“It made you feel like you’ve still got it”: experiences of people with chronic low back pain undertaking a single session of body image training in virtual reality

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“It made you feel like you’ve still got it”: experiences of people with chronic low back pain undertaking a single session of body image training in virtual reality

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ABSTRACT

Introduction: Embodiying fit avatars in virtual reality (VR) is proposed as a possible treatment for cortical body representations and pain-related self-perceptions.

Objective: To explore consumer perceptions of a novel VR intervention (VR-BiT) for chronic low back pain.

Methods: Adults (n = 17, mean age(SD) = 52(14)) with chronic low back pain who had undergone a single session of VR-BiT as part of a randomized controlled trial underwent a semi-structured interview using open-ended questions. Interviews were audio-recorded, transcribed verbatim, and analyzed thematically.

Results: Data reduction identified four themes: clinically beneficial and beyond; helping and hindering use; desire for more; and individualized future. Participants experienced wide ranging effects, including improved physical self-efficacy, pain, ability to perform physical activity and psychological symptoms. The intervention was well tolerated, except for two reports of nausea, and a few participants indicating pain associated with unaccustomed movement. Most participants were motivated to use VR-BiT again, despite some having technical issues. Participants suggested that personalizing VR-BiT and regular use would be beneficial.

Conclusions: There was strong consumer support for further use of VR-BiT. Future studies of VR-BiT effectiveness are warranted and should consider incorporating individual user preferences, including people with diverse pain presentations, and involving a multi-session design.

Introduction

Chronic low back pain affects almost one in five people, is the leading cause of disability worldwide (Vos et al., 2016) and results in an enormous individual and societal burden (Brevik, Eisenberg, and O’Brien, 2013). While progress has been made, limitations in current management strategies for chronic low back pain (CLBP) suggest that innovation is needed. For review of limitations see George, Goertz, Hastings, and Fritz (2020). Virtual reality body image Training (VR-BiT) is an example of using emerging technologies in attempt to innovate new approaches (Harvie et al., 2020). VR-BiT involves the use of virtual reality (VR) to facilitate the embodiment of hyper-muscular and hyper-capable avatars. The intervention attempts to facilitate re-encoding of the body as healthy and resilient, while targeting negative self-perceptions, and ultimately aiming to reduce pain. While early reviews and meta-analyses suggests that VR is capable of reducing acute, experimental, and chronic pain; studies are typically of low quality (Ahern et al., 2020; Tack, 2021). Moreover, VR should be considered a tool or medium for treatment delivery, and not the treatment itself. Thus, each application of VR should be assessed on its own merits. Conceptual support for the premise of VR-BiT, derives from studies demonstrating altered body-related perceptions and attitudes in people with chronic pain and the finding that perceptions, attitudes and behaviors can be altered by VR embodiment. For example, negative body-related attitudes such as reduced physical efficacy are prevalent in chronic pain populations (Levenig et al., 2019) as are impressions of the body as malfunctioning (Crombez...
et al., 2012; Levenig et al., 2019). The hypothesis that these factors might be changed using virtual reality comes from non-clinical studies demonstrating that embodying avatars with particular characteristics evokes perceptions and behaviors consistent with those characteristics (Slater and Sanchez-Vives, 2014). For example, becoming a child in VR induces child-like implicit attitude changes and a tendency to overestimate the size of virtual objects (Banakou, Groten, and Slater, 2013).

A feasibility randomized controlled trial (RCT) investigated whether a single, clinic-based session of VR-BiT could augment body image and improve clinical outcomes in adults with CLBP relative to a usual VR control (Harvie et al., 2022). Participants in the experimental group were fitted with a VR head mounted display (Oculus Rift S) with connected touch controllers (Oculus, Facebook Technologies, LCC, Menlo Park, USA), and guided by a physiotherapist researcher in interacting with three preexisting VR applications (Figure 1). A boxing application (Creed: Rise to Glory) required participants to make muscle poses, throw air punches, and punch a virtual punching bag. In Avengers Powers Unite, participants became the Incredible Hulk and were instructed to throw air punches and adopt various muscle poses while fixing their attention on their newly adopted musculature. In The Climb, participants were instructed to notice their strength and effortlessness while scaling a virtual cliff. These applications could be completed in a sitting or standing position to suit the tolerance of each participant and were undertaken for approximately six minutes each (total exposure 18 minutes).

Gaining consumer perspectives on interventions such as VR-BiT is critical to both development and implementation, given evidence suggests that consumers may be unwilling to try VR interventions, the potential for adverse events as a result of VR hardware and software, and the presence of barriers to use and integration with current health care delivery (Costello, 1997; Mosadeghi et al., 2016; Smith et al., 2020). As such, recently published standards for the development of therapeutic VR interventions, recommend seeking continuous user feedback regarding acceptability, feasibility, tolerability, and clinical efficacy (Birckhead et al., 2019). Investigation of consumer perspectives of VR-BiT is yet to occur. Further, findings from other VR-based studies such as those targeting pain-related fear or activity management in populations with CLBP and fibromyalgia cannot be easily generalized, and are typically limited by their brief survey or questionnaire-based designs (Garcia-Palacios et al., 2015; Thomas et al., 2016). The aim of this study was to explore consumer experiences of VR-BiT, delivered as part of the aforementioned RCT, with focus on the aforementioned acceptability, feasibility, tolerability, and clinical efficacy domains.

Methods

Design

A qualitative descriptive study of participants’ experiences of VR-BiT was conducted in the week following the RCT VR-BiT intervention, to enable exploration of potential reasons for intervention success or failure, and identification of possible implementation strategies (Palinkas et al., 2015; Sandelowski, 2000). Qualitative interview was used to ensure the collection of rich information (Noaks and Wincup, 2004), and a semi-structured and open-ended question approach allowed participants to direct the conversation and provide a sense of what was most salient (Arksey and Knight, 2012). The study was approved by Metro South Health (HREC/2019/QMS/53077) and Griffith University (2019/763) ethics committees.

Participants

Participants from a tertiary persistent pain service who were randomized to the experimental group of the RCT and were willing to be interviewed were purposively sampled to gain insight into consumer experiences of VR-BiT. RCT eligibility criteria are presented in Table 1. When designing the clinical trial, it was anticipated that the sample size of the experimental group (n = 20) would be sufficiently large to achieve saturation of

![Figure 1. Visualization of the VR applications. Panel A: ‘Creed: Rise to Glory’; Panel B: ‘Avengers Powers Unite’; Panel C ‘The Climb.’](image-url)
themes (Creswell and Poth, 2017; Guest, Bunce, and Johnson, 2006). All participants provided informed consent prior to inclusion. Participants did not receive compensation for completing the interview.

**Data collection**

One-on-one telephone interviews were conducted within 7 days of intervention completion to optimize recall of the study experience. A single interviewer, experienced in collecting and analyzing qualitative data (JK), used a standardized question guide (Figure 2) to facilitate dependable data collection (Guba and Lincoln, 1989). This guide was drafted based on recommendations for the development of therapeutic VR applications (Birckhead et al., 2019) then piloted 

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult (&gt;18 years of age)</td>
<td>Diagnosis/presence of red flags indicating serious spinal pathology (i.e., infection, tumor, recent fracture, significant structural deformity, such as unstable/unstabilized spondylolisthesis or progressive scoliosis, inflammatory disorder, and neuropathic radicular syndrome or cauda equina syndrome)</td>
</tr>
<tr>
<td>Referred to tertiary persistent pain management service for CLBP (duration ≥6 months)</td>
<td>Inability to tolerate visual stimulation (e.g., susceptibility to migraines aggravated by light)</td>
</tr>
<tr>
<td>SF-36 Question 7 (“How much bodily pain have you had during the past 4 weeks?”) and 8 (“During the past 4 weeks, how much did pain interfere with your normal work [including both work outside the home and housework]?”) score ≥ “moderate”</td>
<td>Inability to tolerate the head mounted display (e.g., sensitivity to touch around the face and head)</td>
</tr>
<tr>
<td>Able to read and understand English language</td>
<td>● Able to provide informed consent</td>
</tr>
<tr>
<td>Access to a computer</td>
<td>● CLBP = chronic low back pain</td>
</tr>
</tbody>
</table>

**Table 1. VR-BiT RCT eligibility criteria.**

Interview transcripts were uploaded to NVivo (QSR International, Australia), and analyzed thematically using a within- and across-case approach (Ayres, Kavanaugh, and Knafl, 2003; Braun and Clarke, 2006). The presence of established domains considered important in the development of VR applications (Birckhead et al., 2019) meant that the analysis was predominantly deductive (Braun and Clarke, 2006). However, investigators also remained alert to more novel participant perceptions. As outlined by Braun and Clarke (2006) two authors, one with past experiences. However, immersion in these individuals' perceptions, personal trial of the intervention, and her experience as a physiotherapist treating people with CLBP meant that she may be considered an ‘acting member researcher’ who works in the space between outsider and insider (Adler and Adler, 1987; Dwyer and Buckle, 2009). These factors were disclosed to participants upon interview commencement.

**Analysis**

Why were you interested in participating in this study?

Had you any experience with VR before the study?

Can you tell me about your overall experiences of the VR session?

What benefits or detriment did you experience as a result of the session?

How well did you tolerate the session?

How confident did you feel in your ability to use the VR system once it had been demonstrated?

How willing would you be to continue using VR, or to try it again in the future?

What would make the VR session better?

What do you think is needed to help other people use this type of treatment in the future?

Are there any other comments you would like to make?

VR = virtual reality

Figure 2. Interview question guide.
experience in thematic analysis, and one without (JK and DH respectively), familiarized themselves with interview transcripts and contextual field notes. JK then recorded preliminary patterns and salient issues, which were reviewed by DH and formed a framework for category development and initial coding of text. Progressive coding of basic themes with commonality were arranged into organizing themes to create a set of categories that best reflected the content of the data considering the research aims. The authors met regularly throughout this process to review and challenge emerging interpretation so that robust representation of data occurred (Elliott, Fischer, and Rennie, 1999; Guba and Lincoln, 1989). The trustworthiness of findings were further enhanced by conducting a synthesized member check (Birt et al., 2016).

**Results**

**Participants**

Seventeen VR-BiT participants were interviewed mean (SD) four (1.7) days post intervention between February 2020 and January 2021 for a mean (SD) duration of 22.5 (8.1) minutes. The remaining three participants in the experimental group were not approached for interview given saturation of themes occurred upon analysis of the 13th transcript. Participant characteristics are presented in Table 2. Most participants were male (n = 12, 71%) with a history of spinal surgery or invasive spinal procedures (n = 15, 88%). Participants reported severe pain (mean (SD) = 6.2 (1.3) out of 10) of varied duration (mean (SD) = 17.6 (15.4) years) and severe pain-related disability (Roland Morris Disability Index mean = 57.1%, range = 16.7 to 95.8%).

**Themes**

Data reduction identified four themes: 1) “Clinically beneficial and beyond”; 2) “Helping and hindering use”; 3) “Desire for more”; and 4) “Individualized future” (Table 3). Feedback from the member check process was confirmatory and did not lead to alterations of results. Supplementary data provides additional quotes in support of these themes.

**Clinically beneficial and beyond**

While the extent of impact varied from small to profound, all participants described having benefited from VR-BiT. These changes related to: 1) ‘Altered physical self-efficacy; 2) ‘Controlling pain’; 3) ‘Achieving exercise’; and 4) ‘Psychological response.’

**Altered physical self-efficacy.** Most participants indicated that VR-BiT had helped them feel more confident in their physical ability or that their capacity had increased. These new abilities were described as improvements in strength or agility, gaining a sense of security or invincibility, or having rediscovered prior physical form:

“I could sit on the chair and scale a mountainside . . . It made you feel like you’ve still got it” (P08).

Two participants thought that prior real-world experience with the activities being undertaken might have enhanced this benefit:

“I’ve done rock climbing before, so I know what it’s like . . . you need to be very strong and very agile to do that” (P01).

<table>
<thead>
<tr>
<th>ID</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Pain duration (yrs)</th>
<th>7-day average pain intensity (0-10)</th>
<th>Hx of spinal surgery (S) or medical intervention (I)</th>
<th>Roland Morris Disability Index (%)</th>
<th>Past VR experience (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01</td>
<td>32</td>
<td>Male</td>
<td>10</td>
<td>4</td>
<td>I</td>
<td>33.3</td>
<td>No</td>
</tr>
<tr>
<td>P02</td>
<td>63</td>
<td>Female</td>
<td>50</td>
<td>8</td>
<td>S, I</td>
<td>45.8</td>
<td>No</td>
</tr>
<tr>
<td>P03</td>
<td>53</td>
<td>Male</td>
<td>7</td>
<td>6</td>
<td>S, I</td>
<td>45.8</td>
<td>No</td>
</tr>
<tr>
<td>P04</td>
<td>50</td>
<td>Male</td>
<td>38</td>
<td>7</td>
<td>I</td>
<td>66.7</td>
<td>Yes*</td>
</tr>
<tr>
<td>P05</td>
<td>70</td>
<td>Female</td>
<td>15</td>
<td>6</td>
<td>S, I</td>
<td>45.8</td>
<td>No</td>
</tr>
<tr>
<td>P06</td>
<td>63</td>
<td>Male</td>
<td>25</td>
<td>8</td>
<td>S, I</td>
<td>95.8</td>
<td>Yes*</td>
</tr>
<tr>
<td>P07</td>
<td>38</td>
<td>Female</td>
<td>8</td>
<td>6</td>
<td>I</td>
<td>20.8</td>
<td>Yes*</td>
</tr>
<tr>
<td>P08</td>
<td>43</td>
<td>Male</td>
<td>17</td>
<td>6</td>
<td>I</td>
<td>66.7</td>
<td>No</td>
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<tr>
<td>P09</td>
<td>70</td>
<td>Male</td>
<td>8</td>
<td>8</td>
<td>S, I</td>
<td>62.5</td>
<td>No</td>
</tr>
<tr>
<td>P10</td>
<td>57</td>
<td>Male</td>
<td>49</td>
<td>4</td>
<td>I</td>
<td>45.8</td>
<td>No</td>
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<tr>
<td>P11</td>
<td>76</td>
<td>Male</td>
<td>26</td>
<td>5</td>
<td>I</td>
<td>16.7</td>
<td>No</td>
</tr>
<tr>
<td>P12</td>
<td>44</td>
<td>Male</td>
<td>2</td>
<td>8</td>
<td>I</td>
<td>70.8</td>
<td>Yes*</td>
</tr>
<tr>
<td>P13</td>
<td>30</td>
<td>Male</td>
<td>3.5</td>
<td>7</td>
<td>I</td>
<td>58.3</td>
<td>Yes*</td>
</tr>
<tr>
<td>P14</td>
<td>37</td>
<td>Male</td>
<td>3</td>
<td>5</td>
<td>I</td>
<td>54.2</td>
<td>Yes*</td>
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<tr>
<td>P15</td>
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<td>4.5</td>
<td>6</td>
<td>I</td>
<td>58.3</td>
<td>No</td>
</tr>
<tr>
<td>P16</td>
<td>58</td>
<td>Female</td>
<td>20</td>
<td>5</td>
<td>I</td>
<td>87.5</td>
<td>No</td>
</tr>
<tr>
<td>P17</td>
<td>41</td>
<td>Female</td>
<td>13</td>
<td>6</td>
<td>I</td>
<td>95.8</td>
<td>Yes*</td>
</tr>
</tbody>
</table>

*Not in therapeutic context, VR = virtual reality.
Table 3. Coding tree.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
<th>Salient content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinically beneficial and beyond</td>
<td>Altered physical self-efficacy</td>
<td>Changes to bodily trust and perceived physical capability – strength, agility, vulnerability. Impacts on, longevity and lack of same</td>
</tr>
<tr>
<td></td>
<td>Controlling pain</td>
<td>Changes in pain, potential mechanisms and longevity of effect. Lack of same</td>
</tr>
<tr>
<td></td>
<td>Achieving exercise</td>
<td>VR as a way of exercising where benefit is general</td>
</tr>
<tr>
<td>Helping and hindering use</td>
<td>Psychological response</td>
<td>Changes to emotions and psychological symptoms, or strategies for same</td>
</tr>
<tr>
<td></td>
<td>Safety and comfort</td>
<td>VR-specific side effects. Comfort of set-up. Pain increase where seen as side effect (lumbar or other). Cause, impact and strategies for reducing same</td>
</tr>
<tr>
<td></td>
<td>Making it comfort</td>
<td>Ease of operation. Constraint of comorbidities. Equipment malfunction and impact within session. Confidence in use. Instructional needs</td>
</tr>
<tr>
<td>Desire for more</td>
<td>VR as pain therapy</td>
<td>Search for new therapy. Merit to idea or further research. Parallels drawn to current management. Recommend same to others</td>
</tr>
<tr>
<td></td>
<td>Motivated users</td>
<td>Feelings or attitudes toward experience. Support for continued use and drivers or limitations. Projected longevity</td>
</tr>
<tr>
<td>Individualized future</td>
<td>Tailoring the experience</td>
<td>Individualization. Program and session improvements. Use beyond RCT aims</td>
</tr>
<tr>
<td></td>
<td>How I'd use it</td>
<td>Recommendations for future use – indications, content, timing, dose, whereabouts. Barriers and facilitators of access and use</td>
</tr>
</tbody>
</table>

VR = virtual reality, RCT = randomized controlled trial

The depth of immersion appeared important, given that participants who described benefit reported feeling more immersed in VR compared to those who did not. Further, participants who experienced enhanced physical self-efficacy were often able to articulate the concept behind the study better than others:

“You’re basically taking your mind out of your own body and putting it into another body in which you feel more capable” (P01).

Finally, while most did not describe the longevity of this benefit, two participants reported feelings persisted for several days.

Controlling pain. Many participants experienced relief from CLBP as a result of VR-BiT, of which some indicated complete resolution and others noticed a more minor reduction. Most participants believed that distraction accounted for the mechanism behind such pain control:

“You’re doing all these things, your mind is being taken off that pain, and it seems to have that sensory input, which I think is breaking the chain” (P01).

Subsequently, it was thought that VR did not address the underlying cause of pain, and instead provided symptomatic relief that was limited to during the session or a short period after:

“I jumped in my car and hit the first bump in the road . . . The pain’s come back” (P04).

Achieving exercise. Several participants described the intervention as a modern way of working out, which was of general benefit to their health. Other participants thought VR-BiT had enabled them to undertake exercise or movement, which they might normally avoid or find intolerable:

“I was blocking when the [boxing bag] would come at me. Not blocking, but like dodging . . . so you’re moving more than you normally would and in ways that you normally wouldn’t” (P01).

Some participants thought that such exercise was superior to traditional forms because it was gentler and could be increased in a more controlled way:

“I go to the physio and their exercises kill me . . . when if you do something like [VR], start off [softly], and maybe get into harder things or more intense things, it will probably come more naturally” (P16).

Psychological response. A few participants described VR as having helped them to enhance their mood or escape negative emotions. Two participants also reported a reduction in symptoms associated with a mental health condition, one of whom was considering investing in their own VR system:

“Depression is a weird thing. for me it feels heavy and everything you do is a hassle . . . I sort of felt a bit lighter, just normal . . . and that’s why I’m now looking at getting a headset” (P08).

Further, one participant felt that the VR experience had helped them to question pain-related negative thought patterns:

“Letting that [strong] feeling in may be a focus . . . it may be somewhere to go for my reflection on pain, rather than just saying, I’m sick of this or-“. Like a more empowering thought” (P07).
Helping and hindering use
Participants described how the tolerability and ease of operating the system might help or hinder their use of VR. This theme was informed by the sub-themes: 1) ‘Safety and comfort’; and 2) ‘Making it work.’

Safety and comfort. A few participants reported feeling some muscle soreness or increase in CLBP because of the experience, of which most thought that new or excessive movement was the cause:

“I haven’t done that sort of movement for quite a while. So yeah, it was something that the muscles weren’t used to doing” (P17).

Several participants noted that flexibility in the position of use and brevity of time in the experience had helped manage, or entirely avoid such discomfort:

“I’m not in as much pain when I’m seated as when I’m standing, so it was quite easy for me to do the movements” (P05).

Most participants denied experiencing any VR-specific side effects, which also included some who reported a history of motion sickness from other causes. However, one participant experienced mild nausea, and another reported more severe symptoms:

“It made me feel sick . . . I had to take a couple of breaths before I threw up” (P12).

Making it work. While most participants did not experience physical constraints to operation, preexisting hand dysfunction meant that two participants had difficulty with the hand controls:

“I’ve got really bad arthritis too at the moment so holding onto those [hand controls] was an issue” (P02).

Several participants reported that the VR system had malfunctioned. However, these mishaps were not viewed negatively, and instead were seen as part of the development process:

 “[the VR] didn’t want to behave itself . . . but that’s to be understood when you’re trying to refine a situation” (P09).

Further, despite a lack of resolution to the problem in some instances, most participants expressed confidence in their ability to intuitively use or rapidly work out how to operate the system. Participants who had past experience using other technologies, such as gaming platforms, seemed particularly confident. Conversely, while level of confidence did not appear associated with age, many participants speculated that older people might find VR more difficult to navigate:

“A lot of people, especially older people . . . might see it as being too complex” (P14).

Finally, both participants who remained unconfident upon completion of their session, believed that they would master VR with further instruction and/or practice:

“. . . maybe twice and it’d sink in” (P04).

Desire for more
Most participants reported being eager to use VR again, of which two had commenced sourcing their own systems. This desire for continued use is explained in: 1) ‘VR as pain therapy’; and 2) ‘Motivated users.’

VR as pain therapy. When asked why they had taken part in the RCT, many participants described being on a quest for new and more effective therapies. While two participants were not hopeful that VR would be of therapeutic benefit, the vast majority thought there was merit to the idea and were eager for further development to occur:

“You’ll fine tune it to the point where it’s mind blowing” (P09).

Further, numerous participants appeared to accept VR-BiT as treatment in its current form. These participants likened it to other therapies, detailed how it might work in conjunction with usual management, and described its superiority to other treatments:

“I’ve taken opiates for 40 years and they don’t work as well as what the virtual reality did” (P04).

Additionally, several participants indicated they had recommended therapeutic VR to others:

“I talked to my sons about it and yeah, they sound interested” (P09).

Motivated users. While a couple of participants described their VR experience as strange, the majority reported more positive feelings such as having found it to be fun, engaging, interesting or entertaining:

“I found it satisfying and meaningful . . . I wanted to do more” (P15).

With the caveat of providing a positive therapeutic benefit, most participants expressed a drive toward trying VR again or using it on an ongoing basis. This enthusiasm came as a surprise to some who were previously uninterested in such technology:
“[My relative] has [a VR system] and he’s brought it over a few times and every time he wants me to use it, I go, ‘Nah’. And now I’m like, ‘Shit, I should have done that!’” (P08).

While a couple of participants appreciated the gaming aspect, most cited enjoyment and the opportunity for novel experiences as factors that might maintain motivation toward continued use:

“... you’re enjoying yourself, you can do things you’ve never experienced before, obviously you’re going to do it” (P04).

However, the projected longevity of enthusiasm toward VR use was mixed with two participants concerned that repeated use of programs might become boring, and another speculating that users might become obsessed.

**Individualized future**

Participants described how they thought VR could be adapted, accessed and used so that it would be of most future benefit. This vision is outlined in the subthemes: 1) ‘Tailoring the experience’; and 2) ‘How I’d use it’.

**Tailoring the experience.** Preferences for future use of each VR program varied across participants. Many indicated that they would use the programs exactly as presented in the RCT, while several thought that omitting one potentially aggravating program would improve their experience:

“Not the rock climbing one. Yeah, it’d probably be alright then” (P06).

Some participants recognized that pain journeys are individual and hence thought having a range of VR programs might be ideal:

“You run through the whole set, then you fine tune it ... decide which programs would suit that person” (P09).

The majority of participants preferred programs that maximized interaction and included a movement-centric activity that they personally connected with:

“I loved the first [program]. I used to be a pro-amateur kick boxer so it was like being back in the office ... I was like, ‘Hell yeah!’” (P12).

When asked what might improve the session several participants thought that developing programs that involve movement in more body regions would be helpful. Program-specific suggestions were directed toward Incredible Hulk, where participants felt that more opportunities for interaction might engender a stronger response:

“Maybe have like a bunch of blocks or something that you need to break through ... not an empty room” (P01).

**How I’d use it.** Several participants thought that an increase in pain intensity would provide indication for initiating VR use. Alternatively, others suggested that routine use, or use ahead of function would be beneficial:

“[Do] it for a certain amount of time, and then use the time afterwards to do something productive” (P16).

Irrespective of these approaches, most participants stressed the need for regular use and suggested that a twice daily to weekly dose of 10 to 30 minutes was reasonable to start with. It was anticipated that the time, intensity, or position of use would be gradually progressed in a graded fashion. Such frequent use and/or use in immediate response to pain changes meant that all participants who favored further VR use thought that home access would be essential:

“If I’m [at the research site] to do it and then I have to drive back, and then my back’s sore before I get home. But if I do it at home I’d be happy” (P04).

Most participants recognized that the cost of a VR system might provide a substantial barrier to such use. However, participants were hopeful that government subsidy, rental schemes or future price reduction might enable access:

“The technology’s moving along ... prices are coming down. That should make it available to more people” (P14).

**Discussion**

This study sought to explore the experiences of people with CLBP undertaking a novel VR intervention aimed at altering body image and reducing pain. Notably, the study was conducted in a tertiary pain clinic setting, and as expected participants typically reported severe pain and disability. This is important to note, as this makes engaging with tasks that involve (often painful) movement inherently more difficult. Moreover, pain can occupy cognitive resources and make engaging with new technology more challenging. With this in mind, the findings nonetheless indicated that participants welcomed new therapeutic innovations, and considered VR-BiT to be an acceptable, tolerable and beneficial therapy that was worthy of further development and use.

While all interviewed participants described some benefit of VR-BiT, variability in the described nature and strength of these benefits was notable. For example, many participants reported experiencing pain control during the intervention. However, a few participants described an increase in such symptoms or a latent-
onset pain in other body regions. Reductions in pain were frequently explained as having resulted from distraction, a mechanism that is widely acknowledged in relation to VR management of acute pain (Gupta, Scott, and Dukewich, 2018; Mallari, Spaeth, Goh, and Boyd, 2019; Spiegel, 2018). Notably, some increase in pain was reported by other participants. Given participants in the current study had generally severe pain and disability, these cases were likely due to unaccustomed movement. Other studies using VR for CLBP have also suggested that cases of increase in symptoms also occurred as a result of unaccustomed movement (Thomas et al., 2016) and future studies might consider introducing VR-BiT more gradually in some participants. Further, some participants were able to rapidly identify VR activities which had aggravated their symptoms, indicating that the opportunity for consumers to briefly trial and choose from a range of programs before proceeding may be of benefit. Results from a systematic review of VR interventions for reducing pain, as well as a recent case-study of VR-BiT provide further support to this personalized multi-session approach (Harvie et al., 2020; Mallari, Spaeth, Goh, and Boyd, 2019).

Regarding altered physical self-efficacy, participants who expressed strong changes in this domain frequently demonstrated a thorough conceptual understanding of the intervention. Thus, it may be that more effective education on VR-BiT purpose and underlying mechanisms prior to commencement may enhance this benefit. That said, many participants expressed using VR-BiT for a purpose that was different to the RCT’s intention. For example, participants saw value in using the intervention to facilitate physical activity or relieve psychological symptoms. Given management strategies that target these domains are part of best practice care for individuals with CLBP (National Institute for Health and Care Excellence, 2021) it may be that VR-BiT has broader application than expected. Nonetheless, such heterogeneity in perception of the intervention may reflect underlying differences in treatment preferences and expectations. Indeed, the ability to personalize VR interventions to accommodate such preferences was recommended by participants in the current, as well as a past study (Kraus, Geng, Fæster, and Nielsen, 2018) and have been called for in recent literature on the topic (Ahmadpour et al., 2019; Spiegel, 2018).

Except for the aforementioned pain increases, VR-BiT was generally well tolerated. Only two participants (12%) reported experiencing any symptoms of simulation sickness. A recent review of VR interventions for relieving acute-pain during medical procedures indicated that simulation sickness is usually mild and infrequent (Indovina et al., 2018). However, reports from chronic pain populations have indicated more variation (Edwards et al., 2004; Garrett, Taverner, and McDade, 2017; Jones, Moore, and Choo, 2016; Kraus, Geng, Fæster, and Nielsen, 2018). The mechanism of such symptoms likely relates to an imperfect matching of real and virtual motion, which creates sensorimotor conflict and induces feelings of sickness (Birckhead et al., 2019; Bruck and Watters, 2009). Advancements in technology mean that the VR system we used likely had greater fidelity and capacity to minimize sensorimotor conflict compared with those from earlier studies. Moreover, brevity of time spent in VR minimizing exposure and past experience of VR by seven (41%) of the interviewed participants, may also explain such high tolerability (Birckhead et al., 2019; Porcino et al., 2017).

Despite some technical issues with operation, participants in the current study expressed positive feelings toward VR-BiT and were motivated to use the intervention further. The presence of technical and complexity barriers appears common in VR intervention studies (Bakker, Janssen, and Noordam, 2018; Garrett, Taverner, and McDade, 2017; Indovina et al., 2018). Moreover, participants were naïve to virtual reality, with 12 participants never experiencing virtual reality and 5 having only passing experience. As such, repeated sessions might diminish the perceptions of complexity. Nonetheless, reports suggest that consumers trying VR interventions to manage chronic pain frequently perceive such treatment as useful and satisfying and are motivated for further and more extended use (Garcia-Palacios et al., 2015; Jones, Moore, and Choo, 2016; Thomas et al., 2016). The expressed desire to continue using VR-BiT seems critical given variable compliance with other active management strategies for CLBP (Friedrich et al., 1998; Härkäpää et al., 1991; Kolt and McEvoy, 2003; Mailloux, Finno, and Rainville, 2006). According to participant recommendations, ensuring novelty or variety in experience, providing a suite of VR activities that enable individuals to choose those that are personally meaningful and relatable, and maximizing opportunities for movement-centric interaction should be adopted to augment and maintain such motivation.

This study addresses the paucity of literature relating to consumer experiences of chronic pain-related VR interventions, using recommended methods (Birckhead et al., 2019). Moreover, it adds depth of understanding to
the findings of past studies reliant on brief survey or questionnaire methods (Garcia-Palacios et al., 2015; Thomas et al., 2016). However, several limitations must be acknowledged. First, as noted VR should not be considered an intervention, but rather an intervention delivery tool. As such, our findings have limited generalizability to other VR-interventions. Secondly, the findings of this study cannot be used to support efficacy, and instead should be used to inform further development and investigation of VR-BiT and similar approaches. Thirdly, the high severity of pain and prevalence of past surgical or medical intervention of the included participants, mean that the experiences of populations with less severe symptoms may be different to those presented in this study. Finally, further exploration in relation to feasibility considerations is needed given the single-session nature of the VR-BiT intervention, participant trial of VR-BiT in the clinical setting (and not the home, where it may be used), and the omission of feedback from clinicians delivering the intervention.

Conclusions

Based on a single session experience, the findings of this study demonstrate strong consumer support for future use of VR-BiT in the management of severe, disabling CLBP. Participants indicated that the intervention was acceptable and tolerable, and had benefitted them, including effects beyond changes in body image and pain outcomes anticipated by the associated RCT (Harvie et al., 2022). As such, we recommend further development and evaluation of VR-BiT as an adjunct treatment for people with CLBP. Heterogeneity in experience suggests that the ability to accommodate individual user preferences and movement tolerances should be built into future VR applications and/or intervention designs to maximize consumer motivation and perceived clinical benefit. Further, investigation of health care professionals’ perceptions of providing VR-BiT in the clinical setting, as well as consumer experiences of use in the home setting, are needed.

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