UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL, HUMAN AND MATHEMATICAL SCIENCES

Academic Unit of Psychology

A Process Evaluation of Engagement and Outcomes in Internet Supported Physical Rehabilitation for Chronic Dizziness

by

Rosie Alexandra Essery

Thesis for the degree of Doctor of Philosophy in Health Psychology Research and Professional Practice

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ABSTRACT

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A PROCESS EVALUATION OF ENGAGEMENT AND OUTCOMES IN INTERNET SUPPORTED PHYSICAL REHABILITATION FOR CHRONIC DIZZINESS

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Vestibular-related dizziness is a highly debilitating condition, especially common amongst older adults. It can often be successfully managed with physical therapy exercises known as Vestibular Rehabilitation (VR) but access to VR is very limited. The ‘Balance Retraining’ digital intervention was developed to meet the need for increased availability of this therapy, and a primary-care based Randomised Controlled Trial demonstrated it to be effective. In order to maximise the potential efficacy, reach and acceptability of such interventions, it is important to investigate causal mechanisms and contextual factors. This provides insight how and why outcomes occur under given circumstances, and the underlying psychological mechanisms. This thesis employed quantitative and qualitative methodologies to investigate the processes involved in individuals’ engagement with, and outcomes of, the Balance Retraining intervention.

A systematic review of 30 studies investigating predictors of adherence to self-managed physical therapies revealed that self-efficacy, self-motivation, intention, previous adherence behaviour and social support were most consistently associated with adherence. Following this, a qualitative study explored older adults’ experiences of engaging with Balance Retraining over a 6-week period. Participants experienced internet-delivered VR very positively; many were motivated by improvements in their symptoms, but some also found that practical issues, or doubts about the exercises caused difficulties. A quantitative investigation of predictors of change in dizziness-severity revealed that adherence-problems, particularly those relating to symptom exacerbation, were especially detrimental for dizziness outcomes and that those who were more anxious or less confident about their ability to complete VR were more susceptible to these. A final mixed-methods analysis found that the intervention appeared to operate primarily through addressing adherence problems and that greater overall use, and use of specific features, was beneficial for outcomes. The findings of this thesis provide promising evidence that digitally-delivered VR is acceptable and accessible amongst older adults, and highlight key intervention features and the underlying BCTs that appear instrumental in Balance Retraining’s effectiveness.

Table of Contents

List of Tables

List of Figures

DECLARATION OF AUTHORSHIP

I, Rosie Alexandra Essery, declare that this thesis, entitled "A Process Evaluation of Engagement and Outcomes in Internet Supported Physical Rehabilitation for Chronic Dizziness", and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

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Date: ....

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Definitions and Abbreviations

AAQII	Acceptance and Action Questionnaire (version two)
ACL	Anterior Cruciate Ligament
AMPB	Adapted Model of Planned Behaviour
ASE	Attitude –Social Influence- Self-Efficacy Model
BCT	Behaviour Change Technique
BPPV	Benign Paroxysmal Positional Vertigo
CBT	Cognitive Behavioural Therapy
CEQ	Credibility and Expectancy Questionnaire
CNS	Central Nervous System
CVD	Central Vestibular Disorder
DHI	Dizziness Handicap Inventory
DI	Digital Intervention
ELM	Elaboration Likelihood Model
HADS	Hospital Anxiety and Depression Scale
HAPA	Health Action Process Approach
HBM	Health Belief Model
HBPT	Home-based Physical Therapy
HLoC	Health Locus of Control
IMRSI	Integrated Model of Response to Sport Injury
MeSH	Medical Subject Headings
MOHO	Model of Human Occupation

MRC	Medical Research Council
NRES	National Research Ethics Service
PBA	Person Based Approach
PBC	Perceived Behavioural Control
PCRN	Primary Care Research Network
PETS	Problematic Experiences of Therapy Scale
PFME	Pelvic Floor Muscle Exercises
PMT	Protection Motivation Theory
PVD	Peripheral Vestibular Disorder
RCT	Randomised Controlled Trial
SCT	Social Cognitive Theory
SDT	Self Determination Theory
SEM	Structural Equation Modelling
SRM	Self-Regulatory Model
STRObE	Strengthening Reporting of Observational studies in Epidemiology
TDF	Theoretical Domains Framework
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTM	Trans-Theoretical Model
VIF	Variance Inflation Factors
VR	Vestibular Rehabilitation
VSS-SF	Vertigo Symptom Scale (short form)
WHO	World Health Organisation

Chapter 1: Introduction and Thesis Outline

1.1 General introduction

The studies included in this thesis were designed to investigate psychological and behavioural processes involved in older adults' use of a digital intervention to support self-management of dizziness. The constituent studies were nested within a Randomised Controlled Trial (RCT) of this digital intervention. The RCT aimed to determine the intervention's effectiveness, and cost-effectiveness, for use in UK primary care (for trial protocol, see Geraghty et al., 2014). The studies in this thesis investigate individuals' engagement with the digital intervention and potential barriers to adherence to the associated physical rehabilitation therapy. They examine the role of psychosocial and contextual factors in understanding these engagement and adherence behaviours, and symptom-related outcomes. This initial chapter introduces and defines key concepts, establishes the key theoretical underpinnings of the research, and provides an overview of current empirical evidence. In doing so, it will highlight the rationale for the thesis and set out the research aims. The chapter will end with an outline of the thesis structure.

1.2 Dizziness: what is it and why is it important?

1.2.1 Definitions and prevalence

The term 'dizziness' encapsulates a range of sensations resulting from disturbed perceptions of spatial orientation. These sensations including light-headedness, feeling off balance, and disorientation. Vertigo is an associated but distinct symptom which refers specifically to sensations of spinning, swaying or revolving whilst remaining stationary (Bisdorff, Von Brevern, Lempert, & Newman-Toker, 2009; Yardley & Kirby, (in press)). In the UK, the lifetime prevalence estimates of significant dizziness fall between 17 and 30%, and between 3 and 10% for vertigo (Murdin & Schilder, 2015). Dizziness symptoms are particularly common amongst older adults (Lee & Elder, 2013) with as many as 7% of older adults presenting in primary care reporting dizziness (Sloane, Coeytaux, Beck, & Dallara, 2001). Amongst community dwelling older adults, the prevalence of dizziness symptoms has been reported to be in excess of 30% (Colledge, Wilson, MacIntyre, & MacLennan, 1994; Kroenke & Price, 1993).

1.2.2 Causes of dizziness

1.2.2.1 Challenges of diagnosis

There are a vast array of potential causes of dizziness and vertigo symptoms (Neuhauser et al., 2008). Given that dizziness can cause dysfunction in multiple body systems, particularly amongst older adults, the cause is often difficult to diagnose (Sloane et al., 2001). Indeed, dizziness symptoms can remain unexplained in 40 – 80% of cases (Bird, Beynon, Prevost, & Baguley, 1998; Kroenke & Price, 1993). Potential causes of dizziness and vertigo include: cardiovascular conditions such as stroke, cardiac arrhythmias and abnormal blood pressure; psychiatric conditions including depression and anxiety; neurological conditions such as brain lesions and progressive degenerative diseases; and peripheral vestibular disorders such as labyrinthitis (Maarsingh et al., 2010). Serious, life-threatening illness as a cause of dizziness is rare (Sloane et al., 2001), and more often dizziness and vertigo is attributed to 'peripheral vestibular disorders' (Hanley & O' Dowd, 2002).

1.2.2.2 Vestibular Disorders

The body's vestibular system includes parts of the inner ear and the brain which process sensory information to control balance and eye movements. Vestibular disorders occur when disease or injury alters the way these receive or process this sensory information (Bronstein & Lempert, 2007). A distinction is often made between 'central' and 'peripheral' vestibular disorders (Lawson, Fitzgerald, Birchall, Aldren, & Kenny, 1999). Central vestibular disorders (CVDs) result from problems with the Central Nervous System (CNS), such as the aforementioned neurological conditions (Thompson & Amedee, 2009). Peripheral vestibular disorders (PVDs) refer to any dysfunction of the vestibular structures within the inner ear (the labyrinth) and the nerve that connects these to the CNS. They include Benign Paroxysmal Positional Vertigo (BPPV), vestibular neuronitis, labyrinthitis and Meniere's disease (Thompson & Amedee, 2009). PVDs are a very common cause of dizziness reported to GPs (Bird et al., 1998; Hanley & O' Dowd, 2002) with estimates that up to 45% of reported cases of dizziness are attributable to such causes (Kroenke, Hoffman, & Einstadter, 2000; Polensek, Tusa, & Sterk, 2009). Dizziness symptoms resulting from PVDs are often made worse by simple head, neck and eye movements, and by certain visual triggers (Bronstein & Lempert, 2007; Thompson & Amedee, 2009). Activities such as turning over in bed, reaching objects from a high shelf and watching busy traffic are amongst those typically reported to trigger or worsen symptoms (Bronstein & Lempert, 2007; Thompson & Amedee, 2009).

1.2.3 Impact of dizziness symptoms

Dizziness and vertigo can have a highly detrimental effect on individuals' physical and mental wellbeing and place substantial demand on healthcare and broader societal systems (Grill, Bronstein, Furman, Zee, & Müller, 2012). For individuals with vestibular-related dizziness, even the simplest day-to-day tasks can trigger symptoms. As a result, they often become fearful of such movements and their potential consequences, and so begin to avoid them (Sloane et al., 1994; Yardley, Owen, Nazareth, & Luxon, 1998). Such fear-avoidance can lead to severe functional impairment (Kroenke, Lucas, Rosenberg, & Scherokman, 1993; Maarsingh et al., 2010; Nazareth, Yardley, Owen, & Luxon, 1999). In addition to this, the unsteadiness and poor balance caused by dizziness symptoms means that these individuals are at high risk of falling and sustaining injuries (Friedman, Munoz, West, Rubin, & Fried, 2002). A study investigating the longitudinal impact of dizziness symptoms reported that, at two year follow-up, older people who are dizzy are at increased risk of becoming disabled (Boult, Murphy, Sloane, Mor, & Drone, 1991).

Dizziness can also have an extremely negative emotional impact on sufferers. Restriction of activities resulting from fear-avoidance can ultimately mean that individuals stop participating in their usual activities, leading to isolation and loss of independence (Burker et al., 1995; Matheson, Darlington, & Smith, 1999). Dizziness is also closely associated with psychological distress, particularly anxiety (Yardley, 2000). The relationship between dizziness and anxiety is well documented (Haug, Mykletun, & Dahl, 2004; Yardley & Redfern, 2001). This association can be partly explained by the frightening nature of experiencing dizziness, often leading to panic, distress and avoidance of situations believed to trigger or exacerbate symptoms (Mendel, Lützén, Bergenius, & Björvell, 1997). Additionally, anxiety arousal may exacerbate somatic symptoms induced by balance disorders (Yardley & Redfern, 2001). Anxiety, and the associated experience of autonomic symptoms such as dizziness and nausea, can encourage individuals to self- restrict activity, therefore maintaining the cycle of inactivity and failure to habituate (Yardley & Redfern, 2001). Thus, the relationship between dizziness and anxiety can become self-perpetuating.

Dizziness is also very demanding on the healthcare system. It frequently involves patients making multiple visits to primary care (Bird et al., 1998) and a multidisciplinary approach to investigation and diagnosis is often required, meaning costly referrals to secondary care (Bird et al., 1998; Neuhauser et al., 2008; Sloane, 1989). Relatedly, dizziness is also a large risk factor in falls, particularly amongst older adults; falls cost the NHS over £2 billion each year (National Institute for Health and Care Excellence (NICE), 2013). Beyond the impact on healthcare services, there is also evidence that dizziness may have a significant impact on lost earnings, with one study reporting that 40% of its working age participants reported occupational difficulties (Yardley, Owen, et al., 1998).

Evidently, dizziness symptoms are highly prevalent with extremely damaging effects for individuals' wellbeing, and the potential to place high demand on healthcare systems. It is important that they are treated in a timely and effective manner; unfortunately the reality is often quite different.

1.2.4 Care pathways for treating dizziness

Due to the non-specific nature of dizziness, when a patient presents with these symptoms in primary care, diagnosis is often based on clinical judgement and basic examination, as definitive causes can be difficult to confirm (Colledge, Barr-Hamilton, Lewis, Sellar, & Wilson, 1996; Yardley, Owen, et al., 1998). Unless more serious underlying pathology is indicated, dizziness symptoms presenting in primary care are most frequently attributed to PVD (Karatas, 2008). Usual care of vestibular-related dizziness within primary care will, in the first instance, often comprise reassurance and medication for the relief of associated symptoms such as nausea (Bird et al., 1998; Colledge et al., 1996; Geraghty et al., 2014; Hanley & O' Dowd, 2002). Referral to secondary or specialist care for further investigation or treatment may occur if problems persist, although research suggests that this is often rare (Jayarajan & Rajenderkumar, 2003; Neuhauser et al., 2008). Across four health authorities in England and Wales, one study reported that only 13% of patients reporting dizziness in primary care were referred to a specialist clinic (Jayarajan & Rajenderkumar, 2003). Unfortunately, in many cases of chronic vestibular dysfunction there is little evidence for the efficacy of pharmacological, and even surgical, therapy in relieving symptoms (Rascol et al., 1995; Smith-Wheelock, Shepard, & Telian, 1991; Wrisley & Pavlou, 2005). Instead, there has been increasing recognition of the efficacy of using exercises to treat these individuals, with Vestibular Rehabilitation (VR) therapy now considered the optimal treatment (Hanley & O' Dowd, 2002; McDonnell & Hillier, 2015; Wrisley & Pavlou, 2005).

1.3 Vestibular Rehabilitation Therapy

1.3.1 What is vestibular rehabilitation therapy?

Vestibular Rehabilitation is an exercise-based therapy, predicated on stimulating neurological adaption to altered signals from the dysfunctional labyrinth (Brandt, 2000; Cohen, 2006). In PVDs the signals that the brain receives from the dysfunctional labyrinth do not match the input from other sources such as the eyes; this mismatch is responsible for dizziness (Bronstein & Lempert, 2007). VR exercises work through frequent repetition of the movements that provoke these signals. Consequently the balance system begins to habituate to them and, over time, learns that these altered signals are now normal (Brandt, 2000; Cohen, 2006). The exercises also aim to help patients overcome fear and avoidance of dizziness-inducing movements (Beidel & Horak, 2001).

VR therapy is based on exercises developed in the 1940s (Cawthorne, 1946; Cooksey, 1946) to improve vestibular system functioning and reduce vertigo (Cowand, Wrisley, Walker, Strasnick, & Jacobson, 1998). Over the years the exercises have been refined, and an increasing evidence base for their efficacy in treating vestibular-related dizziness has developed (McDonnell & Hillier, 2015). The core component of most programmes of VR exercises is a series of simple graded head, neck and eye movements which individuals are encouraged to practise multiple times each day for a prolonged period. The movements involved are nodding and shaking actions of the head, and involve progression from performing the exercises seated, to standing and then whilst walking (Geraghty et al., 2014; Herdman & Clendaniel, 2014).

1.3.2 Does VR work?

There is extensive evidence, including from numerous RCTs and systematic reviews, that VR therapy is effective in reducing dizziness. A recent Cochrane review concluded that VR is a safe and effective means of managing unilateral peripheral vestibular dysfunction. It stated that VR resolves symptoms and improves functioning in the medium term (McDonnell & Hillier, 2015). Studies have demonstrated VR therapy's effectiveness: when delivered in supervised clinic sessions (Topuz et al., 2004); amongst older adults (Johansson, Akerlund, Larsen, & Andersson, 2001); when delivered in combination with Cognitive Behavioural Therapy (CBT: Andersson, Asmundson, Denev, Nilsson, & Larsen, 2006); in comparison to other treatments (Horak, Jones-Rycewicz, Black, & Shumway-Cook, 1992)and with minimal support from nurses in primary care (Yardley, Beech, Zander, Evans, & Weinman, 1998; Yardley et al., 2004). Despite its apparent effectiveness, referral to services to gain access to VR is often not readily available in the UK (Jayarajan & Rajenderkumar, 2003; Yardley et al., 2012). In one trial only 3% of patients had previously been offered VR therapy, despite an 8 year mean duration of symptoms (Yardley et al., 2004). Despite this limited access to VR therapy, there is promising evidence that VR therapy is also effective when predominantly self-directed by the patient. A booklet-based version of VR therapy, with minimal telephone support was effective in reducing dizziness amongst primary care patients (Yardley et al., 2012) and amongst a volunteer sample of members of the Meniere's Society, without any telephone support (Yardley & Kirby, 2006). This has important implications for the potential delivery of VR therapy as a self-managed treatment for long term dizziness.

1.4 Self-management and digital health interventions

1.4.1 What is self-management?

Self-management of long-term conditions such as persistent dizziness, involves individuals engaging in tasks, often with initial guidance from a healthcare provider, that help to manage symptoms, treatments and the physical and psychosocial implications of having a long-term health condition (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002; Clark et al., 1991). This requires individuals to make decisions and modify behaviours to adapt their lifestyle in response to the needs of their condition (Corben & Rosen, 2005). Ageing populations and continuous advancements in diagnostic medicine across the Western world are seeing a growing proportion of patients having to manage long-term health conditions (Lawn & Schoo, 2010). Greater numbers of individuals with long-term health conditions, coupled with increasingly stretched healthcare resources, and patients taking a more active role in managing their own lifestyles (Barlow et al., 2002), mean that self-managed healthcare interventions are increasingly in demand (Fu, Yu, McNichol, Marczewski, & José Closs, 2016; Lorig et al., 2016; Ory et al., 2013).

As is the case with the management of long-term dizziness symptoms, for many long-term health conditions, a multifaceted approach to self-management includes some form of physical or exercise-based rehabilitation therapy; for example, in arthritis (Iversen et al., 2004; Schoo, Morris, & Bui, 2005), pain-related conditions (Alexandre, Nordin, Hiebert, & Campello, 2002; Crandall, Howlett, & Keysor, 2013), and urinary incontinence (Alewijnse, Mesters, Metsemakers, & Van Den Borne, 2003). Home-based physical therapy (HBPT), in particular, is an increasingly common element of these self-managed rehabilitation programmes (Bassett, 2003; Ben Salah Frih, Fendri, Jellad, Boudoukhane, & Rejeb, 2009; Chan & Can, 2010; Karingen, Dysvik, & Furnes, 2011; Kolt & McEvoy, 2003); a trend likely to continue given physiotherapists' limited time and resources (Henry, Rosemond, & Eckert, 1999).

Whilst self-management interventions are predominantly managed by the individual, they are generally initiated and accompanied by supporting materials (Barlow et al., 2002; Corben & Rosen, 2005). These supporting materials take on a variety of formats; sometimes face-to-face support in the form of lectures or demonstrations, but frequently written materials such as booklets are provided (Barlow et al., 2002; Corben & Rosen, 2005). However, there has been a dramatic increase in the use of digital technologies, particularly the internet, as a platform for delivering self-guided health interventions (Bennett & Glasgow, 2009; Ritterband & Thorndike, 2006).

1.4.2 Digital interventions to support illness self-management

1.4.2.1 What are digital interventions?

Digital interventions (DIs) utilise technologies such as web-based systems and mobile apps to support individuals with changing behaviours to improve physical and/or mental health outcomes (Alkhaldi et al., 2016; Yardley et al., 2016). DIs provide a means of reaching large numbers of these individuals at a relatively low cost (Birnbaum, Lewis, Rosen, & Ranney, 2015). They also allow delivery of content that paper-based materials cannot provide, such as user-tailoring and audio-visual content (Griffiths, Lindenmeyer, Powell, Lowe, & Thorogood, 2006). As such, DIs are increasingly implemented as an alternative to paper-based self-management materials (Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004; Webb, Joseph, Yardley, & Michie, 2010).

DIs to support self-management of health conditions typically consist of supportive and instructional content about condition-relevant health behaviours. They are most often presented in a website or mobile app format that individuals can access and engage with independently, and generally include interactive elements (Eysenbach, 2011). DIs frequently include features such as information and instruction, audio-visual demonstration of relevant behaviours, tailored feedback and advice, self-monitoring, goal-setting and planning, printable resources and reminders and prompts (Mohr, Burns, Schueller, Clarke, & Klinkman, 2013; Webb et al., 2010). DIs are sometimes supplemented by support in the form of text, telephone, or face-to-face contact with relevant healthcare professionals, but are also frequently intended to be fully self-contained (Mohr et al., 2013).

1.4.2.2 Do they work?

There is substantial evidence from systematic reviews that DIs are effective in instigating health-related behaviour change and supporting illness self-management across a range of physical and mental health conditions (Alkhaldi et al., 2016; Webb et al., 2010). These include: self-management of long-term physical health (e.g. diabetes, asthma: Bond et al., 2007; Morrison et al., 2014) and mental health (Andersson et al., 2005) conditions; chronic pain conditions (Buhrman, Fältenhag, Ström, & Andersson, 2004); lifestyle management (e.g. weight management, physical activity: Foster, Richards, Thorogood, & Hillsdon, 2013; Kohl, Crutzen, & de Vries, 2013) and reduction of harmful behaviours (e.g. smoking, alcohol consumption: Hutton et al., 2011; Khadjesari, Murray, Hewitt, Hartley, & Godfrey, 2011). Of particular relevance to the present topic, there is growing evidence from the related field of hearing-health, that digital interventions are an effective way to support self-management in this context (Greenwell & Hoare, 2016).

Furthermore, there is substantial evidence that DIs are also accessible and effective amongst an older adult population. This is especially relevant in the context of a chronic dizziness population given the high prevalence of such symptoms in this demographic (Lee & Elder, 2013). Recent UK government statistics demonstrate that the proportion of older adults using the internet is rapidly increasing. Amongst 55-64 year olds, 88.3% reported recent (in past three months) internet use. Although this proportion declines across age groups (74.1% in 65-74 year olds and 38.7% amongst over 75 year olds), this latter age-group have demonstrated the fastest growth. Over the past five years, the proportion of adults aged 75 and over reporting recent internet use has nearly doubled from just 19.9% in 2011 (Office for National Statistics, 2016). With regard to use of digital interventions in particular, research has reported that older patients, even without internet experience, are quite willing to take part in internet-based self-management programmes (Feil, Glasgow, Boles, & McKay, 2000; Gustafson et al., 1998; Strecher, 2007). Importantly, studies also provide evidence that such self-management interventions are effective amongst older adults across a range of health conditions (Aalbers, Baars, & Rikkert, 2011; Burns, Jones, Iverson, & Caputi, 2013; Stellefson et al., 2013). These studies provide insight into particular features of such interventions that older adults report to be especially helpful, including progress tracking features (Stellefson et al., 2013), self-monitoring and goal setting (Aalbers et al., 2011).

In summary, there is good evidence that digital interventions to support illness self-management are both accessible and effective for older adults. Coupled with the obvious demand for improved access to VR therapy highlighted in section 1.3.2, a digital intervention seems a practicable means of addressing this need. A digital intervention for adults aged fifty and over was developed to support the self-management of chronic dizziness through VR therapy (Geraghty et al., 2014). The intervention is called 'Balance Retraining' and is described in more detail in the following sections.

1.5 Development of the 'Balance Retraining' digital intervention

Medical Research Council (MRC) guidance on developing complex interventions suggests that this process should begin with consulting the relevant underlying evidence base, followed by identification of pertinent theories which may guide how important behavioural determinants can be targeted (Craig et al., 2008). In accordance with these recommendations, the development of the Balance Retraining intervention (Essery et al., 2015) was conducted according to an evidence-, theory-, and person-based approach. This was to ensure that the intervention: utilised existing theoretical and empirical evidence to identify and target appropriate behavioural determinants;

followed principles of health-related behaviour change in order to achieve this; and accommodated the perspectives of intended users.

1.5.1 Evidence base: likely determinants of VR outcomes

The ultimate goal of the Balance Retraining intervention is to reduce individuals' dizziness by changing their behaviour; specifically, it aims to encourage regular and consistent practise of VR exercises, and reduce avoidance of movements that trigger dizziness (Geraghty et al., 2014). Accordingly, the literature (both empirical and theoretical) regarding modifiable determinants of outcome in VR therapy, and health-related behaviour change more generally, was consulted to determine what behavioural determinants may be important to address via the intervention. This identified a range of factors which appear instrumental in the outcomes of either: VR therapy, self-managed physical therapies more generally, or digital behaviour change interventions. The identified factors can broadly be split into two categories: behavioural determinants, including illness perceptions, psychological distress and self-efficacy; and behaviours including adherence and engagement. The evidence relating to these factors is outlined below.

1.5.1.1 **Behavioural determinants**

1.5.1.1.1 **Illness perceptions**

The existing literature revealed that several illness-related perceptions, including beliefs of illness severity and impact, and expectations about consequences of treatment, seem important for VR outcomes. Illness perceptions refer to cognitions, attitudes or beliefs held by an individual that relate to different aspects of their illness; for example, their beliefs about how serious their condition is, how long it is likely to last, and whether engaging in certain behaviours (e.g. treatments) is likely to help (Leventhal & Cameron, 1987; Leventhal, Meyer, & Nerenz, 1980).

In studies of VR therapy outcomes, research has demonstrated associations between higher levels of perceived disability pre-therapy and more successful outcomes based on objective and subjective measures (Brown, Whitney, Marchetti, Wrisley, & Furman, 2006; Shepard, Smith-Wheelock, Telian, & Raj, 1993). In addition, although they don't appear to have been widely investigated as predictors of VR outcome, perceptions of treatment credibility and outcome expectancy have both been shown to be positively associated with better patient outcomes in the context of interventions for chronic pain (Goossens, Vlaeyen, Hidding, Kole-Snijders, & Evers, 2005; Smeets et al., 2008). Amongst VR participants, positive outcome expectations are thought to sometimes play a direct role in facilitating improvement in symptoms as a form of non-specific placebo effect (Yardley, Burgneay, et al., 1998). These findings are further supported by several models relating to the performance of health-related behaviours which propose that such illness-related beliefs are key determinants of associated behaviours. For example, the Health Belief Model (HBM) proposes that, alongside a number of additional factors, an individual's perceived severity of their condition and the perceived benefits to taking action predict the likelihood of them engaging in behaviours to address the problem (Rosenstock, 1974). The Self-Regulatory Model of illness cognitions (Leventhal et al., 1980) similarly proposes that individuals' perceptions about their illness, including those about its consequences and its controllability through treatment, are important determinants of how they subsequently attempt to cope with the illness.

1.5.1.1.2 **Psychological distress**

The literature also indicates the potential importance for VR outcomes of a number of factors relating to issues of psychological distress. These include anxiety, depression and problems with illness acceptance.

As discussed in section 1.2.3, the relationship between dizziness and high levels of anxiety is well documented (Haug et al., 2004; Yardley & Redfern, 2001) and, if not addressed, has implications for post-treatment dizziness outcomes. Research has demonstrated that the presence of anxiety predicts lower confidence in balance and a higher proportion of time that dizziness is perceived to interfere with life post VR-therapy (Herdman, Hall, & Delaune, 2012). Given that VR exercises require individuals to routinely practise movements that exacerbate symptoms, high levels of anxiety may also be problematic for adherence to such exercises (Mendel et al., 1997); this, in turn, may be detrimental to successful outcomes (Dimatteo, Giordani, Lepper, & Croghan, 2002; Yardley et al., 2012).

There is also evidence that depression amongst individuals with vestibular dysfunction may reduce the likelihood of participation in VR exercises and therefore impact on outcomes (Krebs, Gill-Body, Parker, Ramirez, & Wernick-Robinson, 2003). This is thought to result from the impact of depression on individuals' cognitions relating to their dizziness symptoms; more highly depressed individuals may believe their symptoms to be uncontrollable which, in turn, may cause them to feel that it is not worth attempting to manage them (Yardley, 2000). Herdman et al. (2012) found that the presence of depression predicted higher levels of perceived dizziness interference in everyday life following VR therapy. Accordingly, there was good reason to suppose that addressing levels of anxiety and depression would be important for achieving positive outcomes. Evidence suggests that implementing psychotherapeutic strategies, including relaxation, stress management, thought control exercises and controlled breathing, has been effective in reducing dizziness and dizziness handicap (Yardley & Kirby, 2006).

Within the context of a long-term condition, acceptance refers to an individual's ability and willingness to engage in meaningful activities in life regardless of unpleasant sensations or experiences associated with their illness (McCracken, Carson, Eccleston, & Keefe, 2004). In asthma self-management, difficulties accepting the condition and its associated limitations were associated with poor adherence to treatment (Baiardini et al., 2006). This association between low acceptance and poor adherence may be explained by experiential avoidance. Experiential avoidance refers to individuals' avoidance of unwanted experiences or bodily sensations, even when doing so produces harm (Lillis, Hayes, & Levin, 2011). Hesser and Andersson (2009) demonstrated that behavioural avoidance was a strong predictor of greater tinnitus-related distress and difficulty functioning. This concept of experiential avoidance seemed highly relevant to VR exercises given their requirement for individuals to repeatedly perform movements that can trigger dizziness symptoms in the short-term, in order to habituate themselves to reduce symptoms in the long-term. As such, it was anticipated that the extent to which individuals were accepting of their dizziness could be instrumental in their VR therapy adherence and, therefore, the extent to which they would achieve beneficial outcomes (Dimatteo et al., 2002).

1.5.1.1.3 **Self-efficacy**

Self-efficacy also appeared to be a potentially important determinant of outcomes for the Balance Retraining intervention. Self-efficacy refers to an individual's perception of their capability to succeed in a given task (Bandura, 1977). Within the specific context of VR therapy, it didn't appear that self-efficacy had been widely investigated as a predictor of outcome. However, Yardley and Donovan-Hall (2007) did demonstrate an association between perceived behavioural control (PBC) and adherence to VR exercises, which is likely to have impacted on outcomes (McDonnell & Hillier, 2015). Although separate constructs, the similarity between PBC and self-efficacy has been acknowledged (Ajzen, 1991). More generally, many health conditions require patients to learn new skills for self-care and improved health outcomes and the inclusion of self-efficacy-enhancing intervention components has been shown to produce better treatment outcomes (Marks & Allegrante, 2005; Smith & West, 2006). Self-efficacy has been demonstrated as an important mediating factor between intentions and behaviour amongst patients undergoing other forms of exercise-based rehabilitation (Sniehotta, Scholz, & Schwarzer, 2005). It has also been demonstrated to be a positive predictor of disease self-management behaviours (Clark & Dodge, 1999). Within this broader context of health-related behaviour change, Social Cognitive Theory (SCT: Bandura, 1986), Protection Motivation Theory (PMT: Rogers, 1975) and the Health Action Process Approach (HAPA: Schwarzer, 1992) all posit that self-efficacy is central to understanding and predicting health related behaviours.

1.5.1.2 **Behaviours**

1.5.1.2.1 **Adherence**

Given that one of the intended primary behavioural outcomes of the Balance Retraining intervention is regular and consistent practise of the VR exercises, adherence was considered a main target of the intervention. The existing literature confirmed that adherence to therapy is particularly important for outcomes of VR, and self-managed physical therapies more generally.

1.5.1.2.1.1 What is adherence?

The World Health Organisation (WHO) define adherence as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider"(Sabate, 2003, p. 3). The term compliance has sometimes been used interchangeably with adherence; however, they are increasingly thought of as divergent concepts. Whereas 'adherence' acknowledges the active role of the patient in decision making about their own treatment, 'compliance' conceives of the patient as a passive recipient of medical expertise (Sabate, 2003). It has further been suggested that the idea of compliance is too closely associated with blame (Horne, Weinman, Barber, Elliott, & Morgan, 2005), whereas adherence more readily encompasses notions of complex change and on-going dialogue between stakeholders (Sabate, 2003). Emerging primarily from the field of rehabilitation, the term 'patient engagement' is also increasingly used in relation to patients' self-management of their health. It is a broader term encompassing not just notions of adherence, but of communicating with professionals and identifying relevant information too (Jordan, Briggs, Brand, & Osborne, 2008; Lequerica & Kortte, 2010). Whilst it is important to note this variation in terminology, the term 'adherence' is thought to be most appropriate in the present context given the self-managed nature of the treatment and the specific focus on the exercise behaviour.

1.5.1.2.1.2 Why is adherence important?

A systematic review and meta-analysis of studies investigating the relationship between treatment adherence and treatment outcomes concluded that not only is there a strong association, but that it is likely to be stronger when the relevant condition is chronic and when treatment regimens are non-medication based (Dimatteo et al., 2002). Further research similarly suggests that the extent to which patients adhere to programmes of self-managed physical therapy is central to their success (Hayden, Van Tulder, & Tomlinson, 2005) with adherent patients having better treatment outcomes (Vermeire, Hearnshaw, Van Royen, & Denekens, 2001). In line with this evidence, findings from previous trials of VR therapy have suggested that successful VR outcomes are strongly positively associated with good adherence to VR interventions (Yardley et al., 2012; Yardley & Kirby, 2006). A recently updated Cochrane review (McDonnell & Hillier, 2015) suggests that this association requires further investigation.

Despite high levels of adherence being recognised as fundamental to positive therapy outcome, there is evidence that non-adherence is often very high – studies have suggested as high as 70% (Sluijs, Kok, Van der Zee, Turk, & Riolo, 1993). A key message of the WHO's (2003) evidence for action report on adherence to long-term therapies states that: "the ability of patients to follow treatment plans in an optimal manner is frequently compromised by more than one barrier, usually related to different aspects of the problem. These include: the social and economic factors, the health care team/system, the characteristics of the disease, disease therapies and patient-related factors" (Sabate, 2003, p. xiv). HBPTs, in particular, often demonstrate the lowest levels of patient adherence (Alexandre et al., 2002; Borello-France et al., 2010) and this adherence has been shown to decline over time (Borello-France et al., 2013). Such self-managed therapies are characterised by many features that make them especially susceptible to non-adherence, including: the prolonged and unsupervised nature of treatment; not providing immediate relief from symptoms; and potential provocation of symptoms (Carter, Taylor, & Levenson, 2003; Kirby, Donovan-Hall, & Yardley, 2014; Yardley & Donovan-Hall, 2007). This poor adherence is potentially problematic, both for patients' own treatment outcomes and healthcare resources (Alexandre et al., 2002; Hayden et al., 2005; Vermeire et al., 2001). When adhered to, though, research has demonstrated that HBPT can sometimes even be superior to standard care (Karingen et al., 2011).

This existing literature highlighted the necessity of the Balance Retraining intervention to effectively facilitate adherence to VR exercises. With evidence that adherence to such therapies is typically poor, it seemed important to also investigate the determinants of adherence to such self-managed physical therapies to understand how best to achieve this.

1.5.1.2.2 **Engagement with digital interventions**

As well as adherence to the VR therapy, existing literature suggested that broader engagement with the Balance Retraining intervention as a whole would be of central importance to achieving positive outcomes.

1.5.1.2.2.1 What is engagement?

There is extensive variability and lack of consensus regarding the conceptualisation of 'engagement' (Barello, Graffigna, Vegni, & Bosio, 2014; Graffigna, Barello, Bonanomi, & Lozza, 2015). From a health research perspective, it is broadly defined as a process through which individuals' cognitions, emotions and behaviours influence the extent of their immersion in relevant health-care behaviour(s) and the impact on relevant health outcomes (Graffigna et al., 2015; Yardley et al., 2016). However, within the context of digital health interventions, engagement has traditionally been conceptualised more in terms of perceived usability, acceptability and usage of the digital technologies (Yardley et al., 2016).

1.5.1.2.2.2 Why is engagement important?

As discussed in section 1.4.2.2, there is good evidence that digital interventions are an effective means of initiating and supporting self-management of healthcare behaviours. Patient engagement has been repeatedly linked to better health outcomes (Birnbaum et al., 2015), and sufficient use of digital health interventions is recognised as a pre-condition for their effectiveness (Yardley et al., 2016). As such, it seems important that users engage with Balance Retraining sufficiently in order to achieve the intended outcomes. However, research has also documented high rates of attrition and non-usage of such interventions (Kohl et al., 2013; Yardley et al., 2016). Furthermore, what constitutes 'sufficient use' of a digital intervention is not well understood.

Investigation of engagement within the field of digital health interventions has tended to focus on how far individuals adhere to the usage recommendations and expectations set out by developers (Alkhaldi et al., 2016; Yardley et al., 2016). Levels of usage of various digital intervention components have become frequently used as a proxy for individuals' engagement (Kraft & Yardley, 2009) and are suggested to be one of the more consistent predictors of outcomes across a range of digital health interventions (Bennett & Glasgow, 2009). Based on this operationalisation of engagement, research has identified factors associated with engagement in an attempt to better understand how and why individuals use digital interventions differently. This has demonstrated that demographic variables including age, gender and level of education are associated with level of engagement with digital health interventions across a variety of conditions and behaviours (Couper et al., 2010; Hasson, Brown, & Hasson, 2010; Strecher et al., 2008; Van't Riet, Crutzen, & De Vries, 2010; Verheijden, Jans, Hildebrandt, & Hopman-Rock, 2007). A systematic review of studies investigating digital interventions for anxiety and depression also demonstrated that factors such as disease severity and treatment length predicted attrition from such interventions (Christensen, Griffiths, & Farrer, 2009). Characteristics of the digital health interventions themselves, such as levels of tailoring and personalisation, have also been suggested to influence their degree of use (Strecher et al., 2008). All of these findings are based on the supposition that greater usage of a digital health intervention is more beneficial compared to less use. However, more recent literature proposes this to be a potentially problematic assumption.

Low usage of an online intervention – for example, perhaps only accessing one of multiple available sessions - does not necessarily translate to poor adherence to target behaviours, or mean that the individual has failed to acquire sufficient knowledge to perform these required behaviours (Yardley et al., 2016). Instead, it could be that the intervention has not met the needs of the user, or that one session was enough for the user to master the skills they required to implement a change in behaviour (Yardley et al., 2016). Despite the aforementioned evidence that usage metrics are often associated with health outcomes, these effect sizes are often small and highly variable across different health behaviours (Webb et al., 2010). With the majority of this evidence being correlational, it is also not possible to determine the extent to which usage is actually playing a mediating role in health-behaviour related outcomes, or if these associations are due to confounding factors (Yardley et al., 2016). In line with these concerns, recent thinking advocates a shift from perceptions of engagement as usage, to a focus instead on what 'effective engagement' is for each specific intervention (Yardley et al., 2016). 'Effective engagement' refers to that which can be demonstrated to mediate positive outcomes and, as such, is defined by the aims of each individual intervention (Yardley et al., 2016).

Whilst the evidence suggested that engagement with the Balance Retraining intervention is important for outcomes and provides some insight into factors which may influence this, exactly 'how much' engagement is necessary is not clear. As such, it seems that investigation of what constitutes 'effective engagement' for the Balance Retraining intervention would be worthwhile.

1.5.2 Theoretical underpinnings of the Balance Retraining intervention

The preceding section outlines the behaviours and behavioural determinants identified from existing evidence as likely to be influential in outcomes of the Balance Retraining digital intervention. In designing how the intervention could effectively target these important determinants, it was also important to consider theoretical principles of health-related behaviour change. There is increasing call for digital interventions to be grounded in theory, with substantial evidence that this leads to greater and more significant effects on target outcomes (Campbell, Fitzpatrick, Haines, & Kinmonth, 2000; Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Webb et al., 2010).

There is an extensive range of theories of health-related behaviour change that were relevant to the development of the intervention (Davis, Campbell, Hildon, Hobbs, & Michie, 2015). By identifying those that included constructs corresponding to the identified key behavioural determinants, it was possible to judge which were likely to be most relevant. However, with many overlapping constructs between theories (Michie et al., 2005) this was still a significant number. Theoretical understandings of the identified key behaviours and behavioural determinants were drawn upon to provide insight into how these could most effectively be targeted; in particular, these included adherence, engagement and self-efficacy. Theoretical approaches that have been applied to understanding these concepts are detailed below, followed by an outline of the theoretical underpinnings of the Balance Retraining intervention as a whole.

1.5.2.1 **Theories of adherence**

Specific theories and models for understanding and predicting adherence behaviour are limited, and those which do exist tend to focus mainly on medication adherence (e.g. Johnson, 2002). However, there are numerous theories of health-related behaviour more generally that are potentially helpful in understanding adherence in the context of self-managed physical therapies. Horne and Weinman (1998) propose that theories relevant to health-behaviour adherence can be grouped into three broad categories: social cognition models; stage-based models; and self-regulatory models.

Social cognition models focus on thoughts, attitudes and beliefs as major determinants of adherence behaviour (e.g. Health Belief Model (HBM; Rosenstock, 1974), Theory of Reasoned Action (TRA; Ajzen & Fishbein, 1980),Theory of Planned Behaviour (TPB; Ajzen, 1985) and Health Locus of Control (HLoC; Rotter, 1954, 1966)). In addition to these, Munro, Lewin, Swart, and Volmink (2007) cite Social Cognitive Theory (SCT; Bandura, 1986, 1991), Protection Motivation Theory (PMT; Rogers, 1975) and Information Motivation Behavioural Skills (Fisher & Fisher, 1992) as relevant to adherence behaviour. According to these models, factors such as: how serious individuals believe their dizziness symptoms to be; how effective they expect the VR therapy to be; and how capable they perceive themselves to be with regard to completing the exercises are likely to play a significant role in whether they complete the exercises as recommended. This is very much supported by the evidence presented in section 1.5.1.1 regarding behavioural determinants of VR and similar self-managed therapies.

Stage-based health behaviour models emphasise different stages of behaviour change being associated with different cognitions (e.g. Trans-Theoretical Model (TTM; Prochaska & DiClemente, 1983), Health Action Process Approach (Schwarzer, 1992), Precaution Adoption Process (Weinstein, 1988) and Goal Setting Theory (Bagozzi, 1992)). These models include some similar constructs to social cognition models but suggest that these are changeable at different stages of the behavioural process. For example, according to the HAPA individuals' initial perceptions about their ability to complete VR exercises (their action self-efficacy) will influence their intention to complete them as instructed. However, other (potentially unforeseen) factors including perceived barriers or resources may alter their self-efficacy, which will then impact on whether they act as intended. As such, this model would suggest that this initial action self-efficacy may not always be a good predictor of adherence behaviour. This is supported by the findings of Yardley and

Donovan-Hall (2007) who demonstrated that participants' post-treatment beliefs and attitudes were a better predictor of adherence to VR exercises than pre-treatment.

Self-regulatory models largely focus on the Common Sense Self-Regulatory Model (SRM; Leventhal et al., 1980). The SRM proposes that patients evaluate illness at both a cognitive and emotional level based on their perceptions and experiences of symptoms and that their decision about how to behave is based on what 'makes sense' in light of this (Leventhal et al., 1980). Individuals hold 'illness perceptions' as part of their cognitive appraisal of illness which can inform decisions about illness relevant behaviours (Horne & Weinman, 1998). According to this model individuals' beliefs regarding: how severe the consequences of their dizziness might be: the extent to which they feel it might be controlled through VR exercises; and the extent to which they identify as having the symptoms of dizziness, all contribute to their cognitive appraisal of their dizziness. Alongside their emotional appraisal, this is likely to impact on whether or not they chose to engage in the VR exercises as a means of coping with their dizziness. Once again this is supported by the evidence presented in section 1.5.1.1 regarding likely behavioural determinants of VR outcomes.

1.5.2.2 **Theories of engagement**

By conceptualising engagement with a digital health intervention as a health-related behaviour, many existing theories and models of health behaviour, (e.g. the SRM (Leventhal et al., 1980), SCT (Bandura, 1986), and the HBM (Rosenstock, 1974)), can be applied to the understanding and prediction of engagement with health interventions. Many of these models share similar constructs and would propose that factors such as individuals' perceived severity of their dizziness, the perceived likelihood of the Balance Retraining intervention helping them, and their perceptions of their own capability in accessing and using the intervention are all likely to impact on the extent to which they engage. This resonates with some of the findings regarding predictors of engagement outlined in section 1.5.1.2.2.2. Furthermore, it is also supported by the findings of a Delphi study investigating influences of exposure to digital interventions. This proposed factors such as ability to use the intervention, and perceived relevance of the intervention as important for determining the likelihood of users beginning, and continuing with, a digital intervention (Brouwer et al., 2008).

Several additional models emerging across disciplines may provide a theoretical framework for understanding engagement processes in the context of digital health interventions. Some models characterise particular aspects of engagement; for example, interest in behaviour change interventions (Crutzen & Ruiter, 2015). This model suggests that individuals' interest in interventions such as Balance Retraining is determined by a two-step appraisal process. In the first, the individual makes a judgement about whether the intervention is relevant to them, and in the second they judge whether or not they are able to manage it. Factors such as novelty and complexity of the information presented are proposed to impact on the first stage, whereas individuals' perceptions of their capability inform the second.

Other models such as the 'Behaviour Change Model for Internet Interventions' (e.g. Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009) attempt to account for factors that contribute to the success of interventions more broadly, and the various mechanisms through which beneficial outcomes are achieved, in which engagement processes play a role. This model proposes that website features, user characteristics, environmental factors and support provision all impact on level of engagement with digital interventions. The aforementioned Delphi study had similarly identified a mixture of intervention and personal characteristics of potential importance to extent of exposure to digital health interventions (Brouwer et al., 2008).

Some models (O'Brien & Toms, 2008; Venkatesh & Davis, 2000) focus specifically on engagement processes, but not necessarily from a health intervention perspective and so do not always account for the psychological and social factors relevant to many health behaviours. Both of these models include some similar constructs to the previously discussed models, including perceived relevance of information presented and novelty of information presented. They also suggest that different perceptions may be relevant at different stages of the engagement process. This Delphi study similarly suggested that different factors may impact on different phases of engagement with behaviour change interventions (Brouwer et al., 2008).

There have been recent attempts to develop models that bridge the fields of health-behaviour science and technology, such as the 'Behavioural Intention Technology' (BIT) model (Mohr, Schueller, Montague, Burns, & Rashidi, 2014). This model outlines a framework for combining behavioural principles with technological feature design to develop digital health interventions that achieve clinical outcomes whilst meeting requirements of usability and accessibility (Mohr et al., 2014). Models such as this may provide a theoretical framework for understanding engagement with digital health interventions, but as yet, are relatively untested (Yardley et al., 2016).

1.5.2.3 **Self-efficacy theory**

Self-efficacy theory (Bandura, 1977) posits that a person's perceptions of their ability to complete a given behaviour (their self-efficacy) is a strong determinant of whether or not that behaviour occurs. The theory suggests that an individual's self-efficacy is influenced by four main factors. The first is 'performance accomplishments' whereby an individual's previous success or failure on the task influences their perceptions of competence. The theory suggests that this can increase self-efficacy by a successful performance increasing mastery experience and mastery expectations for any further performance of the behaviour. It suggests that repeated performance of the behaviour is likely to influence performance accomplishments (Bandura, 1977).

A further proposed influence of self-efficacy is ‘vicarious experience’ which refers to the individual observing another person completing the task. The theory proposes that seeing others performing potentially challenging behaviours without experiencing adverse consequences leads to observer expectations that they will have a similar experience in performing the behaviour. As it relies on social comparison, perceived similarity of the model which the individual is observing is thought to be important (Bandura, 1977).

Verbal persuasion, often in the form of encouragement or discouragement from others, is also proposed to influence self-efficacy. It is argued to be effective simply through the effect of suggestion on individuals’ beliefs about their capabilities. However, given that it is not grounded in experience, it is thought to be a weaker influence of self-efficacy than performance accomplishments (Bandura, 1977).

Finally, the theory identifies management of emotional arousal and physiological states as an influence on self-efficacy. Taxing situations can generate anxiety and stress, which tend to impede performance. As such, individuals are more likely to expect success when their levels of emotional arousal are under control. As such, strategies to manage emotional arousal are thought to improve perceptions of self-efficacy (Bandura, 1977). In a review of self-efficacy enhancing interventions across a range of health conditions and behaviours, applications of all four of these proposed influences on self-efficacy are identified as ‘primary characteristics of self-efficacy enhancing strategies for people with chronic diseases’ (Marks & Allegrante, 2005).

1.5.2.4 **Theoretical frameworks for the Balance Retraining intervention**

Evidently there is extensive variation in theoretical frameworks for understanding key determinants of intended outcomes of Balance Retraining. As a result it was difficult, and not considered appropriate, to select one particular theory as a guiding framework of how the intervention was intended or expected to work. For this reason, the design of Balance Retraining drew on understandings gained from the multiple theories that had been applied to the various relevant behaviours and behavioural determinants. However, one theory in particular - Social Cognitive Theory (Bandura, 1986) - comprised many constructs that related to identified key behavioural determinants. SCT has been applied to the understanding of adherence and engagement behaviours in the context of health, and is closely interrelated with self-efficacy theory (Bandura, 1977). The constructs of the SCT are amongst those most often measured as a means of testing the efficacy of interventions for health-related behaviour change (Luszczynska & Schwarzer, 2005).

1.5.2.4.1 **Social Cognitive Theory**

SCT postulates that personal, behavioural and environmental factors all causally interact, in a model of 'triadic reciprocal causation', to determine the likelihood of an individual performing a given behaviour (Bandura, 1986). It proposes that a person's behaviour is a product of personal and environmental factors. Personal factors include affect, expectations, beliefs, goals, self-perceptions, and intentions as well as personal characteristics, attributes and biological properties (Bandura, 1989b). Environmental factors are external to the individual and include physical and social resources and interactions with others (Bandura, 1989b). In turn, individuals' behaviours influence both personal and environmental factors too (Bandura, 1986). Bandura argues that most aspects of the environment do not act as influence until activated by an appropriate behaviour (Bandura, 1989b). Within the 'personal factors' aspect of the model, self-efficacy and outcome expectancies are cited as major determinants of whether an individual decides to engage in a given behaviour (Bandura, 1986; Luszczynska & Schwarzer, 2005).

Self-efficacy (as detailed in section 1.5.2.3) refers to individuals' beliefs about their capability to complete a given behaviour (Bandura, 1977). Outcome expectancies refer to individuals' beliefs and expectations regarding what the consequences of engaging in a given behaviour are, and how much they value those consequences (Bandura, 1986; Luszczynska & Schwarzer, 2005). According to the model, if a person believes they are capable of completing a behaviour, and that the outcomes of that behaviour are likely to be positive and valuable to them, then the likelihood of the behaviour occurring is high. However, these beliefs and the behaviour itself will also be influenced by (and influence) environmental factors. Environmental factors can act as facilitators or impediments to behaviour, depending on individuals' access to resources and also the impact of their personal factors and behaviours (Bandura, 1986; Luszczynska & Schwarzer, 2005). SCT states that performance of a behaviour is most likely when environmental factors are perceived as controllable and supportive (Bandura, 1991). A depiction of SCT is shown in Figure 1.

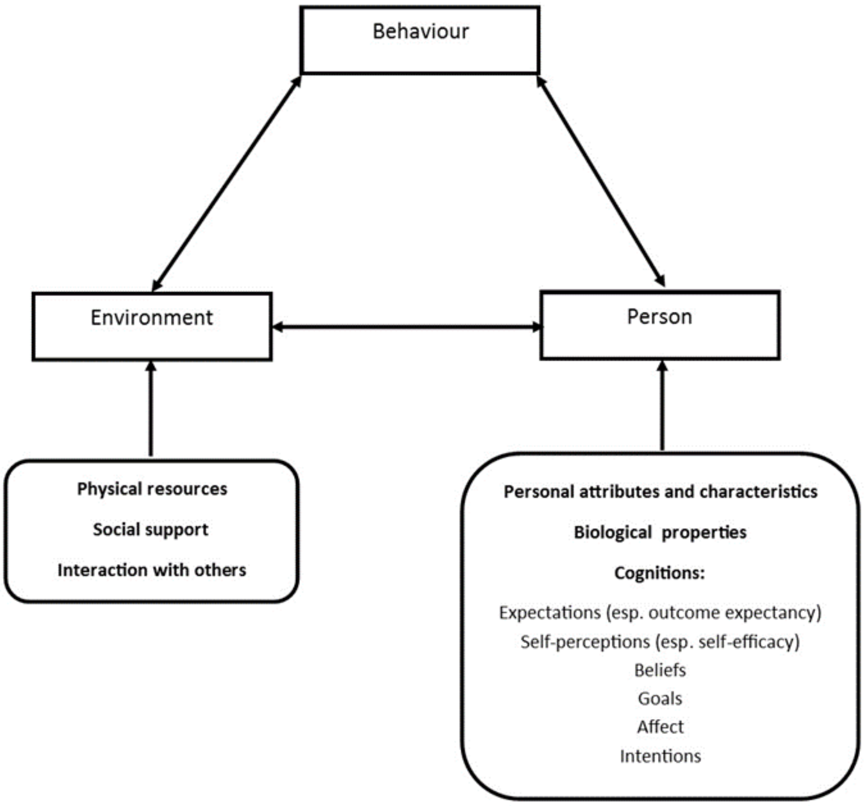


Figure 1 Social Cognitive Theory

Existing evidence has provided support for the explanatory ability of SCT. For example, a literature review of the predictive ability of SCT in physical activity behaviour concluded that interventions designed to increase outcome expectations and self-efficacy significantly increased exercise behaviour (Keller et al, 1999). Furthermore, Booth, Owen, Bauman, Clavisi, and Leslie (2000) reported that self-efficacy and environment-related factors – such as access to appropriate facilities - were significant predictors of levels of physical activity. Reviews of the literature have also concluded that SCT components are good predictors of adherence to therapeutic exercise (Woodard & Berry, 2001). With regard to the self-management of illness, in a study of self-care behaviours amongst diabetics, greater self-efficacy expectations and outcome expectations predicted better adherence to self-care behaviours and greater perceptions of being able to manage such behaviours (Wu et al, 2007).

In the context of the Balance Retraining intervention, SCT accounts for many of the outcome-relevant concepts identified from the literature. For example, the illness-related perceptions including perceived dizziness-related handicap, and beliefs about the outcome of VR therapy can be equated with the perceptions, beliefs and important 'outcome expectancies' constructs that contribute to the proposed 'personal factors' determinant of behaviour. SCT's central construct of self-efficacy was also identified in the literature as potentially influential for intervention outcomes. According to the model then, individuals who feel confident about performing their VR exercises and who hold positive perceptions about the possible outcome of doing so should be likely to engage in regular and consistent practise of their exercises. The psychological distress (i.e. anxiety, depression and problems with acceptance) identified in the literature as important to outcomes, although not directly accounted for in the SCT model, might be seen to contribute to the affect component of 'personal factors'. These may reduce the likelihood of adherence to the VR exercises unless they can be addressed. The intervention content may be perceived as an environmental resource to support individuals which would suggest, in line with the evidence, that engagement with the intervention content should increase the likelihood of regular and consistent practise of VR.

1.5.2.4.2 **Self Determination Theory**

In addition to the functional content of the intervention being grounded in appropriate theory, the style and structure was also informed by theoretical principles. In accordance with the Person-Based Approach (PBA) to intervention development (outlined in section 1.5.3), it is important for users to be self-motivated, both in terms of their engagement with the digital intervention and in completion of the VR exercises (Yardley, Morrison, Bradbury, & Muller, 2015). As such, this approach advocates drawing upon principles of self-determination theory (SDT: Deci & Ryan, 2000; Ryan & Deci, 2000) as a means of facilitating intrinsic motivation. SDT is a theory of motivation which postulates that intrinsic motivation, stemming from internal perceptions of the importance, value and interest in the target behaviour, is more likely to result in persistent performance than extrinsic motivation, resulting from external sources of coercion and feelings of obligation (Ryan & Deci, 2000). SDT proposes that intrinsic motivation itself is enhanced by facilitating individuals' perceptions of competence, autonomy and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2000). The PBA suggests mechanisms through which to achieve this in the development of interventions; these are discussed in the following section.

1.5.3 A Person-Based Approach

With a thorough understanding of the important behavioural determinants and key mechanisms through which intended behaviours should be targeted, it was also vital to ensure that the Balance Retraining intervention would be accessible and appealing for its intended users (Crutzen, Ruiter, & de Vries, 2014). Accordingly, the practical development of the Balance Retraining intervention (Essery et al., 2015) was conducted according to a Person Based Approach (PBA) to digital intervention development. This approach focuses on accommodating perspectives of the intervention's intended users to closely inform content, structure, and functionality (Yardley et al., 2015). In line with the discussed theoretical and empirical evidence, initial content was adapted for online presentation from the successfully trialled (Yardley et al., 2012; Yardley & Kirby, 2006) Balance Retraining booklet, and also drew upon understandings of participants from previous self-managed VR trials (Muller, Kirby, & Yardley, 2015; Yardley et al., 2012; Yardley & Kirby, 2006). This gave rise to five 'guiding principles' which sought to ensure that the intervention would be suited to older adults' views of VR therapy and to their wider psychosocial context. The design objectives and key features of the intervention that sought to fulfil these guiding principles are detailed in Table 1.

In addition to these intervention-specific guiding principles, it was important to address the issues of competence, autonomy and relatedness to foster the development of users' intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000). In accordance with recommendations of the PBA, feelings of competence were addressed by attempting to ensure that interaction with the intervention would be convenient and accessible, and by encouraging behaviour change in small achievable steps to increase confidence through experiences of success (Yardley et al., 2015). Users were provided with choice and flexibility in terms of how, when and in what order they accessed intervention content, and indeed which elements of content they accessed, as a means of facilitating autonomy (Yardley et al., 2015). Finally, attempts were made to foster perceptions of relatedness through the adoption of a positive autonomy-supportive tone. This refers to use of language and structuring of content that invites, rather than instructs, individuals to use a particular feature or technique (Yardley et al., 2015).

During this development process, it was considered important to seek the perspectives of older adults with dizziness about their experiences of engaging with the Balance Retraining intervention (Yardley et al., 2015). In doing so, it was possible to gain insight into these individuals' needs and preferences which were utilised to further refine the intervention.

Table 1 Guiding Principles of the Balance Retraining Intervention (from Essery et al., 2015)

Key Design Objective	**Key Features addressing this**
Ensuring exercise safety	• Safety advice and reminders to exercise at the appropriate level. • Tailored feedback and exercise instructions: on a weekly basis users record their scores on a 'Timed Exercise Scoring Test' which is used to determine the advice given regarding how to conduct exercises for the following week.
Encouraging exercise adherence	• Tailored feedback and exercise instructions. • Reassurance: making explicit the possibility that exercises will induce symptoms but offering information about how to manage this. • Gender-tailored exercise demonstration videos: audio-visual explanation of how to conduct exercises.
Avoiding exacerbation of symptoms	• Short, weekly accessible sessions: information periodically provided in manageable amounts with the facility to revisit this. • Single screen pages: no vertical scrolling required to view page content.
Meeting visual requirements of users	• Minimum font size 14. • Bullet point or short-sentence information presentation. • Key words/ phrases highlighted in bold.
Allowing for limited online experience	• Simple and consistent login and navigation procedures. • Printing options: facility to allow printing of key instruction documents for 'offline' reference.

1.6 The Balance Retraining intervention

Detailed consideration of relevant theoretical and empirical evidence, as well as user-specific needs and preferences, provided a clear understanding of the major requirements of the Balance Retraining intervention. In order to successfully encourage individuals to engage in regular and consistent practise of VR exercises, the intervention would need to:

- manage illness-related perceptions, particularly facilitation of positive outcome expectancies of VR therapy;
- facilitate development of self-efficacy for the performance of VR exercises;
- support management of psychological distress that may perpetuate symptoms and impair adherence to VR exercises;
- provide strategies and techniques to encourage exercise adherence;
- encourage continued engagement with intervention content (Geraghty et al., 2014).

The following section outlines the resulting structure and content of the Balance Retraining intervention.

1.6.1 Key features of the Balance Retraining intervention

Balance Retraining is a standalone digital intervention primarily based on VR therapy. Users are provided with written instructions and audio-visual demonstrations regarding how to conduct the relevant exercises. They are encouraged to access Balance Retraining at least once per week and to practise the VR exercises twice per day. They receive tailored feedback from the intervention in response to their answers to questions about their symptoms. Balance Retraining also includes information about the balance system, and additional psychological symptom management techniques. These additional psychological symptom management techniques are psychophysiological strategies such as controlled breathing and relaxation that have previously been demonstrated as beneficial for managing dizziness and its associated symptoms, such as nausea and fatigue (Yardley & Kirby, 2006). These are referred to throughout this thesis as symptom control techniques. Intervention content is broken down into six main sessions that become available to participants on a weekly basis. Core content necessary for participants to understand and begin VR exercises is presented in session one. Intervention users are provided with email reminders about new sessions and can print off instruction and information documents. Figure 2 outlines the intervention content session by session. Example screenshots of the Balance Retraining pages are provided in Appendix A.

Session 1:

- Welcome to Balance Retraining and overview of session one content
- Introduction to the balance system and dizziness – how does it work, what causes it?
- Introduction to Vestibular Rehabilitation (VR) exercises - how they work, contraindications, information for Meniere's patients
- Planning exercises – planning exercise times
- Exercise demonstration videos
- Timed Exercise Scoring Test (full version)
- Tailored 'exercise prescription' for the following week
- Dealing with side effects
- Session recap and access to main menu*

Session 2:

- Welcome to session two and overview of session content
- Review of last week's exercises
- Information about how to deal with possible difficulties with exercises
- Timed Exercise Scoring Test (option to do short or full version)
- Tailored 'exercise prescription' for the following week
- Stress and dizziness – exacerbation of symptoms
- Introduction to additional symptom control techniques: controlled breathing
- Session recap and access to main menu*

Session 3:

- Welcome to session three and overview of session content
- Review of last week's exercises
- Information about how to deal with possible difficulties with exercises
- Timed Exercise Scoring Test (option to do short or full version)
- Tailored 'exercise prescription' for the following week
- Increasing the difficulty of exercises
- Additional symptom control techniques: relaxation
- Session recap and access to main menu*

Session 4:

- Welcome to session four and overview of session content
- Review of last week's exercises
- Information about how to deal with possible difficulties with exercises
- Timed Exercise Scoring Test (option to do short or full version)
- Tailored 'exercise prescription' for the following week
- Visual environments and dizziness – exercises and techniques to help
- Additional symptom control techniques: stress management
- Session recap and access to main menu*

Session 5:

- Welcome to session five and overview of session content
- Review of last week's exercises
- Information about how to deal with possible difficulties with exercises
- Timed Exercise Scoring Test (option to do short or full version)
- Tailored 'exercise prescription' for the following week
- Everyday situations/ activities and dizziness – exercises and techniques to help
- Additional symptom control techniques: thought control
- Session recap and access to main menu*

Session 6:

- Welcome to session six and overview of session content
- Review of last week's exercises
- Information about how to deal with possible difficulties with exercises
- Timed Exercise Scoring Test (option to do short or full version)
- Tailored 'exercise prescription' for the following week
- Adding general exercises to VR
- Maintaining a healthy balance system
- Session recap and access to main menu*

*Main menu provides access to all session content accessed prior to the current time point.

Figure 2 Summary of Balance Retraining session content

1.6.2 Balance Retraining logic model: how the intervention is expected to work

Based on the evidence and theory consulted, the intervention targets a number of key psychological processes and anticipated behavioural determinants through which it intends to encourage adoption of the target behaviours. In order to clearly outline the intended processes and expected mechanisms of impact, a logic model was developed and is depicted in Figure 3.

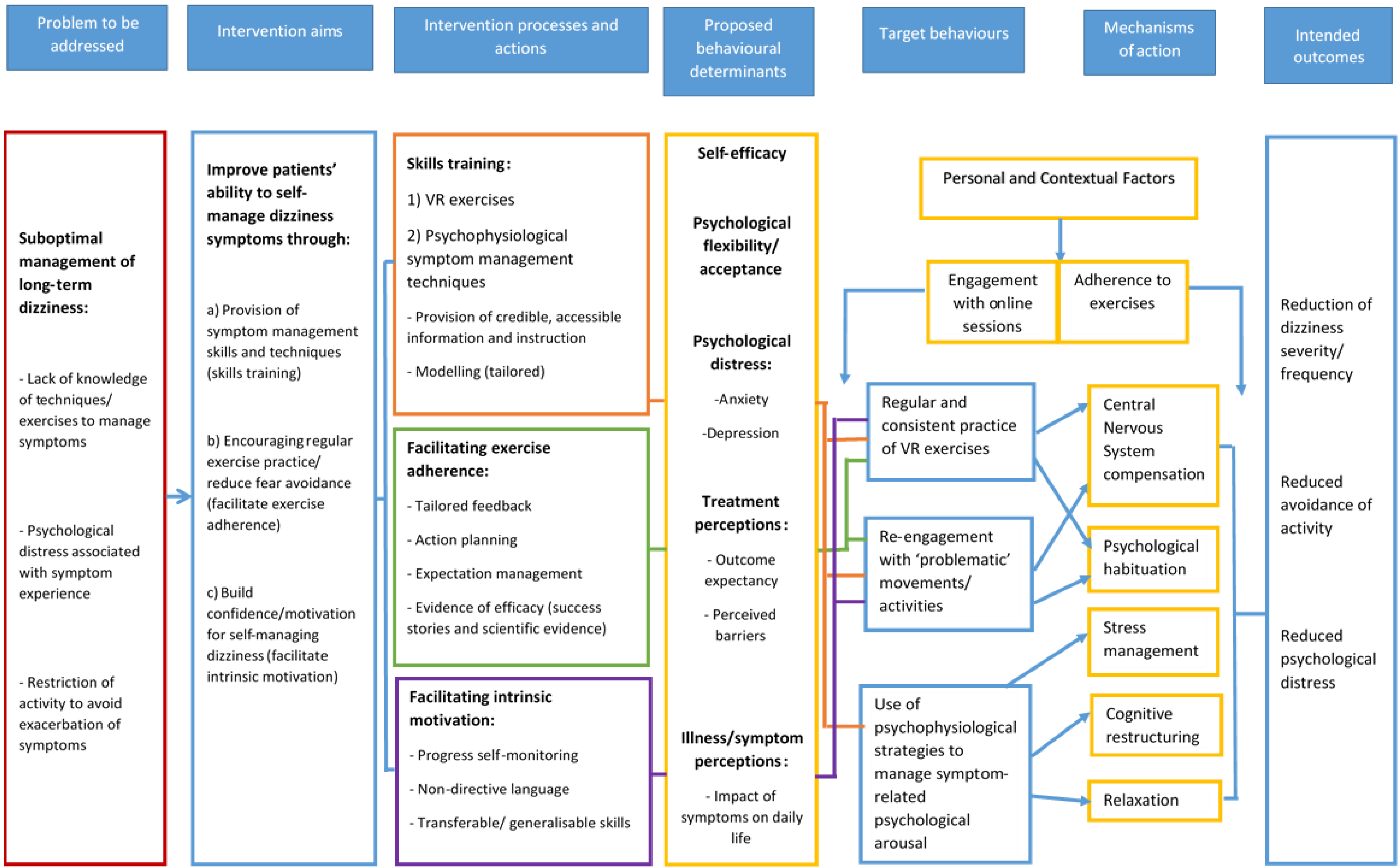


Figure 3 Logic Model of Balance Retraining Online Intervention

1.6.3 Behaviour Change Techniques involved in the Balance Retraining intervention

As represented in the intervention logic model (see Figure 3), Balance Retraining targets key behavioural determinants (e.g. intentions, self-efficacy, beliefs about treatment, perceived barriers etc.) in an attempt to instigate behaviours (e.g. regular practise of VR exercises; reduced avoidance of movement) to facilitate improvement in dizziness symptoms. In order to do this, the intervention utilised well-established, evidence-based Behaviour Change Techniques (BCTs). BCTs are “observable, replicable and irreducible component[s] of an intervention designed to alter or redirect causal processes that regulate behaviour” (Michie et al., 2013, p. 82). The Behaviour Change Taxonomy (v1) (Michie et al., 2013) classified and named these components as a means of consistently labelling and identifying the proposed ‘active ingredients’ of behaviour change interventions. Digital interventions in the related field of hearing health have similarly identified the BCTs utilised in specific intervention features (Greenwell, Featherstone, & Hoare, 2015). By identifying which BCTs are present in each feature of Balance Retraining, analysis of engagement with these components will provide a clearer picture of precisely what is required for effective behaviour change in this intervention. Appendix B, page 225 identifies the features of the Balance Retraining intervention, the BCTs involved in these features and the behavioural determinants they intended to target.

1.6.4 Is Balance Retraining effective?

A primary care based RCT of the Balance Retraining intervention was conducted to determine whether the intervention would be effective and cost-effective for managing chronic dizziness amongst adults aged 50 and over (Geraghty et al., 2014). The RCT was a two-arm parallel group design with participants randomised to either: the intervention arm, in which they had immediate access to the Balance Retraining intervention; or the usual care arm, in which they continued to receive usual care from their GP. The findings demonstrated that, compared to usual care, those using the Balance Retraining intervention showed significantly greater improvements at three and six months in both self-reported dizziness severity (2.75, 95% CI, 1.39 to 4.12; $p<0.001$ and 2.26, 95% CI, 0.39 to 4.12; $p=0.018$ respectively) and perceived dizziness handicap (6.15 95% CI, 2.81 to 9.49; $p<0.001$ and 5.58, 95% CI, 1.19 to 10.0; $p=0.013$ respectively). It also demonstrated positive effects on anxiety and depression (Geraghty et al., under review). This provides evidence that the Balance Retraining intervention is an effective means of improving dizziness amongst older adults. It contributes further to existing evidence for the efficacy of VR-based interventions for long-term dizziness (section 1.3.2).

Despite this evidence, it is still the case that not all patients demonstrate the same improvement from VR therapy (Herdman et al., 2012). In order to understand why and ultimately to be able to improve the potential efficacy of these VR interventions, it is important to ask why some patients and not others benefit from VR interventions, and what factors influence this (Herdman et al., 2012).

1.6.5 Investigating how Balance Retraining works: rationale for this thesis

In line with this need to understand variations in VR therapy outcomes, there are increasing calls for investigation of the processes involved in the use of digital health interventions. A Cochrane review of interactive digital applications for managing chronic illness conditions (Murray, Burns, See, Lai, & Nazareth, 2005), similarly noted substantial variation in outcomes and, therefore, a need for studies to establish *how* these digital interventions have their effects amongst different groups of people.

The MRC guidance on evaluating complex healthcare interventions (Moore et al., 2015) emphasises the importance of process evaluation alongside outcome evaluation. They stress that whilst outcome evaluations (such as RCTs) are important and necessary to determine overall effectiveness, in isolation they are limited in what they can achieve (Moore et al., 2015). They reveal little about the circumstances under which an intervention is likely to be effective. Accordingly, it is important to conduct process evaluations to investigate the causal mechanisms and contextual factors that influence outcomes (Craig et al., 2008). In doing so we can learn more about the mechanisms of impact of the intervention – i.e. how and why do these outcomes occur under given circumstances, and what psychological mechanisms underlie these (Moore et al., 2015). This is important for maximising the potential efficacy, reach and acceptability of interventions (Panagioti et al., 2014). Whilst the intended mechanisms and processes of the Balance Retraining intervention were carefully planned, a process evaluation will determine whether outcomes were achieved through the mechanisms expected, or whether there were unforeseen mechanisms through which users achieved positive outcomes.

Accordingly, alongside the primary-care RCT of Balance Retraining (Geraghty et al., under review), the studies of this thesis comprise a mixed-methods process evaluation of the Balance Retraining intervention. Both quantitative and qualitative methods are employed as recommended by MRC guidelines (Moore et al., 2015). The overall objectives of this process evaluation are to provide a detailed understanding of the mechanisms through which the intervention has its effects and how particular users' adherence and engagement behaviours relate to this. In doing so, it aims to clarify the circumstances under which the intervention is most likely to be effective, and to identify those individuals, or groups of individuals, who may require further support in achieving beneficial outcomes. Through the findings of this process evaluation, this thesis also aims to contribute to the currently very limited literature regarding older adults' engagement with digital self-management interventions. It will also contribute further evidence regarding the utility of the underpinning theoretical frameworks for understanding and predicting likely intervention outcomes in this context.

1.7 Specific aims of thesis

There are several specific aims of the thesis arising from the broader aim stated above. These aims shape the individual studies that make up the thesis. First, given the evidence that adherence to self-managed physical therapies such as VR is so important for outcomes, yet is often very poor, this research aims to provide a better understanding of the factors that predict adherence to such self-managed physical therapies. In doing so, it aims to provide insight into the circumstances and conditions under which adherence is most likely and to identify who may need additional support to adhere to such therapies.

In addition to identifying predictive factors of adherence behaviour in this context, it is also considered important to explore patients' broader experiences of engaging in these self-managed therapies. Accordingly, the thesis includes a study with the aim of understanding how older adults experience self-managed VR therapy supported by a digital intervention. This will include investigation of what they perceive as motivators and barriers to their adherence, but also a wider exploration of their experiences with Balance Retraining as a whole, and the perceived impact of this.

Following confirmation that the Balance Retraining intervention is indeed effective, a further primary aim of the thesis is to understand the mechanisms through which reduction in dizziness occurs. It aims to determine whether the proposed theory- and evidence-based mechanisms of impact are accurate, and/or whether outcomes were achieved via other unexpected or unforeseen mechanisms. This will facilitate identification of those individuals who may need additional support to achieve positive outcomes from Balance Retraining and the ways in which they need to be supported.

Finally, with evidence that engagement to digital interventions is important for behavioural outcomes, the role of engagement with Balance Retraining in user outcomes will be investigated. In particular, it aims to determine: what 'effective engagement' constitutes for Balance Retraining; how differential engagement impacts on outcomes and key behavioural determinants; and what factors influence individuals' level of engagement. The understanding obtained from this investigation will provide insight into the specific features and underlying BCTs that appear most effective. It will also contribute to understandings of how engagement with digital interventions for illness self-management might be optimised.

1.8 Structure of the thesis

The remainder of this thesis will be organised into the following six chapters:

Chapter 2 outlines the methodological approach to the body of research, including consideration of the general approach taken and a discussion of the specific methods used in each study.

Chapter 3 reports a systematic review of predictors of adherence to home-based, self-managed physical therapies.

Chapter 4 is a longitudinal qualitative investigation of older adults' experiences of engaging with the Balance Retraining intervention over a period of six weeks.

Chapter 5 reports a quantitative investigation of predictors of post-treatment dizziness severity amongst users of the Balance Retraining intervention.

Chapter 6 is a mixed methods investigation of the impact, and influences of, differential engagement with the Balance Retraining intervention.

Chapter 7 concludes the thesis with a general discussion of the findings from all studies. This provides a summary of the main findings and discusses them in relation to relevant literature. It draws the findings together to discuss their overall implications for research and practise, and makes suggestions regarding future directions for research in this area.

Chapter 2: Methodological Approach of the Thesis

2.1 Introduction to this chapter

This chapter discusses the methodological approach to this research, and justifies the methods used to investigate the psychological and behavioural processes involved in older adults' use of the Balance Retraining intervention. This begins with a consideration of the philosophical underpinnings of the research approach, followed by discussion of, and rationale for, the mixed methods nature of the research. Specific methods and techniques employed will be outlined in relation to the different phases of the research process: selection and recruitment of participants; data collection methods; and data analysis techniques. Details of study-specific procedures will be outlined in each relevant chapter.

2.2 Philosophical underpinnings of the research

The philosophical assumptions that a researcher brings to a study inform decisions about the approach to be taken to the research, and the methods that best fit this approach (Creswell, 2014). Researchers are increasingly encouraged to make their philosophical assumptions explicit in order to more fully explain their choice of research approach (Creswell, 2014; Ritchie, Lewis, Nicholls, & Ormston, 2013). This should include outlining what their underpinning philosophical 'worldview' is in relation to research, and providing an overview of its basic ideas (Creswell, 2014). These points will be addressed in the following sections.

2.2.1 Underpinning philosophical worldview

A 'worldview' has been defined as "a basic set of beliefs that guide action" (Guba, 1990). Explaining the philosophical worldview of research necessitates consideration of the ontological and epistemological positions taken (Crotty, 1998; Ritchie et al., 2013). Ontology refers to the perceived nature of reality and beliefs about what it is possible to 'know' about the world that surrounds us. It focuses on issues such as whether or not social reality exists independent of human interpretation and perception (Ritchie et al., 2013). Epistemology is a related concept and refers to the nature of knowledge and the relationships between the researcher and the subject of research. It involves questions regarding how we know about reality and what the basis of our knowledge is (Ritchie et al., 2013; Tashakkori & Teddlie, 1998). Various epistemological and ontological stances are espoused by differing philosophical positions. Three frequently discussed philosophical worldviews will be briefly outlined: post-positivism, constructivism and pragmatism. This will be followed by the rationale for choosing a pragmatic approach to the present research.

2.2.1.1 **Post-positivism**

Traditional forms of scientific research were based on positivist assumptions. This positivist position took a 'realist' ontological stance, assuming a single observable real world exists from which scientific enquiry can obtain objective knowledge (Yardley & Bishop, 2008). Post-positivism grew out of a critique of this positivist position, arguing against the 'absolute truth' of knowledge and recognising the impossibility of being certain about claims of knowledge (Phillips & Burbules, 2000). The assumptions underlying post-positivism are more closely associated with a 'critical realist' ontology which still proposes an objective external reality, but also that human influence on the knowledge of that reality is inevitable and impossible to separate (Ritchie et al., 2013). Research underpinned by a post-positivist worldview tends to focus on careful observation and measurement of this objective reality in order to test, and subsequently refine, laws or theories. In doing so, the aim is to provide a more accurate understanding of this external reality (Creswell, 2014). Accordingly, the post-positivist position tends to be associated with quantitative research design and methods which allow testing of falsifiable hypotheses, determination of cause and effect, and control of environments to reduce variability (Ritchie et al., 2013; Yardley & Bishop, 2008).

2.2.1.2 **Constructivism**

In comparison to positivism, constructivism represents the opposite end of the spectrum of philosophical assumptions. The constructivist perspective proposes that an individual's knowledge and understanding of the world is completely determined by their own subjective and sociocultural experiences (Yardley & Bishop, 2008). Accordingly, constructivism takes a relativist ontological stance, arguing that all understandings of reality are constructed and that, therefore, an objective knowledge of reality is impossible to obtain (Ritchie et al., 2013). The goal of research conducted according to a constructivist perspective is to gain an understanding of the complexity and variation of participants' views and experiences of the phenomenon under investigation. Based on these narratives, the role of the researcher is to make sense of the meanings that others hold about the world (Creswell, 2014). This philosophical standpoint tends to underlie qualitative methodologies with their broad, open-ended data collection methods, and reflexive recognition of the co-creation of subjective meanings (Creswell, 2014; Ritchie et al., 2013).

2.2.1.3 Pragmatism

Considering the post-positivist and constructivist worldviews, it is easy to see why these are frequently considered mutually exclusive approaches to designing and conducting research (Yardley & Bishop, 2008). Their fundamental assumptions seem incompatible and they appear to place value on different types of knowledge and different methods of obtaining this. However, a third approach known as ‘pragmatism’ emphasises the importance of research being driven by the research problem itself. It encourages greater acceptance of choosing appropriate methods for addressing specific research questions, rather than becoming entrenched in the underlying philosophical debates (Ritchie et al., 2013; Seale, 1999). Pragmatism has been identified as a potential framework for understanding how quantitative and qualitative methodologies can be combined (Yardley & Bishop, 2008). Instead of focusing on specific methods aligned with either quantitative or qualitative methodologies, from a pragmatic perspective, researchers use all approaches that facilitate further understanding of the research problem (Creswell, 2014).

Taking into consideration the various aims of the current research (see section 1.7), it was evident that both quantitative and qualitative methods would be necessary to fully address the research questions. The MRC guidance on the evaluation of complex health interventions (Craig et al., 2008) advocates the combination of quantitative and qualitative methods in order to fully understand the complexities of processes involved in intervention outcomes. Accordingly, a pragmatic stance, which encourages this mixed-methods approach to most effectively address the research problem (Creswell, 2014), was taken.

2.2.2 Pragmatic underpinnings of mixed-methods research

Pragmatism provides underpinning justification for combining qualitative and quantitative methods (Johnson & Onwuegbuzie, 2004) and provides new options for addressing methodological issues in the social sciences (Morgan, 2007). Morgan (2007) identifies three key issues in social science research methodology to which pragmatism offers an alternative approach. These are: the connection between theory and data; the relationship between the researcher and the research process; and inferences that can be made from data.

With regard to the connection between theory and data, pragmatism suggests an ‘abductive’ approach can be taken. Here the researcher moves back and forth between the inductive conversion of observation into theory and the deductive assessment of theories through action (Morgan, 2007). Such abductive processes are commonly used in research that combines quantitative and qualitative research in a sequential fashion where the inductive results from a qualitative study might inform the deductive aims of a following quantitative study or vice versa (Ivankova, Creswell, & Stick, 2006).

Regarding the nature of the relationship between the researcher and the research process, a pragmatic approach offers an 'intersubjective' position. This allows for necessary movement between subjective and objective stances (Johnson & Onwuegbuzie, 2004; Morgan, 2007). Intersubjectivity responds to the incomparable nature of the epistemological and ontological assumptions underlying quantitative and qualitative approaches. It asserts both that there is a single 'reality', and that all individuals have their own interpretations of that reality (Morgan, 2007; Yardley & Bishop, 2008). Rather than see these differing philosophical underpinnings as a barrier to understanding, pragmatists treat this intersubjectivity as central to an understanding of social life (Morgan, 2007).

Finally, a pragmatic approach rejects the need to distinguish between the types of knowledge that can be inferred from data. From a pragmatic perspective, emphasis is placed on transferability: the extent to which knowledge obtained in one setting, with one particular method can be most appropriately and effectively applied elsewhere (Morgan, 2007). This perspective stresses the importance of considering factors that influence whether knowledge gained from one method/approach can be transferred to other settings (Lincoln & Guba, 1985).

2.3 Mixed-methods research design

Evidently, the pragmatic philosophical approach underpinning the present research justifies and encourages use of both quantitative and qualitative methodologies in addressing the research aims (Johnson & Onwuegbuzie, 2004). Accordingly, a mixed-methods approach was adopted. The following section will consider: what a mixed-methods approach to research involves; how quantitative and qualitative methodologies contribute to this; different ways in which they can be combined; and an outline of the specific mixed-methods design of the present research.

2.3.1 What is a mixed-methods design?

Mixed-methods research involves combining or integrating quantitative and qualitative methods, techniques and approaches within a research study for the purposes of gaining a better understanding of the research problem (Creswell, 2014; Johnson & Onwuegbuzie, 2004; Teddlie & Tashakkori, 2003). Indeed, in a mixed-methods approach the research question is fundamental and the methods should follow research questions in a way that allows the best opportunity to obtain useful data (Johnson & Onwuegbuzie, 2004). In combining methods in this way, the aim is to draw from the strengths and minimise the weaknesses of the individual quantitative and qualitative approaches (Johnson & Onwuegbuzie, 2004). To understand how quantitative and qualitative methods offer complementary modes of enquiry, and to understand how they can most usefully be combined, it is helpful to consider the strengths and limitations of each approach (Johnson & Onwuegbuzie, 2004; Yardley & Bishop, 2008).

2.3.2 The contribution of quantitative and qualitative methodologies

Quantitative methodologies have traditionally been characterised by features such as hypothesis testing, prediction, standardised measures and statistical analyses (Creswell, 2014). Some of the strengths of a quantitative approach include the potential to generate findings with high internal validity, and therefore strong and generalisable conclusions (Yardley & Bishop, 2008). Internal validity refers to how well a study has controlled for variability in the data due to factors that are considered irrelevant to the hypothesis being tested. This is facilitated through quantitative approaches' use of precise, reliable measures and controlled experimental conditions (Yardley & Bishop, 2008). Furthermore, quantitative approaches allow testing and validation of existing theories about how phenomena (e.g. behaviour change) occur, and the ability to quantify the strength of relationships between variables. Quantitative approaches also provide means of collecting large amounts of data relatively quickly and easily (e.g. standardised questionnaires), and analysis can often be much less time-consuming than qualitative data analyses (Johnson & Onwuegbuzie, 2004). However, in creating such controlled research environments free from confounding variables, quantitative approaches tend to limit their external validity, i.e. the extent to which their findings correspond to 'real life' conditions (Yardley & Bishop, 2008). Quantitative approaches are recognised as less able to provide a deep understanding of the complexities and subtleties of experiences, perceptions and interactions. These require recognition and acknowledgement of the role that contextual factors play in experience, rather than trying to control for them (Creswell, 2014; Johnson & Onwuegbuzie, 2004).

Qualitative methodologies, conversely, prioritise context above precision and control in collecting and interpreting data (Yardley & Bishop, 2008). The major characteristics of qualitative research are discovery, exploration, hypothesis generation and inductive interpretation (Johnson & Onwuegbuzie, 2004). This approach allows examination of phenomena in context which, in turn, facilitates identification of meanings, processes and relationships that may be central to a more holistic understanding of that target phenomena (Camic, Rhodes, & Yardley, 2003; Yardley & Bishop, 2008). This approach is facilitated by use of less structured, more open-ended methods of data collection that are usually implemented in naturalistic settings (Johnson & Onwuegbuzie, 2004). However, whilst valuable for this holistic understanding of complex real-world phenomena, a qualitative approach makes it impossible to isolate the effect of specific variables and to assign causal attributions to these. As such, qualitative approaches are not appropriate for deductive hypothesis testing (Yardley & Bishop, 2008). They also don't allow for the same strength and generalisability of conclusions afforded by the high internal validity of quantitative approaches (Johnson & Onwuegbuzie, 2004). In practical terms, qualitative methods of data collection and analysis also tend to be more time- and resource-intensive (Creswell, 2014; Johnson & Onwuegbuzie, 2004).

2.3.3 Complementary nature of quantitative and qualitative methods

This understanding of the relative strengths and weaknesses of quantitative and qualitative approaches allows researchers to combine them effectively as 'complementary modes of enquiry' (Johnson & Onwuegbuzie, 2004; Yardley & Bishop, 2008). For example, integration of the internal validity afforded by a quantitative approach with the external validity of a qualitative approach can provide valuable insight into different aspects of a particular research problem (Yardley & Bishop, 2008). Indeed, in intervention research such as this, whilst a quantitative approach will be able to determine and quantify the effectiveness of an intervention, an accompanying qualitative approach will provide insight into how and why the intervention does or doesn't work through consideration of contextual and experiential processes (Moore et al., 2015; Yardley & Bishop, 2008). The holistic understanding of complex real-world environments afforded by qualitative approaches is complemented by quantitative research's ability to isolate effects of particular variables in order to test hypotheses and attribute causality within identified relationships (Yardley & Bishop, 2008).

By mixing quantitative and qualitative methods it is possible to achieve a deeper, more holistic understanding of the research problem (Yardley & Bishop, 2008). However, it is not always the case that the two approaches will provide supporting evidence (Johnson & Onwuegbuzie, 2004), nor should seeking corroboration necessarily be the ultimate goal of mixed-methods research (Yardley & Bishop, 2008). In the case that the approaches do provide corroborating evidence, this provides greater confidence in a singular emergent conclusion. However, if they are conflicting then this provides a greater depth of understanding which researchers can then use to modify their interpretations and conclusions as appropriate (Johnson & Onwuegbuzie, 2004).

2.3.4 Rationale for a mixed-methods approach

In conducting mixed-methods research, it is important to identify a clear rationale for why both quantitative and qualitative methods would be superior to using just one of these approaches

(Yardley & Bishop, 2008). Given that the primary aim of the present research was to understand the psychological, behavioural and contextual process involved in Balance Retraining users' symptom-related outcomes, MRC guidelines relating to the evaluation of complex interventions were highly pertinent (Craig et al., 2008; Moore et al., 2015). These guidelines strongly advocate the use of both quantitative and qualitative methods. This enables testing of hypothesised causal pathways, as well as being able to better understand complex pathways or provide insight into unexpected mechanisms (Moore et al., 2015). Considering some of the specific aims of the thesis, it was considered that a qualitative approach would be most suited to understanding older adults' perceptions and experiences of using the Balance Retraining intervention and in identifying their perceived barriers and motivations to their VR exercises. A qualitative approach was also seen as valuable in understanding users' decisions about their engagement with the Balance Retraining intervention. Quantitative methods were identified as more appropriate for identifying the mechanisms through which users achieved positive outcomes, and for measuring how differential levels of engagement impacted on outcomes.

Greene, Caracelli, and Graham (1989) highlight five main rationales for conducting mixed-methods research: triangulation, whereby researchers seek convergence and corroboration of results between different methods; complementarity, in which the aim is to enhance, clarify or elaborate the results of one method with the results of another; initiation, where contradictions between methods' findings lead to re-framing of the research question; development, in which the findings of one method help to inform the other method; and expansion, which refers to expanding the breadth of research by using different methods for investigating different elements of the research problem. In terms of Greene et al. (1989)'s proposed rationales, the present study employed a mixed-methods approach in order to permit triangulation and complementarity. It was expected that the findings of the quantitative and qualitative elements would corroborate each other in some respects, but that the results of one approach may also help to further explain the findings of the other in some situations.

2.3.5 Design of the mixed-methods approach

As well as justifying *why* quantitative and qualitative methods are being combined, it is also vital to explicitly outline exactly *how* (Bishop, 2015; Creswell & Plano-Clark, 2007). This involves considerations of: the weighting assigned to each component; the sequence in which they are conducted; and the stage at which they are to be integrated (Johnson & Onwuegbuzie, 2004; Yardley & Bishop, 2008), or the 'point of interface' (Morse & Niehaus, 2009).

2.3.5.1 Weighting of quantitative and qualitative components

Researchers must decide whether the quantitative and qualitative components of a mixed methods intervention should be equally weighted, or whether one approach should be prioritised (Bryman, 2006). Within the present research, quantitative and qualitative components were given equal weighting. In line with the underpinning pragmatic approach, and the design of similar process evaluations of complex digital health interventions (Bradbury, Dennison, Little, & Yardley, 2015), neither quantitative or qualitative methods were perceived as inherently superior and so the methods that best suited the specific research aims of each study within the thesis were employed. This also resonated with relevant guidelines which suggest that, in investigating the processes involved in complex interventions such as Balance Retraining, quantitative and qualitative methods can be equally valuable for different aspects of understanding (Moore et al., 2015).

2.3.5.2 Sequence of quantitative and qualitative components

Researchers must also specify whether the quantitative and qualitative components of their mixed-methods study will be sequential, i.e. the first component is completed before the second is begun; or concurrent, i.e. both quantitative and qualitative components are conducted together (Bishop, 2015; Creswell & Plano-Clark, 2007). In the present research, there was an additional layer of complexity in that the overall thesis took a mixed-methods approach, but also the final study of the thesis in isolation employed mixed-methods. In this way, the design of the overall thesis might be considered what Creswell and Plano-Clark (2011) identify as a ‘multiphase’ mixed-methods design. In a multiphase model mixed-methods are used concurrently or sequentially in order to address the overall project objective (see Figure 4). With regard to the overall thesis, the research took a predominantly sequential mixed-methods design with each component usually being completed prior to the next one commencing. For example, the qualitative investigation of users’ experiences of engaging with the Balance Retraining intervention (see Chapter 4) suggested that perceptions of self-efficacy may play an important role in users’ outcomes. This provided further evidence that self-efficacy should be included as a potentially important predictor in the following quantitative process analysis of predictors of symptom-related outcome (see Chapter 5). The sequential nature of the mixed-methods components was sometimes complicated by the nested nature of these studies within the aforementioned RCT of the Balance Retraining intervention (Geraghty et al., under review), and the resulting necessity to collect data at given time-points. This sometimes meant that data for a subsequent qualitative or quantitative component had to be collected prior to completion of the preceding one, meaning that the earlier could not always fully inform the latter. The final study of the thesis (see Chapter 6) employed a concurrent mixed-methods approach with both quantitative and qualitative data about users' engagement with Balance Retraining interpreted and discussed simultaneously. The qualitative data sought to further elucidate quantitative analyses by exploring whether participants' accounts of their experiences resonated with, explained or perhaps even challenged, the quantitative relationships found.

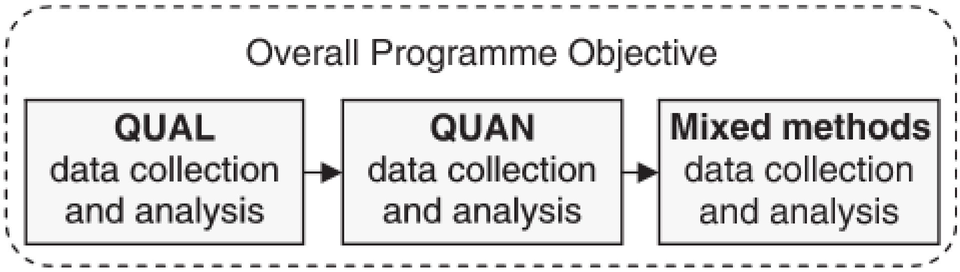


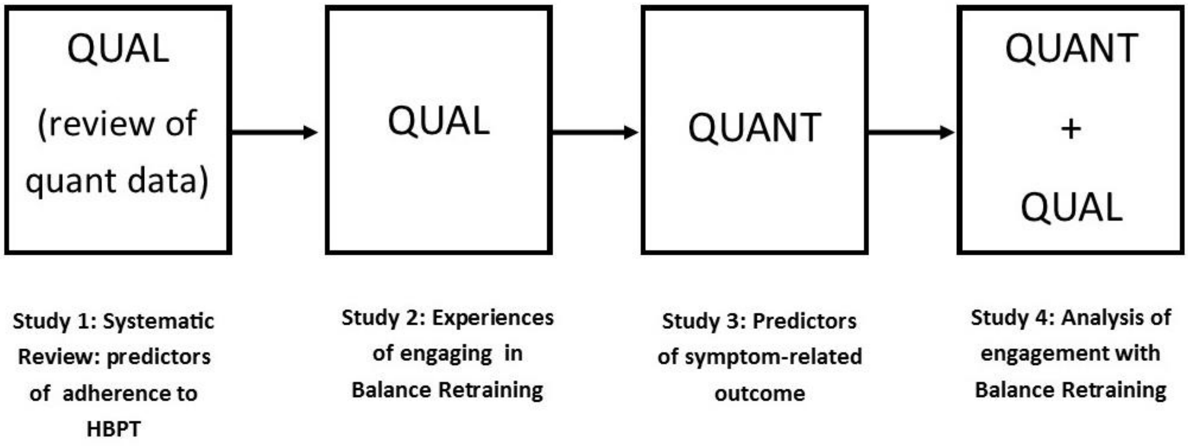
Figure 4 Multiphase model of mixed-methods design (Creswell & Plano-Clark, 2011)

2.3.5.3 **Synthesis of quantitative and qualitative components: point of interface**

A final important consideration for mixed-methods designs is at what stage the researcher chooses to integrate or synthesise the quantitative and qualitative components (Bishop, 2015; Morse & Niehaus, 2009). This can occur at several different stages: sampling, data collection, data analysis, or interpretation (Bishop, 2015; Creswell & Plano-Clark, 2011; Yardley & Bishop, 2015). For example, some choose to integrate data from qualitative and quantitative components during analysis. This involves converting both elements into either qualitative or quantitative data so that they can be analysed with one approach (Creswell & Plano-Clark, 2011; Johnson & Onwuegbuzie, 2004). However, it has been suggested that combining the quantitative and qualitative components at this stage risks losing valuable aspects the data, particularly if rich descriptive qualitative data is quantified (Yardley & Bishop, 2008). In the present body of work the 'point of interface' (Morse & Niehaus, 2009) was during interpretation., i.e. quantitative and qualitative components were conducted separately and then once data had been analysed it was integrated for interpretation and discussion of findings. This has been referred to as a 'composite analysis' approach and is suggested to retain the respective methodologies' differing characteristics, therefore actualising their potential to provide complementary insights (Yardley & Bishop, 2008). Yardley and Bishop (2008) further argue that this approach is valuable in allowing the separate methodological approaches to be judged against their respective quality assessment standards.

Note: QUAL, qualitative methods; QUANT, quantitative methods

Figure 5 provides an outline of the mixed-methods model of this thesis.



Note: QUAL, qualitative methods; QUANT, quantitative methods

Figure 5 Mixed-methods model of the thesis

Having considered the underpinning philosophy and design of the research, this chapter now turns to consideration of the specific methods and procedures employed. As previously mentioned, the research was nested within the RCT for the Balance Retraining intervention. As such, many of the studies' recruitment and data collection, as well as some data analysis procedures, overlapped with those of the trial; it is therefore useful to outline these here. These trial procedures are most relevant to the quantitative predictors of outcome study (Chapter 5) and the quantitative element of the mixed-methods investigation of levels of engagement (Chapter 6).

In addition, two separate qualitative elements of the thesis employed similar data collection and analysis approaches. These were the longitudinal investigation of participants' experiences of Balance Retraining, reported in Chapter 4 and the qualitative element of the mixed-methods investigation of levels of engagement, reported in Chapter 6. Accordingly these are outlined in the current chapter to avoid duplication.

2.4 Recruitment of participants into Balance Retraining RCT

Participants for both the quantitative predictor study outlined in Chapter 5, and the mixed-methods investigation of levels of engagement reported in Chapter 6, were a sub-group of those recruited to take part in the RCT of the Balance Retraining intervention. To understand how participants for these studies were selected, the RCT recruitment procedures are outlined here. Full ethical approvals from the National Research Ethics Service (NRES) and the University of Southampton ethics committee were in place before recruitment commenced.

Participants were recruited from 54 general practices across the south of England between August 2013 and July 2014. Participating practices searched their electronic patient databases according to guidance provided (Appendix C) for individuals reporting dizziness, or prescribed medications to treat dizziness symptoms, within the preceding two years. Patients were excluded if their dizziness resulted from a known non-vestibular cause, if completing VR exercises would be medically contraindicated (e.g. cervical disorders), if suffering from serious comorbidity (e.g. life-threatening conditions or progressive central disorders) or if unable to comprehend written English. The database search results were screened by GPs to remove anyone not eligible on the basis of these criteria.

Potential participants were posted a pack from their GP practice containing an invitation letter, information about the study and a reply slip (Appendix D). Interested patients were advised to contact the research team directly, either via telephone, email or returning the reply slip. Those indicating interest were contacted by the research team via telephone to ensure that: they experienced ongoing dizziness; that their dizziness tended to be exacerbated by head movements; that they did not have neck pain or injury that would prevent them from conducting VR exercises; and finally that they had access to the internet. Eligible patients were emailed the hyperlink to the online intervention along with instructions about how to sign up and start using it (Appendix E). They provided consent via a form in the online intervention, which required completion prior to intervention content being accessed (Appendix F). After consenting, participants were presented with the electronic baseline questionnaire via the intervention. Once the baseline questionnaire had been completed, participants were randomised by the online intervention to either a ‘usual care’ control group or the online intervention group. Following randomisation, intervention arm participants were provided with immediate access to the Balance Retraining online intervention. The intervention is fully described in section 1.6, page 24. Those participants allocated to the intervention arm provide data for the aforementioned studies outlined in Chapters 5 and 6. The procedures through which this data was collected are outlined in section 2.5.1.

2.5 Data collection procedures

This section outlines the quantitative data collection procedures of the RCT, relevant to Chapters 5 and 6, and qualitative data collection procedures relevant to Chapters 4 and 6.

2.5.1 Quantitative data collected from RCT

After 12 weeks, and again at 24 weeks, participants were emailed prompting them to log in to the intervention to complete their three and six month follow-up measures respectively. The measures included in the intervention group's baseline and follow-up questionnaires are indicated in Table 2. Participants were sent a reminder email at four and then eight days after the initial emails if they had still not completed their online follow-up questionnaires within these times. If participants did not complete online follow-up within two weeks, they were posted a paper version of the questionnaire along with a freepost envelope to complete and return to the study team. If the paper questionnaires were not returned within two weeks of sending, telephone contact was made with the participant. A member of the research team blind to the participant's treatment allocation then asked the participant to provide answers to the primary outcome measure (the Vertigo Symptom Scale Short Form: VSS-SF) over the telephone.

Table 2 Placement of quantitative measures during RCT

Measure	Baseline	Post first-session	3 month follow up	6 month follow up
VSS SF	X		X	X
Dizziness Handicap Inventory	X		X	X
Credibility and Expectancy		X	X	
Self-efficacy		X	X	
HADS	X		X	X
PETS			X	X
Acceptance and Action Questionnaire-II	X		X	X
General Information (demographics)	X			
Objective usage	→	→	→	→

2.5.1.1 Quantitative measures

This section provides details about the measures that were utilised to obtain data regarding the variables of interest to the research.

2.5.1.1.1 Vertigo Symptom Scale – Short Form (VSS-SF)

The VSS-SF comprises fifteen items in two subscales measuring the frequency of participants' experience of vertigo and autonomic symptoms related to dizziness (e.g. nausea, headaches). Participants respond to each item on a five-point scale ranging from 'Never' (0) to 'Very Often' (4). Higher total scores indicate more frequent experience of dizziness related symptoms. This short-form version was successfully developed and validated (Wilhelmsen, Strand, Nordahl, Eide, & Ljunggren, 2008; Yardley, Masson, Verschuur, Haacke, & Luxon, 1992; Yardley et al., 1999) and has subsequently demonstrated high internal consistency, e.g. $\alpha = 0.88$ (Yardley, Beech, et al., 1998), in trials of VR (Yardley et al., 2012; Yardley et al., 2004). In the present sample Cronbach's alpha was α = 0.83 and 0.88 at three and six months respectively, indicating a very good level of internal consistency at both time points (DeVellis, 1991).

2.5.1.1.2 **Dizziness Handicap Inventory (DHI)**

The DHI (Jacobson & Newman, 1990) measured individuals' perceptions of how dizziness symptoms impact on their lives. The measure consists of 25 items across three subscales measuring the physical, emotional and functional impacts of dizziness. Participants respond to each item on a three-point scale: 'No' (0), 'Sometimes' (2) and 'Yes' (4), with higher total scores indicating greater perceived levels of dizziness-related handicap. This measure has previously demonstrated good internal consistency for the total scale (α = 0.95; Tamber, Wilhelmsen, & Strand, 2009) and across subscales (α = 0.72 to 0.89; Jacobson & Newman, 1990), and has been successfully utilised in RCTs of VR (Yardley et al., 2012; Yardley et al., 2004). In the present sample, Cronbach's alpha was α = 0.90 for the DHI total scale, indicating very good levels of internal consistency (DeVellis, 1991).

2.5.1.1.3 **Credibility and Expectancy Questionnaire (CEQ)**

Participants' expectations regarding the outcome of their VR therapy and their perceptions of credibility of the intervention were measured by the Credibility and Expectancy Questionnaire (Devilly & Borkovec, 2000). This six-item scale was originally developed for use in psychotherapy trials, but its subscales have also demonstrated good internal consistency (α= 0.82 and 0.84) in a trial of behavioural interventions for chronic pain (Smeets et al., 2008). The scale requires participants to report both what they *think* and *feel* about the therapy and its possible outcomes. Cronbach's alpha for the CEQ in the present sample was α = 0.90, indicating a very good level of internal consistency (DeVellis, 1991).

2.5.1.1.4 **Self-efficacy for exercise**

Participants' self-efficacy for conducting the VR therapy was measured using a scale originally developed to measure individuals' self-efficacy for exercise-related behaviours (Resnick & Jenkins, 2000) and adapted for the study of adherence to physiotherapy exercises (Tijou, Yardley, Sedikides, & Bizo, 2010). This adapted scale has previously demonstrated very high internal consistency (α = 0.91; Tijou et al., 2010). Similarly, within the present sample, Cronbach's alpha was α = 0.92. The measure asks patients to report their confidence in carrying out their therapy under a number of different circumstances, including feeling tired or stressed. Participants are required to respond to each of the eight items on an eleven-point scale ranging from 'Not very confident' (0) to 'Very Confident' (10) with higher total scores indicating greater self-efficacy.

2.5.1.1.5 **Hospital Anxiety and Depression Scale (HADS)**

Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983). A systematic review of 747 studies that had used the HADS concluded that it demonstrates good psychometric properties amongst both clinical and community samples (Bjelland, Dahl, Hang, & Neckelmann, 2002). The measure consists of 14 items across two subscales; seven items measure anxiety, and seven measure depression. Each item comprises a short statement and participants must pick from four possible responses to indicate the extent to which they agree with the statement. Responses are scored from zero to four, with higher subscale totals indicating higher levels of anxiety and depression. Cronbach's alpha values for the present sample were $\alpha = 0.85$ and $\alpha = 0.81$ for the anxiety and depression subscales, respectively, indicating very good levels of internal consistency (DeVellis, 1991).

2.5.1.1.6 **Problematic Experiences of Therapy Scale (PETS)**

Participants' perceptions of any adherence problems were measured by the Problematic Experiences of Therapy Scale (Kirby et al., 2014). The PETS was developed specifically to measure patient perceptions' of barriers to adherence to home-based rehabilitation, and demonstrated good internal consistency across subscales ($\alpha = 0.84$ to 0.96; Kirby et al., 2014). Within the present sample, internal consistency was very good across all subscales, ranging between $\alpha = 0.88$ and $\alpha = 0.93$. The measure's five subscales assess the extent to which participants feel they have been prevented from carrying out therapy due to: symptom severity or exacerbation; uncertainty regarding how to conduct the therapy; doubts about therapy efficacy; practical problems; or a lack of support. All items require participants to respond on a five-point scale from 'Agree Strongly' (5) to 'Disagree Strongly' (1). Scores can either be collated on each subscale, with higher scores indicating more problems with adhering to treatment, or else dichotomous scoring can be utilised. Within the dichotomous scoring system, any endorsement of an item within a subscale (i.e. any response other than '1') is counted as the individual having experienced that barrier. Conversely, responses of '1' on all items within a subscale would be counted as the individual not having experienced that barrier.

2.5.1.1.6.1 Self-reported adherence

In addition to adherence-problems, a single item measure presented at the start of each new session attempted to measure self-reported adherence to the VR exercises. It asked participants to report how many times during the past week they had completed their VR exercises. It required them to respond on a six-point scale from 'Not at all' (0 times) to 'At least twice everyday' (14 or more times). However, this data could not be used as it was completed by less than half of all participants due to the large proportion of users who did not progress past session one. Subsequently, the PETS subscales (as a measure of problems with adherence) were used as a proxy to indicate participants' adherence to the VR exercises.

2.5.1.1.7 **Acceptance and Action questionnaire (AAQII)**

The seven-item revised Acceptance and Action Questionnaire (Bond et al., 2011) was used to measure participants' acceptance, experiential avoidance and psychological inflexibility. Participants respond to each item on a seven-point scale from 'Never True' (1) to 'Always True' (7), with higher scores indicating lower acceptance and greater levels of avoidance and psychological inflexibility. A study investigating the psychometric properties of the measure revealed good internal consistency ($\alpha = 0.78$ to 0.88) and test-retest reliability ($r = 0.79$ to 0.81; Bond et al., 2011) amongst six varied samples. Cronbach's alpha for the AAQII in the present sample was $\alpha = 0.93$, indicating a very high level of internal consistency (DeVellis, 1991).

2.5.1.1.8 **Demographic questionnaire**

Single items collected data from participants at baseline regarding their gender, age, level of education, duration of symptoms and any dizziness-related diagnoses.

2.5.1.1.9 **Intervention usage data**

In addition to these measures, the LifeGuide software automatically recorded data regarding individuals' frequency and duration of intervention usage. This was used as an objective measure of engagement with the online intervention.

2.5.2 Qualitative data collection

2.5.2.1 **Semi-structured qualitative interviews**

Qualitative interviews involve participants verbally responding in their own words to a series of questions relating to the topic under investigation. This method of data collection facilitates understanding of individuals' personal reactions to a given topic, rather than an opinion elicited from a forced choice between pre-determined response options (Marks & Yardley, 2004). As such, they are a valuable method of obtaining rich data about individuals' experiences and perceptions that cannot (and often should not) be quantified or otherwise simplified (Howitt, 2010).

In a semi-structured qualitative interview, such as those employed in this thesis, the interview is guided by a schedule of relevant topics or questions, but the order in which these are asked can vary (Potter & Hepburn, 2005). An important factor in developing the schedule for such interviews is ensuring that questions: do not lead the participants towards a particular response; are open-ended and invite respondents to elaborate rather than give single word answers; and are easy to understand in terms of their wording and structure (Howitt, 2010). Asking about concrete rather than abstract experiences has also been identified as a more effective means of eliciting understandings of individuals' beliefs, motivations and feelings (Marks & Yardley, 2004).

Interviewers do not always stick rigidly to the schedule and will often ask follow-up questions or prompts to gain deeper insight into a particular comment or topic of interest raised by the participant (Howitt, 2010). During interviews conducted during the current body of research, participants were prompted to discuss both the online intervention content and their practise of the exercises in response to each of the questions. Neutral prompts such as "Could you tell me a bit more about…?" and "Can you explain what you mean by…?" were also utilised to encourage participants to expand on issues they raised that seemed relevant to the study aims. This allowed the interview to cover topics that were salient to participants that might not have been anticipated. At the end of the interviews participants were given the opportunity to ask any further questions.

Recruitment continued until no novel insights appeared to be arising from the data. At this point it was assumed that data saturation had been reached. Data saturation refers to the point at which it is felt that new data is no longer providing new insights into relevant codes, themes or categories (Smith, 2007). Interviews were audio-recorded, transcribed verbatim and checked against recordings to ensure accuracy. Participants were allocated a participant ID to protect their identity and any identifiable data including names of spouses, friends, partners etc. were removed.

2.5.2.1.1 **Telephone interviews**

Telephone rather than face-to-face interviews were conducted to allow individuals from more geographically-remote locations to participate, particularly in the longitudinal study (Chapter 4), given the need for multiple interviews per participant. Concerns are sometimes voiced that telephone interviews do not allow the same rapport between interviewer and interviewee and, therefore, may limit the depth and quality of data that can be collected (Novick, 2008). However, previous studies investigating patient experiences of interventions for long-term health conditions have very successfully collected high-quality, rich data via telephone interviews (Dennison, Moss-Morris, Yardley, Kirby, & Chalder, 2013). As such, it was not felt that conducting the interviews via telephone would necessarily be detrimental to the quality of data collected, and indeed may allow individuals to feel more comfortable and willing to share information than if face-to-face (Novick, 2008).

2.5.2.2 **The issue of reflexivity**

In the context of qualitative research, reflexivity refers to critical self-reflection in which the researcher explicitly acknowledges their own assumptions, perspectives and beliefs, and identifies how these are likely to impact on various stages of the research process (Marks & Yardley, 2004). This is particularly important during qualitative data collection and analysis. Referring back to the assumptions underlying qualitative methodologies, the social constructivist perspective argues that all understandings of reality are co-created through interaction with the world and others in it (Creswell, 2014; Ritchie et al., 2013). Accordingly it is important for the researcher to recognise how their role in the data collection process (i.e. the interview) and in analysing the data is influenced by their own experiences and perceptions, and in turn how this is likely to have influenced the data and findings obtained (Howitt, 2010). In doing so this might allow the researcher to move beyond initial assumptions they make to consider alternative possibilities and interpretations (Marks & Yardley, 2004). As such, the researcher adopted a reflexive approach to qualitative data collection and analysis and discussed their reflections alongside the relevant study findings.

2.6 Data analysis procedures

This section provides details of quantitative and qualitative analysis procedures that were employed across multiple studies of the thesis.

2.6.1 Quantitative statistical analyses

The statistical analysis procedures employed differ between studies and, as such, are predominantly reported in the relevant chapters. However, some aspects of these analyses were shared and so are outlined here. All quantitative data analyses in this thesis were conducted using SPSS version 22, and MPlus software.

2.6.1.1 **Data preparation**

As all quantitative data for this thesis was collected during the RCT, the initial data cleaning and preparation was the same for the studies reported in Chapters five and six. Data accuracy was initially examined by checking each variable’s range and minimum and maximum scores. In addition, a proportion of the manually entered paper questionnaire data was double entered. If participants had missing data on a given scale, these values were replaced with their mean score for the scale, but only if less than half of the scale items were missing (Hawthorne, Hawthorne, & Elliott, 2005). The internal consistency of all multi-item measures was assessed by calculating Cronbach's alpha scores for each scale, or subscale where appropriate, as reported in the measures section above (2.5.1.1).

2.6.1.2 **Assumptions underlying statistical tests**

Preliminary analyses checked that the quantitative data for all variables of interest met assumptions for parametric analysis. The distribution of individual variables was assessed using histograms and with the Shapiro-Wilk test. Linearity and bivariate normality of the data was assessed using scatterplots of each of the predictor variables with outcome variables. These were also used to check for any outliers. Given that there was no reason to suppose that participants could have influenced each other's scores, the data was assumed to be independent. The results of these preliminary analyses are presented within the results sections of the relevant studies.

Regression analysis requires additional data assumptions to be checked. Both quantitative studies of the thesis employed regression analyses and so the underlying assumptions are detailed here. For each regression model, collinearity diagnostics were inspected in to ensure that Tolerance was above 0.2, and variance inflation factors (VIF) were less than 10, which would indicate low risk of multicollinearity (Mayers, 2013). Assumptions of homoscedasticity were also tested by visually inspecting ZRESID/ZPRED plots for each predictor variable entered into the regression analysis. These reveal whether variance around the regression line is equal at all levels of the predictor variable (Field, 2013). Finally, the Durbin-Watson statistic was calculated to ensure independence of errors by checking that residuals at different levels of the predictor variable were not correlated (Mayers, 2013).

In line with standard practice in psychological research, an alpha level of $p<0.05$ was adopted as a threshold for statistically significant results (McBride, 2012). However, effect sizes were also examined and relationships commented on where an effect appeared to be present.

2.6.2 Qualitative data analyses

Both the longitudinal study of participants' experiences of the Balance Retraining reported in Chapter 4, and the mixed-methods investigation of engagement outlined in Chapter 6 employed an inductive thematic approach to analysing their qualitative data.

2.6.2.1 **Inductive thematic analysis**

In both studies, an inductive approach to data analysis was taken to ensure that the resulting codes, and ultimately themes, were firmly rooted in the data rather than fitted to preconceived ideas (Patton, 1990). This was key to ensuring that, whilst answering the research questions set out, the experiences of engaging in this intervention reported were those most salient for the individuals involved (Yardley et al., 2015). Thematic analysis of the data was carried out according to guidance set out by Braun and Clarke (2006) with the addition of constant comparison and memoing techniques advocated by grounded theory (Glaser & Strauss, 1967).

Thematic analysis aims to identify, analyse and report patterns in data (Braun & Clarke, 2006), hence its suitability for the qualitative elements of this thesis. The first stage of conducting thematic analysis involves reading and re-reading the qualitative data (in this case interview transcripts) which serve to familiarise the researcher with the data. Following this, the researcher begins the coding process in which they identify and label any meaningful units of data perceived as interesting or relevant to the study's aims. NVivo software was used to facilitate and document this process in the studies of this thesis. Throughout this iterative process, the researcher revisits previously coded transcripts when new codes arise to allow a process of constant comparison (Glaser & Strauss, 1967). This technique is drawn from grounded theory and allows closer consideration of whether certain opinions and experiences seem to be expressed in certain contexts or at certain times. The process also facilitates researchers' immersion in, and understanding of, the raw data through continual checking back to ensure that codes are applied appropriately and the emerging themes remain close to the data. Coding manuals are created that document each code, its definition and examples of data that fit the code. Memoing is utilised to maintain an audit trail and to facilitate transparency of the analysis process (Glaser & Strauss, 1967). Previous examples of qualitative studies conducting thematic analysis whilst implementing such strategies from grounded theory include patient and family experiences of therapy for chronic fatigue (Dennison, Stanbrook, Moss‐Morris, Yardley, & Chalder, 2010) and older adults' views on advice for falls prevention (Yardley, Donovan-Hall, Francis, & Todd, 2006). The approach allowed thorough descriptions of the intricacies of the data whilst remaining firmly grounded in participants' own accounts. In the next phase of analysis, codes that appear to relate to similar or closely related features of the data are grouped into themes. Often, emerging themes can be encapsulated within a broader overarching theme, therefore creating themes and sub-themes.

2.7 Summary

This chapter has provided an overview of the philosophical underpinnings and approach of the researcher to this body of work, in order to justify the design and methods used. It specified the design of the mixed-methods approach and finished with a discussion of the major recruitment, data collection and analysis methods implemented across the thesis. The following chapters will now detail each of the four studies conducted.

Chapter 3: Predictors of Adherence to Home-Based, Self-Managed Physical Therapies: a Systematic Review

3.1 Brief introduction and rationale

As outlined in section 1.5.1.2.1, adherence to self-managed physical therapies is a key factor in whether they are successful (Dimatteo et al., 2002; Hayden et al., 2005); despite this, adherence rates are often poor (Sluijs et al., 1993). An understanding of factors influencing patients' adherence to self-managed HBPTs could facilitate the identification of barriers and help maximise exposure to factors promoting adherence (Jack, McLean, Moffett, & Gardiner, 2010). Furthermore, it will provide insight into adherence behaviours in the context of the Balance Retraining intervention, which may facilitate understanding of variations in patient outcomes.

Although research has begun to investigate these potentially adherence-predictive factors, this work has focused largely on clinic-based physiotherapy. A systematic review identified a number of barriers to clinic-based treatment adherence in physiotherapy outpatients, but noted that barriers for self-managed aspects of physical therapy may well be different and, as such, should be further investigated separately (Jack et al., 2010). Indeed, other studies have noted differences in adherence behaviour between clinic- and home-based elements of physical therapy (Alexandre et al., 2002) and also differential effects of factors such as age on adherence to home- and clinic-based physical therapy (Brewer et al., 2003). Qualitative research exploring patients' perceptions of their reasons for adherence identified distinct phases in terms of reasons given for non-compliance that corresponded to the times when patients were still attending clinic-based sessions and when their programme was fully home-based (Campbell et al., 2001). Further research specifically investigating predictors of adherence to HBPT is seemingly still required.

It seems pertinent to first collate what is already known, highlighting any areas of uncertainty and identify promising directions for further research. A systematic review of the literature was considered the best method of achieving this. The aim of a systematic review is to bring together existing empirical evidence pertaining to a given topic with a view to answering a specific research question about that topic. The methods through which this is achieved are explicitly outlined within the review, and focus on minimising bias, and synthesising data from the primary studies to provide reliable conclusions (Higgins & Green, 2011). Systematic reviews are becoming increasingly important in healthcare as professionals are ever more obligated to demonstrate evidence-based practice (Moher, Liberati, Tetzlaff, & Altman, 2009). A systematic review is an accessible way for busy professionals to keep abreast of evidence and for other researchers to gain a clearer picture of the state of current knowledge on a particular topic (Higgins & Green, 2011).

A systematic review of factors associated with adherence to self-managed HBPT in particular would highlight those that may be specific to this type of physical therapy regimen. Given the assertion that “adherence, or compliance, to exercise programmes is to be viewed as health behaviour, such strategies [to encourage adherence] should be based on theory relating to health behaviour” (Hammer, Degerfeldt, & Denison, 2007, p. 191), it also seems important to consider identified predictive factors in relation to relevant theory. Given the vast array of health behaviour models demonstrated in section 1.5.2.1, there is evidently great variation in theoretical approaches to the study of adherence to HBPTs. It would be informative, therefore, to explore the extent to which these theoretical approaches are supported by empirical findings. Indeed, if strategies to encourage adherence are to be based on such theory, it is important to consider the extent to which the identified factors support various models of health-related behaviour. By doing so, it may help to identify which theoretical frameworks can best explain adherence behaviour in this context, and therefore which are most suitable to base recommendations for increasing adherence on. This theoretical aspect of the review may be especially valuable given the view that “[…] theory testing is a neglected aspect of systematic reviews” (Popay et al., 2006, p. 12).

3.1.1 Aims of the study

The aim of this systematic review is to identify factors which predict adherence to home-based, self-managed physical therapies. Where possible, it also aims to subsequently evaluate the extent to which these empirical findings support investigated theoretical models of health behaviour that have been applied to adherence. This should allow a better understanding of factors that influence individuals’ adherence behaviour to such physical therapy programmes and provide insight into possible adherence-related variations in participant outcomes following Balance Retraining. Furthermore, it will allow some degree of critical evaluation of relevant theoretical models in terms of their ability to predict adherence behaviour in this context.

3.2 Methods

3.2.1 Search strategy

Online databases (MEDLINE, CINAHL, EMBASE, PsychINFO, Psycharticles, PubMed, AMED and The Cochrane Library) were systematically searched for studies investigating factors associated with adherence to HBPTs, published anytime until December 2015. Search terms were agreed upon in consultation with academic supervisors and the psychology subject librarian to ensure, as far as possible, that no potentially important terms were omitted. Keywords of identified studies were also consulted to discover further potential search terms for inclusion.

Scoping searches were conducted to determine the most effective combinations of terms. Inclusion of terms such as “home-based” or “self-managed” restricted returned records too extensively and excluded potentially relevant articles. As such, these terms were not included and this element of the search was conducted during the article screening stage. The scoping searches also revealed that without inclusion of terms such as “barriers” and “facilitators”, more than 2000 records were returned in both Embase and Medline databases, a large proportion of which were not relevant. As such, it was decided that these terms were required to focus the search. Table 3 outlines the final search terms.

Table 3 Search terms (index terms in bold)

Terms combined with:	**Physical therapy** AND	**Adherence** AND	**Predictors** AND
OR	**Exercise therapy**	Compliance	Barriers
OR	Physiotherapy	**Patient compliance**	Facilitators
OR	Home ADJ physiotherapy	**Treatment compliance**	
OR	Home ADJ exercises	Patient ADJ engagement	
OR	Movement ADJ therapy	Adherence behaviour	
OR	**Kinesiotherapy**		
OR	**Physical treatment methods**		
OR	Rehabilitation ADJ exercises		
OR	Physical therapy modalities		

These search terms reflect a combination of free text searching and index terms of the various databases. Index terms, or MeSH (Medical Subject Headings) descriptors, were created by the US National Library of Medicine to produce effective and appropriate search terms of most relevance to the investigated constructs. These terms were also used to search Google Scholar and the University of Southampton’s web catalogue. Following the identification of relevant articles, their reference lists were also hand-searched for additional relevant literature.

3.2.2 Scope of the review

3.2.2.1 Home-based physical therapy

Physical therapy was defined as any treatment regimens involving progressive movement and stretching of specific body parts (usually joints or muscle groups) affected by the condition or injury the individual was experiencing. The therapies considered were usually initiated by a physiotherapist or an occupational therapist, but involved the individual conducting the therapy unsupervised at home. Some therapies involved periodic attendance at healthcare professional-led appointments, but were predominantly focused on self-management.

3.2.2.2 Factors associated with adherence

Studies were considered relevant if they made some measurement of the extent to which participants' behaviours were in accordance with those advocated in the physical therapy regimen recommended to them, i.e. participants' adherence.

This review included studies that had not only measured adherence, but had also analysed the relationship between adherence and at least one factor hypothesised to be predictive of it. Factors investigated for their association with adherence were any characteristics of: the individual; their condition or injury; the therapy itself; their environment; or their relationships with others that had been hypothesised to be associated with adherence to their therapy.

3.2.3 Inclusion of studies

Figure 6 illustrates the process of study selection.

The following criteria were used to identify studies for inclusion:

- Full text, peer-reviewed published journal articles
- English language journal articles
- Original studies reporting measurement of adherence to a HBPT and at least one factor associated with adherence.

Any studies meeting the following criteria were excluded:

- Studies with samples of participants exclusively under 18 years old – given that children may not be expected or required to take responsibility for managing their physical therapy.
- Studies of physical therapies performed by another person – e.g. Cystic Fibrosis chest physiotherapy – given that this may not require patients to self-manage their therapy to the same extent.
- Studies of therapeutic regimens comprising recommendations of general exercise, e.g. cardiac rehabilitation, weight management, diabetes management and cancer rehabilitation – given that there may be no particular set of home exercises to measure adherence to.

- Studies reporting adherence only to a clinic-based element of a physical therapy programme, or those that combine clinic and home-based adherence data for analysis (studies were eligible if home-based data were reported separately).

Although there was no initial intention to exclude qualitative research articles, of the full texts assessed, only five were qualitative studies. Given the limited number of relevant qualitative articles, it was decided only to include quantitative articles, and therefore, the five qualitative articles were excluded.

As with the search strategy, developing the eligibility criteria for the review articles was an iterative process. As such, a number of exclusion criteria were used in later stages of screening that were not included in these initial criteria. Any additional reasons for exclusion are noted in Figure 6.

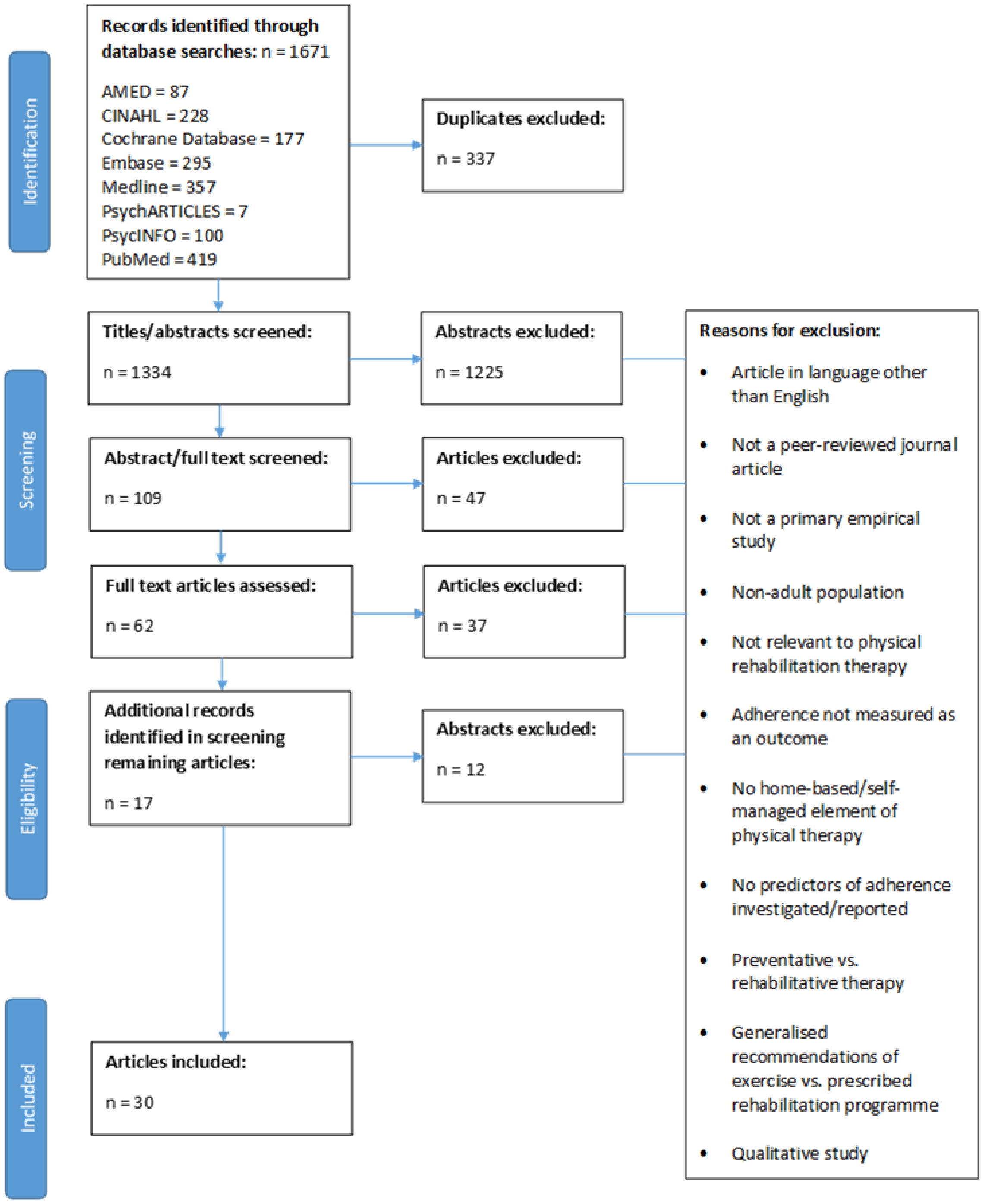


Figure 6 Process of study selection

3.2.4 Quality assessment and data extraction

Quality assessment within a systematic review is the process through which the standard of the included published articles is formally evaluated. Through this appraisal, the reviewer can critically comment upon the design, conduct and analysis of a study and consider the implications for their weighting in the review's conclusions (Juni, Altman, & Egger, 2001). This critical appraisal of the primary studies is an essential feature (Juni et al., 2001; Moher et al., 2009; Moja et al., 2005) to ensure that the conclusions of the systematic review itself are not of dubious quality (Juni et al., 2001). Although acknowledged to be an important feature, the methods through which quality assessments are conducted are not fully agreed upon (Moja et al., 2005). There is debate regarding which tools are most effective, and little consensus about how the outcome of the quality assessment should be utilised within the systematic review (Verhagen, de Vet, de Bie, Boers, & van den Brandt, 2001).

One of the major distinctions of quality assessment tools is between a scoring and non-scoring approach. A scoring approach involves the study being assessed against given criteria and allocated a score according to how fully it meets each criterion. A total score across all criteria is generally calculated and interpreted as an indication of the overall quality of the study (Wells & Littell, 2008). Although such scoring approaches may provide a useful overall idea of quality, it may be more beneficial to employ quality assessment tools that provide explicit discussion of the study's quality across various dimensions (Jüni, Witschi, Bloch, & Egger, 1999).

A non-scoring approach still assesses studies against a checklist of criteria, but rather than allocating a score, information relevant to each criterion is extracted from studies. This information can then be used to assess and discuss the risk of bias or threats to the validity of the study (Wells & Littell, 2008). This non-scoring approach allows for a more transparent assessment of quality, as it encourages explicit discussion of *how* various aspects pose a threat to the study's quality (Ryan, Hill, Prictor, & McKenzie, 2012). Accordingly, a non-scoring approach to quality assessment was adopted for this review. Although the Cochrane risk of bias tool is considered a gold standard, it is targeted towards quality assessment of RCTs. Given that the final articles in this review were not RCTs, this tool was not appropriate. The assessment tool chosen was developed from the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) checklist (von Elm et al., 2007). It had been previously used in other systematic reviews (Hall, Ferreira, Maher, Latimer, & Ferreira, 2010; Pengel, Herbert, Maher, & Refshauge, 2003) and recommended by a recent systematic review of quality assessment tools for observational studies (Sanderson, Tatt, & Higgins, 2007).

Information extracted from the studies for the purposes of quality assessment was tabulated and included information across three main domains: control for bias, including how well defined and representative the sample was, blinding and follow up rate; appropriate measurement, including measures used and reporting of outcome data; and control for confounding, including whether statistical adjustment was made for confounders. No studies were excluded on the basis of their quality assessment but there was variation in the overall quality of the studies. This will be discussed alongside the results to allow consideration of which findings are most reliable and, therefore, potentially more important for the review's conclusions.

Data were extracted from each of the 30 studies and tabulated to allow comparison and for ease of synthesis of the study findings. The data extracted from studies included: sample characteristics, study design, theoretical approach, intervention details, adherence measures, and finally, significant findings and effect sizes. There was some confusion regarding the interpretation of Levy, Polman, and Clough (2008)'s findings, so the corresponding author was contacted to clarify and to aid data extraction. It must be noted that the review's conclusions are very much dependent on the depth and quality of reporting of the primary studies. Where data to be extracted from the studies were missing, this is commented upon within the results.

3.2.5 Data synthesis

Deciding how to combine, or synthesise, the findings from studies identified in a systematic review is an important decision. A meta-analysis is a statistical procedure that integrates the results of several independent studies (Haidich, 2011). It is often considered the 'gold standard' means of synthesising findings across multiple studies and is recognised amongst the highest forms of evidence (Borgerson, 2009; Greenhalgh, 2014). However, it is not always possible due to heterogeneity of the studies whose findings are to be synthesised. Narrative-style reviews can be especially useful for the aggregation of findings when the studies involved are too methodologically diverse for meta-analysis (Baumeister & Leary, 1997). This was the case in the present review.

Across the 30 studies identified, there was huge variation of factors investigated as potential predictors of adherence to HBPTs; where continuity did exist, study designs and measures were rarely consistent and more than one study failed to report required statistics. Consequently, a meta-analytic approach was not possible and, instead, a narrative synthesis approach was taken (Popay et al., 2006). Narrative synthesis focuses predominantly on textual summaries and descriptions of the results with the primary aim of "'tell[ing] the story' of the findings from the included studies" (Popay et al., 2006, p. 5). The elements of this process comprised: developing a preliminary synthesis to organise the findings from the included studies; exploring relationships within this data to understand and explain patterns or differences; and assessing the robustness of the synthesis through consideration of the strength, quality and generalisability of the included data (Popay et al., 2006).

Study findings were organised into conceptually-related categories and each of these reviewed in turn. Within each section, the importance of each factor is discussed by considering: the magnitude of identified relationships with adherence across different studies; how many of the studies reported significant relationships; and the methodological quality of the relevant studies. These data are summarised in Table 4. Where there are discrepancies between findings, potential reasons for this are discussed. This is followed by a discussion of the various theoretical approaches taken by the studies, and the relevance of the findings for each.

3.3 Results

The results are organised into three main sections: a brief overview will first outline key characteristics across studies; the second section will comprise the synthesis and review of the significant factors shown to be associated with adherence to HBPT; in light of these findings, the third section will review the theoretical frameworks for adherence behaviour investigated by the studies with a view to highlighting the extent to which they are supported by empirical data.

3.3.1 Methodological overview of studies

Appendix G, page 239 presents an overview of the key study characteristics. Studies are referred to by their reference ID as indicated in this table. The majority of the 30 studies were longitudinal prospective designs. Two studies analysed data from the same participants [17,18]. Two sets of studies [5,6,7; 3,4] appear to use sub-sets of participants from the same study.

Sample characteristics across studies were highly varied with some defined by the particular therapy investigated. Five studies' samples were gender specific to females [1,3,4,9,19], but all others were mixed. The mean age of samples was also often determined by the condition investigated. Owing to the exclusion of studies with exclusively non-adult samples, all except four studies [10,17,18,29] only included participants over 18. The minimum age of any participant recruited was 14, but all participants conducted their physiotherapy independently. Although the HBPTs studied did vary, several therapies were the subject of multiple studies. Specifically, rehabilitation exercises following anterior cruciate ligament (ACL)-repair surgery was the subject of five studies [5,6,7,21,22]; Pelvic Floor Muscle Exercise (PFME) therapy for symptoms of urinary incontinence was investigated in four studies [1,3,4,9]; rehabilitation exercises following sports injury was investigated in three studies [17,18,27]; physiotherapy exercises as part of falls prevention interventions were also the subject of three studies [14,25,26]; dizziness and balance disorders were investigated by two studies [12,30], as were upper limb disorders and injuries [10,11], non-specific neck or low back pain [13,20], and osteoarthritis of the hip or knee [23,24]. Other HBPTs investigated were for stroke rehabilitation [16]; osteoporosis [19]; rheumatoid arthritis [28], and ankle sprains [2]. Three studies [8,15,29] investigated participants engaged in home physical rehabilitation for a variety of musculoskeletal conditions.

All measures of adherence included participant self-report. In some instances, physiotherapist estimates of adherence were also included. For analysis, the adherence outcomes tended to be dichotomised into 'adherent' and 'non-adherent' participants or expressed as proportions of the recommended exercise completed.

3.3.2 General quality assessment of findings

Although issues of study quality are discussed where relevant to specific findings, the quality assessment also highlighted issues that apply more universally relating to: study design and methods, measures and possible sources of bias.

3.3.2.1 Study design and methods

Studies frequently used sample sizes of 70 or less [6,10,11,14,16,17,18,22,27]. Although there are no universal rules regarding appropriate sample size for multivariate analyses, smaller studies with many predictor variables allow less confidence in findings (Tabachnick & Fidell, 2001). Variation in studies' sample sizes (and therefore power) potentially account for inconsistencies in significant findings for a given factor. Levy and colleagues' non-significant finding regarding self-efficacy [17], for example, may be due to the study not being sufficiently powered to detect a small association with adherence. This is supported by other studies demonstrating that the association between self-efficacy and adherence was indeed small [10,20]. Additionally, nearly a third of studies either did not conduct multivariate analyses [8,11,12,13,15,16,24,28] or did not fully report the results [18], meaning that it was not always possible to interpret the nature of certain relationships identified or to know whether other factors acted as confounders. Finally, studies generally utilised correlational methods to assess associations between adherence and other investigated factors and so could, at best, only indicate an independent predictive association.

3.3.2.2 Measures

Non-validated measures of various constructs were often employed [2,7,8,10,14,15,16,20,25,28] and the reliability of scales for the given sample were sometimes not conducted [16], reported [8,10,13,15,25,28], or did not always demonstrate acceptable reliability [2,11,14]. This is consistent with findings of a recent systematic review of self-report measures of adherence to unsupervised, home-based rehabilitation programmes. This review concluded that almost all of 61 measures identified lacked any psychometric validation (Bollen, Dean, Siegert, Howe, & Goodwin, 2014). Within the current review, use of such non-validated measures may account for inconsistencies in findings for certain factors, with non-validated measures potentially less likely to accurately measure target concepts. Some studies attempted to overcome these issues by creating new measures modelled on existing scales or theory in the scientific literature [2,8,16,20] or through pre-testing and piloting of the scales [14,15,28].

More generally, self-report measures utilised by all these studies rely on participants accurately remembering and reporting their exercising. As such, they are susceptible to social desirability and memory biases, potentially resulting in overestimations of adherence. However, many studies employed methods to minimise social desirability reporting and inaccuracies resulting from memory biases such as collecting daily diary data [7], by asking about difficulties encountered with adhering to the HBPT [30], or by asking participants to also record other incidental data to remove their focus from adherence [14]. Furthermore, although self-report measures are subject to these potential biases, the unsupervised, home-based nature of the exercises provide little alternative for measuring adherence without creating much greater participant burden (e.g. asking them to provide video evidence of exercise completion). Alternatives to self-report are also associated with their own limitations. For example, in-clinic assessments are not necessarily an accurate reflection of unsupervised home practise (Bollen et al., 2014). Furthermore, devices for objective measurement of exercise adherence such as accelerometers may not capture the movements required in therapeutic regimes, and also depend on individuals wearing them appropriately (Bollen et al., 2014). In addition, these objective measures may remove participants' sense of autonomy over their decision to adhere and, accordingly, may provide an unrealistic view of adherence (Salt, Hall, Peden, & Horne, 2012).

3.3.2.3 **Sources of bias**

Response bias was a potential issue for a number of included studies which reported that their dropout rates were very high (45%; [21]), and sometimes that the characteristics of their continuing compared to non-continuing participants were significantly different in outcome-relevant dimensions such as severity and frequency of symptoms [1,4]. Both could exacerbate the risk of outcome data being skewed towards those more likely to adhere and potentially mask significant associations with other factors. Additionally, a small number of studies [12,16,21,24,27] provided little information regarding recruitment methods or eligibility criteria, or those that are detailed suggest that the sample selection procedures could potentially have introduced bias towards likely high-adherers; this, in turn, risks a lack of variance in adherence outcomes.

3.3.3 Factors associated with adherence to home-based physical; therapies

Results relating to factors associated with adherence were grouped into eight conceptually-related categories: perceptions of illness, condition or injury; characteristics of, and perceptions about, therapy; perceptions of ability to complete therapy; motivation and intention; behaviours related to home physical therapy; stress and coping; negative cognitions or emotional experiences and social support. Table 4 summarises the relative strength of evidence for each factor. These factors correspond to each individual factor with the eight categories described above; the evidence for each one is presented after the table.

The process of determining the relative overall strength of evidence for each factor was a multistage process. It involved allocation of weighted values to each factors' evidence sources, and using these resulting 'scores' in consideration of the collated evidence to agree the most appropriate categorisation of factors. Prior to overall categorisation, the initial decision about whether each individual study provided 'strong', 'moderate' or 'weak' evidence (and therefore which of three main columns it features in in Table 4) was based on the likely quality of the evidence (based on quality assessment) in combination with the effect size of the relationship in question. For example, a large effect size from a study with few identified quality limitations was counted as strong evidence, whereas a small effect size from a study with a number of identified limitations was counted as weak evidence – particularly if these limitations related to the particular factor under investigation. Cases with a less immediately evident categorisation were discussed, and their placement agreed upon, with supervisors. All final categorisations of individual studies' evidence were agreed with supervisors.

In the next stage, the overall strength of evidence for each factor's association with adherence was categorised as either 'strong', 'moderate' or 'limited' based on the amount and strength of evidence provided across studies. To provide a preliminary means of comparing the relative strength of overall evidence between factors, the first part of this process involved assigning weighted values to each instance of 'strong', 'moderate' or 'weak' evidence from individual studies. Accordingly, for every instance of 'strong' evidence, a factor was allocated three points; for 'moderate' evidence, two points; and for 'weak' evidence, one point. For each factor, total scores were calculated for evidence of significant associations (either positive or negative) as well as evidence of non-significant associations. For each factor, the non-significant associations score was subtracted from the significant associations score to give an indication of the overall evidence strength on balance. These final scores were used to provisionally categorise the factors overall strength of evidence of association with adherence. Based on the resulting range of scores, threshold scores of less than five, less than ten, and ten or more were used to categorise factors into 'limited', 'moderate' or 'strong' overall evidence respectively. These scores and thresholds were not intended to necessarily represent final categorisations of the factors; more to provide a means of comparison and to guide further discussion and final categorisation.

Accordingly, the final step was a consideration of whether each factors' provisional categorisation appeared congruent with the collated evidence of the review, and that any intricacies of individual studies' findings that may influence categorisation had not been lost. In completing this exercise, for the vast majority of factors (i.e. 17 out of 19), the provisional categorisation was deemed appropriate after consideration of the evidence, and also agreed by supervisors. For the remaining two, re-categorisation was considered appropriate. The first of these was 'negative cognitions and emotional experiences' whose score of six (based on three studies of varying evidence strength demonstrating a significant effect) would have placed it in the 'moderate' level of evidence category. However, the evidence of associations for this factor from different studies were actually contradictory, with one study suggesting a positive association with adherence and two suggesting a negative association. On balance, there was little overwhelming evidence of an effect in either direction, so the overall evidence was considered limited. The second factor to be re-categorised was 'intention' whose score of nine placed it close to the provisional 'strong' overall evidence category. Consideration of the collated evidence for this factor was strongly suggestive that it was positively associated with adherence across a range of different patient groups. The only study demonstrating no significant effect reported their intention data to be very positively skewed with small standard deviations and openly acknowledged that this may have hindered a relationship between intention and adherence [1]. Accordingly, with the only presented evidence of non-significance as potentially flawed, it was considered that the overall evidence for intention's association with adherence was 'strong'. The final categorisations of all factors along with the reasoning for each was discussed and agreed with supervisors.

Condition-specific factors or factors only investigated by one study, for example, level of fluid intake in relation to PFME adherence [3], are not discussed as little can be strongly concluded or generalised from these to HBPT more generally. The findings of one study [14], although eligible for inclusion, will not be discussed as they are unclear. Whilst the study reported significant correlations between home adherence and two variables, it also stated that these variables were not predictive of adherence. Attempts to contact two authors of the paper to clarify were unsuccessful.

Table 4 Summary of evidence strength for predictive factors of adherence to HBPTs based on number and size of significant findings and evidence quality

Factor Investigated	Strong evidence				Moderate evidence				Weak evidence			
	+	**-**	**NS**	**I**	**+**	**-**	**NS**	**I**	**+**	**-**	**NS**	**I**
Perceived severity			[10]		[17]		[18]	[27]	[1,3,9]	[4]	[8]	
Perceived susceptibility			[25]		[17,18]			[27]				
Perceptions of health status	[19,26]		[4,25]			[24]	[13]		[12]		[8]	
Number of exercises		[7,20]									[8]	
Attitudes towards therapy			[9]		[18]				[15]			
Expectations of therapy outcome			[9,10]				[17,18]	[27]	[28]		[8]	
Not having time for exercises		[3,20]				[26]						
Forgetting to do exercises		[3,4]										
Perceived ability to complete therapy	[1,4,9 10,20, 29,30]		[21]		[18,27]		[17]					[11]
Intention to adhere	[21,30]				[2,18]		[1]		[11]			
Self-motivation	[5,6]				[18,19]				[8]			
Previous adherence behaviour	[1,20, 23]				[18]							
Current Physical Activity Level	[23]		[26,29]								[8]	
Daily stress		[7]								[3]		
Distraction coping style					[18]							
Palliative coping style						[18]						
Instrumental coping style					[18]							
Negative cognitions and emotional experiences		[7]			[13]					[12]		
Social support and guidance	[5,6, 20,29]			[18]					[8, 28]		[28]	

Note: **+**, positive association; **-**, negative association; **NS**, no significant association; **I**, inconsistent evidence of association; [#], ID of study providing evidence; , strong overall evidence of association with adherence; , moderate overall evidence of association with adherence; , limited overall evidence of association with adherence.

3.3.3.1 **Perceptions of illness, condition or injury**

3.3.3.1.1 **Perceived symptom severity**

There was limited evidence of perceived severity as predictive of HBPT. Despite one study [17] investigating adherence to HBPT for sports injury, demonstrating a large positive relationship, no multivariate analysis was conducted to control for the effect of other variables, and three further studies [8,10,18] investigating musculoskeletal injury, upper-extremity injury and tendonitis-related injuries respectively, provided no evidence of association. One further study [27] demonstrated that physiotherapists' but not patients' estimates of adherence were positively associated with perceptions of severity in multivariate analyses. However, only the overall regression model was reported which does not provide information about the size of the association with perceived severity [27]. Amongst studies investigating predictors of adherence to home-based PFME therapy, potentially more objective symptom severity, in terms of frequency and severity of urine loss, was shown to be associated with adherence in three studies [1,3,9] but not in another [4]. However, it is not clear whether this more objective consideration of severity in terms of counting occurrences of symptoms is predictive of adherence amongst other patient populations.

3.3.3.1.2 **Perceived susceptibility**

Four studies investigated perceived susceptibility as a potential predictor of HBPT adherence. Two studies examining HBPT following tendonitis found positive associations ranging from small-moderate [18] to large [17]. A study examining sports-related injury [27] demonstrated mixed findings; physiotherapists' estimates of adherence (but not patients') were positively associated with perceived susceptibility, and completion of time-based recommendations (but not patient or physiotherapist adherence estimates) were independently predicted by perceived susceptibility in multivariate analyses. One large study (n = 293) of tailored exercises in older adults at risk from falls [25] found no association. The differences in findings between the previous studies and this latter one may relate to differences in participant age and the target of the intervention. Indeed, it has been suggested that older adults acknowledge their susceptibility to falling yet still view it as something that 'just happens' or is out of their control (Bunn, Dickinson, Barnett-Page, Mcinnes, & Horton, 2008).

3.3.3.1.3 Perceptions of physical health status

Patients' perceptions relating to their health status and functional ability were investigated by eight studies [4,8,12,13,19,24,25,26]. Four [12,19,24,26] provided evidence supporting an association with HBPT adherence. Greater perceived physical function [19] and physical health status [26] predicted better adherence to HBPT amongst post-menopausal women at high risk of osteoporosis [19], and older adults at risk of falls [26]. Both studies utilised validated measures of perceived quality of life and health status (SF-12 and SF-36: Ware Jr, Kosinski, & Keller, 1996; Ware Jr & Sherbourne, 1992). Negative perceptions of health status (including being in poor health, lack of strength, shortness of breath and having an existing illness or limitation) were negatively associated with adherence [12] or were self-reported as reasons for non-adherence [26]. Conversely, amongst older adults with osteoarthritis, higher levels of pain were positively associated with home exercise adherence [24], suggesting that pain acted as a motivator. Additionally, desires to improve health and functional ability were expressed by 82% and 75% of adults recovering from stroke, as motivators to adhere to home exercises [16]. However, 57% of these participants also reported undefined 'musculoskeletal issues' as a barrier to adhering. It is not clear, however, exactly what 'musculoskeletal issues' refer to; whilst this is likely to include pain, it seems a broader concept that may encapsulate other difficulties too.

Four studies found no evidence that overall health status [4], general physical function [8], limitations of daily living, self-perceived health [25] or perceived disability [13] were associated with adherence, amongst: females with urinary incontinence; older adults engaged in falls prevention interventions; adults with chronic low back pain; and adults engaged in various HBPTs for musculoskeletal injury.

3.3.3.2 Characteristics of, and perceptions about, therapy

3.3.3.2.1 Number of exercises

The number of exercises prescribed by a HBPT was investigated by three studies [7,8,20]. Two found that amongst patients undergoing HBPT post-ACL repair surgery [7] and those with chronic back pain [20], the more exercises prescribed, the less likely patients were to adhere to recommendations. Both studies controlled for other factors, and the similar association demonstrated across two different patient populations supports the generalisability of the findings. However, one [20] analysed only completed data which, as recognised by the authors, could potentially bias conclusions towards greater adherence as it is likely that many of those who did not complete the study were non-adherent. One study [8] found no evidence that the number of exercises was associated with patient's adherence to HBPTs for various musculoskeletal impairments.

Whilst there is some evidence that individuals prescribed a greater number of exercises tend to complete a lesser proportion of them, it does not necessarily follow that they are completing fewer exercises. For example, completing half of a set of ten exercises would involve completing more exercises than being fully adherent to four exercises. Therefore, although the number of exercises may negatively influence adherence, this may not necessarily have a detrimental effect on therapy outcomes. The number of exercises completed, rather than the proportion of prescribed exercise completed, is more significant for outcome.

3.3.3.2.2 **Attitudes towards therapy**

Three studies investigated factors relating to attitudes towards exercise therapy as predictors of adherence to HBPT amongst: women with urinary incontinence [9], individuals with tendonitis-related injuries [18] and adults undergoing osteopathic treatment [15]. Two [15,18] provided evidence of small to moderate associations with adherence, whereas one [9] suggested there to be no association. However, the two studies evidencing an association both used a single item measure, one of which [15] asked about attitudes more generally towards health, sports and exercise. The study which did not find an association utilised a validated 13-item measure of attitudes towards PFME therapy.

3.3.3.2.3 **Expectations of therapy outcome**

Of seven studies [8,9,10,17,18,27,28] investigating whether participants' perceived efficacy and benefits of their HBPT were associated with their adherence, only two [27,28] found limited evidence. Athletes with lower perceptions of the efficacy of their sports injury rehabilitation were less likely to spend the required amount of time completing their exercises as demonstrated by multivariate analyses. Physiotherapist estimates of adherence were associated with perceived efficacy but this did not remain significant in multivariate analyses. However, patient estimates of adherence were not associated with perceived efficacy in this same study. In a further study, a greater belief in benefits of home exercises for rheumatoid arthritis was positively associated with adherence [28]. However, this study relied on a very brief non-validated measure utilising single items to measure these constructs. Nevertheless, in support of outcome expectations predicting adherence, Forkan and colleagues [12] found that older adults endorsing an item suggesting they had low expectations of their home balance exercises were less likely to adhere. The item used to assess outcome expectation in this sample was from a pre-existing validated measure (Expected Outcomes for Habitual Exercise scale: Steinhardt & Dishman, 1989).

Conversely, five studies reported no associations with adherence when investigating perceived benefits of HBPT for musculoskeletal injury [8], upper extremity impairment [10] and urinary incontinence [9], and perceived efficacy of HBPT for tendonitis-related injury [17,18].

3.3.3.2.4 **Practicalities of conducting therapy**

Four studies provided evidence that certain practical barriers are associated with reduced levels of adherence to various HBPTs. Difficulties fitting the exercises in were independently predictive of poorer adherence amongst women engaged in PFME therapy [3], and associated with poorer adherence in adults with chronic neck and back pain [20] (but no longer significant in multivariate analyses). Furthermore, 15% of non-adherers to HBPT to reduce risk of falls [26], and 36% of all participants undergoing stroke rehabilitation [16] cited lack of time a barrier to adherence. Two studies [3,4] found that women reporting difficulties remembering to do their PFMEs were less likely to be adherent. One provided evidence of an independent predictive association [4], but whilst the other also demonstrated a negative relationship [3], this was no longer significant in multivariate analyses.

There is some evidence that finding the time to fit exercises in and remembering to do them is associated with how successful patients are in completing them. However, social-desirability responding could potentially mask genuine reasons for non-adherence in favour of those considered more ‘socially acceptable’. Rather than divulge real reasons, non-adherent participants may report those they feel are more socially acceptable barriers such as those described above. This may lead to an overestimation of those factors’ associations with adherence.

3.3.3.3 **Perceptions of ability to complete therapy**

Two aspects of participants’ perceptions regarding their ability to complete their HBPTs were investigated by twelve studies: perceptions of self-efficacy [1,4,9,10,11,17,18,20,27,29], and perceived behavioural control (PBC) [21,30]. The similarity between these constructs has previously been acknowledged (Ajzen, 1991) and as such, the findings pertaining to these factors are considered together. Ten of these studies [1,4,9,10,11,17,20,27,29,30] provided evidence of an association with adherence. Three [9,10,20] found that patients reporting higher self-efficacy were more likely to be adherent to HBPTs for chronic neck and back pain [20], upper limb impairments [10], and urinary incontinence [9], suggesting that the importance of self-efficacy for adherence is not limited to a specific patient population. Amongst individuals with sports injuries physiotherapist (but not patient) estimates of adherence were predicted by participants’ self-efficacy [27]. Once again, only the overall regression model was reported in this study which does not provide us with information about the size of the association with self-efficacy. In the other cases, these effects ranged from small [10,20] to large [9] but all remained significant in multivariate analyses.

A further five studies provided evidence of an association between patients' perceptions of their ability and their adherence to HBPTs for: urinary incontinence [1,4]; tendonitis-related injury [18]; musculoskeletal injury [29]; and dizziness [30]. However, these associations did not remain significant in multivariate analyses, suggesting that the other factors taken into account, including intention [1,30], previous adherence behaviour [1], difficulty remembering to do exercises [4], and practitioner-client relationship factors [29], were at least partially responsible for these effects.

However, one study demonstrated that, amongst individuals with a soft-tissue shoulder injury, whilst maintenance self-efficacy (confidence to continue with exercises over the period) was strongly associated with adherence, recovery self-efficacy (confidence in recovery from an adherence relapse) was not [11]. Two studies [17,21] found no association between perceptions of ability and adherence to HBPT amongst patients' taking part in home rehabilitation post ACL-repair surgery.

3.3.3.4 **Motivation and Intention**

3.3.3.4.1 **Intention to adhere**

Participants' intentions to complete their HBPT exercises were investigated by six studies [1,2,11,18,21,30]. All except one [1] found that those reporting higher intention were more likely to adhere across four patient groups: patients undergoing HBPT following ACL-repair surgery [18,21], patients with ankle sprains [2], patients with a soft-tissue shoulder injury [11] and patients carrying out HBPT to reduce dizziness [30]. The size of these effects varied; two [21,30] demonstrated large independent associations with intention, whereas three [2,11,18] demonstrated small to moderate effects which did not remain significant in multivariate analyses.

One study [1] found that women's intention to conduct their exercises was not associated with adherence to home-based PFME therapy. However, the authors note that the intention data were very positively skewed with small standard deviations which could potentially hinder statistical identification of a relationship between intention and adherence.

3.3.3.4.2 **Self-motivation**

Self-motivation refers to individuals' tendency to persevere with a behaviour in the absence of external drives (Dishman & Ickes, 1981). Patients' self-motivation to engage in their HBPT was investigated by four studies. Two demonstrated that higher self-motivation independently predicted greater adherence to HBPT for rehabilitation from ACL-repair surgery, accounting for between 23% [6] and 26% [5] of the variance in adherence behaviour. One [6] demonstrated that further predictive ability could be achieved by considering self-motivation's interaction with age; self-motivation was predictive of adherence only amongst older participants.

Two additional studies found small-moderate positive associations between self-motivation and home adherence amongst patients with musculoskeletal impairments [8] and those undergoing rehabilitation following ACL-repair surgery [18]. However, neither provided evidence of a multivariate association. All four studies employed the same validated and reliable measure of self-motivation. Consistent with this evidence, another study [19] reported that amongst women engaged in home exercises to reduce their risk of osteoporosis, 61% of those who withdrew cited lack of motivation as a reason for doing so. Similarly, 57% of stroke rehabilitation patients cited lack of motivation as a barrier to their home exercise adherence [16].

3.3.3.5 **Behaviours related to physical exercise therapy**

3.3.3.5.1 **Previous adherence behaviour**

Three studies [1,20,23] provided evidence that patients who had previously demonstrated good adherence to HBPTs [1,23], or who had not demonstrated poor adherence [20] were more likely to be adherent at the current time point. The generalisability of this finding is strengthened by the fact that the three studies involved different patient populations: older adults with osteoarthritis of the hip or knee [23]; women engaged in PFME therapy for urinary incontinence [1]; and patients undergoing HBPT for neck and low back pain [20]. All three demonstrated that previous adherence behaviour remained associated with adherence after other factors were accounted for, suggesting this to be an independent predictive association. Relatedly, an additional study [18] reported that habit (measured by participants' frequency of engagement in clinic-based activities across the whole rehabilitation period) significantly predicted adherence to home exercises amongst athletes with a tendonitis-related injury. A further study also reported that previous positive experiences relating to health, sport and exercise were associated with greater adherence to home rehabilitation exercises amongst those undergoing osteopathy treatment [15].

3.3.3.5.2 **Current Physical Activity Level**

Four studies [8,23,26,29] investigated whether participants' involvement in physical activity was associated with adherence, but only one [23] supported this. Amongst older adults with osteoarthritis, those reporting the highest levels of concurrent physical activity were much more likely to be adherent to their home exercises in weeks five to eight than those reporting the lowest levels [23]. Those who perceived themselves as physically inactive were also far less likely to be adherent. The authors acknowledge that this was not the case for weeks one to four, suggesting that these factors may only be predictive of longer-term adherence. These large effects were from multivariate analyses, suggesting that patients' perceptions of their physical activity levels were independently predictive of home exercise adherence.

However, three studies [8,26,29] found no evidence amongst patients' undertaking HBPT for various musculoskeletal impairments [8,29], nor older adults engaged in home exercises for falls prevention [26], that current activity level was associated with adherence. Variations in follow-up durations between studies may account for some differences in findings.

3.3.3.6 **Stress and coping**

Two studies [3,7] provided evidence that stress may act as a barrier to HBPT adherence. One [7] found that adults engaged in HBPT following ACL-repair surgery adhered less on days when they reported elevated stress. Furthermore, there was an interaction between daily stress and participants' athletic identity; on days when participants experienced low stress, level of athletic identity did not influence adherence rates, whereas on high-stress days, those strongly identifying as athletes were more likely to be adherent. Relatedly, Borello-France and colleagues [3] found a significant association between 'other barriers' and reduced levels of adherence amongst women engaged in home-based PFME therapy for urinary incontinence, with 'life stress' reported as one of these.

One study [18] found that both distraction coping and palliative coping were independently predictive of home adherence. Patients who avoided thinking excessively about their ACL injury (distraction coping) were more likely to be adherent to rehabilitation exercises. Conversely, those focused on alleviating the negative *consequences* of their injury (palliative coping) were less likely to be adherent. This study also found an association between instrumental coping and home exercise adherence, but multivariate analyses revealed that this was accounted for by other factors.

3.3.3.7 **Negative cognitions and emotional experiences**

Two studies provide evidence that negative cognitions and emotional experiences may act as barriers to HBPT adherence for rehabilitation from ACL-repair surgery [7] and impaired balance [12]. On days when participants reported negative mood, they completed a lower proportion of their home exercises [7]. Additionally, more pessimistic patients performed a smaller proportion of their exercises on days they experienced greater pain [7]. Both factors remained significant after other factors were accounted for suggesting an independent predictive association.

Feelings of depression interfering with exercise were also shown to be associated with reduced HBPT adherence [12]. Individuals reporting this were less likely to complete their exercises as those who did not report having trouble with their exercises whilst depressed. However, as this study did not conduct multivariate analyses, it is not possible to understand the nature of this relationship further. Conversely, a further study suggests that higher baseline distress was associated with a longer total training time at both four and 12 month follow-up amongst low back pain patients [13]. However, this was also not investigated using multivariate analyses.

3.3.3.8 **Social support and guidance**

3.3.3.8.1 **Guidance and advice from physiotherapist**

Five studies investigated the relationship between support from a physiotherapist and adherence to HBPTs for: rheumatoid arthritis [28]; musculoskeletal injury [8,29]; tendonitis-related injuries [18]; and neck and low back pain [20]. They provided evidence that participants were more likely to adhere to HBPT exercises when they were satisfied with their physiotherapist [8,20,29], received clarification of doubts and had questions answered [8,20], felt ‘stimulated’ or encouraged by the physiotherapist [28], had at least one instance of supervised exercises [8,20], and perceived that the physiotherapist appreciated what was required of them as a patient [18]. Evidence from multivariate analysis was mixed but demonstrated some support for all factors except ‘stimulation from physiotherapist’, which was only investigated in univariate analyses. The generalisability of these findings is supported by the range of therapies studied.

It should be considered, though, whether participants truthfully report any negative experiences of their physiotherapists if they perceive that the therapist might see this. In two studies [8,18], the relevant questionnaires were completed during clinic and so were potentially vulnerable to socially desirable responding which could bias the results in favour of more positive physiotherapist evaluations. One study did attempt to mitigate this effect by offering participants the opportunity to complete the questionnaire at home [8], and another two either sent the questionnaires by post a month later [20] or only contacted participants after discharge [28]. However, participants may still have had concerns about who would see the returned questionnaire that may have influenced their responding.

3.3.3.8.2 **Support from friends and family**

Four studies investigating HBPTs for: rehabilitation following ACL-repair surgery [5,6]; tendonitis-related injuries [18]; and neck and low back pain [20] demonstrated that emotional support

[5,18,20] and listening support from teammates, and personal assistance from family [18] were associated with greater home-exercise adherence. One study demonstrated an interaction between age and general social support such that higher levels of social support predicted greater adherence only amongst the oldest third of participants [6]. With the exception of emotional support from family and friends, for which analyses provided mixed results, all other factors remained significant in multivariate analyses. 50% of stroke rehabilitation patients also reported social support to be a motivating factor in adhering to their home rehabilitation therapy [16].

Conversely, one study suggested that encouragement from relatives was not associated with adherence to HBPT for rheumatoid arthritis [28]. However, this study relied on a very brief non-validated measure that only used a single item to measure this construct, and asked participants to recall information retrospectively.

3.3.4 Theoretical frameworks for adherence behaviour in home-based, self-managed physical therapies

Only one third of the included studies (n= 10) explicitly aimed to investigate the predictive ability of an existing psychological or behavioural theory in the context of adherence behaviour in HBPTs. Furthermore, within these ten studies, eight different theoretical models were investigated, meaning that there was little commonality regarding factors investigated as potential predictors of HBPT adherence. As such, an evaluation of each of the investigated theories would be based on empirical findings for such heterogeneous factors that it would be somewhat meaningless and difficult to draw conclusions from. Instead, the factors shown to demonstrate the strongest and most consistent evidence of association with adherence to HBPTs will be briefly discussed with reference to their support for theoretical frameworks explicitly investigated by these ten studies, but also suggestions as to other theories that could potentially better explain these findings. Table 5 summarises the eight models investigated by the studies included in the review.

Table 5 Summary of theories investigated by included studies

Model/ Theory	Summary of key points	Studies investigating this model
Theory of Planned Behaviour (TPB: Ajzen, 1991)	• Intentions to engage in a given behaviour are the most immediate determinants of that behaviour. • Intentions a product of three further factors: attitudes; subjective norms; and PBC.	Niven, Nevill, Sayers, and Cullen (2012) Yardley and Donovan-Hall (2007)
Adapted Model of Planned Behaviour (AMPB: Levy et al., 2008)	Two stages of behaviour change: • Initiation: decision making stage characterised by primary factors (e.g. attitude, threat appraisal) that influence formation of behavioural intentions which, in turn, influence behaviour. • Maintenance: underpinned by secondary factors (e.g. social support, coping ability) that are directly involved in initiating behaviour.	Levy et al. (2008)
Attitude-Social Influence-Self-Efficacy Model (ASE: de Vries, Dijkstra, & Kuhlman, 1988)	• Behavioural intention as best predictor of behavioural change. • Intention is determined by three types of proximal cognitive factors: attitudes, social influences and self-efficacy expectations. • Sociodemographic, psychological, sociocultural and medical variables influence intention via the proximal variables. • Barriers and skills impact on the performance of the behaviour itself.	Alewijnse, Mesters, Metsemakers, and Van Den Borne (2003)
Model of Human Occupation (MOHO: Kielhofner & Burke, 1980)	Three subsystems determine behaviour: • the volitional subsystem, including perceptions of personal causation, values and interests • the performance subsystem, in which individuals' skills are important • the habituation subsystem in which patient's roles and habits are expected to influence behaviour.	Chen, Neufeld, Feely, and Skinner (1999)

Integrated Model of Response to Sport Injury (IMSRI: Wiese-Bjornstal, Smith, Shaffer, & Morrey, 1998)	• Behavioural responses to injury influenced by: stable characteristics of the individual (e.g. personality) and also by more fleeting cognitive and emotional responses to everyday living. • These personal and situational factors are proposed to induce cognitive and emotional responses which, in turn, impact upon behavioural responses.	Brewer, Cornelius, Van Raalte, Tennen, and Armeli (2013)
Protection Motivation Theory (PMT: Maddux & Rogers, 1983; Rogers, 1975)	Four cognitive appraisal processes are commonly considered in fear-arousing situations. These are: • perceptions of the severity of a potentially harmful situation; • perceptions of susceptibility to harm; • perceptions of how likely a given course of action is to reduce or prevent the threat; • perceptions of one's own ability to perform the given actions (self-efficacy). • These cognitive process impact upon intentions which, in turn, are proposed to influence behaviour.	Taylor and May (1996) Bassett and Prapavessis (2011)
Health Action Process Approach (HAPA: Schwarzer, 1992)	• Initiation, adoption and maintenance of health behaviours involves motivational and volitional phase. • Motivation phase is when intention is formed • Volitional phase is when planning and action occurs • Perceived self-efficacy a key determinant at each stage	Clark and Bassett (2014)
Social Cognitive Theory (SCT: Bandura, 1986)	• Personal, behavioural and environmental factors causally interact, in a model of 'triadic reciprocal causation', to determine likelihood of individual performing a given behaviour. • Self-efficacy and outcome expectancies as key behavioural determinants (see section 1.5.2.4.1, page 20).	Hardage et al. (2007)

Based on the review of the included studies' findings, five factors in particular demonstrate relatively strong and consistent evidence of their ability to predict adherence to HBPTs. These were: intention to engage in the HBPT; self-motivation; self-efficacy; previous adherence to exercise-related behaviours; and social support.

In terms of the eight theoretical models investigated by the studies included in this review, the overall findings provided limited support for the MOHO, the IMRSI or PMT in terms of their ability to predict adherence to HBPTs. Two of these models (MOHO and IMSRI) were only investigated by one study each and so it was often only these individual studies that investigated, let alone provided evidence for, their relevant constructs.

However, certain constructs of these models were well supported by the findings; for example, self-efficacy is proposed to be part of the coping-appraisal process within PMT and, furthermore, the model proposes that the threat and coping appraisal processes influence intentions which in turn influence behaviour (Maddux & Rogers, 1983; Rogers, 1975). Within the MOHO, self-efficacy is also proposed to be an element of the personal causation aspect of the volition subsystem and previous behaviours are also thought to play a role in influencing behaviour via the habituation subsystem (Kielhofner & Burke, 1980). As such, these elements of the MOHO can be seen to be supported by these findings that self-efficacy and previous behaviours appear to predict adherence to HBPTs.

There appears to be greater supporting evidence for the predictive ability of the five additional theoretical models investigated by studies in this review: TPB, AMPB, ASE, SCT and HAPA. In contrast to the three previously-discussed models, this greater support may stem from the similarity and overlap in constructs between the models; this is less surprising given that the ASE and AMPB are derived from the TPB itself, and that the HAPA is proposed to draw upon SCT. This overlap in constructs between the models meant that more evidence was provided relating to these models' relevant constructs.

Several overlapping constructs between SCT and the HAPA are supported by the findings of this review. For example, SCT proposes that individuals' cognitive factors including self-efficacy and intentions, in combination with environmental factors including social support, influence the extent to which behaviour is likely to occur (Bandura, 1986, 1989a). HAPA similarly recognises the central role of self-efficacy and behavioural intentions in predicting behaviour, and also identifies perceived social support as an element of the 'perceived or actual environment' which influence action (Schwarzer, 1992). However, both models propose outcome expectancies to be an important behavioural determinant, which is less supported by the present findings.

A number of constructs of the TPB model were also well supported by the findings of this review. For example, the model proposes that behavioural intentions impact on behaviour, and that PBC influences behaviour directly and via its influence on behavioural intentions (Ajzen, 1985). As such, the finding that intention appeared to predict adherence behaviour supports the utility of the TPB in understanding adherence to HBPT. Furthermore, the strong evidence for the role of self-efficacy in predicting adherence behaviour and the similarity of this construct with PBC (Ajzen, 1991) would suggest that this element of the model could also contribute to its predictive ability in this context. The authors of one study investigating the TPB concluded that their findings supported "the relevance of the TPB in understanding and predicting adherence to exercise therapy in the clinical context of undertaking rehabilitation for dizziness" ([21], p. 61) but also noted that it could not account for all variance in adherence behaviour. This suggests that consideration of other constructs is required to account for further variation.

In support of this suggestion, the evidence from this review would seem to best support the predictive ability of the two models that are based on the TPB but also incorporate additional factors as constructs within the model. For example, the ASE's supposition that self-efficacy and social influence (including an element of social support) impact on intention, which in turn impacts on behaviour, is very much supported by the findings that self-efficacy, intentions and social support appear the be the strongest predictors of adherence to HBPTs. The model also proposes that barriers can influence the relationship between intention and behaviours (de Vries, Dijkstra, & Kuhlman, 1988). Although mixed, there was some evidence from the review that certain barriers, such as not having time and forgetting, were associated with participants' adherence to their HBPTs.

The constructs of the AMPB are also well supported by the findings of the review. The model proposes that self-efficacy and self-motivation, alongside primary factors such as attitudes and threat appraisals act as cues to decision regarding individuals' intentions to adhere. The model suggests that intentions then influence behaviour which is also influenced by secondary factors including social support and habit (Levy et al., 2008). Although the findings of the review do not provide strong support for some constructs of the model, e.g. threat appraisals, perceived treatment efficacy etc., all five of the factors that emerged as the strongest predictors of adherence to HBPTs are included as constructs in this model. This would suggest that the predictive ability of this model for adherence behaviour in this context is relatively good.

In addition to those theoretical models investigated by studies within this review, it should also be considered that these findings may better support other models and frameworks as predictors of adherence to HBPTs. For example, Self-Determination Theory (SDT: Deci & Ryan, 2000; Ryan &

Deci, 2000) proposes that intrinsic motivation, stemming from internal perceptions of the importance, value and interest in the target behaviour, is more likely to result in persistent performance than extrinsic motivation, resulting from external sources of coercion and feelings of obligation (Ryan & Deci, 2000). Intrinsic motivation itself is proposed to be influenced by perceptions of competence, autonomy and relatedness. The fact that self-motivation emerged as such a strong predictor of adherence to HBPTs would suggest that SDT may be a good framework for understanding adherence behaviour in this context. Furthermore, the evidence for the roles of self-efficacy, social-support and previous behaviours may also provide support for the model's proposed influence of competence and relatedness perceptions on intrinsic motivation.

In summary, the lack of consistency with regard to: whether included studies investigated a specific theoretical model; the models that were investigated by included studies; and, therefore, the factors investigated as potential predictors of adherence, very much limit the conclusions that can be drawn about the models' predictive ability with respect to HBPT adherence. Given their inclusion of constructs related to many of the five factors emerging as the strongest predictors of adherence to HBPTs, those models derived from the TPB appeared to receive the greatest support as predictive frameworks in this context. However, it should also be considered that other theories not investigated by studies in this review, such as SDT, may better predict adherence to HBPTs.

3.4 Discussion

There was relatively strong evidence that the following factors predicted adherence to HBPTs: intention to engage in the HBPT, self-motivation, self-efficacy, previous adherence to exercise-related behaviours, and social support. However, robust conclusions about the predictive ability of these factors were significantly challenged by the limited number of studies investigating many factors, studies' methodological limitations, variations in concept definition and operationalisation, and discrepancies between findings. Of particular note is the problematic measurement of home exercise adherence. The lack of validated and standardised methods (Bollen et al., 2014) pose a real methodological limitation within this field of research and make it very challenging to compare across findings of studies.

3.4.1 Predicting adherence to home-based physical therapies

Self-efficacy emerged from the review as a strong predictor of adherence to HBPTs. Given that self-efficacy refers to individuals' confidence in their ability to complete a given task (Bandura, 1977), in a situation that is reliant predominantly upon their own skills and knowledge, it is perhaps not surprising that patients' self-efficacy is predictive of the extent to which they continue with their HBPT. Greater self-efficacy allows individuals to overcome challenges with greater ease (Sniehotta et al., 2005) which, again, seems especially important whilst individuals are engaged in therapies without professional supervision. Several reviews have similarly reported that individuals with greater self-efficacy tend to be more adherent to outpatient physical therapy (Jack, McLean, Moffett, & Gardiner, 2010), cardiac rehabilitation and general exercise recommendations (Martin & Sinden, 2001; Slovinec D'Angelo, Pelletier, Reid, & Huta, 2014).

Higher self-motivation and greater intention to complete HBPT exercises also emerged as strong predictors of greater adherence to HBPTs. Given the self-managed nature of physical therapy programmes considered, it is perhaps to be expected that greater intention and self-motivation were predictive of adherent behaviour. Self-Determination Theory (SDT: Deci & Ryan, 2000; Ryan & Deci, 2000) postulates that intrinsic motivation, stemming from internal perceptions of the importance, value and interest in the target behaviour, is more likely to result in persistent performance than extrinsic motivation, resulting from external sources of coercion and feelings of obligation (Ryan & Deci, 2000). In a self-managed therapy programme relatively free of external motivators, individuals reporting higher intentions and self-motivation are likely to have comparatively high intrinsic motivation and, therefore, should be most likely to adhere. These findings are also concordant with theoretical models and empirical findings in related areas of study. Certain theoretical models propose that intentions are the most immediate determinant of behaviour (e.g. Theory of Planned Behaviour (TPB): Ajzen, 1991) and empirical findings have also demonstrated intentions to be predictive of treatment-related exercise adherence (Courneya, Friedenreich, Arthur, & Bobick, 1999). Self-motivation has also been shown to be independently predictive of adherence to sports rehabilitation therapies (Duda, Smart, & Tappe, 1989; Fields, Murphey, Horodyski, & Stopka, 1995; Fisher, 1988) and cardiac rehabilitation therapies (Daly et al., 2002; Slovinec D'Angelo et al., 2014).

Previous adherence behaviour emerged as a further strong predictor of adherence to HBPT exercises. If an individual has successfully completed similar behaviours before, this is likely to increase their perceptions of competence (McAuley, 1993), and therefore their likelihood of conducting the behaviour again. Furthermore, increased perceptions of exercise competence are likely to enhance interest in the behaviour (McAuley, 1993), which in turn may increase intrinsic motivation and the likelihood of persistence. In support of these findings regarding previous adherence behaviour, a systematic review of adherence to outpatient physical therapies (Jack et al., 2010) similarly revealed that greater past adherence behaviour is predictive of higher current adherence. Other empirical findings have revealed similar results amongst chronic back pain sufferers (Carroll & Whyte, 2003) and individuals with Rheumatoid Arthritis (Iversen et al., 2004). Rejeski and colleagues (Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997) also concluded that a patient's history of adherence to home exercises may be indicative of future performance.

A final factor emerging from this review as a strong predictor of adherence to HBPTs was that of social support. Social support is believed to facilitate adherence via encouraging optimism and self-esteem, buffering stresses of illness, reducing depression and giving practical assistance (Shumaker & Hill, 1991; Wallston, Alagna, DeVellis, & DeVellis, 1983). The review's findings in this regard are in line with previous reviews of adherence to medical treatments in general (DiMatteo, 2004) and, more specifically, outpatient physiotherapy (Jack et al., 2010), which also demonstrated greater levels of support to be associated with greater adherence.

3.4.2 The role of theory in understanding adherence to home-based physical therapies

The extent to which eight psychological theories were useful predictive frameworks of HBPT adherence was investigated by evaluating how well the empirical findings supported their various constructs. However, several issues make it difficult to draw succinct conclusions regarding which may be of greatest predictive ability. The heterogeneity of studies' theoretical approaches meant that only two theoretical models were investigated by more than one study. Although other studies could provide evidence for individual constructs of the various models, this was not necessarily sufficient to provide evidence for models as a whole, as they did not contribute evidence regarding the relationships between models' constructs. A further complication was that so many of the models have common constructs (e.g. intention, attitudes, self-efficacy, perceived susceptibility), that whilst empirical evidence regarding the predictive ability of intention supports the TPB (Ajzen, 1985, 1991), it also supports the AMPB (Levy et al., 2008), the ASE (de Vries et al., 1988) and PMT (Rogers, 1975), SCT (Bandura, 1986) and HAPA (Schwarzer, 1992).

A common feature of the majority of investigated models was that behavioural intentions featured as a central construct with a direct influence upon behaviour. Given that empirical evidence provided substantial support for intentions as predictive of HBPT adherence, it could be concluded that this is an important central feature of models attempting to predict adherence behaviours in this context. It should also be noted that whilst only two studies examined the TPB as an explanatory framework [21,30], two additional studies [1,18] investigated theoretical models closely based on the TPB: the AMPB and the ASE. Collectively, there was a great deal of support for the majority of constructs in these models; indeed, the AMPB contains all five of the factors emerging as the strongest predictors of adherence to HBPTs. The addition of extra constructs such as habit and self-motivation appeared to account for an additional proportion of the variance in HBPT adherence compared to the TPB.

Until a greater proportion of studies investigating predictors of HBPT adherence are theory-driven, it is hard to obtain strong evidence for the predictive ability of particular models over others. In the meantime, we can conclude that models such as the AMPB including constructs such as intention, social-support, self-efficacy, self-motivation and previous behaviour are likely to predict the greatest proportions of variance in HBPT adherence.

3.4.3 Limitations of the review

Only published full-text English language articles were included which may have introduced a publication bias as unpublished studies may be more likely to have reported null-findings. It might also be considered that the review did not give sufficient consideration to variations in adherence measures between studies. Given that the review considered a broad range of different HBPTs with differing patient-population characteristics, making full consideration of different adherence measures would have added further complexity to the synthesis and may have limited conclusions further. The fact that some predictors are differentially associated with adherence depending on whether frequency, intensity, duration or proportion of recommendations completed is measured, suggests that this need to be considered in future (Martin, Bowen, Dunbar-Jacob, & Perri, 2000).

The heterogeneity of the HBPTs included within the review, and the associated variations in both therapy and patient characteristics, may also be considered a limitation of the synthesis and interpretation of findings across studies. However, the review intended to take a broad overview of self-managed rehabilitation therapies to understand whether there are factors predictive of adherence to self-managed physical rehabilitation regardless of the specific focus of the therapy. As such, it seemed important to consider a broad range of self-managed therapies. The nature and duration of HBPTs, as well as characteristics of specific patient populations, are likely to be influential in adherence. Additional reviews with narrower, perhaps condition-specific, focus could potentially investigate whether predictors of adherence are specific to particular therapy types or patient subgroups. Similar reviews investigating intervention-related factors for adherence in musculoskeletal pain (Jordan, Holden, Mason, & Foster, 2010) and, more specifically, chronic low back pain (Beinart, Goodchild, Weinman, Ayis, & Godfrey, 2013) have already been conducted.

3.4.4 Implications

3.4.4.1 Implications for research

Further research could look to clarify the nature of the relationships between HBPT adherence and each of the five factors identified as consistent predictors; i.e. whether there are certain groups of people or circumstances for which these predictors are especially strong, and whether other factors mediate or moderate the relationship. In conjunction with the growing behaviour change technique literature, e.g. (Michie et al., 2008), these findings could help to inform the most effective ways to increase adherence to new HBPT interventions. Having provided evidence regarding the most important determinants of adherence behaviour to target in this context, this could guide the appropriate choice of behaviour change techniques for implementation in these interventions. Finally, future research should aim to address the discussed methodological limitations – particularly issues relating to the measurement of home based exercise adherence - to provide more robust support for predictors of adherence to HBPTs.

3.4.4.1.1 Implications for this thesis

This review has provided valuable insight into the likely predictors of adherence to the VR exercises that participants in the Balance Retraining intervention will be required to complete. This understanding is valuable for confirming that the intervention's planned focus on facilitating self-efficacy and intrinsic motivation are important aspects of helping these individuals to achieve the target behaviour. It has also highlighted additional factors that appear influential in adherence behaviour in this context which are likely to be valuable in understanding outcomes when these are evaluated in subsequent studies.

3.4.4.2 Implications for practice

The findings of this review have implications for practitioners instigating HBPT regimes with patients. Given that greater self-efficacy, self-motivation, social support, intentions and previous adherence to physical therapies appear to predict higher adherence to HBPTs, prior assessment of these domains may identify any 'risk factors' for poor adherence. With regard to social-support and self-motivation, these assessments may be especially important amongst older adults given the findings that their adherence is more likely to be influenced by these factors. Furthermore, HBPT interventions could include elements designed to target self-efficacy and self-motivation to improve adherence to HBPTs. It has previously been suggested that strategies such as agreeing realistic expectations (Jensen & Lorish, 1994), setting treatment goals (Evans & Hardy, 2002), action planning (Sniehotta et al., 2005), and positive reinforcement (Göhner & Schlicht, 2006) may help increase patient self-efficacy. Interventions to increase self-efficacy can effectively reduce non-adherence to exercise programmes (McAuley, Courneya, Rudolph, & Lox, 1994).

3.4.5 Conclusions

This systematic review has found that intention to engage in HBPTs, self-motivation, self-efficacy, previous adherence behaviour, and social support appear to be strong predictors of HBPT adherence. Understanding these predictors provides greater scope for researchers and practitioners to improve adherence through intervention design and implementation targeted at enhancing facilitators and minimising barriers to adherence. Having also given consideration to the potential theoretical underpinnings of adherence behaviour, the review has highlighted the need for more theory-driven research to fully understand the relative importance of various theories for predicting behaviour in this context. Finally, the review identified predictors of adherence behaviour in a self-managed context that are still not fully understood; in noting the contradictory findings and methodological limitations, the review has highlighted areas for further research.

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Chapter 4: Older Adults’ Experiences of the Balance Retraining Intervention: a Longitudinal Qualitative Study

4.1 Brief introduction and rationale

As reported in the systematic review in Chapter 3, quantitative studies have provided evidence that a variety of factors, including psycho-social (e.g. self-motivation, social support, self-efficacy: Brewer et al., 2003; Brewer et al., 2000; Chen et al., 1999), situational (e.g. finding time and remembering to complete exercises: Borello-France et al., 2010) and condition-related (e.g. symptom severity, co-morbidities: Alewijnse et al., 2003; Forkan et al., 2006), are predictive of adherence to self-managed physical therapy exercises. However, there is much contradiction and inconsistency in results across studies; indeed, this was a major finding of this review (Essery, Geraghty, Kirby, & Yardley, 2016).

Previous qualitative research has recognised the importance of seeking patients’ experiences and attitudes of engaging in healthcare interventions for improving understanding of their decisions about adherence to treatment recommendations, and their perceptions of barriers and facilitators (Campbell et al., 2001; Medina-Mirapeix, Escolar-Reina, Gascón-Cánovas, Montilla-Herrador, & Collins, 2009). This more holistic perspective of the patient’s experience of therapy may allow a better understanding of *how* and *why* certain factors influence adherence and the perceived importance or relevance of these for the individuals themselves. Understanding the mechanisms through which these factors help or hinder an individual would be valuable for knowing how best to improve adherence behaviour within the context of the Balance Retraining intervention to maximise beneficial outcomes.

A small amount of qualitative work has examined patients’ experiences of their self-managed physical therapies and has provided some insight into their perceptions about their own adherence behaviours. Medina-Mirapeix, Escolar-Reina, Gascan-Cnovas, et al. (2009), for example, reported that patients with chronic neck or back pain perceived their adherence to be associated with their degree of pain such that, when they were in greater pain, they felt more need to complete their home exercises. However, when pain started to decrease, they talked about having to make a decision about whether to exercise and, often, other perceptions relating to barriers, social support and their physical environment would then interfere with their intention to continue (Medina-Mirapeix, Escolar-Reina, Gascan-Cnovas, et al., 2009). This illustrates the value of qualitative research in fully understanding the mechanisms through which these factors impact on adherence. A further qualitative study of patients' experiences of self-managed home physiotherapy for osteoarthritis suggested that patient decisions about adherence to recommendations in the initial stages of a programme were made on the basis of different perceptions and experiences to those made later on (Campbell et al., 2001). This illustrates that factors influencing patients' adherence may not always be perceived as important at any given time and that the salience of various factors can change across individuals' participation in the programme. It would be valuable, then, to investigate participants' experiences and perceptions of their self-managed therapy at multiple stages throughout their programme. Rather than a 'snapshot' of their experience, this would provide an understanding of how their experiences and perceptions may change with continued participation.

Further investigating experiences of self-managed physical rehabilitation therapy within this context will build upon existing understandings of patients' perceptions of their adherence to self-managed physical therapies. Very little research to date has considered the role that a supporting intervention, particularly an online one, might play in patients' experiences of self-managed therapies and how they might perceive this to relate to their adherence (Donkin & Glozier, 2012; Gerhards et al., 2011). A recent qualitative study of patients engaged in home-based, booklet-guided VRT with physiotherapist telephone support, reported that participants recognised the support and positive attitude of their therapist as contributing to their perseverance with their exercises (Muller et al., 2015). Whether a standalone intervention in an online format would be perceived as similarly supportive is unclear. An additional qualitative study has explored perceptions of an online support intervention for depressive symptoms in those with cardiovascular risk (Donkin & Glozier, 2012). It showed that participants who continued with their programme tended to recognise external motivators that assisted them with developing and maintaining new behaviours and attributed some of these to the online programme itself. Features of online interventions do appear to be perceived as facilitative of adherence but further research is required in the context of a self-managed physical therapy programme.

4.1.1 Aims of the study

The present study qualitatively investigates older adults' experiences of engaging in a self-managed programme of VR exercises supported by an online intervention over a period of six weeks. In doing so, the aim is to gain a greater understanding of: how older adults experience self-managed VR supported by an online intervention; participants' perceptions of what may help or hinder their adherence to self-managed VRT; and how participants' experiences changed over the duration of the programme. This user-perspective of the Balance Retraining intervention will provide valuable insight into reasoning and motivation underlying their engagement with the intervention. This insight is important for a comprehensive understanding of user outcomes.

4.2 Methods

4.2.1 Design

This study was a longitudinal qualitative interview study conducted via telephone with adults aged fifty and over from the south of England. These adults were trialling the prototype of the Balance Retraining self-management intervention for dizziness. Interviews were conducted at two-week intervals for a period of six weeks.

4.2.2 Recruitment

Purposive sampling was employed to recruit individuals aged 50 and over who currently experienced vestibular-related dizziness symptoms, and were able to access an online self-management intervention. Purposive sampling is a form of non-probability sampling in which the sample is selected on the basis of having certain characteristics relevant to the objectives of the study (Coolican, 2014). Accordingly, it was a useful means of recruiting the present participants given the multiple selection criteria applicable, i.e. aged 50 or over, specific symptom-requirements, access to internet.

There were three recruitment sources: NHS primary care, The Meniere's Society (a UK charity supporting individuals with balance disorders), and the University of Southampton's Psychology Participant Volunteer Pool. Within the NHS recruitment arm, three GP practices in Hampshire were identified by the local Primary Care Research Network (PCRN) to participate in the study. Each conducted a search of their patient databases according to specified criteria provided by the research team to identify patients with relevant characteristics. The lists of patients matching initial database searches were screened by GPs to exclude any who were not suitable candidates for medical reasons or if they did not speak, read or write English. Full details of suggested database search terms and exclusion criteria are detailed in Appendix B.

Non-excluded matching patients were posted a pack including a written invitation to the study, a participant information sheet and a freepost reply envelope (Appendix H). The invitation letter included a tear-off reply slip that patients could return to indicate interest in participation and to arrange a suitable time for an initial telephone call. The letter also included the email address and contact telephone number for patients to make contact with the researcher if they preferred.

Those indicating interest were contacted by the research team via telephone to ensure that: they experienced ongoing dizziness; that their dizziness tended to be exacerbated by head movements; that they did not have neck pain or injury that would prevent them from conducting VR exercises; and finally that they had access to the internet. If they satisfied all criteria, patients were informed that they were eligible to take part and given the opportunity to ask questions. If happy to participate, patients were then provided with the hyperlink to the online intervention via email, along with instructions about how to access this and information about the telephone interviews they would be asked to take part in (Appendix I). The first webpage they accessed upon signing up to the intervention was a consent form (Appendix J) which they had to complete before being able to progress.

The recruitment procedure via The Meniere's Society included a number of additional steps to ensure potential participants' medical safety and agreement of their GPs. They conducted a search of their members' database for individuals within Hampshire aged 50 and above and contacted these individuals via letter or email with details of the study. Any members expressing an interest and giving permission for their contact details to be passed on were sent a mail-out pack direct from the research team. This pack was similar to those provided to NHS patients but with the addition of a letter for the individual's GP explaining what the study would involve (Appendix K). Those who contacted the study team then had the same screening call and, if eligible, were emailed the hyperlink to access the intervention. On accessing the intervention, they viewed a consent form with an additional question necessitating them to confirm they had consulted their GP before allowing them to proceed (Appendix L).

Finally, the researcher emailed (Appendix M) 40 members of the University of Southampton's Psychology Volunteer Participant Pool. These 40 members were selected on the basis of being 50 years old or over; having a contact email-address (required for the study); living in the local area; and not having been contacted to participate in research for the previous year. The email detailed the study and asked anyone who experienced dizziness symptoms with an interest in taking part to reply via email or telephone. Anyone expressing an interest was sent a mail-out pack enclosing the same documentation as sent to the Meniere's Society respondents. The remainder of the recruitment process followed the same procedures as documented above.

4.2.3 Procedure

Participants were provided with access to a full prototype version of the Balance Retraining online intervention that they were asked to access at least once per week for the six week duration of the study. The intervention is fully described in section 1.6, page 24. When participants accessed the first online session, the researcher emailed them to arrange a convenient time for their first telephone interview (see section 2.5.2.1.1, page 48). This was suggested to be two weeks from the date of the email although exact times were decided in discussion with the participant.

Participants took part in a minimum of one, and up to three, semi-structured telephone interviews with either the researcher (RE) or another member of the research team. Each participant was interviewed by the same researcher for all of their interviews. At the beginning of each call, the interviewer reintroduced themselves, confirmed participants' continued consent and reminded them of information relevant to the interview procedure before beginning the audio-recording.

More general details of the qualitative interview procedure were outlined in section 2.5.2.1, page 47. Each interview comprised a series of open-ended questions which addressed participants' experiences of using the Balance Retraining intervention and of practising VR exercises. Interview one asked about participants' existing management of their dizziness, their expectations about the Balance Retraining intervention and initial experiences of engaging with it, any features they had found especially difficult or especially helpful, concerns they might have about continuing, and finally, their overall initial impressions. Interviews two and three asked participants about how they had got on with Balance Retraining since the last interview and again asked them about how they were managing their dizziness, any particularly helpful features, difficulties and concerns. Interview three also asked about participants overall experience of the intervention and anything they felt they had learned (see Appendix N for interview schedules). By asking similar questions at all three time points, the researcher aimed identify patterns or changes over the course of individuals' participation in the programme.

Recruitment continued until data saturation had been reached (see 2.5.2.1, page 47) and audio-recorded interviews were transcribed and checked. Participants were posted a £10 high street voucher at the end of the study as a token of thanks for their time and effort.

4.2.4 Analysis

A thematic analysis of the data was carried out according to guidance set out by Braun and Clarke (2006) with the addition of constant comparison and memoing techniques advocated by grounded theory (Glaser & Strauss, 1967). This approach to analysis was discussed in detail in section 2.6.2.1, page 51.

The researcher first coded across all interview one transcripts before moving on to interview two, and then interview three. The emerging themes and subthemes were discussed and agreed with the researcher's supervisory team. The coding manual (Appendix O) illustrates the structure and definitions of the final themes, subthemes and their corresponding codes.

Constant comparison (Glaser & Strauss, 1967) techniques further explored patterns in the thematic codes across interview phases and certain participant characteristics. NVivo software was used to examine the frequency of occurrences of thematic codes across interview phases, age and gender of participants. However, it became apparent that there was not sufficient variation in the ages of participants to make any meaningful comments about variations in perceptions based on this characteristic (i.e. only five of eighteen participants were under sixty-five). As such, these differences were not further investigated. Despite this, the analysis provided a sense of how often, and from how many participants, certain codes were arising at different stages during the six week period as a possible reflection of how important, relevant or salient these elements were to participants at those times. It also gave an idea of whether experiences and perceptions seemed to vary substantially between men and women. Any patterns identified are discussed in the findings under the relevant theme, each of which will be discussed.

4.3 Results

4.3.1 Participants

A total of 18 participants were recruited; 10 from primary care, four from the Meniere's Society, and four from the University of Southampton's Psychology Volunteer Participant Pool. Eleven participants were women. Participants ranged between 50 and 79 years with a mean age of 66.5 years (SD = 9.15 years). The mean reported duration of dizziness symptoms was 4.75 years (SD = 7.41 years) and ranged between two months and 25 years and two months. All participants took part in the first interview, fifteen took part in the second interview and fourteen were still participating by the third interview. During the interviews it became apparent that two participants, both recruited via the Meniere's Society, had previously had access to the booklet version of Balance Retraining from which the online intervention content had been adapted. This did not exclude them from participation and provided some valuable insight into perceptions of the booklet compared to the online intervention.

4.3.2 Overview of findings

The thematic analysis of the resulting 47 transcripts (18 Interview one, 15 Interview two, 14 Interview three) gave rise to 51 codes. These were organised into four common themes encompassing 15 subthemes. The four themes arising as common to respondents’ experiences of engaging in the programme were: users’ perceptions of the Balance Retraining intervention; facilitators of users’ engagement; the difficulties users faced in engaging; and finally, their management of dizziness. The structure of each theme, including its subthemes and corresponding codes, is illustrated in Table 6.

Within each theme, patterns and discrepancies regarding participants’ experiences are discussed and illustrated with direct quotes. The findings are presented, as much as possible, in participants’ own words. Participants’ gender, age and interview phase is indicated alongside their participant ID after any direct quotes.

Table 6 Summary of themes arising from analysis

Theme	Subthemes	Codes Included
Perceptions of Balance Retraining intervention	Acts as a reminder	• ability to revisit content helpful • printing facility a useful function
	Informative and educational	• 'symptom control techniques' offer additional management strategies • video demonstrations offer additional clarity
	Reassurance and support	• human contact important • intervention as support and reassurance • personalised feedback encouraging • 'retraining stories' reassuring
	Usability	• ease of use • familiarising process • level of engagement
	Presentation and style	• amount of information • manageable and accessible information presentation • perceptions of appearance • tone of the intervention
Facilitators of engagement with Balance Retraining	Motivation to continue	• can see relevance to real life • perceived improvement as encouragement to continue • social facilitation • wanting to be helpful
	Helping self to succeed	• setting an exercise routine • strategies to manage exercises • importance of doing something to help oneself • need to challenge myself • need to be disciplined • willing to persevere
	Intervention as facilitator	• intervention as motivation and structure • simplicity of programme

Difficulties engaging with Balance Retraining	Practicalities	• difficulty remembering • find exercises difficult or unclear • illness, injury or pain as barrier to adherence • life comes before exercises • technical problems
	Doubts about exercises	• uncertain exercises responsible for improvement • worries and concerns about exercises
	Symptoms worse/not improved	• negative effects of exercises • not noticed improvement
Managing Dizziness	Strategies employed	• medical advice and treatment • implementing new strategies • symptom acceptance
	Acknowledging change	• building confidence in managing dizziness • reduced worry • more knowledgeable and skilled • raising consciousness • greater control and ability to manage symptoms
	Looking ahead	• recovery as process not immediate • long-term exercise intention • optimism for self and others

4.3.3 Perceptions of Balance Retraining

This theme summarises a broad range of perceptions about the Balance Retraining intervention including the content being informative and educational, the intervention acting as a reminder, providing reassurance and support, and perceptions about its ease of use and presentation style.

Participants discussed their perceptions of the Balance Retraining intervention throughout the duration of the programme. However, perceptions more focused on appearance-related issues tended to be raised more frequently, and by a larger proportion of participants, in the early stages of the programme rather than later on.

4.3.3.1 **Balance Retraining as informative and educational**

Participants expressed, nearly unanimously, that the intervention provided new information and equipped them with new skills. The audio-visual demonstrations of the exercises and the symptom control techniques in particular were frequently cited as contributing to this. These were discussed as elements of the intervention that added to users' knowledge of how to manage dizziness or clarified details about how to do so.

The exercise demonstration videos were described as 'immensely helpful', and 'valuable' features. Participants found these informative in terms of confirming written exercise instructions and clarifying uncertainties about exactly how to carry out the exercises. They noted how having the visual demonstration added something that they might not have taken from the written instructions alone:

> "…and I certainly found the little video, with actually seeing somebody do it, very helpful, because like the nodding one, you know, the head up and down, I wouldn't have put my head that far back. […]. So that's very good in that respect because, you know, then you know exactly what to do, rather than perhaps misinterpreting it with just written instructions." (P204, F, 70, Interview 1)

The videos also appeared to be something that participants felt they could refer back to as a reminder and to check they were still doing the exercises correctly; one participant described them as a form of gold-standard to compare herself to:

> "I sometimes have to go over it, for instance, if I'm doing my stare nod or whatever, shake stare, nod stare, then I go over because sometimes I think, 'Oh, I'm not looking at it,' or turning my head at the right angle, and just looking on the video that refreshes me. […] .

> So the video gives me the very good example which I try and aspire to. And that, I found, useful." (P302, F, 73, Interview 2)

The symptom control techniques that included stress management, controlled breathing and relaxation were described as simple, beneficial, transferable skills that were seen as relevant for managing symptoms in day-to-day life. Some participants suggested the techniques were helpful by offering a distraction from sensations of dizziness or a focus on more pleasant sensations:

> "I certainly like the breathing exercises. That was very easy to follow and I was able to start using that immediately and I, as I said earlier, that's become beneficial to me over the last sort of seven days or so." (P203, M, 66, Interview 1)

> "I think that's [the relaxation exercise] a very good idea because when I'm really rotational I have to think… I try and think of something else so that I'm not concentrating on that, and that's a very good thing if I concentrate on relaxing, on watching my toes and that, I realise, no. And when I felt sick on Monday, when doing that I suddenly realised, no, I'm okay, I'm feeling much better." (P204, F, 70, Interview 2)

4.3.3.2 **Balance Retraining acts as a reminder**

Participants often also perceived the intervention as a valuable reminder to do their exercises, and as a means of recapping information that had already been provided. The ability to revisit content from previous sessions, and the facility to print certain instruction documents were frequently mentioned as instrumental in this.

A number of participants were particularly pleased to be able to review content they had previously seen, as they felt that it was sometimes easy to miss details the first time around and so it gave the opportunity to revisit these. It also allowed them to refresh their memory and the opportunity to see how they were progressing by looking back.

> "And then whilst you're sort of recapping you think, 'Ooh, perhaps I didn't read this one' or 'Ooh, there's one there that reminds me I should do this' or 'That's a good tip'. So, yes, I like... the fact it's there, it's like a little handbook that you can refer to." (P410, F, 63, Interview 2)

> "I suppose just to see how I'm progressing, also to refresh my memory maybe something I've forgotten about or something like that so, I can go back over it again. It just makes life fairly easy." (P203, M, 66, Interview 2)

The facility to print instruction or information documents was welcomed by a number of participants who didn't want to log in to the website every time they practised the exercises. This meant they weren't dependent on the website for the exercises and allowed them the freedom to do them at times when they might not have access to a computer:

> "I don't have to go onto the website to be able to do the exercises every time. (Interviewer: No.) I've got the exercise instruction sheet. I don't even need that really because, you know, I can remember what to do and whenever I get the chance I do it." (P422, M, 71, Interview 2)

> "No, I'm determined to do it, this carrying on. No. I'm going to [nearby town] today for a couple of days to stay with my brother but I'm taking my sheet with me." (P201, F, 76, Interview 2)

4.3.3.3 **Balance Retraining as reassurance and support**

A very common perception amongst participants was of the Balance Retraining intervention as supportive, reassuring and encouraging. This appeared to help participants overcome concerns and set-backs. This included perceptions that the intervention provided sufficient information to pre-warn users about possible side-effects; this was reassuring if they did then go on to experience these, as it had managed their expectations.

> "Yes, which is why I thought no I will continue because of the information that was there. I mean had I not had that information after a couple of days when I was feeling really dizzy I probably would have stopped" (P505, F, 65, Interview 1)

Some also said that the tailored feedback element prevented them feeling disheartened about these setbacks and was an important mechanism in encouraging them to continue.

> "There was one where I had to... because I found that by nodding I was great but as soon as I tried nodding and walking backwards and forwards, again, it obviously had an adverse effect. But the fact that the website says, 'Don't worry about it, go back to your original sitting down or standing up', that is a great comfort because then you don't feel a failure." (P410, F, 63, Interview 2)

> "In general life, feedback mechanisms are important and the booklet doesn't give feedback mechanisms whereas the website has structured – does give you a feedback mechanism, so it's almost 'well done. Now move to exercises standing up', which is doing the exercise standing up." (P202, M, 68, Interview 1)

Those participants who had previous experience of the booklet version of Balance Retraining seemed to perceive that these features of the online format made it more successful in terms of providing additional incentive and encouraging them to engage with the exercises:

> "Well I've been quite happy using the, with your, using your website. I find it so much more helpful, as I say comparing with a booklet, which I had for many years and I kept meaning to do the things and somehow with the computer and the website it's just that extra incentive I think, I think it's because you're doing something, you know it's much easier to do the next thing." (P201, F, 76, Interview 3)

Other features of the intervention also contributed to this sense of support and encouragement. As part of the research process, participants had intermittent contact with a member of the research team. Although this was not a feature of the intervention itself, a small number of participants described this as helpful for discussing anything they were uncertain about and also made them feel an important and valued part of the process:

> "I think the whole process… I was saying to you, you know you're probably a number in part of this research you're doing, but you're not made to feel that – you are made to feel you're important. And the interviews and backup phone calls, I feel that I am doing something that is valuable and useful, rather than just ticking a few boxes to say how my dizziness is getting on." (P402, F, 50, Interview 2)

Another feature that appeared reassuring for participants was the 'Retraining Stories' which allowed them to read about others' experiences of dizziness and engaging in the Balance Retraining programme. Some participants described this as a realisation that there were others out there who experienced the same difficulties, and they found it encouraging to hear that they had managed to improve their situation:

> "Well, it's always encouraging, I think, to hear, you know, other poor old people are suffering as well, but, you know, and in fact it did help them. Yes." (P201, F, 76, Interview 1)

4.3.3.4 **Usability of Balance Retraining**

Participants also expressed views about more practical aspects of the intervention, such as how easy they found it to use and the extent to which they tended to engage in this element. With the exception of one participant, all were very positive about how simple, user-friendly and easy to navigate they found the website component, which seemed to enhance their overall experience of using the intervention:

> "Well it was just easy. It was just, I felt it was user-friendly, you know, I could get on with it quite well." (P101, M, 53, Interview 1)

> "A nice easy, friendly site, easy to get around, navigate, no harsh threatening colours, anything of that sort of nature, so a pleasant experience." (P202, M, 68, Interview 1)

This even seemed to be the case amongst a number of participants who acknowledged that their experience with computing and online technologies was relatively limited:

> "Well the website, once you've got in, it's all pretty self-explanatory and very easy. I don't have any problem with that, and I am not a computer genius, I only know what I've taught myself. I find the actual website quite easy to use, very self-explanatory and if you need to go back you can, or you can go forward, that's easy." (P505, F, 65, Interview 2)

One participant, however, was much less positive and seemed to view the website as overcomplicated and requiring further development; a view that did not change over the course of using the intervention.

> "No, in fact I find it over-complicated, more things to check up on, I don't want to watch the videos again, it keeps on offering to let me, I don't want to keep a chart of how I am getting on, because my reaction to each of the exercises is broadly the same…" (P302, M, 76, Interview 2)

> "I think you would have a lot more to do to make the website more user friendly" (P302, M, 76, Interview 3)

Reviewing this participant's data overall, it is difficult to gain much insight into why his views may have differed to the majority; it may have simply been a matter of personal preference. However, he did frequently express a desire to give constructive feedback in order to provide useful data for the development of the intervention (as participants were asked to do in the introduction to the interview). It may be, therefore, that he was approaching the intervention from a relatively critical standpoint in order to provide what he felt was constructive criticism.

A number of participants did mention a process of familiarisation with the online element but that it was becoming easier and quicker the more they used it:

> "No, it's got considerably easier because I've begun to... well I suppose speed read the website; I know what it's going to say so it's quicker. Initially I found it really quite

> complicated, difficult to go from one step to the next, but by Week 2 I'd got the hang of it." (P405, F, 78, Interview 3)

There appeared to be substantial variation amongst participants in their levels of engagement with the online component. Some users reported that they accessed all new sessions, whereas others accessed the initial sessions but thereafter only logged back in to recap on information or go back to sections they missed. In either case, the vast majority seemed satisfied with the sessions they did choose to access:

> "Oh gosh, especially useful… I'm using the whole thing… I think the whole thing is good you see. I don't think I can draw out any one thing that I could say was better than the rest, and certainly it has been very helpful and I'm really pleased that I'm doing it." (P201, F, 76, Interview 2)

> "I've got on really well with using the website, I mean, I don't have to refer to it on a daily basis but just weekly when I'm entering up my test results and reading a little bit more about things to refresh me that I'm doing things properly and to see what else you're putting up." (P302, F, 73, Interview 3)

4.3.3.5 **Presentation and style of Balance Retraining**

Although participants' perceptions of Balance Retraining's presentation and style included their views on its visual appearance, this was only a minor part. Their views focused more on how the content came across to participants, including whether they felt the quantity of information and the manner in which it was presented was suitable.

Participants talked about the overall 'feel' or 'tone' of the intervention in a very positive manner. They described it as being encouraging without being too forceful, and also as something they looked forward to using as they became more used to it:

> "Yes, it's become an old friend. (Laughter) (Interviewer: Good) You know, you can sort of think, 'Oh, I can do this' and you quite look forward to when the time comes and you know it. It's a bit like a little reference library." (P410, F, 63, Interview 1)

Regarding the amount of information presented, participants generally expressed that they had been able to find answers to any queries and described the information provided as very comprehensive:

> "It certainly gives me information if I feel dizzy, ill, if I feel nausea coming on or anything like that. I've got somewhere I can go back to and reread through it and there are things there to help me to, you know, I'm quite happy there. Quite honestly I don't know what else you could put on there that would make anything easier." (P203, M, 66, Interview 1)

A small proportion of participants found there to be a little bit too much information at times and could sometimes experience the sessions as a little repetitive. However, others seemed to feel that the set-up of the website allowed them to read as much or as little as they wished:

> "Yes, the repetition, that you can't get the information once, you've got to go through it the first time, it'd be nice to be able to flip to page three or something…" (P201, F, 76, Interview 3)

> "It was informative and you could use it as much as or as little as wished to gain information to reassure you." (P408, M, 62, Interview 1)

In terms of the accessibility of information presented, a large proportion of participants described the instructions and information provided as extremely clear and very straightforward to understand. They felt that it was pitched at the right level and didn't use medical jargon or terminology that they found difficult to comprehend:

> "And at the right, sort of at the right level without being too, oh…you know medical words or jargon. Very easy to sort of read in layman terms." (P402, F, 50, Interview 3)

Many participants were also very pleased with the layout and gradual presentation of information. They were especially positive about screens not being too cluttered, and the break-down of information into sessions as it allowed them to find information they wanted quickly:

> "Not too much reading, which is good, because if there's too much information you don't take it all in, I thought the way that it was done was fairly good, because it was a small bit on one page and you go on to the next and etc. I thought that was very good." (P505, F, 65, Interview 1)

With regard to perceptions of visual appearance, with the exception of two participants who disliked particular elements, all others who commented on this aspect were very positive. They felt that it was bright and welcoming and that the pleasant appearance encouraged them to continue using it:

> "And, as I say, I like your bright presentation; that really is welcoming, yes, not a mass of typed script that I have to sit carefully and look through especially if you are feeling a bit giddy at the time. So it really does – it really is helpful." (P201, F, 76, Interview 2)

4.3.4 Facilitators of engagement with Balance Retraining

Participants frequently talked of factors that were helpful in enabling them to engage in the Balance Retraining programme and to practise the exercises regularly. These largely seemed to fall into one of three main categories: motivations to continue with the therapy; helping themselves to succeed; and the intervention as a facilitator.

Throughout the period of their participation, users discussed their motivations to continue with the exercises fairly consistently, whereas their discussion of how the intervention had facilitated their engagement and of strategies they had implemented themselves seemed to gradually lessen over time. There appeared to be some gender differences related to perceptions of social facilitation of engagement, with just over a third of women raising issues related to this, but no men.

4.3.4.1 **Motivation to continue**

Participants discussed a range of experiences, thoughts and desires relating to their participation in the programme, and specifically the exercises, that motivated them to continue once they had begun. By far the most common were perceptions that the exercises had already had a positive impact either by reducing symptoms, allowing them to do more, or both. Consequently they were very keen to continue with the exercises and even increase the frequency or duration of their practise in the hope of maintaining, and increasing, these benefits. With the exception of one, all participants discussed an improvement in their symptoms since beginning the exercises:

> "I tell you what, the last time I went rotational it was much slower, yes, and that really is a good thing because it meant that the ceiling light was just winding round gently as opposed to whipping round at a horrible rate. So I assume it is those exercises and I certainly am keeping them up." (P201, F, 76, Interview 2)

> "I'm doing it more often because I have found it beneficial." (P203, M, 66, Interview 1)

> "I've just been to Paris and I went to the top of the Eiffel Tower. I would have never done that. (Interviewer: Oh really?) Hmm. (Interviewer: Oh, that's really good.) And in four weeks, you know, you wouldn't have thought. And, yes, perhaps I've become, I do them twice a day. I have tried to increase them a little faster. But if that's in four weeks, I mean, what's it going to be like in 12?" (P410, F, 63, Interview 1)

Another factor that appeared to encourage participants to continue was their recognition that the exercises had relevance to their day-to-day activities that might, or already had, lead to improvements in these other areas of life. Again, this encouraged participants to continue to achieve or maintain these benefits:

> "Yes, yeah, because I find, you know, there are things that I can do that I haven't been able to do for some years. (Interviewer: That's brilliant.) Just silly things like hanging out the washing without sort of looking up and thinking, 'Oh my goodness'." (P410, F, 63, Interview 2)

A number of participants mentioned the role of others as instrumental in encouraging them to continue with their exercises. For some, this was people they knew that had acknowledged an improvement or had supported them with the programme in some way. For others, this was simply other people's stories they could read in the intervention that gave them a sense of shared experience. It seemed that these experiences provided encouragement either via positive feedback that the exercises were already working, helping to overcome difficulties and challenges, or from evidence of other people's past successes:

> "…like I said to you last time even my husband noticed – (Interviewer: Yeah.) – I mean so that's got to be a good thing. [Laughter] He's a man, he doesn't notice that much. You know he sort of… Yes, I mean I'm quite happy, I shall probably continue doing them all the time now, because I do feel they do help." (P505, F, 65, Interview 3)

> "I would say, other people's experiences. They, it sort of gives you the confidence to have a go, if you like." (P410, F, 63, Interview 1)

A small number of participants appeared to be motivated to continue with the programme simply because they had said they would help and described a feeling of obligation to keep to their word to the research team and to potentially help others:

> "Just really, I mean it's more because I said I would do it, because I volunteered to do it" (P501, F, 50, Interview 2)

> "Desperation. I would try anything. And if, in trying anything, it helps somebody else, well, why not?" (P405, F, 78, Interview 2)

4.3.4.2 **Helping oneself to succeed**

As well as factors that participants reported as motivational in continuing with their exercises, they also described strategies they'd found necessary to implement to help themselves to continue. In addition, they revealed a sense of personal responsibility towards helping themselves with their condition.

A large proportion talked about the importance of setting routines or setting aside time to ensure that they got into the habit of doing their exercises. They described how making concrete plans had made them more likely to stick to their routine and helped the exercises become almost an automated part of daily life:

> "Yes, I've got into the routine. I try to maintain the same times, roughly, at the beginning and the end of the day, and I think that's the first… that was the first thing I had to ensure that I didn't forget and so on. So I have managed to establish a routine and I found that the exercises, I can manage them." (P301, M, 79, Interview 1)

More than half of participants also mentioned practical strategies they had developed themselves that had helped them overcome minor difficulties or any exacerbation of symptoms resulting from the exercises. These techniques appeared to help participants remember to do the exercises and to feel confident in doing them:

> "I tend to do it the same room so I know how many steps from one end of the room to the other so I can turn round without too much of a problem" (P203, M, 66, Interview 1)

> "I've stuck a piece of paper somewhere where I see it and it says 'Exercises', so for the last few days I've been doing them no problem." (P303, M, 76, Interview 1)

Nearly all participants' reported notions of personal responsibility for their own health. This was expressed primarily as a necessity to push themselves to overcome challenges in order to improve their health. Some talked of the psychological importance of feeling that they were doing something to help themselves:

> "As I've said several times, if you think you're physically doing something to help yourself, I think that's half the battle. It gives you that confidence to think, "Right, I'm doing everything within my power to get this sorted." And that's all you can do, isn't it?" (P204, F, 70, Interview 3)

This notion of challenging oneself was closely related to a recognition from a large proportion of participants that, for the exercises to be effective, they needed to be disciplined about completing them regularly, even in the face of adverse effects.

> "I would say by all means engage in it but be prepared to make the effort and do it regularly, don't mess about." (P301, M, 79, Interview 3)

> "And it is quite hard to discipline yourself to do it. Especially when it makes you feel a bit worse. You're sort of thinking, oh, you know, do I really want that, but I know they're saying if it makes you worse, it's making you better." (P426, F, 66, Interview 1)

However, even when people did experience difficulties such as an exacerbation of symptoms, there was an almost unanimous expression of being willing to persevere. This was usually expressed either as a 'no pain, no gain' attitude whereby participants acknowledged that to get better they might need to get worse first, or as recognition that the exercises might take time to demonstrate results:

> "No. I am one of those people, if it is going to help in the long term I will just keep doing it, because I realise things don't happen overnight. No, I've got no concerns about continuing at all." (P505, F, 65, Interview 1)

> "[…] sometimes when you get older you realise, things have got to go down in order to go up. (Laughter) So, that's why I thought, right, I'm going to do this. Nothing lost, nothing gained." (P410, F, 63, Interview 1)

These notions of responsibility for one's own health continued to be expressed fairly consistently over the duration of the programme. However, a far greater proportion of participants discussed an awareness of the need to be disciplined by the last interviews than in the first.

4.3.4.3 **Intervention as a facilitator**

One further important group of factors for facilitating users' engagement in the programme was the perceived simple and supportive nature of the Balance Retraining intervention itself. Nearly all participants perceived the exercises as very easy and straightforward, and therefore not too much of a burden on their time and efforts. They felt the exercises didn't intrude into their daily lives and routines largely because they found them simple, quick and didn't require specialist equipment:

> "They don't involve a lot of time and they don't involve any special equipment or anything like that, so it's something that one can do informally at any time." (P301, M, 79, Interview 2)

> "…but I don't find the exercises intrusive, in fact I've sort of incorporated them into my daily routine now, and it's… even when I'm home or down my mum's or wherever, I find I can still do them without them interrupting my day, which is a good thing I feel." (P505, F, 65, Interview 3)

A large proportion of participants described the intervention as providing additional motivation and structure that they may not otherwise have had. Having the online component in addition to the exercises; particularly features such as the tailored feedback or the knowledge that the research team *could* monitor their activity, seemed to encourage participants to be more disciplined and rigorous about their exercises.

> "Yes, so another advantage of doing it on the computer because you know I'm doing it. (Interviewer: Yeah.) And therefore I'm conscious that you know I'm doing it or not doing it. It makes you do it. (Interviewer: Does that…, how does that sort of make you…?) No problem. I think that's a good thing." (P422, M, 71, Interview 1)

4.3.5 Difficulties with engagement in Balance Retraining

Participants commonly mentioned three main groups of difficulties they encountered with fully participating in the programme: practical barriers to engagement, doubts about the exercises and symptoms being worse or unimproved.

Although a similar proportion of participants continued to discuss difficulties they faced over the duration of their participation, those that did raise these issues seemed to report them less in later stages of taking part. In particular, participants' expression of doubts and concerns relating to the exercises vastly reduced across the duration of their participation. Furthermore, although participants' discussion of practical issues that interfered with exercise participation seemed to initially increase over the first few weeks, these then substantially declined after this time. There appeared to be some differences in men and women's perceptions of difficulties with the programme. Whereas all women made some mention of other life events preventing them from fully engaging in the programme, and more than three quarters mentioned experiencing technical difficulties, only three of the seven men raised any comments pertaining to either of these issues.

4.3.5.1 **Practical barriers to engagement**

Several factors that proved problematic for participants regarding their engagement with Balance Retraining were related to practical issues that they encountered. The most common of these seemed to be other life events - whether day-to-day occurrences or one-off events - being prioritised over the exercises or lessening participants' motivation. It seemed that this sometimes occurred out of necessity, but other times it was evident that a conscious decision not to do the exercises was made:

> "… and the evenings are getting lighter and my work's starting to take over. I've got to earn money whilst I can. (Interviewer: Sure.) So, what I got is, I haven't got the dizziness as bad as it was so my eagerness to do the programme is probably less than it was three or four weeks ago." (P101, M, 53, Interview 1)

> "I was about to start the third week, or third lot, but with it being Father's Day and my daughter's birthday I'm putting it off until this week." (P402, F, 50, Interview 3)

Other practical issues that proved problematic included technical difficulties. These sometimes meant users were not able to access sessions or made them feel frustrated and, therefore, unwilling to continue. Often, these difficulties were caused by problems outside the control of the participant or the research team, such as internet provider faults which prevented users from being able to access the internet. However, on occasions it was unclear exactly what the cause of the problem was such as when users talked about their session 'freezing'. Some participants speculated that any technical problems could be compounded for users with limited ability regarding computer-related technologies:

> "Yeah, because two or three times I've gone to go on there and you haven't been able to get on and then, if I haven't had time again, so in the end, you know, I did sort of email. (Interviewer: Yeah.) Which I didn't do for a quite a few times. I'd just thought, oh, well it'll come up. But that was a bit frustrating and I think, you know, for two pins you could have easily said, oh well, blow it." (P426, F, 66, Interview 1)

Poor health, pain or injury was another issue that a number of participants said prevented them completing their exercises. This was sometimes incidental illness that prevented participants feeling well enough to do the exercises as normal, but sometimes was pain or injury – especially of the neck, that seemed to be aggravated by the exercises themselves:

> "You can possibly tell, I've got a head cold at the moment and I was a bit knocked out with that probably three or four days ago. And so there has been a period where I haven't been exercising at all since we last spoke, for three or four days. […] I've not found terribly easy to do and I found it particularly difficult when I was feeling a bit woozy with a cold, and consequently stopped." (P303, M, 76, Interview 3)

> "I must admit, I didn't particularly like doing it, because I've still got this neck ache. I did find sometimes it did make me feel, I know you feel worse before you feel better, but I didn't particularly like doing all of them." (P426, F, 66, Interview 3)

As is noted in the intervention, amongst individuals with pre-existing neck pain or stiffness, it is possible that the exercises may induce slight pain or discomfort to begin with. However, evidence suggests that gentle continuation of the exercises over time is highly unlikely to be harmful and can actually improve mobility of the neck. Indeed, this was the experience of one participant:

> "The one thing it does help is the creaking in my neck. And as you do shaking up and down a lot, it cracks and creaks, and that is being reduced." (P405, F, 78, Interview 2)

In relation to these physical limitations, there appeared to be a recognition of the importance of not pushing oneself too far (whether this meant doing exercises slower, reducing the number of repetitions or just being accepting of what they were able to achieve). There did appear to be a slight gender discrepancy though with more than two thirds of women but no men expressing this need to 'know their limits':

> "I mean I have a condition so I know that I have osteoporosis of the neck, so I know I just have to be careful. And if the old bones start clicking, then I know I've got to slow down a bit, so no, I think, let's be fair, everyone's responsible for their own destiny so you have to look after yourself and not be silly." (P410, F, 63, Interview 1)

A number of users reported difficulties with the practicalities of conducting certain exercises; either finding them physically difficult or just being unsure whether they were doing them correctly. They described certain exercises – usually at the walking level - as challenging and requiring a great deal of effort. This sometimes led to participants reducing their practise of these particular exercises, but for the most-part they reported continuing to try. Furthermore, where participants were uncertain about how to conduct exercises they sometimes described using the online content to clarify this:

> "When you are walking and trying to shake, I think that is odd, walking forward and shaking your head side-to-side and I find that difficult. I don't know that it makes me particularly dizzy, I just find that I am having to stop because I can't do those things all at the same time!" (P303, M, 76, Interview 2)

> "The only one is the staring at my finger going across on the nodding because it's the angle of, I had to go back to the website to see where you put your finger rather than, not at nose level but more at eye level." (P302, F, 73, Interview 1)

A final practical barrier to completing their exercises for a small number of participants was a difficulty with remembering information relevant to engaging in the programme. This included difficulties with remembering login details and also actually remembering to do the exercises. However, the majority of those who raised these issue also reported strategies they had implemented to overcome this:

> "Well, it has not been not being able to, it is remembering to. (Interviewer: Okay.) But I have got a Post-It note on the desk near the computer, where I sit most days, and that is just to remind me. It is a question of age, I think." (P303, M, 76, Interview 2)

4.3.5.2 **Doubts about exercises**

A number of participants mentioned doubts about the exercises, predominantly relating to concerns about possible side-effects. They often described being fearful and apprehensive before beginning the exercises, largely due to the possibility of inducing their symptoms which, in turn, impacted on their willingness to engage. However, some described how they reduced these concerns by trying the exercises:

> "Yeah, no. I must admit, I was a bit apprehensive at first, to do the shaking one. I thought, 'Oh, gosh, I'm not like that.' I've gained confidence and I've got better at it. So that's been good. Because there again, that encourages me." (P204, F, 70, Interview 3)

Even after starting the exercises and noticing some improvements, some participants seemed reluctant or unsure about attributing these improvements to the exercises. They often expressed uncertainty about the exact reason for their improved symptoms and so, unlike those who were encouraged by their symptom improvement, did not immediately express the same willingness to continue. Certain participants' accounts of this issue revealed attributions of improvement in dizziness to factors that were highly unlikely to be responsible, or potential misunderstandings about how the exercises were designed to work. For instance, regarding the example below, given the physiological mechanisms involved in the experience of such dizziness, it is very unlikely that a change in temperature could be responsible for this improvement:

> "I am managing it better and I don't honestly think it's as a result of doing what's on your website because what I do find is, now that the weather's warmed up that helps; the cold weather certainly didn't help my dizziness." (P422, M, 71, Interview 2)

4.3.5.3 **Symptoms worse or unimproved**

A further potential barrier for engagement with the programme was some participants' experiences that their symptoms were unchanged, or even exacerbated by the exercises. A number talked about not having noticed any significant changes, which did sometimes seem to discourage them from continuing. The intervention does highlight the necessity of consistent practise of the exercises for experiencing improvement, and some of these participants did qualify their comments by saying that they could perhaps have practised more frequently or that they still intended to continue trying:

> "At this point in time really it hasn't had much effect, if I'm honest, but that's not to say I don't intend to continue, because I do, because there may come a point where it really starts to have some effect. And I think the other thing is I've got to try and do it more regularly, not just here and there." (P422, M, 71, Interview 2)

Lots of participants talked about the exacerbation of their symptoms or other negative side effects such as a stiff neck or nausea, particularly when discussing their initial experiences. Some mentioned that this left them concerned, especially when they were yet to see any benefits as it made it difficult to want to continue. However, whilst raising these concerns, many acknowledged that the website had explained that this initial exacerbation of symptoms was part of the process, and that they were willing to keep trying. All but one participant who expressed these concerns went on to talk about some form of improvement they had noticed by the final interviews:

> "Some of the exercises make me a bit a dizzy, but then that's what the website said they would do." (P408, M, 62, Interview 1)

4.3.6 Managing Dizziness

A final theme of participants' experiences of engaging in the Balance Retraining programme was how they managed their dizziness. Within this theme participants discussed strategies they implemented, changes they had noticed since beginning Balance Retraining, and a sense of 'looking ahead' to their future plans and expectations for managing dizziness.

4.3.6.1 Strategies employed to manage dizziness

Whilst describing how they attempted to manage their dizziness, all participants engaged in discussion about specific strategies. The types of symptom management strategies participants talked about tended to change across the course of the interviews. For those who discussed consulting medical professionals and seeking medical attention, this tended to be predominantly in interviews one or two. They talked about what had led them to seek medical attention and treatments they'd been prescribed, but also began to touch upon perceived limitations of medical advice and expertise in this context:

> "…the doctors are still searching around in the dark trying to find different ways of making Meniere's easier to live with, and for me all I've been doing really since I was diagnosed with it is just taking tablets." (P203, M, 66, Interview 3)

This medical advice seeking strategy was raised much less in later interviews but participants talked fairly consistently about the new strategies they were implementing across the duration of their participation. These included the Balance Retraining exercises and additional symptom control techniques that allowed them to manage a broad range of related symptoms. More than three quarters of the women (but only one of the men) also discussed how the intervention had helped them develop a greater awareness and knowledge of their symptoms that helped them to avoid inducing them:

> "Yes, it's taught me about the speed of movement and not to attempt things too quickly because that can be the cause of things. And that regular practise of everything, I mean, it takes time but it works, just practise, practise sort of stuff, and, you know, like brushing your teeth or doing things, incorporating these nods and shakes into your daily life can ward things off." (P302, F, 73, Interview 3)

Something that many participants discussed, primarily at the start of their participation and less-so towards the end, was a notion of symptom acceptance that, although perhaps not a practical symptom management strategy, seemed to be a psychological one. Participants talked of a sense of having to 'get on with it', which seemed to allow them to manage their life and day-to-day activities despite still experiencing symptoms:

> "I have tried to ignore it and just get on with life because I keep myself busy and that's how I cope I think, just don't think about it too much. It has become part of a daily routine if you understand what I mean, so I am so used to it, I try to ignore it. Does that make any sense?" (P505, F, 65, Interview 1)

4.3.6.2 **Acknowledging change**

Whilst discussing the management of their dizziness symptoms, participants also tended to talk about changes they had noticed in how they dealt with their symptoms and their perceived ability to manage their symptoms having taken part in Balance Retraining. This topic arose much more frequently, and amongst a much larger proportion of participants, by the end of the period. Many mentioned feeling more confident with managing their symptoms and, closely linked to this, feeling less anxious at the prospect of experiencing dizziness and managing it in the future.

> "I suppose that it has given me a more positive feeling about my ability to not be unbalanced and so, to get on and let the world run as it will do, I am going to do what I want with it." (P202, M, 68, Interview 3)

> "Well it's silly to say, but it's given me my life back. (Interviewer: How's that?) You know in areas that I didn't think I would be able to participate any more or do things. It's given

me the confidence and the knowhow how to use exercise to benefit." (P410, F, 63, Interview 3)

Another important change they discussed was that of feeling more informed and having more skills to manage their condition. Although the information they had obtained from the programme was not always new to them, it often reiterated information which subsequently reinforced these messages or ideas:

"[…] about ten years ago, I had a virus and I had labyrinthitis which… I was away on a holiday with a friend, and I just didn't know how to manage it. If I had it today or tomorrow, I would know because I would be able to use exercises. […] But with the knowledge I have now and my experience over a six week period it can only be helpful" (P302, F, 73, Interview 2)

Overall, participants seemed to feel that they had a better understanding of how their condition specifically affected them and felt they had been provided with new skills and techniques to better manage this. This appeared to be closely linked to a notion of feeling more in control and more able to manage symptoms, particularly in the later stages of the programme:

"You know, you're just thinking 'when's the next attack going to happen?' and 'when's the next episode going to appear?' I must admit that when the Balance Retraining course first started I was still thinking down that line, but since then I've stopped, so I am managing the way I deal with my Meniere's better since I've been doing the Balance Retraining." (P203, M, 66, Interview 3)

"So I'm in a situation where I'm more in control." (P204, F, 70, Interview 3)

4.3.6.3 **Looking ahead**

With regard to how they managed their dizziness, there was a tendency for participants to discuss expectations and plans for the future – particularly relating to their practise of the Balance Retraining exercises. There was a real acknowledgement amongst a large proportion of participants that the symptoms couldn't be expected to resolve 'overnight' and that it was something they expected to do for some considerable time:

"Oh yes, I am beginning to notice a difference, yes. I think it probably is just persevering, I think it does probably take time because you've had it a long time you know, it's a huge thing really." (P201, F, 76, Interview 3)

> “I thought that this might be a fairly long-term thing. You know, it’s not something that I would expect an instant response from or recovery through. […]. So I was expecting it to take time.” (P422, M, 71, Interview 1)

Closely linked to this was the common expression of an intention to continue the exercises after the study and to incorporate these into existing exercise routines of daily life:

> “Now, I think I will continue to do something of this nature, possibly put it into my normal exercise routine, but I do some isometrics first thing in the morning, second thing in the morning, and then go on the strider. So I start that routine now by doing my Balance Re-training exercises. So I will probably continue to do that for some considerable time.” (P202, M, 68, Interview 1)

A final element of these expectations about the future included many participants’ expressions of optimism or hope that, even if they were yet to experience improvement, they would do at some stage in the future. Even amongst those who did not seem to hold this optimism for themselves some recognised that the exercises could be very beneficial to others:

> “So far, I have enjoyed it and I hope that it’s going to be helpful for me. At the moment, […] I’m not a, how can I say, I don’t suffer much from dizziness as at present. But it doesn’t mean to say that I won’t further on down the line and these exercises now would help me an awful lot…” (P406, F, 73, Interview 1)

> “I do feel that it will definitely help people, but not necessarily me because like I keep saying over and over again, I’ll be, I reckon I’m over the worst. Someone that’s got it pretty severe, it would help.” (P101, M, 53, Interview 1)

4.4 Discussion

4.4.1 Summary of findings

Older adults generally experienced the ‘Balance Retraining’ online intervention as supportive of their VR exercises and found it reassuring, accessible and visually appealing. As will be discussed, these responses to website features and usability provided insight into more fundamental processes underlying engagement with the intervention and changes in dizziness management behaviours (Yardley et al., 2016). These perceptions of Balance Retraining seemed to contribute to participants’ broader experiences of self-managed Vestibular Rehabilitation. Positive perceptions of intervention features seemed to contribute to participants’ perceptions that their continued engagement was facilitated by the encouraging and motivational nature of the intervention. These positive perceptions also seemed to have a buffering effect on certain barriers; the negative impact of concerns about exercises and experiences of symptom exacerbation were often lessened by the reassuring and supportive aspects of the intervention. However, on the rare occasion that perceptions of the intervention were negative, this had the potential to exacerbate barriers (e.g. negative perceptions of usability and technical problems). A final important aspect of participants' experiences was how they managed their dizziness, including strategies they employed and expectations for the future. Many strategies they discussed were those introduced by the intervention, linking to perceptions that the intervention taught new skills. Furthermore, expressions of intending to continue with the exercises or return to them in the future were closely linked to facilitators of engagement in which participants' reported experiences that had motivated them to continue. Participants' accounts of their experiences revealed situations and events that both facilitated and hindered their engagement with the programme, and the longitudinal data revealed that these barriers and facilitators could change over time. These findings are summarised in Figure 7.

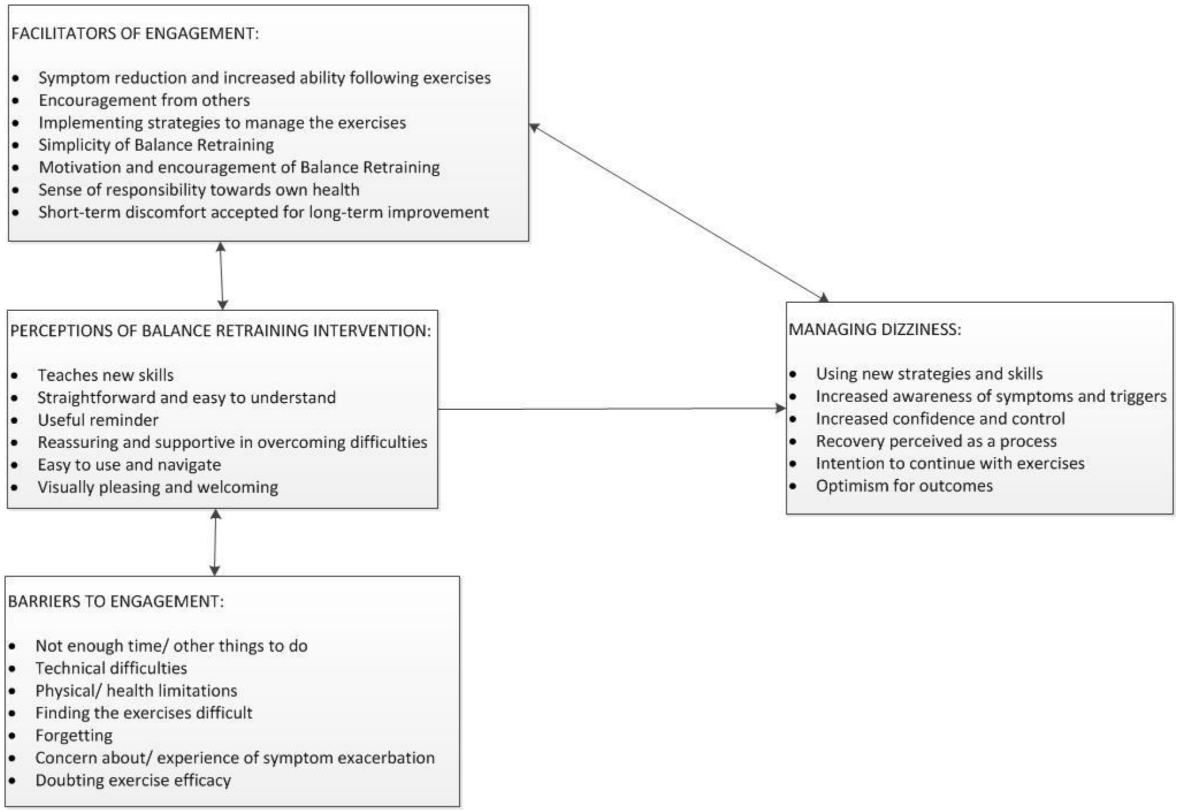


Figure 7 Summary of main findings

4.4.2 Experiences and perceptions of the Balance Retraining Intervention

The vast majority of participants reported the online intervention to be easy to use and well-presented in terms of visual appearance and the amount and complexity of information provided. They reported that this made their experience of using the intervention straightforward, enjoyable and encouraged them to continue. Consistent with research that has investigated how users appraise e-health interventions (Kerr, Murray, Stevenson, Gore, & Nazareth, 2006), features such as simple login and navigation procedures, use of appropriate language and the provision of practical and relevant content seemed important to users' overall positive experience.

Participants also perceived that certain elements, particularly the tailored feedback and previous users' stories, prepared them for what to expect, helped them to overcome problems and, as such, were reassuring and encouraging. This resonates with the findings of existing research into other web-supported health interventions (Gerhards et al., 2011) and features of online interventions that promote utilisation (Bennett & Glasgow, 2009), which have suggested that managing participant expectations and positive feedback are key to facilitating utilisation and engagement. Previously, however, little was understood about the mechanisms through which these strategies improved utilisation; only that they did (Bennett & Glasgow, 2009). The findings of the present study suggest that these features may promote continued use of online self-management interventions via providing reassurance and support that helps individuals to foresee possible problems and overcome them, perhaps making them feel more able to continue.

Participants identified particular strategies they employed to manage their dizziness, including seeking medical advice, trying out new techniques learned as part of the intervention and psychological management strategies such as notions of acceptance. Having taken part in the programme, some reported feeling more confident in managing their dizziness, feeling less anxious and having a greater self-awareness of their symptoms. This perception of being more self-aware regarding symptoms and triggers was expressed by a larger proportion of women than men. This might simply reflect the types of changes that these men and women felt were relevant to discuss; men may have also experienced this increased awareness, but felt that practical and tangible changes were more relevant. Indeed, discussion of feeling more skilled and having more practical techniques to manage dizziness was much more gender balanced.

Participants discussed expectations regarding future symptom management, with many recognising their recovery as a process rather than an immediate fix. This suggests that, for the most part, participants held realistic expectations regarding their therapy outcomes and requirements for continued practise; especially given that previous trial results have demonstrated that the greatest benefits from these exercises may be experienced up to a year later (Yardley et al., 2012). Whilst these realistic expectations about self-managed VR therapy may reflect participants' pre-existing knowledge, it might also be considered to demonstrate the effectiveness of the intervention in helping to manage expectations. This is supported by some participants' expressions that the intervention helped them know what to expect in terms of the exercises.

On the basis of these participants' experiences of engaging with the Balance Retraining intervention, it certainly seems that older adults can experience a web-supported, self-managed therapy programme as both acceptable and beneficial. In this context older adults were willing and able to access an online intervention to support their self-managed therapy and they appeared to find this element accessible, appealing and supportive to their engagement in the exercise therapy itself. They were able to identify the methods they relied upon in managing their symptoms, and generally appeared to have realistic expectations about the requirements and potential outcomes of the self-managed therapy.

4.4.3 Perceived facilitators and barriers of adherence to self-managed VR

Participants recognised certain factors which either facilitated their adherence to their self-managed VR, or acted as a barrier. Facilitators included the perceived simplicity of the programme and the tailored feedback that provided encouragement and motivation. Participants also reported strategies they implemented independently to manage their exercises such as setting exercise routines. They also reported improvements in symptoms and abilities, and a small number described interactions with others or feelings of obligation towards the research team as motivations to continue. There was some consistency between perceived facilitators identified by the present study and those identified by qualitative studies of different online self-managed therapy interventions (Bendelin et al., 2011; Donkin & Glozier, 2012), and of other self-managed physical therapies (Campbell et al., 2001; Marshall, Donovan-Hall, & Ryall, 2012; Medina-Mirapeix, Escolar-Reina, Gascón-Cánovas, et al., 2009). Within the present study, symptom improvement and increased ability to engage in other activities really stood out as important facilitators of engagement for participants. This perhaps reflects the debilitating nature of dizziness and individuals' relief in finding something that helps. This is emphasised by the mundane nature of the activities that participants were so encouraged by being able to resume, such as hanging the washing out. Only women in this sample discussed the role of others in facilitating their continuation with the programme. This may simply be an artefact of the study given the very small sample and the greater number of female participants. Research has suggested, though, that women tend to make greater use of social networks in relation to issues of managing health and illness (Heaney & Israel, 2008; Kandrack, Grant, & Segall, 1991).

Participants also seemed motivated by a recognition that they too had a responsibility to help themselves improve their condition which included notions of needing to push oneself and to be disciplined about conducting their VR exercises. Previous studies of online interventions for self-managed mental health therapies have similarly reported a sense of duty to oneself (Donkin & Glozier, 2012) or, amongst some participants, an appreciation of being able to do something for themselves (Bendelin et al., 2011) as perceived facilitators of adherence. Within the present study though, this sense of responsibility also seemed to contribute to a sense of being willing to persevere with the exercises even though they often initially exacerbated symptoms. So whilst this characteristic of the therapy itself was a potential barrier to engagement, the sense of personal responsibility appeared to contribute to an attitude of 'no pain, no gain' and therefore lessened the potential impact of this barrier. Amongst participants in the present study, there also appeared to be a sense of seeking a balance between pushing oneself in order to improve, but also knowing one's limits. A similar perspective was identified regarding exercise behaviour amongst older adults with arthritis who expressed the need to 'listen to your body' but also needing to 'push oneself, but not too far' (Ananian et al., 2006). However, in the present study, the need to know one's own limitations was expressed only by women.

Barriers that participants perceived in continuing with their VR therapy included practicalities such as finding time, technical issues and concerns about the exercises. Previous research suggests that many barriers to adherence perceived by participants in the present study, such as forgetting to complete therapy-relevant behaviours (Donkin & Glozier, 2012; Lee et al., 2014), experience of technical problems (Gerhards et al., 2011), perceived lack of time (Austrian, Kerns, & Reid, 2005; Medina-Mirapeix, Escolar-Reina, Gascón-Cánovas, et al., 2009) and uncertainty about the therapy (Bendelin et al., 2011), are common to experiences of other self-managed physical therapies and technology-supported self-management interventions (Kirby et al., 2014). Amongst the perceived practical barriers to adherence, there appeared to be some gender differences, with a greater proportion of women raising technical problems as a barrier, or difficulty finding time to fit exercises in. The small female-biased sample may, once again, account for these findings so it is difficult to offer potential explanation of these results. However, should these reflect real differences, women's greater experience of technical problems may be partially explained by research suggesting that, amongst older adults in the UK, women are significantly less likely to report use of online technologies (Office for National Statistics, 2016) and so perhaps are less familiar and less experienced in overcoming problems. An alternative interpretation is that men were simply less willing to report difficulties. This is consistent with literature which has highlighted men's reluctance towards help-seeking behaviours more generally, due to notions of such behaviours challenging traditional views of masculinity (O'brien, Hunt, & Hart, 2005).

With regard to difficulties finding time, amongst these participants these reports were frequently related to other life events preventing individuals from being able to complete their exercises. Often, these life events revolved around other family members, such as looking after grandchildren, birthdays, visiting friends and family and arranging trips with friends. Should these findings demonstrate an actual gender difference in experiences, given that family-oriented activities have been more traditionally associated with a maternal role, this perhaps goes some way to explaining why women were more likely to discuss this as a perceived barrier than men. Indeed, studies have recognised that women's traditional familial and caring roles continue into retirement and can contribute to a comparative lack of 'leisure time' (Loretto & Vickerstaff, 2013).

Participants' reported experiences of engaging in self-managed VR confirmed that they perceive certain barriers and facilitators to impact on their ability and willingness to engage. Some of these perceived facilitators and barriers seem to be experienced differentially by men and women in the present sample, suggesting that gender may be influential in determining the importance of various factors for adherence. However, the small sample, and particularly the small number of men, makes it difficult to know whether these findings reflect real differences or are simply an artefact of the sample composition. The findings build upon quantitative findings relating to predictors of adherence to self-managed physical therapies. They provide a deeper understanding of how factors such as self-motivation, social-facilitation and practical barriers seem to influence participants' adherence to self-managed VR therapy. Many of these factors were found to be relatively strong, consistent predictors of adherence in the systematic review (Chapter 3).

4.4.4 The changing experience of Balance Retraining over time

The longitudinal study design was employed to identify patterns in participants' experiences over time, some of which did seem to change. In attempting to explain these changes, it is necessary to consider the possible underlying psychological mechanisms. For example, perceptions relating to presentation and usability of the online intervention seemed to arise far more in the early stages of the programme which might suggest that they are more important or salient during individuals' initial experiences. This is congruent with models hypothesising how individuals process information from online health information to make judgements about credibility (Liao & Fu, 2014). Based on the Elaboration Likelihood Model (ELM: Petty & Cacioppo, 1986), these frameworks propose that, since the processing of content is more demanding, users often initiate credibility assessments based on superficial elements such as appearance and usability (Wathen &

Burkell, 2002). Furthermore, they suggest that individuals often use this initial assessment to decide whether to continue using the source (Sillence, Briggs, Harris, & Fishwick, 2006). This highlights the importance of these positive perceptions of the presentation and usability of Balance Retraining.

The perceived simplicity of 'Balance Retraining' appeared more instrumental in encouraging continuation in the early stages of the programme. This may reflect participants weighing up the costs and benefits of adherence to the programme (Horne & Weinman, 1999). In the early stages, they may not have experienced any improvement in symptoms (low benefit) and, therefore, it was important that the programme did not require much time or effort (low cost). However, as time progressed and individuals began to experience benefits (i.e. symptom improvement), the costs perhaps became less salient and so the fact that the intervention was so easy to use was no longer as important. This provides further evidence that engagement with internet-supported self-management therapies can be understood in terms of patients' cost-benefit considerations (Donkin & Glozier, 2012; Horne & Weinman, 1999). With regard to the intervention providing additional structure and motivation for users to engage in their exercises early in the programme, this might be considered to reflect an extrinsic motivating process which may be less salient for engagement later on. According to Self Determination Theory (SDT: Deci & Ryan, 2000; Ryan & Deci, 2000) whilst extrinsic motivation may initially drive behaviour, it is less likely than intrinsic motivation to result in persistent performance, hence why these motivations stemming from the intervention may be less important in the later stages.

Over the course of the programme, individuals' expressions of doubt about the exercises seemed to lessen and, although perceptions of practical barriers seemed to initially increase, these substantially reduced towards the end. Taken alongside the widely reported perceptions that the intervention helped overcome problems, and provided an increasing sense of confidence and control in managing dizziness, these findings are proposed to reflect participants' increasing self-efficacy for managing their dizziness. Drawing on self-efficacy theory, the findings of this study appear to represent key processes involved in increasing self-efficacy. As outlined in section 1.5.2.3, page 18, self-efficacy theory suggests that an individual's self-efficacy is influenced by four main factors: performance accomplishments; vicarious experience; verbal persuasion; and management and perceptions of emotional arousal and physiological states (Bandura, 1977). Each of these processes can be illustrated within the current findings. For example, individuals' expressions of desire to continue with the exercises having achieved initial positive outcomes might be viewed as a form of performance accomplishment. Furthermore, the exercise demonstration videos and 'Retraining Stories' highlighted by many participants as informative and supportive features, allow them to see others successfully practising the exercises and hear about their achievements and, therefore, provide a form of vicarious experience. Indeed, participants talked about the videos as useful for understanding exactly how to perform the behaviour, suggesting that this attempt at modelling the behaviour was effective. Many participants also reported finding the tailored exercise feedback very supportive and encouraging, and some discussed encouragement they received from others as beneficial. These might be considered forms of verbal persuasion that were effective in encouraging continued exercise behaviour. Finally, many participants reported the symptom control exercises (designed to manage psychophysiological symptoms associated with dizziness, e.g. anxiety) as beneficial techniques and a distraction from unpleasant sensations. Many also reported the information and advice available to them via the intervention as helping to reduce worry and apprehension about the exercises. These might be considered to reflect participants' management of their emotional arousal related to the exercises. Overall, having engaged with the programme, many participants reported a sense of being more in control and feeling more able to manage their dizziness using these new techniques, which certainly seems to indicate greater self-efficacy. Given that one of the intended mechanisms of impact of the Balance Retraining intervention was to increase participants' self-efficacy towards symptom management behaviours (Geraghty et al., 2014), these findings perhaps provide preliminary evidence that this was successful.

As suggested by previous qualitative investigations of self-managed physical therapy (Campbell et al., 2001), these findings illustrate that barriers and facilitators don't always have a consistent relationship with adherence over time. By studying individuals' perceptions and experiences of the intervention over the six weeks, changes and processes have been highlighted which suggest certain factors may impact on individuals' adherence without them being explicitly aware of them. For example, only by considering participants' perceptions of difficulties with the exercises over time did it seem that self-efficacy may play a role in encouraging individuals to continue.

4.4.5 Limitations

It is important to acknowledge the context in which the present data was collected. Owing to the need for participants to be willing and able to access the online intervention, this may have excluded the experiences of less technically able or confident individuals. Such individuals are likely to have found the intervention more challenging to use, and so may have had held more critical perceptions and potentially experienced greater barriers. Furthermore, the demographic data suggests that this was a predominantly highly educated sample which may have excluded the experiences of less highly educated individuals. The role of the researcher's own experiences and perceptions must also be acknowledged as playing a fundamental role in shaping data collection and analysis. Although every effort was made to maintain objectivity and to approach data analysis in an inductive manner, the researcher can never fully compartmentalise their own perceptions and how these may inform their interpretation of participants' expressions. In the present study, the researcher was closely involved in the online intervention design. To minimise any potential bias resulting from this, a second interviewer who had not been involved in intervention development conducted a proportion of the interviews. Interviewees were also not explicitly informed about RE's involvement in the intervention development to try and ensure they felt comfortable expressing honest opinions. Furthermore, where participants' views were less positive, these have been included to illustrate contrast.

Consideration should also be given to the possibility that some findings pertaining to how participants' experiences and perceptions changed over the programme duration may, in part, be an artefact of the interview schedule design or of participants not wanting to repeat themselves. Both relate to a broader consideration of whether it was an appropriate assumption that the frequency with which certain topics were raised at a given time, was a good indicator of how salient that particular topic was. Whilst the interview schedules across interview phases were largely identical, each one did have one or two unique questions which may have prompted certain topics to arise in certain phases. Furthermore, if participants raised an issue in interview one, they may have not wished to repeat themselves by expressing similar issues in interview two which, again, may have led to the patterning of certain issues across the time points. However, this did not seem to be the case with many participants mentioning if they felt they had already discussed something relevant but continuing to elaborate anyway. Furthermore, considering the perceptions and experiences that did seem to change across time, these were generally issues that could (and did) arise from questioning at various different stages of the interviews, so it did not seem to be the case that the interview schedule influenced this extensively. Participants were also given opportunities in each interview to raise topics they felt had not been covered or that they wished to explore further.

4.4.6 Implications

4.4.6.1 Implications for research

This study has highlighted the importance of continued qualitative investigation of experiences of self-managed therapies supported by online interventions. Seeking these views is vital to understanding how these interventions are likely to be utilised and provides the opportunity to further adapt them to suit the needs of target users. As self-managed health interventions increasingly move towards online formats (Andersson, 2014), it is important for research to explore how these are experienced amongst different patient groups and demographic subgroups. This ensures a patient-centred focus in understanding how individuals can be best supported to fully engage in self-managed therapies and what features of online interventions best facilitate this.

Of relevance to intervention designers, this study has demonstrated that patients have a good awareness of factors that influence their engagement in their self-managed therapies and that these can alter during the course of their participation. Therefore, it seems important that, during both design and implementation, interventions seek patients' perceptions about what is helping and/ or hindering them to most effectively address barriers, and also to be aware that this may need revisiting and reassessing. This supports existing views advocating a person-based approach to intervention design (Yardley et al., 2015).

4.4.6.1.1 **Implications for this thesis**

The present study has provided a more holistic understanding of how certain factors can impact on patients' engagement in a self-managed physical rehabilitation intervention and, in doing so, has raised greater awareness of the complex nature of this experience. Perceived facilitators and barriers to engagement were not necessarily consistent across time, nor did it seem that they were always experienced to the same extent by men and women. As such, in the planned quantitative study of predictors of older adults' dizziness outcomes following home-based self-managed VR, it would be valuable to investigate whether potential predictors at the first follow-up time point differ from those at the second follow-up time point. Furthermore, it may be interesting to investigate whether gender moderates the relationship between any of the potential predictors and outcome.

4.4.6.2 **Implications for practice**

The present study has provided preliminary evidence of the feasibility and acceptability of implementing a self-managed online intervention for dizziness for older adults with long-term dizziness symptoms. These findings have important implications for how VR might be delivered to patients within the UK. This is discussed further in section 7.5.2, page 213.

4.5 Conclusions

The present study has contributed to a very small existing literature regarding experiences of engaging in self-managed physical therapy, including what appears to help and hinder this process, from a patient perspective. An online intervention was perceived as accessible and beneficial by older adults engaged in self-managed vestibular rehabilitation therapy and, therefore, may be considered an appropriate method of supporting self-managed rehabilitation therapies. However, further investigation is required amongst different patient populations to determine whether others' experiences are equally positive. Participants' changing perceptions, revealed by the longitudinal study design, suggest that: appearance-related perceptions of an online intervention may be especially important for engagement in the initial stages of use; that individuals' decisions about engagement with such interventions may be based on a form of dynamic cost-benefit assessment; and finally, that intervention features targeting self-efficacy may be important in overcoming barriers to engagement.

Chapter 5: Identifying Predictors of Post-Treatment Dizziness-Severity Following use of Balance Retraining

5.1 Brief introduction and rationale

In addition to the results of the RCT demonstrating the Balance Retraining to be effective (Geraghty et al., under review), the longitudinal qualitative study outlined in the preceding chapter provided evidence that it was experienced as beneficial, supportive and encouraging. Although very positive that the intervention appears so beneficial, acceptable and accessible amongst older adults, inevitably not all users experienced the same level of benefit. As such, it would be valuable to determine whether clinical outcome (i.e. a reduction in dizziness symptoms) of this internet-based VR therapy could be predicted by individuals' characteristics, perceptions and contextual factors. As discussed in section 1.6.5, it is important to investigate the mechanisms and contextual factors that influence the outcomes of interventions such as Balance Retraining (Craig et al., 2008). This provides insight into how and why outcomes occur under given circumstances and what psychological mechanisms underlie these (Moore et al., 2015). This is important for maximising the potential efficacy, reach and acceptability of the intervention (Panagioti et al., 2014).

Based on theoretical and empirical evidence (see section 1.5), the intervention's logic model (see Figure 3) outlines the expected mechanisms through which outcomes are achieved. However, it is important to test these hypotheses to see if they are an accurate reflection of the processes that actually occur. Accordingly, the present study reports a quantitative process analysis involving statistical investigation of the relationships between change in self-reported dizziness following use of Balance Retraining, and the factors predicted to be instrumental in achieving this. Figure 8 depicts the section of the logic model illustrating the proposed mechanisms to be investigated in the present study (within dashed black line).

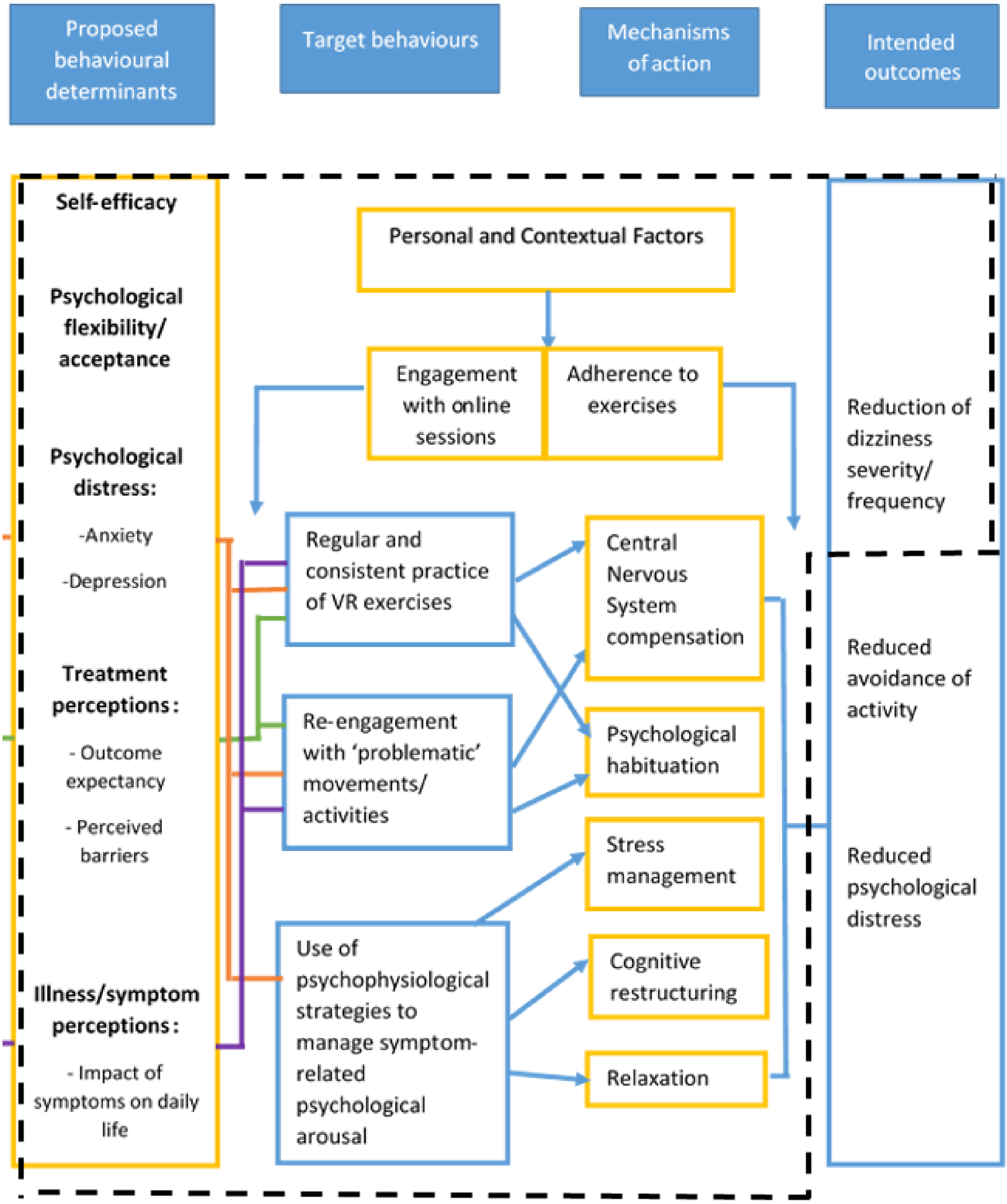


Figure 8 Investigated relationships between proposed behavioural determinants and intended outcomes

5.1.1 Rationale for inclusion of variables

5.1.1.1 Outcome variables

Change in self-reported dizziness symptoms at both three and six months after commencing the online Balance Retraining intervention were chosen as outcome variables. This allowed investigation of whether predictors of outcome immediately following therapy, and at longer term follow-up, remain consistent. Self-reported dizziness is frequently used as a primary outcome measure in trials of VR therapy (Yardley et al., 2012; Yardley, Beech, et al., 1998; Yardley & Kirby, 2006) and, based on the findings of the preceding qualitative study, appears to be of central importance to patients. Many talked about improvements in their symptoms as a key indicator the exercises were working and as instrumental in encouraging them to continue.

5.1.1.2 **Predictor Variables**

The predictor variables to be included within this process analysis correspond to the intervention's expected processes and mechanisms for achieving the primary target outcome, as set out in the logic model. According to this, engagement with online sessions, problems with adherence, self-efficacy, anxiety, depression, outcome expectancy, acceptance and illness perceptions may be associated with participant outcomes. However, given either limited or mixed existing evidence in the specific context of VR therapy, the likely nature of these relationships is not certain and so the mechanisms of impact of Balance Retraining may differ to expectations. Current evidence pertaining to the potential importance of each of these factors for VR therapy outcomes was predominantly outlined in the general introduction (see 1.5.1). However, a brief recap, alongside any additional relevant evidence, is outlined below.

5.1.1.2.1 **Engagement with Balance Retraining intervention**

Based on theoretical and empirical evidence, the logic model of the Balance Retraining intervention positions effective engagement with Balance Retraining - including adherence to VR exercises and sufficient engagement with online sessions - as fundamental to achieving a reduction in dizziness symptoms. With the core content necessary for participants to understand and begin VR exercises presented in session one, completion of this session may reflect a minimum level of engagement required to allow participation in the target behaviour (Yardley et al., 2016). Completion of session one might therefore be considered 'effective engagement' in this context. Indeed, preliminary analysis of usage data from the RCT of the intervention suggested that those completing session one were more likely to experience lower levels of dizziness symptoms at six months than those who did not (Geraghty et al., under review). Failure to engage effectively may be detrimental to reducing dizziness symptoms.

Given that effective engagement with Balance Retraining and adherence to VR exercises are expected to be highly instrumental in determining outcomes, they may also mediate relationships between other predictors and change in dizziness symptoms. Indeed, evidence from the preceding systematic review (Essery et al., 2016) suggests that factors including self-efficacy are good predictors of adherence to self-managed physical rehabilitation therapies such as VR.

5.1.1.2.2 **Self-efficacy**

Existing theoretical and empirical evidence suggests that greater self-efficacy will be an important determinant of positive outcomes following Balance Retraining. Findings from both the systematic review and qualitative chapters of this thesis provide support for this suggestion. The longitudinal qualitative data seemed to reveal a process of increasing self-efficacy for individuals managing their dizziness, supported by participants reporting greater confidence with VR exercises towards the end of the process. This increased confidence in ability to manage symptoms may lead to reduced fear-avoidance of potential dizziness-inducing movements or activities, providing greater habituation to such movements and so decreased symptoms (Yardley, 2000; Yardley & Redfern, 2001). Furthermore, the systematic review suggested self-efficacy to be one of the strongest predictors of adherence to self-managed physical rehabilitation therapies (Essery et al., 2016) which may, in turn, impact on patient outcomes (Dimatteo et al., 2002; Yardley et al., 2012).

5.1.1.2.3 **Perceived dizziness handicap**

Based on existing empirical evidence and supported by theoretical models of health behaviour, the logic model proposes that individuals' perceived level of dizziness handicap may be an important determinant of their outcome. However, Herdman et al. (2012) reported that individuals' baseline perceived disability was not predictive of any subjective or functional measures of VR therapy outcome. Dizziness-related disability will be further investigated in this study.

5.1.1.2.4 **Treatment perceptions and expectations**

Individuals' perceptions of credibility and outcome expectancy regarding the VR intervention are expected to be instrumental in determining their outcomes. Although demonstrated to be important in the management of other long-term conditions, perceptions of treatment credibility and expectancy have not been widely investigated as predictors of VR outcome. However, the findings of the preceding qualitative study suggest that doubts about the efficacy of VR exercises may be detrimental to continued adherence which could also have negative implications for outcome (Dimatteo et al., 2002; Yardley et al., 2012). Some individuals reported being uncertain whether the exercises would help and, therefore, whether it was worth continuing.

5.1.1.2.5 Psychological distress: anxiety, depression and problems with illness acceptance

As outlined in the introduction, there is existing evidence to suggest that anxiety, depression and problems with illness acceptance may all be detrimental to dizziness related outcomes, either as a result of a direct influence on symptoms, or via a negative influence on exercise adherence. The previous qualitative study provided further evidence for the role of anxiety as influential in outcomes, with one of the perceived barriers to exercise adherence centring on concerns about the exercises. These included worries and anxiety about performing the exercises. With evidence to suggest these factors are important to dizziness-related outcomes, it is important to test these relationships in the present study.

5.1.1.2.6 Demographic variables

There is conflicting evidence for the role of age, gender and level of education in predicting outcomes following VR therapy. Several studies have suggested that neither age (Cohen & Kimball, 2003; Herdman et al., 2012; Kao et al., 2010; Topuz et al., 2004; Whitney, Wrisley, Marchetti, & Furman, 2002) nor gender (Cohen & Kimball, 2003; Herdman et al., 2012; Topuz et al., 2004) are predictive of various objective and subjective measures of improvement in dizziness following VR therapy. Conversely, other studies reported that older individuals tended to demonstrate poorer gait stability post VR therapy (Badke, Shea, Miedaner, & Grove, 2004) and that females were more likely to show significant improvement in dizziness related handicap than men (Humphriss, Baguley, Peerman, Mitchell, & Moffat, 2001). Additionally, findings from the preceding qualitative study suggest that men and women may experience barriers to VR exercise adherence differently, which may potentially influence outcomes too.

Given the conflicting evidence regarding the predictive role of demographic variables in VR outcomes, it is possible that these relationships are mediated by individuals' level of engagement. Demographic variables including age, gender and level of education predicted level of engagement amongst a broad range of digital health behaviour change interventions, including for smoking cessation (Strecher et al., 2008), increasing fruit and vegetable consumption (Couper et al., 2010), work-based stress reduction (Hasson et al., 2010), physical activity (Van't Riet et al., 2010) and promoting healthy lifestyles (Verheijden et al., 2007), which in turn predicted outcomes. In all cases, females and older individuals tended to demonstrate greater engagement with the interventions. However, evidence regarding the direction of association between level of education and engagement was mixed. This potential mediating relationship does not appear to have been previously explored within the context of VR therapy.

5.1.2 Aims of the study

The aim of this process analysis was to test the hypothesised mechanisms of impact of the Balance Retraining intervention as set out by the logic model. In doing so, it aimed to understand how, and for whom, the intervention was most effective and who may require further support to achieve beneficial outcomes.

5.2 Methods

5.2.1 Design

This was a longitudinal questionnaire study analysing data provided by participants randomised into the online intervention arm of the RCT (described in section 1.6.4, page 29). Participants completed these questionnaires at baseline, three months, and six months post-randomisation.

5.2.2 Participant recruitment

As the participants for this study were recruited for the RCT, the recruitment procedures were outlined in section 2.4, page 42. This study analyses data provided by those 160 participants randomised to the intervention group only.

5.2.3 Procedure

The procedures of the present study entirely overlap with individuals' participation in the RCT and were outlined in section 2.5.1, page 44.

5.2.4 Measures

The specific variables of interest for the present study were: change in dizziness severity at both three and six months as outcome variables (as measured by the VSS-SF); and perceived dizziness handicap (DHI), credibility and expectancy (CEQ), self-efficacy for exercise; anxiety and depression (HADS), problematic experiences of therapy (PETS), acceptance (AAQII), demographic information, and engagement (usage data) as potential predictor variables. The quantitative measures utilised to collect data about each of these variables were fully detailed in section 2.5.1.1, page 44.

5.2.5 Statistical analyses

Initially, data accuracy was checked, missing data dealt with, and reliability of measures calculated as outlined in section 2.6.1.1, page 49. Preliminary analyses (section 2.6.1.2, page 50) then checked data assumptions to determine whether it was appropriate to use parametric statistical tests.

Pearson's product-moment bivariate correlations were used to analyse relationships between outcome variables and all predictor variables. This was to establish whether a relationship between the variables exists prior to the next stage of analysis.

Hierarchical regression analyses were conducted for each outcome variable to investigate the independent contribution of factors in explaining variation in outcome at three and six months. Variables to be entered in the hierarchical regression analyses, and the order in which this occurred, were determined by their predicted causal priority based on theory and findings (Cohen, Cohen, West, & Aiken, 2003). Based on the initial number of planned variables (n=14), GPower was used to calculate the required sample size assuming a medium effect size at a power level of 0.80. This revealed that a sample size of 137 would be sufficient to power a regression analyses with 14 variables to detect a medium effect size. The additional assumptions relevant to hierarchical regression analyses were checked, as outlined in section 2.6.1.2, page 50.

As previously discussed, it was predicted that effective engagement with the Balance Retraining intervention and problems with adherence may mediate the relationship between change in dizziness symptoms post-VR therapy and variables including demographic factors, depression and acceptance. To investigate these relationships, mediation analyses were conducted using the bootstrapping indirect effects method conducted using the PROCESS macro in SPSS (Hayes, 2009). With a number of advantages including no requirement for normally distributed data and suitability for small samples, Preacher and Hayes (2004) bootstrapping method of estimating indirect effects is increasingly implemented over alternative methods of mediation analyses (Field, 2013). This method involves taking repeated samples from the data, from which the indirect effect of the predictor variable on the outcome variable (i.e. via the mediating variable) is estimated. Over the recommended thousands of resamples, an approximation of the sampling distribution of the indirect effect is obtained (Field, 2013). Both regression and structural equation modelling (SEM) can be used to estimate indirect effects using this method. However, the present study's sample size was not sufficient to conduct SEM (Frazier, Tix, & Barron, 2004; Tabachnick & Fidell, 2001). Using the PROCESS macro in SPSS (Hayes, 2009) and MPlus software, point estimates and bias-corrected accelerated confidence intervals were calculated to determine whether a mediation effect was significant. Point estimates give a mean value for the bootstrapped samples, and if zero does not fall between the confidence intervals of these point estimates, a significant mediation effect can be reported (Preacher & Hayes, 2004).

5.3 Results

5.3.1 Participants and response rate

124 (77.5%) and 112 (70%) of the 160 participants randomised to the intervention arm of the trial provided either complete, or partially complete, data at three and six months, respectively. The mean age of intervention arm participants was 66.26 years (SD 9.01 years), ranging from 50 to 91 years. 107 (66.9%) of the sample were female.

5.3.2 Checking data assumptions

The data met assumptions of independence and linearity and did not deviate substantially from normality. Although the six month VSS outcome variable demonstrated a slight positive skew, the deviation was not considered large enough to necessitate non-parametric analyses. In addition, both the correlation and regression analyses were bootstrapped to account for the possible non-normality of the data (Field, 2013; Preacher & Hayes, 2004). VIF and Tolerance statistics gave no indication of collinearity in regression models and Durbin-Watson statistics were not significant, indicating independence of errors of the dependent variables. Inspection of the ZPRED/ZRESID plots indicated slight heteroscedasticity of the VSS six month data. However, whilst heteroscedasticity can increase the risk of a Type 1 error, when it is only slight it is thought to have little effect on significance tests (Berry & Feldman, 1985; Tabachnick & Fidell, 2001). As a precaution, the regression analyses on the six month VSS outcome were also re-run using the HCREG macro for SPSS. This allows calculation of heteroscedasticity-consistent standard errors which provide a more conservative significance test (Hayes, 2003). The overall model accounted for a similar proportion of variance in the outcome variable and indicated the same significant variables as the original bootstrapped regression analysis conducted in SPSS.

5.3.3 Summary of data

Means, standard deviations and response rates of all continuous variables included in the analyses are provided in Table 7. Response rates and percentages for all dichotomous variables are presented in Table 8. The low response on the self-efficacy for exercise questionnaire and the CEQ is thought to be due to their necessary positioning at the end of session one. Anyone who did not complete session one to the final page would not have completed these.

Having checked the distribution of the PETS data, it was decided that the dichotomous scoring system more accurately reflected the way in which participants had answered these questions; the majority of scores were at the extremes.

Table 7 Descriptive Statistics of all Continuous Variables Included in Analyses

Variable	**n**	**Mean (Standard Deviation)**
Baseline		
Vertigo Symptom Scale (SF)	160	15.56 (10.33)
Dizziness Handicap Inventory	160	34.83 (19.27)
Hospital Anxiety and Depression Scale		
Anxiety subscale	160	7.38 (4.45)
Depression subscale	160	4.38 (3.49)
Acceptance and Action Questionnaire II	160	15.41 (8.91)
Demographics		
Age (years)	160	66.26 (9.01)
Post session one		
Self-efficacy Scale	93	50.30 (17.33)
Credibility and Expectancy Questionnaire		
Credibility subscale	93	18.22 (5.39)
Expectancy subscale	93	16.80 (6.94)
Three month follow-up		
Vertigo Symptom Scale (SF) 3m	124	8.35 (7.08)
Hospital Anxiety and Depression Scale 3m		
Anxiety subscale	115	6.35 (4.54)
Depression subscale	115	3.93 (3.66)
Self-efficacy Scale 3m	110	48.15 (19.46)
Dizziness Handicap Inventory 3m	115	27.17 (18.53)
Six month follow-up		
Vertigo Symptom Scale (SF) 6m	112	8.74 (8.02)
Dizziness Handicap Inventory 6m	101	26.84 (20.54)
Usage data		
Total usage time (minutes)	160	48.36 (43.34)
Average login duration (minutes)	160	18.02 (9.30)

Table 8 Frequencies for all categorical variables included in analyses

Variable	Level of Variable	n	Percentage
Baseline			
Demographics			
Gender		**160**	
	Female (1)	*107*	*66.9%*
	Male (2)	*53*	*33.1%*
Further/higher education?		**160**	
	No (0)	*52*	*32.5%*
	Yes (1)	*108*	*67.5%*
Three month follow-up			
Problematic Experiences of Therapy (3m)			
PETS 3m symptoms subscale		**108**	
	Some problems	*61*	*56.5%*
	No problems	*47*	*43.5%*
PETS 3m doubts subscale		**109**	
	Some problems	*55*	*50.5%*
	No problems	*54*	*49.5%*
PETS 3m uncertainty subscale		**106**	
	Some problems	*31*	*29.2%*
	No problems	*75*	*70.8%*
PETS 3m practical subscale		**108**	
	Some problems	*75*	*69.4%*
	No problems	*33*	*30.6%*
PETS 3m support subscale		**109**	
	Some problems	*26*	*76.1%*
	No problems	*83*	*23.9%*
Subjective Improvement in Dizziness (3m)		**122**	
	Much worse (0)	*3*	*2.5%*
	A little worse (1)	*9*	*7.4%*
	Much the same (2)	*34*	*27.9%*
	A little better (3)	*27*	*22.1%*
	Much better (4)	*40*	*32.8%*
	Completely well (5)	*9*	*7.4%*
Six month follow-up			
Subjective Improvement in Dizziness (6m)		**109**	
	Much worse (0)	*0*	
	A little worse (1)	*7*	*6.4%*
	Much the same (2)	*33*	*30.3%*
	A little better (3)	*26*	*23.9%*
	Much better (4)	*30*	*27.5%*
	Completely well (5)	*13*	*11.9%*
Usage data			
Session one complete?		**160**	
	No (0)	*61*	*38.1%*
	Yes (1)	*99*	*61.9%*

5.3.4 Bivariate correlations

Pearson's product moment correlations with bias corrected accelerated (BCa) 95% confidence intervals were calculated. Intercorrelations between baseline and outcome variables are reported in Table 9. Higher baseline levels of: dizziness severity, perceived dizziness handicap, anxiety, depression and acceptance were all strongly associated with poorer dizziness outcomes at three and six months post-treatment. In addition, females were also more likely to have poorer outcomes at six months. At baseline, women and younger adults were likely to report more severe dizziness, higher perceived levels of disability and greater anxiety. Baseline levels of anxiety, depression and acceptance were all very strongly associated.

Table 10 displays intercorrelations between post-treatment and outcome variables. These reveal that adherence problems due to the exercises exacerbating symptoms are moderately associated with poorer dizziness outcomes at both three and six months. Practical problems with adhering to exercises was also associated with poorer outcomes at six months, and was also approaching significance at three months ($p = .051$). Unexpectedly, there appeared to be no association between self-efficacy, perceived credibility or outcome expectancy and dizziness outcomes at either three or six months. However, self-efficacy appeared to be strongly negatively associated with a range of adherence problems reported at three months.

Table 9 Pearson’s Product Moment Correlations between Baseline and Outcome Variables

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Baseline (pre-treatment)													
1. Dizziness severity (n = 160)	-												
2. Perceived dizziness handicap (n = 160)	.62**	-											
3. Anxiety (n = 160)	.51**	.60**	-										
4. Depression (n = 160)	.45**	.58**	.66**	-									
5. Acceptance (n = 160)	.36**	.50**	.72**	.72**	-								
6. Age (n = 160)	-.29**	-.19*	-.29**	-.14	-.28**	-							
7. Gender (n = 160)	-.16*	-.20*	-.16*	-.05	-.03	.20*	-						
8. Education level (n = 160)	-.05	-.06	-.12	-.06	-.13	-.03	-.02	-					
Usage data													
9. Total login duration (n = 160)	.05	.27**	-.01	.12	.03	.21**	-.07	-.08	-				
10. Completion of session one (n = 160)	.04	.07	.02	-.03	.05	-.07	.03	-.02	.43**	-			
11. Average login duration (n = 160)	.05	.02	-.04	.03	-.09	.15	.06	-.10	-.01	-.19*	-		
Outcome (post-treatment)													
12. 3 month dizziness severity (n = 124)	.61**	.43**	.44**	.41**	.30**	-.11	-.15	-.003	.10	.11	.10	-	
13. 6 month dizziness severity (n = 112 unless otherwise stated)	.52**	.41**	.36**	.38**	.34**	-.14	-.24*	-.02	-.12	.02	.16	.73** n =107	-

* p < .05, ** p < .01

Table 10 Pearson’s Product Moment Correlations between Post Treatment and Outcome Variables

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Post session one										
1. Perceived credibility	-									
2. Outcome expectancy	0.66**	-								
(n = 93)										
3. Self-efficacy	0.35**	0.40**	-							
(n = 93)										
3m follow-up (post-treatment)										
4. PETS symptoms	-.14	-.07	-.24(*)	-						
(n = 67)										
5. PETS uncertainty	-.25*	-.36**	-.26*	.16	-					
(n)	67	67	67	106						
6. PETS doubts	-.27*	-.17	-.31**	.31**	.45**	-				
(n)	67	67	67	106	106					
7. PETS practical	-.03	.06	-.21	.10	.16	.13	-			
(n)	67	67	67	106	106	106				
8. PETS support	-.09	-.18	-.40**	.29**	.42**	.49**	.26**	-		
(n)	67	67	67	106	106	106	106			
Outcome (post-treatment)										
9. 3 month dizziness severity	-.08	-.07	-.17	.33**	-.05	-.04	.19(*)	.09	-	
(n)	76	76	76	106	106	106	106	106		
10. 6 month dizziness severity	-.10	-.20	-.11	.31**	-.02	.04	.23*	.10	.73**	-
(n)	70	70	70	93	93	93	93	93	107	

(*) p <.06 (near significant trend),* p < .05, ** p < .01

5.3.5 Predictors of three and six month dizziness severity

Two bootstrapped hierarchical multiple regression analyses were conducted to determine the extent to which different factors predicted change in dizziness severity at three and six months. In both models, baseline symptom severity was entered in step one to control for this. Demographic variables (age and gender) were entered on step two as factors that individuals have no control over. Psychological variables; baseline perceived handicap, anxiety, depression and acceptance were entered on step three. Finally, adherence problems and usage variables; the five PETS subscales and total login duration were entered on step four. Self-efficacy, credibility and expectancy were excluded from regression analyses due to their lack of association with outcomes in the preceding correlations, and their potential inclusion creating a substantial reduction in statistical power as a result of poor response on these items. Education level and session one completion status were also excluded given their lack of association with other variables in the correlation analyses.

Results of the three month dizziness outcome regression analysis are shown in Table 11. The overall model was significant and accounted for 46.8% of the variance in change in dizziness severity at three months. Baseline dizziness symptoms accounted for 34.1% of this variance; the psychological variables accounted for an additional 4.8%; and finally, adherence problems and usage variables accounted for a further 7.8%. Demographic variables accounted for less than 1% of variance. In the final model, only higher baseline dizziness severity and adherence problems relating to exacerbation of symptoms significantly predicted poorer dizziness outcome at three months.

Table 11 Bootstrapped Hierarchical Regression Analyses for Three Month Dizziness Outcome

Model		**B**	**Std. Error (SE)**	**β**	**BCa 95% Confidence Interval**
1					
	(Constant)	1.69	.87		[-.01 , 3.47]
	Baseline dizziness severity	.42	.06	.58**	[.30 , .55]
2					
	(Constant)	.98	5.00		[-8.61 ,10.48]
	Baseline dizziness severity	.42	.07	.59**	[.30 , .56]
	Age	.01	.07	.01	[-.13 , .16]
	Gender	.04	1.22	.003	[-2.42 ,2.28]
3					
	(Constant)	-.58	5.63		[-10.80, 9.51]
	Baseline dizziness severity	.32	.08	.45*	[.16 , .48]
	Age	.01	.07	.01	[-.14 , .16]
	Gender	.43	1.24	.03	[-2.09 ,3.06]
	Perceived handicap	.02	.04	.06	[-.06 , .10]
	Baseline anxiety	.29	.22	.18	[-.16 , .81]
	Baseline depression	.43	.29	.21	[-.17, .96]
	Baseline acceptance	-.15	.13	-.19	[-.43, .10]
4					
	(Constant)	-5.03	6.05		[-15.83 , 6.19]
	Baseline dizziness severity	.30	.08	.42**	[.15 , .46]
	Age	.04	.08	.05	[-.13 , .20]
	Gender	1.60	1.18	.11	[-.77 , 3.95]
	Perceived handicap	-.001	.05	-.002	[-.11 , .10]
	Baseline anxiety	.29	.23	.18	[-.18 , .78]
	Baseline depression	.49	.28	.24	[-.14 , 1.02]
	Baseline acceptance	-.16	.13	-.20	[-.46 , .10]
	PETS symptoms	3.86	1.29	.27*	[1.35 , 6.34]
	PETS uncertainty	-2.34	1.27	-.15	[-4.90 , .16]
	PETS doubts	-1.26	1.46	-.09	[-4.27 ,1.46]
	PETS practical	1.59	1.32	.10	[-1.07 , 4.39]
	PETS support	.14	1.76	.01	[-3.27 , 3.67]
	Total login time	.003	.00	-.01	[-.001 , .001]

Total R^2 = .47; Step 1 R^2 = .34, F (1, 104) = 53.91**; Step 2 R^2 change = .000, F (3, 102) = 17.64**; Step 3 R^2 change = .05, F (7, 98) = 8.95**; Step 4 R^2 change = .08, F (13, 92) = 6.20**

* p < .01, ** p < .001

Results of the six month dizziness outcome regression analysis are shown in Table 12. The overall model was significant and accounted for 39.2% of the variance in change in dizziness severity at six months. Baseline dizziness symptoms accounted for 22.2% of this variance; the psychological variables accounted for an additional 4.4%; and finally, adherence problems and usage variables accounted for a further 14.2%. Demographic variables accounted for less than 1% of variance. In the final model, less total time using Balance Retraining and adherence problems relating to exacerbation of symptoms and practical problems significantly predicted poorer dizziness outcome at six months. Higher levels of baseline dizziness (p = .058) and baseline levels of perceived handicap (p = .052) also demonstrated near-significant trends towards predicting poorer six month dizziness outcomes.

Table 12 Bootstrapped Hierarchical Regression Analyses for Six Month Dizziness Outcome

Model		**B**	**Std. Error (SE)**	**β**	**BCa 95% Confidence Interval**
1					
	(Constant)	2.63	1.04		[.69 , 4.63]
	Baseline dizziness severity	.37	.08	.47***	[.23 , .55]
2					
	(Constant)	3.01	5.40		[-6.97 , 12.87]
	Baseline dizziness severity	.36	.08	.46***	[.21 , .54]
	Age	.03	.08	.03	[-.13 , .20]
	Gender	-1.53	1.40	-.10	[-4.29 , 1.03]
3					
	(Constant)	-.18	5.56		[-9.90 , 9.14]
	Baseline dizziness severity	.24	.11	.31*	[.04 , .45]
	Age	.04	.08	.04	[-.12 , .20]
	Gender	-1.01	1.62	-.06	[-4.19 , 2.26]
	Perceived handicap	.07	.06	.17	[-.05 , .18]
	Baseline anxiety	.10	.28	.06	[-.52 , .71]
	Baseline depression	.31	.38	.14	[-.49 , 1.02]
	Baseline acceptance	-.06	.21	-.07	[-.45 , .36]
4					
	(Constant)	-2.57	6.12		[-13.96 , 9.12]
	Baseline dizziness severity	.20	.10	.26(*)	[.003 , .43]
	Age	.05	.08	.06	[-.12 , .20]
	Gender	-.30	1.60	-.02	[-3.77 , 2.95]
	Perceived handicap	.11	.06	.28(*)	[-.01 , .22]
	Baseline anxiety	-.18	.28	-.10	[-.80 , .35]
	Baseline depression	.47	.38	.22	[-.32 , 1.22]
	Baseline acceptance	-.01	.20	-.01	[-.39 , .41]
	PETS symptoms	3.76	1.69	.24*	[.80 , 6.70]
	PETS uncertainty	-2.88	1.58	-.17	[-6.04 , .18]
	PETS doubts	.23	1.90	.02	[-3.63 , 4.30]
	PETS practical	3.36	1.53	.20*	[.39 , 6.09]
	PETS support	-1.50	2.05	-.08	[-5.96 , 3.17]
	Total login time	-.001	.000	-.31**	[-.002, .000]

Total R^2 = .39; Step 1 R^2 = .22, F (1, 91) = 25.90***; Step 2 R^2 change = .01, F (3, 89) = 8.89***; Step 3 R^2 change = .04, F (7, 85) = 4.60***; Step 4 R^2 change = .14, F (13, 79) = 4.34***

(*) p <.06 (near significant trend),* p < .05, ** p < .01, *** p < .001

Further exploratory analyses were conducted to ascertain whether individuals with the most severe dizziness were failing to benefit from VR at three months, as these findings initially seem to suggest. This analysis investigated the hypothesis that their improvements were simply masked by higher post-treatment dizziness relative to individuals starting from a lower baseline dizziness level. Baseline dizziness severity was investigated as a predictor of dizziness improvement in terms of two alternative measures: subjective improvement in dizziness; and change in percieved dizziness handicap.

To address concerns that the subjective improvement single item may not be a robust measure of dizziness improvement, partial correlations were first conducted with VSS and DHI outcomes (controlling for baseline VSS and DHI). These revealed high intercorrelations between all three variables (see Appendix P), providing evidence for the utlity of subjective improvement as a reliable measure of dizziness improvement.

Subsequent regression analyses revealed that baseline dizziness severity did not predict subjective improvement in dizziness, or change in percieved handicap. Given the near-significant trend towards baseline dizziness predicting six month dizziness severity, these same analyses were performed with the six month data. Baseline dizziness also failed to predict subjective improvement or change in percieved handicap at six months. Individuals' perceptions about how much they have improved and changes in their dizziness-related impairment are unrelated to how severe their symptoms were to start with.

5.3.6 Mediation analyses

It was hypothesised that the relationship between dizziness outcomes and: demographic variables (e.g. age, gender), and various psychological variables (e.g. anxiety, self-efficacy, depression) may be mediated by levels of engagement (i.e. adherence problems and usage). Taking into consideration the results of both the correlation and regression analyses, many of these demographic and psychological variables were (sometimes very strongly) associated with both three and six month dizziness outcomes. However, once added into a regression model with other variables, they no longer significantly predicted outcomes. In line with the hypotheses, this suggests that some of these other variables may explain demographic and psychological variables' association with dizziness outcomes. In addition, following the six month outcome regression analysis in which baseline symptoms were reduced to marginal significance after the inclusion of engagement variables, it was considered that these may also explain the relationship between baseline dizziness and six month dizziness severity.

Given the evidence that adherence problems relating to symptom exacerbation significantly predicted both three and six month outcome, and that total duration of usage and adherence problems relating to practical problems predicted six month outcome, mediation analyses were conducted to determine whether these factors mediated the relationship between dizziness outcomes and: age, gender, anxiety, depression, self-efficacy, acceptance and baseline dizziness. Self-efficacy was included in the mediation analyses despite no significant correlations with outcomes. These findings were contrary to expectations based on existing literature, but the bivariate correlations did demonstrate some strong associations between self-efficacy and various adherence-problem subscales. Furthermore, it is recognised that a variable may have an indirect effect on an outcome via a mediating variable without demonstrating a direct relationship (Hayes, 2009; Hayes, 2013).

Mediation analyses were conducted as described in the ‘statistical analyses’ section (5.2.5, page 134) using the PROCESS SPSS macro for the continuous mediator variables (e.g. total login duration) and MPlus software for the dichotomous mediator variables (e.g. PETS symptoms). The results of these analyses revealed that neither total login duration, nor adherence problems resulting from practical issues, mediated any of the investigated relationships between post-treatment dizziness outcomes and either demographic or psychological variables. There were also no significant mediation effects of any engagement variables on the relationships between dizziness outcomes and age, depression or acceptance.

However, adherence problems due to exacerbation of symptoms did mediate the relationship between gender and post-treatment dizziness at three months. Figure 9 demonstrates that a person’s gender significantly indirectly effects the severity of dizziness symptoms three months post-treatment through adherence problems relating to exacerbation of symptoms ($b = -2.22$, bootstrapped standard error = 1.0, 99% BCa CI [-5.99 , -.34]). Females were significantly more likely to experience adherence problems as a result of the exercises exacerbating their symptoms. In turn, experiencing such adherence problems predicted poorer dizziness outcomes at three months.

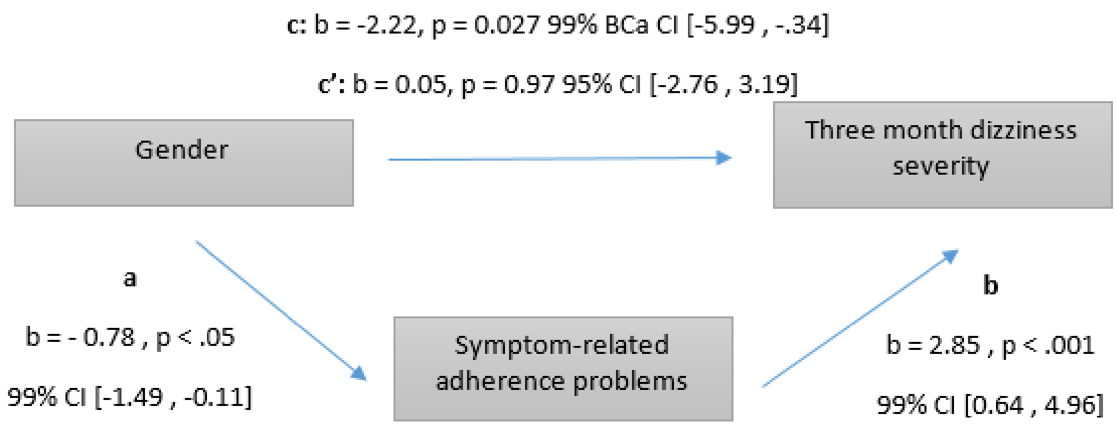


Figure 9 Mediated relationship between gender and change in dizziness at three months

The results of mediation analyses on the relationships between anxiety and dizziness outcomes and self-efficacy and dizziness outcomes were less clear. The 95% BCa confidence intervals for the indirect effects of these variables, via PETS symptoms, on both three and six month dizziness severity did not cross zero, suggesting significant mediation. However, the corresponding p values were not significant. Upon consulting with the authors of the MPlus software regarding this apparent contradiction, they advised that this was an indication that the confidence intervals were asymmetric. Despite this, they stated that these confidence intervals could still be interpreted in the same way and that therefore, the results implied a significant mediation effect. This was also the case for the indirect effect of gender, and of baseline dizziness severity, on six month dizziness severity via PETS symptoms.

This being the case, these results suggest that individuals with: lower beliefs about their ability to complete the VR exercises; higher levels of baseline anxiety; and more severe baseline dizziness, are significantly more likely to experience adherence problems relating to symptom exacerbation. In turn, these adherence problems significantly predict poorer dizziness post-treatment. However, given the contradictory nature of the mediation analyses output, these findings should be interpreted with caution.

5.4 Discussion

This study aimed to identify factors that predict levels of post-treatment dizziness following an internet-based VR intervention amongst adults over the age of fifty. It aimed to provide a clearer understanding of how, why, and under what conditions VR is likely to be effective in reducing dizziness severity, and whether particular groups may need additional support to achieve beneficial outcomes. A depiction of the relationships between investigated variables is provided in Figure 10.

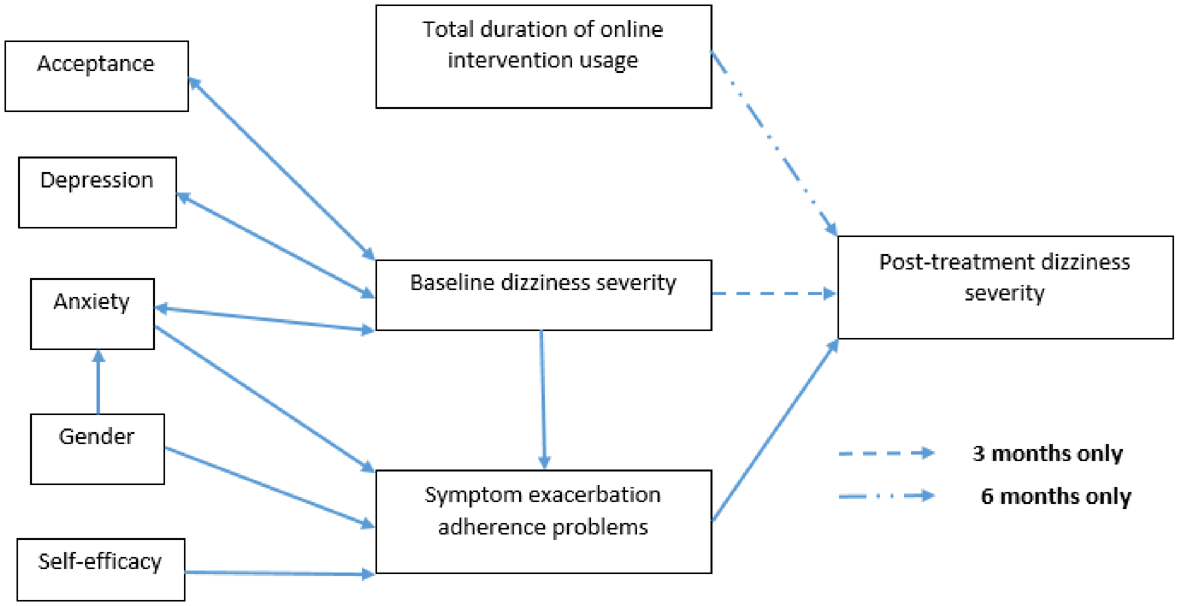


Figure 10 Summary of relationships between variables

5.4.1 Predicting dizziness outcomes following internet-supported VR

5.4.1.1 The role of symptom severity

Individuals reporting more severe dizziness prior to treatment tended to have poorer post-treatment dizziness outcomes. Baseline levels of dizziness were the strongest predictor of change in dizziness severity at three months, and were responsible for more than half of the variance accounted for at three and six months. Pre-treatment levels of dizziness disability and nature of symptoms have similarly predicted subjective dizziness outcomes in previous studies (Herdman et al., 2012; Shepard et al., 1993). Whilst those with higher baseline symptom severity are more likely to have higher post-treatment dizziness severity, further analysis revealed that this does not reflect a lack of improvement following VR. Baseline dizziness severity predicted neither subjective improvement in dizziness, nor change in percieved dizziness handicap at either time point. Individuals' perceptions about how much they have improved and changes in their dizziness-related impairment are unrelated to how severe their symptoms were to start with. Instead, it simply reflects these individuals' improvements being masked by their higher post-treatment scores relative to those starting from a lower baseline of dizziness severity.

This study also provided evidence that adherence problems may be responsible for the effects of baseline dizziness on longer-term outcomes. In predicting six month dizziness outcome, baseline dizziness severity was reduced to only marginal significance once adherence problems and intervention usage were taken into account. Further analysis revealed that individuals with higher baseline dizziness were more likely to have problems with VR exercise adherence due to exacerbation of their symptoms, which in turn predicted poorer outcomes at six months. So whilst baseline dizziness independently predicts dizziness outcomes at three months, by six months this relationship appears more complex, with more severely dizzy individuals being less willing or able to maintain their VR therapy due to their symptoms being exacerbated. This corresponds with suggestions that dizziness is often associated with avoidance of behaviours believed to trigger or worsen symptoms (Mendel et al., 1997; Yardley & Redfern, 2001). It seems plausible that those whose symptoms are more severe may be most likely to avoid these behaviours. VR exercises are liable to be included in such behaviours given their likelihood of initially increasing dizziness symptoms. The reason for the difference between baseline symptoms' impact on three and six month outcomes is unclear. The substantially smaller coefficient of baseline dizziness in the six month outcome final model ($\beta = 0.27$, compared to $\beta = 0.42$ at three months) suggests that it is not simply an effect of decreased statistical power resulting from poorer response rates to six-month questionnaires.

5.4.1.2 **The role of adherence problems**

The findings provide further evidence that exercise adherence problems play an important role in individuals' dizziness outcomes. The most consistent predictor of dizziness outcome across time points was exercise adherence problems due to experiencing exacerbation of symptoms. Those who experienced problems with adhering to their VR exercises because of symptom exacerbation were likely to experience poorer dizziness outcomes at three and six months post-treatment, even after controlling for the effects of baseline dizziness severity. It is unsurprising that those reporting problems adhering to VR therapy are more likely to have poor outcomes, given that regular and consistent practise of the exercises is known to be important for beneficial outcomes (Yardley et al., 2012; Yardley & Kirby, 2006). More interesting is that adherence problems relating to symptom exacerbation and practical barriers, but not other problems, predicted outcome. As suggested previously, practical barriers might be considered more socially acceptable justifications for non-adherence that might, in reality, be due to other factors. The seeming importance of symptom exacerbation as a barrier to adherence is discussed further in section 7.3.1, page 199.

As well as being a strong predictor of outcome in isolation, mediation analyses revealed that symptom-related adherence problems were instrumental in relationships between: gender and change in dizziness; self-efficacy and change in dizziness; and anxiety and change in dizziness.

Highly anxious individuals, individuals with low beliefs about their ability to complete VR exercises, and women appeared more susceptible to poorer post-treatment dizziness outcomes resulting from their higher likelihood of experiencing symptom-related adherence problems. These results extend the findings of previous studies similarly reporting that anxious individuals are likely to have poorer outcomes following VR therapy (Herdman et al., 2012), by providing an understanding of why this might be. Literature regarding the relationship between dizziness and anxiety (Haug et al., 2004) can help explain why more anxious individuals may be more likely to have problems with adhering to VR exercises due to symptom exacerbation. Experiencing anxiety can, in itself, exacerbate autonomic symptoms such as dizziness and nausea and encourage individuals to self- restrict activity, therefore maintaining a cycle of inactivity and failure to habituate (Yardley & Redfern, 2001). As VR exercises work via mechanisms of neurological adaption and habituation, they do induce symptoms and so are susceptible to such avoidance, particularly amongst those most anxious about their symptoms.

Although self-efficacy doesn’t appear to have been previously investigated as a predictor of VR therapy outcomes, these findings are in line with previous research that demonstrated PBC to be predictive of adherence to home-based VR therapy (Yardley & Donovan-Hall, 2007). The similarity of the self-efficacy and PBC constructs have been previously recognised (Ajzen, 1991). More general literature relating to self-efficacy theory (Bandura, 1977) can help to explain why those with low self-efficacy may be susceptible to symptom-related adherence problems. Self-efficacy refers to individuals’ confidence in their ability to complete a given task (Bandura, 1977) and tends to increase with successful performance of a given behaviour through improving individuals’ perceptions of competence (McAuley, 1993). This increases their likelihood of performing the behaviour again and allows them to overcome challenges associated with the behaviour with greater ease (Sniehotta et al., 2005). It is possible that those with low self-efficacy perceived the symptom exacerbation resulting from VR exercises as a sign that they were performing the exercises incorrectly. This may have discouraged them from continuing and limited their sense of competence regarding conducting the exercises. Without this sense of competence, they may have had more difficulty overcoming challenges – such as symptom exacerbation – associated with the exercises. Although the intervention attempted to overcome such issues by providing reassurance that initial exacerbation of symptoms was an indication that the exercises were working, it is possible that this wasn’t sufficient for those with poorer self-efficacy. These individuals may need further support and reassurance in this regard.

The findings relating to gender are somewhat contrary to previous research, with most suggesting that women engage more effectively with digital interventions (Van't Riet et al., 2010; Verheijden et al., 2007) and demonstrate better outcomes from VR therapy (Humphriss et al., 2001). This contradictory finding, in the context of dizziness, may result from women demonstrating tendencies towards being more anxious than men. Correlations between baseline variables did demonstrate women to be significantly more anxious than men. As such, women's greater likelihood of experiencing symptom-related adherence problems may result from their higher anxiety and the associated avoidance of symptom-inducing behaviours, as discussed above.

5.4.1.3 **The role of engagement**

As well as problems with adherence to VR exercises, engagement with the online intervention sessions also appeared important for longer-term dizziness outcomes. Individuals spending a greater amount of time using Balance Retraining had better six-month dizziness outcomes, even after controlling for baseline dizziness severity. This corroborates views that level of usage across a range of digital health interventions are a good predictor of outcomes (Bennett & Glasgow, 2009). However, in the case of internet-supported VR, only longer-term outcomes were predicted by the amount of time spent using the online intervention. Although most intervention content is likely to have been accessed prior to the three month follow-up, some individuals may have continued to use the online intervention beyond this time. In such cases they may have obtained benefit from the online intervention beyond this point, which would not necessarily have been reflected in their three month dizziness outcome reporting. Accordingly, their total usage time of the intervention could not be expected to predict their outcome at three months. Further analysis of the intervention usage data in the following study will allow us to investigate this further.

5.4.1.4 **The role of psychological factors**

Psychological factors (depression, anxiety, and acceptance) were strongly associated with dizziness outcomes: people who were more distressed and less accepting/ more experientially avoidant to start with were more likely to have poorer dizziness outcomes. This supports existing research suggesting that the presence of such psychological distress or avoidance predicts poorer outcomes in dizziness (Herdman et al., 2012) or in related audiological conditions (Hesser & Andersson, 2009). However, once baseline levels of dizziness were accounted for, none of these variables continued to predict dizziness outcomes. This suggests that baseline dizziness may play a role the associations between such psychological variables and dizziness outcome; indeed, the baseline data demonstrates that the people who are most distressed and least accepting to begin with are those who experience the most severe/frequent dizziness symptoms. Those experiencing worse symptoms to start with are, in turn, more likely to have poor dizziness outcomes, as already indicated by the strong predictive ability of baseline symptoms. These baseline associations may be due to the frightening nature of dizziness symptoms meaning that they are often associated with panic and distress (Mendel et al., 1997). It is also thought that depression influences individuals' symptom-related cognitions and can create perceptions that dizziness is not controllable, and that it is therefore not worth trying to control (Krebs et al., 2003; Yardley, 2000). It is evident how these relationships could become cyclical, with dizziness symptoms creating distress and distress then perpetuating symptoms further. In the case of anxiety, however, the association with dizziness outcomes may be also accounted for by symptom-related adherence problems, as revealed by the previously discussed mediation analyses.

It is likely that the association between low acceptance/high experiential avoidance and dizziness severity is due to the intensely frightening and debilitating nature of symptoms. The more severe and/or frequent dizziness symptoms are, the more likely they are to impact upon individuals' ability to continue with, and enjoy, day-to-day life experiences (Mendel, Bergenius, & Langius, 1999).

5.4.1.5 **The limited role of self-efficacy, outcome expectations and demographic factors**

Contrary to predictions based on previous findings (Yardley, Burgneay, et al., 1998) and theoretical literature (Bandura, 1977; Rosenstock, 1974), neither outcome expectations or self-efficacy appeared to play a direct role in individuals' dizziness outcomes. It is possible that the lack of significant findings between these variables and dizziness outcomes was due to poor response rates on these items and, therefore, insufficient statistical power to detect any effects. However, mediation analyses revealed that a relationship between self-efficacy and dizziness outcomes may instead operate through symptom-related adherence problems as discussed.

Aside from gender's adherence problem-mediated relationship with outcome, demographic variables appeared to have little predictive value for dizziness outcomes. This does align with a substantial amount of existing literature suggesting that demographic variables are not important predictors of outcome in VR therapy (Cohen & Kimball, 2003; Herdman et al., 2012; Topuz et al., 2004; Whitney et al., 2002). Despite there being no apparent effect of age on dizziness outcomes, the baseline data demonstrated that older adults were less likely to be anxious and tended to report lower levels of dizziness disability at baseline. This perhaps demonstrates this group's expectations of what is 'normal' or 'to be expected' at their age. This sentiment is reflected in the previous qualitative study's findings within this thesis; some respondents commented on such symptoms simply being 'par for the course' as an older person. Older adults may also perceive their dizziness as less disabling or anxiety provoking compared to other, perhaps more serious, medical conditions they may be attempting to manage.

5.4.2 Limitations

The limitations of the present study mainly stem from the sample size and questionnaire response rate, particularly on the self-efficacy and credibility and expectancy measures. Although the recruited sample size should have provided sufficient statistical power for the number of predictors to be investigated, this was somewhat reduced by non-response on various follow-up measures and the associated listwise deletion of cases. The very poor response on the CEQ and self-efficacy measures necessitated their exclusion from regression analyses altogether. This poor response was due to their placement at the end of the first session of the intervention, which 41% of participants did not reach. However, given that participants needed to view session one content before completing these measures, it is difficult to know how this may have been overcome. In addition, the final regression models indicate that only around 40% of the variance in post-treatment dizziness outcomes was explained. With a substantial amount of the variance still unaccounted for this suggests that there are variables unmeasured by the present study that predict dizziness outcomes.

5.4.3 Implications

5.4.3.1 Implications for research

To address the limitations of the current research and provide further insight into the circumstances under which online VR therapy is likely to be effective, it is important to conduct studies with greater statistical power. This will require larger sample sizes and would allow inclusion of additional potential predictors in statistical analyses. Variables such as motivation and social support were not investigated in the present study and have been identified as strong predictors of adherence to home-based physical therapies (Essery et al., 2016), which may have implications for outcomes. Given the apparent importance of adherence problems for outcome demonstrated by the present study, it would also be valuable to include a more direct measure of adherence to VR exercises. This would allow investigation of the predictive value of actual adherence to VR exercises for post-treatment dizziness outcomes.

These findings also demonstrate the importance of employing more than one outcome-relevant measure in such predictor studies. Without the additional perceived dizziness handicap and subjective improvement in dizziness measures in the present study, it would not have been possible to disentangle more severely dizzy individuals' relatively high post-treatment dizziness severity scores from an apparent lack of improvement post-treatment.

5.4.3.1.1 **Implications for this thesis**

Following the findings that a greater amount of time using Balance Retraining predicted more positive six-month outcomes, it is important to investigate this relationship further. This will allow a better understanding of the mechanisms through which more time on the intervention equated to greater post-treatment dizziness outcomes. The final study will investigate the role of engagement with the Balance Retraining intervention in greater detail.

5.4.3.2 **Implications for practice**

This study has provided valuable information about particular groups who may require additional support to achieve beneficial outcomes from internet-supported VR therapy. It has also provided an understanding of why such individuals had poorer outcomes and, therefore, how additional support may be effectively targeted. This is discussed further in section 7.5.2, page 213.

5.5 Conclusions

This study has identified predictors of internet-supported vestibular rehabilitation amongst adults aged fifty and over. The study supports previous findings that not all groups of individuals benefit equally from VR therapy (Herdman et al., 2012), but provides further insight into potential mechanisms through which poorer outcomes are likely to arise, and who may be most susceptible. Engagement with the online intervention, both in terms of level of use of online sessions and problems with adhering to the VR exercises, is important for dizziness outcomes. Females, anxious individuals and individuals who doubt their ability to complete the exercises appeared especially susceptible to adherence problems resulting from symptom exacerbation, and in turn tended to have poorer outcomes. When implementing such interventions, additional support for these groups may overcome the barriers posed by symptom exacerbation in order for them to achieve the same benefit as others. The role of engagement with the online intervention in predicting outcome requires further investigation to more fully understand the mechanisms through which longer duration of use predicts greater outcomes at longer-term follow-up.

Chapter 6: Investigating the Impact of Varied Engagement with Balance Retraining on Behavioural Determinants and Outcomes

6.1 Brief introduction and rationale

As outlined in the introduction, existing empirical (see 1.5.1.2.2) and theoretical (see 1.5.2.2) evidence suggests that engagement with digital interventions is an important factor for user outcomes. The findings of the preceding chapter also suggest that greater overall engagement with the intervention was predictive of better symptom-related outcomes. However, it is not entirely clear how and why engagement is associated with outcomes in this way. Based on existing evidence, the Balance Retraining logic model proposes that a user's level of engagement with the online intervention is likely to impact on outcomes via the behavioural determinants. It further suggests that personal and contextual factors influence individuals' level of engagement. However, it is not clear whether use of particular features are associated with particular behavioural determinants in the ways intended; neither is it certain which personal and contextual factors are associated with levels of engagement. Recent thinking also suggests that 'effective engagement' may be a more meaningful concept (Yardley et al., 2016). Detailed investigation of exactly how users engaged with the intervention would reveal what constitutes 'effective engagement' for Balance Retraining.

An understanding of 'effective engagement' for this intervention may also help to establish whether beneficial outcomes from Balance Retraining can be further maximised. This is important because, despite the intervention's effectiveness, the effect size was relatively small and attrition amongst the intervention arm was high after session one. In order to determine what 'effective engagement' for the Balance Retraining is, it is necessary to investigate exactly which elements were engaged with by users, and how different patterns of usage impacted on health outcomes and behavioural determinants. Indeed, recent work in the field of hearing health acknowledged the importance of identifying the 'active ingredients' for such interventions in order to fully understand the processes through which they are effective (Greenwell, Sereda, Coulson, El Refaie, & Hoare, 2016; Greenwell, Sereda, Coulson, & Hoare, 2016). Furthermore, it will be valuable to investigate what factors and experiences influence users' engagement with the Balance Retraining intervention – a key research priority identified by Yardley et al. (2016).

6.1.1 Aims of the study

Accordingly, the present study aims to conduct an exploratory analysis to provide a more detailed understanding of the relationships between engagement, behavioural determinants and outcomes in order to refine the logic model. It aims to clarify: which features of the intervention, and therefore which BCTs, were most used, by whom, and under what circumstances; and whether engagement with these particular features is associated with improved outcomes, and through which mechanisms this occurs. It aims to address these objectives via three research questions:

1) **What features of Balance Retraining are most used and why?**

This phase will aim to clarify which features of Balance Retraining were most used and to understand how users perceived these aspects. This will facilitate an understanding of which are the most acceptable, popular and highly used features of the intervention and to get a sense of why this might be the case. It will also allow identification of which of the underlying BCTs (Appendix B) are most likely to be meaningfully related to outcomes, and therefore which are important for the next phase of the analysis; determining what patterns of engagement with these features and the underlying BCTs are most associated with changes in behavioural determinants. For example, if the video demonstrations (BCTs: instruction on how to perform the behaviour; demonstration of behaviour; behavioural practise/rehearsal) are revealed as a highly used feature, then phase two will compare differences in usage patterns (e.g. use compared to non-use) in relation to changes in targeted behavioural determinants (e.g. self-efficacy).

2) **What impact do varied levels of intervention usage, and engagement with particular features have on behavioural determinants and outcomes targeted by the intervention?**

The second research question aims to clarify what ‘effective engagement’ with the Balance Retraining involves. It will investigate whether differential engagement with particular features is associated with user outcomes and behavioural determinants targeted by the intervention (as outlined in the logic model), and whether those who engage to a greater or lesser extent have qualitatively different experiences. In doing so, it will identify which of the underlying BCTs were most predictive of successful dizziness outcomes. For example, were greater overall levels of use associated with greater self-efficacy and reduced dizziness, or was completion of session one enough to achieve these changes? If completion of session one was sufficient, by having identified which BCTs are present in this section, it is possible to understand which BCTs are associated with these specific behavioural changes.

The answers to these questions are important to determine which BCTs are most instrumental in the Balance Retraining intervention and how much they need to be used to maximise the chance of beneficial outcomes. This will provide insight into which features of the intervention users should be most encouraged to engage with, and give a better understanding of the behavioural mechanisms through which positive outcomes are achieved. These findings will also inform the final phase of the study by revealing which aspects of engagement with Balance Retraining it is valuable to attempt to predict. For example, if overall usage time of the intervention has no influence on any of the targeted outcomes or behavioural determinants, whereas completion (or not) of session one does, then it would be more valuable to investigate what influences whether users complete session one than what influences their total usage time.

3) What influences engagement with the key components of Balance Retraining?

The final phase aims to provide an understanding of what influences effective engagement with the key features - as determined by the preceding phases – of the Balance Retraining intervention. This will involve analysis of factors that predict engagement with these features and their underlying BCTs, and also investigation of what users perceive to be barriers and motivators to their engagement with the intervention. This will provide a clearer picture of which particular groups, and under which circumstances, are most and least likely to engage with the key BCTs of the intervention, in order to identify those who may need additional support.

In determining which factors should be included as potential predictors of these various forms of engagement, existing literature was considered. As discussed in section 5.1.1.2.6, there is substantial evidence for the role of demographic factors in predicting usage of digital health interventions. Age, gender and level of education have all demonstrated associations with use, and continued use, but the effects are not always in the same direction. It would be valuable to investigate these demographics factors as predictors of more specific aspects of engagement in the context of the Balance Retraining intervention. There is also mixed evidence for the role of self-efficacy in predicting engagement with digital health interventions that may benefit from further investigation (Glasgow et al., 2007; Strecher et al., 2008). Finally, there appears to be little in the way of psychological factors, including illness perceptions and psychological distress, investigated as predictors of engagement. Given that anxiety and depression are often closely associated with dizziness symptoms (Haug et al., 2004), it seems especially relevant to consider them as potential predictors of engagement behaviour in the context of the Balance Retraining intervention. Illness perceptions have a strong theoretical evidence base as predictors of help-seeking behaviour in the context of health (e.g. CSM; HBM: Leventhal et al., 1980; Rosenstock, 1974); it might be expected, therefore, that illness perceptions (such as perceived severity and impact of dizziness) would predict engagement with a digital intervention design to support self-management of dizziness.

6.1.2 Methodological approach

In order to answer all three research questions, a mixed-methods approach was adopted. Mixed methods approaches are fully discussed in section 2.3. In the present study, although quantitative analysis of the objective usage data helps to identify patterns of use, it can't tell the whole story. It reveals very little about any engagement with intervention content that occurs offline (Yardley et al., 2016); in the case of Balance Retraining, a primary component of the intervention involves practising VR exercises on a daily basis and practising other techniques in day-to-day life. To better understand engagement with these aspects, and to understand patient motivations and perceptions that may influence their engagement, qualitative methods are highly valuable. Indeed, a recent systematic review concluded that there is a lack of methods specified in existing literature to evaluate the interface between web-based behaviour change programmes and their users (Feather et al., 2016). It emphasises the importance of investigating the psychological experience of the individual whilst engaged in the online therapeutic process (Feather et al., 2016).

6.2 Methods

6.2.1 Design

This was a mixed methods study analysing both quantitative and qualitative data provided by participants randomised into the online intervention arm of the RCT (described in section 1.6.4, page 29). Participants completed questionnaires at baseline, three months, and six months post-randomisation and their usage of the online intervention was recorded by the intervention software. A sub-sample of participants randomised to the intervention arm of the trial took part in a semi-structured telephone interview about their experiences, following completion of the trial. Analysis of the qualitative data sought to further elucidate quantitative findings by exploring whether participants' accounts of their experiences of using the online intervention and practising their exercises resonate with, explain, or perhaps even challenge, any quantitative relationships found. Constant comparison between high and low users' accounts of their experiences sought to identify any patterns arising from variation in usage.

6.2.2 Participant recruitment

As the participants for this study were recruited for the RCT, the recruitment procedures were outlined in section 2.4, page 42. On the electronic consent form for the RCT, participants indicated whether they gave permission to be re-contacted for a follow-up qualitative telephone interview after completion of six month follow-up questionnaires. A maximum variation sample in terms of usage of the online intervention (based on number of sessions accessed) selected a sub-group of these participants to be re-contacted for interview. Maximum variation sampling is a form of purposive sampling (see section 4.2.2, page 93) in which participants are selected on the basis of obtaining a diverse range of cases relevant to a particular phenomenon (Coolican, 2014). In the present study, it was important to obtain the views of users who had varying levels of engagement with the Balance Retraining intervention. As such, the researcher aimed to recruit roughly equal numbers of intervention users who demonstrated high and low use of the intervention. This study analyses quantitative data provided by those 160 participants randomised to the intervention group of the RCT, and qualitative data provided by a sub-sample of 27 of these participants.

6.2.3 Procedure

6.2.3.1 Collection of quantitative data

Regarding the collection of quantitative data for this study, the procedures entirely overlap with individuals' participation in the RCT and were outlined in section 2.5.1, page 44.

6.2.3.1.1 Quantitative Measures

The specific variables of interest for the present study were: dizziness severity (VSS-SF), perceived dizziness handicap (DHI), credibility and expectancy (CEQ), self-efficacy for exercise, anxiety and depression (HADS), problematic experiences of therapy (PETS), demographic information, and engagement (usage data). The quantitative measures utilised to collect data about each of these variables were fully detailed in section 2.5.1.1, page 44.

With the focus of the study being on engagement, the intervention usage data was especially important. Of particular interest was the 'page-duration' data, which records how many seconds participants spent on each individual page. This allows analysis of which elements of the intervention are used by which participants and for how long. During the time spent on any given page, users may leave the computer to answer the phone, talk to someone they are with, or become otherwise distracted. As such, it is recognised that page duration is not a flawless indicator of user engagement with specific content pages. However, overall it provides a useful indication of which pages users' tended to spend the longest on and, when averaged over all participants, can be considered a relatively good indicator of engagement.

6.2.3.2 Collection of qualitative data

On completion of the six month follow-up measures, participants who had consented to a follow-up interview were re-contacted by telephone or email. This ascertained whether they were still willing to take part and, if so, sought to arrange a convenient time. The qualitative interviews were conducted via telephone (see 2.5.2.1.1, page 48 for a discussion of this method). At the beginning of the call, the researcher reintroduced themselves, confirmed participants' continued consent and reminded them of information relevant to the interview procedure before beginning the audio-recording.

More general details of the qualitative interview procedure were outlined in section 2.5.2.1, page 47. The semi-structured interviews comprised a series of open-ended questions which addressed participants' experiences of using the Balance Retraining intervention and of practising the VR exercises over the course of the trial period. The interview topic guide can be viewed in Appendix Q, but topics included expectations of the Balance Retraining intervention and the VR exercises, aspects that they had found helpful and why, and any problems they had encountered and how/if they had overcome these.

Sub-sampling of the intervention arm participants for qualitative interviewing continued until no new codes and ideas appeared to be arising from the data and until the sample consisted of approximately equal proportions of 'high' and 'low' users of the intervention. At this point it was felt that data saturation had been reached (see 2.5.2.1, page 47). Audio-recorded interviews were transcribed and checked as described in 2.5.2.1, page 47.

6.2.4 Analyses

6.2.4.1 Quantitative statistical analyses

Data accuracy was checked, missing data dealt with, and reliability of measures calculated as outlined in section 2.6.1.1, page 49. Different phases of statistical analyses were conducted for each of the main research objectives of the study.

6.2.4.1.1 Phase one: investigating which features of the intervention are most used

This initial phase of the quantitative analysis primarily employed frequency and descriptive statistics regarding the incidence and duration of use of different sections of the intervention. However, this was slightly complicated by two factors. Firstly, as Balance Retraining is a sequential, session-based intervention, most content could only be seen in a certain order, on the condition that previous content had been seen, or only in certain sessions. Additionally, the majority of session content was 'tunnelled', meaning that users followed a set path through most session content in order to reach the end of the session. Therefore, if a user reached the end of any given session they would be recorded as having visited every core page in that session even if they didn't engage with the content. Despite this, the usage data provided valuable insight into the most used intervention features in a number of ways. Firstly, overall progression through the six sessions was examined to see which ones were being started and completed by how many users. Participants' start and end times for each session recorded in their user data was used to count the numbers of users who did or didn't start or complete given session.

Average page durations were also calculated for different sections of the intervention, to compare which sections users' appeared to spend most time on. All intervention pages accessed by users were grouped into key intervention components (indicated in Table 17). To gain insight into which of these key components were most/least engaged with, the 'page durations' data was used to calculate total usage time for each component. Following this, a mean usage time per user was calculated based on the number of participants who had accessed that component. Finally, based on the number of pages in each of these components a 'mean page time' was calculated to provide a comparable unit between different components. Given that there were certain key components of the intervention accessible as 'optional' content, the number of users who accessed these particular elements was totalled as an indication of how much these elements were used.

6.2.4.1.2 Phase two: investigating the impact of differential engagement with the intervention on key outcomes

For this phase, partial correlations and chi-squared tests were conducted to examine the relationships between engagement with important components of the intervention (identified by phase one) and key behavioural determinants and outcomes targeted by the intervention (as outlined in logic model, see Figure 3, page 28), whilst controlling for relevant baseline variables. Prior to correlation analyses, preliminary analyses were conducted to check that data met assumptions for parametric analysis (detailed in section 2.6.1.2, page 50).

6.2.4.1.3 Phase three: investigating what factors predict engagement with Balance Retraining

In this final phase, a series of hierarchical (logistic and linear) regression analyses were planned to investigate the independent contribution of factors in explaining variation in overall usage patterns and engagement with key intervention components. The order in which variables were entered in the hierarchical regression analyses was determined by their predicted causal priority based on theory and findings (Cohen et al., 2003). Based on the initial number of planned variables (n=10), GPower was used to calculate the required sample size assuming a medium effect size at a power level of 0.80. This revealed that a sample size of 121 would be sufficient. The additional assumptions relevant to hierarchical regression analyses were checked, as outlined in section 2.6.1.2, page 50.

6.2.4.2 Qualitative analyses

A thematic analysis of the data was carried out according to guidance set out by Braun and Clarke (2006) with the addition of the constant comparison technique advocated by the grounded theory approach (Glaser & Strauss, 1967). The process of this analysis technique was discussed in section 2.6.2.1, page 51.

In the present study, although the initial coding was very much an inductive, data-driven process, it was conducted with the overarching research questions in mind. This was to ensure that the resulting codes were very much grounded in participant experiences, but also of relevance to the concepts under investigation. The emerging themes and subthemes were discussed and agreed with the researcher's supervisory team. The coding manual (Appendix R) illustrates the structure and definitions of the final themes, subthemes and their corresponding codes.

Constant comparison techniques further explored patterns in the thematic codes across participants' differential levels of use of the intervention. This was particularly relevant to the study's second and third aims of understanding how high and low users' experiences differed in terms of their outcomes, motivations and potential barriers. Constant comparison techniques assisted in identifying patterns based on the level of use of the intervention in terms of how users recount their experiences. NVivo software was used to examine the frequency of occurrences of thematic codes across level of use. Any patterns identified in the data are discussed in the findings.

6.3 Results

6.3.1 Participant characteristics

160 participants randomised to the intervention arm of the trial provided complete usage data, and at least partial quantitative follow-up data. The mean age of participants in the intervention arm was 66.26 years (SD 9.01 years), ranging from 50 to 91 years. 107 (66.9%) of the sample were female.

A sub-sample of 27 of those participants completed a follow-up telephone interview following completion of six month follow-up measures. The characteristics of this subsample were representative of the wider intervention arm participants, with a mean age of 66.63 years (SD 8.73 years) and 19 (70.4%) being female. Based on the number of sessions completed, 12 of these were classed as low users, and 15 as high users.

6.3.2 Summary of quantitative data

Means, standard deviations and response rates of all continuous quantitative variables included in the analyses are provided in Table 13. Response rates and percentages for all dichotomous quantitative outcomes are presented in Table 14.

Table 13 Descriptive Statistics of all Continuous Variables Included in Analyses

Variable	**n**	**Mean (Standard Deviation)**
Baseline		
Vertigo Symptom Scale (SF)	160	15.56 (10.33)
Dizziness Handicap Inventory	160	34.83 (19.27)
Hospital Anxiety and Depression Scale		
Anxiety subscale	160	7.38 (4.45)
Depression subscale	160	4.38 (3.49)
Demographics		
Age (years)	160	66.26 (9.01)
Post session one		
Self-efficacy Scale	93	50.30 (17.33)
Credibility and Expectancy Questionnaire		
Credibility subscale	93	18.22 (5.39)
Expectancy subscale	93	16.80 (6.94)
Three month follow-up		
Self-efficacy Scale 3m	110	48.15 (19.46)
Credibility and Expectancy Questionnaire		
Credibility subscale	110	18.62 (6.51)
Expectancy subscale	110	15.47 (8.37)
Six month follow-up		
Vertigo Symptom Scale (SF) 6m	112	8.74 (8.02)
Dizziness Handicap Inventory 6m	101	26.84 (20.54)
Hospital Anxiety and Depression Scale 6m		
Anxiety subscale	101	6.12 (4.38)
Usage data		
Total usage time (minutes)	160	48.36 (43.34)

Table 14 Frequencies for all Categorical Variables Included in Analyses

Variable	**Level of Variable**	**n**	**Percentage**
Baseline			
Demographics			
Gender		**160**	
	Female (1)	*107*	*66.9%*
	Male (2)	*53*	*33.1%*
Further/higher education?		**160**	
	No (0)	*52*	*32.5%*
	Yes (1)	*108*	*67.5%*
Six month follow-up			
Problematic Experiences of Therapy (6m)			
PETS 6m symptoms subscale		**92**	
	Some problems	*49*	*53.3%*
	No problems	*43*	*46.7%*
PETS 6m doubts subscale		**92**	
	Some problems	*49*	*53.3%*
	No problems	*43*	*46.7%*
PETS 6m uncertainty subscale		**90**	
	Some problems	*22*	*24.4%*
	No problems	*68*	*75.6%*
PETS 6m practical subscale		**92**	
	Some problems	*64*	*30.4%*
	No problems	*28*	*69.6%*
PETS 6m support subscale		**92**	
	Some problems	*25*	*27.2%*
	No problems	*67*	*72.8%*
Usage data			
Session one complete?		**160**	
	No (0)	*61*	*38.1%*
	Yes (1)	*99*	*61.9%*

6.3.3 Summary of qualitative data

Thematic analysis of the qualitative data gave rise to six themes, comprising nine subthemes and 62 individual codes. A summary of the themes and subthemes is provided in Table 15.

Table 15 Summary of Themes and Subthemes arising from Thematic Analysis of Qualitative Data

Theme	Subtheme and Description	Number of participants
Barriers to continued engagement	**Physical or practical difficulties:** perceived barriers facing users that are physical or practical in nature	26
	Potentially detrimental beliefs and attitudes: attitudes, beliefs and cognitions that are predominantly negative and have the potential to impact on the extent to which individuals want or are able to engage with Balance Retraining	23
Motivators of continued engagement	**External motivations:** continuing due to external drives and prompts	10
	Initial desire for change: drivers of engagement relating to wanting to change their current experience and symptoms - wanting to do something about it for themselves	26
	Treatment manageable and realistic: Motivations to continue given the simplicity, ease and achievable nature of the treatment	19
Process of engagement	Accounts of different phases of engaging with Balance Retraining and the various stages involved	27
Recognition of benefits	Physical and mental changes recognised; some symptom specific but also relating to broader issues of quality of life and increased opportunities	26
Roles and responsibilities of the individual	**Pre-existing knowledge and experience of dizziness:** Indications of individuals' pre-existing understandings and experiences of their dizziness and the courses of action they have taken to date	24
	Taking responsibility and making sacrifices: Recognition that it's not always going to be pleasant and easy but that individuals have to take control and take responsibility to do something that will help themselves (including how to make the programme work best for them) and that ultimately the outcome will be worth it.	24
Valued qualities	**Nature of the intervention and its content:** perceptions of the intervention as a whole and general aspects including the overall content structure and functionality	27
	Valued features of the intervention: specific features or characteristics of the intervention that were valuable to users and how these contributed to their experiences	24

The quantitative and qualitative findings are grouped together and discussed in relation to each of the three main research questions set out in the introduction.

6.3.4 What features of Balance Retraining are most used and why?

6.3.4.1 Overall session usage

Overall session usage data (Table 16) demonstrates that only session one of a possible six was completed by the majority (59%) of participants. Only half of all participants began session two and the proportion of the sample that completed each subsequent session declined gradually session to session. Due to the sequential session nature of the intervention, we also examined the proportion of participants who completed each session that it was possible for them to complete (i.e. those sessions that they started). This revealed that completion of each *possible* session was substantially higher for sessions two to six than session one. This suggests that if participants made it to the start of sessions two to six, they were more likely to complete these than the first session. More than half (54%) of those who started session three completed all six sessions, suggesting that if a participant reached the start of session three, they were more likely than not to finish all six sessions. A fifth of all participants completed all six sessions. The main obstacles for progression through the sessions appeared to be completing session one and then returning for the start of session two.

Throughout the intervention, and especially in session one, attrition appeared to be mainly within sessions (except higher attrition between sessions one and two), i.e. people start a session but don't complete it or return again. The data suggests that the Timed Exercise Scoring Test (TEST) - particularly the initial one - was predominantly where people stopped progressing within sessions. However, with the exception of session one, only a small proportion (between 1 and 6% across sessions two to five) of those that started the sessions dropped out at that session's TEST.

Table 16 Overall session usage

Session number	Started session (n)	Completed TEST (n)	Completed session (n)	Lost in session	Lost between sessions	Completed TEST % (possible)	Completed session % (possible)
1	100% (160)	61% (98)	58% (93)	67	-	61%	58%
2	50% (80)	44% (70)	42% (67)	13	14	87.5%	84%
3	39% (63)	36% (58)	35% (56)	7	4	92%	89%
4	35% (56)	34% (54)	31% (49)	7	0	96%	88%
5	31% (49)	26% (42)	25% (40)	9	0	86%	82%
6	24% (38)	22% (35)	21% (34)	4	2	92%	89%

The qualitative data provides some additional insight into overall usage of the intervention sessions. The 'process of engagement' theme described various phases that seemed to be involved in users' engagement; from their prior expectations of the intervention, to the practical process of using Balance Retraining and engaging with the content, through to what happened after the end of the official programme. One aspect of this theme was users explicitly discussing how much they used the online sessions, often including some form of quantification of how many sessions they accessed. This revealed complex and variable relationships between the number of sessions that users actually accessed and their reports of how much they wanted, or felt they needed, to engage with the online sessions. Some talked about using multiple sessions, whereas others felt that they learned all they needed from one or two. However, even some users who accessed a high number of sessions said that once they knew what they were doing with the exercises they tended to just focus on these. Users said that they felt confident enough to not need to go back online, or that it was quicker to just use the instructions print-out:

> “I was looking at the website initially but I didn’t carry on with that… the videos and stuff? (Interviewer: Yeah.) No, no, once I got hold of [the exercises] I then was able to just carry on. I was confident that I knew exactly what to do.” (T604, Male, High user)

> “I found it easy for what I wanted. I printed the sheet out so I always had the sheet of exercises, and I found that easier because if I didn’t have much time I had the sheet there and I just did the exercises straight through. I suppose maybe I didn’t always go online to check things but I did find it very useful. There was lots of information there for people who might have become more anxious or something, but I was quite happy with the exercises and just got on with them really.” (T1609, Female, High user)

> “I think I’d probably printed off a couple… to actually look at the thing online and then go away and do it, so sometimes I would print it off and then take it with me just to read it, because actually remembering it from the screen and then do it.” (T2106, Female, Low user)

A subtheme of the ‘roles and responsibilities of the individual’ theme highlighted users’ recognition of the need to be self-disciplined and to take responsibility for helping oneself if the programme is to be successful. This included acknowledgement that it might not always be easy or pleasant but that ultimately the outcome would be worth it and so it was worth persevering. Although both high and low users expressed these sentiments, they were more frequently voiced by high users:

> “From day one I thought, well, I’m going to continue to do this thing and then I just stuck to it and, yeah, was quite happy to do it because I wanted some relief. I’ve other problems as well so to get relief on one was I felt quite worth it really.” (T3407, Male, High user)

These findings demonstrate the importance of considering the quality, as well as quantity, of engagement with the sessions given that users’ perceptions of the extent to which they used the intervention do not always match objective usage measures. Furthermore, it provides indications of why users chose to engage with the sessions in qualitatively different ways and some of the underlying beliefs and perceptions of those who made the greatest use of sessions.

6.3.4.2 Within session usage

Table 17 outlines the duration of use and/or number of users of each specific feature of the Balance Retraining intervention. The length of time users spent on the 'tunnelled' content features of the intervention was first examined. Beyond session one, all sections of the intervention had an average page use of less than a minute, with the exception of the short version of the TEST. The introductory material in session one seemed to be the content that users spent the most time engaging with - the planning exercises section being the longest, with an average page duration of 1:41 minutes. The information about psychophysiological techniques (controlled breathing, relaxation, stress management, thought control) seemed not to be engaged with as much as the information about the balance system and VR exercises, with the average page view time for most of these being between 25 and 40 seconds. Users appeared to spend slightly more time on the relaxation technique, with an average page duration of 50 seconds. Whilst the amount of participants accessing the symptom control information in each session they accessed was high (80-90%), as a proportion of total users less than 50% accessed any symptom control information. This is due to the large proportion who did not complete session one and the fact that the symptom control information was presented from session two onwards.

The optional intervention features accessed most by users were the video demonstrations and the printable instruction documents; these were accessed by 87.5% and 70% of all participants respectively. More detailed analysis reveals that the videos were predominantly accessed in session one (over 80% of participants, with 61% viewing all six), but were also frequently revisited in later sessions, with 71% of participants accessing videos at least once after session one.

Regarding the printable document pages, by far the most popular of these was the exercise instructions and the TEST table for users to record their scores offline and log them online later. This is consistent with data demonstrating that the short TEST was used more than the long version after session one. Just over a quarter of participants (25.6%) also accessed the page to print their exercise prescription at least once. Although the print pages for the psychophysiological techniques and additional activities were very minimally used, access of the controlled breathing print page was substantially higher than the rest.

Following session one when participants were given the choice between completing the long version of the TEST and the short version, the short version was also very highly accessed; 78% used it in at least one subsequent session. However, given that either the long or short version of the TEST had to be completed to progress through sessions two to six, this was not optional content in the same way. The least accessed feature was 'previous users' experiences' stories; these were accessed by less than a quarter of participants (24.4%).

Table 17 Usage Frequency and Duration of Key Features of the Balance Retraining Intervention

Feature	Number of Participants who accessed	Proportion of total	Proportion of possible completers	Total usage time (mins)	Av. usage time per user* (mins)	Av. Page time per user (min:sec)
Session 1						
Intro to dizziness	151	94.4%	94.4%	495.32	3.28	01:05
Intro to VR	150	93.8%	93.8%	600.13	4.00	01:00
Exercise demos	129	80.6%	80.6%	1044.23	8.09	-
Planning exercises	138	86.3%	86.3%	233.87	1.69	01:41
TEST full	138	86.3%	86.3%	1449.20	10.50	00:32
Practical advice	99	61.9%	61.9%	332.95	2.90	00:58
Session 2						
Symptom control	67	41.9%	83.8%	117.90	1.76	00:35
Controlled breathing	67	41.9%	83.8%	90.98	1.36	00:41
Session 3						
Relaxation	57	35.6%	90.5%	95.83	1.68	00:50
Session 4						
Visual environments	52	32.5%	92.9%	110.45	2.12	-
Stress management	49	30.6%	87.5%	82.77	1.69	00:25
Session 5						
Everyday activities	42	26.3%	85.7%	133.43	3.18	-
Thought control	40	25%	81.6%	78.80	1.97	00:29
Session 6						
General exercise	34	21.3%	89.5%	51.52	1.52	00:23
Importance of HBS	34	21.3%	89.5%	34.38	1.01	00:31
Nonspecific session [m]						
(Exercise review)	80	50%	100%	147.75	0.46	00:28
(Reinforcement)	54	33.8%	67.5%	59.50	0.31	00:19
Exercise Difficulties	73	45.6%	45.6%	121.32	1.66	-
TEST short version	73	45.6%	77.7%	624.08	2.67	01:20
Video demos (after S1)	67	41.9%	71.3%	341.07	5.06	-
Video demos (anytime)	140	87.5%	87.5%	1385.30	9.90	-
Printable instructions	109	68.1%	70%	694.13	6.37	-
Print exercise prescription	41	25.6%	25.6%	207.52	5.06	-
Others' experiences	39	24.4%	24.4%	136.62	3.50	-
Long TEST (Post S1)	62	38.8%	66%	835.03	9.10	00:29

[m], these features appeared in multiple sessions, and therefore the number of page visits (or average number of page visits if over multiple pages), rather than number of participants, was used to calculate average time spent per user

-, 'average page time per user' not calculated for some features due to variation in number of pages that may have been accessed (e.g. option to access one page, or 10 possible pages)

The 'valued qualities' theme, arising from qualitative data analysis, provides further insight into the patterns of use of intervention features. It explains the qualities of the intervention that users valued, and some differences between high and low users of the intervention sessions with regard to these. Participants often discussed specific intervention features or characteristics that they found particularly helpful and how these contributed to their experiences. Examples include the information and guidance provided, including the video demonstrations and exercises instructions. Users felt these elements helped to reduce uncertainty by clarifying details, and by clearly explaining instructions and providing new information:

> "I suppose the only [question] was initially am I doing things correctly? I think one of the things I remember rightly the first time I looked at the website I went through – it would show you how to do the exercises, so I did each exercise. So I watched the first one, I did the exercises and then move on to the next one." (T2108, Female, High user)

Reminder and record-keeping features, which included the printable documents, reminder emails and ability to revisit content, were also highly valued by users. They felt that these features allowed then to keep their own records of progress such as their scores for the weekly TEST, recap on details they had forgotten and provided them with useful prompts about when to access new content. Low users of the intervention were more likely to specify these record-keeping and reminder features as of particular value, compared to high users:

> "I think I'd probably printed off a couple because… to actually look at the thing online and then go away and do it, so sometimes I would print it off and then take it with me just to read it, because actually remembering it from the screen and then do it." (T2106, Female, Low user)

As well as specific features, participants discussed how the overall nature and feel of the intervention contributed to their experience. A large proportion, particularly of low users, discussed the clear and accessible nature of intervention content as making it very simple to follow:

> "I think it was very straightforward and easy to understand. I would be surprised if people didn't understand it and find it easy to understand. It was written in plain English, not any jargon or anything, do you know what I mean?" (T1604, Female, High User)

Users also discussed the reassuring nature of the content. They felt it helped them to realise that they weren't alone in their experiences and that how they were feeling was reasonable. They also felt that elements such as the tailored feedback reassured them that they were 'on the right track'. These perceptions of the reassuring and supportive nature of the intervention were expressed more frequently by high users of the intervention:

> "…it was so straightforward and, like I say, it was like a support system, it was almost like having somebody there to say this is okay to feel like this." (T1202, Female, High user)

This data moves beyond simply identifying which specific features were most used, to provide insight into qualities of the intervention that were most valued and why. This is important for understanding what specifically is appealing about certain features of the intervention and how users felt that this helped. It also provides insight into features that users valued that can't be measured by the usage data, such as reminder emails.

6.3.4.3 **Summary**

Considering these findings as a whole, we learn that the majority of users didn't progress beyond the first two sessions, but those who did were much more likely to access all sessions. Drop-out appeared to occur predominantly partway through sessions, particularly at the TEST. Differences between high and low users' recognition of the need for self-discipline seem important with regard to varied levels of session use. However, participants' accounts of their usage suggest that low use of sessions does not necessarily equate to non-engagement with the intervention. Users spent the longest on the introductory material in the first session, particularly the exercise planning. The psychophysiological symptom managing techniques were not highly used, but the relaxation technique more so than others. The exercise demonstration videos and printable documents were the most frequently accessed optional features, with the qualitative data suggesting that users valued the clarification of uncertainty that these provided. High and low users of sessions seemed to value different features and qualities of the intervention. High users were more likely to cite the importance of features such as the tailored feedback and reassurance provided, whereas low users favoured the record keeping and reminder features and the easy and accessible nature of the intervention.

6.3.5 What impact do varied levels of intervention usage, and engagement with particular features, have on behavioural determinants and outcomes targeted by the intervention?

Having identified features of the intervention that were most accessed and valued by users, we investigated whether differential engagement with these features, or of key measures of overall intervention usage, were associated with outcomes targeted by the intervention. As outlined in the logic model, the outcomes and behavioural determinants of interest were perceived adherence-problems, and changes in: dizziness severity, perceived handicap, anxiety, depression, self-efficacy and outcome expectancy. Checking of data assumptions revealed that a large proportion of these outcome variables were not approximately normally distributed. Accordingly, non-parametric analyses were employed. Due to the high proportion of users who used video demonstrations (87.5%), the 'use of video demonstrations' variable did not exhibit sufficient variance to use in these analyses. Instead, we examined the amount of time users spent revisiting video demonstrations after session one. The dichotomous use/non-use version of this variable did not meet assumptions of chi-squared analyses (i.e. one cell contained an expected count of less than 5) and so could not be used.

Partial Spearman's Rank Correlations were conducted between the usage and outcome variables, controlling for baseline levels of the outcome variables, and are presented in Table 18. Simple bivariate Spearman's correlations were conducted to assess the relationships between adherence problem variables (PETS subscales) and continuous usage variables, Table 19, and chi-squared analyses examined the relationships between PETS subscales and any dichotomous outcomes, Table 20.

Table 18 Effect Sizes (r) for Spearman's Partial Correlations between Usage Variables and Outcome Variables, Controlling for Baseline

	Change in dizziness severity at 6m (n=112)	**Change in perceived handicap at 6m (n=101)**	**Change in anxiety at 6m (n=101)**	**Change in depression at 6m (n=101)**	**Change in self-efficacy at 3m (n=70)**	**Change in outcome expectancy at 3m (n=69)**
Overall usage						
Total time spent	-.24*	-.11	.11	-.02	.03	.10
No. of sessions started	-.18	-.07	.07	.003	.22	.36**
Session one completion$	-.08	.03	.17	.07	a	a
Specific feature usage						
Video demonstrations post-session one (duration)	-.19*	-.12	.11	.02	-.07	-.04
Dizziness information (duration)	-.11	-.03	-.01	-.11	.02	.23
Exercise information (duration)	-.12	-.07	.06	-.04	.02	.20
Practical advice (duration)	-.25**	-.25*	.10	.03	.05	-.06
Planning (duration)	-.15	-.21*	.01	-.12	.14	.11
Relaxation (duration)	-.13	-.03	-.01	-.06	.02	.24(*)
Use of print documents$	-.18(*)	-.17	.04	.09	-.02	-.21
Use of 'exercise difficulties'$	-.15	-.05	.08	.03	-.07	-.12

$, dichotomous usage variables

a, analysis not possible due to self-efficacy and outcome expectancy data being collected post session one.

(*), approaching significance p<0.06; *, p<.05; **, p<.01

Table 19 Effect Sizes (r) for Spearman's Correlations between Continuous Usage Variables and Six Month PETS subscales

	PETS-symptoms (n=92)	PETS-uncertainty (n=90)	PETS-doubts (n=92)	PETS-practical (n=92)	PETS-support (n=92)
Overall usage					
Total time spent	-.24*	-.24*	-.14	-.05	-.12
No. of sessions started	-.31**	-.30**	-.21*	-.18	-.11
Specific feature usage					
Video demonstrations post-session one (duration)	-.03	-.08	.07	.10	-.03
Dizziness information (duration)	-.01	.10	-.06	.09	-.03
Exercise information (duration)	-.07	.001	-.14	.11	-.07
Practical advice (duration)	-.30**	-.17	-.16	-.06	-.13
Planning (duration)	-.07	-.09	-.12	-.02	-.17
Relaxation (duration)	-.30**	-.20	-.20	-.14	-.20

*, p<.05; **, p<.01

There were small-medium significant relationships between overall time spent on the intervention and: change in dizziness severity at six months, and also symptom-related, and uncertainty-related, adherence problems. Those who spent longer using the intervention overall reported less severe dizziness post-treatment and were also less likely to report problems with adherence due to exacerbation of symptoms or being uncertain about their VR therapy.

The number of sessions accessed by users had a medium-sized association with change in outcome expectancy at three months such that the more they accessed, the more positive outcome expectancy they had for the VR therapy. The number of sessions accessed was also associated with symptom-, uncertainty-, and doubt-related adherence problems; those accessing more sessions were less likely to report adherence problems resulting from symptom exacerbation, or having doubts or uncertainties about the VR therapy. Although it did not reach significance, there also appeared to be a small association between number of sessions and change in users' self-efficacy, with those accessing more sessions tending to report higher levels of self-efficacy for managing their VR therapy.

These findings, alongside the baseline association between poorer outcome expectancy and greater likelihood of uncertainty-related adherence problems found in the previous study (Table 10, page 141), suggest that improving expectations may have been responsible for reductions in uncertainty-related adherence problems. A brief exploratory analysis was conducted to see if there was support for this hypothesis and it seemed there was; outcome expectancy at three months was negatively associated with uncertainty-related adherence problems at six months (r=-.26, p=0.02).

In terms of specific intervention features, there was a small significant relationship between the amount of time users spent revisiting demonstration videos and change in dizziness severity at six months. Those who spent longer revisiting these demo videos reported less severe dizziness symptoms post-treatment. There were also small-medium associations between the amount of time spent on practical advice about managing exercises and changes in dizziness severity, and changes in perceived handicap at six months. The length of time using this practical advice also demonstrated a medium association with experience of symptom-related adherence problems such that those who spent longer were less likely to report these problems.

The amount of time users spent on the planning exercises feature was significantly associated with change in perceived dizziness handicap such that those who spent longer reported lower perceived levels of handicap at six months. Use of the relaxation symptom management feature also appeared to be associated with more positive outcomes; users who spent longer on this were less likely to report a range of adherence problems, although symptom-related adherence problems most significantly.

Although the relationships did not reach significance, the amount of time spent on the initial information about dizziness and the balance system, and on the introduction to the VR exercises, seemed to have a small positive association with change in outcome expectancy. The longer users spent on these sections, the more positive outcome expectancy they tended to report at three months. Similarly, although the relationships didn't quite reach significance, accessing printable document pages seemed to be associated with reduced dizziness severity at six months and more positive outcome expectancy at three months.

Table 20 Results of chi-squared analyses between PETS subscales and dichotomous usage variables

	Session one complete? (Y/N)		Used printable documents? (Y/N)		Use 'exercise difficulties' support? (Y/N)	
	χ^2	Odds Ratio	χ^2	Odds Ratio	χ^2	Odds Ratio
PETS symptoms	3.94	0.40	3.71	0.40	6.94*	0.31
PETS uncertainty	7.46**	0.26	0.79	0.63	6.10*	0.29
PETS doubts	1.80	0.63	0.63	0.67	0.10	0.83
PETS practical	0.79	0.63	0.30	1.25	1.39	0.56
PETS support	0.85	0.63	1.35	0.56	0.40	0.71

*, $p<.05$; **, $p<.01$

There was a significant association between completion of session one and whether or not users reported uncertainty-related adherence problems $\chi^2(1) = 7.46$, $p = .009$. Based on the odds ratio, if users completed session one, they were nearly four times less likely to report uncertainty related adherence problems than if they didn't. Although not statistically significant, users were also 2.5 times less likely to report symptom related adherence problems if they completed session one, compared to if they didn't, $\chi^2(1) = 3.94$, $p = .076$.

There was also a significant association between the use of 'exercise difficulties' support pages and whether or not users reported uncertainty-related, and symptom-related, adherence problems; $\chi^2(1) = 6.10$, $p = .024$ and $\chi^2(1) = 6.94$, $p = .011$ respectively. Users were 3.4 times less likely to report uncertainty related adherence problems, and 3.2 times less likely to report symptom-related adherence problems when they accessed these pages, compared to when they didn't.

Finally, although not significant, users were 2.5 times less likely to report symptom related adherence problems if they did not use the printable documents, than if they did, $\chi^2(1) = 3.71$, $p = .066$.

The combined results of these analyses demonstrate which indicators of overall usage are insightful, and which specific intervention features are associated with outcomes or behavioural determinants that the intervention aimed to target. Total time spent, completion of session one and number of sessions used all provide indications about the extent to which users are likely to benefit across various outcomes. Regarding specific features, the video demonstrations, practical advice, exercise planning, printable documents and exercise difficulties support pages are all associated with at least one intervention-targeted outcome. Referring back to Appendix B, page

225, this allows us to consider which of the underlying BCTs seem instrumental for Balance Retraining outcomes. Amongst the aforementioned features, the most frequently occurring BCTs were in the ‘shaping knowledge’, ‘associations’, ‘repetitions and substitution’ and ‘antecedents’ subgroups. Specifically, instruction on how to perform the behaviour (4.1), information about antecedents (4.2), prompts and cues (7.1), behavioural practise and rehearsal (8.1), habit formation (8.3), and adding objects to the environment (12.5) are BCTs that underlie at least two features associated with intervention-targeted outcomes.

The ‘recognition of benefits’ theme arising from the qualitative data analysis reveals consequences of engaging with Balance Retraining that aren’t directly captured by the quantitative measures, and these differed slightly between high and low users. For example, nearly all participants discussed noticing an improvement in their symptoms, but many went on to talk about what this meant for them, both in practical terms and emotionally. They talked about things they could now do that they wouldn’t have been able to before and the opportunities this gave them. Sometimes these were very simple, day-to-day tasks:

> “The main thing I have a problem with is, say, supermarkets. For example, my wife will often go in the supermarket first and I have to walk along the bottom or top row looking left and right to see where she is, and after a few years at that I used to feel quite dizzy and sick, and even have to take a tablet and go outside. I don’t have that problem anymore.” (T3407, Male, High User)

> “I’m feeling excellent at the moment and I’m looking forward to my holiday whereas last year I was having [dizziness symptoms] just before I was on, I was going on holiday and advised not to fly by the doctor which didn’t go down very well with my children and my wife.” (T2004, Male, Low user)

Participants also talked of an increased sense of confidence with regard to managing their dizziness and a feeling that, even if the symptoms did return, they would feel more in control and able to handle them. Closely related to this, they also expressed a notion of reduced anxiety and worry about their symptoms and feeling that they no longer had to be constantly vigilant about what they were doing and whether this might trigger symptoms:

> “It has given me a lot more confidence to carry on with life as per normal. There was a time when it was so bad I was almost frightened to go out because you didn’t know when it was going to turn up and under what circumstances.” (T3403, Male, High user)

> "There's certain things that you think, well if I do that is that going to be alright? Whereas now I've stopped, to be honest, thinking that way now. If I go out and do something and I have a problem well then I deal with it then. It's a more positive approach, I think." (T1604, Female, High user)

Participants also recognised an increased knowledge and understanding of their condition as an outcome of their use of Balance Retraining:

> "And the other thing was the bits that went around it that explained a bit more about the subject and why and where, do you know what I mean, so that you got a bigger understanding of – because it's very easy to think you've got this problem and perhaps nobody else has got it, well clearly they have. But it was just nice to have a bit more reading around it." (T1604, Female, High user)

Although nearly all users discussed an improvement in their symptoms, these increased feelings of knowledge, confidence, ability to do things and reduced worry and consciousness about symptoms were all raised by a greater proportion of high users of sessions than low users. This suggests that whilst both and high and low users of the intervention may experience an improvement in symptoms, those who make greater use of the sessions may recognise a greater impact of this improvement both practically and emotionally.

6.3.5.1 **Summary**

These findings reveal that differential levels of both overall usage (total time, number of sessions, completion of session one), and specific feature usage (revisited video demonstrations, practical advice, planning exercises, relaxation, printable documents) were associated with key outcomes targeted by the intervention, including: changes in dizziness severity, perceived handicap and outcome expectancy, perceived adherence problems, and self-efficacy. All of these relationships suggest that greater overall engagement or use of these features is associated with more beneficial outcomes. High and low users' accounts of their experiences add to this notion, revealing that high users are more likely than low users to discuss being more able to do things, and being more confident in managing their symptoms and knowledgeable about their condition. Based on the features that were most associated with outcomes, these findings suggest that the most influential groups of BCTs in the intervention were 'shaping knowledge', 'associations' and 'antecedents'.

6.3.6 What influences engagement with the key components of Balance Retraining?

A series of hierarchical regression analyses were conducted to investigate which factors predict use of the identified key intervention features and patterns of overall usage. The outcome variables investigated were: total usage time, number of sessions used and completion of session one; time spent on: revisiting video demos, planning exercises, practical advice and relaxation sessions; and use (or not) of printable documents and exercise difficulties support. The continuous variables were all positively skewed and some also demonstrated evidence of heteroscedasticity, so did not meet the assumptions for multiple linear regression. Instead these variables were dichotomised; either by performing a median split (e.g. on the total time variable) to create a ‘high’ and ‘low’ levels of the variable, or by recoding the variable to identify use or non-use of the feature (e.g. on variables such as relaxation with a substantial number of zero-value cases, indicating users had spent no time on this feature at all). The dichotomous variables all met the assumptions relating to linearity, independence of errors, and multicollinearity necessary for logistic regression, and were analysed accordingly. As specified in the introduction, the variables to be investigated as potential predictors were: demographic variables (age, gender, education level) on the first step; baseline symptom perceptions (perceived severity, perceived handicap) on the second; and baseline psychological distress (anxiety and depression) and baseline perceptions of capability (self-efficacy) on the final step. However, self-efficacy was removed from the analysis due to a poor response rate that reduced the overall power (inclusion of self-efficacy reduced n from 160 to 93).

Logistic regression analyses examining predictors of number of sessions used and use of: practical advice, relaxation, print documents and exercise difficulties sections were not significant. Furthermore, the overall models accounted for a very small proportion of variance (between 3 and 7%), and odds ratios for the individual predictors were extremely small. Accordingly, the results of these analyses are not presented here. However, Table 21, Table 22 and Table 23 present the results of regression analyses for: total duration of use, use of the planning exercises section, and use of revisited exercise demonstrations.

Table 21 Multiple Logistic Regression Analysis for Total Duration of Use

Predictor	B	Std. Error (SE)	Wald	Odds Ratio Exp (B)	95% Confidence Interval for Exp(B)
Gender (categorical)	0.36	0.37	0.98	1.44	[0.70 – 2.90]
Education level (categorical)	0.37	0.36	1.05	1.44	[0.72 – 2.90]
Age	0.04	0.02	3.06	1.04	[1.00 – 1.08]
Baseline dizziness severity	-0.03	0.02	1.40	0.98	[0.93 – 1.02]
Baseline perceived handicap	0.03	0.01	6.80**	1.04	[1.01 – 1.06]
Baseline anxiety	-0.07	0.06	1.72	0.93	[0.83 – 1.04]
Baseline depression	0.04	0.07	0.35	1.04	[0.91 – 1.20]

*, p<.05; **, p<.01
Model Nagelkerke R^2 = .12

The overall model only accounted for approximately 12% of the variance in total time spent using the intervention. Only baseline perceived handicap appeared to significantly predict overall usage time. This was a small effect: with each point increase in perceived handicap, users were 1.04 times more likely have a high rather than low total usage time for the intervention.

Table 22 Multiple Logistic Regression Analysis for Use of Revisited Video Demonstrations

Predictor	B	Std. Error (SE)	Wald	Odds Ratio Exp (B)	95% Confidence Interval for Exp(B)
Gender (categorical)	0.75	0.39	3.75(*)	2.11	[0.99 – 4.50]
Education level (categorical)	-0.01	0.37	0.001	0.99	[0.48 – 2.03]
Age	0.04	0.02	4.33*	1.05	[1.00 – 1.09]
Baseline dizziness severity	-0.06	0.02	5.83*	0.95	[0.90 – 1.00]
Baseline perceived handicap	0.03	0.01	6.41*	1.04	[1.01 – 1.06]
Baseline anxiety	0.01	0.06	0.01	1.01	[0.90 – 1.13]
Baseline depression	0.02	0.07	0.06	1.01	[0.90 – 1.17]

(*), approaching significance p<0.06; *, p<.05; **, p<.01

Model Nagelkerke R^2 = .16

The overall model only accounted for 16% of the variance in whether or not users revisited the exercise demonstration videos. Age, baseline dizziness severity and baseline perceived handicap were all significant predictors, but again these effects were small. For each year older and each point increase in perceived handicap, users were 1.05 and 1.04 times more likely to revisit the video demonstrations respectively. For example, someone who is 75 is 2.25 times as likely to revisit the video demonstrations as someone who is 50. Conversely, for every point increase in pre-treatment dizziness severity, users were only 0.95 times as likely to revisit the video demonstrations, i.e. they were less likely the more severe their baseline dizziness was. Although the effect did not quite reach significance, the findings also suggest that men were more than twice as likely to revisit the video demonstrations as women.

Table 23 Multiple Logistic Regression Analysis for Use of 'Planning exercises' section

Predictor	**B**	**Std. Error (SE)**	**Wald**	**Odds Ratio Exp (B)**	**95% Confidence Interval for Exp(B)**
Gender (categorical)	0.15	0.37	0.16	1.16	[0.56 – 2.42]
Education level (categorical)	0.25	0.37	0.45	1.28	[0.62 – 2.63]
Age	0.05	0.02	5.56*	1.05	[1.01 – 1.10]
Baseline dizziness severity	-0.03	0.02	2.09	0.97	[0.93 – 1.01]
Baseline perceived handicap	0.05	0.01	10.94**	1.05	[1.02 – 1.08]
Baseline anxiety	-0.11	0.06	3.24	0.90	[0.80 – 1.01]
Baseline depression	0.07	0.07	1.07	1.08	[0.94 – 1.23]

*, p<.05; **, p<.01

Model Nagelkerke R^2 = .19

The overall model accounted for 19% of variance in time spent on the 'planning exercises' section of the intervention. Age and baseline handicap predicted high or low amounts of time spent on this section of the intervention. For each year older and for each point increase in perceived handicap, participants were 1.05 times more likely to have a high usage time for the planning exercises section.

Evidently there are large amounts of variance in usage-related variables (both specific features and overall use) that aren't accounted for by the quantitative variables measured in the present study. Two themes arising from the qualitative data provide further insight into what motivates and discourages engagement with Balance Retraining, and how these seemed to differ between high and low users.

Participants frequently recognised situations, experiences and events that challenged their continued engagement with the Balance Retraining intervention; both the exercises and online sessions. These seemed to largely fall into two main groups; physical or practical difficulties, or detrimental beliefs and attitudes. The physical and practical difficulties encountered by participants included other life events taking precedence, complications caused by existing illness, injury or pain and exacerbation of dizziness symptoms. These experiences often meant that participants didn't have the time, inclination or ability to continue, or that it was simply not prioritised above other things:

> "I have to say to you that I haven't been doing them for a little while because I have a lot of back trouble and I do a lot of exercises for my back, and by the time I've done those twice a day, I got swimming twice a week, and I look with my husband after our grandchildren, I just don't seem to have a lot of hours in the day. (T1301, Female, Low user)

> "Following the finger really made me so dizzy I had to stop. That one in particular, I thought I really can't do this." (T306, Female, Low user)

They also expressed beliefs and attitudes that were sometimes problematic for continuing with Balance Retraining as these were often associated with perceptions that they didn't need to do it or that it wouldn't be worth it for them. For example, some users felt that perhaps their symptoms weren't really that bad and that Balance Retraining was intended for people worse off than themselves. Some users' comments also seemed to reflect uncertainty regarding whether any improvement they had noticed could actually be attributed to the exercises:

> "I thought it probably was related more to people who have suffered more than I had. I really feel that I'm not somebody who has got this situation very badly." (T3406, Female, Low user)

> "Whether it was the exercises or whether it's just luck, I don't know." (T3403, Male, High user)

Many of these potential barriers, including life events taking precedence, perceptions of symptom non-severity and uncertainty regarding the exercises being responsible for improvements, were expressed by a greater proportion of low users than high users of the sessions. This provides further insight into some of the reasons why users may not engage with sessions.

Participants' accounts of their experiences also revealed a great deal about their motivations for continuing with Balance Retraining. There seemed to be three main types of motivator: individuals' desire to change their current situation; a sense that the programme was manageable and realistic; and sources of external motivation. The desire to change their current situation included wanting to reduce their symptoms and the amount that this impacted on their daily lives:

> "I just think by doing the exercises hopefully I'm going to ward off getting another attack. I wouldn't want to go through that again." (T1202, Female, High user)

> "But I think must do that because I hate having them because it's so – I won't drive and things then and that slows you down." (T1504, Female, Low user)

It also included a desire to better understand their condition the notion that they'd not really got anything to lose by trying:

> "So I was interested to take part […] to see how it was going to help me and give me a better understanding of what was happening." (T2108, Female, High user)

> "And so I thought, well, nothing ventured, nothing gained. And so I went in with it thinking – and I can't lose anything and hopefully I'll learn something." (T3401, Female, High user)

Participants' perceptions that the Balance Retraining programme was realistic and manageable also seemed to encourage their continued engagement. This reflected their view that the exercises were not overly demanding and didn't require them to commit large amounts of time to doing them:

> "Well, once you know what to do it doesn't actually take that long, I found. I'd get up in the morning and have a wash or a shower and then I'd do them before I went down for breakfast. And then, likewise, I'd come home from work and just do them about 5 or 5.30 before lunch and, yes, I got into quite a routine with it really. It wasn't a problem." (T3407, Male, High user)

> "I found it easy to do upstairs in my house. No, the fact that they were so easy to do made me do them quite regularly" (T3403, Male, High user).

Participants sometimes expressed that they felt encouraged or even obligated to continue with Balance Retraining due to others' expectations. Some talked about being encouraged by the programme's endorsement by a medical professional, such as their GP. Others talked about a sense of obligation towards the research team and it being important that they kept to their word. These apparent extrinsic motivators were less frequently expressed than the others, and more so by low users of the intervention sessions:

> "I had great faith in you because it was recommended by my doctor and I've got great faith in my doctor." (T1606, Male, Low user)

> "Well, to tell you the truth, I was doing so as an obligation that I had signed up to it so I had to continue doing it." (T1714, Female, Low user)

This qualitative data is valuable in beginning to understand what is important to the individuals themselves in terms of whether or not they engage with the intervention.

6.3.6.1 **Summary**

In summary, the findings suggest age and baseline perceived handicap to be the most consistent predictors of engagement with key intervention features. Older adults and those with higher perceived disability at baseline were likely to engage to a greater extent. However, large amounts of variance in engagement behaviours remain unexplained. Participants' accounts of their experiences provide some further insight into what encouraged and hindered their overall use of

Balance Retraining. Recognised barriers such as other life events taking precedence, perceptions that their symptoms ‘weren’t that bad’ and uncertainty about exercises were more frequently raised by low users of intervention sessions. Conversely, users felt they were motivated by a desire to change their current situation, by the fact that the treatment programme seemed realistic and achievable and also as a result of external factors such as others’ persuasion. These ‘external motivations’ including feelings of obligation to the researchers and being persuaded by their GP were expressed more frequently by low users.

6.3.7 Further exploratory analyses

The results indicated a high proportion of early attrition from the intervention, with some users indicating that they ‘got what they needed’ from only minimal session use. This suggested that different subgroups of users may be qualitatively different in terms of their overall engagement. These subgroups were: (1) users who stopped engaging before they completed the initial TEST (n= 62); (2) users who completed the initial TEST but did not progress as far as completion of session two (n=31); and (3) users who completed multiple sessions (n=67). It was hypothesised that: group one were those who either were not able, or didn’t wish to complete the initial TEST; group two were those who, on completion of the TEST, did not progress much further, either due to the TEST not making them dizzy or because they felt confident they had all the information they needed; and finally group three were those who were keen to receive the additional support provided across the sessions. Across these subgroups, based on the results from the main analyses, it was speculated that: (a) engagement may be differentially predicted; (b) users may differentially engage with specific features (specifically the printable documents given that users might access these and then not need to log in further); and (c) users’ outcomes may differ. Given the exploratory nature of these analyses, the relevant tables are presented in Appendix S, and only an overview of the results presented here.

(a) To address the question of whether engagement was differentially predicted between these sub-groups, a multinomial logistic regression was conducted to understand what predicts users’ membership of these subgroups. The relevant assumptions relating to linearity, independence of errors and multicollinearity were met. The predictors entered into the model were the same as those in the regressions of the main analyses. Self-efficacy could not be included in this analysis due to the collection of this data post session-one meaning that no members of the first subgroup would have provided this data. The overall regression model was not significant (Model χ^2= 11.34, p= .659) and only accounted for a very small proportion of variance (Nagelkerke R^2 = .08). Even considering the individual predictors, effect sizes were very small. This suggests that these baseline characteristics are not helpful for differentiating between users in each of these overall engagement subgroups.

(b) A chi-squared analysis investigated whether membership of the subgroups was associated with use of the printable documents. This was significant $\chi^2(2) = 10.40$, $p = .006$, but the findings were contrary to our speculation that those in subgroup two might be most likely to use the print documents. It demonstrated that those who accessed multiple sessions were over three times more likely to access the print documents than either of the other subgroups. This suggests that the more sessions users complete, the more likely they are to use these print documents.

(c) ANCOVAs (for continuous outcome variables) and chi-squared analyses (for the dichotomous PETS subscales) were conducted to investigate whether users' outcomes differed dependent on their sub-group membership. As with the main analyses, the outcomes were those behavioural determinants and outcomes targeted by the intervention. Although the dependent variables did not meet all assumptions necessary for ANCOVA (e.g. normality at each level of the categorical variable), ANCOVA are relatively robust to violation of assumptions (Field, 2013) and the corresponding non-parametric Kruskal-Wallis test would not have allowed the necessary control for baseline variables.

Only the ANCOVA for six month anxiety was significant, demonstrating a medium effect of engagement subgroup ($F(2, 97) = 3.09$, $p = .05$, partial $\eta^2 = .06$) after controlling for the very large significant relationship between baseline and six month anxiety ($F(1, 97) = 81.23$, $p<.001$, partial $\eta^2 = .46$). Contrary to expectations, follow-up contrasts revealed that those who completed the TEST but stopped prior to completing session two had significantly higher anxiety at six months than those who didn't complete the initial TEST ($p = .018$).

Following chi-squared analysis for the relationship between engagement subgroup and symptom-related adherence problems, odds ratios revealed that users who did not complete the initial TEST were more than two-and-a-half times as likely to experience symptom-related adherence problems as those who completed multiple sessions. However, these results did not reach significance ($\chi^2(2) = 4.56$, $p = .097$). The results of chi-squared analyses for the remaining PETS subscales were also not significant.

Although many of these result did not reach significance, the small to medium effect sizes point towards a suggestion that longer term use of intervention sessions is beneficial for dizziness outcomes and may reduce symptom-related barriers to adherence. Furthermore, they suggest the partial engagement without receiving support from additional sessions may be associated with greater anxiety than for those who don't even complete the initial TEST.

A further brief exploratory analysis (Appendix S.4) was conducted following the qualitative finding that users' perceptions of low dizziness severity sometimes acted as a barrier to engagement. With evidence that poorer engagement (e.g. less total time spent) was associated with less improvement in dizziness severity at six months, this raised the question of whether lower levels of engagement were necessarily problematic for outcomes or whether the associated smaller change in dizziness symptoms may have been due to a ceiling effect amongst less severely dizzy individuals. It's possible that individuals with less severe baseline symptoms who engaged less did in fact improve, but they didn't need (and weren't able) to improve to the same extent as individuals with worse baseline symptoms who engaged more, because they had less improvement to make. A Spearman's correlation revealed that the relationship between total time spent on Balance Retraining and absolute dizziness severity at six months was not significant ($r=-.16$, $p=0.09$) which provides additional support for this hypothesis. Spending less time using Balance Retraining is associated with less improvement in dizziness; however, it is not necessarily associated with poorer absolute levels of dizziness at six months and may simply reflect those individuals who only required minimal engagement to achieve a small improvement.

6.4 Discussion

This study aimed to provide a greater understanding of engagement with an internet-based VR intervention amongst adults over the age of fifty. It aimed to determine: which features were most used and why this seems to be; how differential use of these features related to behavioural determinants and outcomes targeted by the intervention; and what seems to influence the extent to which individuals engage with the intervention. In answering these questions, it aimed to identify which underlying BCTs seem most effective in this context. Figure 11 summarises the quantitative relationships found relating to specific features of Balance Retraining. The results are discussed in relation to each of the three main research questions.

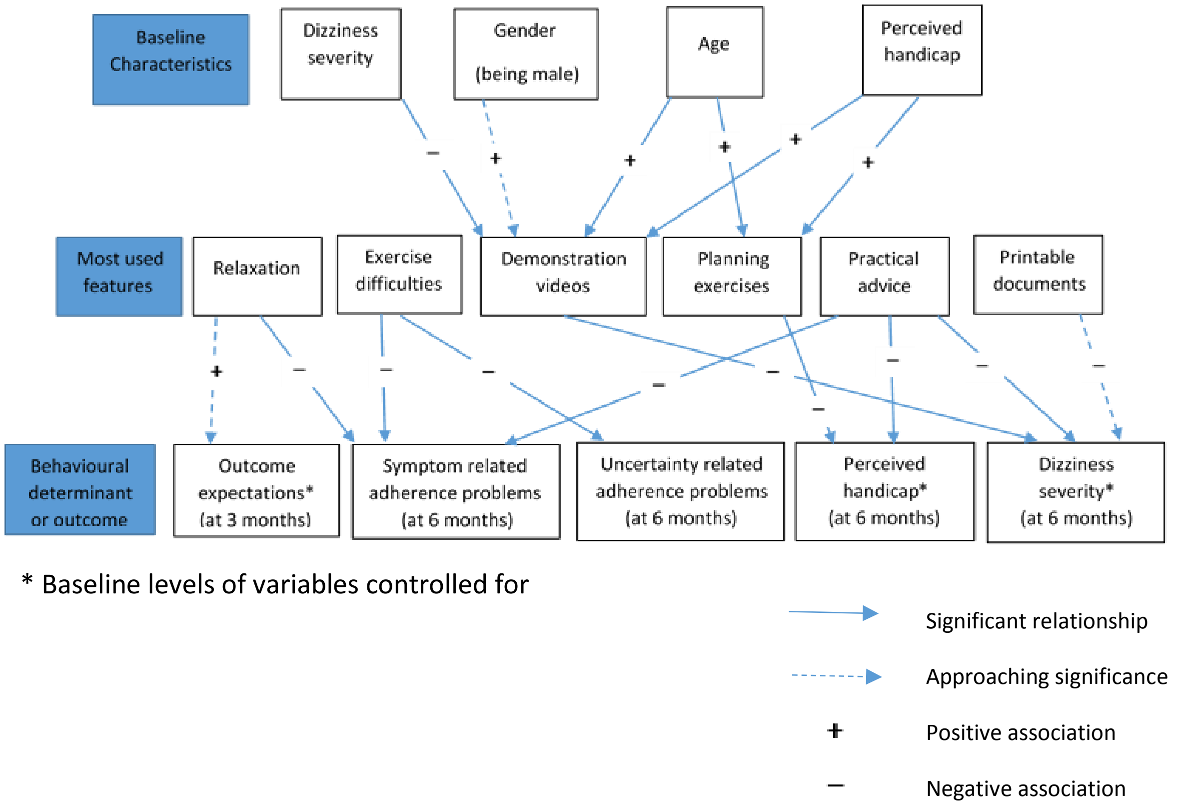


Figure 11 Summary of quantitative relationships relating to specific features of Balance Retraining

6.4.1 What features of Balance Retraining are most used and why?

The majority of users didn't progress beyond the first two sessions, but those who did were much more likely to access all sessions. This may simply reflect the typical characteristics of those individuals who completed these initial sessions – potentially those who were more committed to engaging, or most in need of support. A recent review and meta-analysis did suggest that user characteristics may be related to disengagement with digital health interventions, and that future research should investigate what these may be (Alkhaldi et al., 2016). The present findings do provide some insight into users' underlying perceptions that may drive these differential engagement behaviours. For example, greater recognition of the need for self-discipline seemed characteristic of high users of intervention sessions. However, participants' accounts of their usage suggest that low use of sessions does not necessarily equate to non-engagement with the broader programme, with some users (both high and low) reporting that they felt they got what they needed from early sessions and that it was sometimes easier and quicker just to use the printable instructions offline. These findings very much support the rationale for a focus on 'effective engagement' which states that apparent disengagement may simply reflect sufficient mastery of the intervention content (Yardley et al., 2016). However, the findings also suggested that there were further benefits to be gained from continued engagement through the sessions, with users accessing multiple session being less likely to experience symptom-related barriers to exercise adherence, and experiencing greater benefit in terms of dizziness severity. This supports the notion that ‘dose matters’ in terms of level of engagement with digital health interventions (Couper et al., 2010; Vandelanotte, Spathonis, Eakin, & Owen, 2007; Wantland et al., 2004). Overall, these findings seem to suggest that whilst use of the initial sessions may be been enough to gain ‘sufficient mastery’ of the intervention content, continued use across multiple sessions continues to enhance benefit.

Attrition seemed to occur predominantly during session one, mostly around the TEST. The initial TEST would have been the first time that participants were likely to have tried the exercises and perhaps experienced an exacerbation of their symptoms. As a result of this, some may have decided that these were not suited to them. Indeed, due to their mechanism of action, VR exercises can initially exacerbate symptoms and research has documented individuals feeling anxious or uncertain about persevering as a result of this (Muller et al., 2015). Additionally, the initial TEST was a long process (20 pages) which participants may have tired of and decided not to continue. This is supported by the fact that after session one the short version of the TEST was favoured over the long version. This initial long TEST was considered necessary to provide new users with an initial ‘walk-through’ of the exercise process. However, given the high attrition at this point, it might be considered a barrier to users accessing additional material; for example, the symptom control information was only presented from session two onwards. This has implications for the session structure of Balance Retraining and suggests that this may need to be reconsidered.

Although attrition was much lower in sessions two to six, it still seemed to occur around the TEST. In these sessions, the material presented was very similar up until the TEST with new content presented after this. If users were unsure about continuing, they may have lost interest prior to reaching this new content, despite it being sign-posted from the start of the session. Indeed, previous research has suggested that a multi-session intervention that does not change between visits and does not provide new information (as may have been users’ perception) may not encourage continued use (Brouwer et al., 2008; Napolitano et al., 2003).

Users spent the longest on the introductory material in the first session, particularly the exercise planning. This may simply reflect the fact that this was the initial material presented and was novel information for users. However, it also provided important background information about the exercises and how they worked. The exercise planning also required users to input information to tailor their exercise plan. A Delphi study has suggested that tailoring and provision of information perceived to be valuable in changing a health behaviour is likely to encourage prolonged usage (Brouwer et al., 2008). The psychophysiological symptom management techniques were not extensively used, but the relaxation technique more so than others. The exercise demonstration videos and printable documents were the most frequently accessed optional features. This is in line with findings of a systematic review which suggested that interactive elements, including audio-visually presented materials, to be amongst the mostly highly used features of digital behaviour change interventions as they tend to keep users' interest (Brouwer et al., 2011; Wantland et al., 2004). The qualitative data in the present study provides further insight, suggesting that users valued the clarification of uncertainty that these instructional features provided. This qualitative data also revealed that high and low users of sessions seemed to value different features and qualities of the intervention. High users were more likely to cite the importance of features such as the tailored feedback and reassurance provided, whereas low users favoured the record-keeping and reminder features and the easy, accessible nature of the intervention. It is difficult to say whether these perceptions of the intervention and its features represent a cause or consequence of the different levels of use. It may be that lower engagement with the intervention meant that these users were only able to comment on the more superficial and immediately evident aspects such as how easy it was to navigate and the email reminders they received. Indeed, research suggests that users base early judgements of online health information on superficial elements such as appearance and usability before considering more in-depth elements (Wathen & Burkell, 2002). However, it could be that the perceptions reflect underlying drivers of engagement behaviour. For example, high users valuing the reassuring nature of the intervention may reflect them seeking out this reassurance to a greater extent. This resonates with the earlier speculation that those who engaged more fully with sessions were perhaps simply those who needed the programme most.

6.4.2 What impact do varied levels of intervention usage, and engagement with particular features have on intervention targeted behavioural outcomes?

Varied levels of intervention usage and differential engagement with specific features were associated with: changes in dizziness severity, perceived handicap, outcome expectancy, and perceived adherence problems. All of these relationships indicate that greater overall engagement or use of these features are associated with more positive outcomes in these areas. There is also some evidence to suggest that individuals who are less severely dizzy may not need to engage as much in order to gain the smaller improvements they require. These findings highlight the importance of considering overall engagement, as well as engagement with specific features of the intervention, given that: the amount of time users spend, the number of sessions they complete, and whether or not they complete the initial session, are related to symptom-related outcomes. This is consistent with evidence from trials of digital interventions for various health conditions which suggest that the greater: number of pages accessed, number of intervention visits, or amount of time spent, were associated with better intervention-targeted outcomes (Christensen, Griffiths, & Korten, 2002; Couper et al., 2010; Flatley-Brennan, 1998). Users' accounts of their experiences in the present study provide further support, revealing that high users of overall intervention sessions were more likely than low users to discuss an improved ability to complete various activities, a greater confidence in managing their symptoms, and increased knowledge of their condition.

These findings also reveal which of the intervention's most used features are important for outcomes. The quantitative relationships found are depicted in Figure 11. Video demonstrations, the 'practical advice', 'planning exercises' and 'exercise difficulties' sections, the 'relaxation' technique, and printable documents features were variously associated with: changes in dizziness severity, perceived handicap, outcome expectancy and adherence problems due to symptom exacerbation or uncertainty about exercises. Greater overall intervention use, and higher use of three of these features (relaxation, practical advice, exercise difficulties), were associated with fewer reported adherence problems. As such, it seems plausible that the positive outcomes (e.g. reduced dizziness severity and perceived handicap) were, at least in part, a result of these features promoting better adherence to VR exercise therapy, as proposed by the intervention logic model. Indeed, existing literature provides evidence that digital self-management interventions for a variety of long-term conditions do promote greater adherence to relevant treatment regimens (Morrison et al., 2014; Murray et al., 2005; Pal et al., 2013; Ritterband et al., 2009). With no objective measure of VR exercise adherence it is not possible to definitively confirm this hypothesis for the present study, but the overall aim of the BCTs underlying these features was to encourage regular and consistent practise of the VR exercises.

The findings suggest that the most influential BCTs in the intervention were: 'instruction on how to perform a behaviour', 'information about antecedents', 'behavioural practise/rehearsal', 'habit formation' and 'adding objects to the environment'. Each was present in at least two of the identified 'key features' of the intervention (i.e. those most highly used and associated with intervention targeted outcomes). These BCTs largely focus on the practical aspects of learning the behaviour, and of maximising the chances of practising regularly and consistently. Given that regular and consistent practise of VR exercises is so central to achieving positive outcomes (Yardley et al., 2012; Yardley & Kirby, 2006), it seems very likely that this was an important mechanism through which those who engaged most with these BCTs achieved the greatest improvement with regard to dizziness severity and perceived handicap.

Although these were the most frequently occurring BCTs, there were 21 BCTs present in total in the key intervention features, all of which may have contributed to the positive outcomes. For example, in the ‘practical advice’ key feature, the BCT ‘information about health consequences’ explained the potential health-related outcomes of performing the target behaviour (Michie et al., 2013) . This included information about performing the VR exercises, a warning that these may (and in fact should) initially exacerbate symptoms and advice about how to manage this. Knowledge of what to expect with regard to possible side-effects is important for alleviating fear about treatment and therefore beneficial for adherence (Apollo, Golub, Wainberg, & Indyk, 2006). As such, it is apparent that this feature may have reduced the negative impact of any symptom exacerbation on these users’ adherence by managing their expectations of the therapy. Indeed, there was combined evidence from the findings of this study and the preceding one that greater overall use of the intervention may have been beneficial for reducing adherence problems by improving outcome expectations.

Engagement with some features (e.g. demonstration videos, planning exercises, use of print documents) was associated with dizziness-related outcomes but not any of the proposed behavioural determinants (e.g. adherence problems, outcome expectancy, self-efficacy), so it is less clear how and why use of these features was associated with positive outcomes. Consideration of the qualitative findings suggest that, as with the other features, these also facilitated users’ performance of the VR exercises. Users talked about the video demonstrations acting as clarification about exactly how to do the exercises, the planning feature as helping them to set a routine, and the print documents as an easy and quick means of reminding themselves (how) to do the exercises. This being the case, we might have expected use of these features to be associated with changes in self-efficacy for completing VR exercises, which they were not. This is especially so when taking into account some of the BCTs underlying these features (e.g. demonstration of behaviour, behavioural practise/rehearsal, instruction on how to perform behaviour), as these resonate with mechanisms through which self-efficacy is known to be influenced (e.g. performance accomplishments, vicarious experience, persuasion: Bandura, 1977). Indeed, a Cochrane review has demonstrated that digital interventions for managing long-term health conditions frequently improve individuals’ self-efficacy for behaviours relevant to managing their condition (Murray et al., 2005). However, although non-significant, there did appear to be a small association between the number of sessions accessed and improvements in self-efficacy. Furthermore, this effect is possibly non-significant due to low statistical power resulting from poor response on the baseline self-efficacy items. Additionally, it may be the case that those who used these features were more likely to also use the other key features. Accordingly it may be the combined effect of using multiple features that lead to positive outcomes.

6.4.3 What influences engagement with the key components of Balance Retraining?

The findings suggest age and baseline perceived handicap to be the most consistent predictors of overall engagement (total duration) and engagement with key intervention features such as the revisited exercise demonstration videos and the ‘planning exercises’ section. Older adults and those who with higher baseline perceived disability were likely to engage to a greater extent. These findings are very much in line with existing theory and literature. Older age has similarly predicted greater levels of engagement amongst a range of digital health behaviour change interventions (Couper et al., 2010; Strecher et al., 2008; Van't Riet et al., 2010) (Verheijden et al., 2007). This is discussed further in section 7.3.2, page 205.

With regard to perceived handicap, again these results are in line with existing literature. Several theories relating to the performance of health-related behaviours propose that constructs similar to perceived handicap are key determinants of illness response behaviours. For example, the Health Belief Model (HBM) proposes that an individual’s perceived severity of their condition is one of the factors that predicts whether they engage in behaviours to address the problem (Rosenstock, 1974). The Self-Regulatory Model of illness cognitions (Leventhal et al., 1980) similarly proposes that individuals’ perceptions about their illness, including those about its consequences, are an important determinant of how they subsequently attempt to cope with the illness. In line with these models, individuals who perceived the negative impact of their dizziness symptoms to be greater (i.e. higher perceived handicap) were more likely to engage with the Balance Retraining intervention as a means of trying to address the problem.

Large amounts of variance in Balance Retraining engagement behaviours remain unexplained. There were factors not measured by the present study which may have helped to further explain engagement behaviour. For example, whether the individual felt they had the appropriate skills to engage with the online intervention; how strong their exercise intentions were; how supported they felt; and how motivated they were to complete the VR exercises. Indeed the systematic review reported in chapter 3 found that social support, intentions and self-motivation are consistent predictors of adherence to such self-managed physical therapies (Essery et al., 2016). As such it would have been valuable to measure these variables to see if they were associated with engagement in this context. However, data collection for the present study had unfortunately already begun before the results of the systematic review were finalised. Perceptions of relevant skills are also suggested to be determinants of the extent to which users engage with digital health interventions (Brouwer et al., 2008). Indeed, although it was only raised by a small number of users in this study, some did discuss their perceived poor computer literacy as either a barrier, or potential barrier, to their engagement with Balance Retraining. A further potential explanation for the low proportion of variance accounted for is the possibility that the relationships between engagement with specific features and various characteristics are more complex and dynamic than this analysis allows for. The results of a Delphi-method study have suggested that different factors may impact on different phases of engagement with digital behaviour change interventions (Brouwer et al., 2008).

Participants' accounts of their experiences did provide some further insight into what encouraged and hindered their overall use of Balance Retraining. Recognised barriers such as other life events taking precedence, perceptions that their symptoms 'weren't that bad' and uncertainty about exercises were more frequently raised by low users of intervention sessions. Returning to theoretical models of health behaviour, these findings appears to reflect perceptions of low illness severity and low perceived benefits of taking action, that these models would suggest contribute to a reduced likelihood of action (in this case engagement with the intervention) being taken to address the illness problem (Leventhal et al., 1980; Rosenstock, 1974).

Conversely, users seemed motivated by a desire to change their current situation, by the fact that the treatment programme seemed realistic and achievable and also as a result of external factors such as others' persuasion. This motivation of the treatment programme seeming realistic resonates with the findings of the Delphi study which also highlighted the importance of users' perceiving that an internet intervention provides behaviour change information that is achievable in order for them to continue engaging (Brouwer et al., 2008). The 'external motivations' including feelings of obligation to the researchers and being persuaded by their GP were expressed more frequently by low users. This finding is consistent with self-determination theory which suggests that extrinsic motivators are poorer predictors of behaviour than intrinsic motivations (Deci & Ryan, 2000; Ryan & Deci, 2000).

6.4.4 Limitations

Within the present study, poor completion rates of certain measures, particularly the self-efficacy and CEQ baseline measures, limit the statistical power of analyses in which they are included. As a result, it is possible that small relationships between variables may have been overlooked. However, attempts were made to minimise the likelihood of this by considering the effect sizes of non-significant relationships too. The poor follow-up rates on these particular measures were discussed in section 5.4.2, page 153.

Given the apparent importance of promoting adherence to the VR exercises as a mechanism through which the intervention achieved positive outcomes, it would have been valuable to have an objective, or at least self-report, measure of adherence to VR exercises. Although the PETS subscales measured problems with adherence and can be used as a proxy for adherence, a more direct measure of adherence behaviour may have provided additional information about the importance of this mechanism.

The analyses of predictors of engagement behaviour revealed that a substantial amount of variance in engagement behaviour was not accounted for. Drawing on existing literature, there are a number of additional factors that it would have been valuable to investigate as potential predictors that were not measured by the present study. However, the nested nature of this study mean that decisions about measures were made before the present study was fully designed.

Finally, it is also important to acknowledge the context in which the qualitative data was collected. As the participants were a sub-sample of those who had participated in the intervention arm of the trial, it is likely that those who consented to a follow-up interview were relatively more positive and engaged to a greater extent. Those who were less inclined to fully engage or who didn't like it are less likely to have wanted to engage in the research process further, and may have provided a more critical view.

6.4.5 Implications

6.4.5.1 Implications for research

In order to more fully investigate the proposed mechanisms of action of the Balance Retraining intervention (and many complex interventions like it), it would be beneficial to be able to conduct structural equation modelling (SEM). This would require a much larger sample size than in the present study (Tabachnick & Fidell, 2001) but would allow consideration of the complexities and interrelation of the many variables involved. For example, it would permit investigation of how specific BCTs, or clusters of BCTs present in a particular intervention feature, impact on outcomes and which behavioural determinants act as mediators and/or moderators of these relationships. Whilst the correlational analyses conducted in the present study allow investigation of these relationships in isolation, they do not give an idea of how these fit into the broader model of the intervention. The results of SEM would allow the development of highly accurate intervention logic models and more effective means of predicting which users are likely to achieve beneficial outcomes and under what circumstances.

Process evaluations of complex digital interventions should also continue to include analysis of usage in relation to outcomes in order to determine 'effective engagement' in that context. The present study revealed that absolute engagement and 'effective engagement' (i.e. that which can be shown to be associated with target outcomes (Yardley et al., 2016)) are not always the same.

Knowing what constitutes ‘effective engagement’ for any given intervention can help researchers and practitioners guide users to make the most efficient use of that intervention.

6.4.5.2 Implications for practice

The findings of the present study have implications for potential further development and delivery of the current intervention, and for the future development of similar digital self-management interventions. These are discussed further in section 7.5.2, page 213.

6.5 Conclusions

This mixed-methods study has provided a greater understanding of engagement behaviour in relation to a digital intervention for chronic dizziness, and the implications of this for user outcomes. Overall it appears that users can generally obtain sufficient skills, knowledge and support from an initial session to achieve positive outcomes. However, there appears to be added benefit to continuing to engage with sessions after this. The key features of the intervention important to outcomes are underpinned by behaviour change techniques that focus on providing clear instruction on completing VR exercises and facilitating regular and consistent practise. It appears that these primarily act by reducing barriers to adherence and encouraging consistent exercise behaviour. Users’ accounts of their experiences revealed that illness and treatment-related perceptions could sometimes act as barriers to engagement, alongside more practical problems. However, they were also driven by a desire to change their current situation and by the perceived achievable nature of their treatment. It seemed that older adults and those who were most impacted by their symptoms were most likely to engage. A consideration of what ‘effective engagement’ means for the Balance Retraining intervention has provided insight into key mechanisms through which the intervention functions and how it might be optimised. Future research should look to investigate the complexities of these mechanisms further in order to provide a more robust and thorough understanding of how these complex interventions have their effects.

Chapter 7: General Discussion

7.1 Chapter overview

This chapter concludes the thesis by bringing together the findings from each study and considering their contributions to the aims as a whole. The aims of this thesis were to provide a detailed understanding of the mechanisms through which the Balance Retraining intervention is effective in reducing self-reported dizziness amongst its users. In doing so, it intended to contribute a greater understanding of older adults' engagement with digital self-management interventions. Finally, it also aimed to evaluate the utility of the underpinning theoretical frameworks for understanding and predicting likely intervention outcomes.

The chapter begins with a brief recap of the main findings of each study, followed by an evaluation of all findings in relation to each of the main aims. It will discuss the strengths and limitations of the research and identify important implications for research and practice.

7.2 Recap of study findings

7.2.1 Chapter 3: Systematic review of predictors of adherence to home-based, self-managed physical therapies

Regular and consistent practise of VR exercises is fundamental to their success, but evidence suggests that adherence to such self-managed physical therapies is often very poor (see section 1.5.1.2.1, page 12). A systematic review collated evidence about likely predictors of adherence behaviour in this context. The review identified 30 eligible studies examining predictors of adherence to home-based self-managed physical therapies for a range of different conditions. It revealed extensive variation in factors investigated as predictors of adherence to such therapies, partly attributable to the a-theoretical approach of the majority of studies. Five factors appeared to most consistently predict adherence behaviour across these studies: intentions, self-efficacy, self-motivation, previous adherence-related behaviour and social support. With so few theory-driven studies investigating predictors of HBPT adherence, it was hard to draw strong conclusions about the utility of particular theories over others with regard to predicting HBPT adherence. However, models developed from the TPB, such as the AMPB, include many of the constructs identified by the review as consistent predictors and so seem likely to account for the greatest proportions of variance in HBPT adherence.

7.2.2 Chapter 4: Longitudinal qualitative study of users' experiences of Balance Retraining

This study explored older adults' experiences of the Balance Retraining intervention over a period of six weeks, including their use of the digital intervention itself and the VR exercises. Balance Retraining was reported to facilitate engagement with rehabilitation exercises, providing motivation to continue through symptom reduction and simple but helpful strategies. It was perceived as informative, reassuring, visually pleasing and easy to use. Users did report some barriers to engagement including practicalities, symptom-related issues, and doubts or concerns about exercise efficacy. Participants' changing perceptions over the course of the intervention, revealed by the longitudinal study design, suggested that: appearance-related perceptions of such online interventions may be especially important for engagement in the initial stages of use; that individuals' decisions about engagement with such interventions may be based on a form of dynamic cost-benefit assessment; and finally, that intervention features targeting self-efficacy seem important in overcoming barriers to engagement and achieving positive outcomes.

7.2.3 Chapter 5: Predictors of dizziness-related outcomes following use of Balance Retraining

This study aimed to determine whether the proposed theory- and evidence-based mechanisms of impact of the Balance Retraining intervention were accurate, and/or whether outcomes were achieved via other unexpected or unforeseen mechanisms. The findings demonstrated the importance of level of engagement with the intervention, and of barriers to adherence for post-treatment dizziness severity. Greater amounts of time spent using Balance Retraining predicted better outcomes at six months, whereas barriers to adherence – particularly related to symptom exacerbation and practicalities – predicted poorer outcomes at both three and six months. Females, more anxious individuals and those who doubted their ability to complete the exercises appeared especially susceptible to these adherence problems resulting from symptom exacerbation, and in turn tended to have poorer outcomes. Whilst more severe baseline dizziness severity predicted poorer outcomes, individuals' change in their dizziness-related impairment and their perceptions of improvement were unrelated to how severe their symptoms were to start with. As such, there was evidence of improvement amongst the most severely dizzy individuals. It is likely that it simply reflects these individuals' improvements being masked by their higher post-treatment scores relative to those starting from a lower baseline of dizziness severity.

7.2.4 Chapter 6: Impact of varied engagement with Balance Retraining on behavioural determinants and outcomes

This final mixed-methods study investigated the role of engagement with the digital intervention and aimed to determine: what 'effective engagement' constitutes for Balance Retraining; how differential engagement impacted on outcomes and key behavioural determinants; and what factors appear to influence individuals' level of engagement. Overall it appeared that users could generally obtain sufficient skills, knowledge and support from the initial session to achieve positive outcomes. However, there appears to be added benefit to continuing to engage with sessions after this. The exercise demonstration videos and printable documents were the most frequently accessed optional features, with the qualitative data suggesting that users valued the clarification of uncertainty that these provided.

Differential levels of overall usage (total time, number of sessions, completion of session one), and specific feature usage (revisited video demonstrations, practical advice, planning exercises, relaxation, printable documents) were associated with key outcomes targeted by the intervention, including: changes in dizziness severity, perceived handicap and outcome expectancy, perceived adherence problems, and self-efficacy. Greater overall engagement or use of these features was associated with more beneficial outcomes. These key features of the intervention were underpinned by behaviour change techniques that focused on providing clear instruction on completing VR exercises and facilitating regular and consistent practise. It appeared that these primarily acted by reducing barriers to adherence and encouraging consistent exercise behaviour. Users' accounts of their experiences revealed that illness and treatment-related perceptions could sometimes act as barriers to engagement, alongside more practical problems. However, they were also driven by a desire to change their current situation and by the perceived achievable nature of their treatment. It seemed that older adults and those who were most impacted by their symptoms were most likely to engage.

7.3 Contribution of findings to thesis aims

7.3.1 Understanding the mechanisms of impact of the Balance Retraining intervention

The findings of the studies in this thesis have provided evidence to support many of the proposed behavioural determinants as instrumental in dizziness outcomes, but not necessarily via the expected mechanisms. As was expected, though, adherence-problems played a central role in outcomes. The original logic model of the intervention has been reconfigured (Figure 12) to demonstrate the updated understandings of the intervention's mechanisms based on these findings.

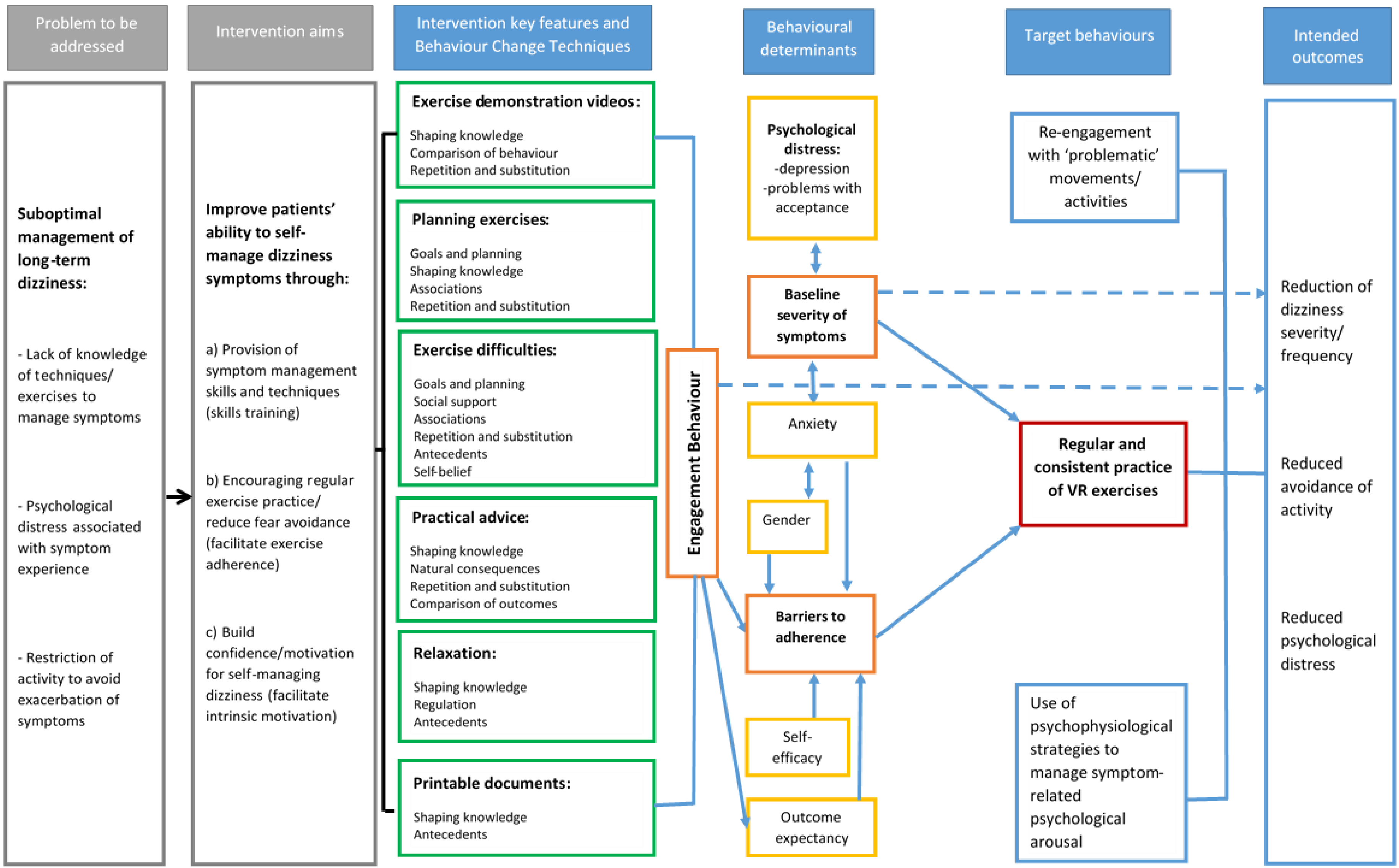


Figure 12 Amended logic model

This amended logic model provides a more informed understanding of the likely mechanisms of the Balance Retraining intervention. The greyed out elements indicate aspects that remain unchanged from the initial model. The ‘mechanisms of action’ from the original model have been omitted for diagrammatic simplicity given that they were not directly measured within the present studies.

Facilitating regular performance of the VR exercises appeared to be the fundamental mechanism through which Balance Retraining promoted positive outcomes, as had been a primary aim of the intervention. This is very much consistent with existing evidence that digital self-management interventions for a variety of long-term conditions do promote greater adherence to relevant treatment regimens (Morrison et al., 2014; Murray et al., 2005; Pal et al., 2013; Ritterband et al., 2009). The findings suggest that the intervention achieved this facilitation through provision of clear instructions about how to conduct the exercises, regular encouragement and reminders to practise the behaviour, and support to reduce or manage adherence-related problems. Two main aspects of the findings contribute to these conclusions; firstly, that adherence problems were a major predictor of outcomes; and secondly, evidence regarding the nature of intervention features that were most associated with positive changes in outcomes and determinants.

Adherence problems were demonstrated to be the most consistent predictor of poorer outcomes, supporting existing literature regarding the central importance of adherence in VR exercises and self-managed therapies more generally (Dimatteo et al., 2002; Yardley et al., 2012). This was particularly the case for symptom-related adherence problems that not only predicted both three and six month outcomes, but also were responsible for the relationship between other user characteristics and outcomes. Females, highly anxious individuals and those with lower beliefs about their ability to complete their exercises were all more likely to experience poorer outcomes due to their increased likelihood of experiencing symptom-related adherence problems. Participants’ accounts of their experiences frequently cited exacerbation of symptoms or doubts and concerns about the exercises as a barrier to continuing to practise them. Symptom exacerbation in particular appeared to be most problematic for adherence in this context, which is expected given the nature of the exercises in combination with the association between dizziness symptoms and avoidance of triggers. VR therapy necessitates symptom inducement in order to obtain benefit (McDonnell & Hillier, 2015), whilst dizziness is strongly associated with avoidance of behaviours that trigger or worsen symptoms (Mendel et al., 1997; Yardley & Redfern, 2001). Therefore, it is apparent how exacerbation of symptoms could be the most prominent reason for not continuing with VR exercise, despite being necessary for positive outcomes. The findings confirmed that such adherence problems were a key target for the intervention in terms of achieving positive dizziness outcomes.

The intervention features associated with greatest improvements in dizziness symptoms and handicap were those underpinned by BCTs that focus on practical aspects of learning the behaviour, and of maximising the chances of practising regularly and consistently. In line with evidence that regular and consistent practise of VR exercises is so central to achieving positive outcomes (Yardley et al., 2012; Yardley & Kirby, 2006), it seems very likely that this was an important mechanism through which the greatest improvements in dizziness severity and perceived handicap were achieved. These were features such as the exercise demonstration videos, exercise planning, practical advice and advice about dealing with exercise difficulties. In line with this suggestion, greater use of many of these key features (e.g. planning exercises, managing exercise difficulties), and greater overall use of the intervention, were associated with fewer adherence problems, particularly relating to exacerbation of symptoms and uncertainty about the VR exercises.

Cumulative evidence from across all four studies suggests that self-efficacy is likely to have played a part, via these key features, in addressing adherence problems and therefore in reducing dizziness severity. This resonates with Cochrane review evidence suggesting that digital interventions for managing long-term health conditions frequently improve individuals' self-efficacy for behaviours relevant to managing their condition (Murray et al., 2005). Those with higher baseline self-efficacy were demonstrated to be less likely to experience symptom related adherence problems and therefore had better dizziness outcomes at three months. This is consistent with the findings of the systematic review which revealed self-efficacy to be one of the most consistent predictors of adherence to such home-based self-managed physical therapies. The longitudinal qualitative data appeared to demonstrate a process of increasing self-efficacy over the duration of the intervention with participants more frequently reporting feelings of confidence and ability to manage their dizziness as they progressed. Although the usage analysis showed no significant associations between intervention use and self-efficacy, there was a small association such that the more sessions users accessed, the greater improvement in self-efficacy they displayed. Furthermore, individuals who used the intervention to a greater extent also more frequently reported feelings of greater confidence in managing their dizziness.

Managing and enhancing users' expectations of their exercises also appears to have been an important part of facilitating adherence. Those intervention features identified as most highly used and most associated with outcomes contained information about performing the VR exercises, including a warning that these may (and in fact should) initially exacerbate symptoms and advice about how to manage this. Knowledge of what to expect with regard to possible side-effects is important for alleviating fear about treatment and therefore beneficial for adherence

(Apollo et al., 2006). Indeed, participants' reports of their experiences of the intervention similarly revealed that Balance Retraining helped them know what to expect from the exercises which facilitated their adherence when they might otherwise have stopped due to symptom exacerbation. As such, it is apparent that this feature may have reduced the negative impact of any symptom exacerbation on these users' adherence by managing their expectations of the therapy. In further support of this, the findings demonstrated that the more sessions users accessed, the greater their improvement in their outcome expectancy, and the less likely they were to experience symptom-, doubt- and uncertainty-related adherence problems. Given that outcome expectancy at three months was negatively associated with uncertainty-related adherence problems at six months, it seems feasible that improving expectations was instrumental in these usage-related reductions in adherence problems.

Whilst it seems that adherence problems were the primary determinant of outcomes, and facilitating adherence a fundamental means through which the intervention was effective, the studies also provided a greater understanding of the role of other factors that are important for outcomes. The initial severity of an individuals dizziness seems important, but not in the way it first appears. Whilst those with higher baseline symptom severity are more likely to have higher post-treatment dizziness severity, this does not necessarily reflect a lack of improvement following VR. There is evidence that these individuals' improvements are masked by their higher post-treatment scores relative to those starting from a lower baseline of dizziness severity, so it is not necessarily the case that those with most severe dizziness will not benefit. In fact, evidence from the analysis of usage data suggests that those who perceive the impact of their dizziness to be worse at baseline, are most likely to use the intervention highly; relatedly, perceptions of symptoms not being very severe appeared to act as a barrier to users engaging with the intervention. With the findings indicating that greater use of the intervention (particularly certain features) is associated with better outcomes, this is reassuring that those who are likely to need the intervention most do appear to benefit. However, over the longer term, more severely dizzy individuals appear less willing or able to maintain their VR therapy due to their symptoms being exacerbated. This corresponds with the aforementioned evidence that dizziness is often associated with avoidance of behaviours believed to trigger or worsen symptoms (Mendel et al., 1997; Yardley & Redfern, 2001). It seems plausible that those whose symptoms are more severe may be most likely to avoid these behaviours.

The findings revealed a limited role of psychological distress as a direct influence on dizziness outcomes, with evidence that the association may simply be a result of higher baseline dizziness being associated with greater psychological distress. Those experiencing worse initial symptoms are, in turn, more likely to have higher post-treatment dizziness. However, as discussed, this does not necessarily mean a lack of improvement. These baseline associations may be due to the frightening nature of dizziness symptoms meaning that they are often associated with panic and distress (Mendel et al., 1997). Anxiety does indirectly influence outcomes however, via higher levels being associated with increased symptom-related adherence problems. Although the RCT provided evidence that those using Balance Retraining did significantly reduce their distress (Geraghty et al., under review), there is limited evidence from these studies regarding how this was achieved. Analysis of intervention usage did not demonstrate effects on these distress variables. Furthermore, given low use of the psychophysiological symptom control techniques, these were not extensively investigated in terms of their impact on outcomes and determinants. Participants' accounts of their experience are consistent with the findings of the RCT, with users expressing feeling less anxious and worried about managing their symptoms towards the end of the intervention. It may be that the reduced distress was a non-specific effect of simply having something to try to help, which is common amongst dizzy patients (Yardley et al., 2004).

7.3.2 Understanding older adults' use of a digital intervention to support self-management of physical rehabilitation

The three empirical studies of this thesis provide evidence that a digital intervention is a feasible means of supporting older adults' with self-managing physical rehabilitation. This is consistent with evidence for the accessibility of other digital interventions for managing health behaviours and conditions amongst older adults (Burns et al., 2013; Stellefson et al., 2013). The findings have also provided insight into how such an intervention is used and the psychological processes that seem to underpin this. Participants accounts of their experiences of using Balance Retraining were almost unanimously very positive, with reports that it was very easy to use, simple to navigate and visually appealing and attractive. Whilst design considerations of a digital intervention are only one of many aspects, the findings suggested that these may be especially important in initial stages of engagement to encourage continued use. Participants' perceptions of presentation and usability of the intervention appeared far more salient in these initial stages. These findings were consistent with existing evidence regarding how individuals make credibility judgements about online health information (Liao & Fu, 2014) and cost-benefit assessments of behaviour (Donkin & Glozier, 2012; Horne & Weinman, 1999) in order to determine their likelihood of continuing.

Whilst there have traditionally been concerns about whether older adults are likely to engage with online technologies, there was evidence that older age actually predicted greater use of the intervention overall, and of certain features, such as the video demonstrations. Older age has similarly predicted greater levels of engagement amongst a broad range of digital health behaviour change interventions, including for smoking cessation (Strecher et al., 2008), increasing fruit and vegetable consumption (Couper et al., 2010), physical activity (Van't Riet et al., 2010) and promoting healthy lifestyles (Verheijden et al., 2007). Within our sample, it is possible that the effect of age reflects a difference between those adults who have retired and perhaps have more time to spare, compared to those still working. A number of older adults interviewed did comment on the fact that, being retired, committing time to the intervention was not a problem. With regard to older adults' greater use of specific features such as the revisited video demonstrations, it is possible that this reflects a greater need to refresh their memory from time to time, regarding exactly how to do the exercises. Once again, the qualitative data did reveal perceptions of older age being associated with poor memory. However, amongst a sample of users whose mean age was 67 years and of which nearly one third were over the age of 70, the overwhelming consensus was that the intervention was very straightforward to use – this in fact appeared to be an important factor in motivating users' continued engagement.

The studies provided insight into what seems to facilitate, or act as a barrier, to users' continued engagement with digital interventions such as Balance Retraining; some of these relate to the characteristics of the intervention, whereas some relate to characteristics of, or beliefs and cognitions held by, the users. As mentioned, the nature of the intervention itself played an important role in motivating continued engagement. The simple, informative, supportive and reassuring nature of the intervention and its content appeared to act as a buffer to potential difficulties, such as concerns or uncertainties. Greater engagement with the intervention facilitated continued engagement with the exercises, seemingly by managing and enhancing expectations about outcomes, and increasing users' self-efficacy. Specific features such as the video demonstrations and tailored feedback about exercises were highlighted as especially supportive and reassuring. Indeed, some of these interactive elements were identified as key features of the intervention that seemed to be used most, and were most associated with outcomes. This is consistent with evidence that interactive elements, including audio-visually presented materials to be amongst the mostly highly used features of digital behaviour change interventions as they tend to keep users' interest (Brouwer et al., 2011; Wantland et al., 2004).

In terms of user characteristics that seem influential in engagement, those who: experience improvements; hold a sense of personal responsibility for helping themselves; and have a strong desire to improve their symptom-related quality of life seem likely to be highly motivated to engage with the intervention. Those whose dizziness had a more significant impact on their life used the intervention more than those whose symptoms were less disruptive. Conversely, those who: don't perceive their symptoms to be very severe; express more concerns or uncertainty about the therapy, particularly in relation to symptom exacerbation; or report that other life-events take precedence, appear less motivated to engage. Perceptions of barriers and facilitators to engagement were consistent with some of those identified in existing studies of related interventions (see section 4.4.3, page 121). However, the apparent importance of symptom improvement seemed particularly pertinent to the experience of dizziness, as is discussed in the above mentioned section.

Whilst there was inevitably variation in the extent to which these users engaged with the intervention, the findings also indicated that lower use of the sessions was not necessarily problematic. Indeed, even amongst low users there were perceptions that they had got what they needed from the intervention. Features such as the printable instruction documents seem important in this respect. Relatedly, based on the findings it was also speculated that those with less severe symptoms may not need to engage to the same extent to achieve the required level of benefit. These findings are consistent with the notion of 'effective engagement' highlighted by Yardley et al. (2016), introduced in section 1.5.1.2.2.2.

7.3.3 Evaluating the utility of underlying theoretical models for predicting outcomes

As outlined in Chapter 1, given the extensive range of potentially relevant models with shared constructs, the development of the Balance Retraining intervention drew upon multiple theories of health-related behaviour change. The primary behaviour of interest was regular and consistent practise of VR exercises in order to help people reduce their dizziness severity. These theoretical models were consulted, alongside empirical evidence, to identify the behavioural determinants that should be targeted to maximise the chance of the behaviour occurring. SCT (Bandura, 1986) in particular was identified as especially relevant in this process given that it encapsulated many of the behavioural determinants identified by the literature as important for outcomes. SDT (Deci & Ryan, 2000; Ryan & Deci, 2000) was also used to inform how the intervention could facilitate development of intrinsic motivation. Considering the relevant findings of this thesis, it is now possible to evaluate the suitability of these models as an underpinning framework for the Balance Retraining intervention.

The findings of the initial systematic review confirmed the vast array of theories available for the prediction of adherence-related behaviours. It illustrated how the frequent lack of theoretical approach to studying adherence behaviour makes it difficult to evaluate the utility of specific theories and models for understanding and predicting it. However, considering the factors identified as the most consistent predictors of adherence to home-based physical therapies (intention, self-efficacy, self-motivation, previous adherence behaviour and social support), the findings of this review suggest that drawing on both SCT and SDT should provide good predictive ability with regard to regular and consistent behaviour of VR exercises. This is because all of the predictors of adherence identified were addressed within these two models. For example, according to SCT, self-efficacy is one of the primary determinants of behaviour; if a person believes they are capable of successfully completing a behaviour, then it increases the likelihood of that behaviour occurring (Bandura, 1986; Luszczynska & Schwarzer, 2005). Intentions are also recognised as a further person-related determinant of behaviour, and social support is identified by the model as part of environmental factors that may influence behaviour (Bandura, 1986). The theory states that performance of behaviour is most likely when such environmental factors are perceived as controllable and supportive (Bandura, 1991). As SCT proposes that person-related, environment-related and behaviour-related factors all causally interact (Bandura, 1986), this can also be seen to account for the previous adherence behaviour identified by the review as a consistent predictor of adherence to HBPTs. The final factor identified as a consistent predictor of adherence behaviour in this context is self-motivation; this resonates with SDT's construct of intrinsic motivation, which it proposes to be a central determinant of behaviour (Deci & Ryan, 2000; Ryan & Deci, 2000). Accordingly, the findings of this review provide support for the combination of these models as a theoretical underpinning of the intervention.

Across the three empirical studies, there was further substantial support for the utility of these theories in understanding adherence to VR exercises. Lower levels of both self-efficacy and outcome expectancy, proposed as central determinants of behaviour by SCT (Bandura, 1986), were associated with greater reported adherence problems. Symptom-related adherence problems explained the relationship between self-efficacy and dizziness severity at both three and six months. This was also the case for anxiety, which, although not directly accounted for in SCT, is likely to be an influence on individuals' affect which the model recognises as a person-related determinant (Bandura, 1986).

Participants' accounts of their experiences of Balance Retraining provide further support for these models through the apparent motivations and barriers to exercise adherence. The intervention itself was recognised as an important motivating factor in continuing with VR exercises, particularly when individuals had concerns about these, as it was a source of reassurance and also helped to manage expectations of the exercises. This appears to reflect the interaction between person and environmental factors proposed by SCT, and supports the suggestion that a behaviour is more likely to occur when the environment is supportive (Bandura, 1986). Furthermore, greater use of the Balance Retraining intervention, particularly certain features such as advice about managing exercise difficulties, was shown to be associated with fewer adherence problems. This seems consistent with SCT's identification of physical resources as a determinant of behaviour (Bandura, 1986) and the notion that such environmental factors don't act as an influence until acted on by an appropriate behaviour (Bandura, 1989b). Users' perceived barriers to adherence also provide further support for the utility of SCT, with less favourable beliefs about, or attitudes towards, the VR exercises being expressed more frequently by lower users of the intervention. This can be seen to reflect the expectations and beliefs elements of person-related determinants of behaviour (Bandura, 1986).

Finally, participants' accounts of their experiences also provide evidence to support the notion of intrinsic motivation as a strong predictor of continued performance of VR exercises in line with SDT (Deci & Ryan, 2000; Ryan & Deci, 2000). Users identified what may be considered intrinsic motivations to continue, such as a desire to change their current situation and a sense of personal responsibility for doing so. This sense of personal responsibility was expressed more by individuals who engaged with the intervention to a greater extent. Users who discussed being motivated by feelings of obligation to the researcher or the research process tended to be those who engaged less. The longitudinal qualitative data also seemed to reflect a process of users moving from extrinsic motivations for continued engagement with the programme to intrinsic ones, with less emphasis placed on the importance of the intervention as a facilitator as time progressed.

Overall, the findings across these studies provide substantial evidence that SCT and SDT are useful theoretical frameworks to draw upon for understanding adherence to VR exercises. Whilst there were numerous additional theories of potential relevance identified by the systematic review, and in the wider literature, many of these share similar constructs with SCT so it seems likely they would be of similar utility. However, one difference between SCT and some of these other potentially useful models such as the HAPA and AMPB (see section 3.3.4, page 75) is that the latter are multistage models. Multistage models propose that different variables predict behaviour at different stages during the behaviour process and have been proposed to have more predictive utility than motivational models such as SCT (Armitage & Conner, 2000). It does seem possible that such models may be even more useful for predicting adherence behaviours in this context, with existing evidence that participants' post-treatment beliefs and attitudes were a better predictor of adherence to VR exercises than pre-treatment (Yardley & Donovan-Hall, 2007). However, in order to more definitively test and compare the predictive ability of such models, a larger sample would be required to allow SEM to more thoroughly analyse the complex interrelationships between variables.

A further potentially useful underpinning theoretical framework for Balance Retraining may have been the Theoretical Domains Framework (TDF: Cane, O'Connor, & Michie, 2012) and the associated COM-B model (Michie, Atkins, & West, 2014; Michie, van Stralen, & West, 2011). TDF draws on 19 existing models of behaviour change and identifies 14 domains likely to be important for changing behaviour. These include skills, knowledge, emotions etc., which map directly onto three ‘sources of behaviour’: Capability, Opportunity and Motivation, which all influence behaviour (COM-B) and highlight targets for behavioural intervention (Cane et al., 2012). Perhaps as a consequence of having drawn upon multiple theories, TDF would appear to account for all of the key determinants of outcomes in the context of Balance Retraining and so potentially would have been a highly appropriate underpinning theoretical framework. Indeed, recent research has advocated the utility of TDF and COM-B models in designing and implementing complex interventions in the field of audiology (Barker, Atkins, & de Lusignan, 2016; Coulson, Ferguson, Henshaw, & Heffernan, 2016).

7.4 Strengths and limitations

This thesis provides insight into how a novel digital intervention to support self-management of chronic dizziness is effective in reducing dizziness amongst older adults. This understanding is important in order to fully understand the circumstances under which such interventions are likely to be effective, and to be able to maximise this effectiveness (Craig et al., 2008). In addition to explaining intervention-specific processes, the findings also contribute to the currently very limited literature regarding how individuals engage with digital interventions to self-manage physical rehabilitation therapies. Furthermore, it provides further evidence of such interventions feasibility and utility amongst an older adult population.

Several design and methodological aspects of this body of work can be considered amongst its strengths. This includes the longitudinal design of the qualitative study to explore users’ experiences of the intervention. This provided valuable insight into how perceptions and experiences changed over the duration. Furthermore, the evaluation of objective intervention usage data provided detailed insight into the important features and underlying BCTs central to its effectiveness. This allows an in-depth understanding of how intervention components interact with behavioural processes in reaching outcomes. The overall mixed-methods approach of this thesis has also contributed to a more holistic understanding of the Balance Retraining than could have been achieved with quantitative or qualitative approaches alone. Using both approaches has allowed identification of relationships that appear responsible for dizziness outcomes, but also deeper insight into what drives users to engage with the intervention in the way they do and how they feel about it. In combination, these approaches provide a richer understanding of users’ experiences of the Balance Retraining intervention. Whilst it has made several valuable contributions, a number of potential limitations of the body of work are acknowledged and discussed below.

Firstly, consideration of the recruitment methods of these studies may highlight potential threats to the external validity of findings. Given that participants volunteered to contact the study team if interested by the information sent by their GP, this volunteer sample may not be reflective of the characteristics of patients with chronic dizziness as a whole. Those who volunteer their participation may be more willing and motivated to engage with potential treatment, and accordingly may demonstrate different behaviours and have different experiences of Balance Retraining than those who do not.

Issues relating to sample size and statistical power should also be considered as a potential limitation. As previously mentioned, all quantitative data analysed for this thesis was collected as part of the aforementioned RCT. Power calculations to determine the required sample size were conducted on the basis of the comparison of the primary outcome measure between intervention users and the control group. In this regard, although a-priori power calculations were conducted for all main quantitative analyses conducted, some of the additional analyses, such as the mediation, might still be considered as somewhat exploratory and risk being statistically underpowered. This problem was potentially compounded for certain analyses by low response rates on some of the measures – in particular the self-efficacy and CEQ baseline measures. Given their necessary positioning at the end of the first session of Balance Retraining (in order to allow users to learn about the therapy first), a large proportion of users did not complete these as they failed to reach this point. Any analyses that were underpowered risk not having identified significant effects where they might have existed – particularly if these were small. As well as being potentially problematic for some of the analyses conducted, the sample size was also not sufficient to permit structural equation modelling (SEM) to be conducted. SEM is a set of statistical analysis methods that allow data to be fitted to models of constructs (Tabachnick & Fidell, 2001). It would have been valuable for assessing the complex interrelation of variables that were proposed in the intervention's logic model and may have allowed more robust theoretical conclusions to be drawn regarding the relationships between various constructs.

A further limitation of this body of work relates to the measure of adherence. Due to a large proportion of participants not progressing beyond session one, the planned measure of self-reported adherence (described in section 2.5.1.1.6.1, page 46) was not completed by approximately half of participants, and as such it was not possible to use this data. This meant that the studies lacked the direct (albeit self-reported) measure of adherence behaviour planned. The rationale for placement of this measure in the intervention sessions rather than the study questionnaires was to reduce the length of time over which participants would be required to retrospectively recall their exercise adherence (i.e. over the previous week rather than the previous month). However, in hindsight, it would have been valuable to also include this measure in the study questionnaires as insurance against low usage of subsequent sessions. Despite not having a direct measure of adherence behaviour, the PETS subscales do provide a proxy for adherence via an indication of the extent to which participants experienced various adherence problems.

Finally, the nested nature of these studies within the broader RCT sometimes dictated the progression of the studies in a manner which did not fully allow the findings of one to inform the next. For example, the measures to be included in the RCT had to be decided before the results of the systematic review and qualitative longitudinal study had been finalised. This meant that some factors identified as potentially important for outcomes, such as social support, motivation and intentions, were not quantitatively measured. It is possible that, had they been, a greater proportion of variance in dizziness in outcomes may have been accounted for.

7.5 Implications of this work

7.5.1 Directions for future research

The findings have implications for the recommended direction of any further research in this area. Primarily, it would be valuable to address the methodological limitations identified. This could provide further robust evidence for the identified mechanisms of the intervention, and a more comprehensive understanding of the possible interrelations between these mechanisms. By recruiting a sample large enough to employ SEM, it would be possible to 'map' the complex network of interactions between BCTs, behavioural determinants, behaviours and outcomes to provide this more complex understanding. This would allow stronger theoretical conclusions to be drawn about predictors of behaviour in this context. In order to achieve this, it would also be important to address the problematic adherence measure identified in the present research. Although measuring adherence has been identified as problematic in the wider literature (Bollen et al., 2014), even a self-reported measure of VR exercise frequency would provide a more direct indication of adherence behaviour than was possible in the present thesis.

The findings of this thesis also highlighted questions that still need to be answered. One of these relates to the processes through which psychological distress such as anxiety and depression are reduced via the Balance Retraining intervention. Evidence from the RCT confirmed that Balance Retraining was effective in reducing such distress-related factors (Geraghty et al., under review), but it is still not entirely clear exactly how and why this occurred. Although participants' accounts of their experiences confirmed a sense of reduced worry and concern as the intervention progressed, the results demonstrated no differential effects of engagement with intervention features on anxiety or depression. A study which focused specifically on predictors of these distress variables as outcomes could provide further insight.

More broadly, it seems important that process evaluations of digital interventions to support illness self-management should increasingly include analyses of objective usage data and also employ longitudinal qualitative designs. Such research designs and analyses have been exceptionally valuable for these studies' findings: in being able to identify specific elements of the intervention which appear most effective; and in understanding the underlying processes that seem influential in determining users' experiences and perceptions of the intervention.

7.5.2 Implications for practice

These findings have important implications for: how chronic dizziness is currently self-managed; identifying those who made need greater support with dizziness self-management; and, more broadly, how digital interventions can be designed and implemented to maximise their beneficial effects. Importantly, the findings demonstrate that a digital intervention is highly acceptable and accessible amongst older adults as a means of delivering VR therapy. In combination with evidence of Balance Retraining's efficacy (Geraghty et al., under review), this has important implications for how VR is delivered to patients within the UK. A standalone internet-based intervention that could be rolled out to large numbers of patients at a relatively low cost is a much needed (and seemingly acceptable) means of providing patients with access to VR. It could provide immediate access to VR for those who otherwise would have an extensive wait and also potentially free up existing audiology/physiotherapy resources and services for those requiring more complex treatment and assessment.

Whilst it seems that the Balance Retraining intervention may be a promising means of individuals' self-managing dizziness, these findings also importantly highlight those individuals who may need additional support and monitoring to ensure that they achieve benefit. Symptom exacerbation appears particularly problematic for adherence to the VR exercises and, as a result, for achieving positive outcomes. It is apparent that reassurance and support to overcome this symptom exacerbation is very important. Individuals who are more highly anxious (who it seems are also more likely to be female) and have less confidence in their ability to manage their dizziness through VR exercises appear especially susceptible to such adherence problems. It seems, therefore, that additional support should be targeted at these groups in particular; screening during the early stages of accessing an online VR intervention could identify those who are highly anxious or have low self-efficacy. Furthermore, whilst psychological distress appears to be an indicator of dizziness outcomes, it seems that this is associated with pre-treatment dizziness severity. Identifying those with the most severe dizziness symptoms prior to treatment may help to recognise who may benefit from additional support with the psychological impact of dizziness. It did appear that greater engagement with the Balance Retraining intervention could address some of these issues and improve outcomes. However, it seems that those who feel their symptoms are less severe or have less impact on their life may be less likely to do so. Whilst this is not problematic for those who only have a small improvement to make, it may be a barrier to improvement for those whose symptoms are severe but who have come to regard regular, potentially 'treatable', dizziness as 'normal'. Screening to identify such individuals could be valaluble for targeting support to ensure that they have realistic expecations and beliefs about the the current level of their symptoms, and the level that they might expect to achieve.

With regard to how users engage with such digital interventions, individuals appeared to gain sufficient skills and support from the initial session to achieve positive outcomes, but did continue to gain benefit from engaging with subsequent sessions. This has implications for the structure, design and implementation of such interventions and suggests that a single core session with optional access to additional content may be a more appropriate format than the current session-based configuration. The findings also propose that techniques to clearly explain the procedures, and to encourage and facilitate regular and consistent practise seem key to overcoming barriers and achieving positive outcomes. Practitioners delivering support for such physical therapies (digital or otherwise) should ensure that these techniques form a core element of their intervention.

7.6 Conclusions

In addition to providing evidence of its acceptability and accessibility amongst older adults, the studies in this thesis provide detailed insight into how the Balance Retraining digital intervention is effective in reducing self-reported dizziness. Consistent with theory and evidence informed expectations, difficulties adhering to VR exercises – particularly difficulties resulting from exacerbation of dizziness symptoms – were the biggest threat to achieving positive outcomes. Certain groups of individuals, such as those who were more anxious or had low perceptions of their ability to complete the exercises, were most vulnerable to such problems. Conversely, perceptions of improvement were a strong motivator of continued engagement.

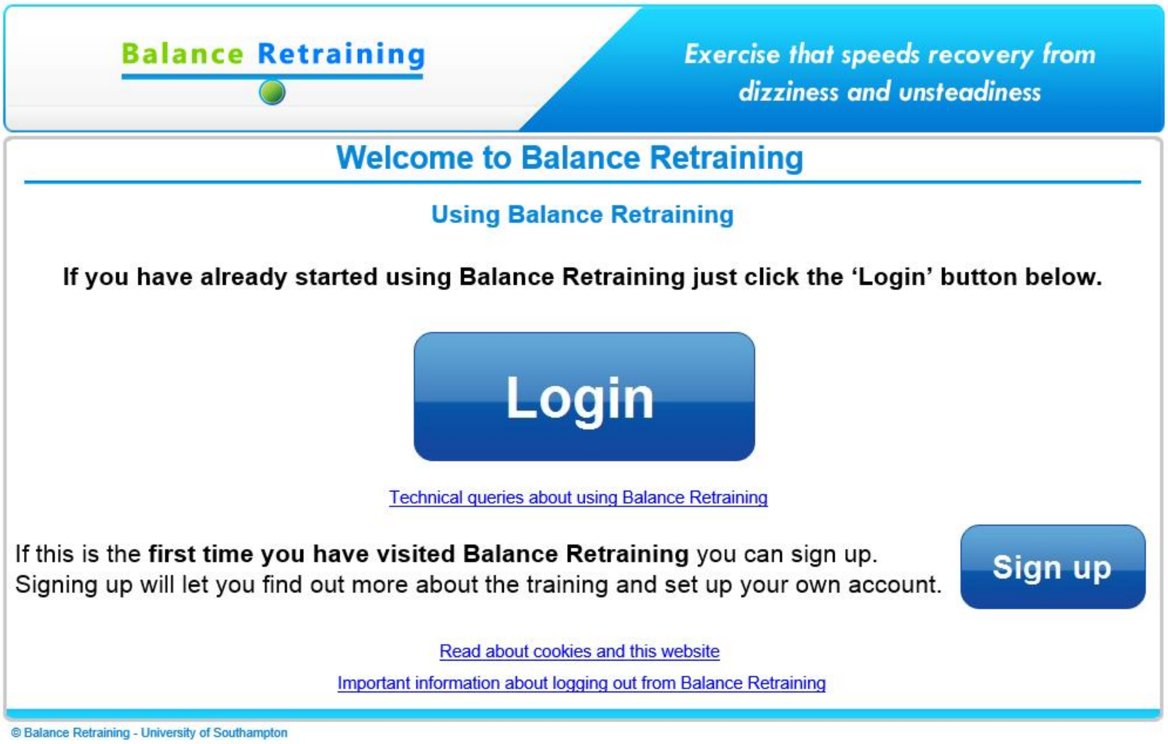
Balance Retraining appears to have been effective primarily by facilitating adherence to VR exercises through use of behaviour change techniques that that focus on provision of clear instruction about the exercises and encouraging and facilitating regular and consistent practise. In doing so, there is evidence that the intervention increases users' self-efficacy and manages and improves expectations about the likely consequences of completing the exercises. Further work with more advanced statistical methods is required to clarify understandings of the complex interrelationships between the mechanisms of impact of the intervention. Further research is also required to understand the likely mechanisms through which the intervention improved psychological distress. Overall, the findings suggest that SCT (Bandura, 1986) is a relatively useful theoretical framework for understanding and predicting adherence behaviour in the context of the Balance Retraining intervention.

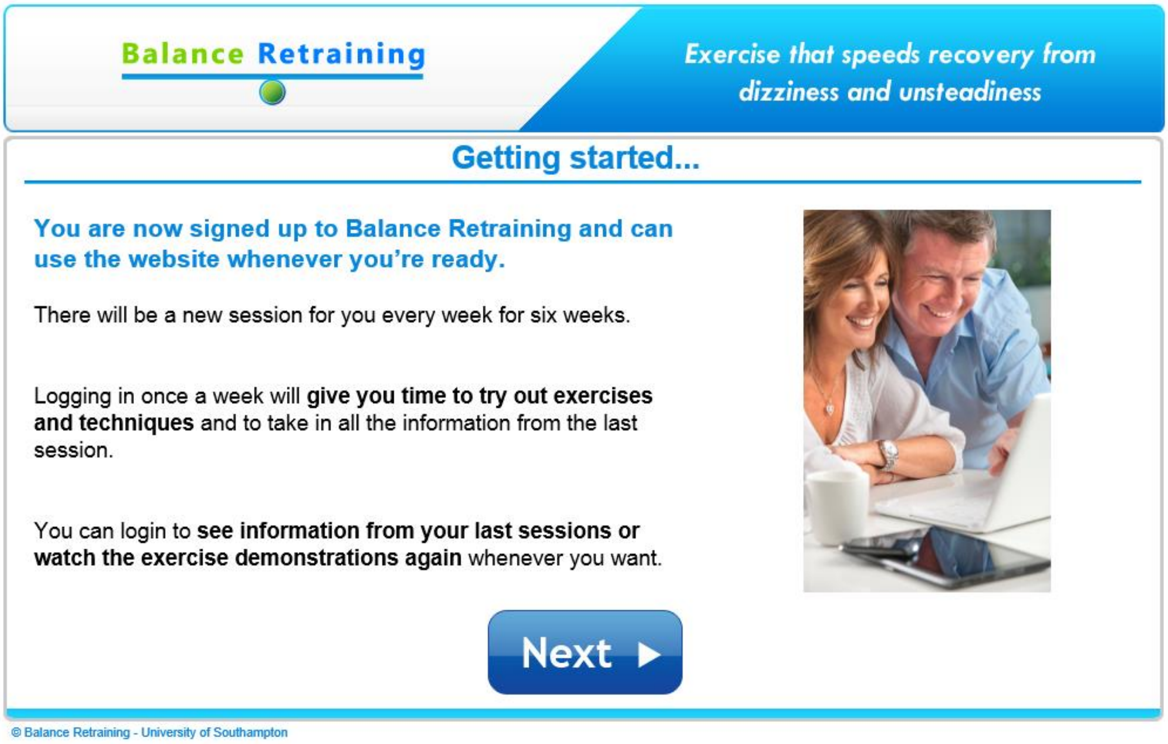
There is evidence that whilst use of the initial sessions of Balance Retraining may be been enough to gain ‘sufficient mastery’ of intervention content, continued use across multiple sessions continues to enhance benefit. This has important implications for the design of this intervention, and others like it, suggesting that a single core session with access to optional content may be a more effective structure.

The Balance Retraining digital intervention is an effective, and much needed, means of training chronically dizzy individuals in vestibular rehabilitation, and supporting them in overcoming barriers in adhering to this therapy. Whilst some individuals may require additional support in order to reduce their dizziness, there is substantial evidence that this digital intervention is a promising means through which these debilitating symptoms can be addressed.

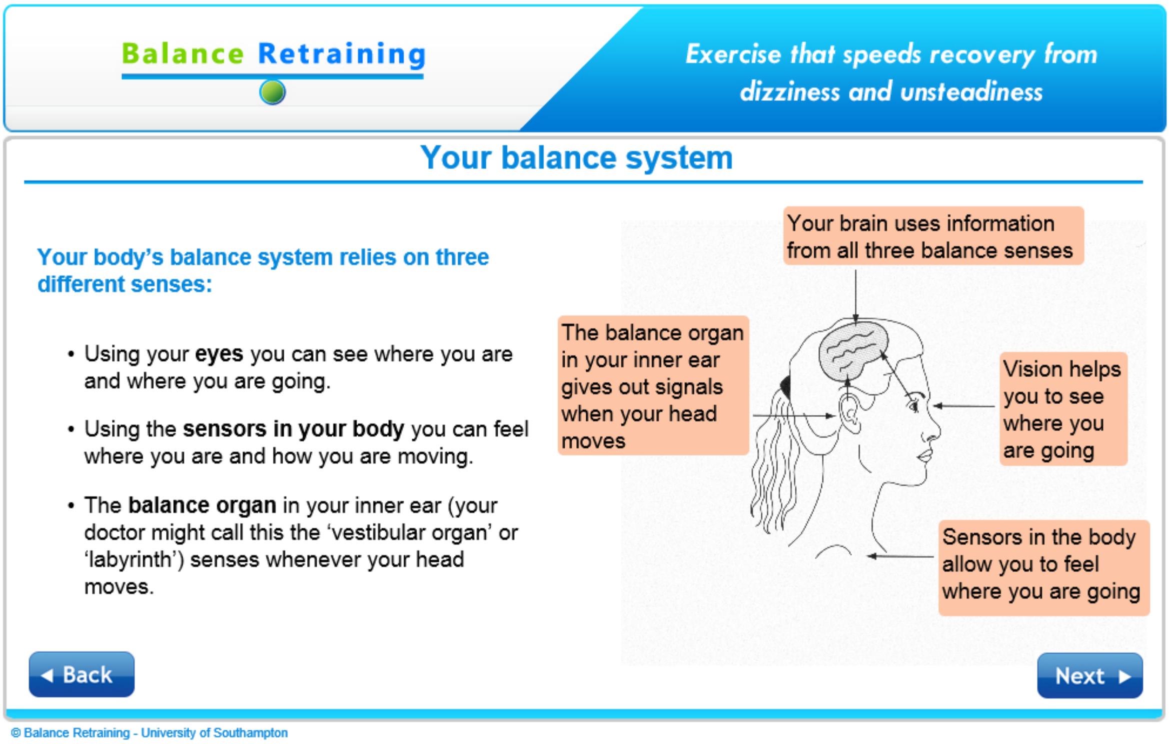
Appendices

Appendix A Screenshots of Balance Retraining pages

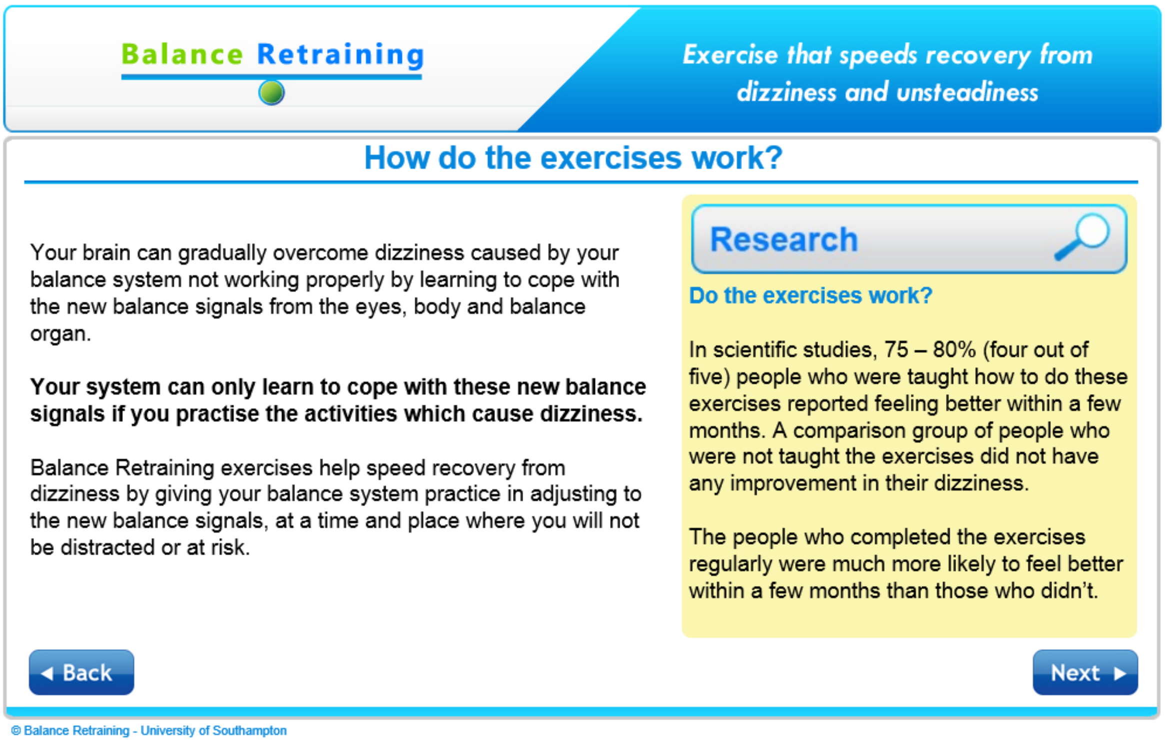




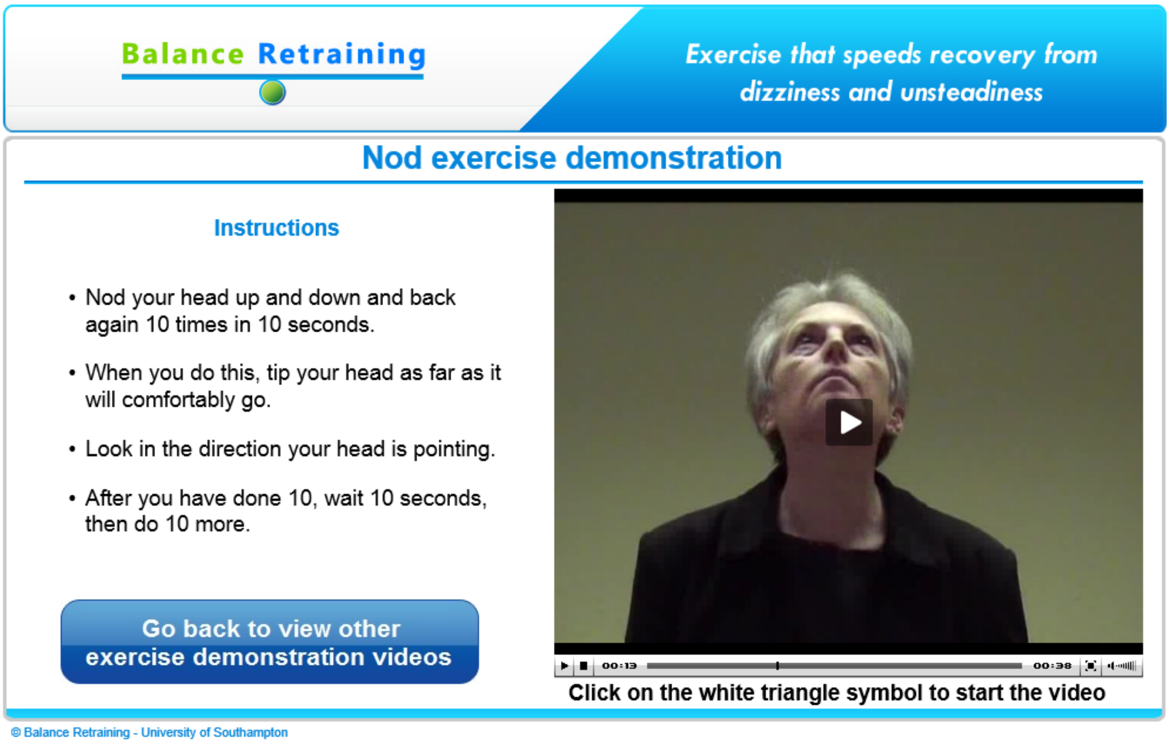
Introduction to the intervention



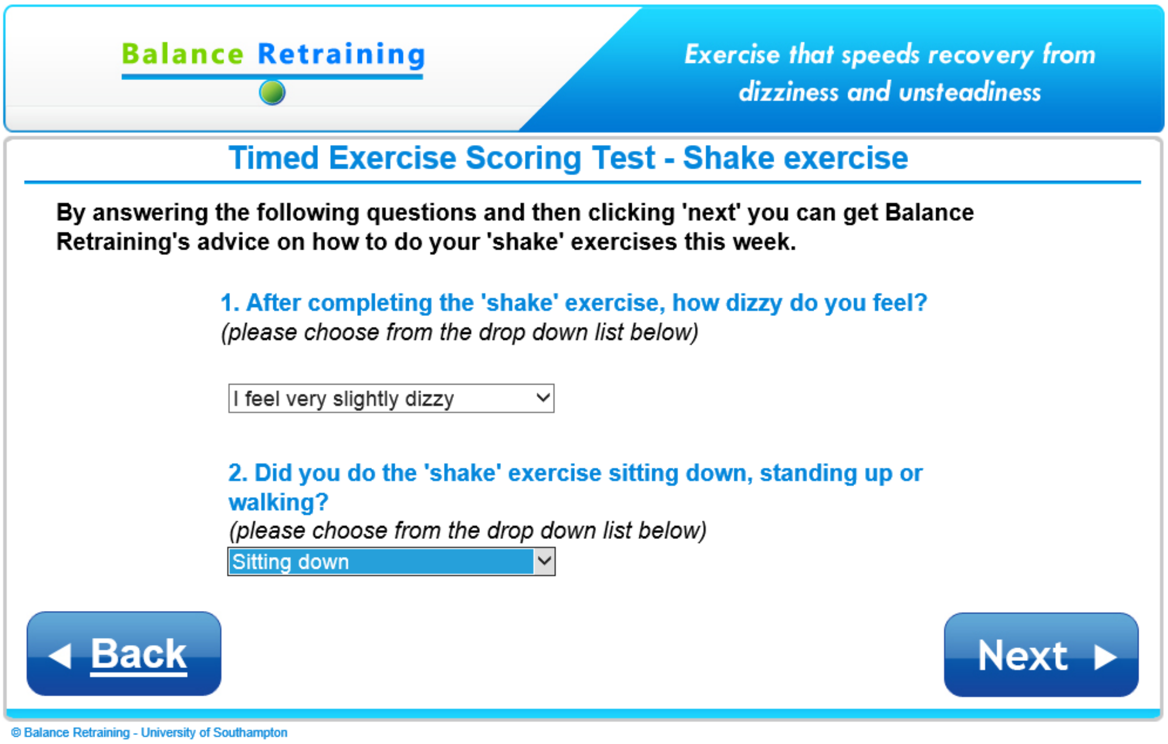
Introductory information about the balance system



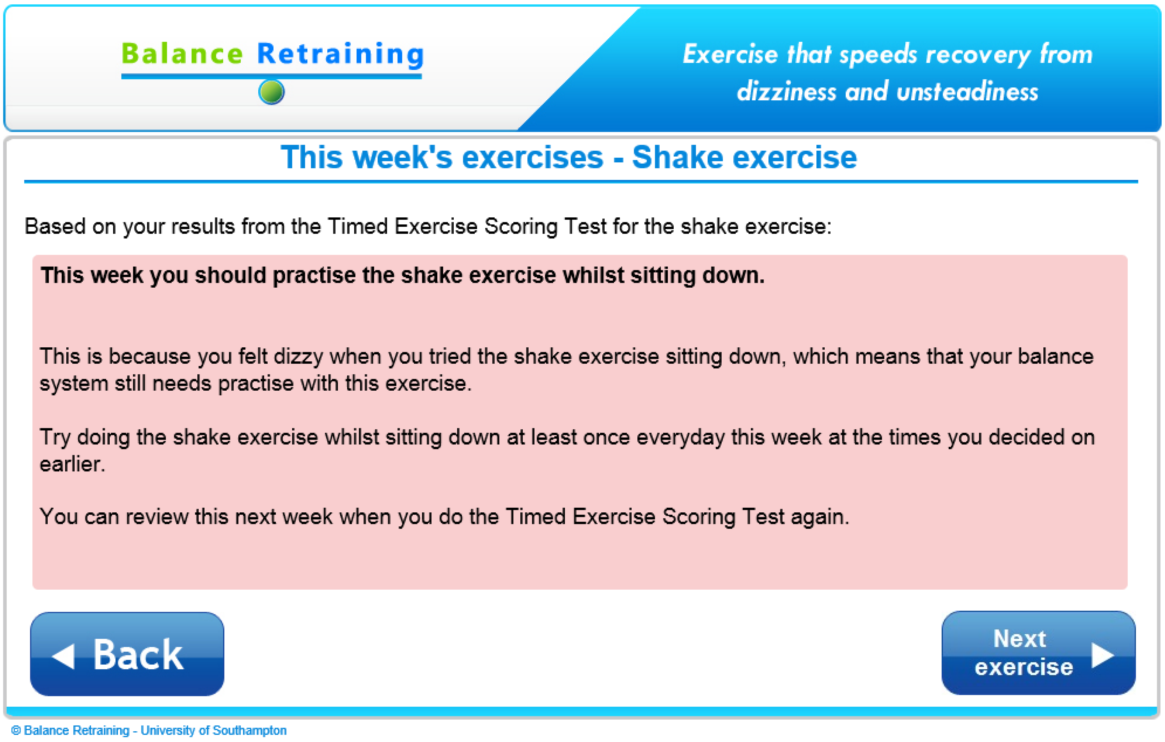
Introductory information about VR exercises



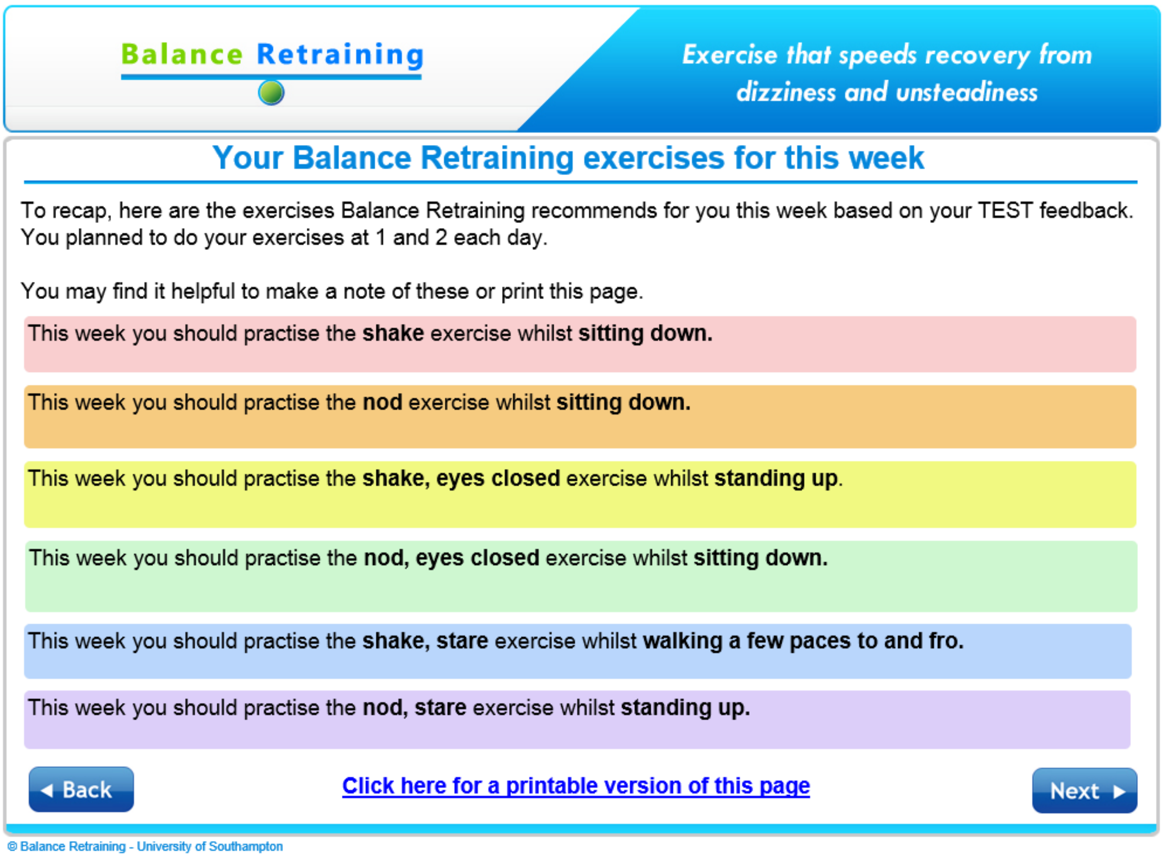
Example video demonstration page



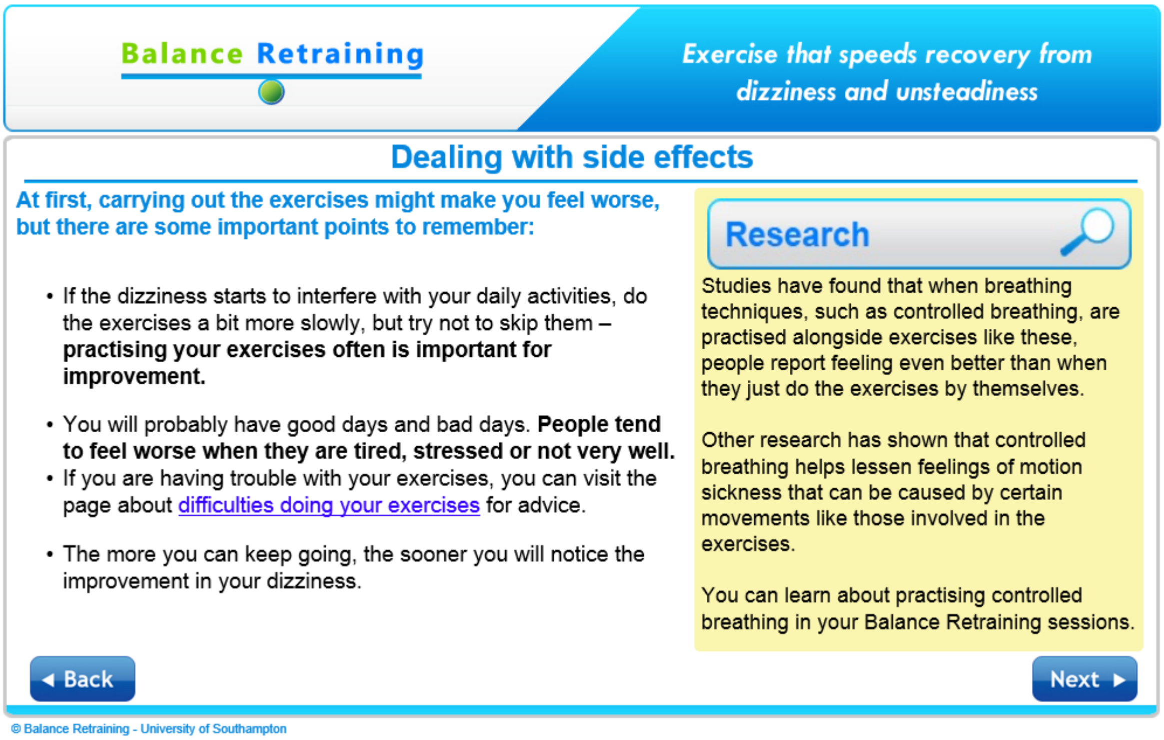
Timed Exercise Scoring Test (TEST) – long version, shake exercise. Users' input appropraite responses



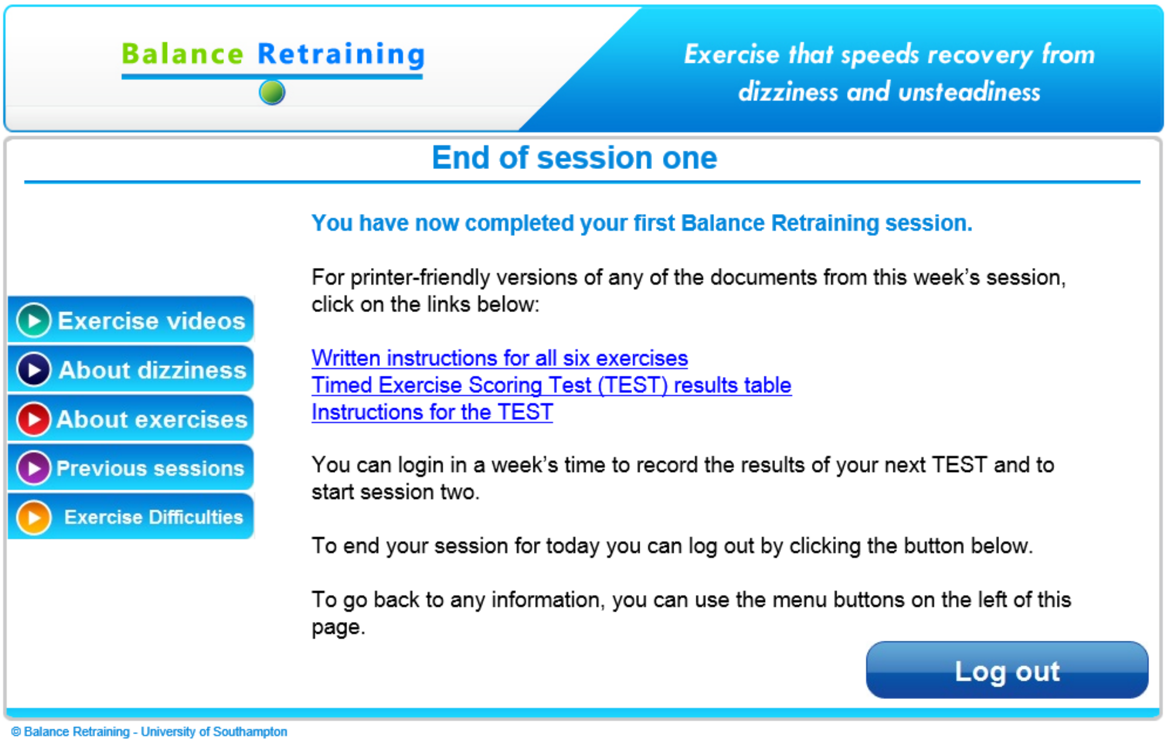
Example tailored feedback on shake exercise



Example tailored ‘exercise prescription’ based on results of TEST



Advice on dealing with exercise side effects



Example end of session menu from which users can revisit content

Appendix B Intervention features, BCTs and Intended Behavioural Determinant Target

Intervention feature	BCTs present	Intended Behavioural Determinant(s) Target
Session One:		
Information: balance system and dizziness	**Natural consequences:** 5.1 Information about health consequences	Illness perceptions
Information: Vestibular Rehabilitation exercises	**Natural consequences:** 5.1 Information about health consequences **Comparison of outcomes:** 9.1 Credible source **Self-belief:** 15.1 Verbal persuasion about capability	Outcome expectancy Self-efficacy
Exercise demonstration videos	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Comparison of behaviour:** 6.1 Demonstration of behaviour **Repetition and substitution:** 8.1 Behavioural practise/ rehearsal	Self-efficacy
Planning exercises	**Goals and planning:** 1.1 Goal setting (behaviour); 1.4 Action planning; 1.8 Behavioural contract **Shaping knowledge:** 4.2 Information about antecedents **Associations:** 7.1 Prompts/ cues **Repetition and substitution:** 8.1 Behavioural practise/ rehearsal; 8.3 Habit formation	Self-efficacy Perceived barriers
Timed Exercise Scoring Test (TEST: full version)	**Goals and planning:** 1.7 Review outcome goal(s) **Feedback and monitoring:** 2.3 Self-monitoring of behaviour; 2.4 Self-monitoring outcome(s) of behaviour; 2.7 Feedback on outcome(s) of behaviour **Associations:** 7.7 Exposure **Repetition and substitution:** 8.7 Graded tasks **Antecedents:** 12.6 Body changes	Self-efficacy Psychological distress
Information: Practical exercise advice	**Shaping knowledge:** 4.2 Information about antecedents **Natural consequences:** 5.1 Information about health consequences **Repetition and substitution:** 8.7 Graded tasks **Comparison of outcomes:** 9.1 Credible source	Self-efficacy Perceived barriers Outcome expectancy
Session Two:		
Information: managing associated symptoms	**Natural consequences:** 5.1 Information about health consequences; 5.6 Information about emotional consequences **Regulation:** 11.2 Reduce negative emotions	Illness perceptions Outcome expectancy Self-efficacy
Information and resources: controlled breathing	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Comparison of behaviour:** 6.1 Demonstration of behaviour **Regulation:** 11.2 Reduce negative emotions	Psychological distress
Session Three:		
Information and resources: relaxation	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Regulation:** 11.2 Reduce negative emotions; 11.3 Conserving mental resources **Antecedents:** 12.4 Distraction; 12.6 Body changes	Psychological distress
Session Four:		
Information and resources: dealing with visual environments	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Associations:** 7.7 Exposure **Repetition and substitution:** 8.1 Behavioural practise/ rehearsal; 8.7 Graded tasks **Antecedents:** 12.5 Adding objects to the environment	Psychological distress Self-efficacy Illness perceptions

Information and resources: stress management	**Goals and planning:** 1.2 Problem solving **Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Regulation:** 11.2 Reduce negative emotions**;** 11.3 Conserving mental resources **Antecedents:** 12.2 Restructuring the social environment	Psychological distress Self-efficacy
Session Five:		
Information and resources: everyday activities	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour; 4.2 Information about antecedents **Comparison of behaviour:** 6.1 Demonstration of behaviour **Repetition and substitution:** 8.1 Behavioural practise/ rehearsal; 8.7 Graded tasks	Psychological distress Self-efficacy Illness perceptions
Information and resources: thought control	**Goals and planning:** 1.2 Problem solving **Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Regulation:** 11.2 Reduce negative emotions; 11.3 Conserving mental resources **Antecedents:** 12.4 Distraction	Psychological distress Self-efficacy
Session Six:		
Information and resources: general exercise	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Associations:** 7.7 Exposure **Repetition and substitution:** 8.7 Graded tasks	Psychological distress Self-efficacy Illness perceptions
Information: importance of a healthy balance system	**Natural consequences:** 5.1 Information about health consequences **Self-belief:** 15.3 Focus on past success	Psychological distress Self-efficacy
General:		
Exercise review and feedback	**Goals and planning:** 1.5 Review behaviour goal(s); 1.6 Discrepancy between current behaviour and goal **Reward and threat:** 10.4 Social reward	Self-efficacy
Dealing with exercise difficulties	**Goals and planning:** 1.2 Problem solving **Social support:** 3.2 Social support (practical); 3.3 Social support (emotional) **Associations:** 7.1 Prompts/ cues **Repetition and substitution:** 8.3 Habit formation **Antecedents:** 12.5 Adding objects to the environment **Self-belief:** 15.2 Mental rehearsal of successful performance	Perceived barriers
TEST (short version)	**Goals and planning:** 1.7 Review outcome goal(s) **Feedback and monitoring:** 2.3 Self-monitoring of behaviour; 2.4 Self-monitoring outcome(s) of behaviour; 2.7 Feedback on outcome(s) of behaviour **Associations:** 7.7 Exposure **Repetition and substitution:** 8.7 Graded tasks **Antecedents:** 12.6 Body changes	Self-efficacy Psychological distress
Previous users experiences	**Comparison of outcomes:** 9.1 Credible source **Covert learning:** 16.3 Vicarious consequences	Self-efficacy Outcome expectancy
Printable instructions	**Shaping knowledge:** 4.1 Instruction on how to perform behaviour **Antecedents:** 12.5 Adding objects to the environment	Self-efficacy

Appendix C GP database search instructions for primary care patient recruitment

1. Database Search

Search practice database for:
- patients aged 50 years or more

AND
- search terms such as: vertigo OR dizziness OR Meniere's disease OR balance problems OR vestibular (symptoms presenting in past two years) OR prochlorperazine OR cinnarizine OR betahistine OR diuretics.

If you require further advice on carrying out the search, please contact Rosie Essery on 02380 599395 or r.a.essery@soton.ac.uk

2. Screen List

Please ask GP to manually check this list to exclude individuals where there may be potential difficulties, for instance:

- identifiable non-labyrinthine cause of dizziness;
- medical contra-indications for making required head movements (e.g. severe cervical disorder);
- serious co-morbidity (life threatening condition or progressive central disorder).
- Non-English speakers and people unable to read and write English.

3. Obtain packs for mail out

When you have completed the database search and list screening, please contact the study team on 02380 599395 or via email (r.a.essery@soton.ac.uk). We will send you the correct number of packs for mail-out and we will also provide an electronic version of the invitation letter.

4. Mail out packs

Modify the invitation letter to include your practice header and name of the GP and add one to each pack. Print labels for each pack, add to outer envelope, and then mail out.

5. Save list

Please save a copy of the list you have mailed to for 6 months, in case of any queries. (A wallet is provided on the following page for you to place this in.)

6. Claim service support costs

Please see documentation in this file relating to service support costs. Please log all relevant recruitment data onto e-dge.

Appendix D Participant materials for participation in RCT

D.1 Patient invite letter and reply slip

Practice Headed paper and Trust logo

<*patient name and address*> Study ID

<*insert date*>

Dear <*insert patient name*>

Online Dizziness Intervention

We are writing to invite you to participate in a study being led by the University of Southampton.

You have been identified as a potentially suitable participant for the study by your GP. Attached is a patient information leaflet outlining the study and telling you more about it. There are contact details should you require further information. If you are interested in taking part, please complete the reply slip at the bottom of this letter and return it directly in the FREEPOST envelope to the research team who will contact you by phone and answer any questions you may have.

Thank you very much for taking the time to read this letter and the attached information sheet.

Yours sincerely

Dr <*insert GP name*>

✂ ………………………………………………………………………………

<*insert patient name and address details*> Study ID:

I am interested in taking part in the above study and would like to be contacted,

My phone number is:

Mobile …………………………………….
Home ……………………………………..
Work……………………………………….

Email ……………………………………………………………

The following days and times are best to contact me:

Day(s)…………………………………………………………… Time(s)……………………………………………………………………….

D.2 Participant information sheet for RCT

Participant Information Sheet
Phase 2 – Randomised Controlled Trial
CI: Professor Lucy Yardley

Trial of a website designed to help overcome dizziness

You are invited to take part in our research study. Before you make a decision, it may help to understand why the research is being done and what it would involve for you.

What is the study about?

Research has shown that a set of simple exercises that patients can do at home help many people to overcome dizziness. We have designed a website that explains how to do these exercises. This study will test whether using the website, alongside the care you normally have from your doctor, improves dizziness more than normal care alone.

Why have I been invited?

You have been invited to take part because this study is for people aged 50 or over who have visited their doctor about dizziness in the last two years; nearly 300 people will be included.

Do I have to take part?

No. It is up to you whether to take part in the study. If you do decide to, you can let us know by: emailing us on this address: *r.a.essery@soton.ac.uk* ; calling us on this number: *02380 599395;* or returning the reply slip in the enclosed FREEPOST envelope.

*If you do **not** want to take part you do not need to do anything, as we will not contact you again.* Whether or not you choose to take part will not affect your medical care in any way.

What will happen to me if I take part and what do I have to do?

Once you have been in touch with the study team either by phone, email or returning your reply slip we will call you. We will check that you still want to take part and can answer any questions you might have about the study.

If you are still happy to take part, we will tell you all about how to get started. At the very start of the study, you will have the chance to be in one of two groups: group one will be able to use the website straight away; group two will be able to use the website after 6 months. In order to find out as much as we can about the website, the group you go into will be decided by chance (randomly).

The website has six sections with information and exercises to help reduce your dizziness. You will be able to look through a new part of the website each week, for six weeks. It may take around 15 – 20 minutes to look through each weekly section. To overcome the dizziness you will need to spend about 10 minutes each day practising the exercises, for several weeks. The exercises are simple head and neck movements.

After 3 months, both groups will be asked to visit the website again to answer some questionnaires or if you do not want to return to the website we will call you to ask about your symptoms. This will happen again after 6 months.

To find out what people who use the website think of it we will ask if you are happy to be interviewed about this – but if you decide to take part in the study of the website you do not have to be interviewed. If you are happy to be interviewed we will contact you to arrange a time that suits you to be interviewed in your home or by telephone. We will record the interview and it is likely to take between 20-30 minutes.

What are the possible disadvantages of taking part?

The main disadvantage of taking part is the time and effort it takes to carry out the exercises and complete the online sections. The exercises can also make dizziness symptoms a little worse at first; this is a sign that they are working, and you can avoid becoming too dizzy by taking the exercises very gently.

What are the possible benefits of taking part?

You will have the opportunity to use a website containing information and exercises that have been found to be help reduce dizziness in three previous research studies. This website is only currently available to people who take part in the study.

What will happen if I don't want to carry on with the study?

You are free to change your mind about taking part at any time without giving a reason.

Will my taking part in this study be kept confidential?

All information collected about you during the course of the research will be kept strictly confidential. With your permission, we will advise your doctor if you agree to take part. However, they will not have access to any of the information you provide in the study. Any quotes that arise from interviews will be made anonymous and your name will not appear on any publications. The interview recordings will be deleted as soon as they are transcribed. The anonymous transcripts will be stored as encrypted files on password protected University of Southampton computers until the end of the study period. After this time, these files will be electronically archived and kept for 15 years in accordance with University policy. At the end of this period the archived electronic files will be destroyed. Documentation linking your name to your study ID number will be kept separate to all other study documents in a locked filing cabinet. This will be disposed of at the end of the study in accordance with the University's confidential waste procedures. We will handle, process, store and destroy data following procedures in keeping with the Data Protection Act 1998. Data from this study will be kept for 10 years and will then be disposed of securely.

What personal data do I have to provide and what will it be used for?

Some information about your use of the dizziness website will be automatically recorded (e.g. which sessions you use). This will help us to see how people use the website. You will also be asked to give some basic information about yourself (e.g. gender, email address) which will be used to create your personal account, and give you personalised advice. Other information is asked for because it will help the researchers to understand if the programme is useful and who it works best for. Your contact details will only be used to contact you while the study is running and to send you a summary of the research findings (if you want one). Nobody outside the research team will see information that you enter into the website.

What will happen to the results of the research study?

At the end of the study we will write a report of our results to be published in medical journals. A summary can be made available to you if you wish to see this.

Who is organising and funding the research?

This study is organised by researchers from the Departments of Primary Care and Psychology at the University of Southampton. The Dunhill Medical Trust (reference R222/1111) has funded this project and is paying the costs of undertaking the study and its analysis.

Who has reviewed the study?

The study has been reviewed approved by **Southampton A Research Ethics Committee, reference number 13/SC/0119**. The study is sponsored by the University of Southampton and has also been approved by the University of Southampton ethics committee.

What if there is a problem?

If you wish to complain, or have concerns about any part of this study please contact Dr Adam Geraghty (Phone: 02380 241051, email: A.W.Geraghty@soton.ac.uk). If you are still unhappy and wish to complain more formally, please contact: Dr Martina Prude, Head of Research Governance for the University of Southampton (Phone: 02380 595058; email: mad4@soton.ac.uk); or, alternatively, through the NHS complaints procedure (details available from your doctors surgery). It is highly unlikely that you will be harmed during this study. If you are, however, you may have grounds for legal action against the University of Southampton and the NHS.

Further information and contact details

If you have any further questions or queries then please contact:

Rosie Essery, Senior Research Assistant (r.a.essery@soton.ac.uk, 02380 599395)

THANK YOU FOR YOUR TIME IN READING THIS INFORMATION SHEET

Phase 2 Dizziness PIS v1.1 26 March 2013 REC Ref: 13/SC/0119

Appendix E Email instructions for accessing Balance Retraining

Dear (name),

Thank you once again for your interest in the study and for agreeing to take part.

Further to our recent phone conversation, please find the link (below) to the website for the study:

https://balanceretraining.lifeguidewebsites.org

You can access this either by clicking on the link or copying and pasting this into your browser address bar (**not** into google search). The website is called Balance Retraining.

When you visit the website you will first need to **sign up**. You will then be asked to provide consent to take part in the study and then will need to answer a few questions. Once this is complete you will be told which group you have been put into – this is decided completely at random, so there is an equal chance of being in either group. You will receive further instructions and information at this point.

Please don’t hesitate to contact us if you have any further questions or if you experience any difficulties in using Balance Retraining.

Kind regards,

The Balance Retraining Study Team

Appendix F Online consent form for RCT

Balance Retraining

Exercise that speeds recovery from dizziness and unsteadiness

Consent Form

UNIVERSITY OF Southampton

Phase 2 Consent Form
Trial of an Online Dizziness Intervention

Chief Investigator: Professor Lucy Yardley

Please click on the tick box for each statement to indicate that you agree

1. I confirm that I have read and understand the information sheet dated 26 March 2013 (version 1.1) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ○

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 if I withdraw from the study before completing all exercises, advice and measures that any data I have given up to that time may still be used in the study unless I instruct the researchers differently. ○

4. I understand that relevant sections of my medical notes and data collected appropriate to the study, may be looked at by individuals from the research team, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ○

5. I agree to be contacted later to take part in a telephone interview about my experiences of taking part in the research study. ○

6. I agree to my GP being informed of my participation in the study. ○

7. I agree to take part in the above study. ○

Full name of participant: ____________________

Date: __________

By clicking 'continue' you are agreeing to take part in the study **Continue**

Appendix G Characteristics of studies included in the systematic review

ID	Study and Design	Sample Details	Home-based Physical Therapy Intervention	Adherence Outcome Measure(s)	Significant predictors (effect sizes presented where available)	
					Uni/bivariate	**Multivariate**
1	Alewijnse et al. (2003) Longitudinal prospective study	129 females, mean age 55.6 years (SD 10.9 years), stress, urge or mixed UI (non-medicated), Netherlands.	Pelvic floor muscle exercises (PFME) at home in follow up period	Participant diary and self - report adherence questionnaire at one year follow-up	**Self-efficacy**, β=0.27, p<0.018	**Final model:** R^2=0.50, R^2 change = 0.133, p<0.001, **previous good adherence**, β=0.43, p=0.000; **weekly wet episodes,** β=0.28, p=0.010
2	Bassett and Prapavessis (2011) Secondary data analysis from RCT	69 adults (29 males, 40 females), mean age 35.2 years (SD 12.9 years), with a sustained ankle sprain, New Zealand	Strengthening and balancing activities post discharge from physiotherapy to maintain integrity of ankle	Participant self-report scale measuring extent of adherence to all modalities of treatment from 1 = none to 5 = all	**Intention,** r = 0.25, p<0.05	
3	Borello-France et al. (2010) Prospective secondary data analysis from RCT	144 females, mean age 55.8 years (SD 14.2 years), urge-predominant UI, USA.	PFME in 12 months following 10-week behavioural intervention for urinary incontinence	Self-report exercise questionnaire.	**'Other barriers' including life stress**, B=-3.6, p=0.02 **difficulty remembering to do exercises**, B = -2.6, p=0.03, **baseline symptom severity,** p <0.05	**Difficulties finding time for exercises**, B = -2.5, p=0.03
4	Borello-France et al. (2013) Prospective secondary data analysis from RCT	296 females, mean age 49.6 years (SD 13.0years), stress predominant UI, USA.	PFME in 12 months following 10-week behavioural intervention for stress incontinence	Self-administered questionnaires at clinic attendance.	**Unsure whether doing exercise correctly**, p=0.046	**Difficulty remembering to do exercises**, OR=0.20, p=0.01

5	Brewer et al. (2000) Prospective study	95 athletes (28 female, 67 male), mean age 26.92 years (S.D. 8.23 years) undergoing Anterior Cruciate Ligament (ACL) repair operation, USA	Post-surgery home exercises to promote strength and flexibility in lower limb	Six month post-surgery visits: reported on a scale of 1 (none) to 10 (all) (extent to which they had completed therapy since last visit).	**Social support**, r=0.22, p<0.05	**Self-motivation**, R^2=0.26, β=0.39, p<0.05
6	Brewer et al. (2003) Longitudinal prospective study	61 athletes (21 female, 40 male), mean age 26.03 years (SD 7.99 years) undergoing ACL repair operation, USA	Post-surgery home rehabilitation exercises to promote strength and flexibility in lower limb.	Reported at each subsequent clinic appointment on a scale of 1 (none) to 10 (all) (extent to which they had completed therapy since last visit).		**Self-motivation**, R^2=0.23, β=0.37, p<0.05; **Interactions:** R^2=0.24, **self-motivation x age**, β=0.31, p<0.05; **social support x age**, R^2=0.24, β=0.25, p<0.05
7	Brewer et al. (2013) Prospective daily process study	91 athletes (33 female, 58 male), mean age 29.73 years (S.D. 10.24 years) undergoing ACL reconstruction surgery, USA	Six weeks of post-surgery home rehabilitation exercises to promote strength and flexibility in lower limb.	Self-reported number of sets of home exercises completed per day divided by number of sets of exercises they had been advised to for each of those days. Home exercise ratio calculated.		**Number of exercises**, R^2=0.44, B=-0.251, p<0.001; **daily-stress**, R^2=0.025, B=-0.049, p<0.05; **negative mood**,R^2=0.025, B=-0.011, p<0.05; **Interactions: daily stress x athletic identity,** B= 0.005, p<0.05**; pessimism x pain,** B = -0.020, p<0.05
8	Chan and Can (2010) Cross-sectional study	82 patients (58 female, 24 male) age range 16 – 75 years (mean not reported), completing physiotherapy for various conditions, Turkey	Various home physiotherapy exercise regimes (of at least one week duration at recruitment) for musculoskeletal injury	Two item self-report measure of adherence on 5-point Likert scale: 1) times exercises performed per week; 2) number of exercises per session.	**Self-motivation**, r=0.24, p=0.035; **satisfaction with physiotherapist**, r=0.31, p=0.004; **explanation from physiotherapist**, r=0.34, p=0.002; **reassessment of exercises**, r=0.31, p=0.005	
9	Chen and Tzeng (2009) Cross-sectional study	106 women, mean age 48.6 years (S.D. 11.39 years), being treated for urinary incontinence, Taiwan	Daily exercise repetitions of PFMEs carried out at home for 12 week period	Three item scale rating average daily time spent on PFMEs and number of daily exercise repetitions.		**Final model:** r^2 = 0.40: **Self-efficacy** r=0.59, p<0.001; **severity of urine loss** r=0.18, p<0.05

10	Chen et al. (1999) Cross-sectional study	62 patients (23 male, 39 female), mean age 47.8 years (SD 13.8 years), upper extremity impairment, USA	Home exercises involving mobilisation of upper extremity as part of physiotherapy programme (of at least one week duration at recruitment)	Self-report questionnaire - for each exercise: number of reps per session & number of sessions per day recommended and actually performed during typical day in previous week.		**Self-efficacy**, r^2=0.08, β=0.33, p<0.05
11	Clark and Bassett (2014) One group prospective design	24 adults (14 male, 10 female) mean age 44.2 years (SD 20.4 years) with soft tissue injury of the shoulder, New Zealand	Prescribed home exercise programme for treatment of shoulder injury	Home exercise diary required participant to answer 'yes' or 'no' to two questions regarding whether they completed the required number of exercises prescribed by physio.	**Behavioural intentions,** r= 0.24, no p value reported; **maintenance self-efficacy** r= 0.67, p <0.05	
12	Forkan, et al. (2006) Cross-sectional study	175 over 65 year-olds, (156 female, 19 male) mean age 81.04 years (SD 7.08 years), impaired balance , USA	Life-long home exercise plan of balance and flexibility exercises upon discharge from physiotherapy (4-6 week programme).	Self-report survey - measured frequency, duration and combination of mode of exercise	**Negative perceptions of health status**, OR=0.23, p=0.004; **low expectations of therapy**, OR = 0.40, p=0.05; **feelings of depression as barrier**, OR=0.28, p=0.032	
13	Friedrich, Gittler, Halberstadt, Cermak, and Heiller (1998) Double-blind prospect randomised controlled trial	93 adults (46 male, 47 female) mean age 44,1 years (SD 10.7 years) with chronic and recurrent low back pain	Home physical therapy sessions to improve spinal mobility, muscle strength and coordination post-inpatient treatment for back pain.	Daily exercise diary indicating whether, and for how many minutes, exercises performed. Also asked to confirm at 4 and 12 month follow up how long after end of treatment they continued exercising.	**Level of distress,** r=0.18, p=0.036 (4 months,) r = 0.19, p=0.045 (12 months)	

14	Hardage et al. (2007) Cross-sectional study	50 older adults (14 male, 36 female) mean age 79. 9 years (SD 7.1 years) recently discharged from home health physiotherapy, USA	Home exercise programme including resistance exercises to improve strength and balance to avoid recurrent falls/injury	Daily home exercise log – monthly calendar on which they marked 'e' on dates they performed exercises. (also asked to record days they had falls as a distractor variable)	**Self-efficacy expectations,** r_{pb}= 0.370, p =0.014; **outcome expectations,** r_{pb}= 0.434, p=0.003 (However, text describes as negative correlations and also states that both factors **did not** predict exercise adherence)
15	Howard and Gosling (2008) Cross-sectional study	146 adults (no demographic data reported) prescribed an exercise rehabilitation prescription following attendance at Osteopathy Clinic, Australia	Exercise rehabilitation prescription to be conducted outside formal treatment setting including stretching, strengthening, proprioception and functional rehabilitation	Single item measure in scale: "Did you complete all of the exercises prescribed to you as directed?" Yes/No dichotomous response	**Attitude to health, sport and exercise,** t_{144}=10.16, p<0.001; **past experience of health, sport and exercise,** Mann-Whitney U = 192, corrected z = -9.70, p<0.001
16	Jurkiewicz, Marzolini, and Oh (2011)	14 adults (7 male, 7 female), mean age 62.9 year, (SD 13 years) post stroke engaged in home-based exercise rehabilitation programme	Resistance training programme conducted at home 2-3 times per week: emphasis on retraining of balance and coordination	As part of questionnaire administered asked to report number of workouts per week.	No significant correlations but participant reported motivators: **desire to improve overall health** (82%)**; desire to improve functional ability** (75%)**; social support** (50%); and barriers: **lack of motivation** (57%); **musculoskeletal issues** (57%); **not enough time** (36%)
17	Levy, Polman, Clough, Marchant, and Earle (2006) Longitudinal prospective study	70 athletes (44 male, 26 female) mean age 32.5 years (SD 10.2 years), tendonitis related injury, UK	Daily home exercises for tendonitis related injury as part of 8-10 week physical rehabilitation programme.	Self-report 5 point Likert scale re. extent to which they had completed recommended exercises.	**Perceived severity**, r= 0.60, p<0.01; **perceived susceptibility**, r=0.72, p<0.05

18	Levy et al. (2008) Longitudinal prospective study	70 athletes (44 male, 26 female) mean age 32.5 years (SD 10.2 years), tendonitis related injury, UK	Daily home rehabilitation exercises for tendonitis related injury as part of 8-10 week physical therapy rehabilitation programme.	Self-report 5 point Likert scale re. extent to which they had completed recommended exercises.	**Perceived susceptibility**, r=0.26, p<0.05; **self-efficacy** r=0.36, p<0.01; **intention**, r=0.27, p<0.05; **self-motivation**, r=0.24, p<0.05;**attitude**, r =0.31, p< 0.05; **instrumental coping**, r=0.34, p<0.01; **listening support from teammates**, r=0.87, p<0.01; **personal assistance from family**, r=0.26, p<0.05	**Final model** R^2= 0.60: **Habit**, β=0.202, p<0.05; **distraction coping**, β=0.223, p<0.05; **palliative coping**, β=-0.453, p<0.001; **task-appreciation by physiotherapist**, β=0.370, p<0.01; **emotional support from friends**, β=0.292, p<0.05
19	Mayoux-Benhamou et al. (2005) Longitudinal prospective study	135 post-menopausal females, mean ages 59.6 years (SD 6.2 years) (all < 70 years), risk factors for osteoporosis, France	Daily programme of four strength and flexibility exercises focusing on hips and back to be carried out at home following one-off session	18-month follow up: proportion of prescribed exercise reps per week compared to number self-reported as completed.		**General physical function**, OR=1.26, no p value reported
20	Medina-Mirapeix, Escolar-Reina, Gascan-Cnovas, et al. (2009) Prospective cohort study	184 adults (148 female, 36 male)aged 18-70 years (mean age not reported), chronic non-specific neck or low back pain, Spain	Stretching and strength exercises to be completed at home after four-week physiotherapy intervention in clinic - individual recommendations of frequency per week and duration per session	One month post-intervention: adherence to frequency per week and duration per session: self-report 5 point Likert assessing how often they adhered to frequency and duration recommendation (Never-Always).	**Difficulties fitting exercise in**, OR=7.4, p<0.05;**satisfaction with physiotherapist**, OR=1.2, p<0.05; **positive emotional support**, OR=3.5, p<0.05	**Number of exercises**, OR = 0.2, p<0.05; **self-efficacy**, OR=1.5, p<0.05; **previous poor adherence**, OR=0.3, p<0.05; **clarification of doubts and questions answered**, OR=4.1, p<0.05; **supervision of exercises**; OR=3.3, p<0.05

21	Niven et al. (2012) Longitudinal prospective study	87 athletes (65 men, 22 women), mean age = 28.95 years, (SD 7.7 years)post ACL repair operation, UK	Eight week home based rehabilitation programme post-surgery including mobilisation and stretching of affected leg.	Participants' self-report estimation in rehabilitation diary and 7-point Likert scale regarding extent to which they adhered in previous 2 weeks at 2, 4, 6 and 8 weeks.		**Intention (at week 4)**, adj. R^2= 0.47, p<0.01
22	Scherzer et al. (2001) Prospective study	54 athletes (17 female, 37 male), mean age = 28 years (SD 8.33 years) post ACL surgery , USA	Home-based rehabilitation exercises following ACL repair surgery focusing on knee extension and flexion, quadriceps strength and normal gait.	Patients rated their completion of prescribed home exercises since their last appointment for five weeks post-surgery.	No significant findings discussed in this review – included as investigated a number of common factors but these were not found to predict HBPT adherence in this study.	
23	Schoo et al. (2005) Prospective study	115 adults (41 male, 74 female), mean age = 70.4 years (SD 6.80 years), osteoarthritis of hips or knee, Australia	Eight week programme of home mobility and strengthening exercises for knees and hips. Supported with brochure.	Calculated from participant self-report log sheet as percentage of exercises completed for prescribed routine.		**Previous good adherence**, OR=19.86, p<0.001; **high levels of physical activity**, OR=5.58, p=0.033; **perceptions of physical inactivity**, OR=0.07, p=0.009
24	Seçkin, Gündüz, Borman, and Akyüz (2000) Prospective observational study	120 adults (20 male, 100 female), mean age 57.3 years (SD 8.4 years) with osteoarthritis of the knee	3 month home exercise programme to be conducted daily including flexibility, strength, endurance and active range of motion movements.	Asked at each follow-up visit: how many days they had done the exercises, how often they did the exercises per day, and the number of times they had exercised.	**Pain score,** r=0.40, p<0.05	

25	Sjösten et al. (2007) Prospective secondary data analysis from RCT	293 over 65 year-olds (214 female, 79 male), mean age 73.4 years (SD 6.0 years) at risk of frequent falls, Finland	Tailored home exercises to be performed three times per week over one year intervention. Lower leg muscle strength, balance and coordination exercises increasing in intensity as individual progressed.	Participant self-report daily diaries returned monthly. Total number of performed sessions over intervention divided by number of monthly diaries returned - this was divided by 30 and multiplied by 7 for weekly rates.	No significant findings discussed in this review – included as investigated a number of common factors but these were not found to predict HBPT adherence in this study.	
26	Spink et al. (2011) Prospective secondary data analysis from RCT	153 older adults (47 male, 105 female) mean age 74.2 years (SD 6.0 years) high risk of falls, Australia	Home-based foot and ankle exercises - 30 minutes, 3 times per week for 6 months, aimed at stretching and strengthening muscles	Self-report daily exercise diary - advised to return each month.		**Physical health status**, Canonical $R^2 = 0.05$, p=0.007
27	Taylor and May (1996) Prospective study	62 athletes (42 female, 20 male) mean age 21.7 years (SD 2.85 years), various sports injuries, UK	Home-based exercises part of individualised sports injury rehabilitation plan recommended by physiotherapist (3-10 day follow-up)	Compliance data sheets completed by patient and physiotherapist at 1st and 2nd appointment - estimation of extent to which they complied with the exercises (0 to 5).	**Perceived susceptibility***, r=0.28, p<0.05; **perceived treatment efficacy***, r=0.26, p<0.05	**Perceived severity***; **perceived susceptibility****; **perceived treatment efficacy****; **self-efficacy***
28	Terpstra, de Witte, and Diederiks (1992) Retrospective cross-sectional study	104 patients (28 men, 71 women, 5 undisclosed), mean age 59 years (range 18-78 years) with diagnosis of definite or classical rheumatoid arthritis, Netherlands	Daily home-based exercise programme post discharge from hospital consisting of 26 exercises for all parts of the body.	Four items of the questionnaire asked about whether, and how often, participants exercised: during the month after discharge, and in the past month.	**Stimulation by health care professional,** p=0.043**;** **belief that exercising worthwhile,** p=0.003**;** **belief that exercising does good,** p=0.001 (Mann-Whitney U tests – effect sizes not presented)	

29	Wright, Galtieri, and Fell (2014) Cross-sectional study	87 patients (62 female, 25 male) mean age 43.8 years (SD 17.57 years), various musculoskeletal injuries, Australia	Home exercises prescribed as part of various individualised physiotherapy regimens for musculoskeletal injuries	3 item self-report asking whether participants: completed all exercises recommended (yes/no); how much effort they put into exercises (– 'a lot of effort' to 'no effort'); and percentage of exercises they completed	**Self-efficacy**, r=0.27 (p value not reported)	**Satisfaction with physiotherapist**, r^2=0.16, p=0.001
30	Yardley and Donovan-Hall (2007) Prospective observational study	150 (44 male, 106 female) mean age = 61.1 years (SD 14.68 years), vestibular-related dizziness and balance disorders, UK	12 week programme of Vestibular Rehabilitation Exercises conducted daily at home with periodic nurse support phone calls.	Self-report postal questionnaire - first 12 items: problems faced in adhering. Asked how many weeks they continued therapy and if they stopped because asymptomatic.	**Perceived behavioural control**, r=0.19, p<0.05 pre-treatment, r=0.39, p<0.01 post-treatment	**Intention**, OR=1.23, p<0.05 (post-treatment), final model r^2=0.39

*, physiotherapist estimate of adherence only

**, time-based element of compliance measure only

Appendix H Participant materials for longitudinal qualitative study (primary care recruited)

H.1 Patient invite letter

Practice Headed paper and Trust logo

<patient name and address> Study ID

<insert date>

Dear *<insert patient name>*

Development of an Online Dizziness Intervention

We are writing to invite you to participate in a study being led by the University of Southampton. As someone who has suffered from dizziness in the past two years, you have been identified as a potentially suitable participant for the study. Attached is a patient information leaflet outlining the study and telling you more about it. If you are interested in taking part, please complete the reply slip at the bottom of this letter and return it directly in the FREEPOST envelope to the researcher. You can also contact the researcher by phone, on 02380 599395, or by email, on r.a.essery@soton.ac.uk.

The researcher will then contact you by phone to answer any questions you may have and, if you are still happy to take part, to arrange a convenient time with you to carry out the telephone interviews. If you indicate that you also wish to take part in the face-to-face session with the researcher, they will also arrange a convenient time and place for this meeting.
Thank you very much for taking the time to read this letter and the attached information sheet.

Yours sincerely

Dr <insert GP name>

<insert patient name and address details> Study ID:

I am interested in taking part in the above study and would like to be contacted,
My phone number is:
mobile …………………………………….
home ……………………………………
work……………………………………..
My email address is:
…………………………………………………………….
Please contact me at the following:

Date……………………. Time …………………………..

H.2 Participant information sheet

Participant Information Sheet
Phase 1 – Interviews
CI: Professor Lucy Yardley
Development of an Online Dizziness Intervention

You are being invited to take part in a research study. Before you decide whether you wish to take part or not, it is important for you to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully and discuss it with others if you wish.

What is the purpose of the study?
Dizziness is a very common symptom that can reduce quality of life. Research has shown that chronic dizziness can be treated effectively by teaching patients exercises and techniques that help the brain to overcome dizziness and improve balance. We are designing a website that contains these exercises and techniques. The purpose of this phase of the study is to find out what people who have experienced dizziness think about our new website.

Why have I been invited?
We will be recruiting 25 participants with dizziness. You have been invited as you are registered with one of the doctors' surgeries taking part in the study, and you have seen your doctor for dizziness at some point over the last two years. We are also most interested in patients who are aged 50 or over.

Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part you should keep this information sheet and either contact us via email on this address: r.a.essery@soton.ac.uk , call our study team on this number: 02380 599395, or alternatively you can return the enclosed reply slip to the research team in the enclosed FREEPOST envelope. If you do decide to take part, you are still free to change your mind and withdraw at any time without giving a reason. This will not affect the medical care you receive in any way.

If you do not want to take part you do not need to do anything, as we will not contact you again.

What will happen to me if I take part and what do I have to do?
You will need contact the study team either by phone or email address as indicated above or you can return your reply slip in the FREEPOST envelope provided.

You will be contacted by a member of the research team to make sure that you are still willing to take part and who will also answer any queries that you may have.

You will be given the link to the newly designed website and will be asked to visit it once a week for about six weeks. Each time you visit, you will complete a session which should take no longer than 15 – 20 minutes. The researcher will arrange to phone you on three separate occasions to talk with you about your use of the website. This will happen at approximately 2, 4 and 6 weeks after you start using the website. The researcher will arrange times to call that are convenient for you.
When the researcher calls you, they will ask you some questions about what you think about using the internet to help manage your dizziness, how you are getting on with using the website and with trying out the activities that the website tells you about.

If you would be happy to meet face-to-face with the researcher and agree to do this, you will also be asked to look through the first session of the newly designed website with the researcher and let them know what you think. This would happen before your first telephone interview. The researcher will ask you to let them know your feedback as you have a look through each page of the session on the website. If you choose to take part in this part of the study, the researcher will arrange a time and a place to meet that are convenient for you; this may be at the University, in your home or in your doctor's surgery.

What are the possible disadvantages of taking part?
The main disadvantage of taking part in the development phase of this study is that you will have to give up some of your time.

What are the possible benefits of taking part?
You will be provided with 15 pounds worth of high street vouchers for your time in taking part. You will also get the opportunity to contribute to a process that may improve the information and advice available for patients experiencing dizziness, and also use strategies that have been found to be effective in reducing dizziness in 3 previous trials.

What will happen if I don't want to carry on with the study?
If you choose to take part in the study you are free to change your mind and withdraw at any time without giving a reason. This will not affect the medical care you receive in any way.

What if there is a problem?
If you wish to complain, or have any concerns about any aspect of this study please contact Dr Adam Geraghty (Phone: 02380 241051, email: A.W.Geraghty@soton.ac.uk). If you are still unhappy and wish to complain more formally, please contact Dr Martina Prude who is Head of Research Governance for the University of Southampton who are sponsoring the study (phone: 02380 595058; email: mad4@soton.ac.uk) mailto:Dr or through the NHS complaints procedure (details are available from your doctors surgery). It is highly unlikely that you will be harmed during this study, however, if you are harmed by taking part in this study, you may have grounds for legal action for compensation against the University of Southampton and the NHS.

Will my taking part in this study be kept confidential?
All information which is collected about you during the course of the research will be kept strictly confidential. Any quotes that arise from your interview will be anonymised and your name will not appear on any publications. We will handle, process, store and destroy data following procedures in keeping with the Data Protection Act 1998. Data from this study will be kept for 10 years and will then be disposed of securely.

What will happen to the results of the research study?
At the end of the study we will submit our results to be published in medical journals. A simplified version of the results will be made available to anyone who wishes to receive it. If you would like to receive a copy of this then please let us know.

Who is organising and funding the research?
The Dunhill Medical Trust (reference R222/1111) has funded this project and is paying the costs of undertaking the study and its analysis. It is being sponsored by the University of Southampton and managed by a team of researchers from the Departments of Primary Medical Care and Psychology.

Who has reviewed the study?

The study has been reviewed and given approval by Southampton B Research Ethics Committee, reference number 12/SC/0271.

Further information and contact details
If you have any further questions or queries then please contact:
Rosie Essery, Senior Research Assistant (r.a.essery@soton.ac.uk)

THANK YOU FOR YOUR TIME IN READING THIS INFORMATION SHEET

Appendix I Email instructions for accessing development version of Balance Retraining

Dear *(name)*,

Thank you once again for your interest in the study and for agreeing to take part.

Further to our phone conversation this morning, please find the link (below) to the website for the study:

https://pips.ecs.soton.ac.uk/player/play/Balance-Retraining_Pilot

You can access this either by clicking on the link or copying and pasting this into your browser address bar. The website is called Balance Retraining.

When you visit the website you will first need to sign up. You will then be asked to provide consent to take part in the study and then will need to answer a few questions. Once this is complete you will be able to begin your first session.

As I mentioned on the phone, there are 6 main sessions – a new one each week for 6 weeks. You will be able to access your second session a week after you begin the first. Each session should take no more than 20 minutes. If possible it's a good idea to try and complete a session in one go so as you don't lose your place in the session.

Once you have first signed up to the website and your first session, we will be in touch via email again to let you know when I will try to contact you for your first telephone interview – this will be approximately two weeks after you start.

We also agreed to meet on *(date and time)* at *(location)* for you to take part in the face-to-face session. I will be in contact closer to the time just to confirm this is still ok.

Please don't hesitate to contact us if you have any further questions or if you experience any difficulties in using Balance Retraining.

Kind regards

The Balance Retraining Team

Appendix J Consent form for primary care recruited participants in longitudinal qualitative study

Balance Retraining

Exercise that speeds recovery from dizziness and unsteadiness

Consent Form

UNIVERSITY OF Southampton

Interviews - Phase 1 Consent Form
Development of an Online Dizziness Intervention

Chief Investigator: Professor Lucy Yardley

Please click on the tick box for each statement to indicate that you agree

1. I have read and understood the information sheet dated 15 October 2012, version 2 and have had the opportunity to ask questions that have been answered satisfactorily. ○

2. I agree to take part in this research study and understand that all my details will be kept confidential and my name will not appear on any reports or documents. ○

3. I understand that the interviews will be tape-recorded and that no one but the research team will hear the recording. ○

4. I understand that my participation is voluntary and that I am free to withdraw at any stage without giving reasons and without my medical care or legal rights being affected. ○

5. I give permission for anonymous quotes from the interviews to be included in reports of the findings from the research and used in the dizziness website. ○

Full name of participant: ____________

Date: ____________

By clicking 'continue' you are agreeing to take part in the study **Continue**

Appendix K GP letter for non-primary care recruited participants in longitudinal qualitative study

University of Southampton
Highfield Campus
Southampton
SO17 1BJ
United Kingdom

Development of an Online Dizziness Intervention

Dear General Practitioner,

Your patient has been informed of the opportunity to take part in this study led by the University of Southampton and funded by the Dunhill Medical Trust. The study is developing, and trialling, an internet based intervention aiming to relieve symptoms of dizziness caused by vestibular imbalance. The components of the intervention are based upon stress reduction exercises and balance retraining exercises. We have made it quite clear that these therapies cannot, of course, cure the underlying disease or prevent new attacks of vertigo.

Your patient has been invited to take part in the development phase of the study in which they will be provided with a trial version of the intervention and asked to work through it and complete the exercises in their own time. The intervention will instruct them precisely how to carry out the exercises. The stress reduction exercises are of the usual type (e.g. breathing control, muscle relaxation), and are of course entirely safe. The balance retraining exercises are also very safe, as they consist of self-paced eye, head and body movements within the normal range (similar to the 'Cawthorne-Cooksey' exercises used in vestibular rehabilitation). Participants will be instructed not to make movements that cause adverse reactions, such as pain or acute dizziness, and they commence with very slow, gentle movements, building gradually to brisker movement only if they experience no problems with gentle movements. Consequently, the only people for whom these exercises could pose a risk are those who are unable to carry out normal head and body movements safely, such as patients with serious cervical damage, or patients in whom neck movement provokes neurological symptoms other than dizziness (e.g. face or limb numbness or weakness, diplopia).

If participants have any concerns about the therapies they can have direct communication with the principal investigators, who have longstanding clinical expertise in treatment of vestibular imbalance. If we have any reason to doubt their suitability for continuing with treatment we will advise them not to continue until they have consulted you again. You are very welcome to contact us yourself if you have any queries regarding the trial; please contact Professor Lucy Yardley in the first instance, on L.Yardley@soton.ac.uk or 02380 594581.

Yours sincerely,

Professor Adolfo Bronstein — Lucy Yardley

Consultant Neuro-otologist — Professor of Health Psychology

Appendix L Online consent form for non-primary care recruited participants into longitudinal qualitative study

Balance Retraining

Exercise that speeds recovery from dizziness and unsteadiness

Consent Form

UNIVERSITY OF Southampton

Interviews - Phase 1 Consent Form
Development of an Online Dizziness Intervention

Chief Investigator: Professor Lucy Yardley

Please click on the tick box for each statement to indicate that you agree

1. I have read and understood the information sheet dated 19 February 2013, version 2.1 and have had the opportunity to ask questions that have been answered satisfactorily.

2. I agree to take part in this research study and understand that all my details will be kept confidential and my name will not appear on any reports or documents.

3. I understand that the interviews will be tape-recorded and that no one but the research team will hear the recording.

4. I understand that my participation is voluntary and that I am free to withdraw at any stage without giving reasons and without my medical care or legal rights being affected.

5. I give permission for anonymous quotes from the interviews to be included in reports of the findings from the research and used in the dizziness website.

6. I have consulted my GP to confirm that there are no medical reasons why I should not take part in the study.

Name of participant:

Date:

By clicking 'continue' you are agreeing to take part in the study

Continue

Appendix M Recruitment email for university participant pool

Dear (name),

My name is Rosie Essery and I am a Research Assistant in Health Psychology at the University of Southampton. I am writing to you, as a member of the School of Psychology's Volunteer Database, to ask whether you experience symptoms of dizziness? If so, we are interested whether you would like to take part in a project we are currently working on.

We have designed a website for **adults over the age of 50 who suffer with dizziness**. The website includes information about dizziness and the balance system and advice about certain exercises and activities that can be practised to try and reduce dizziness. As part of the development of this website, we are looking for people to use it for a period of 6 weeks and to tell us what they think about it.

To take part in this research you will need to:

- Currently experience symptoms of dizziness that are made worse by quick head movements (e.g. nodding or shaking the head, bending over, looking up etc.)
- Be 50 years old or more
- Have access to the internet and an email address
- Be able to read and speak English fluently

To take part in this research you should NOT:

- have any other medical conditions/ illnesses or injuries (related to your dizziness or not) that would prevent you from taking part in this research.
- have any medical conditions/ injuries that would prevent you from being able to carry out the required exercises (simple head and neck movements).
-

We will ask you to check with your GP prior to beginning the study to make sure they don't have any concerns about your participation.

If you think you meet these criteria and feel you would like some more information, we would really like to hear from you.

Please contact myself, either by reply to this email, or by telephone (02380 599395). We can then send you out a pack in the post which will provide you with more information and allow you to contact us to indicate whether you would like to take part. If, after receiving the information pack you decide not to take part you do not have to – we won't contact you further unless you wish us to.

If you do not wish to take part, you don't need to do anything – we won't contact you again regarding this project unless we hear from you.

Many thanks for your time and we hope to hear from you soon.

Kind Regards,

Rosie

Appendix N Interview schedules for longitudinal qualitative study

N.1 Introductory material

Re-introduce self and purpose of call

Check with participant:

- that they are still willing to be interviewed, and for the interview to be recorded
- remind them it will take approximately between 30 minutes and 1 hour
- that they are comfortable and in a quiet suitable place

Remind participant that:

- their responses will be kept confidential, and quotes used in the results will not identify them as an individual
- they can change their mind about taking part and stop the interview at any point.
- I am not medically trained or an expert in any way in terms of dizziness so the point of this study is to find out their experiences of using the website and trying the exercises. Therefore there are no right or wrong answers, because this interview is about finding out about your experiences and views of using the website and trying the exercises and your dizziness in relation to this.

Just to give an outline of the sorts of questions I will ask:

- First ask about your experiences of dizziness before using Balance Retraining Intervention
- I'll then ask you about both the website advice (which refers to the information, advice, demo's etc. on the website) and practising the exercises.
- For each of these I'll ask, what you expected and about positive and negative experiences of using so far.
- Finally ask a bit about your overall impressions so far – that's of the intervention altogether – the website advice and doing the exercises.

Ask if the participant has any questions.

Ask if they can speak reasonably loudly and clearly (for the tape recorder), and to let me know if there appears to be any problem with the phone line at any point.

Start recording. Check participant feels comfortable with the tape recorder.

N.2 Interview 1

Broad topic guide: initial (brief) exploration of participants experiences of their dizziness, their perceptions of how it has changed their day-to-day life, changes they have had to make and their level of acceptance of their illness. Also touching upon their initial perceptions of the internet as a source of health information/ support for their dizziness and their initial thoughts about using the intervention and carrying out the exercises and their expectations about how successful/otherwise it will be.

1. First of all, can you tell me about how you have coped with your dizziness before you began using the Balance Retraining intervention?

- on a practical level? E.g. any things you do/ don't do to manage your dizziness, any changes you've had to make?

- emotionally? How has your dizziness made you feel? How did you cope with that?

2. So you've mentioned some changes (give examples) that you've had to make because of your dizziness, can you tell me about how those have affected your day to day life?

- in a positive way?

- in a negative way?

3. Can you tell me what you were expecting from the website advice?

What did you think it would be like?

If 'like I was expecting' ask: Can you describe what it was you were expecting/ what features were you expecting there to be? Was there anything not there that you were expecting?

4. Can you tell me what you were expecting from the exercises?

What did you think it would be like?

If 'like I was expecting' ask: Can you describe what it was you were expecting/ what features were you expecting there to be? Was there anything not there that you were expecting?

5. Can you tell me all about your initial experiences of using the website advice?

How did you find it at first?

How did you finding it having used it for a couple of weeks? Has this changed at all?

6. Can you tell me all about your initial experiences of practising the exercises?

How did you find it at first?

How did you finding it having used it for a couple of weeks? Has this changed at all?

If talking about symptoms ask: did the website advice support you with that enough? How did you cope with that? How did you feel about being more dizzy?

7. Thinking about the exercises and website advice as a whole, can you tell me about any particular parts or features that you found especially helpful with getting started with Balance Retraining?

Which parts were helpful? Why these parts? How did they help?

Were some parts more helpful than others?

If talking about one part all the time, prompt the other (e.g. so you've mentioned that you found certain aspects of the website advice really useful – how about the exercises?)

Again thinking about both practising the exercise and using the website advice, can you tell me about anything you found particularly difficult when starting to use Balance Retraining?

8. Can you tell me about any problems you have experienced?

(How) did you manage to overcome these?

If talking about one part all the time, prompt the other (e.g. so you've mentioned that you found certain aspects of the website advice really difficult – how about the exercises?)

9. Can you tell me about any concerns you have about continuing to use the website advice?

What are you concerns? Why does this concern you?

Can you tell me about any particular parts which concern you more than others?

Can you tell me about any concerns you have about continuing to practise the exercises?

What are you concerns? Why does this concern you?

Can you tell me about any particular parts which concern you more than others?

10. What are your overall initial impressions of the Balance Retraining intervention?

N.3 Interview 2

Broad topic guide: exploring perceptions of how useful (or not) intervention appears to be at this stage and which aspects are particularly helpful or those aspects which are particularly difficult. How participants are finding use of the intervention compared to more traditional sources e.g. leaflets or advice from health care professional. Exploring whether participants identify any areas of difficulty with using intervention/ carrying out exercises – trying to identify potential barriers to adherence.

How have you got on with using the web advice since the last time we spoke?

- what's encouraged you to keep using it?

- if not used:

- Can you tell me about anything in particular that meant you weren't able to or didn't want to?

- Can you tell me about why you think that is?

How have you got on with your exercises?

- what's made you keep doing them?

- how is your dizziness having been practising the exercises for a few weeks now?

- if not done:

- Can you tell me about anything in particular that meant you weren't able to or didn't want to?

- Can you tell me about why you think that is?

- if dizzy:

- how have you coped with that?

- has the website supported you with that? Could it have done more?

Now that you have been using it for a few weeks, can you tell about aspects of the website advice that you are finding especially useful?

- Why these ones?
- How have these changed (or not) since you first started using it?

Now that you have been using it for a few weeks, can you tell about aspects of the exercises that you are finding especially useful?

- Why these ones?
- How have these changed (or not) since you first started using it?

Can you tell me about any parts of the website advice that are not so helpful for you?

- Why these ones?
- How have these changed (or not) since you first started using it?

Can you tell me about any parts of the exercises that are not so helpful for you?

- Why these ones?
- How have these changed (or not) since you first started using it?

Can you tell me a bit about any aspects of using the website and doing the exercises that are particularly easy?

- how would you say that affects how much you want to carry on?

Can you tell me a bit about any aspects of using the website and doing the exercises that are particularly difficult?

- how would you say that affects how much you want to carry on?

Having been using the intervention for four weeks, can you tell me about how you are finding managing you dizziness now?

- Can you tell me about how this has changed? (any changes to day-to-day life?)
- Can you tell me about how this has stayed the same?
- Can you tell me about what made you notice these differences? (if any)
- What do you think brought about these changes?

-if no dizziness:

- how much do you think Balance Retraining has helped you with this?

- if you were to experience dizziness again, how do you think you would manage it?

Can you tell me about any concerns you still have about using Balance Retraining – both using the website advice and doing the exercises?

- How has this changed from before? (if at all) What has caused the change in your concerns?

How would you say you are finding using the intervention generally?

- Now?
- Compared to when you first started?

N.4 Interview 3

Broad topic guide: continuing to explore participant perceptions of utility of intervention and how these may have changed with continued use*.* How participants are feeling about any improvements they may have experienced and whether they would see the intervention and exercises as being successful in helping them or not? Revisiting any areas of difficulty they have identified to determine whether these remain an issue. Exploring their perceptions of how not having direct support and advice from a health care professional may/ may not have affected the utility of the intervention. Revisiting perceptions of how dizziness affects day-to-day life after use of intervention.

How have you got on with using Balance Retraining since the last time we spoke?

- what's encouraged you to keep using it?

- if not used:

- Can you tell me about anything in particular that meant you weren't able to or didn't want to?

- Can you tell me about why you think that is?

How have you got on with your exercises?

- what's made you keep doing them?

- how is your dizziness having been practising the exercises for a few weeks now?

- if not done:

- Can you tell me about anything in particular that meant you weren't able to or didn't want to?

- Can you tell me about why you think that is?

- if dizzy:

- how have you coped with that?

- has the website supported you with that? Could it have done more?

What has been your overall experience of using the intervention?

- Can you tell me about parts that you particularly enjoyed and found helpful? Why these? How did they help?

- Can you tell me about parts that you didn't find so useful? Why these? Why were they not so useful for you?

Can you tell me about any aspects of using the intervention or doing the exercises that remain difficult?

- How has this changed since you first started using Balance Retraining? (if at all)

Can you tell me about your dizziness since using Balance Retraining?

- Can you tell me about anything you've started doing? Why?
- Can you tell me about anything you've stopped doing? Why?
- Can you tell me about anything you do differently to before? Why? How?

Can you tell me about anything you think using the intervention has taught you about managing your dizziness?

Is there anything else you would like to say about your experiences of using Balance Retraining and doing the exercises?

- Feedback for designers?
- Advice to others thinking about using?

N.5 Debrief

- Tell participant that the tape recorder is now switched off
- Thank participant for taking part in the interview
- Remind participant that the aim of the interview was to try to find out their experiences of using the website and trying the exercises so as to help us understand which factors are important in helping people manage their dizziness
- Ask if the participant has any questions about the study.
- Remind participant that their next interview will be in two weeks' time and you will email them with reminder details of this and in mean time they can continue to use the intervention.
- Remind participants if they have any questions about their rights as a participant on this research or feel that they have been placed at risk, they can contact the details on PIS.
- Thank participant again for taking part in the interview.

Appendix O Coding manual for longitudinal qualitative study

Theme	Subtheme and description	Codes included	Description	Examples
Difficulties engaging with Balance Retraining	**Practicalities:** Issues of a practical, 'real-world' or 'everyday life' nature that have made it difficult for individuals to do their exercises or maintain them regularly	difficulty remembering	trouble with remembering to conduct exercises	"No, the only thing that's difficult is remembering to do it, because it isn't a normal...well, it's not a normal activity, is it?" (P405,Int2,F)
		finding the exercises difficult or unclear	concerns about being able to complete the exercises as they are supposed to or finding them difficult, sometimes in general, sometimes specific exercises	"Well, there's no doubt that doing these rather complex exercises, as I call them, the head shaking and moving in different directions and so on, is hard to do" (P303,Int3,M)
		'life' comes before exercises	discussion of other life events or occurrences (often unexpected) that mean that exercises etc. are not done or 'put on the back burner' – especially as they don't want induced symptoms to interfere with life events	" I was about to start the third week, or third lot, but with it being Father's Day and my daughter's birthday I'm putting it off until this week" (P402,Int3,F)
		technical problems	mentions of problems with the online intervention preventing people from continuing or being potentially off-putting	"Yes, and at one point I couldn't switch it off, I couldn't switch it on and that happened twice. The third time I didn't – well, I didn't try it again. I managed to print off two eventually but each time the computer screen locked on and I had a job to get rid of it." (P201,Int2,F)
		Illness/ injury/pain as barrier to exercises	experience of other health conditions as barriers to doing exercises or speculation that this might be the case for others	"I must admit, I downloaded the relaxation one and, to be perfectly honest, I did hurt my neck a bit so I haven't done as much as I should" (P426,Int2,F)
	Symptoms worse or not improved: Discussion of symptoms as either being worse having started practising the exercises or not being noticeably improved	negative effects of exercises	dizziness symptoms and other negative symptoms experienced as a result of practising the exercises, feelings that symptoms may have got worse to start with	"Because it did make me go back, I'd sort of done one step back. There's one exercises that made me actually feel dizzy at the time, I can't think what it is now" (P101,Int1,M)
		Not noticed improvement	Participants note not feeling that their symptoms have improved or noticing a significant change	"I'm just hoping that it's going to improve. It hasn't, it doesn't seem to have improved a great deal at the moment." (P202,Int2,M)

	Doubts about exercises: Expressions of doubt: initially about whether the exercises will be manageable and later whether any positive effects experienced can actually be attributed to the exercises themselves	uncertain whether exercises responsible for improvement	expression of uncertainty as to whether improvement in symptoms is due to exercises or other factors or even placebo effect	"I mean I haven't had anything, you know any starts of any dizziness. I've just done the exercises, whether that has just helped I don't know. Yeah, I can't really explain it really." (P501,Int2,F)
		worries and concerns about exercises	expressions of concern or apprehension about difficulty or demanding nature of exercises	"Well I was a bit apprehensive because it kept saying that you might experience some of that dizzy, you might experience dizzy… while you were doing the exercises and I must admit, I was apprehensive because actually I don't want to trigger anything. So I was a bit, I suppose sceptical and unsure" (P402,Int1,F)
Facilitators of engagement with Balance Retraining	**Motivation to continue:** Mentions of certain experiences, thoughts or desires that have provided encouragement to continue with exercises (or to start in the first place)	can see relevance to real life	exercises recognised as being of relevance to behaviours/ activities in everyday life	"It's interesting, you know, the things that I'm in, the tennis and yoga and so on, it incorporates what you're doing, to a lesser extent obviously" (P302,Int3,F)
		perceived improvement as encouragement to continue	experiencing less dizziness or more generally 'feeling better' and being able to do more since beginning techniques of intervention, even if uncertain whether this can be attributed to exercises and therefore being willing/eager to continue	"Well I've found it very helpful. I tell you what, the last time I went rotational it was much slower, yes, and that really is a good thing because it meant that the ceiling light was just winding round gently as opposed to whipping round at a horrible rate. So I assume it is those exercises and I certainly am keeping them up." (P201,Int2,F)
		social facilitation	mentions of positive comments or support from others being encouraging or making the process easier	"…I've been making steady progress, like I said to you last time even my husband noticed – I mean so that's got to be a good thing. He's a man, he doesn't notice that much. You know he sort of…Yes, I mean I'm quite happy, I shall probably continue doing them all the time now, because I do feel they do help." (P505,Int3,F)
		wanting to be helpful	expressed interest in helping out in research more generally, focus on being helpful to researcher as much as (or even more than) themselves	"And wanting to complete something that you've decided, or you know, agreed to take part in" (P402,Int3,F)
		wanting to be well, valuing good health	desire to maintain or return to good health as motivation for exercising - references to the importance of being in good health	"So self-preservation, the fact that, you know, I want to go on for as long as I can enjoying life, that may have been the motivation" (P302,Int3,F)

	Helping self to succeed: Planning and techniques implemented by the individual that they feel have helped them continue with exercises	setting an exercise routine	discussion of certain times of day when exercises are practised or certain events that people link exercises to as a way of making sure they do them	"I try and fit it in myself to do them twice a day and, you know, I'm doing that, so usually when I'm sitting up in bed I do them, when I'm first up in the morning, and when I go to bed" (P201,Int1,F)
		Strategies to manage exercises	techniques and methods employed by participants to overcome difficulties with exercises or make them easier	"I tend to do it in the same room so I know how many steps from one end of the room to the other so I can turn around without too much of a problem" (P203,Int1,M)
	Intervention as facilitator: Intervention as additional motivation to continue with exercises and certain characteristics that contribute to this	simplicity of programme	description of exercises as being straight forward, not too complex and easy to be able to remember and fit in to daily routines	"So one of the real positives about it is that it can only take 2,3,4 minutes at one particular time which should be very easy to fit in. You're reaching for the cornflake packet, no you've got three minutes to do your exercises, go and do them" (P202,Int1,M)
		intervention as motivation and structure	intervention viewed as extra 'push' to do something about dizziness symptoms, providing a structured approach to do so	"Well it's been worthwhile because it's got me into a sort of routine where I'm working at it, which is helpful, and it's given me an opportunity to record progress in a fairly coherent way, which is also helpful" (P301,Int3,M)
Individual responsibility	**Individual responsibility (overall theme):** Overall sense that the individual also needed to take some control over the situation in addition to the external help and support in terms of things that they should do or self-knowledge they should utilise and implement.	importance of doing something to help yourself	notions of needing to do something to address the problem for yourself, taking control	"But if you feel you're physically doing something to help the situation, then it's very encouraging. So anything I can do within my power to help my balance, I'm only too pleased to do" (P204,Int3,F)
		knowing one's limits	recognition of limitations and being realistic about what is achievable in terms of practising the exercises	"And if the old bones start clicking, then I know I've got to slow down a bit, so no, I think, let's be fair, everyone's responsible for their own destiny so you have to look after yourself and not be silly" (P410,Int1,F)
		need to be disciplined	recognition of need to be self-disciplined and that it's up to the individual	"As I say, it is just programming yourself to find time to do it but that is mainly sort of…I mean, that's…you know, it's down to yourself really, isn't it?" (P426,Int3,F)
		need to challenge myself	feeling the need to push oneself to increase difficulty in order to improve	"I think the fact that one can conduct the exercise at a faster speed is useful because that, if anything, can help if you find that induces dizziness then you now that there is a threshold in the exercise that you've got to push" (P301,Int2,M)

		Willing to persevere	mentions of needing to 'stick with it' even though it may feel worse to start with and acknowledging that it is necessary to induce symptoms to improve	"Yes, but reinforcing that message and trying to, something I need to work for myself is to sort of think positive things that er, yeah, you may be uncomfortable or you may be trying, feeling uncomfortable in this journey, but the end result, and you're making the journey because you're going to have a pleasant experience at the end of it" (P202,Int2,M).
Perceptions of Balance Retraining Intervention	**Informative and educational:** Notion that the intervention provided new information and equipped users with new skills that were useful in a variety of different ways; mentions of a number of specific elements of the intervention that contributed to this	'Symptom control techniques' offer additional management strategies	specific mention of the controlled breathing, relaxation etc. techniques being helpful additional strategies to use alongside exercises - a distraction or as learning new skills	"because there are exercises that try and show you how to relax, and deep breathing exercises, if you try and relate and put them together, I feel sure it will help" (P410,Int1,F)
		Video demonstrations add additional clarity	mention that the video demonstrations add additional clarity to the written instructions when it might not have been clear how to conduct exercises otherwise	"I think again the explanation of what you need to do and the follow up, the pictures and the video. I think it made it easier for me to do, because I can see it visually as well, so the visual side was very good. Sometimes in your mind, nodding and shaking your head could be something completely different, but having that visual and the explanation has made them easy" (P501,Int2,F)
	Acts as reminder: Online contents useful to refer back to intermittently to act as a reminder for various details and plenty of opportunity to do this	Ability to revisit content as helpful	ability to revisit information and go back to things as a good memory refresher or helpful to know they don't have to remember it	"I suppose just to see how I'm progressing, also to refresh my memory maybe something I've forgotten about or something like that so, I can go back over it again. It just makes life fairly easy" (P203,Int2,M)
		Email reminders as helpful component	email reminders as a good memory aid and motivator	"The emails and your calls certainly prod me. If that didn't happen, I'm quite sure I'd forget it for weeks on end" (P405,Int1,F)
		Printing facility as useful function	the ability to be able to print documents mentioned an especially helpful feature as it allowed flexibility in how users engaged with intervention, printed copy as 'back up'	"Yea the exercise instructions. And that sort of thing at the beginning of each session, I print everything off. And I find that works really well for me. I think I can collate all the information that I need from the site, print it all out, put it on my desk and just carry on with the exercises" (P203,Int1,M)
	Reassuring and Supportive: Nature of the intervention programme overall as providing reassurance and support regarding the negative experiences of dizziness and also encouragement to continue; mentions of specific elements of the intervention that facilitate and contribute to this	grateful for opportunity	general comments about feeling positive about the intervention and glad they have had the opportunity to try it	"It's been a well presented programme that I've found beneficial and pleased to have been on it" (P202,Int3,M)
		human contact as important	mention that being able to talk to a human as part of the process was valuable in terms of feeling valued and being able to resolve problems	"I think actually having someone that's contacted me through email and now by phone and is going to make, has made an appointment to see me personally, I mean all those things are reassuring when you take part in something, you're not just a statistic. You're a person taking part in a trial" (P402,Int1,F)

		intervention as support and reassurance	intervention as a whole as a source of support and reassurance with regard to symptoms and practising exercises	"Yes, which is why I thought no I will continue because of the information that was there. I mean, had I not had that information after a couple of days when I was feeling really dizzy I probably would have stopped, but I didn't because I had that information."(P505,Int1,F)
		personalised feedback as encouragement	mentions that receiving personalised feedback was encouraging to continue	"And also, I think what's quite useful is that 'do this for a week, do your scores and then get feedback on how you are progressing'. In general life, feedback mechanisms are important and the booklet doesn't give feedback mechanisms whereas the website has structured – does give you a feedback mechanism, so it's almost 'well done. Now move to exercises standing up'" (P202,Int1,M).
		'Retraining Stories' element as reassuring	The retraining stories element of intervention recognised as being reassuring and help them to feel that there were others out there who shared their experience	"Well, again, the information; the things that other people had gone through the similar thing that, if you like, you'd broken the barrier and sometimes when you get older you realise, things have got to go down in order to go up" (P410,Int1,F)
	Presentation and style: Opinions about appearance and more general perceptions of how the intervention is presented including the tone and manner of information presentation (including amount of information).	amount of information	notions about whether all the information they needed was there, or not enough or too much	"It's all there in front of me. Everything I need to know" (P203,Int1,M) "I think you could perhaps find it, I didn't mind it, but you could perhaps find it a bit repetitive" (P402,Int3F)
		manageable and accessible information presentation	perceptions that the content was presented in a manner that was manageable, easy to understand and not overly complex	"It's, it's excellent, it's clear and, you know, the instructions are, are fine." (P601,Int1,F).
		perceptions of appearance	comments about the physical appearance of the intervention	"And, as I say, I like your bright presentation, that really is welcoming, yes, not a mass of typed script that I have to sit carefully and look through especially if you are feeling a bit giddy at the time. So it really does – it really is helpful." (P201,Int2,F)
		'tone' of the intervention	comments on the overall 'feel' or way that the intervention addresses users and presents information	"Yes, it's become an old friend. You know, you can sort of think 'Oh, I can do this', and you quite look forward to when the time comes and you know it. It's a bit like a little reference library" (P410,Int1,F).
	Usability: Perceptions regarding how easy (or otherwise) the user interface of the	ease of use	how easy to navigate the site was, how easy to find things and to get from page to page etc.	"Well it was just easy. It was just, I felt it was user-friendly, you know, I could get on with it quite well" (P101,Int1,M)

	online intervention was, any changes in this, and relatedly, the extent to which users accessed the intervention sessions.	level of engagement	referring to HOW individuals use the website: how many sessions accessed, how frequently they log in, how extensively they read content, the order in which they access content	"I could remember thinking that it was quite handy to know the various different examples that they gave you, but like I say, I feel a bit terrible because I haven't had a chance to go back. The site you need to go back and look at it really daily, have a look at it daily, and then it would digest properly, but I have done it quite quickly on occasions." (P501,Int2,F)
		Familiarising process	needing to 'get used' to webpages, discussion of experience of using intervention being different at first to later on	"Yes, I think you gain the confidence, and so you know the routine, so to speak, yeah. Where of course, you're finding out at first, aren't you?" (P204,Int2,F)
Managing dizziness	**Looking ahead:** Expressions of behavioural intention or beliefs regarding the programme and managing dizziness for the future	Long-term exercise intention	expressions of the need or desirability to continue with the exercises long-term to maintain benefits	"Yes, I do mean to carry the exercises on for some time, I think that's the best just to see what it, I'll certainly go through the walking and then, well I'll review it then again, but I might keep it up for some time, yes" (P201,Int3,F).
		optimism for self and others	positive expectations about continuing with exercises and using intervention either as applied to self or more general perceptions of being helpful for people with similar symptoms	"with something like balance retraining it gives me a better hope for the future, but maybe just maybe I will be able to reorganise my life through some of the instructions that I am getting, and make a change. I may well be able to cut down on the tablets that I am using, I may well be able to do away with them entirely. I don't know but from that point of view I find it very positive and I shall keep working at it, because it appears to be working for me." (P203,Int3,M)
		recovery as process not immediate	recognition that symptoms won't go overnight and that it will require a period of time and consistent practise	"No. I am one of those people, if it is going to help in the long term I will just keep doing it, because I realise things don't happen overnight. No, I've got no concerns about continuing at all." (P505,Int1,F)
	Acknowledging change: Recognition of certain behaviours, cognitions or emotions/attitudes that have changed since beginning the intervention	building confidence	process of feeling more confident and able to manage condition, either through knowing how to avoid symptoms or being able to manage them if they did occur	"Well it's silly to say, but it's given me my life back." (Interviewer: How's that?) "You know in areas that I didn't think I would be able to participate any more or do things. It's given me the confidence and the knowhow how to use exercise to benefit." (P410, Int3,F).
		greater control and ability to manage symptoms	identification of exercises as a new means of managing and controlling symptoms	"I suppose that it has given me a more positive feeling about my ability to not be unbalanced and so, to get on and let the world run as it will do, I am going to do what I want with it." (P202, Int3, M)
		More knowledgeable and skilled	mentions of information, techniques, ideas etc. provided by the intervention that they were previously not aware of or were aware of that the intervention had reinforced	"I think sometimes, when you go to the doctor's, it's not always explained as clearly as it can be. So I think my knowledge of what can bring on the onset of dizziness has improved. I think that's quite valuable" (P402,Int2,F)
		raising consciousness	mentions of being more aware of how to manage symptoms or avoid them in first place through being more	"Yes, I suppose it has made me think about what I should do rather than get irritated by what is happening, so I don't turn around the kitchen too quickly and I tend to hold onto things before I move" (P405,Int3,F)

		reduced worry	being less worried about experiencing symptoms, less anxious about engaging in situation which MIGHT provoke symptoms	"And I'm generally less worried about what might happen; 'what do I do if…?...is further down in the subconscious" (P202,Int2,M)
	Strategies employed: Methods described and explained by users regarding how they manage their dizziness. Appears to show decreasing talk of use of medical advice etc. and increasing implementation of new strategies across interviews	Implementing new strategies	trying out techniques learned in intervention and how they are using these in day to day life	"It's one of those that it's now in the mind. They are nice and easy to remember, and so if I do start feeling funny, give myself two minutes, even just run through a couple of the exercises and see how that impacts on me is another management tool." (P202,Int1,M)
		medical advice and treatment	any advice, information or treatment provided by healthcare professionals. Details of appointments attended or intentions to seek medical attention re. dizziness symptoms	"the doctors are still searching around in the dark trying to find different ways of making Meniere's easier to live with, and for me all I've been doing really since I was diagnosed with it is just taking tablets." (P203,Int3,M)
		symptom acceptance	a sense of 'I'm used to it now', and 'just have to get on with life' as this is now part of life	"I'm getting older and all my faculties are deteriorating, some faster than others, so I accept that that's something that maybe I've just got to live with." (P303,Int1,M)

Appendix P Exploratory analyses in quantitative predictor study

P.1 Partial Correlations between Change in Dizziness Severity, Change in Perceived Handicap and Subjective Improvement at 3 Months

Variable	1	2	3
1. Subjective improvement	-		
2. Dizziness severity (controlling for baseline)	-.43*	-	
3. Percieved handicap (controlling for baseline)	-.43*	.51*	-

* p < 0.001

P.2 Predictors of 3m dizziness handicap

Model Summary[e]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.695[a]	.483	.478	13.43223	.483	97.119	1	104	.000	
2	.718[b]	.515	.496	13.19464	.033	2.260	3	101	.086	
3	.745[c]	.554	.522	12.84624	.039	2.851	3	98	.041	
4	.771[d]	.595	.538	12.64012	.041	1.537	6	92	.175	1.870

a. Predictors: (Constant), dhi_tot

b. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total

c. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, dep_f, anx_tot, AAQ2_f

d. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, dep_f, anx_tot, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

e. Dependent Variable: dhi3m_total_imputed

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17522.669	1	17522.669	97.119	.000[b]
	Residual	18764.185	104	180.425		
	Total	36286.854	105			
2	Regression	18702.895	4	4675.724	26.857	.000[c]

	Residual	17583.959	101	174.099		
	Total	36286.854	105			
3	Regression	20114.310	7	2873.473	17.412	.000[d]
	Residual	16172.544	98	165.026		
	Total	36286.854	105			
4	Regression	21587.778	13	1660.598	10.394	.000[e]
	Residual	14699.076	92	159.773		
	Total	36286.854	105			

a. Dependent Variable: dhi3m_total_imputed

b. Predictors: (Constant), dhi_tot

c. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total

d. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, dep_f, anx_tot, AAQ2_f

e. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, dep_f, anx_tot, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

Bootstrap for Coefficients

			Bootstrap[a]				
						BCa 95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	2.209	.105	2.256	.344	-1.920	7.117
	dhi_tot	.673	-.002	.072	.001	.525	.802
2	(Constant)	-12.848	.148	10.996	.241	-35.175	9.026
	dhi_tot	.570	.001	.098	.001	.381	.760
	Age	.231	-.002	.159	.148	-.075	.540
	gi_gende	-1.804	.074	2.324	.441	-6.206	3.117
	VSS_total	.372	-.010	.189	.043	.008	.703
3	(Constant)	-18.991	-.238	11.257	.095	-40.629	2.646
	dhi_tot	.441	-.001	.111	.001	.233	.660
	Age	.306	.002	.155	.057	-.014	.614
	gi_gende	-2.809	.233	2.346	.251	-7.357	2.390
	VSS_total	.266	-.008	.186	.142	-.118	.599
	anx_tot	.602	.027	.519	.243	-.461	1.749
	dep_f	.440	.009	.611	.444	-.771	1.681
	AAQ2_f	.147	-.024	.311	.631	-.417	.673
4	(Constant)	-23.531	.643	12.875	.071	-47.944	4.529
	dhi_tot	.389	-.008	.131	.005	.146	.620
	Age	.256	-.006	.166	.130	-.073	.562
	gi_gende	-.487	.160	2.515	.839	-5.542	5.021
	VSS_total	.209	-.001	.165	.200	-.148	.529
	anx_tot	.610	-.009	.567	.281	-.544	1.719

dep_f	.482	.034	.587	.413	-.686	1.797
AAQ2_f	.107	-.016	.310	.731	-.466	.686
Psymp_f	6.411	.095	2.921	.029	.604	12.212
Puncer_f	-.720	-.082	3.056	.807	-6.598	4.831
Pdoubt_f	-1.296	-.089	3.221	.716	-7.642	4.826
Ppract_f	3.547	-.076	2.818	.208	-1.912	8.852
Psuppo_f	2.119	.130	4.094	.604	-5.822	10.626
Tot_mi_f	.017	.000	.022	.433	-.026	.058

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

P.3 Predictors of 6m dizziness handicap

Model Summary[e]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.647[a]	.418	.411	16.28449	.418	59.696	1	83	.000	
2	.707[b]	.500	.475	15.37750	.082	4.360	3	80	.007	
3	.718[c]	.516	.471	15.43031	.015	.818	3	77	.488	
4	.763[d]	.582	.505	14.92767	.066	1.879	6	71	.096	1.726

a. Predictors: (Constant), dhi_tot

b. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total

c. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, anx_tot, dep_f, AAQ2_f

d. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, anx_tot, dep_f, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

e. Dependent Variable: dhi6m_total_imputed

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15830.407	1	15830.407	59.696	.000[b]
	Residual	22010.331	83	265.185		
	Total	37840.737	84			
2	Regression	18923.329	4	4730.832	20.006	.000[c]
	Residual	18917.408	80	236.468		
	Total	37840.737	84			
3	Regression	19507.471	7	2786.782	11.705	.000[d]

	Residual	18333.267	77	238.094		
	Total	37840.737	84			
4	Regression	22019.426	13	1693.802	7.601	.000[e]
	Residual	15821.311	71	222.835		
	Total	37840.737	84			

a. Dependent Variable: dhi6m_total_imputed

b. Predictors: (Constant), dhi_tot

c. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total

d. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, anx_tot, dep_f, AAQ2_f

e. Predictors: (Constant), dhi_tot, Age, gi_gende, VSS_total, anx_tot, dep_f, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

Bootstrap for Coefficients

			Bootstrap[a]				
						BCa 95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	.012	.103	3.477	.996	-6.628	7.241
	dhi_tot	.718	-.002	.104	.001	.514	.911
2	(Constant)	-26.910	.408	13.236	.044	-53.200	-.358
	dhi_tot	.543	.004	.127	.001	.288	.810
	Age	.443	-.011	.211	.047	.036	.827
	gi_gende	-4.272	.221	3.708	.282	-11.554	3.406
	VSS_total	.620	-.005	.223	.007	.198	1.058
3	(Constant)	-28.884	.077	12.738	.021	-52.592	-2.372
	dhi_tot	.442	-.005	.128	.006	.186	.682
	Age	.487	-.009	.198	.021	.137	.815
	gi_gende	-5.620	.349	3.877	.161	-13.813	3.213
	VSS_total	.549	-.006	.262	.043	.014	1.061
	anx_tot	-.047	.004	.696	.951	-1.641	1.287
	dep_f	.322	.016	.795	.707	-1.140	1.937
	AAQ2_f	.294	.013	.373	.431	-.394	1.055
4	(Constant)	-32.303	.736	14.436	.039	-63.259	-2.146
	dhi_tot	.499	-.008	.136	.001	.247	.735
	Age	.433	-.019	.232	.079	.029	.802
	gi_gende	-3.738	.284	3.833	.358	-12.836	5.496
	VSS_total	.462	.009	.254	.075	-.020	1.012
	anx_tot	-.341	-.027	.830	.698	-2.257	1.248
	dep_f	.518	.022	.910	.582	-1.074	2.418
	AAQ2_f	.247	.022	.401	.551	-.420	1.105
	Psymp_f	8.032	-.096	4.284	.065	.042	15.718

Puncer_f	-2.066	.373	4.467	.657	-11.969	8.348
Pdoubt_f	-.531	-.102	4.348	.915	-9.285	8.380
Ppract_f	8.658	-.201	3.969	.042	1.610	15.254
Psuppo_f	-.704	.262	5.176	.881	-12.817	9.838
Tot_mi_f	-.027	.001	.030	.371	-.084	.031

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

P.4 Predictors of 3m subjective improvement

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.239[a]	.057	.038	1.1215	.057	3.021	2	100	.053	
2	.258[b]	.067	.029	1.1271	.010	.509	2	98	.603	
3	.298[c]	.089	.022	1.1311	.022	.767	3	95	.515	
4	.413[d]	.170	.049	1.1150	.082	1.460	6	89	.201	2.017

a. Predictors: (Constant), VSS_total, dhi_tot

b. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age

c. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, anx_tot, dep_f, AAQ2_f

d. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, anx_tot, dep_f, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

e. Dependent Variable: qsubjimprdizz3m.subjdizzimp

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.599	2	3.800	3.021	.053[b]
	Residual	125.780	100	1.258		
	Total	133.379	102			
2	Regression	8.891	4	2.223	1.750	.145[c]
	Residual	124.488	98	1.270		
	Total	133.379	102			
3	Regression	11.835	7	1.691	1.321	.249[d]
	Residual	121.544	95	1.279		
	Total	133.379	102			
4	Regression	22.729	13	1.748	1.406	.172[e]
	Residual	110.650	89	1.243		

	Total	133.379	102

a. Dependent Variable: qsubjimprdizz3m.subjdizzimp

b. Predictors: (Constant), VSS_total, dhi_tot

c. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age

d. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, anx_tot, dep_f, AAQ2_f

e. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, anx_tot, dep_f, AAQ2_f, Psuppo_f, Ppract_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	BCa 95% Confidence Interval	
						Lower	Upper
1	(Constant)	3.559	.005	.248	.001	2.988	4.026
	dhi_tot	-.003	.000	.007	.656	-.018	.009
	VSS_total	-.023	.000	.014	.108	-.050	.005
2	(Constant)	3.718	.014	.947	.001	1.766	5.690
	dhi_tot	-.005	.000	.007	.543	-.020	.009
	VSS_total	-.022	.000	.015	.139	-.051	.006
	Age	.003	-7.639E-5	.012	.798	-.020	.027
	gi_gende	-.238	-.003	.235	.326	-.679	.187
3	(Constant)	3.353	.050	1.005	.002	1.241	5.632
	dhi_tot	-.006	.000	.008	.463	-.023	.009
	VSS_total	-.020	.000	.017	.220	-.055	.011
	Age	.007	-.001	.013	.586	-.016	.030
	gi_gende	-.271	-.006	.246	.287	-.716	.181
	anx_tot	.009	.001	.039	.811	-.071	.094
	dep_f	-.065	.001	.055	.221	-.175	.053
	AAQ2_f	.025	-.001	.022	.263	-.018	.064
4	(Constant)	3.471	.034	1.003	.002	1.317	5.608
	dhi_tot	-.004	.000	.009	.599	-.021	.011
	VSS_total	-.015	.000	.016	.331	-.050	.016
	Age	.014	.000	.014	.298	-.013	.041
	gi_gende	-.415	-.001	.271	.130	-.989	.111
	anx_tot	.016	.003	.046	.719	-.079	.110
	dep_f	-.071	.001	.055	.181	-.176	.040
	AAQ2_f	.029	-.001	.024	.240	-.017	.072
	Psymp_f	-.385	.005	.273	.174	-.934	.163
	Puncer_f	.060	-.004	.306	.845	-.522	.648
	Pdoubt_f	-.044	.000	.319	.892	-.693	.592

Ppract_f	-.409	-.015	.268	.125	-.933	.040
Psuppo_f	-.285	.027	.335	.388	-1.005	.466
Tot_mi_f	-.001	9.780E-5	.002	.717	-.005	.003

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

P.5 Predictors of 6m subjective improvement

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.247[a]	.061	.040	1.1170	.061	2.897	2	89	.060	
2	.313[b]	.098	.057	1.1073	.037	1.781	2	87	.175	
3	.353[c]	.125	.052	1.1101	.027	.852	3	84	.469	
4	.386[d]	.149	.007	1.1360	.024	.370	6	78	.896	2.108

a. Predictors: (Constant), VSS_total, dhi_tot

b. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age

c. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, dep_f, anx_tot, AAQ2_f

d. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, dep_f, anx_tot, AAQ2_f, Ppract_f, Psuppo_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

e. Dependent Variable: qsubjimprdizz6m.subjdizzimp

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.228	2	3.614	2.897	.060[b]
	Residual	111.041	89	1.248		
	Total	118.269	91			
2	Regression	11.595	4	2.899	2.364	.059[c]
	Residual	106.674	87	1.226		
	Total	118.269	91			
3	Regression	14.747	7	2.107	1.709	.118[d]
	Residual	103.522	84	1.232		
	Total	118.269	91			
4	Regression	17.609	13	1.355	1.050	.415[e]
	Residual	100.660	78	1.291		
	Total	118.269	91			

a. Dependent Variable: qsubjimprdizz6m.subjdizzimp

b. Predictors: (Constant), VSS_total, dhi_tot

c. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age

d. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, dep_f, anx_tot, AAQ2_f

e. Predictors: (Constant), VSS_total, dhi_tot, gi_gende, Age, dep_f, anx_tot, AAQ2_f, Ppract_f, Psuppo_f, Psymp_f, Puncer_f, Tot_mi_f, Pdoubt_f

Bootstrap for Coefficients

			Bootstrap[a]				
						BCa 95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	3.711	.016	.254	.001	3.153	4.278
	dhi_tot	-.009	-.001	.008	.274	-.024	.005
	VSS_total	-.014	.000	.015	.340	-.045	.015
2	(Constant)	5.565	-.042	.897	.001	3.718	7.143
	dhi_tot	-.010	-.001	.008	.236	-.026	.003
	VSS_total	-.020	.000	.016	.227	-.053	.013
	Age	-.023	.001	.013	.088	-.049	.006
	gi_gende	-.144	-.003	.274	.598	-.657	.397
3	(Constant)	5.342	-.019	.963	.001	3.359	7.105
	dhi_tot	-.007	-.001	.009	.393	-.024	.007
	VSS_total	-.015	.001	.018	.407	-.049	.025
	Age	-.022	.001	.014	.125	-.048	.007
	gi_gende	-.091	-.003	.278	.736	-.639	.468
	anx_tot	.020	.001	.043	.633	-.071	.110
	dep_f	-.078	-.003	.046	.088	-.173	-.003
	AAQ2_f	.006	.000	.022	.807	-.041	.052
4	(Constant)	5.371	-.017	1.210	.001	2.963	7.597
	dhi_tot	-.009	-.001	.009	.347	-.027	.006
	VSS_total	-.012	.001	.018	.498	-.049	.029
	Age	-.019	.001	.017	.262	-.051	.015
	gi_gende	-.159	-.005	.298	.582	-.766	.419
	anx_tot	.036	-.001	.050	.474	-.063	.133
	dep_f	-.087	-.004	.051	.089	-.195	.000
	AAQ2_f	.007	.000	.024	.759	-.042	.054
	Psymp_f	-.204	.019	.306	.498	-.853	.498
	Puncer_f	.133	-.021	.321	.684	-.435	.686
	Pdoubt_f	-.120	.014	.340	.721	-.716	.623
	Ppract_f	-.158	.020	.310	.621	-.804	.538
	Psuppo_f	-.153	-.030	.330	.636	-.749	.414

Tot_mi_f	.001	.000	.002	.732	-.003	.004

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Appendix Q Interview schedule for RCT follow-up participants

ONLINE DIZZINESS INTERVENTION STUDY

Phase 2a Intervention Participants only

Introduction

- Introduce self to participant.
- Ensure comfortable/uninterrupted.
- Explain purpose of study: what they thought about the online intervention.
- Explain that there are no wrong or right answers and that it is their perspective and their experiences that are of interest to us.
- Remind about confidentiality, reason for tape-recording, and ability to stop at any time.

1. **First of all, can you start by telling me what you were expecting from the Balance Retraining programme?**
    - What did you think the website advice would be like?
    - What did you think the exercises would be like?

2. **How did you find the Balance Retraining programme overall?** (prompt discussion of website and exercises)
    - Tell me how you found Balance Retraining at first
    - Tell me about how Balance Retraining progressed.
    - If no/low usage can you tell me about any reasons you can think of for this?

3. **What problems (if any) did you come across using the Balance Retraining programme?** (prompt discussion of website and exercises)
    - What happened?

4. **Can you tell me what you liked about the Balance Retraining programme?** (prompt discussion of website and exercises)
    - What was helpful? Why? How?
    - Were there some aspects of the intervention that were more helpful than others?

5. **Can you tell me what concerns you have about the Balance Retraining programme?** (prompt discussion of website and exercises)

    - What is your concern? Why? How?
    - Were there some aspects of the intervention that caused more concern than others?

6. **Can you tell me about anything that you would change about the Balance Retraining programme?** (prompt discussion of website and exercises)

    - Is there anything you thought was missing? Why is this important?
    - Is there anything you would take out? Why?

7. **Tell me about anything that you feel has changed as a result of using Balance Retraining?**

    - Can you tell me what changed? (Anything different in your day-to-day life?)
    - Can you tell me how you came to notice things changing?
    - Why/how do you think things changed?

8. **Do you have anything else you would like to tell me about your experiences of the Balance Retraining programme that we haven't already covered?**

    - What would you feed back to the people who designed Balance Retraining?
    - What advice would you give to people thinking about carrying out this sort of self-treatment?

Appendix R Coding manual for qualitative data for role of engagement study

Theme	Subtheme and Description	Codes included	Description	Frequency	Example
Barriers to continued engagement with Balance Retraining	**Physical or practical difficulties:** Difficulties or barriers facing users that are physical or practical in nature	complications by comorbidity, pain or injury	other illness experiences and pain either unrelated to or exacerbated by exercises can make it more complicated to continue with VR exercises	14	"Some of it was quite difficult for me because of having arthritis in my neck." (T1904)
		exacerbation of symptoms	exercises exacerbate dizziness and associated symptoms - particularly at the start; some reaction that they couldn't/ didn't wish to continue as a result	12	"the first time I started doing the exercises I had a period of dizziness quite soon afterwards, and my immediate reaction was if this is what's going to happen I'm not going to carry on with it." (T1301)
		life events take precedence	life events make it difficult to fit exercises in or lack of other things going on in life makes it more simple	9	"I did have a few problems because we had a family crisis at the same time, unfortunately, so I found it a little bit more difficult than I would normally." (T1202)
		memory as a barrier	difficulties remembering to do exercises - often linked to perceptions about age or being busy	9	"I must admit there were some days when I completely forgot to do them but I don't think I perhaps did enough of them as I should have." (T3403)
		specific exercise difficulties	specific exercises as hard to complete - walking exercises perceived to be hard regardless of dizziness symptoms	9	"Obviously the slight difficulty is when it got to the stage of trying to do the closed eye exercises at the same time as walking and not bumping into the furniture, as it were." (T3701)
		technical issues as a barrier	technical issues as problematic to engaging with the intervention, either caused by participants own computer or internet or problems with the website	6	"I think we did have a period when our internet was down for quite a while. There was a problem with the BT lines for about eight weeks which they took a long time to resolve." (T2004)
	Potentially detrimental beliefs and attitudes: Attitudes, beliefs and cognitions that are predominantly negative that have the potential to impact on the extent to which	age as analogous to poor health and decline	perceptions of age as being responsible for poor memory, inability to use technology, physical decline	9	"I can remember reading it. Whether I retained much of it, I don't know. I'm at that age where there's only so much room left." (T2004)
		feeling better as barrier to adherence	recognition that a reduction in symptoms reduces feeling that you need to exercise	4	"I must confess that over that time, of course, you think, well, I'm feeling okay so you let the exercises slip rather." (T3701)

	individuals want or are able to engage with BR	'not for me'	feeling that it wasn't appropriate for their particular symptoms	4	"No, I don't think that applied to me really." (T1606)
		perceived non-severity of symptoms	perceptions that condition not that severe - not frequent, minimal impact on life, or had it so long they just get on with it	10	"I thought it probably was related more to people who have suffered more than I had. I really feel that I'm not somebody who has got this situation very badly." (T3406)
		perceptions of own abilities (negative)	perceptions of computer illiteracy	4	"Well, I'm not very good at that so my husband filled it in. I gave the answers and he did the website for me." (T1802)
		self-conscious about exercises	worrying or being conscious of others reactions to them doing the exercises	4	"I did it upstairs in my computer room with no one looking on so I didn't feel self-conscious about doing it." (T3403)
		uncertainty re. attributing	statements that appear to be uncertain about/ query whether/ or not even consider the fact that the exercises may be responsible	6	"Whether it was the exercises or whether it's just luck, I don't know." (T3403)
		uncertainty, anxiety or concern about exercises	uncertainty or confusion about how to do exercises and whether/how they may be beneficial etc. or that they were worried about doing them or even sceptical about their positive effects	10	"I think I was a bit wary at first because when you do have vertigo it does knock your system and you are a bit worried it's all going to happen again. So that was my main worry that it might set it all off again." (T2401)
Motivators of continued engagement with Balance Retraining	**External motivations:** continuing due to external drives and prompts rather than internal motivations	endorsed by medical authority	credibility perception linked to recommendation from trusted medical professional	4	"I had great faith in you because it was recommended by my doctor and I've got great faith in my doctor." (T1606)
		motivated by others	Obligation to others or social encouragement as motivator	3	"Well, to tell you the truth, I was doing so as an obligation that I had signed up to it so I had to continue doing it." (T1714)
		feelings of gratitude	positive perceptions re. programme and researchers more generally for opportunity to take part and that fact that someone	3	"I was quite glad and fortunate that I'd been given that opportunity to be part of a programme." (T3401)
	Initial desire for change: Drivers of engagement relating to wanting to change their current experience and symptoms - wanting to do something about it for themselves	desire for improvement	desire to experience an improvement in their symptoms or help for them to achieve this	15	"I just think by doing the exercises hopefully I'm going to ward off getting another attack. I wouldn't want to go through that again." (T1202)
		desire for knowledge and understanding	desire to know more about condition and understanding exactly what is happening; importance of this for individuals	7	"So I was interested to take part in the experiment to see how it was going to help me and give me a better understanding of what was happening." (T2108)
		seeking alternative to medical treatment	previous attempts at treatment or diagnosis whether successful or not; sense of having exhausted other options	12	"I think people are very keen on self-helping themselves because there's not much medication you can have." (T1504)

		symptoms interfere with life	unpredictable nature of symptoms and how they impact on life through stopping people being able to do the most simple day to day tasks; others perceptions of their symptoms and also the emotional impact of symptoms	14	"Well, yeah, a reasonable amount actually because I had that very isolated feeling when my symptoms were very bad and I felt really depressed at times and first of all I didn't want to see people." (T3407)
		got nothing to lose	BR worth a try because current symptom experience is so bad, anything is worth trying; perception that you have nothing to lose and potentially everything to gain - not going to be harmful and can stop anytime. But have to be willing to give it a proper go	12	"And so I thought, well, nothing ventured, nothing gained. And so I went in with it thinking – and I can't lose anything and hopefully I'll learn something." (T3401)
	Treatment manageable and realistic: Motivations to continue given the simplicity, ease and achievable nature of the treatment	exercises as time for self	exercises as valued time for oneself- peaceful, not having to think about other things or people	2	"I just did mine when I was on my own, quiet time on my own, and able to have access to the seat and standing up and walking space." (T1609)
		exercises don't take up too much time	exercises as very quick and easy to fit in as they don't require large amounts of time to be set aside	8	"I had no problems because they don't take that long, and I used to just find five minutes." (T2401)
		exercises not too demanding	exercises perceived as simple and straightforward to complete and not too physically or mentally demanding	15	"I found it easy to do upstairs in my house. No, the fact that they were so easy to do made me do them quite regularly" (T3403)
		treatment perceptions - logical	treatment as 'making sense'/ they can see why they are being asked to do it	3	"Okay, yes, I thought it was very good, very clear, and it did actually make sense what we were doing which was good." (T1202)
Process of engagement		carried on with exercises	continuation of exercises beyond end of training programme - even if not at the same frequency intensity	7	"I think I will carry on doing them. I probably won't be as often as I did them twice a day. Five times a week will probably be about the maximum I will do. But I will still keep them" (T1802)
		feeling of progress	recognised progression through exercises as time went on, reducing levels of symptoms, feeling of being on the right path	7	"And as your exercises changed slightly some weeks, watched them being done and then you knew you were on the right path." (T2401)
		habit forming via routine	tie in exercises with other daily activities and routines or setting specific times of the day- helps form routines and get into the habit of doing the exercises	16	"I'd get up in the morning and have a wash or a shower and then I'd do them before I went down for breakfast. And then, likewise, I'd come home from work and just do them about 5 or 5.30 before lunch and, yes, I got into quite a routine with it really." (T3407)

		initial learning and adjustment process	strange/ difficult/ challenging at first but once you learned your way around/ got used to the system / got the hang of it, no problems	10	"I would say after the first few weeks things bedded down, shall we say, and it became the norm." (T2004)
		level and nature of intervention use	quantification of how much of the intervention used and explanations for different usage patterns	9	"Yes, I went online the once, I suppose, each time. Each question that came in I went online that once and printed off what I needed and that was it." (T1609)
		Uncertain expectations	didn't know what to expect, had no previous experience to compare it to, went in with no ideas about what it would be like, don't know until you start using it	17	"Well, I understood what it was about so I was quite willing to have a go to see if it was going to help me in any way. But until you start actually using it you don't really know what to expect and whether it's going to help you." (T2108)
Recognition of benefits following Balance Retraining		can be less conscious of symptoms	less vigilant and constantly conscious and on the lookout for symptoms occurring and the possibilities this opens up	10	"I don't necessarily think I do things differently but I do things in a far more relaxed manner because I'm not expecting to get dizzy" (T3403)
		exercises as management techniques or tools to use	exercises recognised as something they were 'given' as a means of being able to manage their symptoms and something they are left with after the programme to use at will - a toolkit	11	"But at the moment I think it has helped and I would always go back to it if I start to feel the need. I would revert right back to the training programme again." (T3401)
		improved quality of life	feeling more able to 'do things', more able and less reliant on others due to symptoms, greater confidence and examples of simple day to day activities that are now an option	7	"I feel it has worked, I've got part of my life back again which is really good." (T1802)
		improved understanding and awareness	content helped to provide context and greater understanding of condition and awareness of symptoms triggers etc.	11	"there was a lot of interesting information and it did make me feel as though I wasn't being isolated because to start with I did feel I was the only person who had it, which was really interesting."
		increased confidence	exercises/intervention provided a sense of increased confidence about managing symptoms and being able to carry on with 'life as usual' and confidence about future management too	9	"As I say, I'm far more confident when I'm out now where it was getting to the stage where if you were invited out for a meal or travelling or anything like that, oh, panic would set in." (T1802)
		perceptions of symptom improvement	reduction in severity or frequency of symptoms or general perceptions that the exercises were helpful even if this took a while and whilst recognising that they are not a total cure; conversely those who recognised no improvement at all	25	"It's such a relief not to have your head swirling continuously. Oh yes, I think it's a very good set of exercises. I'm still doing them." (T705)
		positive side-effects	positive by-products of completing exercises that were not the direct target of exercises	4	"After I got used to it then that was a good thing that it gave me movement in my neck and I must say it is much easier now." (T1606)

		reduced worry about symptoms	less anxiety, worry and pre-emption of possible symptoms; takes up less mental space; feel more relaxed about completing activities	8	"I suppose I'm more relaxed going out and about, I suppose." (T1609)
Roles and responsibilities of the individual	**Pre-existing knowledge and experience of dizziness:** Indications of individuals pre-existing understandings and experiences of their dizziness and the courses of action they have taken to date	illness perceptions - cause	particular diagnoses received as well as own perceptions of what the cause of symptoms might be and speculation about origin of condition; doubts about medical diagnoses	14	"But I think my things are normally due to viral infections that set things off." (T1504)
		previous exercise experience	Sources of previous exercises and comparisons to current exercises; discussion of how previous exercises influenced expectations	11	"Yes, I was told how to do them but, of course, you didn't feel as if, as I said, this isn't a criticism, but it didn't feel as if you got any support about it. whereas when you are on that programme you feel as if you've got the support" (T1604)
		recognised or feared triggers	recognition of specific actions or situation that are known to trigger symptoms or fear of situations that might in the future	6	"it's usually my fault because I know perfectly well what triggers it but I still do it sort of thing." (T705)
		recognised role of emotion in condition	recognition of emotions and cognitions as cause and effect of symptoms - can exacerbate and be a product of, Importance of mind set for managing condition	4	"But I think it's like with any condition, your mind plays such an important role in it and I think if you can get your mind to think more positively about it then you deal with it more effectively." (T3401)
		sources of existing knowledge	source of knowledge about condition or treatment they already possess - internet use primarily	4	"Obviously when I was diagnosed with the problem with the labyrinthitis and such like I did some research on the internet and I did know that there were exercises that you could do, but I wasn't really clear about what those exercises involved." (T3701)
	Taking responsibility and making sacrifices: Recognition that it's not always going to be pleasant and easy but that individuals have to take control and take responsibility to do something that will help themselves (including how to make	acknowledgement of insufficient adherence	acknowledgement that exercises not completed as frequently as they really should or that this has declined as they started to feel better. also issues with remembering to do them	12	"I'm very naughty, I haven't done them for ages and I keep thinking to myself I ought to really, I suppose" (T1504)
		have to adapt to your own needs	adjustments to frequency, intensity of exercises to suit individuals needs and reasons for doing so	10	"But, again, I think you've just got to get used to it and you've got to do it at a speed that suits you, really." (T2108)

	the programme work best for them) and that ultimately the outcome will be worth it.	importance of positive attitude	perceptions that a positive attitude facilitates better outcomes	2	"it was a matter of, right, let's just stick with this and be positive and I'm sure it will get better if I just keep going on. And with that attitude it worked." (T1604)
		need to be self-disciplined	recognition that although it may be hard and even unpleasant, you won't get anything out of it without making an effort and applying yourself; things sometimes have to get worse before they can get better. Recognition that intervention supported discipline.	12	"Do it properly. Put the effort into it and it does help and it doesn't cut into your time at all." (T1715)
		persevered despite symptoms	willingness to carry on despite exacerbation as recognised that it was for greater gain	10	"Now, you might have given up at that point and thought I'm not doing this because it makes it worse, but then you could say that about anything else in your life, couldn't you, and you wouldn't do anything." (T1604)
		taking control	sense of taking control of own condition and doing something to help oneself; taking ownership and responsibility	12	"I suppose I liked it because it gave me something positive to do to help you so that was good." (T1904)
		worth investment of time	worth the investment of time - perceived as a valuable use of time	4	"Without a doubt it's well worth it. I'm certainly glad my GP put me onto it anyway." (T3407)
Valued qualities of Balance Retraining	**Nature of the intervention and its content:** Perceptions of the intervention as a whole and general aspects including the overall content structure and functionality	clear and accessible content and structure	intervention content perceived as simple/straightforward/clear/ easily understandable with no jargon, well set out and thoughtfully planned out and conceived of	20	"The pages were very good, they were clear and everything was there that you could possibly read, I think, information wise." (T1609)
		convenience of online intervention	being able to do it in your own home, in your own time without having to meet others reduces disruption and flexibility of programme means it can be adapted to suit individual	6	"It's something that's easy to do without needing to visit a physiotherapist or needing any one-to-one face-to-face tuition as it were in how to do it." (T3701)
		easy to use	intervention as simple to engage with and navigate around - no difficulties experienced and all seemed to function as expected	19	"No, I just think the whole thing was really clear and well-laid out [...]. It was a very user-friendly website." (T2207)
		nature of content	views on the quantity and type of content available with mixture of ability to recognise need for intervention to appeal to range of needs and preferences	18	"I found it very interesting. I found it very exacting so there wasn't anything you weren't sure about, it was very well put together." (T3401)

	Valued features of the intervention: Specific features or characteristics of the intervention that were valuable to users and how these contributed to their experiences	guidance helps to clarify uncertainties	features of intervention valued as they help to confirm details if there is any uncertainty, provide info, explain and check understanding - mainly relates to exercise instructions and videos	10	"I suppose the only one was initially am I doing things correctly. I think one of the things I remember rightly the first time I looked at the website I went through – it would show you how to do the exercises, so I did each exercise. So I watched the first one, I did the exercises and then move on to the next one." (T2108)
		intervention as support and encouragement	acts as a support mechanism; almost as if someone is there; provided motivation and encouragement; conversely small proportion who say support wasn't sufficient - would prefer face to face contact	9	"when you are on that programme you feel as if you've got the support that, yes, you've got this exercise, yes, you get the feedback, then somebody is going to come back to you and say, 'How did you get on? This is what you should do next.' Or, 'Perhaps you shouldn't do that next.' So that supportive element I think worked." (T1604)
		reassurance and validation of (shared) experience	realisation of not being the only one or that they're not alone in their experiences and that how they are feeling is acceptable; features of the intervention facilitated this and reassured them that they were on the right tracks	8	"And I think it does give you a feeling that you are not the only one. Actually, there are a lot of people out there that suffer and some of them obviously suffer far greater than me. So I found the website good." (T2108)
		value of immediate feedback	feedback reassured people they were on the right track - felt like extra support	3	"as soon as you completed them you get the immediate feedback of either carry on doing it like this or don't do it as much or do it sitting down or whatever it might be. So that in itself, because it was immediate, so you weren't going to go on perhaps doing the wrong thing." (T1604)
		value of reminders and records	print docs, email reminders and recap ability enable people to keep their own records and act as useful reminders about how exactly do exercises and when to lo back in	13	"You have given me some help and I've got all the print-outs and, as I say, I can refer to them when I'm feeling a little bit in need of it so I know exactly what to do knowing that it probably will help me again." (T3407)

Appendix S Statistics for exploratory analyses conducted in engagement study (Chapter 6)

S.1 Multinomial logistic regression

To assess potential predictors of sub-groups of engagement

Model Fitting Information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	335.955			
Final	324.612	11.343	14	.659

Pseudo R-Square

Cox and Snell	.068
Nagelkerke	.078
McFadden	.034

Parameter Estimates

Engagementlevel[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	95% Confidence Interval for Exp(B) Upper Bound
pre-TEST	Intercept	-1.529	1.633	.877	1	.349			
	dhi_tot	-.015	.014	1.270	1	.260	.985	.959	1.011
	anx_tot	-.036	.060	.356	1	.551	.965	.858	1.085
	dep_f	.037	.071	.276	1	.599	1.038	.903	1.194
	Age	.024	.022	1.198	1	.274	1.024	.981	1.069
	VSS_total_no_outliers	.016	.023	.460	1	.497	1.016	.970	1.064
	[gi_gende=1]	.434	.398	1.188	1	.276	1.544	.707	3.371
	[gi_gende=2]	0[b]	.	.	0	.	.	.	.
	[gi_fhed=0]	-.056	.389	.021	1	.885	.945	.441	2.024
	[gi_fhed=1]	0[b]	.	.	0	.	.	.	.
post-TEST	Intercept	-1.530	2.027	.570	1	.450			
	dhi_tot	-.005	.018	.065	1	.799	.995	.961	1.031
	anx_tot	-.066	.076	.739	1	.390	.936	.806	1.088

dep_f	-.127	.102	1.553	1	.213	.881	.722	1.075
Age	.019	.027	.467	1	.494	1.019	.966	1.075
VSS_total_no_outliers	.022	.029	.579	1	.447	1.022	.966	1.082
[gi_gende=1]	.337	.498	.456	1	.499	1.400	.527	3.717
[gi_gende=2]	0[b]	.	.	0	.	.	.	.
[gi_fhed=0]	.212	.473	.200	1	.654	1.236	.489	3.126
[gi_fhed=1]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Multiple session.

b. This parameter is set to zero because it is redundant.

S.2 Chi squared analysis: level of engagement x use of print documents

To determine whether different engagement subgroups make differential use of this particular feature

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.396[a]	2	.006	.006		
Likelihood Ratio	10.585	2	.005	.005		
Fisher's Exact Test	10.576			.004		
Linear-by-Linear Association	9.159[b]	1	.002	.003	.002	.001
N of Valid Cases	160					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.74.

b. The standardized statistic is 3.026.

S.3 ANCOVA (continuous) and chi squared (dichotomous) analyses

To assess whether specific engagement 'cut off points' were associated with different outcomes

S.3.1 Dizziness outcome

Tests of Between-Subjects Effects

Dependent Variable: VSS6m_f

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2086.909[a]	3	695.636	14.863	.000	.292
Intercept	208.307	1	208.307	4.451	.037	.040
VSS_total_no_outliers	1948.809	1	1948.809	41.638	.000	.278
Engagementlevel	163.367	2	81.684	1.745	.179	.031
Error	5054.761	108	46.803			

Total	15705.423	112
Corrected Total	7141.670	111

a. R Squared = .292 (Adjusted R Squared = .273)

Engagementlevel

Dependent Variable: VSS6m_f

Engagementlevel	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
pre-TEST	8.674[a]	1.110	6.473	10.874
post-TEST	11.307[a]	1.570	8.196	14.418
Multiple session	7.908[a]	.923	6.079	9.737

a. Covariates appearing in the model are evaluated at the following values: VSS_total_no_outliers = 16.3125.

Contrast Results (K Matrix)

Engagementlevel Simple Contrast[a]			Dependent Variable VSS6m_f
Level 1 vs. Level 3	Contrast Estimate		.766
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		.766
	Std. Error		1.444
	Sig.		.597
	95% Confidence Interval for Difference	Lower Bound	-2.096
		Upper Bound	3.628
Level 2 vs. Level 3	Contrast Estimate		3.399
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		3.399
	Std. Error		1.821
	Sig.		.065
	95% Confidence Interval for Difference	Lower Bound	-.210
		Upper Bound	7.009

a. Reference category = 3

S.3.2 Perceived handicap outcome

Tests of Between-Subjects Effects

Dependent Variable: dhi6m_total_imputed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17635.038[a]	3	5878.346	23.221	.000	.418
Intercept	30.948	1	30.948	.122	.727	.001
dhi_tot	17183.479	1	17183.479	67.879	.000	.412
Engagementlevel	175.807	2	87.903	.347	.708	.007
Error	24555.383	97	253.148			
Total	114948.811	101				
Corrected Total	42190.421	100				

a. R Squared = .418 (Adjusted R Squared = .400)

Engagementlevel

Dependent Variable: dhi6m_total_imputed

Engagementlevel	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
pre-TEST	25.062[a]	2.816	19.473	30.651
post-TEST	28.706[a]	3.652	21.458	35.953
Multiple session	27.269[a]	2.251	22.802	31.736

a. Covariates appearing in the model are evaluated at the following values: dhi_tot = 36.7723.

S.3.3 Depression outcome

Tests of Between-Subjects Effects

Dependent Variable: HADS6m_dep_total_imputed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	733.776[a]	3	244.592	40.394	.000	.555
Intercept	5.568	1	5.568	.920	.340	.009
dep_f	716.469	1	716.469	118.324	.000	.550
Engagementlevel	2.355	2	1.177	.194	.824	.004
Error	587.351	97	6.055			
Total	2727.599	101				
Corrected Total	1321.128	100				

a. R Squared = .555 (Adjusted R Squared = .542)

Engagementlevel

Dependent Variable: HADS6m_dep_total_imputed

Engagementlevel	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
pre-TEST	3.507[a]	.435	2.644	4.371
post-TEST	3.825[a]	.567	2.699	4.950
Multiple session	3.840[a]	.349	3.147	4.533

a. Covariates appearing in the model are evaluated at the following values: dep_f = 4.5050.

S.3.4 Anxiety outcome

Tests of Between-Subjects Effects

Dependent Variable: HADS6m_anx_total_imputed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	912.110[a]	3	304.037	29.248	.000	.475
Intercept	33.212	1	33.212	3.195	.077	.032
anx_tot	844.353	1	844.353	81.225	.000	.456
Engagementlevel	64.129	2	32.065	3.085	.050	.060
Error	1008.340	97	10.395			
Total	5693.722	101				
Corrected Total	1920.450	100				

a. R Squared = .475 (Adjusted R Squared = .459)

Engagementlevel

Dependent Variable: HADS6m_anx_total_imputed

Engagementlevel	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
pre-TEST	5.078[a]	.570	3.946	6.210
post-TEST	7.324[a]	.742	5.852	8.796
Multiple session	6.314[a]	.457	5.406	7.221

a. Covariates appearing in the model are evaluated at the following values: anx_tot = 7.3267.

Contrast Results (K Matrix)

Engagementlevel Simple Contrast[a]		Dependent Variable HADS6m_anx_total_imputed
Level 2 vs. Level 1	Contrast Estimate	2.246

	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		2.246
	Std. Error		.934
	Sig.		.018
	95% Confidence Interval for Difference	Lower Bound	.391
		Upper Bound	4.100
Level 3 vs. Level 1	Contrast Estimate		1.236
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		1.236
	Std. Error		.732
	Sig.		.094
	95% Confidence Interval for Difference	Lower Bound	-.216
		Upper Bound	2.688

a. Reference category = 1

S.3.5 Self-efficacy outcome

Tests of Between-Subjects Effects

Dependent Variable: Seef3m_f

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2555.827[a]	2	1277.914	5.093	.009	.132
Intercept	4279.810	1	4279.810	17.056	.000	.203
Selfef_f	2416.669	1	2416.669	9.631	.003	.126
Engagementlevel	177.334	1	177.334	.707	.404	.010
Error	16812.275	67	250.929			
Total	203469.163	70				
Corrected Total	19368.102	69				

a. R Squared = .132 (Adjusted R Squared = .106)

Engagementlevel

Dependent Variable: Seef3m_f

Engagementlevel	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
post-TEST	45.542[a]	7.087	31.396	59.689
Multiple session	51.725[a]	1.965	47.803	55.647

a. Covariates appearing in the model are evaluated at the following values: Selfef_f = 52.9571.

S.3.6 PETS symptoms outcome

Engagementlevel * PETSsymptoms6m_dichotomised Crosstabulation

			PETSsymptoms6m_dichotomised		
			no problems	some problems	Total
Engagementlevel	pre-TEST	Count	9	18	27
		Expected Count	12.6	14.4	27.0
		% within Engagementlevel	33.3%	66.7%	100.0%
		% within PETSsymptoms6m_dichotomised	20.9%	36.7%	29.3%
		% of Total	9.8%	19.6%	29.3%
	post-TEST	Count	7	11	18
		Expected Count	8.4	9.6	18.0
		% within Engagementlevel	38.9%	61.1%	100.0%
		% within PETSsymptoms6m_dichotomised	16.3%	22.4%	19.6%
		% of Total	7.6%	12.0%	19.6%
	Multiple session	Count	27	20	47
		Expected Count	22.0	25.0	47.0
		% within Engagementlevel	57.4%	42.6%	100.0%
		% within PETSsymptoms6m_dichotomised	62.8%	40.8%	51.1%
		% of Total	29.3%	21.7%	51.1%
Total		Count	43	49	92
		Expected Count	43.0	49.0	92.0
		% within Engagementlevel	46.7%	53.3%	100.0%
		% within PETSsymptoms6m_dichotomised	100.0%	100.0%	100.0%
		% of Total	46.7%	53.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.560[a]	2	.102	.097		
Likelihood Ratio	4.609	2	.100	.101		
Fisher's Exact Test	4.488			.101		
Linear-by-Linear Association	4.271[b]	1	.039	.042	.025	.011
N of Valid Cases	92					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.41.

b. The standardized statistic is -2.067.

Odds ratio for likelihood of experiencing symptoms related barriers, non-completion of TEST vs multiple sessions = (18/20)/(9/27) = 2.7

S.3.7 PETS uncertainty outcome

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.475[a]	2	.065	.074		
Likelihood Ratio	5.182	2	.075	.095		
Fisher's Exact Test	5.185			.074		
Linear-by-Linear Association	5.051[b]	1	.025	.031	.019	.010
N of Valid Cases	90					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.40.

b. The standardized statistic is -2.247.

S.3.8 PETS doubts outcome

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.225[a]	2	.329	.340		
Likelihood Ratio	2.236	2	.327	.340		
Fisher's Exact Test	2.192			.340		
Linear-by-Linear Association	1.890[b]	1	.169	.187	.105	.038
N of Valid Cases	92					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.41.

b. The standardized statistic is -1.375.

S.3.9 PETS practical outcome

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.411[a]	2	.300	.339		
Likelihood Ratio	2.448	2	.294	.339		
Fisher's Exact Test	2.237			.339		

Linear-by-Linear Association	1.737[b]	1	.188	.236	.117	.045
N of Valid Cases	92					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.78.

b. The standardized statistic is -1.318.

S.3.10 PETS support outcome

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.171[a]	2	.205	.230		
Likelihood Ratio	3.588	2	.166	.181		
Fisher's Exact Test	3.182			.230		
Linear-by-Linear Association	.070[b]	1	.792	.893	.446	.103
N of Valid Cases	92					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.89.

b. The standardized statistic is -.264.

S.4 Correlations between total engagement time and absolute 6m symptom severity

Investigating whether lower levels of engagement were likely to be necessarily problematic for outcomes

Correlations

			TotaltimeNO	VSS6m_f
Spearman's rho	TotaltimeNO	Correlation Coefficient	1.000	-.162
		Sig. (2-tailed)	.	.088
		N	160	112
	VSS6m_f	Correlation Coefficient	-.162	1.000
		Sig. (2-tailed)	.088	.
		N	112	112

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