcher. See Table 2 for the intervention meeting schedule. The first meeting involved the person with stroke completing a study questionnaire assessing: demographics, how the stroke affects them, goal setting, planning, self-monitoring, and goal maintenance. See Appendix B for concepts discussed in first meeting. These were measured by examining

seven-day PA levels using the Physical Activity Scale for the Elderly (Washburn et al., 1993), functional mobility using the Rivermead Mobility Index (Collen et al., 1991), self-reported confidence in balance using the Activities-Specific Balance Confidence Scale (Botner et al., 2005), confidence in walking using the Self-Efficacy Questionnaire for Walking (Kawajiri et al., 2019), and fatigue using the Fatigue Assessment Scale (Michielsen et al., 2003). These evaluations provided baseline information on participants which the facilitator used to personalize intervention to them. The subsequent sessions discussed with dyads feedback on their goals, reflection on their progress and maintenance, and their overall experience and ways the programme could improve. See Appendix C for concepts discussed in all We Walk sessions.

Table 2: We Walk Phase 2 intervention components

Week of study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Type of contact	Home visit	Home visit		Phone call / visit if needed		Phone call		Phone call				Home visit

The We Walk intervention invited dyads to plan how they could increase their walking outside. This was accomplished by setting a goal every week in their diary, constructing a plan of how to accomplish it, and discovering how their buddy could best help them. Along with this, participants were requested to keep a diary every day to help monitor steps where they walked, how they felt, and at the end of the week, reflect with their walking buddy. Through this, dyads were asked what they found challenging or difficult and how they resolved any problems and overcame challenges.

Behaviour Change Theory and Physical Activity Interventions

Interventions like We Walk that aim to support a behaviour change may benefit from integrating behaviour change theories into the development process (Michie & Johnston., 2012). Behavioural theories identify and provide a scientific explanation for the key constructs and relationships within the process of behaviour and behaviour change (Michie et al., 2008). Many theories aim to describe why, when, and how change may occur which may aid in the understanding of how certain interventions succeed or fail (Michie et al., 2008). The use of theory-based behaviour change components allows the integration of interventions based on a hypothesised causal pathway (Michie & Johnston, 2012).

Effective mapping of theoretical causal pathways for behaviour change techniques (BCTs) requires to specify the theoretical framework, identify techniques to change desired behaviour, and selecting the appropriate techniques to map differing determinants of behaviour (Michie & Johnston, 2012). Theory based behaviour change interventions can help promote the long-term maintenance of PA after stroke (Morris et al., 2014) and should be applied to ensure interventions address and overcome barriers specific to a person with stroke (Morris et al., 2014). We Walk implemented BCTs in the first study questionnaire (See Appendix B) in order to uphold the theoretical framework and identify techniques to change the desired behaviour of promoting the maintenance of PA after stroke. For a full and detailed description of the development process see Morris et al., 2022.

Data collection

The dataset used in this study comprised three sources of information i) 18 participant interviews, ii) 21 fieldnotes, and iii) one facilitator interview.

Participant interviews were conducted between January and April 2020. Of the 22 dyads recruited, 18 dyads provided an exit interview, and four dyads either withdrew midway through the intervention (n=2) or did not provide a final interview due to the COVID-19 pandemic restrictions (n=2). Dyad 22 was recruited shortly before COVID-19 pandemic restrictions were enforced, and therefore did not provide an interview and was not included in the analysis. The remaining three dyads provided an initial interview and the facilitator documented fieldnotes up to their departure from the intervention.

Of the 18 completing dyads, 8 completed the full 12 weeks of the intervention and exit interviews and 10 did not complete the full intervention but provided a final interview. During the final visit, n=eight exit interviews were conducted face-to-face including the person with stroke and their walking buddy. Due to public health requirements related to the COVID-19 pandemic, the remaining ten interviews were conducted via telephone, including six joint interviews where the dyads were co-habiting, and four separate interviews where dyads lived in separate households. Alongside dyad interviews, the lead researcher (LI) made fieldnotes following every meeting for each study dyad. These fieldnotes included background information of the dyad and walking buddy, general notes on the progress, challenges, use of diary and pedometer, notes on the researcher's thoughts, and quotations from the meetings.

An interview was conducted with the intervention facilitator to gain their perspective on the dyadic process and contextualise initial findings identified in the data. This study was reviews by the ethics review board at the University of New Brunswick, for the collection of additional original data from the facilitator (REB 2022-176). A topic guide was created to conduct the interview (see Appendix D) which included a preface on the purpose of the interview, an ethics preface, and questions pertaining to broad opening questions, general thoughts on the dyadic element, prompted questions on the dyadic element, and broad final reflection questions. The interview was conducted virtually via Microsoft Teams and was then transcribed for analysis.

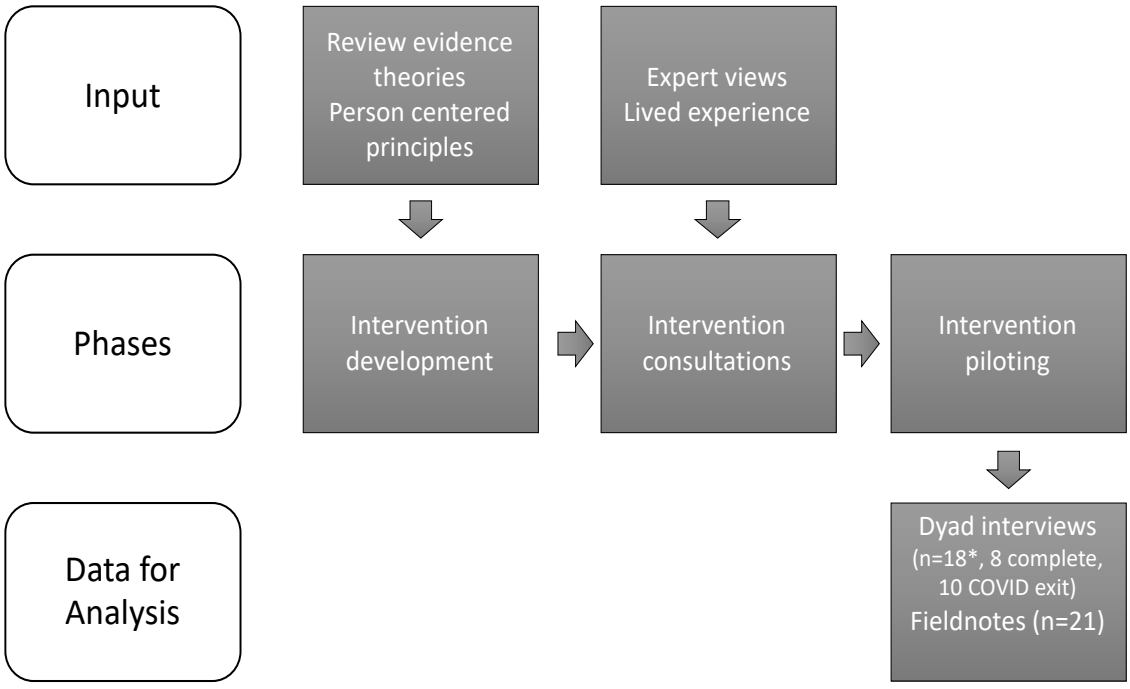

Figure 2: Data used to perform secondary analysis to achieve aim
*4 separate for person with stroke and walking buddy

Analysis

The data were analysed using a thematic analysis approach. This method allowed the development of themes beyond the primary study and the ability to build new hypotheses and interpretations as the purpose of a thematic analysis is to analyze, report, and identify themes within a dataset (Braun & Clarke, 2006). This was accomplished in five steps. The first step included reading, re-reading, and making notes on the initial thoughts of the anonymized interviews and field note transcripts to gain an understanding of the data. Second, the data was uploaded to the qualitative data analysis program NVivo, where interesting features were coded based on the initial thoughts of the researcher. Third, the codes were then used to identify patterns which were coded further into relevant themes (i.e. broad topics or issues coded in the data) and subthemes (i.e. subcomponents of a theme, which share some unifying feature). See Figure 3 for example of steps 1-3 were implemented. Fourth, these themes were reviewed and discussed first with a supervisor (SD) who ensured the themes and subthemes were applicable in relation to the coded extracts. Next, they were reviewed with the lead researcher (LI) who confirmed the themes and subthemes adhered to the content of the data set. These reviews aided in confirming the themes were coherent and properly addressed the research question (Braun & Clarke, 2006). Fifth, clear definitions and detailed analysis of the identified themes were developed as well as created appropriate names for each theme and subtheme. These steps, along with the checklist of criteria for a good thematic analysis – outlined by Braun & Clarke (2006) (see Appendix E) – were followed closely to ensure a proper thematic analysis was completed and aided in focusing the analysis on the overall research aim of

examining dyadic processes, as opposed to any other aspects which may be present within the data.

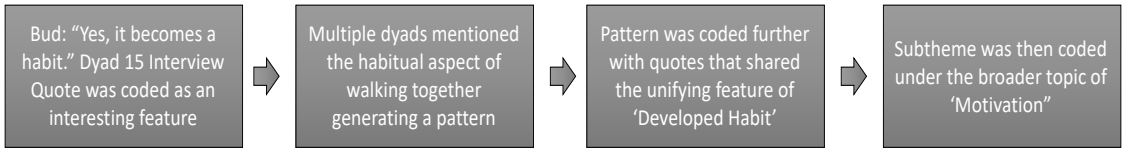

Figure 3: Example of how themes and subthemes were developed

Results

Participant characteristics

The 21 persons with stroke consisted of 15 (71%) men and 6 (29%) women whose age raged from 43 and 82 years (median age of 65.5 years) (Morris et al., 2023). The time since the stroke was between one month to 15 years prior to recruitment, with 11 (52%) being less than one-year poststroke, six (29%) between 1-5 years poststroke, and four (19%) over five years poststroke. Fifteen (71%) of the persons with stroke lived with their walking buddy, two (10%) did not live with their walking buddy but lived accompanied, and four (19%) lived alone (Morris et al., 2023). The relationship between the person with stroke and their walking buddy differed, 13 (62%) of the dyads were spouses/partners, four (19%) were a family member (other than a spouse), and four (19%) were unrelated (volunteer/support worker/friend).

Qualitative findings

Four major themes with 12 total corresponding subthemes were constructed and developed to help understand how dyadic process emerged during an intervention

aimed to increase outside walking poststroke. These are outlined in Figure 3. The four major themes are: communication, motivation, confidence, and enjoyment

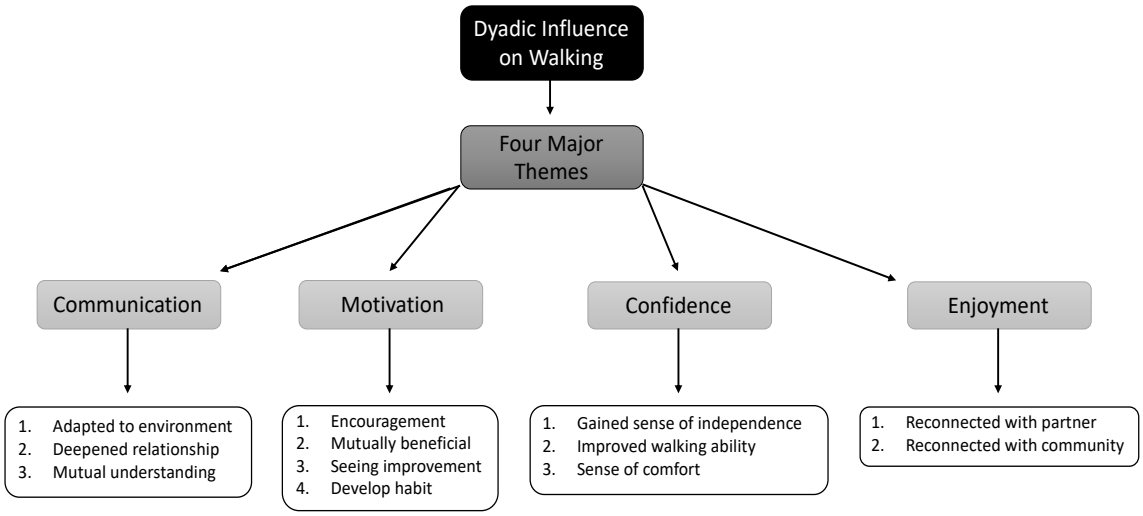

Figure 4: Major themes and subthemes on the influence of dyadic process walking poststroke

Communication

The theme 'communication' refers to how the inclusion of a walking buddy promoted meaningful discussions between dyads (*Walking buddy (Bud): "I think it's been good—it sounds like marriage guidance, but it has meant that we talk to each other rather than just announcing to each other that we're doing this or that."* Dyad 15 Interview). As a part of this theme, three subthemes were identified: 'adapted to environment', 'deepened relationship', and 'mutual understanding'.

Adapted to Environment

Dyads frequently mentioned that communicating allowed them to adapt their walking to the environment (*Person with Stroke (PwS): "It* [planning to walk] *is more logistics than anything else you know."* Dyad 6 Interview). This adaptation to their environment was expressed in relation to both the physical and social environments. In

terms of the physical environment, people with stroke communicated with their walking buddies to adapt to physical aspects such as the weather (*F: "The weather has been poor and has affected his walking outside but he tends to walk in the supermarket* [and] *the house if he can't get out."* Dyad 5 Fieldnotes), environmental walking conditions (*Bud: "Reasonable surfaces and places to maybe get the car up, if you did struggle there is no way I could carry him back again.*" Dyad 6 Interview), or their physical capabilities (*F: "Longer term goal is to walk to the* [location] *and back… They were already discussing and planning how they could break down the walk into sections and build up to walk to whole way."* Dyad 12 Fieldnotes).

With regards to social environment, several dyads mentioned they would regularly communicate to prioritize walking by managing their time and adapt to their other social commitments (*Bud: "Trying to make time, yes, squeezing it* [walks] *in between knowing that we want to do it* [walk] *—both of us."* Dyad 2 Interview). Walking buddies mentioned that working with the partner led to an increased understanding in the challenges associated with walking following a stroke, and the need to therefore adapt walking behaviour to the available environmental contexts and capabilities.

> *Bud: "Yeah and I think that is why the study has probably helped me as well to appreciate how tricky it is for somebody after a stroke to just get used to the different surfaces again and different conditions and weather conditions that it isn't just as straight forward as you might think, so that has been quite interesting."* (Dyad 7 Interview).

Deepened Relationship

Walking with a buddy sparked communication between dyads which led to deepening partner relationships (*PwS: "I certainly think that it can build on relationships, that's a good thing."* Dyad 15 Interview). Though the intervention was designed to improve walking and maintenance for people with stroke, the relationship between the dyads was crucial in having the intervention work to its full potential (*F: "You know, although it was about walking for the person who had stroke the study was very much about both of them as dyad members."* Facilitator Interview). Dyads expressed the deepened relationships was experienced on an emotional and social level. Emotionally, dyads mentioned communication led to deeper understanding of one another's needs, beyond just surface level *(Bud: "That* [working together] *has been quite useful, and it helps us care for each other I think to have a consensus about what are we doing."* Dyad 15 Interview). Some dyads experienced a greater benefit from deepening their emotional relationship with their partner than they did from the walking itself.

> *PwS: "Yes, definitely, she helped. Remember when I was a wee bit down and <buddy name> came the next time on her own and she said, "What do you want to do?" and I said, "I don't know" we went out and we had a talk, we had a walk—we walked but we more or less talked and that did me a power of good"* (Dyad 11 Interview).

On a social level, a number dyads reported experiencing a deepened appreciation and understanding of how best to achieve common walking goals by tailoring to both partners' capabilities and interests (*Bud: "No, we're laughing a lot but at the same time it is important for us to go forward and change our way of thinking as well."* Dyad 2 Interview).

Mutual Understanding

Whether a person with stroke had an established relationship with their walking buddy, or if the buddy was a volunteer without a pre-existing relationship, dyads expressed a sense of mutual understanding between one another through communication (*PwS: "Likes of us, we know where we're going to because we know exactly what the problems were."* Dyad 1 Interview). People with stroke with an already established relationship mentioned the established relationship allowed them to feel comfortable communicating to their buddy as they mutually understood each other's needs (*PwS: "I wouldn't have felt comfortable at all with somebody I didn't know, but with <buddy name>, it was totally different."* Dyad 16 Interview).

A number of walking buddies seemed to understand the person with strokes walking limits in terms of knowing when to push them or when to slow down and were able to communicate this to them (*F: "She pushes him at times when he's low, when he feels he can't be bothered to do things, but also knows when he's done enough."* Dyad 3 Fieldnotes). People with stroke with a volunteer buddy who had also experienced a stroke felt comfortable communicating as it allowed for a mutual understanding of a person with stroke's needs that even close family or friends did not understand (*PwS: "Do you know what <buddy name> did, because she had a stroke, I was able to get out a lot of things that I couldn't tell anybody else because they would never understand"* Dyad 11 Interview: SS).

There was however a discrepancy in perceptions as to whether an established relationship or volunteer walking buddy was more advantageous in terms of having

mutual understanding. Dyads with a volunteer walking buddy believed communicating with a person with stroke would be a better buddy (*Bud:" I think it's more useful if the buddy is a stroke survivor. If the buddy is more so—like myself, somebody that's gone through it and has come, well, basically, has come out the other end."* Dyad 11 Interview), whereas dyads with an established relationship believed communicating with their partner would make better buddy.

> *PwS: "Well, I think so, because no one would understand me more than <buddy name> or know how I felt on a particular day and that would go with anyone in the situation if they were married or whatever—a mother and a son or something. So, it's better to do it that way than with a stranger, I think."* (Dyad 10 Interview).

When comparing established relationships to volunteer relationships, the facilitator expressed they believe the intervention worked best for established relationships.

> *F: "It certainly worked best within a partnership, you know, a loving relationship where the, the partner had been there from the start and knew what, you know, what the person was stroke had gone through, what stage they were at, and what the strengths were and where the problems lay."* (Facilitator Interview).

Motivation

The theme 'motivation' refers to how the inclusion of a buddy helped motivate the dyads to walk (*Bud: "I think it's* [the intervention] *great for motivating."* Dyad 1 Interview). As a part of the theme, four subthemes were constructed: 'encouragement', 'seeing results', 'mutually beneficial' and 'developed habit'.

Encouragement

Dyads expressed that their buddies were able to help motivate them to walk through the use of encouragement (*PwS: "Well, I think it's* [working together] *an*

encouragement, <buddy name> has said on a number of occasions, 'Well, we could go for a walk now'." Dyad 5 Interview). People with stroke mentioned they may not have walked as much had it not been for the encouragement from their partner to walk together (*PwS: "Whereas that might not have happened otherwise, somebody giving you a nudge and saying, 'Come on, there's no reason not to' sort of thing."* Dyad 5 Interview).

Some participants highlighted the fine line between encouragement and nagging – where nagging would be perceived as undesirable (*PwS: "I'll do anything to avoid being nagged."* Dyad 7 Interview), although some dyads mentioned that nagging was perceived as encouraging (*F:* "*Buddy says she is a real nag. When asked if the PwS thought she was a real nag or whether he appreciated what she was doing, he said 'both'."* Dyad 2 Fieldnotes). By encouraging to walk, some people with stroke voiced their walking buddies motivated them to push themselves beyond what they believed they were capable of (*PwS: "Maybe if you've got a partner with you, you push yourself more.*" Dyad 8 Interview).

Some people with stroke mentioned that encouragement was not always enough to motivate them to overcome certain physical or psychological barriers, such as fatigue (*F: "Buddy says that when* [PwS] *says he's too tired, he's stubborn and you can't sort of say, come on, overcome that"* Dyad 2 Fieldnotes) or low mood (*F: "Sometimes* [PwS] *has difficulty in going out, buddy acknowledged that this can be down to how he feels psychologically"* Dyad 6 Fieldnotes). However, the people with stroke expressed the encouragement from the walking buddy meant there was

someone who has their best interest in mind to be held accountable to and thereby motivated them to walk.

> *PwS: "I think that was true, the fact that you've got somebody—a buddy, who is actively checking up-- you're accountable to someone apart from your own—my own goodwill to walk more"* (Dyad 18 Interview).

The facilitator mentioned how they thought even if the intervention was designed solely for people with stroke, many of them would have looked to a buddy for encouragement (*F: "I think a lot of them would have brought in their partner to support them anyway."* Facilitator Interview). As the study continued, some walking buddies found they had to use less encouragement to help motivate the person with stroke.

> *Bud: "She's more determined now that she would have been if nobody was going out to see her and nobody was—not forcing her but nobody was actually encouraging her to do it. She's had some encouragement now, I think."* (Dyad 11, Buddy Interview).

Seeing Results

People with stroke mentioned when their walking buddy highlighted improvements in their walking abilities this motivated them to continue walking.

> *PwS: "I think possibly, mentally, the stroke might take some of that motivation away but the fact that you've got people helping you, like your family, you can see the improvement, it's great.*" (Dyad 9 Interview).

People with stroke highlighted how walking buddies helped them set realistic expectations when it came to walking improvements being gradual so as not to disappoint or deter their motivation (*Bud: "Yes, rather than trying to think you could do it all at once, yeah, just do it gradually."* Dyad 8 Interview). As well, people with stroke found their walking buddies were sometimes more motivated than they were to

improve (*PwS: "It's good to have somebody as close as your wife or your husband because they do egg you on because they're more determined to get you better."* Dyad 3 Interview).

Mutually Beneficial

The theme 'mutually beneficial' refers to walking buddies revealing they were motivated along with the person with stroke when they noticed they were also benefitting from the walking activities (*F:* "*They both feel they have benefited from the study. Thought it came at just the right time for them* [dyad]*. That helped with motivation."* Dyad 6 Fieldnotes). The 'spillover effect' had not been anticipated by the facilitator had not expected prior to the study (*F:* "*Yes, and that was something we didn't expect* […] *how much the buddy thought that it can help them in some way or other*." Facilitator Interview). Buddies expressed they experienced physical benefits *(Bud: "Well, I am getting fitter."* Dyad 2 Fieldnotes), social benefits *(F: "Buddy said going out together brings benefits for both because they chat and have a laugh, so it is very sociable."* Dyad 16 Fieldnotes), as well as psychological benefits.

> *F: "Note: at the next visit, after we left the house together, he told me that he was suffering from depression and was not able to engage in the discussion as much as he would usually. He also said that he was pleased to be taking part in the study and found it helpful."* (Dyad 18 Fieldnotes).

Walking buddies also mentioned they benefitted from motivating the person with stroke when they noticed them improving (*Bud: "I think personally that I found I got something out of it as well as her, I felt I was doing somebody some good."* Dyad 11 Buddy Interview). However, some people with stroke expressed that they felt to be a

burden to their buddy (*F:* "*Buddy happy to bring car to bring him home during walks. SS feels that is a bit of an imposition on her.*" Dyad 5 Fieldnotes). Walking buddies were asked explicitly in each interview if they felt burdened by the intervention (see Appendix C) and most buddies stated they felt no burden *(F: "The buddy feels no burden in taking part in the study. Score of 0."* Dyad 17 Fieldnotes).

People with stroke mentioned they were motivated as they felt they were helping their buddy benefit (*PwS:* "*I felt good because I actually felt that she needed me sometimes, you know; she was glad to be saying some of the things that she said."* Dyad 11 PwS Interview). Walking buddies themselves noted the dyad motivated them (*F:* "*The buddy says he doesn't need any motivation but he's given her motivation"* Dyad 16 Fieldnotes).

Develop Habit

Dyads expressed that they were motivated to continue walking after completing the intervention as the walking became more habitual (*Bud: "Yes, it becomes a habit."* Dyad 15 Interview). Participants were motivated to continue walking beyond the study as they made a part of their routine (*PwS: We just go on the walks, we're not really discussing why we're doing it, it's just become part of the routine now* Dyad 1 Fieldnotes). Walking had become a routine, dyads did not feel right if they could not go for a walk (*PwS: "The thing is, if I can't get out for a couple of days, the next time—the next day, I'm chomping at the bit, I'm dying to get out."* Dyad 16 PwS Interview). Some buddies highlighted that habitual walking resulted in less need to motivate the person with stroke as much as initially.

Bud: "But that is now we are just, 'Right we'll go for a walk now' whereas at the start, 'Oh we've got to go for a walk, we've got to do this, we've got to fit this in.' (Laughs)
PwS: Yes, we had to push for the motivation to do this you know?" (Dyad 6 Interview).

Confidence

The theme of 'confidence' refers to how the inclusion of a walking buddy, increased beliefs on capabilities while walking in people with stroke (*Bud: "Confidence has grown in a week – absolutely."* Dyad 14 Fieldnotes). Within this theme, three subthemes were constructed: 'improved walking abilities', 'sense of comfort', and 'gained sense of independence'.

Improved Waking Abilities

People with stroke mentioned that having their walking buddies helped increase their confidence, which this led to improvements in their walking abilities (*PwS: "Yes, I would say, it* [the intervention] *was absolutely fantastic. It's got me walking better than I've ever walked in eighteen months."* Dyad 16 Interview). This was exhibited through dyads accomplishing new walking milestones (*F: "The first goal was to get rid of the quad stick, which she has"* Dyad 14 Fieldnotes) and walking buddies helping improve not just the quantity, but quality of a partners' walking form.

F: "*Buddy said that the target for this week is not to increase distance but to increase stride length. They're trying to look at ways of improving the quality of his walking rather than distance."* (Dyad 5 Fieldnotes).

Walking buddies mentioned the improved confidence a person with stroke experienced also improved their confidence in their walking abilities (*Bud: "I think you're much more*

confident, which is great, I think it's really been helpful from that point of view as well, I'm not so worried now" Dyad 7 Interview).

Some people with stroke mentioned they did not perceive any improvements in their walking which could be '*disappointing'* (F: *"Other people say they notice improvement, but he* [PwS] *doesn't notice it."* Dyad 3 Fieldnotes). However, no person with stroke expressed they found the disappointment discouraging from continuing to walking. Even if a person with stroke expressed feeling disappointed with their progress, some still experienced improvements in their walking abilities (*Bud: "From a distance, I thought, 'Oh, there's an able-bodied person out for a walk' and it's not until I got closer, I'm like, 'Oh, that's— '"* Dyad 9 Interview).

Sense of Comfort

People with stroke expressed the inclusion of a walking buddy provided them with confidence knowing they had support if they needed.

> *Bud: "In the beginning, because we were able to go out together and you still got the confidence that way and it was in case anything happened, then at least you've got that other person there."* (Dyad 9 Interview).

This sense of comfort helped provide people with stroke the confidence to push themselves and overcome challenges.

> *PwS: "I was holding <buddy's name> hand just to keep my brakes on, using her as a brake but now I can do it on my own, I don't worry about it the same. It all helps, it all builds up with the confidence and the ways to do things"* (Dyad 7 Interview).

As well, people with stroke mentioned they felt comfort knowing someone would be there to help them if something went wrong, whether that be helping them after

something happened (*F: "No, the confidence was there that there was someone there to pick me if I fell really"* Dyad 18 Interview: SS), or preventing something from happening all together (*PwS: "But I knew if I fell outside there was a good chance it could be—but when <buddy name> was there, I felt confident, I didn't feel I was going to fall*" (Dyad 16 PwS Interview). Though the dyadic process was not equally beneficial for all dyads, the sense of somebody being by their side to support them brought comfort.

> *F: "The dyad didn't work that well for everyone. Although, I think everyone probably thought that it did work quite well… But I think just the support that they felt was really important as well… just somebody being there knowing what they're doing."* (Facilitator Interview).

Gained Sense of Independence

People with stroke expressed that improving their confidence alongside their walking buddy led to an increased sense of independence, both with and without their buddies present.

> *F: "In shops, buddy was letting him go on his own and he was happy with that… Buddy feels he is quite steady. Wanting to give him some freedom if possible."* (Dyad 4 Fieldnotes).

In addition to the people with strokes confidence leading to a gained sense of independence, their walking buddies also mentioned wanting to increase the confidence in the person with stroke to gain independence (*F:* "*She* [Bud] *doesn't want to take confidence away or independence away and he* [PwS] *says he needs a degree of independence."* Dyad 4 Fieldnotes).

This gained sense of independence led to some dyads being confident enough the person with stroke to go on walks on their own if their walking buddy was not available (*Bud: "Yeah, so, the confidence thing, you wouldn't have had the confidence to go away out too much especially on your own, you would have had to have somebody with you at the start."* Dyad 8 Interview). Through this gained sense of independence, it provided people with stroke the confidence to complete new tasks independently (*F:* "*Since last visit, now confident going up and down kerbs, going out on his own. Takes the rubbish out to the bins."* Dyad 3 Fieldnotes).

Enjoyment

The theme 'enjoyment' refers to how the inclusion of a dyad led to many participants expressing they enjoyed walking together (*Bud: "I quite enjoy it. We enjoy getting out and about together"* Dyad 1 Fieldnotes). Through this enjoyment, two subthemes were identified: 'reconnection with partner' and 'reconnection with the community'.

Reconnected with Partner

Dyads frequently expressed that they enjoyed the time they spent walking together which allowed them the opportunity to reconnect with each other (*PwS: "[I liked that* [walking with buddy]*. You never talk to your husband as such… you know what I mean?"* Dyad 21 Interview) or build a connection with the volunteer (*F: "PwS said that he's quite shy, but he feels very comfortable with the buddy, so it is very easy and enjoyable."* Dyad 16 Fieldnotes). People with stroke frequently mentioned they

enjoyed the company associated with the quality time walking together (*F:* "*She likes doing it because she likes company when she's walking."* Dyad 6 Fieldnotes).

As well, people with stroke enjoyed the conversations shared with their buddy as they were not only enjoyable (*F:* "*PwS says he talks all the time when they're out, but he really enjoyed it"* Dyad 16 Fieldnotes*),* but also described as *'therapeutic'* and a form of pleasant distraction from overthinking how they are walking (*PwS: "What I find is walking with somebody, you're inclined to talk and forget about the walk."* Dyad 21 Interview). None of the dyads indicated they did not enjoy the time spent walking together with their buddy.

Reconnected with Community

Dyads expressed they enjoyed reconnecting with their community. Community included the social community such as the neighbours, (Bud: "*I just felt that she really appreciated getting out and having a chat with somebody, she's meeting people when we were out that she hadn't seen for ages."* Dyad 11 Buddy Interview), as well as physical community including nature (*Bud: "Yeah, that's something I've learned as well, you don't have to be talking all the time, you can just enjoy being outside."* Dyad 7 Interview), and the wildlife while out walking together (*F:* "*Managed a nice walk, spotting birds. They both enjoy bird watching."* Dyad 20 Fieldnotes). Reconnecting with the community provided the dyad an enjoyable distraction from the walking itself.

> *F: "Enjoying having walks where there is a distraction, e.g. enjoying watching the seals or windsurfers. They find that having something to focus on and distract them makes the works better."* (Dyad 6 Fieldnotes).

Dyads expressed that the conversations shared with neighbours provided a social benefit in addition to the physical benefits of walking leading to increased perceptions of enjoyment (*Bud: "[it's the social aspect as well, definitely."* Dyad 16 Buddy Interview). Along with this, nature and wildlife aspect provided some dyads a psychological benefit as well.

> *Bud: "In the past, we had been quickly out for a walk and then back again and we seemed to—because we'd repurposed the walk, I guess, that it was therapeutic and so on it gave us permission to loiter a bit and look at things."* (Dyad 15 Interview).

One aspect of reconnecting with the nature in their communities that the majority participants expressed they did not enjoy was if there was poor weather (*PwS: "But walking, it was very, very, cold and it wisnae* [wasn't] *nice."* Dyad 17 Interview). However, when the weather was pleasant dyads expressed they would enjoy expanding their horizon beyond their own community (*F: "They might like to go sightseeing getting to see parts of Scotland they haven't seen before."* Dyad 4 Fieldnotes), and enjoyed the nature and wildlife aspect so much they have discovered new hobbies (*PwS: "Yes. When we go out walking, we go out dog spotting."* Dyad 14 Interview).

Discussion

Principal Findings

This study identified four major themes with regards to understanding the dyadic process that were identified in the context of an intervention aimed at increasing walking outside following a stroke. First, the inclusion of a walking buddy

increased communication and discussions between dyads. This communication allowed people with stroke adapt to their physical and social environments, as well as socially and emotionally deepen their relationship, and gain a mutual understanding in both previously established and newly formed partnerships. Second, the aspect of a walking buddy helped dyads motivate walking. Walking buddies were able to motivate a person with stroke to walk through the use of encouragement, highlighting improvements in their walking abilities, noticing they were also obtaining benefits from walking and continuing to walk postintervention as the act of walking became habitual. Third, the addition of a walking buddy improved the person with strokes confidence. An increase in confidence led to people with stroke improving their walking abilities, feeling a sense of comfort with the presence of their walking buddy, as well as a gained sense of independence both with, and without their walking buddy present. Four, dyads expressed they enjoyed walking together as it allowed them to reconnect with their partner, as well as to the community in a social, physical aspect.

Strengths and Weaknesses of the Study

Several strengths can be identified in the present study. Currently, there are no studies which analyze the dyadic process in the context of interventions aimed to increasing walking following a stroke. The use of a secondary analysis permitted the ability to maximize the use of the We Walk data to further understanding of how dyadic interventions may operate. To uphold the credibility of trustworthiness, triangulated data was used in the form of the facilitator's fieldnotes and interviews of

the participants and the facilitator. Interviewing of the facilitator provided an additional perspective of the intervention for the researcher when analyzing the themes.

Limitations should be accounted for when interpreting the findings. The results presented are descriptive in nature and do not link to behaviour change techniques which may limit application to future interventions. Regarding the data collection of We Walk, COVID-19 restrictions interfered with the study, permitting some dyads from completing the full 12 weeks of the intervention. As well, there was an uneven representation regarding gender (15 men, 6 women) and relationship between dyads (17 spouse/family member, 4 unrelated) as most people with stroke were men and most walking buddies were a spouse or family member. This led to a shortage of data from the volunteer dyadic perspective. Lastly, since the majority of the data was analyzed by a secondary analysis, there was no ability to question dyads further on their thoughts of the dyadic process.

Relation to Other Studies

Martinsen and colleagues conducted a process evaluation of nurses and occupational therapists in stoke rehabilitation experience in a home-based dialogical intervention for enhancing the psychosocial support of people with stroke (Martinsen et al., 2021). This entailed assessing 22 intervention personnel's (18 registered nurses and 4 occupational therapists) experiences conducting the intervention, their thoughts on any weaknesses of the intervention and their thoughts of future facilitators for delivery in six focus groups across eight sessions. Similar to this study, their qualitative analysis found the intervention was perceived as meaningful and increased participant

understanding of how to best support a person living with stroke. The analysis identified two major themes: 'developing a supportive relationship to facilitate the adjustment process following stroke', and 'developing professional skills in providing psychosocial support' (Martinsen et al., 2021). Moreover, each theme consisted of two subthemes, the first themes being 'getting personally involved' and 'handling challenges' and the second themes consisting of 'becoming confident in conducting dialogues' and 'integrating psychosocial topics'. In the current study, the process evaluation identified the facilitator believed the We Walk intervention worked best with relationships that were established prior to the intervention in comparison to the volunteer dyads. The psychosocial support aspect within Martinsen and colleagues process evaluation may be applicable to incorporate in the We Walk in the future to help increase volunteers understanding of how to best support a person living with stroke.

Another study preformed a qualitative exploration on the perceptions from people with stroke, cares and physiotherapists to identify how their beliefs on PA hindered or supported the participation in PA (Morris et al., 2015). Researchers identified people with stroke working with a dyad co-constructed poststroke narratives and shared recovery outcomes and future goals. These poststroke narratives and shared recovery outcomes extended to the support of PA (Morris et al., 2015). Carers had adopted motivating strategies to attain the shared outcomes which supported both the person with stroke's recovery and participation in PA (Morris et al., 2015).

These outcomes coincide with two of the major themes identified in the current study 'communication' and 'motivation'.

Pucciarelli and colleagues (2020) preformed a systemic review and a meta-analysis which aimed to identify dyadic interventions that were designed to improve a person with stroke, the outcome for the person with stroke and the carer, and which intervention was the most effective. In the meta-analysis 16 studies were included involving 2997 people with stroke and 2187 caregivers. Within these studies, the dyadic interventions displayed a significant effect for people with strokes in their physical functioning ($p=0.05$), memory ($p<0.01$) and quality of life ($p=0.01$), as well as the caregivers' depression ($p=0.05$). This data supports the notion that dyadic interventions for people with stroke can improve their physical functioning, memory, and quality of life, as well as their caregiver's depression (Pucciarelli et al., 2020). Many of the effects in the Pucciarelli and colleagues quantitate data extraction overlap with qualitative themes that were identified in the current study. The significant effect of improved physical functioning coincides with the subtheme 'improved walking ability', quality of life relates to the theme of 'enjoyment', and caregiver depression with the subtheme 'mutually beneficial'. This highlights the influence that dyadic processes can have on increasing walking following a stroke.

Implications for Future Research

Key dyadic processes identified in the current study may aid future applications of We Walk if integrated into the intervention. Although this study directly relates to increased walking following a stroke in the context of the UK, future research may use

the dyadic process to increase walking and develop an intervention in a context outside of the UK or a person with stroke. Integrating these dyadic processes into future interventions may increase the understanding of how they to correlate with the BCTs used to maintain walking post-intervention.

Conclusion

This study sought to gain an understanding of the dyadic process in relation to increasing walking following a stroke. The dyadic structure of We Walk gave rise to several dyadic processes perceived to be beneficial for initiating and maintaining behaviour change. These included 'communication', 'motivation', 'confidence' and 'enjoyment'. The identified processes may be useful to help optimise future intervention content and delivery.

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Appendix A: Examples Provided to Participants of Diary Entries

Daily walking diary

Day and date	Where I walked (how long or how far)	Notes	Total steps today
Monday 19 August	Paper shop 20 minutes	The shop is not as far away as I thought. Take a detour next time. Seeing people when you're out cheers you up.	4,120
Tuesday 20 August	Garden	Nice day, walked round the garden. Good to hear the birds singing.	3,880
Wednesday 21 August	Park 45 minutes	Enjoyable but very tired at the end. Had a rest half-way round. Knowing that I could have a rest encouraged me to keep going.	5,540
Thursday 22 August	Stairs at home	Didn't go out. Very windy. Climbed stairs twice instead.	3,267
Friday 23 August	Supermarket 35 minutes	Walked an extra circuit to make the walk longer. A trolley makes walking easier.	4,897
Saturday 24 August			
Sunday 25 August	Paper shop 30 minutes	Went beyond the shop to make the walk 30 minutes.	4,595

Example provided to participants of a goals diary entry:

Goal for this week

Date	Goal
18th August 2019	To walk for 30 minutes outside on 3 days

Example provided to participants of an action plan diary entry:

Plan of action

WHEN will I walk?	Monday, Wednesday and Friday mornings
WHERE will I walk?	Monday - to the paper shop Wednesday - in the park Friday - in the supermarket
HOW MUCH walking will I do (distance, time, steps)?	Half an hour each day
HOW will my buddy support me?	Monday - text me to make sure I've done it Wednesday - come with me to the park Friday - our usual time for shopping

Appendix B: Concepts Discussed in First Session

Table 1 Outline of the components of WeWalk and associated behaviour change techniques

Intervention component/HAPA constructs	Description	Behaviour Change Techniques [27] *denotes core BCTs
Discuss benefits of walking with dyad	Increase motivation to walk by discussing benefits of walking after stroke for physical and mental health and maintaining and improving walking and recovery. Discuss barriers and how others have addressed them by drawing on positive experiences of other PWS. Introduce handbooks	3.1.Social support (unspecified)* 5.1.Information about health consequences 5.2.Salience of consequences 5.3.Information about social and environmental consequences 5.6.Information about emotional consequences 11.2.Reduce negative emotions 15.1.Verbal persuasion about capability
Discuss working as a dyad	Explain dyadic working. Discuss how the dyad can work together to develop goals and plans to support walking. Discuss role of walking buddy and benefits of social support for walking. Discuss potential benefits for buddy	1.9.Commitment 3.1.Social support (unspecified)* 12.2. Restructuring the social environment
Identify and set personally meaningful walking goals	Explore and develop intentions to walk more. Encourage the dyad to agree personally meaningful walking goals for the PWS, based on the capabilities and desires of PWS. Agree how buddy will provide support (the buddy may not always walk with the PWS)	1.1.Goal setting (behaviour)* 1.3. Goal setting (outcome)* 3.1.Social support (unspecified)*
Action Planning	Suggest that the dyad makes an action plan after they have set a goal. Explain that when a meaningful, shared goal based on step counts, time spent walking and on desired activity or walking route has been agreed, laying out a plan provides a way to help achieve their goal. Plan when, where, and how much they will walk for the week ahead	1.4.Action planning* 3.1.Social support (unspecified)* 7.1.Prompts/cues 8.1Behavioral practice/ rehearsal
Monitor progress, coping planning	Identify and agree a self-monitoring strategy. Select personally relevant monitoring approach: step-count using pedometer provided or monitor time spent walking, distance, places walked to. Provide pedometers. Discuss completion of activity diary. Anticipate challenges and discuss ways the dyad can negotiate ways to overcome them when they arise	1.2 Problem-solving* 2.3.Self-monitoring of behaviour* 2.4.Self-monitoring of outcomes of behaviour* 3.1.Social support (unspecified)* 4.1Instruction on how to perform the behaviour
Reviewing goals, problem-solving and maintenance	Review goals with the dyad, review diaries and progress made towards goals. Review action plans, discuss lessons learned, offer encouragement. Discuss goal revision and review how the dyad is working. Explore challenges encountered, setbacks. Discuss coping planning and discuss building support and reminders to include walking into everyday life	1.2.Problem solving* 1.5.Review behaviour goal(s)* 1.6.Discrepancy between current behaviour and goal 1.7.Review outcome goal(s)* 2.2. Feedback on behaviour 2.7.Feedback on outcome(s) of behaviour 3.1.Social support (unspecified)* 7.1.Prompts/cues 8.3 Habit formation 13.5.Identity associated with changed behaviour 15.1.Verbal persuasion about capability 15.3. Focus on past success

Appendix C: Concepts Discussed in Subsequent Sessions

Table 2 Concepts within the Theoretical Framework for Acceptability [27] and their definitions

Concept	Definition
Affective Attitude	How an individual feels about WeWalk before, during or after taking part
Burden	The perceived amount of effort that is required to participate in WeWalk
Ethicality	The extent to which WeWalk has good fit with an individual's value system
Intervention Coherence	The extent to which the participant understands WeWalk and how it works
Opportunity costs	The extent to which the benefits, profits or values must be given up to engage in WeWalk
Perceived effectiveness	The extent to which WeWalk is perceived as likely to or has achieved its intended purpose
Self-efficacy	The participant's confidence that they can perform the behaviours required to participate in WeWalk

Appendix D: Topic Guide for Facilitator Interview

Topic Guide

Examining dyadic processes in a person-centred intervention to increase outdoor walking after stroke

I would like to begin by thanking you for agreeing to provide feedback on your experience with the We Walk study. In this interview I will inquire about your experience and perspective on the dyadic aspect of the We Walk study. This interview will use a semi-structured format and I will ask you open ended questions about the study.

Ethical Preface

Thank you again for your participation in this study. This interview will take approximately 60 minutes of your time. The information provided in this interview is confidential. Identifiable information will be replaced with pseudonyms and numbers in any publications or thesis papers.

This interview will be recorded. You may end the interview at any point if you choose. Information provided up until that point will still be included in the study dataset, unless you specify otherwise. There are no consequences from the researcher for ending the interview early. I will now review the information letter before beginning the interview.

Questions:

Broad opening questions

Can you tell me a little bit about your background, and how you ended up being the facilitator of the We Walk intervention?

How did you think the We Walk intervention went in general from the perspective of the facilitator?

Dyadic elements questions - general

How important do you think the dyadic element was in the context of the intervention?

- Was it the key element?

What do you think were important aspects of the dyad that influenced how the intervention was taken up by participants?

- Anything else?
- Were these different for established vs. newly formed relationships?

How much did dyadic elements differed across the dyads?

- Were the dyadic process broadly similar for each dyad, or were the differences how dyads worked?

How much did the dyadic elements change over time as the study went on?

- Was there an evolution of how dyads engaged in the intervention over time?

What were some of the *surprising* aspects of the dyadic elements of We Walk?

- Anything else?

What were some of the *challenging* aspects of the dyadic elements of We Walk?

- Anything else?

Dyadic elements questions - prompted

In what way do you think We Walk influenced the *communication* between dyadic partners?

- Anything else?
- Can you give examples?

In what way do you think the dyadic element influenced *motivation* in participants and partners?

- Anything else?
- Can you give examples?

In what way do you think the dyadic element influenced *confidence* in participants and partners?

- Anything else?
- Can you give examples?

In what way do you think the dyadic element influenced *enjoyment* in participants and partners?

- Anything else?
- Can you give examples?

Broad final reflections on intervention

Are there any changes you would suggest to improve the intervention?

What would be the important aspects to train future facilitators in delivering We Walk?

Do you have any other comments about We Walk from the perspective of the facilitator?

Thank you very much for your time today!

Appendix E: 15-Point Checklist of Criteria for Thematic Analysis (Braun & Clarke, 2006)

Process	#	Criteria
Transcription	1	The data have been transcribed to an appropriate level of detail, and the transcripts have been checked against the tapes for 'accuracy'.
Coding	2	Each data item has been given equal attention in the coding process.
	3	Themes have not been generated from a few vivid examples (an anecdotal approach).
	4	All relevant extracts for all each theme have been collated.
	5	Themes have been checked against each other and back to the original data set.
	6	Themes are internally coherent, consistent, and distinctive.
Analysis	7	Data have been analysed – interpreted, made sense of – rather than just paraphrased or described.
	8	Analysis and data match each other – the extracts illustrate the analytic claims.
	9	Analysis tells a convincing and well-organized story about the data and topic.
	10	A good balance between analytic narrative and illustrative extracts is provided.
Overall	11	Enough time has been allocated to complete all phases of the analysis adequately without rushing a phase or giving it a once-over-lightly.
Written Report	12	The assumptions about, and specific approach to, thematic analysis are clearly explicated.
	13	There is a good fit between what you claim you do, and what you show you have done – ie, described method and reported analysis are consistent.
	14	The language and concepts used in the report are consistent with the epistemological position of the analysis.
	15	The researcher is positioned as active in the research process; themes do not just 'emerge'.

Curriculum Vitae

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Universities attended (with dates and degrees obtained): University of New Brunswick | Master of Science in Kinesiology | In Study

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Publications: Thesis will be submitted for publication.