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## Mixed-method feasibility outcomes for a novel ACT-based videogame 'ACTing Minds' to support mental health

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3 **Mixed-method feasibility outcomes for a novel ACT-based videogame**  
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6 **‘ACTing Minds’ to support mental health**  
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58 Short title: Feasibility outcomes ACTing Minds  
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## Abstract

**Objectives:** To determine the feasibility and acceptability of ‘ACTing Minds’, a novel single-player adventure videogame based on acceptance and commitment therapy (ACT).

**Design:** A single arm, mixed-methods repeated measures feasibility study.

**Setting:** Intervention and questionnaires were completed at home by participants. Semi-structured interviews were also conducted at home via the Zoom platform.

**Participants:** Thirty-six participants were recruited into the study, 29 completed all phases of the feasibility design. Eligibility criteria required participants to be over the age of 18 and self-reporting experiencing ongoing depression, anxiety, or stress.

**Intervention:** Participants completed a single session of the ‘ACTing Minds’ videogame, lasting approximately 1-hour, designed to educate users on key principles from acceptance and commitment therapy (ACT).

**Primary outcome measures:** Participant recruitment and retention, questionnaire completion, long-term intervention adherence, and acceptability of the intervention. Reflexive thematic analysis was conducted on semi-structured interviews run immediately postintervention and 3-weeks later.

**Secondary outcome measures:** Measures of depression, anxiety, stress, psychological flexibility, social connectedness, and wellbeing were assessed at baseline, immediately following intervention completion, and at a 3-week follow-up period. Using a standardised battery of questionnaires.

**Primary results:** Twenty-nine participants completed the study. A reflexive thematic analysis indicated that participants responded positively to the intervention and the study at all stages. Themes reflect participants’ desire for an engaging therapeutic experience, use of

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2  
3 game for exploring emotions, as well as their perspectives on how they had applied their  
4  
5 learning to the real-world.  
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7

8 **Secondary results:** Quantitative results indicated small to large effect sizes associated with  
9  
10 decreases in depression ( $\eta^2 = .011$ ), anxiety ( $\eta^2 = .096$ ), stress ( $\eta^2 = .108$ ), and increases  
11  
12 in psychological flexibility ( $\eta^2 = .060$ ), social connectedness ( $\eta^2 = .021$ ), well-being ( $\eta^2$   
13  
14  $=.011$ ), and participation in usual activities ( $\eta^2 = .307$ ).  
15  
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17  
18 **Conclusions:** Implementation of the 'ACTing Minds' intervention is warranted, based on  
19  
20 both qualitative and quantitative outcomes.  
21  
22

23 **Trial Registration number** NCT04566042  
24  
25

### 26 27 **Strengths and limitations off this study** 28 29

- 30 • Mixed methods approach, combining thematic analysis of interviews and quantitative  
31  
32 questionnaires.  
33
- 34 • Collection of quantitative data at three time points and qualitative at two time points,  
35  
36 allowing the process of change and identification of patterns to be examined.  
37  
38
- 39 • Remote data collection due to COVID restrictions meant that participants could not be  
40  
41 directly observed while completing the intervention. We were also unable to record  
42  
43 planned psychophysiological measurements of wellbeing such as heart rate  
44  
45 variability.  
46  
47
- 48 • Reliance on self-report measures introduces the potential for bias.  
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### 55 **Introduction** 56

57 Global prevalence of common mental disorders and a lack of available resources for  
58  
59 identification and treatment of those with such conditions underpins an increasing burden on  
60

1  
2  
3 society (1). The Global Burden of Disease study conducted in 2017, reported a UK  
4 prevalence rate of 4.12% for depression, and 4.65% for anxiety disorders (2). Since this  
5 estimation, events such as the Covid-19 pandemic and the increasing threat of climate crises  
6 have had substantial impact on societal wellbeing, a meta-analysis including 14 studies  
7 (n=46,158) found that 32% of adults in the UK experience moderate to severe depressive  
8 symptoms in 2022, and 31% of adults reported high levels of anxiety (3), indicating a societal  
9 increase of 27.88% for depression, and 26.35% increase for anxiety. These findings require a  
10 shift toward population wide strategies focused on building resilience at scale.  
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22 In order to positively impact on societal wellbeing, it is imperative that contemporary  
23 interventions are affordable and widely accessible. Presently, the demand for mental health  
24 services exceeds the available human resources required to meet this need. A study conducted  
25 for the Centre for Mental Health estimated that services cost the UK economy approximately  
26 £105 billion per year in 2020, 4.8% of the UK's annual GDP (4). Despite significant funding  
27 of £34 billion to public mental health support and services, prevalence of psychological  
28 disorders is high and only 33% of adults with depression and anxiety receive treatment in  
29 England (5), highlighting an urgent need for innovation.  
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41 There are numerous barriers to accessing psychological interventions, including shortage of  
42 therapists, long waiting times, and societal stigma of accessing psychological treatment (6). A  
43 potential solution to these issues might be found in digital health interventions (DHI's). We  
44 live in an age of heavy digital media consumption, especially in the West in which at least  
45 90% of UK adults use the internet regularly (7). We also know that during the COVID-19  
46 pandemic, there were significant increases in online video consumption, social media usage,  
47 remote work, online news consumption, and video-gaming (8). COVID-19 contributed to  
48 significant social isolation and further disconnection from nature further contributing to  
49 increases in mental health conditions (9). We argue that that there is an opportunity to utilise  
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3 the advancements in and to harness increased use of technology to develop psycho-  
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5 educational tools necessary to support mental health at scale.  
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8 DHI's have already been utilised in a variety of contexts for promoting wellbeing, from  
9  
10 delivering healthcare and education to personalised diet and fitness plans. Mobile apps and  
11  
12 online platforms offer guided meditation, breathing exercises, sleep tracking, and relaxation  
13  
14 programs. Such applications aim to enhance overall wellbeing, reduce stress, improve sleep  
15  
16 quality, and cultivate mindfulness practices (10). However, we suggest that effectively  
17  
18 addressing wellbeing at a population level will require development of DHIs that considers  
19  
20 acceptability, feasibility and widespread appeal.  
21  
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23

24  
25 Compared with alternative forms of media, videogame DHI's offer a number of advantages.  
26  
27 By design they are interactive, applying behavioural principles for controlling and modifying  
28  
29 behaviour (11), and as a result they are uniquely engaging. In the UK, the COVID-19  
30  
31 pandemic led to a substantial increase in the number of people playing videogames, with  
32  
33 males increasing use from 46% to 63% and females increase their use from 32% to 56% in  
34  
35 2022 (12). Innovations in the use of video games for treating mental health issues have wide  
36  
37 potential application, potentially offering a platform for individuals to explore and regulate  
38  
39 their emotions in a controlled and supportive environment. In theory, by practicing emotional  
40  
41 control within the game context, individuals can transfer these skills to real-life situations to  
42  
43 better manage stress, anxiety, and mood disorders. Certain games specifically designed for  
44  
45 therapeutic purposes, such as 'SPARX' for depression (13) or 'Elude' for anxiety (14), guide  
46  
47 players through interactive challenges and cognitive exercises for developing emotional  
48  
49 regulation skills. Videogames are also being used in clinical settings to promote wellbeing  
50  
51 outcomes. One game designed for this purpose, 'Dojo' (15), aims to treat anxiety by training  
52  
53 users in breathing techniques, muscle relaxation, positive thinking, and guided imagery,  
54  
55 utilising heart-rate variability (HRV) biofeedback. However, when compared against a  
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3 standard commercial game 'Rayman 2' (control condition), a full pre-post RCT (n=1347)  
4  
5 found that playing either game significantly reduced participant anxiety, but no differences  
6  
7 were observed between 'Dojo' and the control condition in their ability to reduce anxiety.  
8  
9 Reasoning for this might be that 'Dojo' failed to develop the psychoeducational skills in the  
10  
11 participants of which it aimed to impart, or that both games only reduced anxiety by means of  
12  
13 distracting participants from anxiety provoking thoughts (16). The researchers concluded that  
14  
15 'Dojo' had crucial design issues that need to be addressed, including a clear theoretical and  
16  
17 therapeutic framework, and that research assessing the real-world effectiveness of  
18  
19 videogames in the treatment of mental health issues requires appropriate methodology for  
20  
21 understanding the causes of improvement.  
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26  
27 A study aiming to explore the well-being effects of playing video games on gamers during  
28  
29 the Covid-19 pandemic (n=781) found that time spent playing had significantly increased in  
30  
31 71% of participants, and 58% of participants reported that playing games had positively  
32  
33 impacted on their wellbeing (17). The researchers conducted an online survey including  
34  
35 closed and open-ended questions, then conducted a thematic analysis in order to identify the  
36  
37 causes of positive improvement. Themes of escape, cognitive stimulation, stress relief,  
38  
39 agency, and socialisation were most associated with feelings that playing videogames had  
40  
41 increased wellbeing. The development of an effective DHI videogame should take such  
42  
43 factors into consideration whilst also building on strong theoretical and therapeutic  
44  
45 foundations that facilitate the uptake of such tools.  
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50  
51 The 'ACTing Minds' videogame, developed in line with our protocol intervention (16), was  
52  
53 designed to be a comprehensive transdiagnostic intervention that will integrate lessons from  
54  
55 acceptance and commitment therapy (ACT) (18). ACT is a third wave behavioural therapy,  
56  
57 which prioritise the holistic promotion of psychological and behavioural processes associated  
58  
59 with health and wellbeing, rather than focusing on the elimination of negative mental health  
60

1  
2  
3 symptoms (19). More specifically, an ACT based DHI videogame will be a comprehensive  
4 approach for managing common mental health issues such as depression and anxiety by  
5  
6 developing explicit psychoeducational skills that promote psychological flexibility,  
7  
8 wellbeing, and resilience. As a consequence, our videogame may have greater reach and  
9  
10 impact than other videogame DHI's not based on third wave psychotherapy, such as 'Dojo',  
11  
12 which primarily aims to teach skills for emotional regulation and symptom reduction.  
13  
14  
15

16  
17 The ACT framework is well-suited for integration into videogame development because it  
18 does not necessitate formal clinical training or accreditation in order to be applied effectively  
19  
20 (20), and resources for education and practice are freely available through the Association of  
21  
22 Contextual Behavioural Science website<sup>1</sup>. A review of 20 meta-analyses, involving 133  
23  
24 studies (n=12,477) found that ACT was efficacious for treating anxiety, depression, chronic  
25  
26 pain, substance use, eating disorders, and for improving quality of life. The results also  
27  
28 showed that ACT was generally superior to most active intervention conditions (excluding  
29  
30 CBT), treatment as usual, and inactive controls (21). ACT has also been effectively  
31  
32 implemented in DHI's in the form of mobile phone applications, which are shown to be  
33  
34 effective in promoting psychological flexibility (22) and reducing smoking intake(23).  
35  
36 Considering this, we believe that choosing ACT as the basis for our game will allow us to  
37  
38 harness the advantages of third-wave therapies as transdiagnostic therapeutic tools and  
39  
40 integrate these with those of videogames, and if made well, will be engaging, educational,  
41  
42 and capable of promoting wellbeing at scale.  
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50 ACT aims to decrease suffering and increase wellbeing through six core processes of change  
51  
52 (24). These are: (1) present moment awareness: the practice of being in the here and now; (2)  
53  
54 acceptance: the practice of being open to the range of human emotional experience, as  
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60 <sup>1</sup> See Association of Contextual Behavioural Science Website: <https://contextualscience.org/>

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2  
3 opposed to experiential avoidance; (3) Defusion: the act of recognising the self as separate  
4 from thoughts, and not interpreting them literally; (4) values: identifying ones' personal  
5 values in contrast to perceived expectations, of which drive us toward self-direction and  
6 purpose; (5) action: a commitment to ones' personal values, facilitating the development of  
7 competence through the act of continual practice of alignment with values (25); (6) self as  
8 context: developing an awareness of self that is more than a conceptualised sense of self, one  
9 that is flexible and facilitates a sense of connection with others.

10  
11  
12 Based on our initial protocol (16)<sup>2</sup>, the ACT-based videogame called 'ACTing Mind', has  
13 been developed as a psychoeducational tool that teaches users the core processes of ACT  
14 through embedded learning. The goal of this research will be to determine the acceptability  
15 and feasibility of 'ACTing Minds' for reducing mental distress. The game teaches skills  
16 based around the ACT principles of acceptance, defusion, and commitment to values. This  
17 will be a feasibility study, following the Medical Research Council (MRC) framework (26),  
18 laying the foundation for a full-scale RCT on which clinical effectiveness will be determined.

19  
20  
21 There have been several changes made to our originally published protocol (16), it was  
22 initially stated that participants would complete five weekly 1-hour sessions where they  
23 would play through six parts of the 'ACTing Minds' videogame, each one focusing on a  
24 different process of ACT. However, because of funding restrictions, 'ACTing Minds' has  
25 been compressed into a single game focusing on the ACT principles of acceptance,  
26 commitment to values, and defusion. Therefore, in this feasibility study participants will be  
27 required to complete a single 1-hour session of 'ACTing Minds'. This meant a significant  
28 change to the overall time to complete the study protocol. Originally it was expected to take 3  
29 months between baseline measurements and the final follow-up. Now, one-on-one semi-

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<sup>2</sup> See Supplementary 1 for Protocol Paper

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3 structured interviews will be conducted immediately postintervention, and after a 3-week  
4  
5 follow-up. The research questions are as follows: Is the intervention acceptable and feasible  
6  
7 for a full-scale RCT? Is there early evidence for effectiveness in reducing mental distress?  
8  
9 Are there any changes in self-reported wellbeing measures following completion of the  
10  
11 game? Are participants able to learn ACT principles and apply them in day-to-day life?  
12  
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14

## 15 **Methodology**

### 16 **Design:**

17  
18 This is a single arm, mixed-method repeated measures study, designed to determine the  
19  
20 feasibility and acceptability of an ACT-based video game called ‘ACTing Minds’ that has  
21  
22 been designed for individuals reporting mild to moderate anxiety, depression and stress. Data  
23  
24 was collected at baseline, immediately post-intervention, and 3-weeks post-intervention Data  
25  
26 was collected between November 1<sup>st</sup> and December 31<sup>st</sup>, 2022.  
27  
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### 33 **Study Setting:**

34  
35 The study was conducted entirely online by participants, including intervention (via a  
36  
37 working prototype of the app; <https://shorturl.at/iqFGI>), quantitative assessment (via the  
38  
39 Qualtrics platform), and qualitative interviews (via the Zoom platform). Strict  
40  
41 recommendations were given to participants to ensure they are in a quiet room and without  
42  
43 disruption for all study components.  
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45  
46  
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### 48 **Participants:**

49  
50 Thirty-six participants were recruited, 29 of which completed all phases of the study.  
51  
52 Participants were recruited using purposive sampling methods, focused on recruiting  
53  
54 participants at least 18 years of age, those who self-reported ongoing experience of mild to  
55  
56 moderate depression, anxiety, or stress within their day-to-day life, as well as those able to  
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2  
3 read, write and speak English. Sample size was justified on the basis of past research  
4 reporting the median numbers of participants recruited for similar feasibility studies,  
5 incorporating both quantitative and qualitative elements (27). Advertisements were posted at  
6 Swansea university and on social media pages. Participants were recruited between October  
7 1<sup>st</sup> and December 1<sup>st</sup>, 2022, they completed a consent form<sup>3</sup> after reading the study  
8 information sheet<sup>4</sup>, and were given a debrief sheet<sup>5</sup> following completion of the study, each  
9 of which are included as supplementary materials.  
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### 20 **Primary outcome measures:**

21  
22 Feasibility outcomes were determined using the MRC framework (26) and reported in line  
23 with CONSORT guidelines (28)<sup>6</sup>. Feasibility measures included data relating to participant  
24 recruitment and retention including number of participants willing to take part, and  
25 completing each stage of the study (i.e., intervention, questionnaires, interviews, and follow-  
26 up), as well as acceptability, assessed through thematic analysis of semi-structured interviews  
27 conducted immediately post-intervention and 3-weeks post-intervention, with interview  
28 question topics including but not limited to: barriers for adoption of the intervention; ACT  
29 adherence in daily life; participants experience with the intervention; and whether they would  
30 be willing to complete further acts of ‘ACTing Minds’ once they have been developed and  
31 released.  
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### 47 **Secondary outcome measures:**

48  
49 Questionnaires were distributed at three points in time (baseline, immediate postintervention  
50 and 3-month follow-up). A rule was created in Qualtrics requiring participants to complete  
51  
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53  
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57 <sup>3</sup> See Supplementary 2 for Participant Information Sheet

58 <sup>4</sup> See Supplementary 3 for Consent Form

59 <sup>5</sup> See Supplementary 4 for Debrief Form

60 <sup>6</sup> See Supplementary 5 for CONSORT Checklist

1  
2  
3 every questionnaire item in order to finish the survey which included the following  
4  
5 questionnaires:  
6

7  
8 Depression Anxiety Stress Scales (DASS-21): a measure of general psychological distress  
9  
10 with good construct validity (confirmatory factor analysis of 0.94), that can be broken down  
11  
12 into subscales relating to stress, anxiety, and depression. It has good internal reliability as  
13  
14 measured through Cronbach's alpha coefficients, which are 0.88 for depression, 0.82 for  
15  
16 anxiety, 0.90 for stress, and 0.93 for the total scale (29).  
17  
18  
19

20  
21 Acceptance and Action Questionnaire-second version (AAQ-II): a questionnaire of seven  
22  
23 items, assessing psychological inflexibility by gauging one's capacity to embrace and remain  
24  
25 receptive to challenging thoughts and emotions, while also actively participating in  
26  
27 meaningful actions despite their presence. A higher score indicates higher psychological  
28  
29 inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of  
30  
31 0.84 (30).  
32  
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35  
36 Social connectedness (adapted from Russell's (1996) UCLA Loneliness Scale (31): this  
37  
38 measure involves two questions: (1) "During social interactions, I feel 'in tune' with the  
39  
40 person/s around me", and (2) "During social interactions, I feel close to the person/s". The  
41  
42 Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98 (M=0.94,  
43  
44 SD=0.03) (32).  
45  
46  
47

48  
49 Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): a metric that emphasises the  
50  
51 positive facets of mental health, aiming to evaluate overall psychological well-being. This  
52  
53 measure has good internal consistency with a Cronbach's alpha coefficient of 0.89 (student  
54  
55 sample) and 0.91 (general population sample) (33).  
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3 EuroQol five dimensions (EQ5D) (34): a measure for health-related quality of life. There are  
4  
5 five components within this measure which assess mobility, self-care, usual activities, pain,  
6  
7 discomfort, anxiety, and a visual analogue scale for measuring current health status.  
8  
9

### 10 **Intervention:**

11  
12  
13 The intervention comprised of an ACT-based video game intervention called ‘ACTing  
14  
15 Minds’, developed and designed by author DJE. Participants attended a single session lasting  
16  
17 approximately 1-hour, during which they completed four in-game chapters.  
18  
19

20  
21 The intervention teaches three core principles pertaining to ACT through embedded learning,  
22  
23 meaning that the player will gain ACT-based skills while completing in-game objectives,  
24  
25 without being directly teaching those skills. These skills include ‘Acceptance’, ‘Cognitive  
26  
27 Defusion’, and ‘Commitment to Values’. Embedded learning refers to the incorporation of  
28  
29 educational elements into the gameplay itself, in contrast to explicit lessons. In this context, it  
30  
31 involves designing the game in a way that promotes positive health-related behaviours  
32  
33 derived from ACT, such that adoption of ACT processes by participants results in positive  
34  
35 long-term quality of life changes. In 'ACTing Minds,' an example of embedded learning is the  
36  
37 'Psychoflexameter' (see Figure 1A), which serves as a gamified version of the Hexaflex (see  
38  
39 Figure 1B), a model used in ACT to illustrate both the theory and goals for clinical change  
40  
41 (36). Similar to the Hexaflex, the 'Psychoflexameter' showcases the 6 core processes of ACT.  
42  
43 Initially introduced to players during the first ACT-oriented activity in the game, which  
44  
45 emphasises acceptance, the ‘Psychoflexameter’ remains visible in the corner of the screen  
46  
47 throughout the game while players engage in other ACT-related activities. As players exhibit  
48  
49 ACT-consistent behaviours, they earn points and gradually increase the dial on the centre of  
50  
51 the 'Psychoflexameter.', and the text reflecting the ACT process improved lights up green<sup>7</sup>. If  
52  
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60 <sup>7</sup> See Supplementary 6 for in-game screenshot illustration

1  
2  
3 players exhibit ACT-inconsistent behaviours, they lose points and the ‘Psychoflexameter’  
4  
5 lights up red<sup>8</sup>.  
6  
7

8 -----**Figure 1 Here**-----  
9

10  
11 The game starts with a text-based chapter, telling the story of a depressed individual, ‘Steve’,  
12  
13 who has recently lost his wife in an accident, he is feeling depressed, isolated, and lonely.

14  
15 The character has built a ‘mind escape machine’ with the intention of entering his own mind  
16  
17 in order to destroy and suppress his unwanted painful thoughts and memories. The player  
18  
19 takes control of ‘Steve’ in chapter two, where they see him in a state of mental distress in his  
20  
21 home, surrounded by items that are reminders of his lost wife. At this stage participants will  
22  
23 learn how to control the character using an onscreen directional stick and interact with the  
24  
25 environment by touching key elements with their finger.  
26  
27  
28

29  
30 Participants engaged with ACT content within chapters three and four, which begin with the  
31  
32 character entering his mind, walking around and viewing representations of his memories.

33  
34 Chapter three focuses on ‘Acceptance’, introducing players to a bar in the centre of the screen  
35  
36 indicating the characters’ present level of distress, as well as the ‘Psychoflexameter’ dial in  
37  
38 the corner of the screen, indicating the characters’ psychological flexibility. While in the  
39  
40 mind of the character, the player is able to approach memories of ‘Steve’ and his wife, which  
41  
42 leads to an increase in present distress and allows the option to destroy the memories.  
43  
44

45  
46 Destroying memories decreases present distress, but also removes points from the  
47  
48 ‘Psychoflexameter’. If the player chooses to destroy the memories (avoidance-based  
49  
50 strategies), the world becomes increasingly distorted, and barriers form making the chapter  
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<sup>8</sup> See Supplementary 7 for in-game screenshot illustration



1  
2  
3 impossible to complete. Alternatively, if the player chooses acceptance-based strategies they  
4  
5 can continue the game and learn that acceptance is functionally better than avoidance<sup>9</sup>.  
6  
7

8 Chapter four focuses on rewarding ‘Commitment to Values’ and ‘Cognitive Defusion’. The  
9  
10 player is still in the mind of the character, where they are then asked to reflect on their values,  
11  
12 to type them out and make them explicit<sup>10</sup>. Following this, they complete a ‘leaves on a  
13  
14 stream’ task, requiring them to type out any negative thoughts that they might have and place  
15  
16 them on a leaf, watching them as they float downstream (see Figure 1C). Both tasks reward  
17  
18 the player by decreasing present distress and increasing their score on the  
19  
20 ‘Psychoflexameter’.  
21  
22  
23  
24

### 25 **Qualitative analysis:**

26  
27  
28 Here we employed a critical realist ontological framework to interrogate the underlying  
29  
30 nature of the phenomena under study. Concurrently, a contextualist epistemological stance  
31  
32 was adopted to facilitate a nuanced understanding of knowledge construction. These  
33  
34 philosophical underpinnings guided the application of reflexive thematic analysis, serving as  
35  
36 a methodological lens for identifying and interpreting emergent themes within the data. The  
37  
38 analytical process commenced with an inductive mode of inquiry, allowing for data-driven  
39  
40 insights to emerge organically. As the analysis progressed, there was a methodological pivot  
41  
42 towards a more deductive approach, guided by pre-existing theoretical frameworks. The  
43  
44 coding schema evolved correspondingly, transitioning from a focus on explicit, semantic  
45  
46 content to an exploration of underlying, latent themes. Two semi-structured interviews (post-  
47  
48 intervention, and 3-week follow-up) formed the foundation for two sequential thematic  
49  
50 analyses, following the guidelines outlined by Braun and Clarke (35). Both interviews were  
51  
52 analysed separately to gain an understanding of differences in participant perceptions of the  
53  
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59 <sup>9</sup> See Supplementary 8 for in-game screenshot illustration

60 <sup>10</sup> See Supplementary 9 for in-game screenshot illustration

1  
2  
3 intervention and relevant outcomes over time. For reporting on the acceptability of the  
4  
5 ‘ACTing Minds’ intervention, findings and themes from both interviews are summarised in  
6  
7 the primary outcomes section of the paper (see Table 1).  
8  
9

10 Interview data were transcribed using Microsoft’s automated audio-to-text software, which  
11  
12 was then double checked and edited to correct for major spelling or grammatical errors.  
13  
14

15 Throughout the data familiarisation phase, multiple points of potential analytical interest were  
16  
17 identified within both interview sets. In the coding phase, several hundred codes were  
18  
19 initially produced, which were then clustered to make them more manageable and categorised  
20  
21 into potential broad patterns of meaning. For the analysis of the first interview set these  
22  
23 included: emotional experience; wellbeing needs, perceptions on mental-health education  
24  
25 within the game; and participant engagement. For the second set of interviews these were:  
26  
27 application of the games’ lessons, perceptions on what was learned, desire for growth, and  
28  
29 sense of development.  
30  
31  
32

33  
34 Themes were then refined in the context of our research questions relating to how the  
35  
36 participants experienced ‘ACTing Minds’, which involved a review of preliminary themes in  
37  
38 relation to the codes, the coded data, and the full dataset. We became most interested in the  
39  
40 latent ideas underpinning statements relating to how participants utilised the game as a  
41  
42 psychoeducational tool. The preliminary theme ‘emotional experience’ was developed, as it  
43  
44 was interpreted from the codes that participants were using the game as a ‘base for exploring  
45  
46 emotions.’ From there many of the remaining codes fell easier into place, allowing for further  
47  
48 development of themes that emphasise the processes involved in participant engagement,  
49  
50 personal therapeutic goals, and feelings regarding the games’ embedded learning features.  
51  
52

53 Themes developed from the second interview codes tended to reflect the participant outcomes  
54  
55 since playing ‘ACTing Minds’, allowing for exploration of specific vectors of growth, how  
56  
57  
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the participants applied their takeaways from the game in the weeks following playing, and what they felt they had learned as a consequence of applying those takeaways in real-life.

**Table 1.**

Themes and subthemes taken from thematic analysis for interviews 1 and 2.

Interview 1 (Immediate postintervention)	Interview 2 (3-weeks postintervention)
Theme 1: Desire for an engaging therapeutic experience	Theme 6: Utility in the real world
Theme 2: Personal process of immersion	Theme 7: Practice facilitates wellbeing
Theme 3: Game as a base for exploring emotions	Theme 8: Closer to the self
Theme 4: Embedded learning pros and cons	
Theme 5: Necessary learning for anyone	

### Quantitative analysis

A repeated measures ANOVA was performed using IBM SPSS Statistics 29 (the most up-to-date version at the time of analysis), to compare the effects of playing the ‘ACTing Minds’ videogame on scores taken from the questionnaires DASS-21, AAQ-II Psychological flexibility questionnaire, Warwick-Edinburgh Mental Well-Being Scale, Social connectedness score, and EuroQol five dimensions.

Descriptive statistics and corresponding effect sizes were used to summarise secondary outcome measures (see Table 2). Changes in scores from baseline are reported for each of the measurement timepoints. Partial eta squared ( $\eta^2$ ) effect sizes were calculated for each independent variable and interpretation was informed by prior literature on the topic (36).

Values 0.14 or higher were interpreted to be a large effect, 0.06 – 0.14 were interpreted to be a moderate effect, and 0.01 – 0.06 were interpreted to be a small effect.

## Results

### Primary outcome measures

#### Participant recruitment and retention (feasibility)

Thirty-six participants were recruited through the initial study advertisement between October 1<sup>st</sup> and December 1<sup>st</sup>, all of which met eligibility criteria. Six participants did not show up for initial baseline measures, while 1 participant did not follow through with the intervention (see Figure 2).

-----**Figure 2 Here**-----

#### Participant feedback (acceptability)

Acceptability measures were assessed through thematic analysis of semi-structured interviews, taken place immediately postintervention and at a 3-week follow-up. The interviews were analysed separately in order to understand participant perceptions before and after applying lessons learned from the game to their everyday lives. The results from both have been summarised and reported together as key themes.

#### Theme 1: Desire for an engaging therapeutic experience

Participants regularly expressed interest in the novelty and potential utility of digital mental health applications, more specifically in a gamified context. Overall, they felt that a videogame platform provided a uniquely stimulating means of engaging with mental health learning. This contrasts with feelings expressed towards more typically used wellbeing applications, which were considered to have potential benefit but are regularly seen as a chore. Participants suggested that psychoeducational tools like ‘ACTing minds’ may be able to function as an alternative, or at least as an adjunct to therapy.

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2  
3 *“I don't really think I've ever played a game that's based on emotions [...] as a gamer I don't*  
4 *really do all these other things, like writing in books or doing all this other stuff, but like*  
5 *playing a game that's based on that for your mental health thing is really good because you*  
6 *can actually like do something therapeutical in the things that I like doing.” -P06.*  
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13 This quote comes from a participant who identifies as a gamer, with little experience or prior  
14 interest in mental-health learning. There is a sense that this relates to the participant having  
15 no exposure to such education within their real-life, and that there is an underlying desire for  
16 personal growth if it were to be made more comfortably accessible.  
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23 *“I'm not one to sit down and just watch a video and then put that in practise. I'm someone*  
24 *who actually needs to be involved in something and interact with it and course work just*  
25 *reminds me too much of school [...] with games it makes me sit, actually interact because I'm*  
26 *enjoying the game at the same time. It's not just that I need to focus on my mental health. I*  
27 *get to play a cool game while learning about my mental health. So yeah, I like I like video*  
28 *games with mental health stuff.” -P08*  
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37 This quotation contrasts with the first in that the participant is not a gamer but has substantial  
38 experience with mental health learning and therapy. Despite this, they express the same  
39 desire for more engaging therapeutic experiences. The participant expresses an aversion to  
40 learning in a way that feels like school, which may reflect their poor experiences with  
41 traditional therapies like CBT. Another idea expressed is that playing a mental health game  
42 removes feelings of seriousness, or that it must be done out of necessity, facilitating a more  
43 relaxed approach to learning.  
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## 54 **Theme 2: Personal process of immersion**

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57 Responses from the semi-structured interviews painted a picture of the individual differences  
58 between participants in their ability to immerse themselves within the content of ‘ACTing  
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60

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3 Minds'. They generally expressed a prior interest in mindfulness or growth, which appeared  
4 to be a driving motivational factor for engaging with the games' activities and story. Along  
5 with this, participants had a vague awareness of the therapeutic intent behind the videogame,  
6 which was explicitly stated to motivate their engagement.  
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13 *"It plays a very good way of dealing with visual metaphor, but also the fact that you're given*  
14 *the agency to do it. When you were smashing the memories and I wish I didn't have to, but I*  
15 *have to carry on Steve's journey and I think it's a really good way of showing like yeah, these*  
16 *memories do hurt and sometimes you just have to accept the fact that it's going to hurt. Move*  
17 *on like it's explained through the visual and like narrative storytelling, and I think it's a really*  
18 *good way to do it."* -P18  
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27 This participant statement provides a window into their own process of immersion, in which  
28 from early into the game, the participant perceives a conflict between what they think is the  
29 right action (choosing not to destroy memories) versus the action they think they need to  
30 complete (destroying memories) in order for the story to progress. The participant chooses to  
31 understand this metaphorically, framing it as supporting the growth of 'Steve', but  
32 vicariously growing in the process. The requirement for participant agency in making  
33 emotionally difficult decisions for the main character 'Steve' appears to have facilitated  
34 immersion into the games' story and engagement with the lessons embedded. The participant  
35 relates to 'Steve', saying "yeah, these memories do hurt...", which likely reflects perspective  
36 taking, a cognitive process central to ACT practice, involving the ability to understand and  
37 consider another persons' experience, which is not a core focus within 'ACTing Minds' but  
38 appears to relate to the uptake of the other ACT oriented lessons.  
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56 *"It sort of grounds it back to you because it's all very well playing the game as Steve and sort*  
57 *of doing Steve's memories and things, you sort of might forget that. So it's been like a*  
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59  
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3 *learning experience, and so the sort of personalised bit at the end with like the lily pads and*  
4 *the values. I think it was quite good because then you actually were able to think about like*  
5 *the purpose of the game within your own situation.” -P10*  
6  
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9

10 This participants’ statement puts significance on the more personalised sections of the game  
11 for cementing the lessons that they might have picked up during the earlier sections. This  
12 contrasts with the prior quotation, as the participants’ process of immersion is less reliant on  
13 relating to the main character of the story, but instead centres on the tasks within the game  
14 that required them to input their own values, and their own negative thoughts.  
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### 23 **Theme 3: Game as a base for exploring emotions**

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25 Participants regularly invoked the idea that the game provided a platform that allowed them  
26 to explore their own emotions. They noted the importance of the games’ art-style and music  
27 in setting a calm environment, from which they were able to engage with the more  
28 emotionally intensive elements of the game and story. Participants reported experiencing a  
29 variety of negative emotions throughout the game, including sadness, anxiety, and grief, but  
30 also felt after playing that there would be long-term benefit to them observing and accepting  
31 those feelings.  
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42 *“I would download it if I was feeling like I really needed it at the time. Although it was*  
43 *engaging, it's not necessarily something I would just download and play for fun, like if I was*  
44 *feeling particularly depressed or unhappy or anxious or whatever. I would genuinely use it as*  
45 *a tool to sort of try and organise my thoughts and do what the game is trying to sort of*  
46 *simulate doing of getting over something and helping yourself to understand something. But*  
47 *yes, I would sort of use it as a reactionary tool, but I think that's just my own fecklessness.” -*  
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56 *P07*  
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3 The participants' statement that they would not replay the game just for enjoyment puts  
4 emphasis on the distinction between this game as a psychoeducational tool and recreational  
5 videogames. This is further highlighted in their perception of the game as simulating an  
6 experience of emotional growth and understanding. Interestingly, this participant does not  
7 suggest that they learned anything new through the program, but instead expresses a sense of  
8 value for the utility of the game as a tool for mental organisation.  
9

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17  
18 *"I think it was sad thinking about how the relationship crumbled within the story. I mean it's*  
19 *quite intense you know. As someone who is feeling those emotions crying out at the moment.*  
20 *But yeah, I think lots of those things could trigger stuff for different people. But you know,*  
21 *there's a lot to be said about if that's a bad thing."* -P02  
22  
23  
24  
25  
26

27 This quotation illustrates the intensity of negative emotion experienced by the participant  
28 during their playthrough of 'ACTing Minds'. They acknowledge that their reaction is to  
29 specific aspects of the games' story that resonate with them personally, and that others might  
30 have stronger reactions to different aspects of the game. The participant states "There's a lot  
31 to be said about if that's a bad thing", which whilst being ambiguous to whether or not the  
32 game is beneficial, seems to put responsibility on the player to engage with the games content  
33 in order to get the benefit. The game may be able to function as a base for emotional  
34 exploration, but it cannot do the exploration for the player.  
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#### 46 **Theme 4: Embedded learning pros and cons**

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49 Data from the immediate post-intervention interviews suggest a mixed response to embedded  
50 learning in 'ACTing Minds'. Many participants reported learning a variety of lessons through  
51 playing the game, most being intended in the games' design, as well as some unintended but  
52 positive takeaways. Participants generally felt positively about the embedded learning  
53 approach, expressing that allowing them to work things out for themselves provided a deeper  
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3 level of learning than being directly taught. A few however, felt that they did not learn  
4  
5 anything through playing, or that they did not feel that they could apply the lessons from the  
6  
7 game to real-life. It was noted that some participants did feel that there was vague learning,  
8  
9 but that it would be ineffective without more explicit information on the core ACT principles  
10  
11 present in the game, or how to actively apply them.  
12  
13  
14

15  
16 *“So when you hit them [memories], the like walls go up right, yeah? Honestly, like I think*  
17  
18 *that at this part of the game I was just confused. I didn't really know what I was or wasn't*  
19  
20 *supposed to do. I think after wondering a bit, I was a bit confused, like what do I do next in*  
21  
22 *the game? But I guess it was like kind of showing you that if you hit the memories, you kind of*  
23  
24 *close yourself off and that's what the walls were.” -P14*  
25  
26

27  
28 Participants often reported some confusion with completing the games' tasks. This is likely a  
29  
30 consequence of the embedded learning approach, as by design players are expected to learn  
31  
32 the ACT oriented lessons by figuring out how to progress through the game. The prior  
33  
34 quotation illustrates how despite confusion, the participant in hindsight had the ACT-  
35  
36 consistent takeaway that choosing to not accept memories closes you off to progress.  
37  
38

39  
40 *“Obviously, like for the character Steve, maybe that wasn't immediately clear when he went*  
41  
42 *in [that destroying memories made progression more difficult], so even the fact that I didn't*  
43  
44 *get that straight away and I went in destroying things, I didn't feel like I was at odds with the*  
45  
46 *game. Like after playing it for a couple of minutes like I realised. Yeah, I suppose he did too*  
47  
48 *then.” -P29*  
49  
50

51  
52 Some participants understood their confusion with the games objectives as being reflective of  
53  
54 the main characters mental state. This participant notes that whilst they experienced  
55  
56 uncertainty with whether or not to destroy memories in the acceptance section of the game  
57  
58 due to already feeling that it was a poor choice, they did still destroy memories with the belief  
59  
60

1  
2  
3 that the behaviour was important for the main characters journey. Providing further evidence  
4 of the effectiveness of perspective taking in helping participants to properly engage with the  
5 ACT lessons embedded within the game. Where other participants might have become  
6 frustrated due to being confused with the games' objectives, this participant was seemingly  
7 able to extend their empathy for Steve to their self.  
8  
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15 *"I just think that like. That's not enough for someone. I mean, they [the game designers]*  
16 *might get someone thinking about it, like it might make someone aware, but to actually like,*  
17 *maybe solidify into someone's life like you have to have kind of a discussion about it. So I*  
18 *wouldn't say they [the lessons in the game] were too abstract. I just think again for it to like*  
19 *fully land that like discussion afterward might be necessary."* -P09  
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27 This quotation is representative of a small number of the participants in this study, who felt  
28 that the game was successful in priming them to consider their own wellbeing and how they  
29 might act to improve it. But also felt that the information in the game was not thorough  
30 enough to provide them with a sense of explicit learning. This information is valuable to  
31 future development of similar interventions that might benefit from including links to further  
32 learning.  
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#### 42 **Theme 5: Necessary learning for anyone**

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45 Participants widely expressed that they were able to gain skills that they felt would be  
46 applicable to their own lives after playing 'ACTing Minds'. The ACT processes reported as  
47 being most personally relevant varied between participants. However, acceptance, defusion,  
48 and commitment to values were brought up in fairly equal proportions. Participants felt that  
49 even if they already knew the lessons being taught, that the game was effective in reaffirming  
50 those beliefs, making the wellbeing concepts more tangible, and priming them to consider  
51 wellbeing concepts more in their day-to-day lives. There was a notion across participants that  
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1  
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3 the lessons taught in the game are essential for everyone, and that further development of the  
4  
5 technology will have large societal benefit.  
6  
7

8 *“I actually learned that it's good to let your feelings go. You can't just hide from things that*  
9 *have happened or just forget they've happened. You've gotta deal with them. You've gotta find*  
10 *a way that works for you to let things go.” -P16*  
11  
12  
13  
14  
15

16 This participant felt that they struggled with holding on to negative feelings prior to playing  
17  
18 ‘ACTing Minds’. Their statement implies that they would typically respond to this problem  
19  
20 with self-distraction, but that they have realised it to be an ineffective strategy in comparison  
21  
22 to acceptance. Whilst it is uncertain whether this participant had learned how to integrate the  
23  
24 lesson of acceptance into their own life, their statement “You’ve gotta find a way that works  
25  
26 for you to let things go” illustrates their belief that there is value in such lessons for everyone.  
27  
28  
29

30 *“Some people I know struggle a lot. Because I don't really find it difficult to not hold on [to*  
31 *negative thoughts and feelings], but I know a lot of people really do fixate on something, and*  
32 *you know, they just can't get over it, but I can see it [ACTing Minds] being very useful for*  
33 *other people's day-to-day.” -P04*  
34  
35  
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40 Interestingly, despite this participant feeling that they do not find it difficult to avoid fixating  
41  
42 on negative emotions, repeats the notion that the lessons taught in ‘ACTing Minds’ are of  
43  
44 significant value to others. There is a sense that psychological wellbeing skills like  
45  
46 acceptance and defusion should be developed in everyone at some stage in their lives.  
47  
48  
49

## 50 **Theme 6: Utility in the real world**

51

52  
53 In the interview occurring 3-weeks postintervention, participants discussed how they were  
54  
55 able to apply the lessons that they took from ‘ACTing Minds’ into the real-world. Whilst a  
56  
57 few participants had not considered the game since playing or tried to actively apply lessons,  
58  
59 many found that they made a conscious effort to apply ACT principles and techniques from  
60

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2  
3 the game, or that situations in real life prompted them to consider and apply the core  
4 concepts, each of which were mentioned by participants (i.e. Acceptance; Defusion; and  
5 Commitment to Values). Some also found that they had an easier time helping others through  
6 emotional challenges by sharing what they had learned from the game.  
7  
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12  
13 *“I have noticed I’ve actively now, if I get like a negative thought in my brain. I try and*  
14 *register it and I don't hold on. But like, because sometimes before, even though I kind of*  
15 *subconsciously did it with some things, I just didn't [always], you know. But now if it's even*  
16 *something stupid like I've been lazy. I was like alright don't think about it all day. Actually go*  
17 *out for a walk. Go to the gym you know. Don't just keep in your head, I'm so lazy and*  
18 *miserable and fat. Get out to do something about it.” -P04*  
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27 This statement was given by a participant who in the immediate-postintervention interview  
28 felt that they did not have a problem with holding on to negative thoughts. Despite this, in the  
29 weeks since playing ‘ACTing Minds’, the participant found that they were more conscious of  
30 how their thoughts have impacted on their real life, and as a result has been able to apply the  
31 core ACT concepts in tandem. Their statement indicates that they were able to apply defusion  
32 lessons to negative thoughts about their self (“I’m so lazy and miserable and fat”), acceptance  
33 of their own behaviours (“I’ve been lazy”), and commitment to values in taking part in  
34 positive wellbeing activities regardless of their negative thoughts.  
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46 *“I wouldn't necessarily say I've sat there and primed those thoughts [regarding ACT*  
47 *concepts], but in like unconscious thinking, if you know like passive thought and stuff like*  
48 *that in my day-to-day, I've definitely had hints of some of those topics. Do you know what I*  
49 *mean? Like even today, I was going about my day doing my thing and you know you'll have a*  
50 *thought that'll throw you back to the past, and then you learn like I came to accept it.” -P11*  
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3 Many participants noted that even if they had not explicitly tried to apply the ACT principles  
4 learned from the game to real life, that they felt the game had influenced them  
5  
6 subconsciously, and that they considered those topics more readily when real-life situations  
7  
8 demanded them. In these cases participants most commonly felt that they were passively  
9  
10 more accepting of difficult emotions and situations.  
11  
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13

### 14 15 **Theme 7: Practice facilitates wellbeing** 16

17  
18 A core theme present across follow-up interviews was that the real learning occurred during  
19 application of ACT concepts in the real-world or during discussions regarding the game, as  
20  
21 opposed to during their playthrough. Participants felt that they gained a deeper understanding  
22  
23 of why the ACT concepts are useful since playing, which facilitated a shift in thinking and a  
24  
25 sense that learning them had a subconscious influence over their actions. Several positive  
26  
27 outcomes were reported as a result of practice, these being: a more positive mindset; a new  
28  
29 interest in personal mental health; better able to take a step back; and reduced reactivity.  
30  
31  
32

33  
34  
35 *“Well, it's like actually testing on a real situation as to just generally learning it. But then*  
36  
37 *when you come into a situation, you start to understand a bit better why you do those things*  
38  
39 *[referring to ACT skills] and what benefit those things have, because the situation is actually*  
40  
41 *impacting on your emotions or your feelings and stuff like that, and so then you're like ohh,*  
42  
43 *this is why this is a good technique.” -P05*  
44  
45  
46

47  
48 In practicing real life application of ACT principles, participants were able to get a deeper  
49 sense of how and why the techniques worked for them personally. The prior statement  
50  
51 implies that these increases in understanding occur as moments of insight during emotionally  
52  
53 challenging situations, providing a general sense of relief and growth.  
54  
55

56  
57 *“Yeah, I'd say, uh. I've learned ways to engage with my thoughts, and like I've always tried to*  
58  
59 *practise letting go of things that aren't like too meaningful, like things that won't matter in a*  
60

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3 *day and all that sort of stuff. But I feel like the game has helped me also realise the opposite,*  
4  
5 *like a way to really put my values down in a more straightforward manner.” -P13*  
6  
7

8 This statement gives an outlook on how practice of some ACT principles, might lead to  
9  
10 insights that involve others. By actively observing thoughts and through practice of  
11  
12 disregarding thoughts that did not strike them as meaningful, they were able to get a clearer  
13  
14 sense of what is meaningful to them (their values), which facilitated living in a way that  
15  
16 prioritises those values.  
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### 19 20 **Theme 8: Closer to the self**

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23 One of the most consistent patterns across interview responses was that participants felt they  
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25 had learned more about themselves, or that practicing the lessons taught in the game brought  
26  
27 them closer to their selves. For some, this was in becoming more aware of their personal  
28  
29 values, or that playing the game had revitalised a sense of mindfulness and awareness of their  
30  
31 feelings. Participants also discussed becoming closer to their self through practice of  
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33 acceptance, which was seemingly more the case for those who applied acceptance internally  
34  
35 to their own thoughts and emotions, compared to those that focussed on accepting external  
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37 situations.  
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43 *“Since playing the game I've downloaded a few different things with visibility and mental*  
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45 *ability and stuff. And taking a few online tests and stuff and just to know, just down to*  
46  
47 *interest. But I wouldn't have done that if I hadn't played the game.” -P16*  
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50 Many of the participants since playing the game felt that they had a renewed interest in  
51  
52 personal wellbeing, which from interview data appears to have a circular relationship with a  
53  
54 desire to learn about the self. Such that increase in one appears to correspond to an increase  
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56 of the other. The prior quotation illustrates that since playing the game, this participant has  
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3 explored various other avenues of self-learning, believing it to be a direct consequence of  
4 playing 'ACTing Minds'.  
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8 *"I just feel like it actually brought something into my life that is happening, if you're saying*  
9 *that about the practises, then of course I cannot be like, [these are the] step-by-step stages,*  
10 *but I actually learned a lot from this game about like these inner emotions or bad memories*  
11 *are not sinful. They're a part of you, and they contribute what you're going to be or the*  
12 *current you. So yeah, that's the core lessons I guess I learned from the game."* -P23  
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20 In discussing their feelings on what they learned, this participant articulates a point that is  
21 expressed across many of the other participants, that the growth experienced from playing  
22 'ACTing Minds' is intangible. Understanding the growth as a collection of processes in  
23 motion that cannot be broken down into steps and easily captured in language. Expanding on  
24 this, the participant states they have learned that internal feelings and bad memories are not  
25 sinful, implying that before playing the game they held the belief that some parts of their  
26 internal experience could be inherently wrong. This contrasts substantially with the belief  
27 they now hold, that those negative internal experiences should be accepted as part of the self.  
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### 40 **Secondary outcome measures**

41 A large effect size was found for the EQ5D usual activities score ( $\eta^2 = .307$ ), while medium  
42 effect sizes were found for DASS-21 Stress scores ( $\eta^2 = .108$ ), DASS-21 Anxiety scores  
43 ( $\eta^2 = .096$ ), and AAQII Psychological Flexibility scores ( $\eta^2 = .060$ ). Small effect sizes  
44 were obtained for the DASS-21 Depression scores ( $\eta^2 = .011$ ), the WEMWBS ( $\eta^2 = .011$ ),  
45 UCLA Social Connectedness scale ( $\eta^2 = .021$ ), EQ5D Pain/Discomfort ( $\eta^2 = .010$ ), and the  
46 EQ5D Anxiety/Depression ( $\eta^2 = .018$ ). While no significant effects were observed, the  
47 observed large and moderate effect sizes provide preliminary evidence of beneficial impacts  
48 (see Table 2).  
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### **Convergent outcomes**

Integration of results is considered a defining feature of mixed-methods research (37). In the interest of inferential transparency, we have included a visualisation of the research outcomes taken from our qualitative and quantitative approaches, illustrating how each outcome links back to feasibility, as well as the conclusions made following each outcome (see Figure 3).

For peer review only



**Table 2.**

Illustrating change in intervention outcomes over time (n=29)

	<b>Preintervention Baseline, mean (SD)</b>	<b>Postintervention, mean (SD)</b>	<b>Follow-up (3 weeks), mean (SD)</b>	<b><math>\eta^2</math></b>	<b>Effect size</b>
DASS-21 Depression	14.34 (5.97)	14.21 (5.54)	13.90 (4.75)	.011	Small
DASS-21 Stress	15.34 (4.55)	14.52 (4.40)	14.28 (4.65)	.108	Medium
DASS-21 Anxiety	12.79 (5.19)	12.10 (4.42)	11.66 (4.75)	.096	Medium
AAQII (Psychological Flexibility)	27.34 (10.47)	28.38 (9.86)	28.86 (8.65)	.060	Medium
WEMWBS	42.07 (7.31)	42.62 (7.91)	42.07 (7.00)	.011	Small
UCLA Social- Connectedness	64.72 (7.52)	64.24 (8.85)	63.90 (8.33)	.021	Small
EQ5D Mobility	4.83 (.38)	4.83 (.38)	4.83 (.38)	.000	None
EQ5D Self- Care	4.78 (.58)	4.79 (.49)	4.76 (.51)	.000	None
EQ5D Usual Activities	4.14 (.79)	4.38 (.68)	4.62 (.68)	.307	Large
EQ5D Pain/Discomfort	4.24 (.64)	4.45 (.63)	4.31 (.81)	.010	Small
EQ5D Anxiety/ Depression	3.86 (.99)	4.03 (.87)	3.97 (.94)	.018	Small
EQ5D Self- rated health score	71.14 (19.01)	72.76 (19.57)	70.93 (20.71)	.000	None

-----**Figure 3 Here**-----

## Discussion

### Statement of principle findings

The overarching aim of this research was to test the feasibility and acceptability of the ‘ACTing Minds’ video game as a DHI for treating depression, anxiety, and stress. Results demonstrate that the study design and videogame intervention are feasible for testing in a full-scale RCT. Thematic analysis on qualitative data revealed several key findings. Firstly, participants were successfully able to learn about core ACT principles through embedded learning, specifically acceptance, defusion from thoughts, and commitment to personal values. Participants felt that the lessons taught within the game could be applied to their daily lives, and that the game was effective in priming them to consider the core principles throughout the weeks following completion of the intervention. Participants also felt that they would recommend the game to someone that they care about, and that they would be interested in downloading and completing future releases of ‘ACTing Minds’.

### Summary of secondary outcomes

Quantitative analysis of measures taken at baseline, immediately post-intervention, and after a 3-week follow up, revealed one large effect size indicating increased partaking in usual activities ( $\eta^2 = .307$ ). As well as three medium effect sizes relating to reduced stress ( $\eta^2 = .108$ ), anxiety ( $\eta^2 = .096$ ), increased psychological flexibility ( $\eta^2 = .060$ ). Small effect sizes were found for depression ( $\eta^2 = .011$ ), social connectedness ( $\eta^2 = .021$ ), general wellbeing ( $\eta^2 = .011$ ), reduced EQ5D pain/discomfort ( $\eta^2 = .010$ ), and EQ5D anxiety/depression ( $\eta^2 = .018$ ).

### Comparison to existing literature

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3 This is the first study to utilise a videogame Digital Health Intervention (DHI) rooted in third-  
4 wave behavioural therapy to address mental distress. 'ACTing Minds' imparts psychological  
5 skills based on Acceptance and Commitment Therapy (ACT) to promote wellbeing. Prior  
6 research has primarily focused on videogame DHIs targeting 'illbeing', that aim to reduce  
7 symptoms of mental illness, two examples are games 'REThink' and 'Dojo'. 'REThink,'  
8 designed for a younger audience, developed the players' ability to discern functional  
9 emotions from maladaptive ones, and was shown to effectively improve emotional symptoms  
10 and reduce depressive mood (38). 'Dojo,' utilising biofeedback and relaxation techniques to  
11 promote emotional regulation, was shown to significantly decrease participants' anxiety and  
12 aggressive behaviour scores post-intervention but exhibited no long-term effects at a 4-month  
13 follow-up (39). Our DHI differs fundamentally from these other games due to strong  
14 theoretical underpinnings based on ACT. Instead of a focus on regulating or reducing  
15 unwanted emotions, ACT teaches acceptance of unpleasant emotions, which are an inherent  
16 part of being human. Practitioners are taught to observe their emotions without judgement or  
17 attempt to change them, a key focus within the 'ACTing Minds' intervention.  
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38 Several meta-analyses have been conducted to explore the potential efficacy of DHI's, one  
39 found that the majority of DHI's were based on Cognitive Behavioural Therapy (CBT), and  
40 that the effect size for such interventions were small for reducing depressive symptoms  
41 compared to non-treatment controls (40). CBT-based DHI's usually do not take the form of  
42 full videogames, but may include elements of gamification such as rewards, badges, and  
43 progress tracking. They are typically structured programs including online education tools,  
44 interactive exercises, and self-assessment tools, which focus on challenging and modifying  
45 negative thoughts and behaviours. Another meta-analysis including 34 RCT's (17 of which  
46 were CBT-based) found that CBT-based DHI's yielded a medium effect size for reducing  
47 symptoms of depression and anxiety (41). However, a meta-analysis of 117 CBT-based  
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3 applications revealed that only 12 of them provided support aligned with the evidence-based  
4 tenets of CBT (42). This finding suggests that the observed effectiveness in earlier studies  
5 could potentially stem from participants' interaction with a DHI rather than their proficient  
6 implementation of CBT principles. CBT-DHI programs often require consistent use, and high  
7 attrition rates have limited their efficacy in research (43). One meta-analysis author suggested  
8 that DHI's may need to be complemented by existing mental health support (40). However,  
9 our study challenges this notion. In just a 40-minute playthrough of 'ACTing Minds',  
10 participants fully explored the game, retained ACT knowledge, and discussed its application  
11 in interviews conducted 3 weeks post-intervention.  
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### 24 **Strengths and limitations**

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27 Our study is the first to explore the feasibility and acceptability of a novel videogame DHI  
28 based on ACT. A core strength of this research was the utilisation of a mixed methods  
29 approach. By incorporating thematic analysis of semi-structured interviews as well as  
30 quantitative analysis of questionnaire data, we were able to gain a comprehensive  
31 understanding of participant experience using 'ACTing Minds' DHI. Collecting quantitative  
32 data at three separate time points, and interviews conducted at two separate time points meant  
33 that we were able to examine the process of change and identify patterns of improvement. We  
34 gained valuable input from participants in terms of suggestions for improving the intervention  
35 which will aid in the further development of 'ACTing Minds' as to optimise effectiveness  
36 and user engagement. The results from the interviews also indicated that 'ACTing Minds' has  
37 broad appeal as a videogame even to those outside of clinical populations. However, it is  
38 important to acknowledge the limitations of our study. Firstly, there was no control group,  
39 meaning that no causal links can be made between the intervention and our findings. There  
40 was a lack of objective data collection, including user activity, adherence to in-game tasks,  
41 and physiological measurements, limiting our ability to draw conclusions about engagement  
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3 with the intervention and changes in physiological wellbeing outcomes such as heart rate  
4 variability. The reliance on self-report measures meant that there was potential for biased  
5 responses, as participants knowing that they are taking part in a study may have answered  
6 interview questions in line with their perceptions of what the study was looking for.  
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12 Participants in the study were also confused by a section of the WEMWBS questionnaire,  
13 which asked about their wellbeing in the two weeks before they completed it. This posed an  
14 issue as participants had to complete the questionnaire twice in one day, both before and after  
15 the intervention. Lastly, it is possible that some of the questionnaires used in this study were  
16 insufficient for capturing the target measurements. The AAQ-II psychological flexibility  
17 questionnaire has been criticised as being too simple a measure for psychological flexibility  
18 (44) and is likely also the case for our social connectedness measurement which included  
19 only two questions adapted from the UCLA loneliness scale.  
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### 31 **Clinical implications and directions for future research**

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34 The ACT based videogame DHI used in this study is a low-cost, engaging, and easy to  
35 disseminate means of supporting those who suffer mental distress. The present study  
36 highlights the clinical implications of ‘ACTing Minds’, including its’ potential therapeutic  
37 value, user engagement, and accessibility. However, further research is warranted to establish  
38 long-term effects, explore specific populations, conduct comparative studies, investigate  
39 underlying mechanisms, and address ethical considerations. Critically, a full randomised  
40 control trial is now needed, in which participants are compared quantitatively with a control  
41 group, incorporating physiological wellbeing measures such as heart rate variability, as well  
42 as research validated questionnaires regarding mental health (i.e., depression, stress, anxiety,  
43 psychological flexibility, social connectedness, and wellbeing). By pursuing these future  
44 research directions, we can leverage the potential of videogames to enhance patient care,  
45 improve outcomes, and expand the reach of interventions in an increasingly digital era.  
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## Conclusion

The results of this study demonstrate that 'ACTing Minds' is feasible to implement in a full-scale randomised control trial. Both the intervention and study were well-received by participants, thematic analysis of semi-structured interviews indicated that a single playthrough of the game was sufficient for teaching several core principles of ACT, namely 'Acceptance', 'Commitment to Values', and 'Cognitive Defusion' to participants, and priming them to implement the lessons in their day-to-day lives. Quantitative results indicate that playing 'ACTing Minds' is associated with decreases in depression, anxiety, and stress, as well as increases in psychological flexibility, social connectedness, and wellbeing. However, these effects will need to be further explored in an adequately powered RCT in order to understand the potential clinical implications, therapeutic value, user engagement, and accessibility of an ACT-based video game DHI.

## Data availability statement

The datasets supporting the conclusions of this article are available in the Open Science Framework: [https://osf.io/3wuh5/?view\\_only=7998f1d0ae4b473ab7089a71be710270](https://osf.io/3wuh5/?view_only=7998f1d0ae4b473ab7089a71be710270).

## Original published protocol

<https://bmjopen.bmj.com/content/10/11/e041667>

## Contribution statement

DJE and AHK designed the original protocol, whilst TCG updated and revised the protocol design. TCG wrote the first draft of the paper and conducted all of the quantitative and qualitative results. DJE and AHK provided substantial revisions on all drafts and advised TCG throughout the development of this manuscript. DJE designed and developed the game development.

## Public and patient involvement

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3 Key stakeholders were consulted and involved in the development of this protocol. The  
4  
5 Patient Experience and Evaluation in Research (Patient Experience and Evaluation in  
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7 Research (PEER): [https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-](https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/)  
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9 [college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/](https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/)) group in  
10  
11 the College of Human and Health Sciences at Swansea University were consulted. This group  
12  
13 represented members of the public, students and staff members, several of whom reported  
14  
15 that they had experienced depression, anxiety or stress at some point in their lives and  
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17 emphasised the need for innovative approaches of the delivery of mental health support. The  
18  
19 feasibility design was explained to them, and they gave positive feedback about the nature of  
20  
21 the design, intervention and outcome measures.  
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### 25 26 **Competing interests**

27  
28 The game ACTing Minds was developed using European development funds via the  
29  
30 commercial entity of Swansea University (AgorIP) and awarded to DJE with the intention to  
31  
32 develop this game with for commercial purposes (as a game app for the Apple and Google  
33  
34 Play stores). DJE was involved in the design of the protocol but did not recruit participants,  
35  
36 collect any data, and did not conduct the analysis on the data. TCG and AHK have no  
37  
38 involvement in any commercial aspects of the game.  
39  
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41

### 42 **Funding**

43  
44 Funding for the development of this game came from European development funds via the  
45  
46 commercial entity of Swansea University called AgorIP (Reference: 229-0256-0046)  
47  
48 awarded to DJE.  
49  
50

### 51 **Acknowledgements**

52  
53 We would like to thank Miricle Tea Studios Ltd and Mikoshi Ltd for the production and  
54  
55 release of the ACTing Minds videogame.  
56  
57

### 58 **Ethics statement**

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3 This study has received ethical approval from Swansea University School of Psychology  
4  
5 ethics sub-committee (2022-5630-4834).  
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## 8 **Figure legends**

### 10 **Figure 1.**

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13 (A) Screenshot from 'ACTing Minds' showing the 'Psychoflexameter'. (B) The Acceptance  
14 and Commitment Therapy Hexaflex and core processes. (C) Screenshot from 'ACTing  
15 Minds', example of 'Cognitive defusion' task. The player is required to type in their own  
16 negative thoughts, before dragging them on to a leaf that floats downstream.  
17

### 18 **Figure 2.**

19 Flow diagram of participants through the study.  
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### 22 **Figure 3.**

23 Visualisation diagram illustrating integrated outcomes of 'ACTing Minds' feasibility and  
24 acceptability study.  
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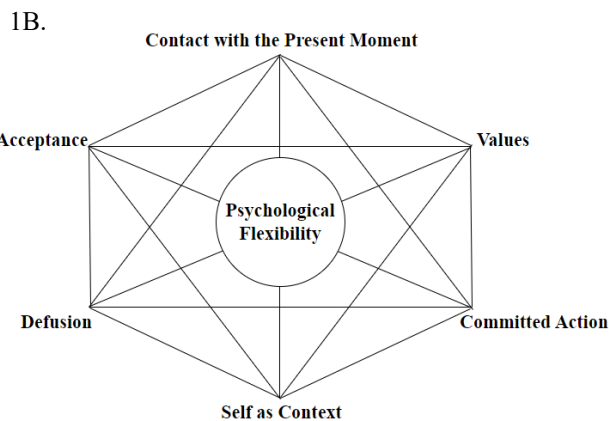
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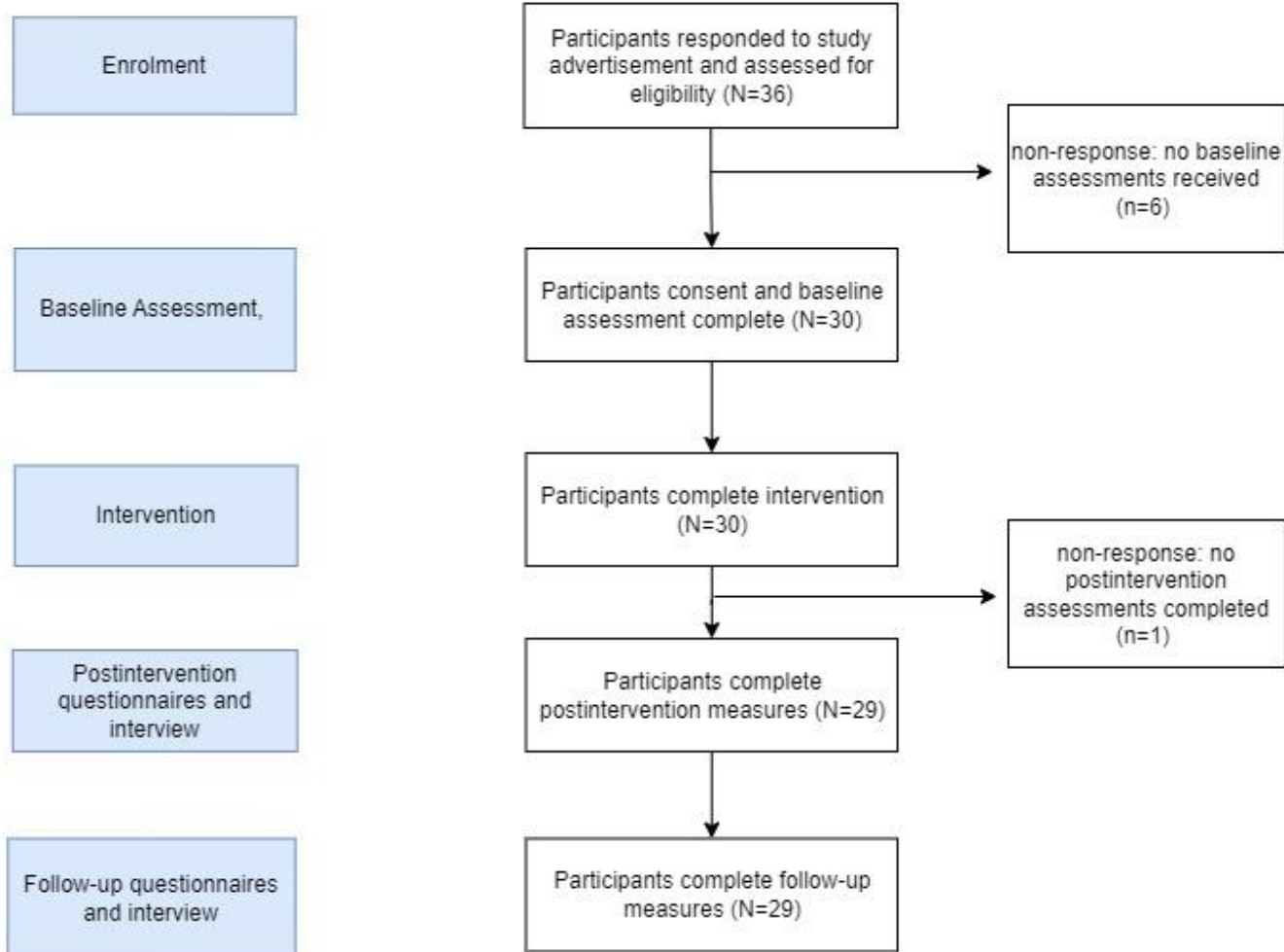
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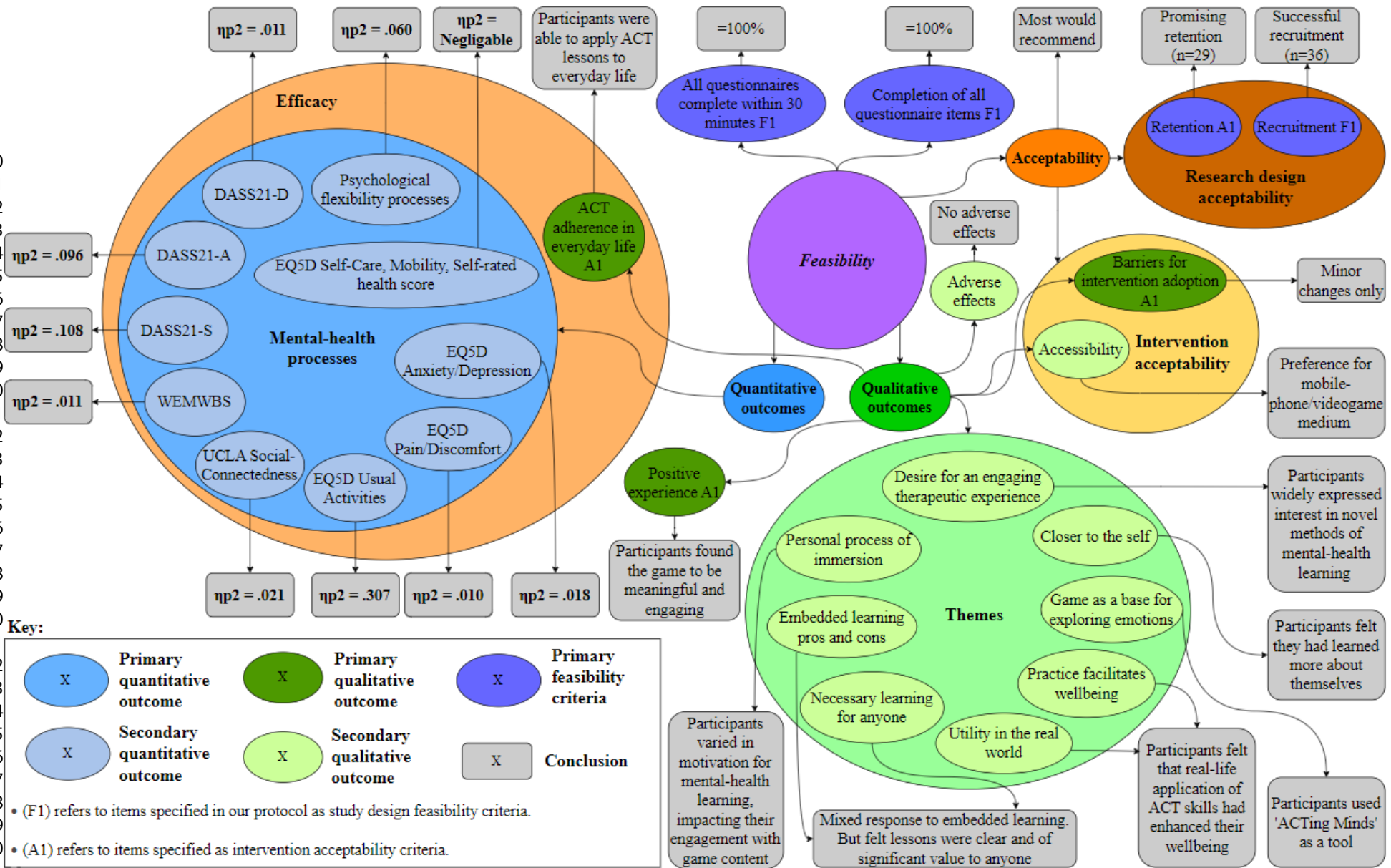
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# BMJ Open A novel ACT-based video game to support mental health through embedded learning: a mixed-methods feasibility study protocol

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## ABSTRACT

**Introduction** In recent years, serious video games have been used to promote emotional regulation in individuals with mental health issues. Although these therapeutic strategies are innovative, they are limited with respect to scope of treatment, often focusing on specific cognitive skills, to help remediate a specific mental health disorder.

**Objective** Here, we propose a protocol for assessing the feasibility of a novel acceptance and commitment therapy (ACT)-based video game for young adults.

**Methods and analysis** The Medical Research Council (MRC) framework will be used for developing a complex intervention to design and test the feasibility of an ACT-based video game intervention using a mixed-methods approach involving qualitative and quantitative data. The primary outcomes will include feasibility testing of recruitment processes and the acceptability of the intervention through qualitative interviews, attendance and rates of attrition. Secondary outcomes will involve a series of quantitative questionnaires to obtain effect sizes for power analysis, allowing for the ideal sample size for an appropriately powered, randomised controlled trial to be determined.

**Ethics and dissemination** This study has been approved by the Psychology Department Research Ethics Committee (2020-4929-3923) at Swansea University in the UK. Dissemination activities will involve publications in peer-reviewed journals, presentations at local and national conferences and promotion through social media.

**Trial registration number** NCT04566042.

## INTRODUCTION

Mental health issues such as anxiety and depression are a global problem of increasing concern, imposing considerable burden on society. The Global Burden of Disease project<sup>1</sup> has identified mental health disorders as a leading cause of disability globally, and suggest that there are 266 million cases of anxiety, and 253 million cases of major depressive disorder globally.

Unfortunately, the demand for mental health services far exceeds the available human resources able to meet this need in high-income and low-income

## Strengths and limitations of this study

- Mixed-methods approach to build a rich dataset on which conclusions will be drawn.
- Protocol follows established Medical Research Council (MRC) guidelines.
- In line with MRC guidelines and stage of game development, randomisation is not a component of this study.
- Aims are to assess feasibility, an important step in the development of complex interventions, although limiting conclusions able to be drawn.

and middle-income countries. This includes ever-growing treatment gaps<sup>2</sup> and lags.<sup>3</sup> These alarming increases have prompted the 2018 Lancet commission on global mental health to suggest that universal health coverage should include efforts to ensure the sustainable development of mental health.<sup>4</sup> Innovations to promote accessibility to mental health treatments include technology such as telephone, internet and smartphone devices, augmenting the psychotherapeutic toolkit.<sup>5</sup>

Innovations in video gaming for remedial mental health issues have wide potential application. In the USA, over 164 million adults play video games, and at least three-quarters of all American families have at least one person who video games regularly.<sup>6</sup> In the EU, 54% of the population play video games between the ages of 6 and 64, where the average age of video gamers is 31, and with a distribution of 46% female and 54% male. Of these, 77% play at least 1 hour per week, 16% play 1 hour per month, while only 7% play 1 hour per year.<sup>7</sup> Given that such a large proportion of the Western population play video games, developing mental health training in the form of psychoeducation may have great potential for building psychological resilience and



1 helping to better manage depression, anxiety and other  
2 forms of distress.

3 Technological developments for tackling such chal-  
4 lenges include the exploitation of gamification.<sup>8</sup> This  
5 involves the application of behavioural principles for  
6 controlling and modifying human behaviour, in which  
7 game design elements are used to increase human inter-  
8 action with or without technology.<sup>9</sup> Some examples of  
9 gamification include gamifying the development of  
10 cognitive skills and emotional regulation by rewarding  
11 the completion of relevant tasks within complex video  
12 games<sup>10–13</sup> in order to promote mental health.

13 When mental health-related video games are designed  
14 well, they have been shown to elevate self-esteem, self-  
15 efficacy, knowledge and awareness of illness, adherence  
16 to treatment and problem-solving skills, while lowering  
17 aggression.<sup>14</sup> One of the most successful in the facilitation  
18 of mental health improvement is a serious video game—a  
19 complex game with multiple levels and settings—called  
20 PlayMancer (PM), which targets emotional regulation and  
21 was specifically designed to help manage impulse control  
22 disorders.<sup>11 13</sup> The objective of the PM game is to develop  
23 emotional and cognitive skills, while reducing impulsivity.  
24 The game has been shown to help treat bulimia nervosa  
25 by improving emotional regulation.<sup>15 16</sup>

26 PM also uses biofeedback (heart rate and heart rate  
27 variability) to model physiological and emotional reac-  
28 tions, feeding this information back to the participant.  
29 Some research has shown that facilitating awareness of  
30 one's own physiology (such as brain activity or cardiac  
31 function) enhances the treatment effects of mental health  
32 disorders (such as anxiety disorder, depression, obsessive-  
33 compulsive disorder (OCD) and schizophrenia) via self-  
34 regulation.<sup>17</sup> Biofeedback has also been shown to improve  
35 impulse control difficulties, and attentional difficulties  
36 in bulimia nervosa and attention deficit hyperactivity  
37 disorder,<sup>15 16 18</sup> as well as symptoms of stress, anxiety and  
38 anger.<sup>19</sup> The focus on physiological data in the psycho-  
39 therapeutic context is gaining traction<sup>20–22</sup> and has strong  
40 theoretical underpinnings.<sup>23–25</sup>

41 Within PM, there are three mini-games: 'The face of  
42 Cronos'; 'Treasures of the sea' and 'Sign of the Magupta'.  
43 Each of these mini-games were designed to train different  
44 skills, for example, 'The face of Cronos' and 'Treasures of  
45 the sea' develops planning skills, impulse control, coping  
46 skills, stress management and emotional self-regulation,  
47 while 'Sign of the Magupta' was designed to train relax-  
48 ation, breathing techniques and improve physiological  
49 and emotional awareness. However, in the study<sup>15</sup> PM  
50 was combined with sessions of cognitive behavioural  
51 therapy (CBT) and without a control measure (eg, CBT  
52 only) so the game was developed as an adjunct to tradi-  
53 tional mental health training, and there is no real way  
54 of knowing the direct benefits of the game as opposed  
55 to training in CBT. In another study—a case study of a  
56 single participant playing PM—anxiety and impulsivity  
57 decreased prior to CBT.<sup>16</sup> However, as this study was  
58 based on a single case, further studies using a randomised

controlled trial (RCT) approach are needed to support  
and provide confidence to these findings.

Another game, Dojo,<sup>26</sup> develops emotional regulation  
in adolescents with anxiety. It uses biofeedback (heart rate  
variability) and trains breathing techniques, muscle relax-  
ation, positive thinking and guided imagery to attempt to  
reduce anxiety in adolescence. It also uses instructional  
videos and then engages players through immersive and  
emotionally evocative puzzles that challenge players to  
use newly acquired emotion regulation skills. However,  
a pre-post RCT with 1347 participants, compared with  
a standard 'off the shelf' commercial game 'Rayman 2'  
(whereby Rayman 2 was the control), reported no differ-  
ence between Dojo and the control condition at reducing  
anxiety. As both of these games significantly reduced  
anxiety, it is possible that the reduction in anxiety was due  
distraction from anxiety-provoking thoughts, rather than  
developing psychoeducational skills per se. The authors  
concluded that crucial design issues need to be carefully  
thought through, which include a clear theoretical and  
therapeutic foundation. This includes appropriate meth-  
odology that can assess the causes of improvement, before  
developing and testing a serious video game for the treat-  
ment of mental health issues such as anxiety.

Commercial games (such as Rayman 2) have been  
explored in their unmodified forms for their effective-  
ness in helping with social skills training for autism, and  
cognitive distraction for anxiety and nausea for patients  
undergoing chemotherapy,<sup>27</sup> with limited success.  
Evidence of generalisability of these games beyond game-  
playing is limited,<sup>28</sup> and this may be because they act as  
simple distractions rather than therapeutic psychoeduca-  
tion applicable to participant's everyday lives. Another  
issue with many of these studies is that they often lack  
appropriate and rigorous methodology such as longitu-  
dinal follow-up,<sup>29</sup> and a mixed-methodological approach  
that can assess the feasibility and acceptability of such  
interventions.

Given these issues, it is important to emphasise that the  
underlying theoretical basis for PM and Dojo relates to  
the development of emotional regulation skills. While  
emotional regulation has transdiagnostic application<sup>30</sup> (ie,  
an intervention designed to treat multiple mental health  
conditions), these applications are not underpinned by  
theoretical frameworks that relate to formal psychother-  
apeutic interventions. Our proposed game is designed to  
be a comprehensive transdiagnostic intervention that will  
integrate a third wave behavioural therapy—as opposed  
to an adjunct to—acceptance and commitment therapy  
(ACT).<sup>31 32</sup> It will therefore be a comprehensive strategy  
for managing many common mental health issues such  
as depression and anxiety and focus on developing clear  
psychoeducational skills in the form of psychological flex-  
ibility, well-being and resilience more generally.<sup>33</sup>

Given this comprehensive transdiagnostic focus on  
psychological flexibility through ACT—a fundamental  
component of general health and well-being<sup>34</sup>—our  
online video game may have much greater reach and

1 impact than other serious video games such as PM,  
2 Dojo and many of the commercial games which are not  
3 based on third wave psychotherapy. Greater accessibility  
4 and impact have important implications for reducing  
5 treatment gaps and lags by making more mental health  
6 services available to those who need them.

7 One reason for choosing ACT in the game development  
8 process was pragmatism. For instance, researchers and  
9 clinicians may access freely available materials through  
10 the Association of Contextual Behavioural Science  
11 website (<https://contextualscience.org/>), and it does not  
12 require formal clinical training or accreditation to practice<sup>35</sup>  
13 which has important implications for translation to  
14 video game platforms. Another reason for choosing ACT  
15 as the basis for the game, is that it has a strong evidence  
16 base, and meta-analysis has found it to be efficacious for  
17 improving chronic pain, depression, psychotic symptoms,  
18 mixed anxiety, OCD, drug abuse and stress at work.<sup>36</sup> This  
19 means it is an ideal general purpose therapeutic tool as  
20 opposed to restricted focus on for example impulsivity  
21 control such as the PM application<sup>11 13</sup> or simple relaxation  
22 skills for adolescence with anxiety, as is the focus of  
23 the Dojo game.<sup>26</sup>

24 ACT principles are designed to undermine the trap-  
25 pings of language in the form of difficult thoughts and  
26 associated feelings, and promotion of psychological flexi-  
27 bility.<sup>37</sup> Language trappings can get individuals entangled  
28 and can prevent them from engaging with what is truly  
29 meaningful to them. The development of psychological  
30 flexibility through ACT is important because it is consid-  
31 ered to be a fundamental component of well-being.<sup>34</sup>

32 The six ACT processes are: (1) the act of being in the  
33 here and now, present and mindful<sup>32 38</sup>; (2) acceptance,  
34 the act of being aware and open to painful thoughts; (3)  
35 cognitive fusion, the act of recognising that thoughts are  
36 just thoughts and not to buy into them (the process of  
37 cognitive defusion)<sup>39</sup>; (4) identifying values, values act  
38 as a life compass and direct us towards a life filled with  
39 purpose; (5) commitment to values orientation, which is  
40 the act of continually working towards a values orienta-  
41 tion, even when an individual goes off track; (6) self as  
42 context (also called the transcendental self), is flexible  
43 and transcendent form of self. This involves the aware-  
44 ness of thoughts and feelings but the complete detach-  
45 ment from the literal meaning of thoughts.<sup>34</sup>

46 ACT has been usefully applied to many forms of mental  
47 health issues and has been applied in many different  
48 forms of delivery. This includes web-based interven-  
49 tions,<sup>40-42</sup> teleconference<sup>43</sup> and a downloadable app for  
50 smartphones.<sup>44 45</sup> So, given the fact that video games can  
51 have positive well-being benefits,<sup>46 47</sup> and are applicable  
52 for therapeutic purposes,<sup>28 48</sup> a transdiagnostic ACT  
53 serious video-game may have great potential for similar  
54 reasons.

55 As ACT is a comprehensive transdiagnostic model and  
56 formal third wave cognitive behavioural approach, then  
57 its reach and impact in the form of a video game may be  
58 greater than that of PM or Dojo which were focused on

simpler emotional skills development and biofeedback.  
For these reasons, we are proposing an ACT-based video  
game called 'ACTing Mind' as an innovative and acces-  
sible intervention to help individuals who struggle with  
anxiety, depression, stress and other forms of distress.

### Aims

The research goals of this proposal are to determine the  
feasibility and acceptability of a novel ACT-based video  
game intervention for individuals with mental distress, in  
line with methodology described in the Medical Research  
Council (MRC) framework.<sup>49 50</sup> This proposal lays the  
foundation for which a pilot and full-scale RCT will be  
conducted to determine clinical effectiveness, and ulti-  
mately the recommendations of the importance of such  
innovations in primary care mental health policies and  
practices.

### METHODOLOGY

This protocol has been developed following the Template  
for Intervention Description and Replication of Studies<sup>51</sup>  
(see online supplemental appendix 1), as well as the  
MRC guidelines for the development of complex inter-  
ventions.<sup>49 50</sup> This includes five stages of development  
for a complex intervention including: (1) preclinical,  
involving a theoretical review of the literature (provided  
here), justifying the need for such an intervention for the  
proposed population; (2) phase I, modelling, involving  
the use of evidence to determine the components for  
underlying mechanisms. For this, we propose a qualita-  
tive element involving thematic analysis to enable us to  
understand what would be most beneficial to a general  
population with anxiety and depression; (3) phase II,  
conducting an exploratory pilot study (outlined here) to  
determine the feasibility of the methodology and design  
where some initial data can be collected; (4) phase III, an  
RCT to test the efficacy of the proposed intervention (in  
subsequent work); (5) phase IV, long-term follow-up to  
assess replicability.

### Public and patient involvement

Key stakeholders were consulted and involved in the  
development of this protocol. The Patient Experience  
and Evaluation in Research (Patient Experience and  
Evaluation in Research (PEER): <https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/>) group in the College of Human and  
Health Sciences at Swansea University were consulted.  
This group represented members of the public, students  
and staff members, several of whom reported that they  
had experienced depression, anxiety or stress at some  
point in their lives and emphasised the need for innova-  
tive approaches of the delivery of mental health support.  
The feasibility design was explained to them, and they  
gave positive feedback about the nature of the design,  
intervention and outcome measures.





## Study design

This is a mixed-methods study which is designed to determine the feasibility and acceptability of an ACT-based video game for individuals with anxiety, depression and stress, and to increase psychological flexibility.

## Study setting

The study will be conducted entirely online including the game and assessment (via the Qualtrics platform), and qualitative interviews (via the Zoom platform). Thus, potential participants will be able to access this study without restrictions, an important consideration for ongoing local lockdowns associated with the COVID-19 pandemic. Strict recommendations will require participants to ensure they are in a quiet room and without disruption for the duration of the study.

## Recruitment and consent

We will recruit participants (n=36) using purposive sampling, focusing on—unlike an opportunity sample—the types of participants needed for a full-scale RCT (ie, individuals with depression, anxiety and stress). The sample size is justified on the basis of past research reporting the median numbers of participants recruited for similar types of feasibility studies,<sup>52</sup> incorporating both quantitative and qualitative elements.

## Eligibility criteria

Participants will be recruited through general public mental health forums, social media and student populations. Thirty-six participants will take part in the study and they will be aged 18 years or older, be experiencing ongoing depression, anxiety and stress, and be able to read, write and speak English.

## Intervention

This ACT-based video game intervention called 'ACTing Mind', developed and designed solely by DE, will involve students and members of the public attending five 1 hour sessions of an ACT-based video game. Each session will involve a different chapter of the video game, and each chapter will explore a different key component of ACT, with there being six in total (see table 1 for the different chapters and sessions involved).

These various components and principles of ACT<sup>31 32</sup> will be taught within the different chapters of the game and through embedded learning. For example, the player will gain ACT skills while completing objectives within the game and without directly being taught these skills, but rewarded indirectly through points and progress awards. For instance, in one scene (see table 1) the character is confronted by painful memories, and the player has two choices: (1) to destroy the painful memories or (2) to accept these memories. If the player chooses to destroy the memories (avoidant-based strategies), the world becomes distorted and barriers form making the chapter impossible to complete. Alternatively, if the player chooses acceptance-based strategies they will be able to continue

the game (hence in this scene they learn that acceptance is functionally better than avoidance).

The game will start with a depressed individual who has recently lost his wife in an accident, and is feeling depressed, isolated and lonely (see figure 1 as an example of this scene). Each chapter will reward ACT consistent behaviour with points on a 'psychoflexameter'. This is a dial on the border of the screen which indicates increased psychological flexibility as the player completes ACT-based tasks such as acceptance (chapter 1), being present (chapter 2), values and commitment (chapter 3), defusion (chapter 4) and self as context (chapter 5). ACT uses metaphors to help clients visualise the key processes of ACT. In the game, these metaphors are real representations, such as the 'sinking sand' game, 'dropping the rope' game, the 'chessboard game', the 'unwanted monster' game, the 'leaves on a stream' game (see table 1).

Within the game, the character will have to enter his own mind through a 'mind escape machine' (see figure 2 of this as an example of the character in his own mind). At the start of the game, it is explained through a brief historical story that he develops this machine to destroy and suppress his unwanted painful thoughts and memories about his wife and loss. Once in his mind, he will learn that destroying or suppressing thoughts creates barriers in his mind which prevents him from continuing the game. So, learning acceptance is crucial throughout this game and the character is rewarded for this through points and progress awards. Also, within the game, psychoeducation components explain thoughts as trappings of language which can often get people stuck in life, and prevent them from value consistent living, as well as the various emotional regulation strategies such as avoidance and acceptance.

As part of the study, in addition to playing the video game, participants will be asked to record events on a weekly basis, aspects of application of the ACT principles learnt in an everyday life in a journal. It is anticipated that greater adherence to the intervention in everyday life, and engagement with the journal will lead to greater success of the intervention (greater psychological flexibility).

## Data collection and management

MSc students will have the opportunity to be involved in this study and will collect and process the data under supervision by project leads, DJE and AK. Questionnaires will be completed online through Qualtrics which will store raw data copies, and also be held on an encrypted university server. Names and other personally identifiable information will not be stored, and consent form information will not be associated with the raw or processed data, instead each participant will be given a unique identifier code. Similarity recorded interviewer transcripts will use identifier codes as opposed to personal information (eg, names). The project leads (DJE, AHK) will frequently audit all processes in data collection and processing to ensure that the procedures stated in this protocol are adhered to.

**Table 1** Overview of the 'ACTing Mind' intervention and everyday journal instructions

Session 1 (week 1): acceptance and openness to pain	<ul style="list-style-type: none"> <li>▶ Chapter 1—Acceptance</li> <li>▶ Introducing participants to the video game and ACT in everyday journal.</li> <li>▶ A brief overview of the purpose of the programme and the content of each session.</li> <li>▶ Explaining basic ACT tenets through introduction text of journal.</li> <li>▶ Explaining the nature of painful thoughts and memories and getting caught up in the struggle explained through journal.</li> <li>▶ Basic story context about the character being depressed and why, at start of video game.</li> <li>▶ Explaining the objective of the video game, that is, to transcend from psychological inflexibility to psychological flexibility.</li> <li>▶ Exercise, within the game there are choice, either to suppress, and break thoughts, or to accept and be open to them.</li> <li>▶ Acceptance and openness are rewarded by psychological flexibility points on the 'psychoflexameter' and game progression, while suppression actions (breaking or suppressing painful memories) are punished with physical barriers, and sinking sand, which prevent the player from progressing in the game.</li> <li>▶ A monster pulls against the player to prevent progress, but if the player fights with the monster, they get even more stuck (analogous to the drop the rope and sinking sand metaphor). Again, acceptance is important and must be learnt here.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 2 (week 1): being present (mindfulness)	<ul style="list-style-type: none"> <li>▶ Chapter 2—Being present (mindfulness)</li> <li>▶ Some instructions form the journal about being present and mindful is given, why it is useful and how to go about achieving with breathing exercises.</li> <li>▶ The character is approached by monsters in the game in the past and future making him worry excessively about imaginary dangers, and reminding him of painful events.</li> <li>▶ The game (in the form of the character's wife's ghost) instructs the player to be present, to focus on your breathing for 10 min.</li> <li>▶ As the participant learns and completes relevant psychological flexibility tasks psychological flexibility on the 'psychoflexameter' will increase, which rewards the player for being present.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 3 (week 2): values identification and commitment	<ul style="list-style-type: none"> <li>▶ Chapter 3—Values identification and commitment</li> <li>▶ Instructions about what are values (a life compass) explained through the journal.</li> <li>▶ Acceptance and commitment to values orientation as opposed to avoidance behaviour is rewarded.</li> <li>▶ There are challenges to reach goals which are linked to the character's values, such as scary weather and monsters.</li> <li>▶ Psychological flexibility on the 'psychoflexameter' and game progress, will increase with values consistent behaviour which rewards the player for committing to values.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 4 (week 2): defusion	<ul style="list-style-type: none"> <li>▶ Chapter 4—Defusion</li> <li>▶ Instructions about what is cognitive fusion and defusion (holding self-stories lightly) explained through journal.</li> <li>▶ The character goes back into the 'Mind Escape' machine but this time there is a flowing river with leaves (analogous to leaves on a stream metaphor).</li> <li>▶ Some of the character's painful memories will beg the player to help them, but if the player interacts, barriers and quicksand appear, punishing the player and preventing them from progressing in the game (analogous to the sinking sand metaphor).</li> <li>▶ The ghost of the character's wife eventually instructs the player to put the memories and thoughts onto the leaves and watch them flow down the river, without interacting with them, and to simply observe.</li> <li>▶ Psychological flexibility on the 'psychoflexameter', will increase when all of the memories and thoughts as left to go down the stream, hence the player is rewarded for defusing.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>

Continued

**Table 1** Continued

<p>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60</p>	<p>Session 5 (week 3): self as context</p> <ul style="list-style-type: none"> <li>▶ Chapter 5—Self as context</li> <li>▶ Instructions about what is self as context (being the observer of your thoughts and not your thought) are explained through journal.</li> <li>▶ The world starts to fall apart and becomes abstract, like a chess board.</li> <li>▶ The player realises that they are the white pieces on the chessboard (analogous to chess board metaphor).</li> <li>▶ The player is compelled by the game to beat the black pieces in the chess game.</li> <li>▶ But the more the players fights against the black pieces, the more they lose points on the ‘psychoflexameter’ and cannot progress in the game.</li> <li>▶ The player must let the battle play out, once they do, they become aware that they are the chess board (they become it) and realise they do not need to be part of the never-ending battle between the opposing forces.</li> <li>▶ Finally, a bus arrives, memories of the character’s wife beg the player to stay, and the monsters pull on player.</li> <li>▶ The player needs to get onto the bus with the monsters to move towards their values, a new beginning (analogues to bus metaphor).</li> <li>▶ Finally, the player has a choice, go back and change the events that led to your wife’s death, or stay on the bus with the monsters.</li> <li>▶ Trying to change events leads to a loss in points and prevents game progression.</li> <li>▶ Only staying on the bus, towards values, and accepting the monsters allows the player to complete the game successfully.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
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### Outcome measures

Questionnaires will be collected at three points in time (baseline, immediate postintervention and 3-month follow-up). Interview data will be collected immediate postintervention only.

### Demographic data

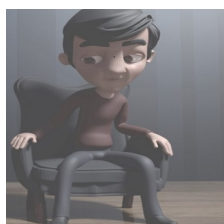
Demographic measures will include age, sex, medication use, which will all be recorded through Qualtrics and assessed by DJE and AHK.

### Primary outcome measure

The primary outcomes for feasibility are determined using MRC framework measure for developing a complex intervention.<sup>49 50</sup> As this is a feasibility study, the primary outcomes (in accordance with the MRC framework) will include the acceptability of the ACT-based video game intervention, the feasibility of the recruitment, outcome measures and intervention adherence.

### Acceptability

- ▶ Number of people dropping out.



**Figure 1** First scene in ‘ACTing Mind’, the character, Steve, is depressed and alone.

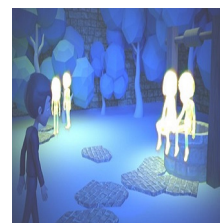
- ▶ Barriers for adoption of intervention as assessed through interviews.
- ▶ Number of sessions attended.
- ▶ Time dedicated to home journal.
- ▶ ACT principles adherence in everyday life setting (as recorded in journal and expressed through interviews).
- ▶ Experience, identifying whether participants had positive experience with the intervention and whether they wanted to continue to be part of the intervention.

### Feasibility

- ▶ Number of participants who are willing to take part.
- ▶ Time taken to complete questionnaires.
- ▶ Number of complete and incomplete questionnaires.

### Secondary outcome measures

Warwick-Edinburgh Mental Well-Being Scale<sup>53</sup>: a measure of mental well-being with a focus on positive aspects of mental health. This measure has good internal



**Figure 2** An example scene, where the character ‘Steve’ is in his own mind, and can see his own memories, through his Mindscape machine.



consistency with a Cronbach's alpha coefficient of 0.89 (student sample) and 0.91 (general population sample).

Depression Anxiety Stress Scales: a short version of this measure and a measure of general psychological distress with good construct validity (confirmatory factor analysis of 0.94). It has good internal reliability as measured through Cronbach's alpha coefficients, which are 0.88 for depression, 0.82 for anxiety, 0.90 for stress and 0.93 for the total scale.<sup>54</sup>

Social connectedness (adapted from Russell's (1996) UCLA Loneliness Scale<sup>55</sup>: this measure involves two questions: (1) "During social interactions, I feel 'in tune' with the person/s around me", and (2) "During social interactions, I feel close to the person/s". The Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98 (M=0.94, SD=0.03).<sup>55</sup>

EuroQol five dimensions (EQ5D): the EQ5D is a measure for health-related quality of life. There are five components within this measure which assess mobility, self-care, usual activities, pain, discomfort and anxiety. It also has a visual analogue scale (VAS) for measuring current health status. Scores for these will be calculated for each of these five subsections as well as including the VAS and total EQ5D score of all five subsections. The EQD5 correlates well with other health-related questionnaires such as the 36-Item Short Form Survey ( $r=0.61$ ,  $p<0.0001$ ) and Parkinson's Disease Questionnaire (PDQ)-39 ( $r=-0.75$ ,  $p<0.0001$ ).<sup>56</sup>

Acceptance and Action Questionnaire-second version: this is a seven-item scale developed by Bond *et al*<sup>57</sup> to measure psychological inflexibility, which involves the ability to accept and be open to difficult thoughts and feelings as well as to engage in valued behaviour in the presence of the difficult thoughts and feelings. A higher score indicates higher psychological inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of 0.84.<sup>57</sup>

### Adherence to the intervention measure and trial

Adherence will be measured in a variety of ways such as intervention feedback, treatment adherence through attrition rates as well as meta-data of relating to game log-in and log-out, as well as how long the game was played for and what sessions of the game were completed for each participant. Similar information can be recorded in Qualtrics for ensuring questionnaires are completed carefully. This includes length of times completing the questionnaire, and paying attention to reverse-scored questions.

### Sample size and statistical analysis

Sample size recruited will help us determine whether it is possible to recruit sufficient numbers of participants to manage a full-scale RCT at a later date.

Quantitative data analysis: analysis will focus on descriptive statistics and feasibility outcomes of the questionnaires. While clinical effectiveness will not be formally evaluated at this stage, effect sizes will be explored for

early evidence that the intervention shows promising signs (including ACT-related process measures). It is predicted that outcomes will improve, and any improvement will be identified using a one-way analysis of covariance with a single within-subjects factor (time). The effect sizes will also allow for a power calculation to be made which will allow for an approximation for a sample size required in a future trial (if indicated).

Qualitative data analysis: transcripts of focus group interview data will be generated from digital audio-recordings of in-depth, face-to-face semi-structured interviews (all online and via a password-protected room in Zoom). In-depth semi-structured interviews will form the core topics to be discussed (see table 2), while leaving space and scope for the identification and exploration of unforeseen information that may emerge. Insights from this will allow for further development and improvement of the intervention, along with the quantitative data in line with the MRC guidelines.<sup>49 50</sup>

Thematic analysis will then be conducted which will explore key overarching themes that may emerge from the focus group interviews following standardised guidelines.<sup>58</sup> The interview questions are based on other novel ACT-based protocols.<sup>40 59</sup> The data will be analysed after the study has been completed. We will follow the inductive and deductive code development as outlined by Fereday and Muir-Cochrane<sup>60</sup> to ensure necessary rigour. Any key overarching themes identified which relate to feasibility of the study design of the acceptability of the intervention, as well as potential adverse effects, will be explored and reported.

The focus groups will comprise 4 to 6 groups with 6 to 10 individuals in each group as has been suggested as optimal in other studies.<sup>61</sup> The interview will take place at the end of the intervention (week 3). It will explore various aspects of the intervention such as perceived process of change, barriers to intervention adherence, trial process and any adverse effects, which help supplement the quantitative approach. Process of change questions indicate whether the participant learnt anything about ACT, and felt any positive change in their life due to participating in the intervention. The question relating to barriers explores any problems and difficulties they had with the intervention. Another question will be asked to elicit suggestions for improvement relating to game or study design. Acceptability questions and process of change in one's life relate to whether the participant accepted the intervention and used skills they learnt through the intervention in daily life. The question relating to the trial process will determine whether there were any difficulties or limitations of the trial itself such as whether the instructions were clear and how it could be improved. Finally, the question on adverse effects explores whether there were any potential unforeseen negative consequences of the intervention.

### Limitations of the study

This study protocol has limitations. First, while physiological measures would ideally be collected to measure



**Table 2** Qualitative interview protocol for the focus groups

Acceptability and feasibility	How would you describe your experience of taking part in 'ACTing Mind' video game programme?
Accessibility of intervention	If this intervention were rolled out as a video game app, do you think you would download it? Would you appreciate the accessibility?
Process of change	What did you learn from this programme?
Acceptability	What was the aspect of the programme that you liked the most? What was your favourite activity within the game (or applied to your everyday life)?
Suggestions for further improvement	What did you least like about the intervention? What do you think could be improved?
Barriers	Were there any difficulties to taking part?
Implementing change in everyday life	Do you practice mindfulness, acceptance, defusion and values? How often? Could you apply what you have learnt through video game intervention to the real world in everyday events? Will you apply this new knowledge to everyday events?
Process of change	Have you noticed any differences in your life as a result of taking part in 'ACTing Mind'? If 'yes', what are these differences?
Acceptability	Would you recommend this intervention to someone you care about? Did you like the theoretical concepts central to the ACT intervention? How did you feel about its delivery? Was any of it too abstract or difficult to understand?
Processes of the trial	Was there anything you liked, or disliked about the study? How could we improve this study? Were all the instructions clear?
Adverse effects	Did you feel that any aspect of the intervention may have made worse any aspect of your anxiety, depression or stress? Were there any adverse effects that you can recognise due to the intervention?

variables such as heart rate variability, the COVID-19 pandemic limits our capacity to do this. However, the present study will provide important data on which such measures could be collected, analysed and interpreted in a future trial. Second, it could be questioned why there is no control condition in this study. Our response to this potential criticism is that the aim of the present study is to assess feasibility and—in line with the MRC guidelines<sup>49 50</sup>—has not been designed to be a full-scale RCT given the current research phase. Once the feasibility component is completed, a control condition will be introduced, which allow for the intervention condition to be compared with control, and as part of a full trial. Finally, although we would like to have ability to monitor the participant more directly, to ensure adherence to the intervention, we are sensitive to privacy issues associated with, for example, capturing participants' identity from the computers video camera. To mitigate this limitation, we have opted for less invasive procedures for measuring intervention adherence that will include logging metadata of the game such as log in and out times, as well as completion of game sections. Several questions in the questionnaire are also reverse scored to ensure participants are paying attention.

### Protocol amendments

If the protocol is amended in any way, it will be communicated to relevant parties immediately, such as to participants, journal and ethics committee.

### Ethics and dissemination

This study has received ethical approval from Swansea University Psychology Department ethics committee (2020-4920-3923). Participants will be informed of their rights to confidentiality and to leave the study at any time and without penalty. Both qualitative and quantitative data will be held on a password-protected computer accessible only to researchers DJE and AHK. The data will be anonymised with a unique identifier code, and any personally identifiable information will be removed.

Dissemination will involve peer-reviewed journals; leading national and international conferences, social media and public events and through general public health engagement such as talks at schools, the Welsh Government and engagement with annual science festivals including 'a pint of science'.

### Impact of intervention

The potential impact of this study is far reaching as it will add to the growing set of online resources which support psychological resilience, flexibility and well-being. These resources are designed to be easy to access and are ideal for situations where travel is limited due to physical (disability) or situational (coronavirus) immobility. Such interventions can help alleviate widely reported mental health treatment gaps<sup>2</sup> and lags,<sup>3</sup> associated with the widely reported scarce human resources needed to provide mental health support for the many individuals who need it. The 2018 Lancet commission on global mental health argued that sustainable development



of mental health should be an essential component of universal health coverage.<sup>4</sup> Technological innovation of mental health support services, in the form of video games, may be one means to achieve this sustainability and a reduction in the treatment gap and lag.

### Ancillary and poststudy care

Postintervention care has not been anticipated given this is a low-level (low-risk) intervention. Of course, all participants will be given a debrief form which will signpost individuals to the relevant free well-being services such as the Samaritans.

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**Contributors** DJE developed the intervention. DJE and AHK agreed on a set of outcomes. DJE wrote the first draft of the protocol and DJE and AHK then revised the subsequent drafts of the protocol. Both authors helped to revise the manuscript for intellectual content and agreed on the final version prior to submission for peer review.

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**Competing interests** At the time of writing this, DJE is discussing with Agor IP at Swansea University the potential to commercialise the described video game as a mobile application; however, at this time no agreements have been made or signed. AHK has no competing interests.

**Patient consent for publication** Not required.

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## PARTICIPANT INFORMATION SHEET

### **A novel ACT-based video game to support mental health through embedded learning**

You are being invited to take part in some research. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please read the following information carefully.

#### **What is the purpose of the research?**

The aim of the research project is to gain insight into whether exposure to a novel-acceptance and commitment therapy (ACT) video game can improve various outcome measures of depression, anxiety, stress, and other measures relating to wellbeing.

If you are above the age of 18 and are currently experiencing ongoing mild to moderate levels of depression, anxiety, or stress you are welcome to participate in this study. For those individuals who present with high levels of depression and anxiety, we will advise the participant to consult either with a GP or with a therapist if they have one, in relation to participating in this experiment.

Participation in this study will take approximately 3 hours over three weeks. Which is broken down into 1 hour for the intervention (the video game itself); 1 hour for online one-on-one qualitative audio interviews via Zoom after completing the game, and after a 3-week follow-up; and 1 hour for the three-questionnaire assessments at baseline (pre-intervention), immediate post-intervention, and after a 3-week follow-up.

#### **Who is carrying out the research?**

The data are being collected by Prof. Andrew Kemp and research assistant Tom Gordon of the Psychology Department within the College of Human and Health Sciences at Swansea University, as well as Dr. Darren Edwards of The Department of Public Health, Policy, and Social Sciences. The research has been approved by the Department of Psychology's Research Ethics Committee.

#### **What happens if I agree to take part?**

If you are happy to take part in this research project, please click "accept" at the bottom of the consent section below, which will then allow you to complete a baseline questionnaire assessment. The questionnaire assessment includes a range of multiple-choice questions. These questions cover a range of factors including depression, anxiety, stress, and wellbeing. There are three questionnaire assessments to complete, the first of which is a baseline assessment prior to the intervention commencing, the second will be completed following the intervention, and a follow-up assessment 3 weeks following the baseline assessment. All of the questionnaires ask the same questions with the addition of demographic questions at baseline assessment, and the second also asking about adherence to the intervention.

The intervention will consist of completing a one-hour session of playing an ACT-based video game, followed by completion of a short reflection workbook. The game itself will be completed by the participant at home, using a mobile phone or any iOS device. This is an adventure game that will teach you about psychological resilience. In the game, you will control the character Steve as he embarks on a journey into his own mind, you will help as he confronts painful past memories and learns how to cope with his full potential.



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6 You will also be interviewed, which will be conducted online via zoom, regarding your experiences of  
7 the game, focusing on what you felt did and did not work. The interviews will be conducted at two  
8 points during the study, post-intervention, and after a 3-week follow-up. Interview audio will be  
9 recorded and transcribed, following which the recordings and any personal information will be  
10 immediately deleted.  
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### 13 **Are there any risks associated with taking part?**

14  
15 We are not aware of any significant risks associated with participation. While some of the questions  
16 will ask about existing states of mental health (e.g., levels of current anxiety and depression) – which  
17 some people may find uncomfortable – the video game has developed in accordance with recent  
18 developments in psychological science to help you manage these, and we expect that participation in  
19 this study will help to ameliorate these feelings.  
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21 If you feel affected by any issues raised by this research and would like to discuss any concerns,  
22 please contact the principal investigators of this study as indicated in the contact details at the bottom  
23 of this information sheet. If you feel that you would benefit from further psychological or psychiatric  
24 support, we advise you to contact your GP (family doctor) in the first instance. Further information on  
25 mental wellbeing can be found at <https://www.mind.org.uk/>. Additional mental health information can  
26 be found at <https://www.nhs.uk/mental-health/>.  
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30 This research has been approved by the Department of Psychology's Research Ethics Committee.  
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### 32 **Data Protection and Confidentiality**

33 Your data will be processed in accordance with the Data Protection Act 2018 and the General Data  
34 Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly  
35 confidential. Your data will only be viewed by the researcher/research team.  
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37 Standard ethical procedures will involve you providing your consent to participate in this study by  
38 ticking the consent box in the consent section  
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40 All electronic data will be stored on password-protected computers.  
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42 Please note that the data to be collected for our study will be made anonymous once you have  
43 completed all stages of the research, and your response data will not hold any personally identifiable  
44 information. We will allocate you with an identifier code, and keep your email information for the  
45 duration of the study, so that we can communicate with you at the time points. We will delete contact  
46 emails at the end of the study.  
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49 All data deposited in Swansea University's OneDrive for Business service is stored within Microsoft's  
50 data centres located in the EU. Swansea University retains full ownership and control over the data  
51 and is satisfied that the data is properly secured and protected.  
52

53 The contractual agreements between Microsoft and Swansea University have been negotiated by the  
54 JISC on behalf of the UK HE sector and abide by all relevant UK and European legislation. In  
55 addition, the UK Government has granted Microsoft Azure and Microsoft Office 365 "OFFICIAL"  
56 accreditation. This means that they are accredited to hold or transact public sector data for business  
57 conducted at the OFFICIAL level of Security Classification.  
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### 60 **What will happen to the information I provide?**

Version 4 4 November 2022





An analysis of the information will form part of our report at the end of the study and may be presented to interested parties and published in scientific journals and related media. *Note that all information presented in any reports or publications will be anonymous and unidentifiable.*

### **Is participation voluntary and what if I wish to later withdraw?**

Your participation is entirely voluntary – you do not have to participate if you do not want to. If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty (simply close your web browser). All identifying information will be stripped from collected data once you have completed all phases of the study. If you wish to withdraw at any time during the study, all personal information will be immediately deleted.

### **Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data, and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent to participate in this study by ticking the consent box on the consent page.

The legal basis that we will rely on to process your personal data will be processing in line with public interest, scientific and statistical purposes.

### **How long will your information be held?**

Anonymised data will be preserved and accessible online, as is encouraged by developments in open science.

### **What are your rights?**

You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)  
Vice-Chancellor's Office  
Swansea University  
Singleton Park  
Swansea  
SA2 8PP  
Email: [dataprotection@swansea.ac.uk](mailto:dataprotection@swansea.ac.uk)

### **How to make a complaint**

If you are unhappy with the way in which your personal data has been processed you may, in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,  
Wycliffe House,



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6 Water Lane,  
7 Wilmslow,  
8 Cheshire,  
9 SK9 5AF  
10 www.ico.org.uk  
11  
12

### 13 **What if I have other questions?**

14 If you have further questions about this study, please do not hesitate to contact us:

16 Tom Gordon  
17 Research Assistant  
18 Swansea University  
19 tom.gordon@swansea.ac.uk  
20

21 Prof. Andrew Kemp  
22 Department of Psychology  
23 Swansea University  
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27 Department of Public Health, Policy,  
28 and Social Sciences.  
29 Swansea University  
30 d.j.edwards@swansea.ac.uk  
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## DEBRIEF FORM

Title of project: **A novel ACT-based video game to support mental health through embedded learning**

Thank you for taking part in our research. Now that your contribution has finished, let us explain the rationale behind this work.

We are interested in how a video game based on recent developments in clinical psychology might enable learning of psychological resilience skills through play. Typically, psychotherapeutic interventions are delivered through face to face sessions, but there is an increasing need for psychological support that is delivered through an online medium such as the video you have been playing in our study.

This work therefore builds on previous efforts to teach people important skills in psychological resilience through psychoeducation and embedded learning. Specifically, the game is designed to build psychological flexibility, which is a key outcome of an ACT intervention. Psychological flexibility within ACT refers to the promotion of positive mental health, contact with present emotions, wellbeing, and positive emotions. We hope that information gained from this study will be useful for further developing our ACT-based video game and expanding further research in this area.

If you feel affected by any issues raised by this research and would like to discuss any concerns, please contact the principal investigators of this study as indicated in the details provided below. If you feel that you would benefit from further psychological or psychiatric support, we advise you to contact your GP (family doctor) in the first instance. Further information on mental wellbeing can be found at <https://www.mind.org.uk/>. Further information regarding mental health can be found at <https://www.nhs.uk/mental-health/>.

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Department of Psychology  
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## CONSORT 2010 checklist of information to include when reporting a pilot or feasibility trial\*

Section/Topic	Item No	Checklist item	Reported on page No
<b>Title and abstract</b>			
	1a	Identification as a pilot or feasibility randomised trial in the title	1
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT abstract extension for pilot trials)	2/3
<b>Introduction</b>			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	4-9
	2b	Specific objectives or research questions for pilot trial	8-9
<b>Methods</b>			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	9
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	8
Participants	4a	Eligibility criteria for participants	10
	4b	Settings and locations where the data were collected	10
	4c	How participants were identified and consented	10
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	12
Outcomes	6a	Completely defined prespecified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	10-12
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	N/A
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	N/A
Sample size	7a	Rationale for numbers in the pilot trial	10
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	N/A
	8b	Type of randomisation(s); details of any restriction (such as blocking and block size)	N/A
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	N/A



Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	N/A
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	N/A
	11b	If relevant, description of the similarity of interventions	N/A
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	14-17
<b>Results</b>			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were approached and/or assessed for eligibility, randomly assigned, received intended treatment, and were assessed for each objective	17
	13b	For each group, losses and exclusions after randomisation, together with reasons	17
Recruitment	14a	Dates defining the periods of recruitment and follow-up	17
	14b	Why the pilot trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	30
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be by randomised group	17
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	30
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	17-29
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	N/A
	19a	If relevant, other important unintended consequences	N/A
<b>Discussion</b>			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	33-34
Generalisability	21	Generalisability (applicability) of pilot trial methods and findings to future definitive trial and other studies	31
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms, and considering other relevant evidence	31-35
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	34-35
<b>Other information</b>			
Registration	23	Registration number for pilot trial and name of trial registry	3
Protocol	24	Where the pilot trial protocol can be accessed, if available	35
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	35
	26	Ethical approval or approval by research review committee, confirmed with reference number	36

1 Citation: Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. BMJ. 2016;355. This is  
2 an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 3.0) license (<http://creativecommons.org/licenses/by/3.0/>), which permits others to  
3 distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited.

4 \*We strongly recommend reading this statement in conjunction with the CONSORT 2010, extension to randomised pilot and feasibility trials, Explanation and Elaboration for important  
5 clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments,  
6 herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up-to-date references relevant to this checklist, see [www.consort-statement.org](http://www.consort-statement.org).

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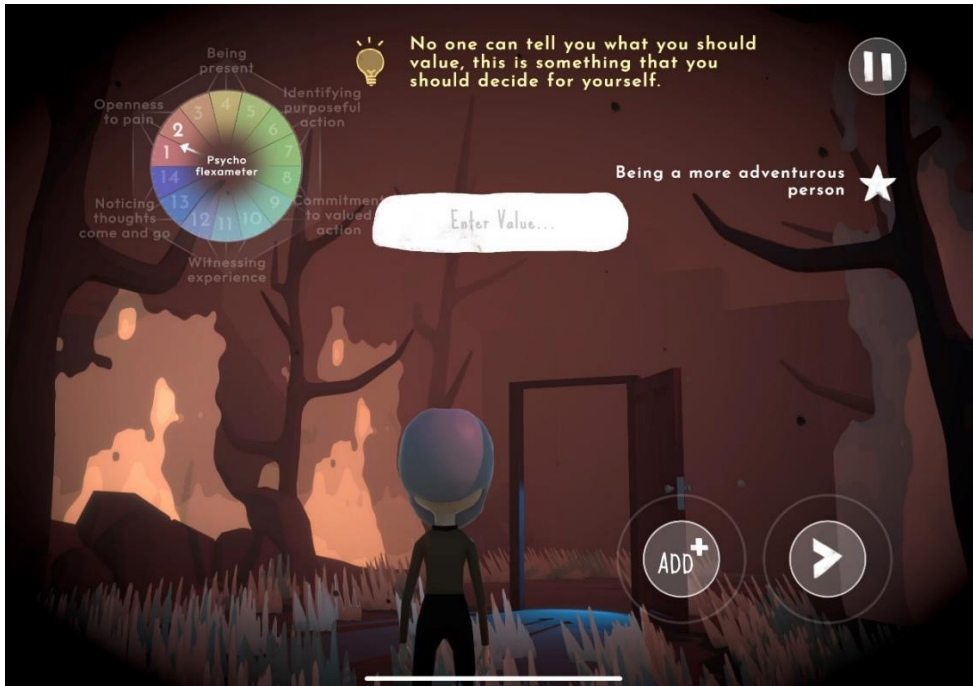
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# BMJ Open

## Mixed-methods feasibility outcomes for a novel ACT-based videogame 'ACTing Minds' to support mental health

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2023-080972.R1
Article Type:	Original research
Date Submitted by the Author:	16-Feb-2024
Complete List of Authors:	Gordon, Tom; Swansea University, School of Psychology ; Swansea University Kemp, Andrew; Swansea University, Psychology Edwards, Darren; Swansea University, Department of Public Health
<b>Primary Subject Heading</b>:	Mental health
Secondary Subject Heading:	Public health
Keywords:	MENTAL HEALTH, Health Education, Depression & mood disorders < PSYCHIATRY

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3 **Mixed-methods feasibility outcomes for a novel ACT-based videogame**  
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6 **‘ACTing Minds’ to support mental health**  
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12 Tom C. Gordon<sup>1,2</sup>, Andrew H. Kemp<sup>2</sup>, & Darren J. Edwards<sup>1</sup>  
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58 Short title: Feasibility outcomes ACTing Minds  
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## Abstract

**Objectives:** To determine the feasibility and acceptability of ‘ACTing Minds’, a novel single-player adventure videogame based on acceptance and commitment therapy (ACT).

**Design:** A single-arm, mixed-methods repeated measures feasibility study.

**Setting:** Intervention and questionnaires were completed at home by participants. Semi-structured interviews were also conducted at home via the Zoom platform.

**Participants:** Thirty-six participants were recruited into the study, 29 completed all phases of the feasibility design. Eligibility criteria required participants to be over the age of 18 and self-reporting experiencing ongoing depression, anxiety, or stress.

**Intervention:** Participants completed a single session of the ‘ACTing Minds’ videogame, lasting approximately 1-hour, designed to educate users on key principles from acceptance and commitment therapy (ACT).

**Primary outcome measures:** Participant recruitment and retention, questionnaire completion, long-term intervention adherence, and acceptability of the intervention. Reflexive thematic analysis was conducted on semi-structured interviews run immediately postintervention and 3-weeks later.

**Secondary outcome measures:** Measures of depression, anxiety, stress, psychological flexibility, social connectedness, and wellbeing were assessed at baseline, immediately following intervention completion, and after a 3-week follow-up period. We used a standardised battery of questionnaires.

**Primary results:** Twenty-nine participants completed the study. A reflexive thematic analysis indicated that participants responded positively to the intervention and the study at all stages. Themes reflect participants’ desire for an engaging therapeutic experience, use of

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3 game for exploring emotions, as well as their perspectives on how they had applied their  
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5 learning to the real-world.  
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8 **Secondary results:** Quantitative results indicated small to large effect sizes associated with  
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10 decreases in depression ( $\eta^2 = .011$ ), anxiety ( $\eta^2 = .096$ ), stress ( $\eta^2 = .108$ ), and increases  
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12 in psychological flexibility ( $\eta^2 = .060$ ), social connectedness ( $\eta^2 = .021$ ), well-being ( $\eta^2$   
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14  $=.011$ ), and participation in usual activities ( $\eta^2 = .307$ ).  
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18 **Conclusions:** Implementation of the 'ACTing Minds' intervention is warranted, based on  
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20 both qualitative and quantitative outcomes.  
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23 **Trial Registration number** NCT04566042  
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### 26 27 **Strengths and limitations of this study** 28

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30 • Mixed methods approach, combining thematic analysis of interviews and quantitative  
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32 questionnaires.  
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- 35 • Collection of quantitative data at three time points and qualitative at two time points,  
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37 allowing the process of change and identification of patterns to be examined.  
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- 40 • Remote data collection due to COVID restrictions meant that participants could not be  
41  
42 directly observed while completing the intervention. We were also unable to record  
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44 planned psychophysiological measurements of wellbeing such as heart rate  
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46 variability.  
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- 49 • Reliance on self-report measures introduces the potential for bias.  
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## Introduction

The global prevalence of common mental disorders and a lack of available resources for the identification and treatment of those with such conditions underpin an increasing burden on society (1). The Global Burden of Disease study conducted in 2017, reported a UK prevalence rate of 4.12% for depression, and 4.65% for anxiety disorders (2). Since this estimation, events such as the COVID-19 pandemic and the increasing threat of climate crises have had a substantial impact on societal wellbeing. A meta-analysis including 14 studies (n=46,158) found that 32% of adults in the UK experienced moderate to severe depressive symptoms in 2022, and 31% of adults reported high levels of anxiety (3), indicating a societal increase of 27.88% for depression, and 26.35% increase for anxiety between 2017 and 2022. These findings suggest the need for a transition towards population-wide strategies aimed at fostering psychological resilience on a broader scale.

To positively impact societal wellbeing, contemporary interventions must be affordable and widely accessible. Presently, the demand for mental health services far exceeds the available human resources required to meet this need. A study conducted for the Centre for Mental Health estimated that services cost the UK economy approximately £105 billion per year in 2020, 4.8% of the UK's annual GDP (4). Despite substantial funding of £34 billion to public mental health support and services, the prevalence of psychological disorders is high and only 33% of adults with depression and anxiety receive treatment in England (5), highlighting an urgent need for innovation.

There are numerous barriers to accessing psychological interventions, including a shortage of therapists, long waiting times, and societal stigma of accessing psychological treatment (6). A potential solution to these issues might be found in digital health interventions (DHIs). We live in an age of heavy digital media consumption, especially in the

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3 West where at least 90% of UK adults use the internet regularly (7). We also know that  
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5 during the COVID-19 pandemic, there were significant increases in online video  
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7 consumption, social media usage, remote work, online news consumption, and video gaming  
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9 (8). COVID-19 contributed to significant social isolation and further disconnection from  
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11 nature, further contributing to increases in mental health conditions (9). We argue that there is  
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13 an opportunity to leverage technological advancements and the growing use of technology to  
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15 develop psycho-educational tools necessary to support mental health at scale.  
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19 DHIs have already been utilised in a variety of contexts for promoting wellbeing, from  
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21 delivering healthcare and education to personalised diet and fitness plans. Mobile apps and  
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23 online platforms offer guided meditation, breathing exercises, sleep tracking, and relaxation  
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25 programs. Such applications might aim to enhance overall wellbeing, reduce stress, improve  
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27 sleep quality, or cultivate mindfulness practices (10). We suggest that effectively addressing  
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29 wellbeing at a population level should involve the development of DHIs that consider  
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31 acceptability, feasibility, and widespread appeal.  
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35 Compared with alternative forms of media, videogame DHIs offer several advantages.  
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37 By design they are interactive, applying behavioural principles for controlling and modifying  
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39 behaviour (11), making them uniquely captivating. In the UK, the COVID-19 pandemic led  
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41 to a substantial increase in the number of people playing video games, with males increasing  
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43 their use from 46% to 63% and females increasing their use from 32% to 56% in 2022 (12).  
44  
45 Innovations in the use of video games for treating mental health issues have wide potential  
46  
47 applications, potentially offering a platform for individuals to explore their ongoing  
48  
49 relationship with their emotions in a supportive environment.  
50  
51

52  
53 In theory, by practicing skills derived from psychological therapies (such as ACT)  
54  
55 within the game context, individuals can transfer these skills to real-life situations to improve  
56  
57 their overall quality of life. Certain games specifically designed for therapeutic purposes,  
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3 such as 'SPARX' for depression (13) or 'Elude' for anxiety (14), guide players through  
4  
5 interactive challenges and cognitive exercises for developing emotional regulation skills.  
6  
7 Videogames are also being used in clinical settings to promote wellbeing outcomes. One  
8  
9 game designed for this purpose, 'Dojo' (15), aims to treat anxiety by training users in  
10  
11 breathing techniques, muscle relaxation, positive thinking, and guided imagery, utilising  
12  
13 heart-rate variability (HRV) biofeedback. However, when compared against a standard  
14  
15 commercial game 'Rayman 2' (control condition), a full pre-post RCT (n=138) found that  
16  
17 playing either game significantly reduced participant anxiety at a 3-month follow-up, and  
18  
19 there were no significant difference between these two games at reducing anxiety for this  
20  
21 time period (15). Reasoning for this might be that 'Dojo' failed to develop the  
22  
23 psychoeducational skills in the participants that it aimed to impart, or that both games only  
24  
25 reduced anxiety by distracting (as a form of avoidance) participants from anxiety-provoking  
26  
27 thoughts (16). The researchers concluded that 'Dojo' had crucial design issues that needed to  
28  
29 be addressed including a lack of clear theoretical and therapeutic frameworks, and that  
30  
31 research assessing the real-world effectiveness of video games in the treatment of mental  
32  
33 health issues should require an appropriate methodology for understanding the underlying  
34  
35 causes of improvement.  
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42 A study aiming to explore the wellbeing effects of playing video games on gamers  
43  
44 during the COVID-19 pandemic (n=781) found that time spent playing had significantly  
45  
46 increased in 71% of participants, and 58% of participants reported that playing games had  
47  
48 positively impacted their wellbeing (17). The researchers conducted an online survey  
49  
50 including both closed and open-ended questions, then conducted a thematic analysis to  
51  
52 identify the causes of improvement. Themes of escape, cognitive stimulation, stress relief,  
53  
54 agency, and socialisation were most associated with feelings that playing video games had  
55  
56 increased wellbeing. The development of an effective DHI videogame should consider such  
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3 factors whilst also building on strong theoretical and therapeutic foundations that facilitate  
4  
5 the uptake of such tools.  
6

7  
8 The 'ACTing Minds' videogame, developed in line with our intervention protocol  
9  
10 (16), was designed to be a comprehensive transdiagnostic intervention that will integrate  
11  
12 lessons from acceptance and commitment therapy (ACT) (18). In contrast to prior mentioned  
13  
14 DHIs, commonly rooted in the medical model and second-wave approaches, ACT as a third-  
15  
16 wave behavioural therapy focuses on promoting psychological flexibility rather than the  
17  
18 elimination of disorder symptoms (19). More specifically, ACT aims to promote  
19  
20 psychological flexibility through six core processes of change (20). These are: (1) present  
21  
22 moment awareness: the practice of being in the here and now; (2) acceptance: the practice of  
23  
24 being open to the range of human emotional experience, as opposed to experiential  
25  
26 avoidance; (3) Cognitive defusion: the act of recognising the self as separate from thoughts,  
27  
28 and not interpreting them literally; (4) values: identifying ones' personal values in contrast to  
29  
30 perceived expectations, of which drive us toward self-direction and purpose; (5) action: a  
31  
32 commitment to ones' values, facilitating the development of competence through the act of  
33  
34 continual practice of alignment with values (21); and (6) self as context: developing an  
35  
36 awareness of self that is more than a conceptualised sense of self, one that is flexible and  
37  
38 facilitates a sense of connection with others.  
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44  
45 Though ACT clinical practice does not focus primarily on reducing mental health  
46  
47 symptoms, many studies have indicated that when the individual works towards greater  
48  
49 psychological flexibility, many mental health symptoms, and destructive behaviours such as  
50  
51 anxiety, depression, stress, pain, and substance misuse, tend to reduce with clinically  
52  
53 acceptable small to high effect sizes. This was, for example, identified within a review of 20  
54  
55 meta-analyses, involving 133 studies (n=12,477) that found that ACT was efficacious for  
56  
57 treating these disorders (22). The results also showed that ACT was generally superior to  
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1  
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3 most active intervention conditions (excluding CBT), treatment as usual, and inactive  
4  
5 controls.  
6

7  
8 As such, an ACT-based DHI video game could allow for both greater psychological  
9  
10 flexibility as well as a reduction in common mental health issues such as depression and  
11  
12 anxiety. This is because by developing explicit DHI psychoeducational transdiagnostic skills  
13  
14 that promote present moment awareness, values orientation, commitment to action, openness,  
15  
16 and acceptance of painful emotions, cognitive defusion, and a transcendental self also have a  
17  
18 positive impact on mental health. As a consequence, our videogame may have greater reach  
19  
20 and impact than other videogame DHIs that are not based on third-wave psychotherapy, such  
21  
22 as ‘Dojo’, which primarily aims to teach skills for limited emotional regulation and symptom  
23  
24 reduction such as avoidance.  
25  
26

27  
28 The ACT framework has already been adapted to a variety of accessible mediums,  
29  
30 including self-help books and mobile phone applications (23). Resources for the education  
31  
32 and practice of ACT are freely available through the Association of Contextual Behavioural  
33  
34 Science website (see <https://contextualscience.org/>). ACT-based mobile phone applications  
35  
36 are shown to be effective in promoting psychological flexibility (24) and reducing smoking  
37  
38 intake (25). Considering this, we believe that choosing ACT as the basis for our game will  
39  
40 allow us to harness the advantages of third-wave therapies as transdiagnostic therapeutic tools  
41  
42 and integrate these with those of videogames, and if made well, will be engaging,  
43  
44 educational, and capable of promoting wellbeing (psychological flexibility) at scale.  
45  
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48  
49 Based on our initial protocol (16) (see Supplementary 1), the ACT-based videogame  
50  
51 called ‘ACTing Mind’, has been developed as a psychoeducational tool that teaches users the  
52  
53 core processes of ACT through embedded learning. The goal of this research will be to  
54  
55 determine the acceptability and feasibility of ‘ACTing Minds’ for promoting psychological  
56  
57 flexibility as well as its clinical relevance for reducing mental distress as a secondary  
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1  
2  
3 outcome. The game teaches skills based on the ACT principles of acceptance, defusion, and  
4 values identification. This is a feasibility study, following the Medical Research Council  
5 (MRC) framework (26), laying the foundation for a full-scale RCT from which clinical  
6 effectiveness will be determined.  
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11  
12 Several changes have been made to our originally published protocol (16), it was  
13 initially stated that participants would complete five weekly 1-hour sessions where they  
14 would play through six parts of the ‘ACTing Minds’ videogame, each one focusing on a  
15 different process of ACT. However, because of funding restrictions, ‘ACTing Minds’ has  
16 been compressed into a single game focusing on the ACT principles of acceptance, values  
17 identification, and defusion. Therefore, in this feasibility study, participants will be required  
18 to complete a single 1-hour session of ‘ACTing Minds’. This meant a significant change to  
19 the overall time to complete the study protocol. Originally it was expected to take 3 months  
20 between baseline measurements and the final follow-up. Now, one-on-one semi-structured  
21 interviews will be conducted immediately postintervention, and after a 3-week follow-up.  
22 The research questions are as follows: Is the intervention acceptable and feasible for a full-  
23 scale RCT? Is there early evidence for effectiveness in reducing mental distress? Are there  
24 any changes in self-reported wellbeing measures following completion of the game? Are  
25 participants able to learn ACT principles and apply them in day-to-day life?  
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## 45 **Methodology**

### 46 **Design:**

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48 This is a single-arm, mixed-methods repeated measures study, designed to determine the  
49 feasibility and acceptability of an ACT-based video game called ‘ACTing Minds’ that has  
50 been designed for individuals reporting mild to moderate anxiety, depression, and stress. Data  
51 was collected at baseline, immediately post-intervention, and 3-weeks post-intervention. Data  
52 collection was conducted between November 1<sup>st</sup> and December 31<sup>st</sup>, 2022.  
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**Study Setting:**

The study was conducted entirely online by participants, including the intervention (via a link to the mobile app; <https://shorturl.at/iqFGI>), quantitative assessment (via the Qualtrics platform), and qualitative interviews (via the Zoom platform). Strict recommendations were given to participants to ensure they were in a quiet room and without disruption for all study components.

**Participants:**

Thirty-six participants were recruited, 29 of which completed all phases of the study. Participants were recruited using purposive sampling methods, they were required to be at least 18 years of age, self-reporting ongoing experience of mild to moderate depression, anxiety, or stress within their day-to-day life, and able to read, write, and speak English. The sample size was justified on the basis of past research reporting the median numbers of participants recruited for similar feasibility studies incorporating both quantitative and qualitative elements (27). Advertisements were posted at Swansea University notice boards and on social media pages (Facebook mental health community groups). Participants were recruited between October 1<sup>st</sup> and December 1<sup>st</sup>, 2022, they completed a consent form (see Supplementary 2) after reading the study information sheet (see Supplementary 3) and were given a debrief sheet (see Supplementary 4) following completion of the study, each are included as supplementary materials.

**Primary outcome measures:**

Feasibility outcomes were determined using the MRC framework (26) and reported in line with CONSORT guidelines (28) (see Supplementary 5). Feasibility measures included data relating to participant recruitment and retention including the number of participants willing to take part, and completing each stage of the study (i.e., intervention, questionnaires,

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3 interviews, and follow-up). Acceptability and efficacy of the intervention was assessed  
4  
5 through thematic analysis of semi-structured interviews conducted immediately post-  
6  
7 intervention and 3-weeks post-intervention, which focussed on participant experiences with  
8  
9 ‘ACTing Minds’. The first interview (see Open Science Framework for first interview  
10  
11 protocol: <https://osf.io/5fvjs>) asked questions about: (1) the acceptability of the intervention;  
12  
13 (2) what they learned from the intervention; (3) suggestions for further improvement; (4)  
14  
15 whether there were any difficulties (barriers) in taking part; (5) aspects they liked and  
16  
17 disliked; and (6) were there any adverse effects that they noticed whilst playing the game.  
18  
19 This was followed by a second interview (see Open Science Framework for second interview  
20  
21 protocol: <https://osf.io/32epw>) that was focused more on the real-world impact that ACTing  
22  
23 Minds had on their lives and their experience over the three-week period. Specifically, the  
24  
25 second interview asked: (1) about their retrospective experience in taking part in the ACTing  
26  
27 Minds intervention; (2) how much they remember about the core ACT concepts; (3) were any  
28  
29 aspects more memorable than others; (4) had they implemented any of the ACT concepts that  
30  
31 they learned whilst playing the game into their day to day lives; (5) had they found that any  
32  
33 particular ACT concepts were more applicable to their everyday lives than others; (6) would  
34  
35 they reuse the intervention; and (7) had they noticed any adverse effects in the three weeks  
36  
37 since playing ACTing Minds.  
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#### 45 **Secondary outcome measures:**

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48 Questionnaires were distributed at three points in time (baseline, immediate postintervention,  
49  
50 and 3-month follow-up). A rule was created in Qualtrics requiring participants to complete  
51  
52 every questionnaire item in order to finish the survey, which included the following  
53  
54 questionnaires:  
55  
56

57       Depression Anxiety Stress Scales (DASS-21): a measure of general psychological  
58  
59 distress with good construct validity (confirmatory factor analysis of 0.94), that can be  
60

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2  
3 broken down into subscales relating to stress, anxiety, and depression. It has good internal  
4 reliability as measured through Cronbach's alpha coefficients, which are 0.88 for depression,  
5  
6 0.82 for anxiety, 0.90 for stress, and 0.93 for the total scale (29).  
7  
8  
9

10 Acceptance and Action Questionnaire-second version (AAQ-II): a questionnaire of  
11 seven items, assessing psychological inflexibility by gauging one's capacity to embrace and  
12 remain receptive to challenging thoughts and emotions, while also actively participating in  
13 meaningful actions despite their presence. A higher score indicates higher psychological  
14 inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of  
15 0.84 (30).  
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24 Social Connectedness Scale (adapted from Russell's (1996) UCLA Loneliness Scale  
25 (31): this measure involves two questions: (1) "During social interactions, I feel 'in tune'  
26 with the person/s around me", and (2) "During social interactions, I feel close to the  
27 person/s". The Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98  
28 (M=0.94, SD=0.03) (32).  
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36 Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): a metric that emphasises  
37 the positive facets of mental health, aiming to evaluate overall psychological well-being. This  
38 measure has good internal consistency with a Cronbach's alpha coefficient of 0.89 (student  
39 sample) and 0.91 (general population sample) (33).  
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45 EuroQol Five Dimensions (EQ5D) (34): a measure for health-related quality of life.  
46 There are five components within this measure which assess mobility, self-care, usual  
47 activities, pain, discomfort, anxiety, and a visual analogue scale for measuring current health  
48 status.  
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#### 54 **Intervention:**

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3 The intervention comprised of an ACT-based video game intervention called ‘ACTing  
4 Minds’, developed and designed by author DJE. Participants attended a single session lasting  
5  
6 approximately 1-hour, during which they completed four in-game chapters.  
7  
8  
9

10 The intervention teaches three core principles of ACT through embedded learning,  
11 meaning that the player should gain ACT-based skills while completing in-game objectives,  
12 without being directly taught those skills. These skills include ‘Acceptance’, ‘Cognitive  
13 Defusion’, and ‘Values Identification’. Embedded learning refers to the incorporation of  
14 educational elements into the gameplay itself, in contrast to explicit lessons. In this context, it  
15 involves designing the game in a way that promotes psychological flexibility oriented  
16 behaviours derived from ACT, such as the adoption values orientation, present moment  
17 awareness, openness to pain and cognitive defusion. In ‘ACTing Minds,’ an example of  
18 embedded learning is the ‘Psychoflexameter’ (see Figure 1A), which serves as a gamified  
19 version of the Hexaflex (see Figure 1B), a model used in ACT to illustrate both the theory  
20 and goals for clinical change (35). Similar to the Hexaflex, the ‘Psychoflexameter’ showcases  
21 the 6 core processes of ACT. Initially introduced to players during the first ACT-oriented  
22 activity in the game, which emphasises acceptance, the ‘Psychoflexameter’ remains visible in  
23 the corner of the screen throughout the game while players engage in other ACT-related  
24 activities. As players exhibit ACT-consistent behaviours, they earn points and gradually  
25 increase the dial on the centre of the ‘Psychoflexameter’, and the text reflecting the ACT  
26 processes that the players use lights up green (see Supplementary 6). If players exhibit ACT-  
27 inconsistent behaviours, they lose points and the ‘Psychoflexameter’ lights up red (see  
28 Supplementary 7).  
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54 -----**Figure 1 Here**-----  
55

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57 The game starts with a text-based chapter, telling the story of a depressed individual, ‘Steve’,  
58 who has recently lost his wife in an accident, he is feeling depressed, isolated, and lonely.  
59  
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1  
2  
3 The character has built a 'mind escape machine' intending to enter his own mind to destroy  
4 and suppress his unwanted painful thoughts and memories. The player takes control of  
5  
6 'Steve' in chapter two, where they see him in a state of mental distress at his home,  
7  
8 surrounded by items that are reminders of his lost wife. At this stage, participants learn how  
9  
10 to control the character using an onscreen directional stick and interact with the environment  
11  
12 by touching key elements with their finger on their mobile phone or tablet.  
13  
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16  
17 Participants then engage with ACT content within chapters three and four, which  
18  
19 begin with the character entering his mind (via the mind escape machine), walking around  
20  
21 and viewing painful representations of his memories (of his lost wife). Chapter three focuses  
22  
23 on 'Acceptance', introducing players to a bar in the centre of the screen indicating the  
24  
25 characters' present level of pain and discomfort, as well as the 'Psychoflexameter' dial in the  
26  
27 corner of the screen, indicating the character's psychological flexibility. While in the mind of  
28  
29 the character, the player can approach memories of 'Steve' (himself) and his wife, which  
30  
31 leads to an increase in present pain and allows the option to destroy the memories (this is  
32  
33 intended as metaphorical representation of thought suppression). Destroying memories  
34  
35 decreases short term pain and discomfort, but also removes points from the  
36  
37 'Psychoflexameter'. If the player chooses to destroy the memories (avoidance-based  
38  
39 strategies), the world becomes increasingly distorted, and barriers form making the chapter  
40  
41 impossible to complete. Alternatively, if the player chooses acceptance-based strategies they  
42  
43 can continue the game and learn that acceptance is functionally better than avoidance (see  
44  
45 Supplementary 8).  
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50  
51 Chapter four focuses on rewarding 'Values identification' and 'Cognitive Defusion'.  
52  
53 The player is still in the mind of the character, where they are then asked to reflect on their  
54  
55 values, to type them out and make them explicit (see Supplementary 9). Following this, they  
56  
57 complete a 'leaves on a stream' task, requiring them to type out any painful thoughts that  
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2  
3 they might have and place them on a leaf, watching them as they float downstream (see  
4  
5 Figure 1C). Both tasks reward the player by increasing their score on the ‘Psychoflexameter’.  
6  
7

### 8 **Qualitative analysis:**

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10  
11 We used a critical realist ontological framework for our reflexive thematic analysis (RTA) as  
12  
13 suggested by Braun and Clarke (36) which involves (after an initial familiarisation pre-coding  
14  
15 phase) actively conducting both bottom-up (raw data driven and without a conceptual  
16  
17 framework in mind) inductive, and top-down (ACT theory driven) deductive stages, to  
18  
19 explore participant experience with the “ACTing Minds” intervention. We adopted this  
20  
21 inductive (i.e., without framing the raw data through a theoretical model) first stage approach  
22  
23 to ensure the themes developed were grounded in the raw data itself rather than potentially  
24  
25 being imposed and biased by preconceived theories of the researcher. This is consistent with  
26  
27 the critical realist approach which assumes that at least some of reality exists independently  
28  
29 of our preconceived knowledge and theories, and the researcher should be actively aware of  
30  
31 this. We then followed this with a deductive top-down ACT theory driven second stage that  
32  
33 then allows for a more theory informed interpretation of the qualitative data based on ACT  
34  
35 concepts and theory. This involved a re-examination of interview content with explicit  
36  
37 consideration of how participant statements might relate to our research questions and ACT  
38  
39 theory. The codes developed accordingly, transitioning from reflecting explicit semantic  
40  
41 content to interpretations of underlying latent themes (via an ACT interpretation). This  
42  
43 iteration of induction and deduction are important within RTA, as it allows for a more  
44  
45 nuanced qualitative understanding of semi-structured interviews, that goes beyond a purely  
46  
47 theory driven lens. This adopts a contextualist epistemological stance of our interpretation,  
48  
49 recognising that both researchers’ and participants’ knowledge and perceptions are shaped by  
50  
51 their subjective experiences and situational contexts (36). This combined (critical realist and  
52  
53 contextualist epistemological) philosophical foundation guided the application of our  
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3 reflexive thematic analysis, serving as a contextualised lens for identifying and interpreting  
4  
5 emergent themes from within the interview data.  
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8         The RTA was conducted on two sets of semi-structured interviews (post-intervention  
9  
10 n=29, and 3-week follow-up n=29), following the guidelines outlined by Braun and Clarke  
11  
12 (36). Both interview sets were analysed separately to gain an understanding of changes in  
13  
14 participant perceptions of the intervention and relevant outcomes over time. For reporting on  
15  
16 the acceptability of the ‘ACTing Minds’ intervention, findings and themes from both  
17  
18 interviews are summarised in the primary outcomes section of the paper (see Table 1).  
19  
20 Interview data was transcribed using Microsoft’s automated audio-to-text software, which  
21  
22 was then double checked and edited to correct for major spelling or grammatical errors.  
23  
24 Throughout the initial data familiarisation phase, multiple points of potential analytical  
25  
26 interest were identified. In the coding phase, several hundred codes were initially produced  
27  
28 (both inductively and deductively), which were then clustered to make them more  
29  
30 manageable and categorised into potential broad patterns of meaning. For the analysis of the  
31  
32 first interview set these included: emotional experience; wellbeing needs, perceptions on  
33  
34 mental-health education within the game; and participant engagement. For the second set of  
35  
36 interviews, these were: application of the game’s lessons, perceptions on what was learned,  
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38 desire for growth, and sense of development.  
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45         Themes were then refined in the context of our research questions relating to how the  
46  
47 participants experienced ‘ACTing Minds’, which involved a review of preliminary themes in  
48  
49 relation to the codes, the coded data, and the full dataset. We became most interested in the  
50  
51 latent ideas underpinning statements relating to how participants utilised the game as a  
52  
53 psychoeducational tool. The preliminary theme ‘emotional experience’ was developed, as it  
54  
55 was interpreted from the codes that participants were using the game as a ‘base for exploring  
56  
57 and accepting difficult emotions’. Further development of the remaining themes emphasised  
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3 the processes involved in participant engagement, personal therapeutic goals, and feelings  
4 regarding the games' embedded learning features. Themes derived from the codes in the  
5 second interview reflect the participant outcomes since playing 'ACTing Minds'. This  
6 allowed for an exploration of specific aspects of growth, how the participants implemented  
7 insights gained from the game in the weeks followed, and their reflections on what they had  
8 learned through the practical application of these insights in real-life scenarios.  
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For peer review only

**Table 1.**  
Themes and sample codes taken from thematic analysis for Interviews 1 and 2

Interview 1 (Immediate postintervention)		
Themes	Raw-data (without preconceived theory) driven inductive codes	ACT-theory driven deductive codes
Theme 1: Desire for an engaging therapeutic experience	Need for wellbeing tools; Surprised by effectiveness; Interest in novelty; Wellbeing development as an enjoyable practice	Psychoflexameter aids engagement; Core ACT concepts useful
Theme 2: Personal process of immersion	Empathy with story; Interest in metaphor, Open mind needed; Personalisation aids relatability	Immersion through visual metaphors and agency; Engagement through ACT therapeutic intent
Theme 3: Game as a base for exploring and accepting difficult emotions	Anxiety while making decisions; Game helped to clear head; Desire for future use as a tool”; “Mood change with game;	ACT skills applicable across emotional scenarios; Long term acceptance benefit despite difficult emotional experience; learning to be open to difficult emotions
Theme 4: Embedded learning game dynamics pros and cons	Concepts made more sense as the game progressed; Lack of instruction, but quickly learned concepts; Conflicting choices	Interpreting ACT metaphors quickly; Priming of ACT-based wellbeing; ACT concepts clear despite confusion with game objectives”
Theme 5: Necessary learning for anyone	Desire to share with others; Growing societal appeal	ACT concepts made tangible; Game provided direction for growth towards ACT-values; ACT-concepts felt relevant
Interview 2 (3-weeks postintervention follow-up)		
Theme 6: Utility in the real world	Sharing lessons with others; Easier time letting go; Built desire to learn more	Applying ACT lessons actively; Potential real world subconscious influence of ACT lessons; Increased perspective-taking in real-life events
Theme 7: Practice facilitates psychological flexibility skills	New interest in wellbeing; Shift in thinking; Combined game and interview helpful	ACT-practice encourages optimism with new ACT knowledge despite present suffering; Trial and error of applying ACT-based lessons; ACT-practice encourages renewed focus on values
Theme 8: Closer alignment to an integrated self (as context), with acceptance, values, as part of who you are	Primed self-reflection; Seeing the bigger picture integration about self; Reduced self-judgment	Integrating present moment awareness, acceptance and values; Dealing with grief through acceptance of self as I am; Acceptance brings the self closer to reality; Self-assurance with values; Self as context identification

## Quantitative analysis

A repeated measures ANOVA was performed using IBM SPSS Statistics 29 (the most up-to-date version at the time of analysis), to compare the effects of playing the ‘ACTing Minds’ videogame on scores taken from the questionnaires DASS-21, AAQ-II Psychological Flexibility Questionnaire, Warwick-Edinburgh Mental Well-Being Scale, Social Connectedness Score, and EuroQol Five Dimensions.

Descriptive statistics were used to summarise secondary outcome measures (see Table 2). Changes in scores from baseline are reported for each of the measurement time points. Partial eta squared ( $\eta^2$ ) effect sizes were calculated for each independent variable and interpretation was informed by prior literature on the topic (37). Values 0.14 or higher were interpreted to be a large effect, 0.06 – 0.14 were interpreted to be a moderate effect, and 0.01 – 0.06 were interpreted to be a small effect.

## Procedure

After recruitment (see ‘Participant’ section for recruitment), and consenting to take part in the study, participants were given a link to Qualtrics where they completed the battery of questionnaires (see ‘Secondary outcome measures’ section) at baseline. They were then given a link to the ACTing Minds game (see ‘Intervention’ section) where they completed this within approximately one hour. Once completed, they then immediately completed the quantitative questionnaires (see ‘Secondary outcome measures’ section) again on Qualtrics as an immediate post-intervention. This was then followed by completing a 45-minute to 1-hour one-on-one interview which asked participants about their experiences with the game (see ‘Primary outcome measures’ section). Participants then, after a 3-week follow-up, completed the same questionnaires again, as well as a second interview (see ‘Primary outcome measures’ section) that focus on real world application of the ACTing Minds intervention.

## Public and patient involvement

Key stakeholders were consulted and involved in the development of this protocol. The Patient Experience and Evaluation in Research (Patient Experience and Evaluation in Research (PEER): <https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/>) group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students and staff members, several of whom reported that they had experienced depression, anxiety or stress at some point in their lives and emphasised the need for innovative approaches of the delivery of mental health support. The feasibility design was explained to them, and they gave positive feedback about the nature of the design, intervention and outcome measures.

## Results

### Primary outcome measures

#### Participant recruitment and retention (feasibility)

Thirty-six participants were recruited through the initial study advertisement between October 1<sup>st</sup> and December 1<sup>st</sup>, all of which met eligibility criteria. Six participants did not show up for initial baseline measures, while one participant did not follow through with the intervention (see Figure 2). Only three participants reported why they were not able to attend, where one indicated they had a hospital appointment, another had forgotten about the study date and did not reschedule, while another said they needed to reschedule without giving a reason, but then failed to book in a new date for the study. The other three participants did not report why they could not attend.

-----**Figure 2 Here**-----

## Participant feedback (acceptability)

Acceptability measures were assessed through thematic analysis of semi-structured interviews (all data is available on the Open Science Framework: <https://osf.io/3wuh5/>) (38), taken place immediately postintervention and at a 3-week follow-up. The interviews were analysed separately to understand participant perceptions before and after applying lessons learned from the game to their everyday lives. The results from both have been summarised and reported together as key themes.

### Theme 1: Desire for an engaging therapeutic experience

Participants expressed interest in the novelty and potential utility of digital mental health applications, specifically in a gamified context. Overall, they felt that a videogame platform provided a uniquely stimulating means of engaging with mental health learning. Participants suggested that psychoeducational tools like ‘ACTing minds’ may be able to function as an engaging alternative, or an adjunct to therapy. For example:

*“[...] playing a game that's based for your mental health is really good because you can actually do something therapeutical in the things that I like doing.” -P06.*

This quote comes from a participant who identifies as a gamer, with little experience or prior interest in mental-health learning. Their statement implies an underlying desire for an engaging, accessible therapeutic environment that he has an interest in. The intervention was also helpful for non-gamers, for example:

*“I'm not one to sit down and just watch a video and then put that in practice. I'm someone who actually needs to be involved in something and interact with it, and course work just reminds me too much of school [...] with games it makes me sit, and actually interact because I'm enjoying the game at the same time. It's not just that I need to focus on my mental health,*



1  
2  
3 *I get to play a cool game while learning about my mental health. So yeah, I like I like video*  
4 *games with mental health stuff.” -P08*  
5  
6  
7

8 In this situation the participant does not identify as a gamer and has substantial experience  
9 with their own mental health learning and therapy. They, like participant one, also express the  
10 same desire for a more engaging therapeutic experience and enjoyed the format of learning  
11 about mental health via a game. The participant expresses an aversion to learning about  
12 mental health in other more traditional ways.  
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## 20 **Theme 2: Personal process of immersion**

21

22 Responses from the semi-structured interviews highlighted the individual differences  
23 between participants in their ability to immerse themselves within the content of ‘ACTing  
24 Minds’ and engage directly with the personal decision-making aspects of the game.  
25  
26 Responses indicated that the video game immersion and narrative helped them visualise the  
27 ACT metaphors and thus helped their understanding of the ACT concepts within the  
28 embedded learning environment. For example:  
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37

38 *“It plays in a very good way of dealing with visual metaphor, but also the fact that you're*  
39 *given the agency to do it. When you were smashing the memories and I wish I didn't have to,*  
40 *but I have to carry on Steve's journey and I think it's a really good way of showing these*  
41 *memories do hurt, and sometimes you just have to accept the fact that it's going to hurt. Move*  
42 *on like it's explained through the visual and narrative storytelling, and I think it's a really*  
43 *good way to do it.” -P18*  
44  
45  
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50

51 This participant refers to the visual immersion and having agency within the game as  
52 facilitating their learning of ACT concepts. The requirement for participant agency in making  
53 emotionally difficult decisions within the game appears to have facilitated the learning of  
54 acceptance.  
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3 Learning was also facilitated by the personalised nature of the game, such as selecting  
4 difficult personal thoughts in the lily pad exercise, for example:

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6  
7  
8 *“[...] it's been like a learning experience, and so the sort of personalised bit at the end with*  
9  
10 *the lily pads and the values. I think it was quite good because then you actually were able to*  
11  
12 *think about like the purpose of the game within your own situation.” -P10*

### 13 14 15 **Theme 3: Game as a base for exploring and accepting difficult emotions**

16  
17  
18 Participants discussed the idea that the game provided a platform which allowed them to  
19  
20 explore their own emotions in an immersive environment. Participants reported experiencing  
21  
22 a variety of difficult thoughts and emotions throughout playing the game, and that the game  
23  
24 encouraged them to observe and be open to sadness, anxiety, and grief with acceptance.

25  
26  
27 Participants reported feeling that after playing the game they had learned to observe and  
28  
29 accept those feelings rather than to actively avoid them, and the importance of values. For  
30  
31 example:

32  
33  
34  
35 *“At least the main bit that I got from it was to first just observe some of the negative feelings*  
36  
37 *that you have, and not necessarily like reject and wrestle with them, just to sit and watch*  
38  
39 *them and observe them, and accept them [...]. You can perhaps do something like remind*  
40  
41 *yourself of values. I like that one too.” -P05*

42  
43  
44  
45 The participant clearly reflects that the game encouraged them to observe and accept their  
46  
47 thoughts and feelings rather than suppress (or “wrestle”) them. They also mention that the  
48  
49 game reminded them of what really matters to them.

50  
51  
52 Participants appreciated the leaves of the stream exercise as promoting acceptance of  
53  
54 difficult thoughts, for example:

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2  
3 *“I'd like the Lily pad thing. I think it's really nice because I myself struggle with my emotions*  
4 *or bad thoughts or whatever, and I stay on them, and I make myself feel guilty about*  
5 *situations. So, it was really nice to accept letting go of yourself.” -P06*  
6  
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9  
10 Other participants reflected on the game encouraging acceptance and observation of difficult  
11 thoughts, for example:  
12

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14  
15  
16 *“I think that section when it's like acceptance and realising that you know, even though you*  
17 *may not like these thoughts you're having, you still need to be aware of them and you can use*  
18 *them as a springboard so that was my favourite section.” -P18*  
19  
20  
21

#### 22 23 **Theme 4: Embedded learning pros and cons**

24  
25  
26 Data from the immediate post-intervention interviews suggest a mixed response to embedded  
27 learning in ‘ACTing Minds’. Many participants reported learning a variety of lessons through  
28 playing the game, most being intended in the game’s design. Participants were sometimes  
29 confused with the lack of explicit objectives but were still able to understand that there were  
30 consequences to avoidant behaviour, and that acceptance of difficult emotions was rewarded.  
31  
32 This indicated the embedded learning within the game dynamics were successfully  
33 implemented. For example:  
34  
35  
36  
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38  
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42  
43 *“So when you hit them [memories], the like walls go up right, yeah?[...] But I guess it was*  
44 *like kind of showing you that if you hit the memories, you kind of close yourself off and that's*  
45 *what the walls were.” -P14*  
46  
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50  
51 Another participant also suggested that they were able to learn relevant ACT concepts  
52 quickly such as not to avoid (suppress) thoughts, for example:  
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3 “I think the fact that I think it was very quickly aware that you shouldn't just destroy  
4 memories and I think that was that was done really well. Maybe too well. As in like it went on  
5  
6 a bit.”  
7  
8  
9

### 10 **Theme 5: Necessary learning for anyone**

11  
12  
13 Several participants expressed that they felt what they learned via ACTing Minds would be  
14 applicable and useful to many others in society, and not just for themselves. For example:  
15  
16

17  
18  
19 “I think it's a good thing that more people are learning about this kind of thing and. It kind of  
20 just leads into more research regarding and. More support out there and more help. It's  
21 generally like, I think. Maybe not my thing, but. It's not like a bad thing, it's. A good thing  
22 there's people doing it.” P27.  
23  
24  
25  
26  
27

28  
29 “I think like the impact did still stick with me like I still mentioned it quite a bit to like my  
30 parents afterwards and I mentioned it to my partner as well. They seemed interested and they  
31 like. I wish I could have done that too.”-P18.  
32  
33  
34  
35

### 36 **Theme 6 (3-week follow-up interview theme): Utility in the real world**

37  
38  
39 In the interview occurring 3-weeks postintervention, participants discussed how they were  
40 able to apply the lessons that they took from ‘ACTing Minds’ into the real-world. Whilst a  
41 few participants had not considered the game since playing or tried to actively apply lessons,  
42 many found that they made a conscious effort to apply ACT principles and techniques from  
43 the game into their lives. Some example quotes and descriptions are given below:  
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45  
46  
47  
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50  
51 “I have noticed I've actively now, if I get like a negative thought in my brain. I try and  
52 register it and I don't hold on. But like, because sometimes before, even though I kind of  
53 subconsciously did it with some things, I just didn't [always], you know. But now if it's even  
54 something stupid like I've been lazy. I was like alright don't think about it all day. Actually go  
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3 *out for a walk. Go to the gym you know. Don't just keep in your head, I'm so lazy and*  
4  
5 *miserable and fat. Get out to do something about it.” -P04*  
6  
7

8 This statement was given by a participant who in the prior immediate-postintervention  
9 interview felt that they did not have a problem with holding on to difficult thoughts. Despite  
10 this, in the weeks since playing ‘ACTing Minds’, the participant found that they were more  
11 conscious of how their thoughts have impacted their real life, and as a result, have been able  
12 to apply the core ACT concepts in tandem. Their statement indicates that they were able to  
13 apply defusion lessons to difficult thoughts about their self (“I’m so lazy and miserable and  
14 fat”), acceptance of their behaviours (“I’ve been lazy”), and commitment to values by taking  
15 part in ACT-oriented activities regardless of their thoughts. Many participants noted that even  
16 if they had not explicitly tried to apply the ACT principles learned from the game to real life,  
17 that they felt the game had influenced them subconsciously:  
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32 *“I wouldn't necessarily say I've sat there and primed those thoughts [regarding ACT*  
33 *concepts], but in unconscious thinking, if you know like passive thought and stuff like that in*  
34 *my day-to-day, I've definitely had hints of some of those topics. Do you know what I mean?*  
35 *Like even today, I was going about my day doing my thing and you know you'll have a*  
36 *thought that'll throw you back to the past, and then you learn like I came to accept it.” -P11*  
37  
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44 This participant found that the ACT principles were more readily available to them when  
45 confronted with real-life situations that demanded them. In these cases, participants most  
46 commonly felt that they were more accepting of difficult emotions and situations.  
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48  
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### 51 **Theme 7 (3-week follow-up interview theme): Practice facilitates psychological** 52 **flexibility skills** 53

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56  
57 A core theme present across follow-up interviews was that participants expressed how  
58 applying what they had learned into their day-to-day activities over three weeks led to an  
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60

1  
2  
3 even deeper understanding of the ACT concepts they learned. Participants reported greater  
4 engagement with values-orientated behaviours in their everyday real lives, and a greater  
5 ability to cognitively defuse (or let go) of difficult thoughts rather than engaging in avoidant  
6 behaviour. Some example quotes and descriptions are given below:  
7  
8  
9

10  
11  
12  
13 *“Well, it's like actually testing on a real situation as to just generally learning it. But then*  
14 *when you come into a situation, you start to understand a bit better why you do those things*  
15 *[referring to ACT skills] and what benefit those things have, because the situation is actually*  
16 *impacting on your emotions or your feelings and stuff like that, and so then you're like oh,*  
17 *this is why this is a good technique.” -P05*  
18  
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25 In practicing real-life application of ACT principles, participants were able to get a deeper  
26 sense of how and why the ACT techniques worked for them, especially during emotionally  
27 challenging situations. Through such practice, participants have noted that their personal  
28 values have become clearer to them:  
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31  
32  
33  
34

35 *“I've learned ways to engage with my thoughts, and like I've always tried to practice letting*  
36 *go of things that aren't like too meaningful, like things that won't matter in a day and all that*  
37 *sort of stuff. But I feel like the game has helped me also realise [...] a way to really put my*  
38 *values down in a more straightforward manner.” -P13*  
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45 The participant refers to the real life practicing of letting go of difficult thoughts (cognitive  
46 defusion), and values identification.  
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50 **Theme 8 (3-week follow-up interview theme): Closer alignment to an integrated self (as**  
51 **context), with acceptance, values, as part of who you are**  
52  
53  
54

55 One of the most consistent patterns across interview responses was that participants felt they  
56 had learned more about themselves through acceptance, or that practicing the lessons taught  
57 in the game helped them align to their values. Some participants seem to have expressed that  
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1  
2  
3 they learned the ACT-concepts in a more integrated way, where they felt that acceptance of  
4 difficult thoughts and their values was part of who they were i.e., self as context. Some  
5  
6 example quotes and descriptions are given below:  
7  
8  
9

10  
11 *“I actually learned a lot from this game about like these inner emotions or bad memories are*  
12 *not sinful. They're a part of you, and they contribute what you're going to be or the current*  
13 *you [self]. So yeah, that's the core lessons I guess I learned from the game.” -P23*  
14  
15  
16

17  
18 The participant reflects here about accepting their personal experiences in the present  
19 moment for what they are (indicating broader integrated acknowledgements about themselves  
20 in context). For other participants, this acceptance of personal experiences in day-to-day life  
21 has facilitated further identification of personal values:  
22  
23  
24  
25  
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27  
28 *“Yeah, as I said, the values that's definitely helped me. Learning to just calm my thoughts for*  
29 *a little and think of the small but important things in life and what I appreciate that helps. It's*  
30 *also made me learn more about how to deal with grief [...]. It's helped to learn that it's OK to*  
31 *feel grief, it's a part of who I am, and I must accept it -P08*  
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### 38 **Secondary outcome measures**

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40 Quantitative results (all data is available on the Open Science Framework:  
41 <https://osf.io/3wuh5/>) (38) revealed a large effect size for the EQ5D usual activities score  
42 ( $\eta^2 = .307$ ), while medium effect sizes were found for DASS-21 Stress scores ( $\eta^2 = .108$ ),  
43 DASS-21 Anxiety scores ( $\eta^2 = .096$ ), and AAQ-II Psychological Flexibility scores ( $\eta^2 =$   
44  $.060$ ). Small effect sizes were obtained for the DASS-21 Depression scores ( $\eta^2 = .011$ ), the  
45 WEMWBS ( $\eta^2 = .011$ ), UCLA Social Connectedness Scale ( $\eta^2 = .021$ ), EQ5D  
46 Pain/Discomfort ( $\eta^2 = .010$ ), and the EQ5D Anxiety/Depression ( $\eta^2 = .018$ ). Given this is a  
47 feasibility study that is intentionally underpowered as it has a small sample size,  $p$  value  
48 significance are statistically meaningless for measuring efficacy of any given measure.  
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3 Instead, the effect sizes allow for a G-Power (39) a-priori analysis to be conducted that  
4 indicate the sample size required to detect meaningful statistical between group differences  
5 within a future full scale RCT. For this, the G-Power (version 3.1.9.7) indicated that when  
6 assuming a between factor (two group), repeated measures (three points in time) design with  
7 an alpha error probability of 0.05, and acceptable power of 0.8 (40), then 436 participants are  
8 required to detect a meaningful statistical difference for the smallest measure effect size  
9 (DASS-21 depression) in a future RCT. See Table 2 for full details including effect sizes,  
10 power, and estimated sample sizes for a future RCT given the observed effects sizes of this  
11 feasibility study.  
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### 23 **Convergent outcomes**

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26 Integration of results are considered a defining feature of mixed-methods research (41). In the  
27 interest of transparency, we have included a visualisation of the research outcomes taken  
28 from our qualitative and quantitative approaches, illustrating how each outcome links back to  
29 feasibility, as well as the conclusions made following each outcome (see Figure 3).  
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**Table 2.**

Illustrating change in intervention outcomes over time (n=29)

	<b>Pre-intervention Baseline, mean (SD)</b>	<b>Post-intervention, mean (SD)</b>	<b>Follow-up (3 weeks), mean (SD)</b>	<b><math>\eta^2</math></b>	<b>Effect size</b>	<b><i>F</i></b>	<b>Power</b>	<b>Full RCT Sample size estimated assuming 0.8 power</b>
DASS-21 Depression	14.34 (5.97)	14.21 (5.54)	13.90 (4.75)	.011	Small	.31	0.43	436
DASS-21 Stress	15.34 (4.55)	14.52 (4.40)	14.28 (4.65)	.108	Medium	3.39	0.999	46
DASS-21 Anxiety	12.79 (5.19)	12.10 (4.42)	11.66 (4.75)	.096	Medium	2.98	0.999	52
AAQ-II (Psychologic al Flexibility)	27.34 (10.47)	28.38 (9.86)	28.86 (8.65)	.060	Medium	1.76	0.999	86
WEMWBS	42.07 (7.31)	42.62 (7.91)	42.07 (7.00)	.011	Small	.31	0.33	436
UCLA Social- Connectedne ss	64.72 (7.52)	64.24 (8.85)	63.90 (8.33)	.021	Small	.60	0.77	236
EQ5D Mobility	4.83 (.38)	4.83 (.38)	4.83 (.38)	.000	N/A	.00	0.05	Negligible (no effect)
EQ5D Self- Care	4.78 (.58)	4.79 (.49)	4.76 (.51)	.000	N/A	.00	0.05	Negligible (no effect)
EQ5D Usual Activities	4.14 (.79)	4.38 (.68)	4.62 (.68)	.307	Large	12.42	1.00	16
EQ5D Pain/Discomf ort	4.24 (.64)	4.45 (.63)	4.31 (.81)	.010	Small	.28	0.25	520
EQ5D Anxiety/ Depression	3.86 (.99)	4.03 (.87)	3.97 (.94)	.018	Small	.52	0.66	288
EQ5D Self- Rated Health Score	71.14 (19.01)	72.76 (19.57)	70.93 (20.71)	.000	N/A	.00	0.05	Negligible (no effect)

-----Figure 3 Here-----

**Discussion****Statement of principal findings**

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2  
3 The overarching aim of this research was to test the feasibility and acceptability of the  
4  
5 ‘ACTing Minds’ video game as a DHI for treating depression, anxiety, and stress. Participant  
6  
7 recruitment and retention, as well as quantitative and qualitative results, demonstrate that the  
8  
9 study design and videogame intervention are feasible for testing in a full-scale RCT.  
10  
11

12 Thematic analysis on qualitative data revealed several key findings. Firstly, participants were  
13  
14 successfully able to learn about core ACT principles through embedded learning, specifically  
15  
16 acceptance, defusion from thoughts, and commitment to personal values. There was also  
17  
18 some indication that participants had learned something about themselves in an integrated  
19  
20 way, in the form of self-as-context. Participants felt that the lessons taught within the game  
21  
22 could be applied to their daily lives and that the game was effective in priming them to  
23  
24 consider the core ACT principles throughout the weeks following their completion of the  
25  
26 intervention. Participants also felt that they would recommend the game to someone that they  
27  
28 care about and that they would be interested in downloading and completing future releases  
29  
30 of ‘ACTing Minds’.  
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35

### 36 **Summary of secondary outcomes**

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38

39 Quantitative analysis of measures taken at baseline, immediately post-intervention,  
40  
41 and after a 3-week follow-up, revealed promising small to large effect sizes in many of the  
42  
43 quantitative measures (38). This included a large effect size for increasing EQ5D usual  
44  
45 activities, medium effect sizes for reducing DASS-21 stress and anxiety, as well as increased  
46  
47 AAQ-II psychological flexibility. Small effect sizes were observed for reducing DASS-21  
48  
49 depression, EQ5D pain and discomfort, EQ5D anxiety and depression, and increased UCLA  
50  
51 social connectedness and WEMWBS general wellbeing. There were no observed effects for  
52  
53 EQ5D mobility, self-care, and self-rated health score. Given this is a feasibility study that is  
54  
55 intentionally underpowered as it has a small sample size, *p* value significance are statistically  
56  
57 meaningless for measuring the efficacy of the interventions, and instead effect sizes are more  
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3 informative as they express the underlying effect and are not influenced by population size.  
4  
5 Instead, the G-Power analysis provided an estimation of participants required (436 to account  
6  
7 for the small effect sizes) to identify meaningful significance in a full scale future RCT.  
8  
9

### 10 **Comparison to existing literature**

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12  
13 This is the first study to utilise a videogame Digital Health Intervention (DHI) rooted in third-  
14  
15 wave behavioural therapy to address mental distress. 'ACTing Minds' imparts psychological  
16  
17 skills based on ACT to promote psychological flexibility. Prior research has primarily  
18  
19 focused on videogame DHIs targeting 'illbeing' that aim to reduce symptoms of mental  
20  
21 illness, two examples are games 'REThink' and 'Dojo'. 'REThink,' designed for a younger  
22  
23 audience, developed the players' ability to discern functional emotions from maladaptive  
24  
25 ones, and was shown to effectively improve emotional symptoms and reduce depressive  
26  
27 mood (42). 'Dojo,' utilising biofeedback and relaxation techniques to promote emotional  
28  
29 regulation, was shown to significantly decrease participants' anxiety and aggressive  
30  
31 behaviour scores post-intervention but exhibited no long-term effects at a 4-month follow-up  
32  
33 (43). Our DHI differs fundamentally from these other games due to strong theoretical  
34  
35 underpinnings based on ACT for promoting psychological flexibility instead of a focus on  
36  
37 reducing unwanted emotions or emotional regulation. Participants within the game were  
38  
39 taught to observe and be open to emotional pain without judgement or any attempt to change  
40  
41 them, and this is a key focus within the 'ACTing Minds' intervention.  
42  
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47  
48 Several meta-analyses have been conducted to explore the potential efficacy of DHIs,  
49  
50 one found that the majority of DHIs were based on Cognitive Behavioural Therapy (CBT)  
51  
52 and that the effect size for such interventions was small for reducing depressive symptoms  
53  
54 compared to non-treatment controls (44). CBT-based DHIs usually do not take the form of  
55  
56 full video games but may include elements of gamification such as rewards, badges, and  
57  
58 progress tracking. They are typically structured programs including online education tools,  
59  
60

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3 interactive exercises, and self-assessment tools, which focus on challenging and modifying  
4 negative thoughts and behaviours. A meta-analysis including 34 RCTs (17 of which were  
5 CBT-based) found that CBT-based DHIs yielded a medium effect size for reducing  
6 symptoms of depression and anxiety (45). However, a meta-analysis of 117 CBT-based  
7 applications revealed that only 12 of them provided support aligned with the evidence-based  
8 tenets of CBT (46). This finding suggests that the observed effectiveness in earlier studies  
9 could potentially stem from participants' interaction with a DHI (perhaps as a form of  
10 distraction) rather than their proficient implementation of CBT principles. CBT-DHI  
11 programs often require consistent use, and high attrition rates have limited their efficacy in  
12 research (47). One meta-analysis author suggested that DHIs may need to be complemented  
13 by existing mental health support (44). However, our study challenges this notion. In less  
14 than one hour of playing 'ACTing Minds', participants fully explored the game, retained  
15 ACT knowledge, and discussed its positive real-world application in interviews conducted 3  
16 weeks post-intervention.

### 17 **Strengths and limitations**

18  
19 Our study is the first to explore the feasibility and acceptability of a novel videogame DHI  
20 based on ACT. A core strength of this research was the utilisation of a mixed-methods  
21 approach. By incorporating thematic analysis of semi-structured interviews as well as  
22 quantitative analysis of questionnaire data, we were able to gain a comprehensive  
23 understanding of participant experience using 'ACTing Minds'. Collecting quantitative data  
24 at three separate time points, and interviews conducted at two separate time points meant that  
25 we were able to examine the gradual processes of change and identify patterns of  
26 improvement consistent with the ACT model. We gained valuable input from participants in  
27 terms of suggestions for improving the intervention which will aid in the further development  
28 of 'ACTing Minds' to optimise effectiveness and user engagement. The results from the  
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3 interviews also indicated that 'ACTing Minds' has broad appeal as a videogame even to those  
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5 outside of clinical populations.  
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8 It is also important to acknowledge the limitations of our study. Firstly, there was no  
9  
10 control group, though this is intentional as this is a feasibility study, it is only when we  
11  
12 conduct a full RCT that we will have an adequate comparator group to determine whether the  
13  
14 intervention is clinically useful at promoting psychological flexibility and reducing  
15  
16 depression, anxiety, and stress. There was a lack of in-game data logging of specific ACT  
17  
18 tasks completed. For example, we did not collect data on whether participants actually  
19  
20 entered text about the difficult thoughts that they were experiencing such as in the leaves on a  
21  
22 steam exercise, though all participants completed the game. The reliance on self-report  
23  
24 measures potentially allowed for biased responses, including psychosociological measures  
25  
26 such as HRV would strengthen the study outcomes. It is also possible that some of the  
27  
28 questionnaires used in this study were insufficient for capturing the target measurements. One  
29  
30 study used exploratory factor analysis to investigate the extent to which the AAQ-II  
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32 Psychological Flexibility Questionnaire can discriminate between experiential avoidance and  
33  
34 psychological flexibility. The researchers found that AAQ-II items were more strongly  
35  
36 related to items measuring distress than items measuring acceptance (48). In line with this,  
37  
38 the AAQ-II has been criticised as being too simple a measure for psychological flexibility  
39  
40 (49). In a future RCT, we may adopt another measure for measuring psychological flexibility  
41  
42 such as The Personalised Psychological Flexibility Index which may be a more valid measure  
43  
44 of psychological flexibility (50). Finally, though thematic analysis can be highly useful for  
45  
46 identifying shared meaning and variation amongst the themes, and bridging subjectivity and  
47  
48 theoretical structure, it also has limitations. The contextualist epistemology used in this  
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50 approach acknowledges the researcher has an active role in shaping the outcomes and can be  
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52 biased by their own knowledge and experience. The subjective nature of the themes means  
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3 that there can be variation in the interpretation of the data between different thematic  
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5 researchers. So, though this approach can be useful, these limitations also need to be  
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7 acknowledged.  
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### 10 **Clinical implications and directions for future research**

11  
12 The ACT-based videogame DHI used in this study is a low-cost, engaging, and easy-to-  
13  
14 disseminate means of supporting those experiencing mental health difficulties. The present  
15  
16 study highlights the clinical implications of ‘ACTing Minds’, including its potential  
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18 therapeutic value, user engagement, and accessibility. However, further research is warranted  
19  
20 to establish long-term effects, explore specific populations, conduct comparative studies,  
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22 investigate underlying processes, and address any ethical considerations that may arise.  
23  
24 Critically, a full RCT is now needed, in which participants are compared quantitatively with a  
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26 control group, incorporating physiological wellbeing measures such as HRV, as well as  
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28 research-validated questionnaires regarding mental health (i.e., depression, stress, anxiety,  
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30 psychological flexibility, social connectedness, and wellbeing). By pursuing these future  
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32 research directions, we can leverage the potential of ACT-based video games such as  
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34 ‘ACTing Minds’ to enhance patient care, improve outcomes, and expand the reach of  
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36 interventions in an increasingly digital era.  
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### 43 **Conclusion**

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45 The results of this study demonstrate that ‘ACTing Minds’ is feasible to implement in a full-  
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47 scale RCT. Both the intervention and study were well received by participants, thematic  
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49 analysis of semi-structured interviews indicated that a single playthrough of the game was  
50  
51 sufficient for teaching several core principles of ACT, namely ‘Acceptance’, ‘Values  
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53 Identification’, and ‘Cognitive Defusion’ to participants, and priming them to implement the  
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55 lessons in their day-to-day lives. There was some evidence that participants also integrated  
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3 their learning about themselves as self-as context, which is interesting. Quantitative results  
4 indicate that playing ‘ACTing Minds’ is associated with decreases in depression, anxiety, and  
5 stress, as well as increases in psychological flexibility, social connectedness, and wellbeing.  
6  
7 However, these effects will need to be further explored in an adequately powered RCT to  
8 understand the potential clinical implications, therapeutic value, user engagement, and  
9 accessibility of an ACT-based video game DHI.  
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### 17 **Data availability statement**

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19 The datasets supporting the conclusions of this article are available in the Open Science  
20 Framework (38): [https://osf.io/3wuh5/?view\\_only=7998f1d0ae4b473ab7089a71be710270](https://osf.io/3wuh5/?view_only=7998f1d0ae4b473ab7089a71be710270).  
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### 24 **Original published protocol**

25  
26 <https://bmjopen.bmj.com/content/10/11/e041667>  
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28

### 29 **Contribution statement**

30  
31 DJE and AHK designed the original protocol, whilst TCG updated and revised the protocol  
32 design. TCG wrote the first draft of the paper and conducted all of the quantitative and  
33 qualitative results. DJE and AHK provided substantial revisions on all drafts and advised  
34 TCG throughout the development of this manuscript. DJE designed and developed the game  
35 development.  
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### 43 **Competing interests**

44  
45 The game ACTing Minds was developed using European development funds via the  
46 commercial entity of Swansea University (AgorIP) and awarded to DJE with the intention to  
47 develop this game for commercial purposes (as a game app for the Apple and Google Play  
48 stores). DJE was involved in the design of the protocol but did not recruit participants, collect  
49 any data, and did not conduct the analysis on the data. TCG and AHK have no involvement  
50 in any commercial aspects of the game.  
51  
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### 59 **Funding**

1  
2  
3 Funding for the development of this game came from European development funds via the  
4 commercial entity of Swansea University called AgorIP (Reference: 229-0256-0046)  
5  
6 awarded to DJE.  
7  
8

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14 (University College Dublin), Dr. Alison Stapleton (Dublin Business School), and Dr. Sarah  
15 Cassidy (Smithfield Clinic) for several helpful comments on various aspects of the ACTing  
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### **Ethics statement**

This study has received ethical approval from the Swansea University School of Psychology  
ethics sub-committee (2022-5630-4834).

### **Figure legends**

#### **Figure 1.**

(a) Screenshot from 'ACTing Minds' showing the 'Psychoflexameter'. (b) The Acceptance and Commitment Therapy Hexaflex and core processes. (c) Screenshot from 'ACTing Minds', example of 'Cognitive defusion' task. The player is required to type in their own difficult thoughts, before dragging them on to a leaf that floats downstream.

#### **Figure 2.**

Flow of participants through the study.

#### **Figure 3.**

Diagram visualising the integrated outcomes of 'ACTing Minds' feasibility and acceptability study.

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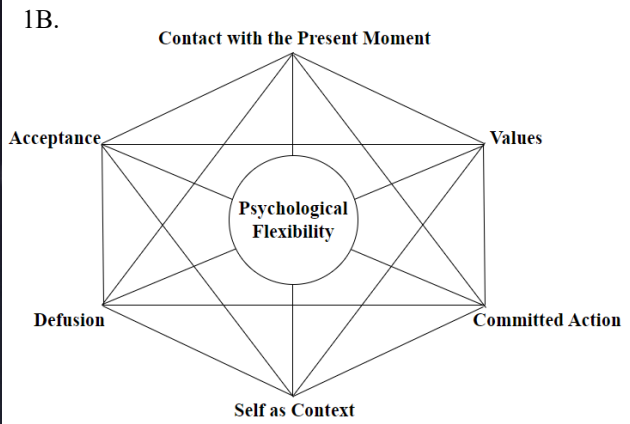
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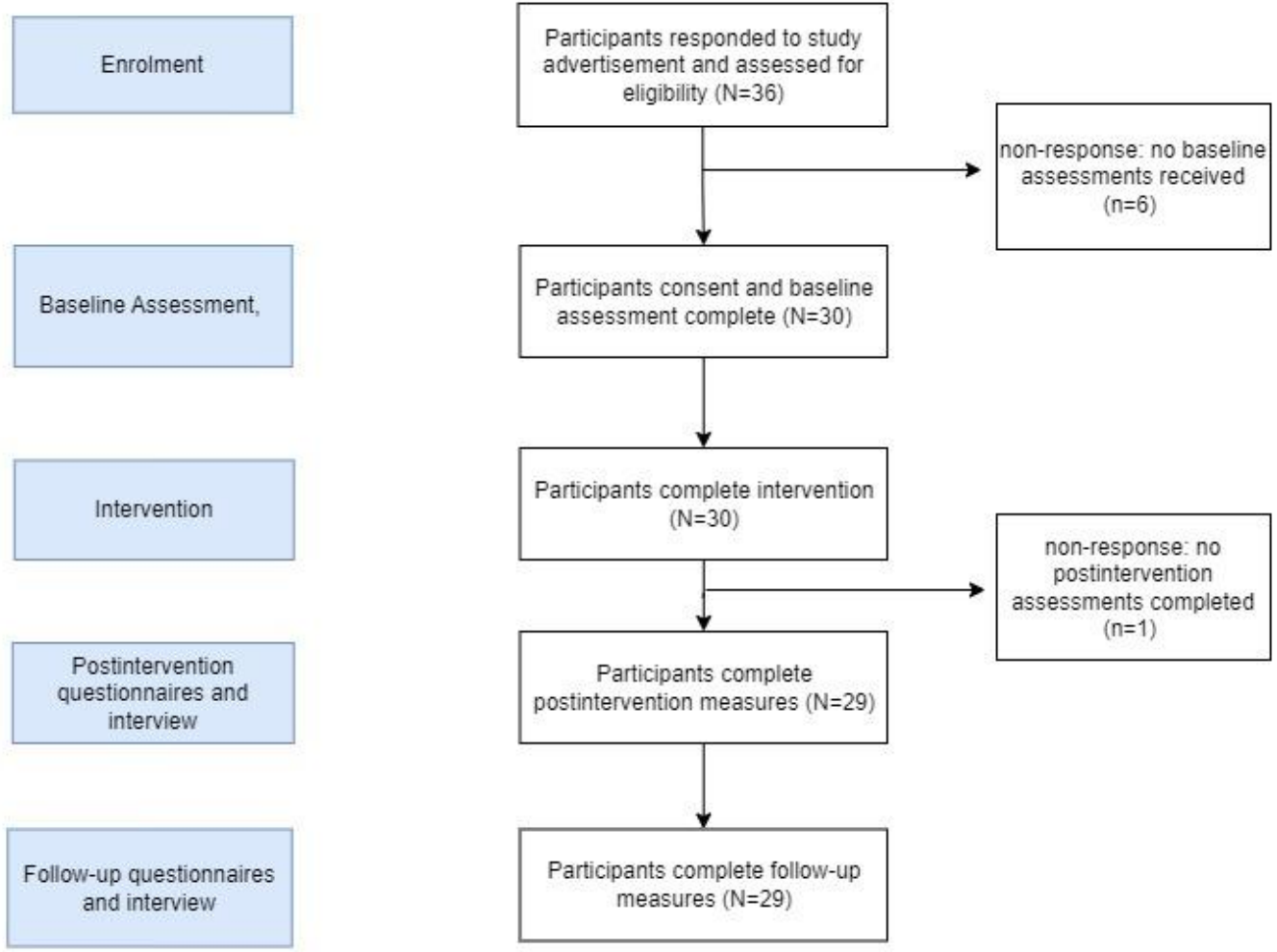


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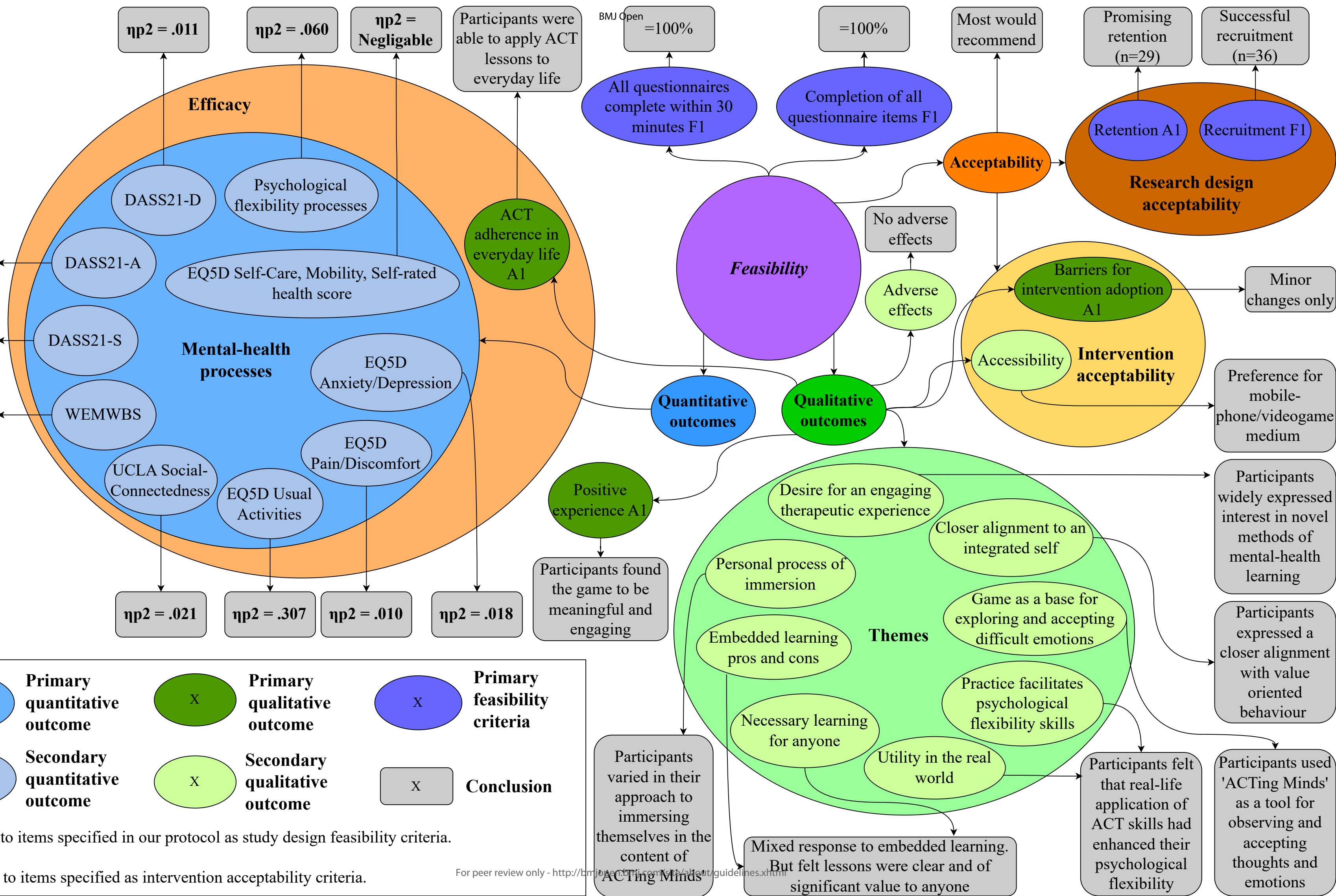


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**Key:**

	<b>Primary quantitative outcome</b>		<b>Primary qualitative outcome</b>		<b>Primary feasibility criteria</b>
	<b>Secondary quantitative outcome</b>		<b>Secondary qualitative outcome</b>		<b>Conclusion</b>

- (F1) refers to items specified in our protocol as study design feasibility criteria.
- (A1) refers to items specified as intervention acceptability criteria.



# BMJ Open A novel ACT-based video game to support mental health through embedded learning: a mixed-methods feasibility study protocol

Darren J Edwards ,<sup>1</sup> Andrew H Kemp<sup>2</sup>

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## ABSTRACT

**Introduction** In recent years, serious video games have been used to promote emotional regulation in individuals with mental health issues. Although these therapeutic strategies are innovative, they are limited with respect to scope of treatment, often focusing on specific cognitive skills, to help remediate a specific mental health disorder.

**Objective** Here, we propose a protocol for assessing the feasibility of a novel acceptance and commitment therapy (ACT)-based video game for young adults.

**Methods and analysis** The Medical Research Council (MRC) framework will be used for developing a complex intervention to design and test the feasibility of an ACT-based video game intervention using a mixed-methods approach involving qualitative and quantitative data. The primary outcomes will include feasibility testing of recruitment processes and the acceptability of the intervention through qualitative interviews, attendance and rates of attrition. Secondary outcomes will involve a series of quantitative questionnaires to obtain effect sizes for power analysis, allowing for the ideal sample size for an appropriately powered, randomised controlled trial to be determined.

**Ethics and dissemination** This study has been approved by the Psychology Department Research Ethics Committee (2020-4929-3923) at Swansea University in the UK. Dissemination activities will involve publications in peer-reviewed journals, presentations at local and national conferences and promotion through social media.

**Trial registration number** NCT04566042.

## INTRODUCTION

Mental health issues such as anxiety and depression are a global problem of increasing concern, imposing considerable burden on society. The Global Burden of Disease project<sup>1</sup> has identified mental health disorders as a leading cause of disability globally, and suggest that there are 266 million cases of anxiety, and 253 million cases of major depressive disorder globally.

Unfortunately, the demand for mental health services far exceeds the available human resources able to meet this need in high-income and low-income

## Strengths and limitations of this study

- Mixed-methods approach to build a rich dataset on which conclusions will be drawn.
- Protocol follows established Medical Research Council (MRC) guidelines.
- In line with MRC guidelines and stage of game development, randomisation is not a component of this study.
- Aims are to assess feasibility, an important step in the development of complex interventions, although limiting conclusions able to be drawn.

and middle-income countries. This includes ever-growing treatment gaps<sup>2</sup> and lags.<sup>3</sup> These alarming increases have prompted the 2018 Lancet commission on global mental health to suggest that universal health coverage should include efforts to ensure the sustainable development of mental health.<sup>4</sup> Innovations to promote accessibility to mental health treatments include technology such as telephone, internet and smartphone devices, augmenting the psychotherapeutic toolkit.<sup>5</sup>

Innovations in video gaming for remedial mental health issues have wide potential application. In the USA, over 164 million adults play video games, and at least three-quarters of all American families have at least one person who video games regularly.<sup>6</sup> In the EU, 54% of the population play video games between the ages of 6 and 64, where the average age of video gamers is 31, and with a distribution of 46% female and 54% male. Of these, 77% play at least 1 hour per week, 16% play 1 hour per month, while only 7% play 1 hour per year.<sup>7</sup> Given that such a large proportion of the Western population play video games, developing mental health training in the form of psychoeducation may have great potential for building psychological resilience and



1 helping to better manage depression, anxiety and other  
2 forms of distress.

3 Technological developments for tackling such chal-  
4 lenges include the exploitation of gamification.<sup>8</sup> This  
5 involves the application of behavioural principles for  
6 controlling and modifying human behaviour, in which  
7 game design elements are used to increase human inter-  
8 action with or without technology.<sup>9</sup> Some examples of  
9 gamification include gamifying the development of  
10 cognitive skills and emotional regulation by rewarding  
11 the completion of relevant tasks within complex video  
12 games<sup>10–13</sup> in order to promote mental health.

13 When mental health-related video games are designed  
14 well, they have been shown to elevate self-esteem, self-  
15 efficacy, knowledge and awareness of illness, adherence  
16 to treatment and problem-solving skills, while lowering  
17 aggression.<sup>14</sup> One of the most successful in the facilitation  
18 of mental health improvement is a serious video game—a  
19 complex game with multiple levels and settings—called  
20 PlayMancer (PM), which targets emotional regulation and  
21 was specifically designed to help manage impulse control  
22 disorders.<sup>11 13</sup> The objective of the PM game is to develop  
23 emotional and cognitive skills, while reducing impulsivity.  
24 The game has been shown to help treat bulimia nervosa  
25 by improving emotional regulation.<sup>15 16</sup>

26 PM also uses biofeedback (heart rate and heart rate  
27 variability) to model physiological and emotional reac-  
28 tions, feeding this information back to the participant.  
29 Some research has shown that facilitating awareness of  
30 one's own physiology (such as brain activity or cardiac  
31 function) enhances the treatment effects of mental health  
32 disorders (such as anxiety disorder, depression, obsessive-  
33 compulsive disorder (OCD) and schizophrenia) via self-  
34 regulation.<sup>17</sup> Biofeedback has also been shown to improve  
35 impulse control difficulties, and attentional difficulties  
36 in bulimia nervosa and attention deficit hyperactivity  
37 disorder,<sup>15 16 18</sup> as well as symptoms of stress, anxiety and  
38 anger.<sup>19</sup> The focus on physiological data in the psycho-  
39 therapeutic context is gaining traction<sup>20–22</sup> and has strong  
40 theoretical underpinnings.<sup>23–25</sup>

41 Within PM, there are three mini-games: 'The face of  
42 Cronos'; 'Treasures of the sea' and 'Sign of the Magupta'.  
43 Each of these mini-games were designed to train different  
44 skills, for example, 'The face of Cronos' and 'Treasures of  
45 the sea' develops planning skills, impulse control, coping  
46 skills, stress management and emotional self-regulation,  
47 while 'Sign of the Magupta' was designed to train relax-  
48 ation, breathing techniques and improve physiological  
49 and emotional awareness. However, in the study<sup>15</sup> PM  
50 was combined with sessions of cognitive behavioural  
51 therapy (CBT) and without a control measure (eg, CBT  
52 only) so the game was developed as an adjunct to tradi-  
53 tional mental health training, and there is no real way  
54 of knowing the direct benefits of the game as opposed  
55 to training in CBT. In another study—a case study of a  
56 single participant playing PM—anxiety and impulsivity  
57 decreased prior to CBT.<sup>16</sup> However, as this study was  
58 based on a single case, further studies using a randomised

controlled trial (RCT) approach are needed to support  
and provide confidence to these findings.

Another game, Dojo,<sup>26</sup> develops emotional regulation  
in adolescents with anxiety. It uses biofeedback (heart rate  
variability) and trains breathing techniques, muscle relax-  
ation, positive thinking and guided imagery to attempt to  
reduce anxiety in adolescence. It also uses instructional  
videos and then engages players through immersive and  
emotionally evocative puzzles that challenge players to  
use newly acquired emotion regulation skills. However,  
a pre-post RCT with 1347 participants, compared with  
a standard 'off the shelf' commercial game 'Rayman 2'  
(whereby Rayman 2 was the control), reported no differ-  
ence between Dojo and the control condition at reducing  
anxiety. As both of these games significantly reduced  
anxiety, it is possible that the reduction in anxiety was due  
distraction from anxiety-provoking thoughts, rather than  
developing psychoeducational skills per se. The authors  
concluded that crucial design issues need to be carefully  
thought through, which include a clear theoretical and  
therapeutic foundation. This includes appropriate meth-  
odology that can assess the causes of improvement, before  
developing and testing a serious video game for the treat-  
ment of mental health issues such as anxiety.

Commercial games (such as Rayman 2) have been  
explored in their unmodified forms for their effective-  
ness in helping with social skills training for autism, and  
cognitive distraction for anxiety and nausea for patients  
undergoing chemotherapy,<sup>27</sup> with limited success.  
Evidence of generalisability of these games beyond game-  
playing is limited,<sup>28</sup> and this may be because they act as  
simple distractions rather than therapeutic psychoeduca-  
tion applicable to participant's everyday lives. Another  
issue with many of these studies is that they often lack  
appropriate and rigorous methodology such as longitu-  
dinal follow-up,<sup>29</sup> and a mixed-methodological approach  
that can assess the feasibility and acceptability of such  
interventions.

Given these issues, it is important to emphasise that the  
underlying theoretical basis for PM and Dojo relates to  
the development of emotional regulation skills. While  
emotional regulation has transdiagnostic application<sup>30</sup> (ie,  
an intervention designed to treat multiple mental health  
conditions), these applications are not underpinned by  
theoretical frameworks that relate to formal psychother-  
apeutic interventions. Our proposed game is designed to  
be a comprehensive transdiagnostic intervention that will  
integrate a third wave behavioural therapy—as opposed  
to an adjunct to—acceptance and commitment therapy  
(ACT).<sup>31 32</sup> It will therefore be a comprehensive strategy  
for managing many common mental health issues such  
as depression and anxiety and focus on developing clear  
psychoeducational skills in the form of psychological flex-  
ibility, well-being and resilience more generally.<sup>33</sup>

Given this comprehensive transdiagnostic focus on  
psychological flexibility through ACT—a fundamental  
component of general health and well-being<sup>34</sup>—our  
online video game may have much greater reach and



1 impact than other serious video games such as PM,  
2 Dojo and many of the commercial games which are not  
3 based on third wave psychotherapy. Greater accessibility  
4 and impact have important implications for reducing  
5 treatment gaps and lags by making more mental health  
6 services available to those who need them.

7 One reason for choosing ACT in the game development  
8 process was pragmatism. For instance, researchers and  
9 clinicians may access freely available materials through  
10 the Association of Contextual Behavioural Science  
11 website (<https://contextualscience.org/>), and it does not  
12 require formal clinical training or accreditation to practice<sup>35</sup> which has important implications for translation to  
13 video game platforms. Another reason for choosing ACT  
14 as the basis for the game, is that it has a strong evidence  
15 base, and meta-analysis has found it to be efficacious for  
16 improving chronic pain, depression, psychotic symptoms,  
17 mixed anxiety, OCD, drug abuse and stress at work.<sup>36</sup> This  
18 means it is an ideal general purpose therapeutic tool as  
19 opposed to restricted focus on for example impulsivity  
20 control such as the PM application<sup>11 13</sup> or simple relaxation  
21 skills for adolescence with anxiety, as is the focus of  
22 the Dojo game.<sup>26</sup>

23 ACT principles are designed to undermine the trap-  
24 pings of language in the form of difficult thoughts and  
25 associated feelings, and promotion of psychological flexi-  
26 bility.<sup>37</sup> Language trappings can get individuals entangled  
27 and can prevent them from engaging with what is truly  
28 meaningful to them. The development of psychological  
29 flexibility through ACT is important because it is consid-  
30 ered to be a fundamental component of well-being.<sup>34</sup>

31 The six ACT processes are: (1) the act of being in the  
32 here and now, present and mindful<sup>32 38</sup>; (2) acceptance,  
33 the act of being aware and open to painful thoughts; (3)  
34 cognitive fusion, the act of recognising that thoughts are  
35 just thoughts and not to buy into them (the process of  
36 cognitive defusion)<sup>39</sup>; (4) identifying values, values act  
37 as a life compass and direct us towards a life filled with  
38 purpose; (5) commitment to values orientation, which is  
39 the act of continually working towards a values orienta-  
40 tion, even when an individual goes off track; (6) self as  
41 context (also called the transcendental self), is flexible  
42 and transcendent form of self. This involves the aware-  
43 ness of thoughts and feelings but the complete detach-  
44 ment from the literal meaning of thoughts.<sup>34</sup>

45 ACT has been usefully applied to many forms of mental  
46 health issues and has been applied in many different  
47 forms of delivery. This includes web-based interven-  
48 tions,<sup>40-42</sup> teleconference<sup>43</sup> and a downloadable app for  
49 smartphones.<sup>44 45</sup> So, given the fact that video games can  
50 have positive well-being benefits,<sup>46 47</sup> and are applicable  
51 for therapeutic purposes,<sup>28 48</sup> a transdiagnostic ACT  
52 serious video-game may have great potential for similar  
53 reasons.

54 As ACT is a comprehensive transdiagnostic model and  
55 formal third wave cognitive behavioural approach, then  
56 its reach and impact in the form of a video game may be  
57 greater than that of PM or Dojo which were focused on

58 simpler emotional skills development and biofeedback.  
59 For these reasons, we are proposing an ACT-based video  
60 game called 'ACTing Mind' as an innovative and acces-  
sible intervention to help individuals who struggle with  
anxiety, depression, stress and other forms of distress.

## Aims

The research goals of this proposal are to determine the feasibility and acceptability of a novel ACT-based video game intervention for individuals with mental distress, in line with methodology described in the Medical Research Council (MRC) framework.<sup>49 50</sup> This proposal lays the foundation for which a pilot and full-scale RCT will be conducted to determine clinical effectiveness, and ultimately the recommendations of the importance of such innovations in primary care mental health policies and practices.

## METHODOLOGY

This protocol has been developed following the Template for Intervention Description and Replication of Studies<sup>51</sup> (see online supplemental appendix 1), as well as the MRC guidelines for the development of complex interventions.<sup>49 50</sup> This includes five stages of development for a complex intervention including: (1) preclinical, involving a theoretical review of the literature (provided here), justifying the need for such an intervention for the proposed population; (2) phase I, modelling, involving the use of evidence to determine the components for underlying mechanisms. For this, we propose a qualitative element involving thematic analysis to enable us to understand what would be most beneficial to a general population with anxiety and depression; (3) phase II, conducting an exploratory pilot study (outlined here) to determine the feasibility of the methodology and design where some initial data can be collected; (4) phase III, an RCT to test the efficacy of the proposed intervention (in subsequent work); (5) phase IV, long-term follow-up to assess replicability.

## Public and patient involvement

Key stakeholders were consulted and involved in the development of this protocol. The Patient Experience and Evaluation in Research (Patient Experience and Evaluation in Research (PEER): <https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/>) group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students and staff members, several of whom reported that they had experienced depression, anxiety or stress at some point in their lives and emphasised the need for innovative approaches of the delivery of mental health support. The feasibility design was explained to them, and they gave positive feedback about the nature of the design, intervention and outcome measures.





## Study design

This is a mixed-methods study which is designed to determine the feasibility and acceptability of an ACT-based video game for individuals with anxiety, depression and stress, and to increase psychological flexibility.

## Study setting

The study will be conducted entirely online including the game and assessment (via the Qualtrics platform), and qualitative interviews (via the Zoom platform). Thus, potential participants will be able to access this study without restrictions, an important consideration for ongoing local lockdowns associated with the COVID-19 pandemic. Strict recommendations will require participants to ensure they are in a quiet room and without disruption for the duration of the study.

## Recruitment and consent

We will recruit participants ( $n=36$ ) using purposive sampling, focusing on—unlike an opportunity sample—the types of participants needed for a full-scale RCT (ie, individuals with depression, anxiety and stress). The sample size is justified on the basis of past research reporting the median numbers of participants recruited for similar types of feasibility studies,<sup>52</sup> incorporating both quantitative and qualitative elements.

## Eligibility criteria

Participants will be recruited through general public mental health forums, social media and student populations. Thirty-six participants will take part in the study and they will be aged 18 years or older, be experiencing ongoing depression, anxiety and stress, and be able to read, write and speak English.

## Intervention

This ACT-based video game intervention called 'ACTing Mind', developed and designed solely by DE, will involve students and members of the public attending five 1 hour sessions of an ACT-based video game. Each session will involve a different chapter of the video game, and each chapter will explore a different key component of ACT, with there being six in total (see [table 1](#) for the different chapters and sessions involved).

These various components and principles of ACT<sup>31 32</sup> will be taught within the different chapters of the game and through embedded learning. For example, the player will gain ACT skills while completing objectives within the game and without directly being taught these skills, but rewarded indirectly through points and progress awards. For instance, in one scene (see [table 1](#)) the character is confronted by painful memories, and the player has two choices: (1) to destroy the painful memories or (2) to accept these memories. If the player chooses to destroy the memories (avoidant-based strategies), the world becomes distorted and barriers form making the chapter impossible to complete. Alternatively, if the player chooses acceptance-based strategies they will be able to continue

the game (hence in this scene they learn that acceptance is functionally better than avoidance).

The game will start with a depressed individual who has recently lost his wife in an accident, and is feeling depressed, isolated and lonely (see [figure 1](#) as an example of this scene). Each chapter will reward ACT consistent behaviour with points on a 'psychoflexameter'. This is a dial on the border of the screen which indicates increased psychological flexibility as the player completes ACT-based tasks such as acceptance (chapter 1), being present (chapter 2), values and commitment (chapter 3), defusion (chapter 4) and self as context (chapter 5). ACT uses metaphors to help clients visualise the key processes of ACT. In the game, these metaphors are real representations, such as the 'sinking sand' game, 'dropping the rope' game, the 'chessboard game', the 'unwanted monster' game, the 'leaves on a stream' game (see [table 1](#)).

Within the game, the character will have to enter his own mind through a 'mind escape machine' (see [figure 2](#) of this as an example of the character in his own mind). At the start of the game, it is explained through a brief historical story that he develops this machine to destroy and suppress his unwanted painful thoughts and memories about his wife and loss. Once in his mind, he will learn that destroying or suppressing thoughts creates barriers in his mind which prevents him from continuing the game. So, learning acceptance is crucial throughout this game and the character is rewarded for this through points and progress awards. Also, within the game, psychoeducation components explain thoughts as trappings of language which can often get people stuck in life, and prevent them from value consistent living, as well as the various emotional regulation strategies such as avoidance and acceptance.

As part of the study, in addition to playing the video game, participants will be asked to record events on a weekly basis, aspects of application of the ACT principles learnt in an everyday life in a journal. It is anticipated that greater adherence to the intervention in everyday life, and engagement with the journal will lead to greater success of the intervention (greater psychological flexibility).

## Data collection and management

MSc students will have the opportunity to be involved in this study and will collect and process the data under supervision by project leads, DJE and AK. Questionnaires will be completed online through Qualtrics which will store raw data copies, and also be held on an encrypted university server. Names and other personally identifiable information will not be stored, and consent form information will not be associated with the raw or processed data, instead each participant will be given a unique identifier code. Similarity recorded interviewer transcripts will use identifier codes as opposed to personal information (eg, names). The project leads (DJE, AHK) will frequently audit all processes in data collection and processing to ensure that the procedures stated in this protocol are adhered to.

**Table 1** Overview of the 'ACTing Mind' intervention and everyday journal instructions

Session 1 (week 1): acceptance and openness to pain	<ul style="list-style-type: none"> <li>▶ Chapter 1—Acceptance</li> <li>▶ Introducing participants to the video game and ACT in everyday journal.</li> <li>▶ A brief overview of the purpose of the programme and the content of each session.</li> <li>▶ Explaining basic ACT tenets through introduction text of journal.</li> <li>▶ Explaining the nature of painful thoughts and memories and getting caught up in the struggle explained through journal.</li> <li>▶ Basic story context about the character being depressed and why, at start of video game.</li> <li>▶ Explaining the objective of the video game, that is, to transcend from psychological inflexibility to psychological flexibility.</li> <li>▶ Exercise, within the game there are choice, either to suppress, and break thoughts, or to accept and be open to them.</li> <li>▶ Acceptance and openness are rewarded by psychological flexibility points on the 'psychoflexameter' and game progression, while suppression actions (breaking or suppressing painful memories) are punished with physical barriers, and sinking sand, which prevent the player from progressing in the game.</li> <li>▶ A monster pulls against the player to prevent progress, but if the player fights with the monster, they get even more stuck (analogous to the drop the rope and sinking sand metaphor). Again, acceptance is important and must be learnt here.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 2 (week 1): being present (mindfulness)	<ul style="list-style-type: none"> <li>▶ Chapter 2—Being present (mindfulness)</li> <li>▶ Some instructions form the journal about being present and mindful is given, why it is useful and how to go about achieving with breathing exercises.</li> <li>▶ The character is approached by monsters in the game in the past and future making him worry excessively about imaginary dangers, and reminding him of painful events.</li> <li>▶ The game (in the form of the character's wife's ghost) instructs the player to be present, to focus on your breathing for 10 min.</li> <li>▶ As the participant learns and completes relevant psychological flexibility tasks psychological flexibility on the 'psychoflexameter' will increase, which rewards the player for being present.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 3 (week 2): values identification and commitment	<ul style="list-style-type: none"> <li>▶ Chapter 3—Values identification and commitment</li> <li>▶ Instructions about what are values (a life compass) explained through the journal.</li> <li>▶ Acceptance and commitment to values orientation as opposed to avoidance behaviour is rewarded.</li> <li>▶ There are challenges to reach goals which are linked to the character's values, such as scary weather and monsters.</li> <li>▶ Psychological flexibility on the 'psychoflexameter' and game progress, will increase with values consistent behaviour which rewards the player for committing to values.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 4 (week 2): defusion	<ul style="list-style-type: none"> <li>▶ Chapter 4—Defusion</li> <li>▶ Instructions about what is cognitive fusion and defusion (holding self-stories lightly) explained through journal.</li> <li>▶ The character goes back into the 'Mind Escape' machine but this time there is a flowing river with leaves (analogous to leaves on a stream metaphor).</li> <li>▶ Some of the character's painful memories will beg the player to help them, but if the player interacts, barriers and quicksand appear, punishing the player and preventing them from progressing in the game (analogous to the sinking sand metaphor).</li> <li>▶ The ghost of the character's wife eventually instructs the player to put the memories and thoughts onto the leaves and watch them flow down the river, without interacting with them, and to simply observe.</li> <li>▶ Psychological flexibility on the 'psychoflexameter', will increase when all of the memories and thoughts as left to go down the stream, hence the player is rewarded for defusing.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>

Continued



**Table 1** Continued

<p>Session 5 (week 3): self as context</p>	<ul style="list-style-type: none"> <li>▶ Chapter 5—Self as context</li> <li>▶ Instructions about what is self as context (being the observer of your thoughts and not your thought) are explained through journal.</li> <li>▶ The world starts to fall apart and becomes abstract, like a chess board.</li> <li>▶ The player realises that they are the white pieces on the chessboard (analogous to chess board metaphor).</li> <li>▶ The player is compelled by the game to beat the black pieces in the chess game.</li> <li>▶ But the more the players fights against the black pieces, the more they lose points on the ‘psychoflexameter’ and cannot progress in the game.</li> <li>▶ The player must let the battle play out, once they do, they become aware that they are the chess board (they become it) and realise they do not need to be part of the never-ending battle between the opposing forces.</li> <li>▶ Finally, a bus arrives, memories of the character’s wife beg the player to stay, and the monsters pull on player.</li> <li>▶ The player needs to get onto the bus with the monsters to move towards their values, a new beginning (analogues to bus metaphor).</li> <li>▶ Finally, the player has a choice, go back and change the events that led to your wife’s death, or stay on the bus with the monsters.</li> <li>▶ Trying to change events leads to a loss in points and prevents game progression.</li> <li>▶ Only staying on the bus, towards values, and accepting the monsters allows the player to complete the game successfully.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
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### Outcome measures

Questionnaires will be collected at three points in time (baseline, immediate postintervention and 3-month follow-up). Interview data will be collected immediate postintervention only.

### Demographic data

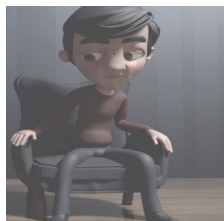
Demographic measures will include age, sex, medication use, which will all be recorded through Qualtrics and assessed by DJE and AHK.

### Primary outcome measure

The primary outcomes for feasibility are determined using MRC framework measure for developing a complex intervention.<sup>49 50</sup> As this is a feasibility study, the primary outcomes (in accordance with the MRC framework) will include the acceptability of the ACT-based video game intervention, the feasibility of the recruitment, outcome measures and intervention adherence.

### Acceptability

- ▶ Number of people dropping out.



**Figure 1** First scene in ‘ACTing Mind’, the character, Steve, is depressed and alone.

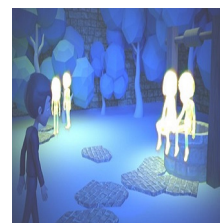
- ▶ Barriers for adoption of intervention as assessed through interviews.
- ▶ Number of sessions attended.
- ▶ Time dedicated to home journal.
- ▶ ACT principles adherence in everyday life setting (as recorded in journal and expressed through interviews).
- ▶ Experience, identifying whether participants had positive experience with the intervention and whether they wanted to continue to be part of the intervention.

### Feasibility

- ▶ Number of participants who are willing to take part.
- ▶ Time taken to complete questionnaires.
- ▶ Number of complete and incomplete questionnaires.

### Secondary outcome measures

Warwick-Edinburgh Mental Well-Being Scale<sup>53</sup>: a measure of mental well-being with a focus on positive aspects of mental health. This measure has good internal



**Figure 2** An example scene, where the character ‘Steve’ is in his own mind, and can see his own memories, through his Mindscape machine.



consistency with a Cronbach's alpha coefficient of 0.89 (student sample) and 0.91 (general population sample).

Depression Anxiety Stress Scales: a short version of this measure and a measure of general psychological distress with good construct validity (confirmatory factor analysis of 0.94). It has good internal reliability as measured through Cronbach's alpha coefficients, which are 0.88 for depression, 0.82 for anxiety, 0.90 for stress and 0.93 for the total scale.<sup>54</sup>

Social connectedness (adapted from Russell's (1996) UCLA Loneliness Scale<sup>55</sup>: this measure involves two questions: (1) "During social interactions, I feel 'in tune' with the person/s around me", and (2) "During social interactions, I feel close to the person/s". The Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98 (M=0.94, SD=0.03).<sup>55</sup>

EuroQol five dimensions (EQ5D): the EQ5D is a measure for health-related quality of life. There are five components within this measure which assess mobility, self-care, usual activities, pain, discomfort and anxiety. It also has a visual analogue scale (VAS) for measuring current health status. Scores for these will be calculated for each of these five subsections as well as including the VAS and total EQ5D score of all five subsections. The EQ5D correlates well with other health-related questionnaires such as the 36-Item Short Form Survey ( $r=0.61$ ,  $p<0.0001$ ) and Parkinson's Disease Questionnaire (PDQ)-39 ( $r=-0.75$ ,  $p<0.0001$ ).<sup>56</sup>

Acceptance and Action Questionnaire-second version: this is a seven-item scale developed by Bond *et al*<sup>57</sup> to measure psychological inflexibility, which involves the ability to accept and be open to difficult thoughts and feelings as well as to engage in valued behaviour in the presence of the difficult thoughts and feelings. A higher score indicates higher psychological inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of 0.84.<sup>57</sup>

### Adherence to the intervention measure and trial

Adherence will be measured in a variety of ways such as intervention feedback, treatment adherence through attrition rates as well as meta-data of relating to game log-in and log-out, as well as how long the game was played for and what sessions of the game were completed for each participant. Similar information can be recorded in Qualtrics for ensuring questionnaires are completed carefully. This includes length of times completing the questionnaire, and paying attention to reverse-scored questions.

### Sample size and statistical analysis

Sample size recruited will help us determine whether it is possible to recruit sufficient numbers of participants to manage a full-scale RCT at a later date.

Quantitative data analysis: analysis will focus on descriptive statistics and feasibility outcomes of the questionnaires. While clinical effectiveness will not be formally evaluated at this stage, effect sizes will be explored for

early evidence that the intervention shows promising signs (including ACT-related process measures). It is predicted that outcomes will improve, and any improvement will be identified using a one-way analysis of covariance with a single within-subjects factor (time). The effect sizes will also allow for a power calculation to be made which will allow for an approximation for a sample size required in a future trial (if indicated).

Qualitative data analysis: transcripts of focus group interview data will be generated from digital audio-recordings of in-depth, face-to-face semi-structured interviews (all online and via a password-protected room in Zoom). In-depth semi-structured interviews will form the core topics to be discussed (see table 2), while leaving space and scope for the identification and exploration of unforeseen information that may emerge. Insights from this will allow for further development and improvement of the intervention, along with the quantitative data in line with the MRC guidelines.<sup>49 50</sup>

Thematic analysis will then be conducted which will explore key overarching themes that may emerge from the focus group interviews following standardised guidelines.<sup>58</sup> The interview questions are based on other novel ACT-based protocols.<sup>40 59</sup> The data will be analysed after the study has been completed. We will follow the inductive and deductive code development as outlined by Fereday and Muir-Cochrane<sup>60</sup> to ensure necessary rigour. Any key overarching themes identified which relate to feasibility of the study design of the acceptability of the intervention, as well as potential adverse effects, will be explored and reported.

The focus groups will comprise 4 to 6 groups with 6 to 10 individuals in each group as has been suggested as optimal in other studies.<sup>61</sup> The interview will take place at the end of the intervention (week 3). It will explore various aspects of the intervention such as perceived process of change, barriers to intervention adherence, trial process and any adverse effects, which help supplement the quantitative approach. Process of change questions indicate whether the participant learnt anything about ACT, and felt any positive change in their life due to participating in the intervention. The question relating to barriers explores any problems and difficulties they had with the intervention. Another question will be asked to elicit suggestions for improvement relating to game or study design. Acceptability questions and process of change in one's life relate to whether the participant accepted the intervention and used skills they learnt through the intervention in daily life. The question relating to the trial process will determine whether there were any difficulties or limitations of the trial itself such as whether the instructions were clear and how it could be improved. Finally, the question on adverse effects explores whether there were any potential unforeseen negative consequences of the intervention.

### Limitations of the study

This study protocol has limitations. First, while physiological measures would ideally be collected to measure



**Table 2** Qualitative interview protocol for the focus groups

Acceptability and feasibility	How would you describe your experience of taking part in 'ACTing Mind' video game programme?
Accessibility of intervention	If this intervention were rolled out as a video game app, do you think you would download it? Would you appreciate the accessibility?
Process of change	What did you learn from this programme?
Acceptability	What was the aspect of the programme that you liked the most? What was your favourite activity within the game (or applied to your everyday life)?
Suggestions for further improvement	What did you least like about the intervention? What do you think could be improved?
Barriers	Were there any difficulties to taking part?
Implementing change in everyday life	Do you practice mindfulness, acceptance, defusion and values? How often? Could you apply what you have learnt through video game intervention to the real world in everyday events? Will you apply this new knowledge to everyday events?
Process of change	Have you noticed any differences in your life as a result of taking part in 'ACTing Mind'? If 'yes', what are these differences?
Acceptability	Would you recommend this intervention to someone you care about? Did you like the theoretical concepts central to the ACT intervention? How did you feel about its delivery? Was any of it too abstract or difficult to understand?
Processes of the trial	Was there anything you liked, or disliked about the study? How could we improve this study? Were all the instructions clear?
Adverse effects	Did you feel that any aspect of the intervention may have made worse any aspect of your anxiety, depression or stress? Were there any adverse effects that you can recognise due to the intervention?

variables such as heart rate variability, the COVID-19 pandemic limits our capacity to do this. However, the present study will provide important data on which such measures could be collected, analysed and interpreted in a future trial. Second, it could be questioned why there is no control condition in this study. Our response to this potential criticism is that the aim of the present study is to assess feasibility and—in line with the MRC guidelines<sup>49 50</sup>—has not been designed to be a full-scale RCT given the current research phase. Once the feasibility component is completed, a control condition will be introduced, which allow for the intervention condition to be compared with control, and as part of a full trial. Finally, although we would like to have ability to monitor the participant more directly, to ensure adherence to the intervention, we are sensitive to privacy issues associated with, for example, capturing participants' identity from the computers video camera. To mitigate this limitation, we have opted for less invasive procedures for measuring intervention adherence that will include logging metadata of the game such as log in and out times, as well as completion of game sections. Several questions in the questionnaire are also reverse scored to ensure participants are paying attention.

### Protocol amendments

If the protocol is amended in any way, it will be communicated to relevant parties immediately, such as to participants, journal and ethics committee.

### Ethics and dissemination

This study has received ethical approval from Swansea University Psychology Department ethics committee (2020-4920-3923). Participants will be informed of their rights to confidentiality and to leave the study at any time and without penalty. Both qualitative and quantitative data will be held on a password-protected computer accessible only to researchers DJE and AHK. The data will be anonymised with a unique identifier code, and any personally identifiable information will be removed.

Dissemination will involve peer-reviewed journals; leading national and international conferences, social media and public events and through general public health engagement such as talks at schools, the Welsh Government and engagement with annual science festivals including 'a pint of science'.

### Impact of intervention

The potential impact of this study is far reaching as it will add to the growing set of online resources which support psychological resilience, flexibility and well-being. These resources are designed to be easy to access and are ideal for situations where travel is limited due to physical (disability) or situational (coronavirus) immobility. Such interventions can help alleviate widely reported mental health treatment gaps<sup>2</sup> and lags,<sup>3</sup> associated with the widely reported scarce human resources needed to provide mental health support for the many individuals who need it. The 2018 Lancet commission on global mental health argued that sustainable development



of mental health should be an essential component of universal health coverage.<sup>4</sup> Technological innovation of mental health support services, in the form of video games, may be one means to achieve this sustainability and a reduction in the treatment gap and lag.

### Ancillary and poststudy care

Postintervention care has not been anticipated given this is a low-level (low-risk) intervention. Of course, all participants will be given a debrief form which will signpost individuals to the relevant free well-being services such as the Samaritans.

**Acknowledgements** The authors would like to thank Professor Louise McHugh (University College Dublin), who provided some very helpful feedback about the gamification of an ACT-based approach through the utilisation of behavioural principles.

**Contributors** DJE developed the intervention. DJE and AHK agreed on a set of outcomes. DJE wrote the first draft of the protocol and DJE and AHK then revised the subsequent drafts of the protocol. Both authors helped to revise the manuscript for intellectual content and agreed on the final version prior to submission for peer review.

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**Competing interests** At the time of writing this, DJE is discussing with Agor IP at Swansea University the potential to commercialise the described video game as a mobile application; however, at this time no agreements have been made or signed. AHK has no competing interests.

**Patient consent for publication** Not required.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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## PARTICIPANT INFORMATION SHEET

### **A novel ACT-based video game to support mental health through embedded learning**

You are being invited to take part in some research. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please read the following information carefully.

#### **What is the purpose of the research?**

The aim of the research project is to gain insight into whether exposure to a novel-acceptance and commitment therapy (ACT) video game can improve various outcome measures of depression, anxiety, stress, and other measures relating to wellbeing.

If you are above the age of 18 and are currently experiencing ongoing mild to moderate levels of depression, anxiety, or stress you are welcome to participate in this study. For those individuals who present with high levels of depression and anxiety, we will advise the participant to consult either with a GP or with a therapist if they have one, in relation to participating in this experiment.

Participation in this study will take approximately 3 hours over three weeks. Which is broken down into 1 hour for the intervention (the video game itself); 1 hour for online one-on-one qualitative audio interviews via Zoom after completing the game, and after a 3-week follow-up; and 1 hour for the three-questionnaire assessments at baseline (pre-intervention), immediate post-intervention, and after a 3-week follow-up.

#### **Who is carrying out the research?**

The data are being collected by Prof. Andrew Kemp and research assistant Tom Gordon of the Psychology Department within the College of Human and Health Sciences at Swansea University, as well as Dr. Darren Edwards of The Department of Public Health, Policy, and Social Sciences. The research has been approved by the Department of Psychology's Research Ethics Committee.

#### **What happens if I agree to take part?**

If you are happy to take part in this research project, please click "accept" at the bottom of the consent section below, which will then allow you to complete a baseline questionnaire assessment. The questionnaire assessment includes a range of multiple-choice questions. These questions cover a range of factors including depression, anxiety, stress, and wellbeing. There are three questionnaire assessments to complete, the first of which is a baseline assessment prior to the intervention commencing, the second will be completed following the intervention, and a follow-up assessment 3 weeks following the baseline assessment. All of the questionnaires ask the same questions with the addition of demographic questions at baseline assessment, and the second also asking about adherence to the intervention.

The intervention will consist of completing a one-hour session of playing an ACT-based video game, followed by completion of a short reflection workbook. The game itself will be completed by the participant at home, using a mobile phone or any iOS device. This is an adventure game that will teach you about psychological resilience. In the game, you will control the character Steve as he embarks on a journey into his own mind, you will help as he confronts painful past memories and learns how to cope with his full potential.



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6 You will also be interviewed, which will be conducted online via zoom, regarding your experiences of  
7 the game, focusing on what you felt did and did not work. The interviews will be conducted at two  
8 points during the study, post-intervention, and after a 3-week follow-up. Interview audio will be  
9 recorded and transcribed, following which the recordings and any personal information will be  
10 immediately deleted.  
11

### 12 13 **Are there any risks associated with taking part?** 14

15 We are not aware of any significant risks associated with participation. While some of the questions  
16 will ask about existing states of mental health (e.g., levels of current anxiety and depression) – which  
17 some people may find uncomfortable – the video game has developed in accordance with recent  
18 developments in psychological science to help you manage these, and we expect that participation in  
19 this study will help to ameliorate these feelings.  
20

21 If you feel affected by any issues raised by this research and would like to discuss any concerns,  
22 please contact the principal investigators of this study as indicated in the contact details at the bottom  
23 of this information sheet. If you feel that you would benefit from further psychological or psychiatric  
24 support, we advise you to contact your GP (family doctor) in the first instance. Further information on  
25 mental wellbeing can be found at <https://www.mind.org.uk/>. Additional mental health information can  
26 be found at <https://www.nhs.uk/mental-health/>.  
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30 This research has been approved by the Department of Psychology's Research Ethics Committee.  
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### 32 **Data Protection and Confidentiality**

33 Your data will be processed in accordance with the Data Protection Act 2018 and the General Data  
34 Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly  
35 confidential. Your data will only be viewed by the researcher/research team.  
36

37 Standard ethical procedures will involve you providing your consent to participate in this study by  
38 ticking the consent box in the consent section  
39

40 All electronic data will be stored on password-protected computers.  
41

42 Please note that the data to be collected for our study will be made anonymous once you have  
43 completed all stages of the research, and your response data will not hold any personally identifiable  
44 information. We will allocate you with an identifier code, and keep your email information for the  
45 duration of the study, so that we can communicate with you at the time points. We will delete contact  
46 emails at the end of the study.  
47

48 All data deposited in Swansea University's OneDrive for Business service is stored within Microsoft's  
49 data centres located in the EU. Swansea University retains full ownership and control over the data  
50 and is satisfied that the data is properly secured and protected.  
51

52 The contractual agreements between Microsoft and Swansea University have been negotiated by the  
53 JISC on behalf of the UK HE sector and abide by all relevant UK and European legislation. In  
54 addition, the UK Government has granted Microsoft Azure and Microsoft Office 365 "OFFICIAL"  
55 accreditation. This means that they are accredited to hold or transact public sector data for business  
56 conducted at the OFFICIAL level of Security Classification.  
57

### 58 **What will happen to the information I provide?** 59 60

Version 4 4 November 2022



An analysis of the information will form part of our report at the end of the study and may be presented to interested parties and published in scientific journals and related media. *Note that all information presented in any reports or publications will be anonymous and unidentifiable.*

### **Is participation voluntary and what if I wish to later withdraw?**

Your participation is entirely voluntary – you do not have to participate if you do not want to. If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty (simply close your web browser). All identifying information will be stripped from collected data once you have completed all phases of the study. If you wish to withdraw at any time during the study, all personal information will be immediately deleted.

### **Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data, and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent to participate in this study by ticking the consent box on the consent page.

The legal basis that we will rely on to process your personal data will be processing in line with public interest, scientific and statistical purposes.

### **How long will your information be held?**

Anonymised data will be preserved and accessible online, as is encouraged by developments in open science.

### **What are your rights?**

You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)  
Vice-Chancellor's Office  
Swansea University  
Singleton Park  
Swansea  
SA2 8PP  
Email: [dataprotection@swansea.ac.uk](mailto:dataprotection@swansea.ac.uk)

### **How to make a complaint**

If you are unhappy with the way in which your personal data has been processed you may, in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,  
Wycliffe House,



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6 Water Lane,  
7 Wilmslow,  
8 Cheshire,  
9 SK9 5AF  
10 www.ico.org.uk  
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12

### 13 **What if I have other questions?**

14 If you have further questions about this study, please do not hesitate to contact us:  
15

16 Tom Gordon  
17 Research Assistant  
18 Swansea University  
19 tom.gordon@swansea.ac.uk  
20

21 Prof. Andrew Kemp  
22 Department of Psychology  
23 Swansea University  
24 a.h.kemp@swansea.ac.uk  
25

26 Dr. Darren Edwards  
27 Department of Public Health, Policy,  
28 and Social Sciences.  
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Swansea University  
Prifysgol Abertawe

## Participant Consent Form

Project title: **A novel ACT-based video game to support mental health through embedded learning**

You must be age 18 or over to complete this online survey.

Name and Contact details of the principal researchers: Tom Gordon [tom.gordon@swansea.ac.uk](mailto:tom.gordon@swansea.ac.uk), Prof. Andrew Kemp [a.h.kemp@swansea.ac.uk](mailto:a.h.kemp@swansea.ac.uk), Dr. Darren Edwards [d.j.edwards@swansea.ac.uk](mailto:d.j.edwards@swansea.ac.uk).

This study is being conducted by Swansea University, Faculty and life sciences.

- I (the participant) consent to participate in the study
- I confirm that I have read and understand the information provided in relation to this study.
- I understand that this study will involve three phases, taking place over a period of three weeks. Within which I will complete a 1-hour therapy-based mobile phone videogame at home, that includes potentially upsetting themes relating to mental health.
- I understand that partaking in this study involves one-on-one online interviews using Zoom audio, and that any identifiable personal information will be immediately deleted following transcription.
- I understand that I have the option of undergoing electrocardiograph recording at three stages during the study, which will take place at Swansea University.
- I understand that my participation is voluntary. I understand that I am free to withdraw at any time during the study but once I have completed all phases of the study, withdrawal will not be possible because data will be completely anonymised.
- I understand what my role will be in this research, and all my questions have been answered to my satisfaction.
- I have been informed that the information I provide will be safeguarded.
- I am happy for the information I provide to be used (anonymously) in academic papers and other formal research outputs, however my name will not be published so anonymity is ensured.

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- I agree to the researchers processing my personal data in accordance with the aims of the study described in the participant information.
  - I am age 18 years or above.

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If you agree with all statements listed above, click **YES** (I consent).

If you disagree with any of the statements above, click **NO** (I do not consent).

For peer review only

## DEBRIEF FORM

Title of project: **A novel ACT-based video game to support mental health through embedded learning**

Thank you for taking part in our research. Now that your contribution has finished, let us explain the rationale behind this work.

We are interested in how a video game based on recent developments in clinical psychology might enable learning of psychological resilience skills through play. Typically, psychotherapeutic interventions are delivered through face to face sessions, but there is an increasing need for psychological support that is delivered through an online medium such as the video you have been playing in our study.

This work therefore builds on previous efforts to teach people important skills in psychological resilience through psychoeducation and embedded learning. Specifically, the game is designed to build psychological flexibility, which is a key outcome of an ACT intervention. Psychological flexibility within ACT refers to the promotion of positive mental health, contact with present emotions, wellbeing, and positive emotions. We hope that information gained from this study will be useful for further developing our ACT-based video game and expanding further research in this area.

If you feel affected by any issues raised by this research and would like to discuss any concerns, please contact the principal investigators of this study as indicated in the details provided below. If you feel that you would benefit from further psychological or psychiatric support, we advise you to contact your GP (family doctor) in the first instance. Further information on mental wellbeing can be found at <https://www.mind.org.uk/>. Further information regarding mental health can be found at <https://www.nhs.uk/mental-health/>.

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## CONSORT 2010 checklist of information to include when reporting a pilot or feasibility trial\*

Section/Topic	Item No	Checklist item	Reported on page No
<b>Title and abstract</b>			
	1a	Identification as a pilot or feasibility randomised trial in the title	1
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT abstract extension for pilot trials)	2/3
<b>Introduction</b>			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	4-9
	2b	Specific objectives or research questions for pilot trial	8-9
<b>Methods</b>			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	9
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	8
Participants	4a	Eligibility criteria for participants	10
	4b	Settings and locations where the data were collected	10
	4c	How participants were identified and consented	10
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	12
Outcomes	6a	Completely defined prespecified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	10-12
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	N/A
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	N/A
Sample size	7a	Rationale for numbers in the pilot trial	10
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	N/A
	8b	Type of randomisation(s); details of any restriction (such as blocking and block size)	N/A
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	N/A

Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	N/A
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	N/A
	11b	If relevant, description of the similarity of interventions	N/A
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	14-17
<b>Results</b>			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were approached and/or assessed for eligibility, randomly assigned, received intended treatment, and were assessed for each objective	17
	13b	For each group, losses and exclusions after randomisation, together with reasons	17
Recruitment	14a	Dates defining the periods of recruitment and follow-up	17
	14b	Why the pilot trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	30
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be by randomised group	17
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	30
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	17-29
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	N/A
	19a	If relevant, other important unintended consequences	N/A
<b>Discussion</b>			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	33-34
Generalisability	21	Generalisability (applicability) of pilot trial methods and findings to future definitive trial and other studies	31
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms, and considering other relevant evidence	31-35
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	34-35
<b>Other information</b>			
Registration	23	Registration number for pilot trial and name of trial registry	3
Protocol	24	Where the pilot trial protocol can be accessed, if available	35
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	35
	26	Ethical approval or approval by research review committee, confirmed with reference number	36

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Citation: Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *BMJ*. 2016;355. This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 3.0) license (<http://creativecommons.org/licenses/by/3.0/>), which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited.

\*We strongly recommend reading this statement in conjunction with the CONSORT 2010, extension to randomised pilot and feasibility trials, Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up-to-date references relevant to this checklist, see [www.consort-statement.org](http://www.consort-statement.org).

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# BMJ Open

## Mixed-methods feasibility outcomes for a novel ACT-based videogame 'ACTing Minds' to support mental health

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Keywords:	MENTAL HEALTH, Health Education, Depression & mood disorders < PSYCHIATRY

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3 **Mixed-methods feasibility outcomes for a novel ACT-based videogame**  
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6 **‘ACTing Minds’ to support mental health**  
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12 Tom C. Gordon<sup>1,2</sup>, Andrew H. Kemp<sup>2</sup>, & Darren J. Edwards<sup>1</sup>  
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58 Short title: Feasibility outcomes ACTing Minds  
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## Abstract

**Objectives:** To determine the feasibility and acceptability of ‘ACTing Minds’, a novel single-player adventure videogame based on acceptance and commitment therapy (ACT).

**Design:** A single-arm, mixed-methods repeated measures feasibility study.

**Setting:** Intervention and questionnaires were completed at home by participants. Semi-structured interviews were also conducted at home via the Zoom platform.

**Participants:** Thirty-six participants were recruited into the study, 29 completed all phases of the feasibility design. Eligibility criteria required participants to be over the age of 18 and self-reporting experiencing ongoing depression, anxiety, or stress.

**Intervention:** Participants completed a single session of the ‘ACTing Minds’ videogame, lasting approximately 1-hour, designed to educate users on key principles from acceptance and commitment therapy (ACT).

**Primary outcome measures:** Participant recruitment and retention, questionnaire completion, long-term intervention adherence, and acceptability of the intervention. Reflexive thematic analysis was conducted on semi-structured interviews run immediately postintervention and 3-weeks later.

**Secondary outcome measures:** Measures of depression, anxiety, stress, psychological flexibility, social connectedness, and wellbeing were assessed at baseline, immediately following intervention completion, and after a 3-week follow-up period. We used a standardised battery of questionnaires.

**Primary results:** Twenty-nine participants completed the study. A reflexive thematic analysis indicated that participants responded positively to the intervention and the study at all stages. Themes reflect participants’ desire for an engaging therapeutic experience, use of

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3 game for exploring emotions, as well as their perspectives on how they had applied their  
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5 learning to the real-world.  
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8 **Secondary results:** Quantitative results indicated small to large effect sizes associated with  
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10 decreases in depression ( $\eta^2 = .011$ ), anxiety ( $\eta^2 = .096$ ), stress ( $\eta^2 = .108$ ), and increases  
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12 in psychological flexibility ( $\eta^2 = .060$ ), social connectedness ( $\eta^2 = .021$ ), well-being ( $\eta^2$   
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14  $=.011$ ), and participation in usual activities ( $\eta^2 = .307$ ).  
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18 **Conclusions:** Implementation of the 'ACTing Minds' intervention is warranted, based on  
19  
20 both qualitative and quantitative outcomes.  
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23 **Trial Registration number** NCT04566042  
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### 26 27 **Strengths and limitations of this study** 28

- 29  
30 • Mixed methods approach, combining thematic analysis of interviews and quantitative  
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32 questionnaires.  
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- 35 • Collection of quantitative data at three time points and qualitative at two time points,  
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37 allowing the process of change and identification of patterns to be examined.  
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- 40 • Remote data collection due to COVID restrictions meant that participants could not be  
41  
42 directly observed while completing the intervention. We were also unable to record  
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44 planned psychophysiological measurements of wellbeing such as heart rate  
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46 variability.  
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- 49 • Reliance on self-report measures introduces the potential for bias.  
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## Introduction

The global prevalence of common mental disorders and a lack of available resources for the identification and treatment of those with such conditions underpin an increasing burden on society (1). The Global Burden of Disease study conducted in 2017, reported a UK prevalence rate of 4.12% for depression, and 4.65% for anxiety disorders (2). Since this estimation, events such as the COVID-19 pandemic and the increasing threat of climate crises have had a substantial impact on societal wellbeing. A meta-analysis including 14 studies (n=46,158) found that 32% of adults in the UK experienced moderate to severe depressive symptoms in 2022, and 31% of adults reported high levels of anxiety (3), indicating a societal increase of 27.88% for depression, and 26.35% increase for anxiety between 2017 and 2022. These findings suggest the need for a transition towards population-wide strategies aimed at fostering psychological resilience on a broader scale.

To positively impact societal wellbeing, contemporary interventions must be affordable and widely accessible. Presently, the demand for mental health services far exceeds the available human resources required to meet this need. A study conducted for the Centre for Mental Health estimated that services cost the UK economy approximately £105 billion per year in 2020, 4.8% of the UK's annual GDP (4). Despite substantial funding of £34 billion to public mental health support and services, the prevalence of psychological disorders is high and only 33% of adults with depression and anxiety receive treatment in England (5), highlighting an urgent need for innovation.

There are numerous barriers to accessing psychological interventions, including a shortage of therapists, long waiting times, and societal stigma of accessing psychological treatment (6). A potential solution to these issues might be found in digital health interventions (DHIs). We live in an age of heavy digital media consumption, especially in the

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3 West where at least 90% of UK adults use the internet regularly (7). We also know that  
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5 during the COVID-19 pandemic, there were significant increases in online video  
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7 consumption, social media usage, remote work, online news consumption, and video gaming  
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9 (8). COVID-19 contributed to significant social isolation and further disconnection from  
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11 nature, further contributing to increases in mental health conditions (9). We argue that there is  
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13 an opportunity to leverage technological advancements and the growing use of technology to  
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15 develop psycho-educational tools necessary to support mental health at scale.  
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19 DHIs have already been utilised in a variety of contexts for promoting wellbeing, from  
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21 delivering healthcare and education to personalised diet and fitness plans. Mobile apps and  
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23 online platforms offer guided meditation, breathing exercises, sleep tracking, and relaxation  
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25 programs. Such applications might aim to enhance overall wellbeing, reduce stress, improve  
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27 sleep quality, or cultivate mindfulness practices (10). We suggest that effectively addressing  
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29 wellbeing at a population level should involve the development of DHIs that consider  
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31 acceptability, feasibility, and widespread appeal.  
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35 Compared with alternative forms of media, videogame DHIs offer several advantages.  
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37 By design they are interactive, applying behavioural principles for controlling and modifying  
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39 behaviour (11), making them uniquely captivating. In the UK, the COVID-19 pandemic led  
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41 to a substantial increase in the number of people playing video games, with males increasing  
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43 their use from 46% to 63% and females increasing their use from 32% to 56% in 2022 (12).  
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45 Innovations in the use of video games for treating mental health issues have wide potential  
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47 applications, potentially offering a platform for individuals to explore their ongoing  
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49 relationship with their emotions in a supportive environment.  
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53 In theory, by practising skills derived from psychological therapies (such as ACT)  
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55 within the game context, individuals can transfer these skills to real-life situations to improve  
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57 their overall quality of life. Certain games specifically designed for therapeutic purposes,  
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3 such as 'SPARX' for depression (13) or 'Elude' for anxiety (14), guide players through  
4 interactive challenges and cognitive exercises for developing emotional regulation skills.  
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6 Videogames are also being used in clinical settings to promote wellbeing outcomes. One  
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8 game designed for this purpose, 'Dojo' (15), aims to treat anxiety by training users in  
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10 breathing techniques, muscle relaxation, positive thinking, and guided imagery, utilising  
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12 heart-rate variability (HRV) biofeedback. However, when compared against a standard  
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14 commercial game 'Rayman 2' (control condition), a full pre-post RCT (n=138) found that  
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16 playing either game significantly reduced participant anxiety at a 3-month follow-up, and  
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18 there were no significant differences between these two games at reducing anxiety for this  
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20 time period (15). Reasoning for this might be that 'Dojo' failed to develop the  
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22 psychoeducational skills in the participants that it aimed to impart, or that both games only  
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24 reduced anxiety by distracting (as a form of avoidance) participants from anxiety-provoking  
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26 thoughts (16). The researchers concluded that 'Dojo' had crucial design issues that needed to  
27  
28 be addressed including a lack of clear theoretical and therapeutic frameworks, and that  
29  
30 research assessing the real-world effectiveness of video games in the treatment of mental  
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32 health issues should require an appropriate methodology for understanding the underlying  
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34 causes of improvement.  
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42 A study aiming to explore the wellbeing effects of playing video games on gamers  
43 during the COVID-19 pandemic (n=781) found that time spent playing had significantly  
44 increased in 71% of participants, and 58% of participants reported that playing games had  
45 positively impacted their wellbeing (17). The researchers conducted an online survey  
46 including both closed and open-ended questions, then conducted a thematic analysis to  
47 identify the causes of improvement. Themes of escape, cognitive stimulation, stress relief,  
48 agency, and socialisation were most associated with feelings that playing video games had  
49 increased wellbeing. The development of an effective DHI videogame should consider such  
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3 factors whilst also building on strong theoretical and therapeutic foundations that facilitate  
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5 the uptake of such tools.  
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8 The 'ACTing Minds' videogame, developed in line with our intervention protocol  
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10 (16), was designed to be a comprehensive transdiagnostic intervention that will integrate  
11  
12 lessons from acceptance and commitment therapy (ACT) (18). In contrast to prior mentioned  
13  
14 DHIs, commonly rooted in the medical model and second-wave approaches, ACT as a third-  
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16 wave behavioural therapy focuses on promoting psychological flexibility rather than the  
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18 elimination of disorder symptoms (19). More specifically, ACT aims to promote  
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20 psychological flexibility through six core processes of change (20). These are: (1) present  
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22 moment awareness: the practice of being in the here and now; (2) acceptance: the practice of  
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24 being open to the range of human emotional experience, as opposed to experiential  
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26 avoidance; (3) Cognitive defusion: the act of recognising the self as separate from thoughts,  
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28 and not interpreting them literally; (4) values: identifying ones' personal values in contrast to  
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30 perceived expectations, of which drive us toward self-direction and purpose; (5) action: a  
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32 commitment to ones' values, facilitating the development of competence through the act of  
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34 continual practice of alignment with values (21); and (6) self as context: developing an  
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36 awareness of self that is more than a conceptualised sense of self, one that is flexible and  
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38 facilitates a sense of connection with others.  
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45 Though ACT clinical practice does not focus primarily on reducing mental health  
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47 symptoms, many studies have indicated that when the individual works towards greater  
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49 psychological flexibility, many mental health symptoms, and destructive behaviours such as  
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51 anxiety, depression, stress, pain, and substance misuse, tend to reduce with clinically  
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53 acceptable small to high effect sizes. This was, for example, identified within a review of 20  
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55 meta-analyses, involving 133 studies (n=12,477) that found that ACT was efficacious for  
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57 treating these disorders (22). The results also showed that ACT was generally superior to  
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3 most active intervention conditions (excluding CBT), treatment as usual, and inactive  
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5 controls.  
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8 As such, an ACT-based DHI video game could allow for both greater psychological  
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10 flexibility as well as a reduction in common mental health issues such as depression and  
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12 anxiety. This is because developing explicit DHI psychoeducational transdiagnostic skills  
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14 that promote present moment awareness, values orientation, commitment to action, openness,  
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16 and acceptance of painful emotions, cognitive defusion, and a transcendental self also have a  
17  
18 positive impact on mental health. As a consequence, our videogame may have greater reach  
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20 and impact than other videogame DHIs that are not based on third-wave psychotherapy, such  
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22 as ‘Dojo’, which primarily aims to teach skills for limited emotional regulation and symptom  
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24 reduction such as avoidance.  
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28 The ACT framework has already been adapted to a variety of accessible mediums,  
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30 including self-help books and mobile phone applications (23). Resources for the education  
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32 and practice of ACT are freely available through the Association of Contextual Behavioural  
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34 Science website (see <https://contextualscience.org/>). ACT-based mobile phone applications  
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36 are shown to be effective in promoting psychological flexibility (24) and reducing smoking  
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38 intake (25). Considering this, we believe that choosing ACT as the basis for our game will  
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40 allow us to harness the advantages of third-wave therapies as transdiagnostic therapeutic tools  
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42 and integrate these with those of videogames, and if made well, will be engaging,  
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44 educational, and capable of promoting wellbeing (psychological flexibility) at scale.  
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48 Based on our initial protocol (16) (see Supplementary 1), the ACT-based videogame  
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50 called ‘ACTing Mind’, has been developed as a psychoeducational tool that teaches users the  
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52 core processes of ACT through embedded learning. The goal of this research will be to  
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54 determine the acceptability and feasibility of ‘ACTing Minds’ for promoting psychological  
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56 flexibility as well as its clinical relevance for reducing mental distress as a secondary  
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3 outcome. The game teaches skills based on the ACT principles of acceptance, defusion, and  
4 values identification. This is a feasibility study, following the Medical Research Council  
5 (MRC) framework (26), laying the foundation for a full-scale RCT from which clinical  
6 effectiveness will be determined.  
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11  
12 Several changes have been made to our originally published protocol (16), it was  
13 initially stated that participants would complete five weekly 1-hour sessions where they  
14 would play through six parts of the ‘ACTing Minds’ videogame, each one focusing on a  
15 different process of ACT. However, because of funding restrictions, ‘ACTing Minds’ has  
16 been compressed into a single game focusing on the ACT principles of acceptance, values  
17 identification, and defusion. Therefore, in this feasibility study, participants will be required  
18 to complete a single 1-hour session of ‘ACTing Minds’. This meant a significant change to  
19 the overall time to complete the study protocol. Originally it was expected to take 3 months  
20 between baseline measurements and the final follow-up. Now, one-on-one semi-structured  
21 interviews will be conducted immediately postintervention, and after a 3-week follow-up.  
22  
23 The research questions are as follows: Is the intervention acceptable and feasible for a full-  
24 scale RCT? Is there early evidence for effectiveness in reducing mental distress? Are there  
25 any changes in self-reported wellbeing measures following completion of the game? Are  
26 participants able to learn ACT principles and apply them in day-to-day life?  
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## 44 **Methodology**

### 45 **Design:**

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48 This is a single-arm, mixed-methods repeated measures study, designed to determine the  
49 feasibility and acceptability of an ACT-based video game called ‘ACTing Minds’ that has  
50 been designed for individuals reporting mild to moderate anxiety, depression, and stress. Data  
51 was collected at baseline, immediately post-intervention, and 3-weeks post-intervention. Data  
52 collection was conducted between November 1<sup>st</sup> and December 31<sup>st</sup>, 2022.  
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**Study Setting:**

The study was conducted entirely online by participants, including the intervention (via a link to the mobile app; <https://shorturl.at/iqFGI>), quantitative assessment (via the Qualtrics platform), and qualitative interviews (via the Zoom platform). Strict recommendations were given to participants to ensure they were in a quiet room and without disruption for all study components.

**Participants:**

Thirty-six participants were recruited, 29 of which completed all phases of the study. Participants were recruited using purposive sampling methods, they were required to be at least 18 years of age, self-reporting ongoing experience of mild to moderate depression, anxiety, or stress within their day-to-day life, and able to read, write, and speak English. The sample size was justified on the basis of past research reporting the median numbers of participants recruited for similar feasibility studies incorporating both quantitative and qualitative elements (27). Advertisements were posted at Swansea University notice boards and on social media pages (Facebook mental health community groups). Participants were recruited between October 1<sup>st</sup> and December 1<sup>st</sup>, 2022, they completed a consent form (see Supplementary 2) after reading the study information sheet (see Supplementary 3) and were given a debrief sheet (see Supplementary 4) following completion of the study, each are included as supplementary materials.

**Primary outcome measures:**

Feasibility outcomes were determined using the MRC framework (26) and reported in line with CONSORT guidelines (28) (see Supplementary 5). Feasibility measures included data relating to participant recruitment and retention including the number of participants willing to take part, and completing each stage of the study (i.e., intervention, questionnaires,



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3 interviews, and follow-up). Acceptability and efficacy of the intervention were assessed  
4  
5 through thematic analysis of semi-structured interviews conducted immediately post-  
6  
7 intervention and 3-weeks post-intervention, which focussed on participant experiences with  
8  
9 ‘ACTing Minds’. The first interview (see Open Science Framework for first interview  
10  
11 protocol: <https://osf.io/5fvjs>) asked questions about: (1) the acceptability of the intervention;  
12  
13 (2) what they learned from the intervention; (3) suggestions for further improvement; (4)  
14  
15 whether there were any difficulties (barriers) in taking part; (5) aspects they liked and  
16  
17 disliked; and (6) were there any adverse effects that they noticed whilst playing the game.  
18  
19 This was followed by a second interview (see Open Science Framework for second interview  
20  
21 protocol: <https://osf.io/32epw>) that was focused more on the real-world impact that ACTing  
22  
23 Minds had on their lives and their experience over the 3-week period. Specifically, the second  
24  
25 interview asked: (1) about their retrospective experience in taking part in the ACTing Minds  
26  
27 intervention; (2) how much they remember about the core ACT concepts; (3) were any  
28  
29 aspects more memorable than others; (4) had they implemented any of the ACT concepts that  
30  
31 they learned whilst playing the game into their day to day lives; (5) had they found that any  
32  
33 particular ACT concepts were more applicable to their everyday lives than others; (6) would  
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35 they reuse the intervention; and (7) had they noticed any adverse effects in the three weeks  
36  
37 since playing ACTing Minds.  
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#### 45 **Secondary outcome measures:**

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48 Questionnaires were distributed at three points in time (baseline, immediate postintervention,  
49  
50 and 3-month follow-up). A rule was created in Qualtrics requiring participants to complete  
51  
52 every questionnaire item in order to finish the survey, which included the following  
53  
54 questionnaires:  
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56

57       Depression Anxiety Stress Scales (DASS-21): a measure of general psychological  
58  
59 distress with good construct validity (confirmatory factor analysis of 0.94), that can be  
60

1  
2  
3 broken down into subscales relating to stress, anxiety, and depression. It has good internal  
4 reliability as measured through Cronbach's alpha coefficients, which are 0.88 for depression,  
5  
6 0.82 for anxiety, 0.90 for stress, and 0.93 for the total scale (29).  
7  
8  
9

10 Acceptance and Action Questionnaire-second version (AAQ-II): a questionnaire of  
11 seven items, assessing psychological inflexibility by gauging one's capacity to embrace and  
12 remain receptive to challenging thoughts and emotions, while also actively participating in  
13 meaningful actions despite their presence. A higher score indicates higher psychological  
14 inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of  
15 0.84 (30).  
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24 Social Connectedness Scale (adapted from Russell's (1996) UCLA Loneliness Scale  
25 (31): this measure involves two questions: (1) "During social interactions, I feel 'in tune'  
26 with the person/s around me", and (2) "During social interactions, I feel close to the  
27 person/s". The Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98  
28 (M=0.94, SD=0.03) (32).  
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36 Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): a metric that emphasises  
37 the positive facets of mental health, aiming to evaluate overall psychological well-being. This  
38 measure has good internal consistency with a Cronbach's alpha coefficient of 0.89 (student  
39 sample) and 0.91 (general population sample) (33).  
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45 EuroQol Five Dimensions (EQ5D) (34): a measure for health-related quality of life.  
46 There are five components within this measure which assess mobility, self-care, usual  
47 activities, pain, discomfort, anxiety, and a visual analogue scale for measuring current health  
48 status.  
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#### 54 **Intervention:**

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3 The intervention comprised of an ACT-based video game intervention called ‘ACTing  
4 Minds’, developed and designed by author DJE. Participants attended a single session lasting  
5  
6 approximately 1-hour, during which they completed four in-game chapters.  
7  
8  
9

10 The intervention teaches three core principles of ACT through embedded learning,  
11 meaning that the player should gain ACT-based skills while completing in-game objectives,  
12 without being directly taught those skills. These skills include ‘Acceptance’, ‘Cognitive  
13 Defusion’, and ‘Values Identification’. Embedded learning refers to the incorporation of  
14 educational elements into the gameplay itself, in contrast to explicit lessons. In this context, it  
15 involves designing the game in a way that promotes psychological flexibility oriented  
16 behaviours derived from ACT, such as the adoption values orientation, present moment  
17 awareness, openness to pain and cognitive defusion. In ‘ACTing Minds,’ an example of  
18 embedded learning is the ‘Psychoflexameter’ (see Figure 1A), which serves as a gamified  
19 version of the Hexaflex (see Figure 1B), a model used in ACT to illustrate both the theory  
20 and goals for clinical change (35). Similar to the Hexaflex, the ‘Psychoflexameter’ showcases  
21 the 6 core processes of ACT. Initially introduced to players during the first ACT-oriented  
22 activity in the game, which emphasises acceptance, the ‘Psychoflexameter’ remains visible in  
23 the corner of the screen throughout the game while players engage in other ACT-related  
24 activities. As players exhibit ACT-consistent behaviours, they earn points and gradually  
25 increase the dial on the centre of the ‘Psychoflexameter’, and the text reflecting the ACT  
26 processes that the players use lights up green (see Supplementary 6). If players exhibit ACT-  
27 inconsistent behaviours, they lose points and the ‘Psychoflexameter’ lights up red (see  
28 Supplementary 7).  
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54 -----**Figure 1 Here**-----  
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57 The game starts with a text-based chapter, telling the story of a depressed individual, ‘Steve’,  
58 who has recently lost his wife in an accident, he is feeling depressed, isolated, and lonely.  
59  
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3 The character has built a 'mind escape machine' intending to enter his own mind to destroy  
4 and suppress his unwanted painful thoughts and memories. The player takes control of  
5  
6  
7 'Steve' in chapter two, where they see him in a state of mental distress at his home,  
8  
9  
10 surrounded by items that are reminders of his lost wife. At this stage, participants learn how  
11  
12  
13 to control the character using an onscreen directional stick and interact with the environment  
14  
15 by touching key elements with their finger on their mobile phone or tablet.

16  
17 Participants then engage with ACT content within chapters three and four, which  
18  
19 begin with the character entering his mind (via the mind escape machine), walking around  
20  
21 and viewing painful representations of his memories (of his lost wife). Chapter three focuses  
22  
23 on 'Acceptance', introducing players to a bar in the centre of the screen indicating the  
24  
25 characters' present level of pain and discomfort, as well as the 'Psychoflexameter' dial in the  
26  
27 corner of the screen, indicating the character's psychological flexibility. While in the mind of  
28  
29 the character, the player can approach memories of 'Steve' (himself) and his wife, which  
30  
31 leads to an increase in present pain and allows the option to destroy the memories (this is  
32  
33 intended as a metaphorical representation of thought suppression). Destroying memories  
34  
35 decreases short-term pain and discomfort, but also removes points from the  
36  
37 'Psychoflexameter'. If the player chooses to destroy the memories (avoidance-based  
38  
39 strategies), the world becomes increasingly distorted, and barriers form making the chapter  
40  
41 impossible to complete. Alternatively, if the player chooses acceptance-based strategies they  
42  
43 can continue the game and learn that acceptance is functionally better than avoidance (see  
44  
45 Supplementary 8).

46  
47 Chapter four focuses on rewarding 'Values identification' and 'Cognitive Defusion'.  
48  
49 The player is still in the mind of the character, where they are then asked to reflect on their  
50  
51 values, to type them out and make them explicit (see Supplementary 9). Following this, they  
52  
53 complete a 'leaves on a stream' task, requiring them to type out any painful thoughts that  
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3 they might have and place them on a leaf, watching them as they float downstream (see  
4  
5 Figure 1C). Both tasks reward the player by increasing their score on the ‘Psychoflexameter’.  
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### 8 **Qualitative analysis:**

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11 We used a critical realist ontological framework for our reflexive thematic analysis (RTA) as  
12  
13 suggested by Braun and Clarke (36) which involves (after an initial familiarisation pre-coding  
14  
15 phase) actively conducting both bottom-up (raw data driven and without a conceptual  
16  
17 framework in mind) inductive, and top-down (ACT theory driven) deductive stages, to  
18  
19 explore participant experience with the “ACTing Minds” intervention. We adopted this  
20  
21 inductive (i.e., without framing the raw data through a theoretical model) first stage approach  
22  
23 to ensure the themes developed were grounded in the raw data itself rather than potentially  
24  
25 being imposed and biased by preconceived theories of the researcher. This is consistent with  
26  
27 the critical realist approach which assumes that at least some of reality exists independently  
28  
29 of our preconceived knowledge and theories, and the researcher should be actively aware of  
30  
31 this. We then followed this with a deductive top-down ACT theory driven second stage that  
32  
33 then allows for a more theory informed interpretation of the qualitative data based on ACT  
34  
35 concepts and theory. This involved a re-examination of interview content with explicit  
36  
37 consideration of how participant statements might relate to our research questions and ACT  
38  
39 theory. The codes developed accordingly, transitioning from reflecting explicit semantic  
40  
41 content to interpretations of underlying latent themes (via an ACT interpretation). This  
42  
43 iteration of induction and deduction is important within RTA, as it allows for a more nuanced  
44  
45 qualitative understanding of semi-structured interviews, that goes beyond a purely theory  
46  
47 driven lens. This adopts a contextualist epistemological stance of our interpretation,  
48  
49 recognising that both researchers’ and participants’ knowledge and perceptions are shaped by  
50  
51 their subjective experiences and situational contexts (36). This combined (critical realist and  
52  
53 contextualist epistemological) philosophical foundation guided the application of our  
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3 reflexive thematic analysis, serving as a contextualised lens for identifying and generating  
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5 themes from within the interview data.  
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8 The RTA was conducted on two sets of semi-structured interviews (post-intervention  
9  
10 n=29, and 3-week follow-up n=29), following the guidelines outlined by Braun and Clarke  
11  
12 (36). Both interview sets were analysed separately to gain an understanding of changes in  
13  
14 participant perceptions of the intervention and relevant outcomes over time. For reporting on  
15  
16 the acceptability of the 'ACTing Minds' intervention, findings and themes from both  
17  
18 interviews are summarised in the primary outcomes section of the paper (see Table 1).  
19  
20 Interview data was transcribed using Microsoft's automated audio-to-text software, which  
21  
22 was then double checked and edited to correct for major spelling or grammatical errors.  
23  
24 Throughout the initial data familiarisation phase, multiple points of potential analytical  
25  
26 interest were identified. In the coding phase, several hundred codes were initially produced  
27  
28 (both inductively and deductively), which were then clustered to make them more  
29  
30 manageable and categorised into potential broad patterns of meaning. For the analysis of the  
31  
32 first interview set these included: emotional experience; wellbeing needs, perceptions on  
33  
34 mental-health education within the game; and participant engagement. For the second set of  
35  
36 interviews, these were: application of the game's lessons, perceptions on what was learned,  
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38 desire for growth, and sense of development.  
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45 Themes were then refined in the context of our research questions relating to how the  
46  
47 participants experienced 'ACTing Minds', which involved a review of preliminary themes in  
48  
49 relation to the codes, the coded data, and the full dataset. We became most interested in the  
50  
51 latent ideas underpinning statements relating to how participants utilised the game as a  
52  
53 psychoeducational tool. The preliminary theme 'emotional experience' was developed, as it  
54  
55 was interpreted from the codes that participants were using the game as a 'base for exploring  
56  
57 and accepting difficult emotions'. Further development of the remaining themes emphasised  
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3 the processes involved in participant engagement, personal therapeutic goals, and feelings  
4 regarding the games' embedded learning features. Themes derived from the codes in the  
5 second interview reflect the participant outcomes since playing 'ACTing Minds'. This  
6 allowed for an exploration of specific aspects of growth, how the participants implemented  
7 insights gained from the game in the weeks that followed, and their reflections on what they  
8 had learned through the practical application of these insights in real-life scenarios.  
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For peer review only



**Table 1.**

Themes and sample codes taken from thematic analysis for Interviews 1 and 2

Interview 1 (Immediate postintervention)		
Themes	Raw-data (without preconceived theory) driven inductive codes	ACT-theory driven deductive codes
Theme 1: Desire for an engaging therapeutic experience	Need for wellbeing tools; Surprised by effectiveness; Interest in novelty; Wellbeing development as an enjoyable practice	Psychoflexameter aids engagement; Core ACT concepts useful
Theme 2: Personal process of immersion	Empathy with story; Interest in metaphor, Open mind needed; Personalisation aids relatability	Immersion through visual metaphors and agency; Engagement through ACT therapeutic intent
Theme 3: Game as a base for exploring and accepting difficult emotions	Anxiety while making decisions; Game helped to clear head; Desire for future use as a tool"; "Mood change with game;	ACT skills applicable across emotional scenarios; Long term acceptance benefit despite difficult emotional experience; learning to be open to difficult emotions
Theme 4: Embedded learning game dynamics pros and cons	Concepts made more sense as the game progressed; Lack of instruction, but quickly learned concepts; Conflicting choices	Interpreting ACT metaphors quickly; Priming of ACT-based wellbeing; ACT concepts clear despite confusion with game objectives"
Theme 5: Necessary learning for anyone	Desire to share with others; Growing societal appeal	ACT concepts made tangible; Game provided direction for growth towards ACT-values; ACT-concepts felt relevant
Interview 2 (3-weeks postintervention follow-up)		
Theme 6: Utility in the real world	Sharing lessons with others; Easier time letting go; Built desire to learn more	Applying ACT lessons actively; Potential real world subconscious influence of ACT lessons; Increased perspective-taking in real-life events
Theme 7: Practice facilitates psychological flexibility skills	New interest in wellbeing; Shift in thinking; Combined game and interview helpful	ACT-practice encourages optimism with new ACT knowledge despite present suffering; Trial and error of applying ACT-based lessons; ACT-practice encourages renewed focus on values
Theme 8: Closer alignment to an integrated self (as context), with acceptance, values, as part of who you are	Primed self-reflection; Seeing the bigger picture integration about self; Reduced self-judgment	Integrating present moment awareness, acceptance and values; Dealing with grief through acceptance of self as I am; Acceptance brings the self closer to reality; Self-assurance with values; Self as context identification

## Quantitative analysis

A repeated measures ANOVA was performed using IBM SPSS Statistics 29 (the most up-to-date version at the time of analysis), to compare the effects of playing the ‘ACTing Minds’ videogame on scores taken from the questionnaires DASS-21, AAQ-II Psychological Flexibility Questionnaire, Warwick-Edinburgh Mental Well-Being Scale, Social Connectedness Score, and EuroQol Five Dimensions.

Descriptive statistics were used to summarise secondary outcome measures (see Table 2). Changes in scores from baseline are reported for each of the measurement time points. Partial eta squared ( $\eta^2$ ) effect sizes were calculated for each independent variable and interpretation was informed by prior literature on the topic (37). Values 0.14 or higher were interpreted to be a large effect, 0.06 – 0.14 were interpreted to be a moderate effect, and 0.01 – 0.06 were interpreted to be a small effect.

## Procedure

After recruitment (see ‘Participant’ section for recruitment), and consenting to take part in the study, participants were given a link to Qualtrics where they completed the battery of questionnaires (see ‘Secondary outcome measures’ section) at baseline. They were then given a link to the ACTing Minds game (see ‘Intervention’ section) where they completed this within approximately one hour. Once completed, they then immediately completed the quantitative questionnaires (see ‘Secondary outcome measures’ section) again on Qualtrics as an immediate post-intervention. This was then followed by completing a 45-minute to 1-hour one-on-one interview which asked participants about their experiences with the game (see ‘Primary outcome measures’ section). Participants then, after a 3-week follow-up, completed the same questionnaires again, as well as a second interview (see ‘Primary outcome measures’ section) that focused on real world application of the ACTing Minds intervention.

## Public and patient involvement

Key stakeholders were consulted and involved in the development of this protocol. The Patient Experience and Evaluation in Research (Patient Experience and Evaluation in Research (PEER): <https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/>) group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students and staff members, several of whom reported that they had experienced depression, anxiety or stress at some point in their lives and emphasised the need for innovative approaches to the delivery of mental health support. The feasibility design was explained to them, and they gave positive feedback about the nature of the design, intervention and outcome measures.

## Results

### Primary outcome measures

#### Participant recruitment and retention (feasibility)

Thirty-six participants were recruited through the initial study advertisement between October 1<sup>st</sup> and December 1<sup>st</sup>, all of which met eligibility criteria. Six participants did not show up for initial baseline measures, while one participant did not follow through with the intervention (see Figure 2). Only three participants reported why they were not able to attend, where one indicated they had a hospital appointment, another had forgotten about the study date and did not reschedule, while another said they needed to reschedule without giving a reason, but then failed to book in a new date for the study. The other three participants did not report why they could not attend.

-----**Figure 2 Here**-----

## Participant feedback (acceptability)

Acceptability measures were assessed through thematic analysis of semi-structured interviews (all data is available on the Open Science Framework: <https://osf.io/3wuh5/>) (38), taken place immediately postintervention and at a 3-week follow-up. The interviews were analysed separately to understand participant perceptions before and after applying lessons learned from the game to their everyday lives. The results from both have been summarised and reported together as key themes.

### Theme 1: Desire for an engaging therapeutic experience

Participants expressed interest in the novelty and potential utility of digital mental health applications, specifically in a gamified context. Overall, they felt that a videogame platform provided a uniquely stimulating means of engaging with mental health learning. Participants suggested that psychoeducational tools like ‘ACTing minds’ may be able to function as an engaging alternative or an adjunct to therapy. For example:

*“[...] playing a game that's based for your mental health is really good because you can actually do something therapeutical in the things that I like doing.” -P06.*

This quote comes from a participant who identifies as a gamer, with little experience or prior interest in mental-health learning. Their statement implies an underlying desire for an engaging, accessible therapeutic environment that he has an interest in. The intervention was also helpful for non-gamers, for example:

*“I'm not one to sit down and just watch a video and then put that in practice. I'm someone who actually needs to be involved in something and interact with it, and coursework just reminds me too much of school [...] with games it makes me sit, and actually interact because I'm enjoying the game at the same time. It's not just that I need to focus on my mental health,*

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2  
3 *I get to play a cool game while learning about my mental health. So yeah, I like I like video*  
4 *games with mental health stuff.” -P08*  
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8 In this situation, the participant does not identify as a gamer and has substantial experience  
9 with their own mental health learning and therapy. They, like participant one, also expressed  
10 the same desire for a more engaging therapeutic experience and enjoyed the format of  
11 learning about mental health via a game. The participant expresses an aversion to learning  
12 about mental health in other more traditional ways.  
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## 19 **Theme 2: Personal process of immersion**

20 Responses from the semi-structured interviews highlighted the individual differences  
21 between participants in their ability to immerse themselves within the content of ‘ACTing  
22 Minds’ and engage directly with the personal decision-making aspects of the game.  
23 Responses indicated that the video game immersion and narrative helped them visualise the  
24 ACT metaphors and thus helped their understanding of the ACT concepts within the  
25 embedded learning environment. For example:  
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38 *“It plays in a very good way of dealing with visual metaphor, but also the fact that you're*  
39 *given the agency to do it. When you were smashing the memories and I wish I didn't have to,*  
40 *but I have to carry on Steve's journey and I think it's a really good way of showing these*  
41 *memories do hurt, and sometimes you just have to accept the fact that it's going to hurt. Move*  
42 *on like it's explained through the visual and narrative storytelling, and I think it's a really*  
43 *good way to do it.” -P18*  
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51 This participant refers to the visual immersion and having agency within the game as  
52 facilitating their learning of ACT concepts. The requirement for participant agency in making  
53 emotionally difficult decisions within the game appears to have facilitated the learning of  
54 acceptance.  
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3 Learning was also facilitated by the personalised nature of the game, such as selecting  
4  
5 difficult personal thoughts in the lily pad exercise, for example:

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8 *“[...] it's been like a learning experience, and so the sort of personalised bit at the end with*  
9  
10 *the lily pads and the values. I think it was quite good because then you actually were able to*  
11  
12 *think about like the purpose of the game within your own situation.” -P10*

### 13 14 15 **Theme 3: Game as a base for exploring and accepting difficult emotions**

16  
17  
18 Participants discussed the idea that the game provided a platform that allowed them to  
19  
20 explore their own emotions in an immersive environment. Participants reported experiencing  
21  
22 a variety of difficult thoughts and emotions throughout playing the game, and that the game  
23  
24 encouraged them to observe and be open to sadness, anxiety, and grief with acceptance.

25  
26  
27 Participants reported feeling that after playing the game they had learned to observe and  
28  
29 accept those feelings rather than to actively avoid them, and the importance of values. For  
30  
31 example:

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34  
35 *“At least the main bit that I got from it was to first just observe some of the negative feelings*  
36  
37 *that you have, and not necessarily like reject and wrestle with them, just to sit and watch*  
38  
39 *them and observe them, and accept them [...]. You can perhaps do something like remind*  
40  
41 *yourself of values. I like that one too.” -P05*

42  
43  
44  
45 The participant clearly reflects that the game encouraged them to observe and accept their  
46  
47 thoughts and feelings rather than suppress (or “wrestle”) them. They also mention that the  
48  
49 game reminded them of what really matters to them.

50  
51  
52 Participants appreciated the leaves of the stream exercise as promoting acceptance of  
53  
54 difficult thoughts, for example:

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2  
3 *“I'd like the Lily pad thing. I think it's really nice because I myself struggle with my emotions*  
4 *or bad thoughts or whatever, and I stay on them, and I make myself feel guilty about*  
5 *situations. So, it was really nice to accept letting go of yourself.” -P06*  
6  
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9

10 Other participants reflected on the game encouraging acceptance and observation of difficult  
11 thoughts, for example:  
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15  
16 *“I think that section when it's like acceptance and realising that you know, even though you*  
17 *may not like these thoughts you're having, you still need to be aware of them and you can use*  
18 *them as a springboard so that was my favourite section.” -P18*  
19  
20  
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22

#### 23 **Theme 4: Embedded learning pros and cons**

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25  
26 Data from the immediate post-intervention interviews suggest a mixed response to embedded  
27 learning in ‘ACTing Minds’. Many participants reported learning a variety of lessons through  
28 playing the game, most being intended in the game’s design. Participants were sometimes  
29 confused with the lack of explicit objectives but were still able to understand that there were  
30 consequences to avoidant behaviour, and that acceptance of difficult emotions was rewarded.  
31 This indicated the embedded learning within the game dynamics were successfully  
32 implemented. For example:  
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43 *“So when you hit them [memories], the like walls go up right, yeah? [...] But I guess it was*  
44 *like kind of showing you that if you hit the memories, you kind of close yourself off and that's*  
45 *what the walls were.” -P14*  
46  
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49

50 Another participant also suggested that they were able to learn relevant ACT concepts  
51 quickly such as not to avoid (suppress) thoughts, for example:  
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3 “I think the fact that I think it was very quickly aware that you shouldn't just destroy  
4 memories and I think that was that was done really well. Maybe too well. As in like it went on  
5  
6 a bit.”  
7  
8  
9

### 10 **Theme 5: Necessary learning for anyone**

11  
12  
13 Several participants expressed that they felt what they learned via ACTing Minds would be  
14 applicable and useful to many others in society, and not just for themselves. For example:  
15

16  
17  
18  
19 “I think it's a good thing that more people are learning about this kind of thing and. It kind of  
20 just leads into more research regarding and. More support out there and more help. It's  
21 generally like, I think. Maybe not my thing, but. It's not like a bad thing, it's. A good thing  
22 there's people doing it.” P27.  
23  
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25  
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28  
29 “I think like the impact did still stick with me, like I still mentioned it quite a bit to like my  
30 parents afterwards and I mentioned it to my partner as well. They seemed interested and they  
31 like wished they could have done that too.”-P18.  
32  
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### 36 **Theme 6 (3-week follow-up interview theme): Utility in the real world**

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39 In the interview occurring 3-weeks postintervention, participants discussed how they were  
40 able to apply the lessons that they took from ‘ACTing Minds’ into the real-world. Whilst a  
41 few participants had not considered the game since playing or tried to actively apply lessons,  
42 many found that they made a conscious effort to apply ACT principles and techniques from  
43 the game into their lives. Some example quotes and descriptions are given below:  
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51  
52 “I have noticed I've actively now, if I get like a negative thought in my brain. I try and  
53 register it and I don't hold on. But like, because sometimes before, even though I kind of  
54 subconsciously did it with some things, I just didn't [always], you know. But now if it's even  
55 something stupid like I've been lazy. I was like alright don't think about it all day. Actually go  
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3 *out for a walk. Go to the gym you know. Don't just keep in your head, I'm so lazy and*  
4  
5 *miserable and fat. Get out to do something about it.” -P04*  
6  
7

8 This statement was given by a participant who in the prior immediate-postintervention  
9 interview felt that they did not have a problem with holding on to difficult thoughts. Despite  
10 this, in the weeks since playing ‘ACTing Minds’, the participant found that they were more  
11 conscious of how their thoughts have impacted their real life, and as a result, have been able  
12 to apply the core ACT concepts in tandem. Their statement indicates that they were able to  
13 apply defusion lessons to difficult thoughts about their self (“I’m so lazy and miserable and  
14 fat”), acceptance of their behaviours (“I’ve been lazy”), and commitment to values by taking  
15 part in ACT-oriented activities regardless of their thoughts. Many participants noted that even  
16 if they had not explicitly tried to apply the ACT principles learned from the game to real life,  
17 that they felt the game had influenced them subconsciously:  
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32 *“I wouldn't necessarily say I've sat there and primed those thoughts [regarding ACT*  
33 *concepts], but in unconscious thinking, if you know like passive thought and stuff like that in*  
34 *my day-to-day, I've definitely had hints of some of those topics. Do you know what I mean?*  
35 *Like even today, I was going about my day doing my thing and you know you'll have a*  
36 *thought that'll throw you back to the past, and then you learn like I came to accept it.” -P11*  
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44 This participant found that the ACT principles were more readily available to them when  
45 confronted with real-life situations that demanded them. In these cases, participants most  
46 commonly felt that they were more accepting of difficult emotions and situations.  
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### 51 **Theme 7 (3-week follow-up interview theme): Practice facilitates psychological** 52 **flexibility skills** 53

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56  
57 A core theme present across follow-up interviews was that participants expressed how  
58 applying what they had learned into their day-to-day activities over three weeks led to an  
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2  
3 even deeper understanding of the ACT concepts they learned. Participants reported greater  
4 engagement with values-orientated behaviours in their everyday real lives, and a greater  
5 ability to cognitively defuse (or let go) of difficult thoughts rather than engaging in avoidant  
6 behaviour. Some example quotes and descriptions are given below:  
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9  
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11  
12  
13 *“Well, it's like actually testing on a real situation as to just generally learning it. But then*  
14 *when you come into a situation, you start to understand a bit better why you do those things*  
15 *[referring to ACT skills] and what benefit those things have, because the situation is actually*  
16 *impacting on your emotions or your feelings and stuff like that, and so then you're like oh,*  
17 *this is why this is a good technique.” -P05*  
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25 In practising real-life application of ACT principles, participants were able to get a deeper  
26 sense of how and why the ACT techniques worked for them, especially during emotionally  
27 challenging situations. Through such practice, participants have noted that their personal  
28 values have become clearer to them:  
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35 *“I've learned ways to engage with my thoughts, and like I've always tried to practice letting*  
36 *go of things that aren't like too meaningful, like things that won't matter in a day and all that*  
37 *sort of stuff. But I feel like the game has helped me also realise [...] a way to really put my*  
38 *values down in a more straightforward manner.” -P13*  
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45 The participant refers to the real life practising of letting go of difficult thoughts (cognitive  
46 defusion), and values identification.  
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50 **Theme 8 (3-week follow-up interview theme): Closer alignment to an integrated self (as**  
51 **context), with acceptance, values, as part of who you are**  
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55 One of the most consistent patterns across interview responses was that participants felt they  
56 had learned more about themselves through acceptance, or that practicing the lessons taught  
57 in the game helped them align to their values. Some participants seem to have expressed that  
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3 they learned the ACT-concepts in a more integrated way, where they felt that acceptance of  
4 difficult thoughts and their values was part of who they were i.e., self as context. Some  
5  
6 example quotes and descriptions are given below:  
7  
8  
9

10  
11 *“I actually learned a lot from this game about like these inner emotions or bad memories are*  
12 *not sinful. They're a part of you, and they contribute what you're going to be or the current*  
13 *you [self]. So yeah, that's the core lessons I guess I learned from the game.” -P23*  
14  
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16

17  
18 The participant reflects here about accepting their personal experiences in the present  
19 moment for what they are (indicating broader integrated acknowledgements about themselves  
20 in context). For other participants, this acceptance of personal experiences in day-to-day life  
21 has facilitated further identification of personal values:  
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24  
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27  
28 *“Yeah, as I said, the values that's definitely helped me. Learning to just calm my thoughts for*  
29 *a little and think of the small but important things in life and what I appreciate that helps. It's*  
30 *also made me learn more about how to deal with grief [...] It's helped to learn that it's OK to*  
31 *feel grief, it's a part of who I am, and I must accept it -P08*  
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### 38 **Secondary outcome measures**

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40 Quantitative results (all data is available on the Open Science Framework:  
41 <https://osf.io/3wuh5/>) (38) revealed a large effect size for the EQ5D usual activities score  
42 ( $\eta^2 = .307$ ), while medium effect sizes were found for DASS-21 Stress scores ( $\eta^2 = .108$ ),  
43 DASS-21 Anxiety scores ( $\eta^2 = .096$ ), and AAQ-II Psychological Flexibility scores ( $\eta^2 =$   
44  $.060$ ). Small effect sizes were obtained for the DASS-21 Depression scores ( $\eta^2 = .011$ ), the  
45 WEMWBS ( $\eta^2 = .011$ ), UCLA Social Connectedness Scale ( $\eta^2 = .021$ ), EQ5D  
46 Pain/Discomfort ( $\eta^2 = .010$ ), and the EQ5D Anxiety/Depression ( $\eta^2 = .018$ ). Given this is a  
47 feasibility study that is intentionally underpowered as it has a small sample size,  $p$  value  
48 significance is statistically meaningless for measuring the efficacy of any given measure.  
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3 Instead, the effect sizes allow for a G-Power (39) a-priori analysis to be conducted that  
4 indicates the sample size required to detect meaningful statistical between-group differences  
5 within a future full-scale RCT. For this, the G-Power (version 3.1.9.7) indicated that when  
6 assuming a between factor (two group), repeated measures (three points in time) design with  
7 an alpha error probability of 0.05, and acceptable power of 0.8 (40), then 436 participants are  
8 required to detect a meaningful statistical difference for the smallest measure effect size  
9 (DASS-21 depression) in a future RCT. See Table 2 for full details including effect sizes,  
10 power, and estimated sample sizes for a future RCT given the observed effects sizes of this  
11 feasibility study.  
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### 23 **Convergent outcomes**

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26 Integration of results are considered a defining feature of mixed-methods research (41). In the  
27 interest of transparency, we have included a visualisation of the research outcomes taken  
28 from our qualitative and quantitative approaches, illustrating how each outcome links back to  
29 feasibility, as well as the conclusions made following each outcome (see Figure 3).  
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**Table 2.**

Illustrating change in intervention outcomes over time (n=29)

	<b>Pre-intervention Baseline, mean (SD)</b>	<b>Post-intervention, mean (SD)</b>	<b>Follow-up (3 weeks), mean (SD)</b>	<b><math>\eta^2</math></b>	<b>Effect size</b>	<b><i>F</i></b>	<b>Power</b>	<b>Full RCT Sample size estimated assuming 0.8 power</b>
DASS-21 Depression	14.34 (5.97)	14.21 (5.54)	13.90 (4.75)	.011	Small	.31	0.43	436
DASS-21 Stress	15.34 (4.55)	14.52 (4.40)	14.28 (4.65)	.108	Medium	3.39	0.999	46
DASS-21 Anxiety	12.79 (5.19)	12.10 (4.42)	11.66 (4.75)	.096	Medium	2.98	0.999	52
AAQ-II (Psychological Flexibility)	27.34 (10.47)	28.38 (9.86)	28.86 (8.65)	.060	Medium	1.76	0.999	86
WEMWBS	42.07 (7.31)	42.62 (7.91)	42.07 (7.00)	.011	Small	.31	0.33	436
UCLA Social-Connectedness	64.72 (7.52)	64.24 (8.85)	63.90 (8.33)	.021	Small	.60	0.77	236
EQ5D Mobility	4.83 (.38)	4.83 (.38)	4.83 (.38)	.000	N/A	.00	0.05	Negligible (no effect)
EQ5D Self-Care	4.78 (.58)	4.79 (.49)	4.76 (.51)	.000	N/A	.00	0.05	Negligible (no effect)
EQ5D Usual Activities	4.14 (.79)	4.38 (.68)	4.62 (.68)	.307	Large	12.42	1.00	16
EQ5D Pain/Discomfort	4.24 (.64)	4.45 (.63)	4.31 (.81)	.010	Small	.28	0.25	520
EQ5D Anxiety/Depression	3.86 (.99)	4.03 (.87)	3.97 (.94)	.018	Small	.52	0.66	288
EQ5D Self-Rated Health Score	71.14 (19.01)	72.76 (19.57)	70.93 (20.71)	.000	N/A	.00	0.05	Negligible (no effect)

-----**Figure 3 Here**-----**Discussion****Statement of principal findings**

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2  
3 The overarching aim of this research was to test the feasibility and acceptability of the  
4  
5 ‘ACTing Minds’ video game as a DHI for treating depression, anxiety, and stress. Participant  
6  
7 recruitment and retention, as well as quantitative and qualitative results, demonstrate that the  
8  
9 study design and videogame intervention are feasible for testing in a full-scale RCT.

10  
11  
12 Thematic analysis on qualitative data revealed several key findings. Firstly, participants were  
13  
14 successfully able to learn about core ACT principles through embedded learning, specifically  
15  
16 acceptance, defusion from thoughts, and commitment to personal values. There was also  
17  
18 some indication that participants had learned something about themselves in an integrated  
19  
20 way, in the form of self-as-context. Participants felt that the lessons taught within the game  
21  
22 could be applied to their daily lives and that the game was effective in priming them to  
23  
24 consider the core ACT principles throughout the weeks following their completion of the  
25  
26 intervention. Participants also felt that they would recommend the game to someone that they  
27  
28 care about and that they would be interested in downloading and completing future releases  
29  
30 of ‘ACTing Minds’.

### 31 32 33 34 35 36 **Summary of secondary outcomes**

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39 Quantitative analysis of measures taken at baseline, immediately post-intervention,  
40  
41 and after a 3-week follow-up, revealed promising small to large effect sizes in many of the  
42  
43 quantitative measures (38). This included a large effect size for increasing EQ5D usual  
44  
45 activities, medium effect sizes for reducing DASS-21 stress and anxiety, as well as increased  
46  
47 AAQ-II psychological flexibility. Small effect sizes were observed for reducing DASS-21  
48  
49 depression, EQ5D pain and discomfort, EQ5D anxiety and depression, and increased UCLA  
50  
51 social connectedness and WEMWBS general wellbeing. There were no observed effects for  
52  
53 EQ5D mobility, self-care, and self-rated health score. Given this is a feasibility study that is  
54  
55 intentionally underpowered as it has a small sample size, *p* value significance is statistically  
56  
57 meaningless for measuring the efficacy of the interventions, instead effect sizes are more  
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3 informative as they express the underlying effect and are not influenced by population size.  
4  
5 Instead, the G-Power analysis provided an estimation of participants required (436 to account  
6  
7 for the small effect sizes) to identify meaningful significance in a full scale future RCT.  
8  
9

### 10 **Comparison to existing literature**

11  
12  
13 This is the first study to utilise a videogame Digital Health Intervention (DHI) rooted in third-  
14  
15 wave behavioural therapy to address mental distress. 'ACTing Minds' imparts psychological  
16  
17 skills based on ACT to promote psychological flexibility. Prior research has primarily  
18  
19 focused on videogame DHIs targeting 'illbeing' that aim to reduce symptoms of mental  
20  
21 illness, two examples are games 'REThink' and 'Dojo'. 'REThink,' designed for a younger  
22  
23 audience, developed the players' ability to discern functional emotions from maladaptive  
24  
25 ones, and was shown to effectively improve emotional symptoms and reduce depressive  
26  
27 mood (42). 'Dojo,' utilising biofeedback and relaxation techniques to promote emotional  
28  
29 regulation, was shown to significantly decrease participants' anxiety and aggressive  
30  
31 behaviour scores post-intervention but exhibited no long-term effects at a 4-month follow-up  
32  
33 (43). Our DHI differs fundamentally from these other games due to strong theoretical  
34  
35 underpinnings based on ACT for promoting psychological flexibility instead of a focus on  
36  
37 reducing unwanted emotions or emotional regulation. Participants within the game were  
38  
39 taught to observe and be open to emotional pain without judgement or any attempt to change  
40  
41 them, and this is a key focus within the 'ACTing Minds' intervention.  
42  
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47  
48 Several meta-analyses have been conducted to explore the potential efficacy of DHIs,  
49  
50 one found that the majority of DHIs were based on Cognitive Behavioural Therapy (CBT)  
51  
52 and that the effect size for such interventions was small for reducing depressive symptoms  
53  
54 compared to non-treatment controls (44). CBT-based DHIs usually do not take the form of  
55  
56 full video games but may include elements of gamification such as rewards, badges, and  
57  
58 progress tracking. They are typically structured programs including online education tools,  
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3 interactive exercises, and self-assessment tools, which focus on challenging and modifying  
4 negative thoughts and behaviours. A meta-analysis including 34 RCTs (17 of which were  
5 CBT-based) found that CBT-based DHIs yielded a medium effect size for reducing  
6 symptoms of depression and anxiety (45). However, a meta-analysis of 117 CBT-based  
7 applications revealed that only 12 of them provided support aligned with the evidence-based  
8 tenets of CBT (46). This finding suggests that the observed effectiveness in earlier studies  
9 could potentially stem from participants' interaction with a DHI (perhaps as a form of  
10 distraction) rather than their proficient implementation of CBT principles. CBT-DHI  
11 programs often require consistent use, and high attrition rates have limited their efficacy in  
12 research (47). One meta-analysis author suggested that DHIs may need to be complemented  
13 by existing mental health support (44). However, our study challenges this notion. In less  
14 than one hour of playing 'ACTing Minds', participants fully explored the game, retained  
15 ACT knowledge, and discussed its positive real-world application in interviews conducted 3  
16 weeks post-intervention.

### 17 **Strengths and limitations**

18  
19 Our study is the first to explore the feasibility and acceptability of a novel videogame DHI  
20 based on ACT. A core strength of this research was the utilisation of a mixed-methods  
21 approach. By incorporating thematic analysis of semi-structured interviews as well as  
22 quantitative analysis of questionnaire data, we were able to gain a comprehensive  
23 understanding of participant experience using 'ACTing Minds'. Collecting quantitative data  
24 at three separate time points, and interviews conducted at two separate time points meant that  
25 we were able to examine the gradual processes of change and identify patterns of  
26 improvement consistent with the ACT model. We gained valuable input from participants in  
27 terms of suggestions for improving the intervention which will aid in the further development  
28 of 'ACTing Minds' to optimise effectiveness and user engagement. The results from the  
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3 interviews also indicated that 'ACTing Minds' has broad appeal as a videogame even to those  
4  
5 outside of clinical populations.  
6

7  
8 It is also important to acknowledge the limitations of our study. Firstly, there was no  
9  
10 control group, though this is intentional as this is a feasibility study, it is only when we  
11  
12 conduct a full RCT that we will have an adequate comparator group to determine whether the  
13  
14 intervention is clinically useful at promoting psychological flexibility and reducing  
15  
16 depression, anxiety, and stress. There was a lack of in-game data logging of specific ACT  
17  
18 tasks completed. For example, we did not collect data on whether participants actually  
19  
20 entered text about the difficult thoughts that they were experiencing such as in the leaves on a  
21  
22 steam exercise, though all participants completed the game. The reliance on self-report  
23  
24 measures potentially allowed for biased responses, including psychosociological measures  
25  
26 such as HRV would strengthen the study outcomes. It is also possible that some of the  
27  
28 questionnaires used in this study were insufficient for capturing the target measurements. One  
29  
30 study used exploratory factor analysis to investigate the extent to which the AAQ-II  
31  
32 Psychological Flexibility Questionnaire can discriminate between experiential avoidance and  
33  
34 psychological flexibility. The researchers found that AAQ-II items were more strongly  
35  
36 related to items measuring distress than items measuring acceptance (48). In line with this,  
37  
38 the AAQ-II has been criticised as being too simple a measure for psychological flexibility  
39  
40 (49). In a future RCT, we may adopt another measure for measuring psychological flexibility  
41  
42 such as The Personalised Psychological Flexibility Index which may be a more valid measure  
43  
44 of psychological flexibility (50). Finally, though thematic analysis can be highly useful for  
45  
46 identifying shared meaning and variation amongst the themes, and bridging subjectivity and  
47  
48 theoretical structure, it also has limitations. The contextualist epistemology used in this  
49  
50 approach acknowledges the researcher has an active role in shaping the outcomes and can be  
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52 biased by their own knowledge and experience. The subjective nature of the themes means  
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3 that there can be variation in the interpretation of the data between different thematic  
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5 researchers. So, though this approach can be useful, these limitations also need to be  
6  
7 acknowledged.  
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### 10 **Clinical implications and directions for future research**

11  
12 The ACT-based videogame DHI used in this study is a low-cost, engaging, and easy-to-  
13  
14 disseminate means of supporting those experiencing mental health difficulties. The present  
15  
16 study highlights the clinical implications of ‘ACTing Minds’, including its potential  
17  
18 therapeutic value, user engagement, and accessibility. However, further research is warranted  
19  
20 to establish long-term effects, explore specific populations, conduct comparative studies,  
21  
22 investigate underlying processes, and address any ethical considerations that may arise.  
23  
24 Critically, a full RCT is now needed, in which participants are compared quantitatively with a  
25  
26 control group, incorporating physiological wellbeing measures such as HRV, as well as  
27  
28 research-validated questionnaires regarding mental health (i.e., depression, stress, anxiety,  
29  
30 psychological flexibility, social connectedness, and wellbeing). By pursuing these future  
31  
32 research directions, we can leverage the potential of ACT-based video games such as  
33  
34 ‘ACTing Minds’ to enhance patient care, improve outcomes, and expand the reach of  
35  
36 interventions in an increasingly digital era.  
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### 44 **Conclusion**

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46 The results of this study demonstrate that ‘ACTing Minds’ is feasible to implement in a full-  
47  
48 scale RCT. Both the intervention and study were well received by participants, thematic  
49  
50 analysis of semi-structured interviews indicated that a single playthrough of the game was  
51  
52 sufficient for teaching several core principles of ACT, namely ‘Acceptance’, ‘Values  
53  
54 Identification’, and ‘Cognitive Defusion’ to participants, and priming them to implement the  
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56 lessons in their day-to-day lives. There was some evidence that participants also integrated  
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3 their learning about themselves as self-as context, which is interesting. Quantitative results  
4  
5 indicate that playing ‘ACTing Minds’ is associated with decreases in depression, anxiety, and  
6  
7 stress, as well as increases in psychological flexibility, social connectedness, and wellbeing.  
8  
9  
10 However, these effects will need to be further explored in an adequately powered RCT to  
11  
12 understand the potential clinical implications, therapeutic value, user engagement, and  
13  
14 accessibility of an ACT-based video game DHI.  
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### 17 **Data availability statement**

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20 The datasets supporting the conclusions of this article are available in the Open Science  
21  
22 Framework (38): [https://osf.io/3wuh5/?view\\_only=7998f1d0ae4b473ab7089a71be710270](https://osf.io/3wuh5/?view_only=7998f1d0ae4b473ab7089a71be710270).  
23  
24

### 25 **Original published protocol**

26  
27 <https://bmjopen.bmj.com/content/10/11/e041667>  
28

### 29 **Contribution statement**

30  
31 DJE and AHK designed the original protocol, whilst TCG updated and revised the protocol  
32  
33 design. TCG wrote the first draft of the paper and conducted all of the quantitative and  
34  
35 qualitative results. DJE and AHK provided substantial revisions on all drafts and advised  
36  
37 TCG throughout the development of this manuscript. DJE designed and developed the game  
38  
39 development.  
40  
41

### 42 **Competing interests**

43  
44  
45 The game ACTing Minds was developed using European development funds via the  
46  
47 commercial entity of Swansea University (AgorIP) and awarded to DJE with the intention to  
48  
49 develop this game for commercial purposes (as a game app for the Apple and Google Play  
50  
51 stores). DJE was involved in the design of the protocol but did not recruit participants, collect  
52  
53 any data, and did not conduct the analysis on the data. TCG and AHK have no involvement  
54  
55 in any commercial aspects of the game.  
56  
57

### 58 **Funding**

1  
2  
3 Funding for the development of this game came from European development funds via the  
4 commercial entity of Swansea University called AgorIP (Reference: 229-0256-0046)  
5  
6 awarded to DJE.  
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### **Ethics statement**

This study has received ethical approval from the Swansea University School of Psychology  
ethics sub-committee (2022-5630-4834).

### **Figure legends**

#### **Figure 1.**

(a) Screenshot from 'ACTing Minds' showing the 'Psychoflexameter'. (b) The Acceptance and Commitment Therapy Hexaflex and core processes. (c) Screenshot from 'ACTing Minds', example of 'Cognitive defusion' task. The player is required to type in their own difficult thoughts, before dragging them on to a leaf that floats downstream.

#### **Figure 2.**

Flow of participants through the study.

#### **Figure 3.**

Diagram visualising the integrated outcomes of 'ACTing Minds' feasibility and acceptability study.

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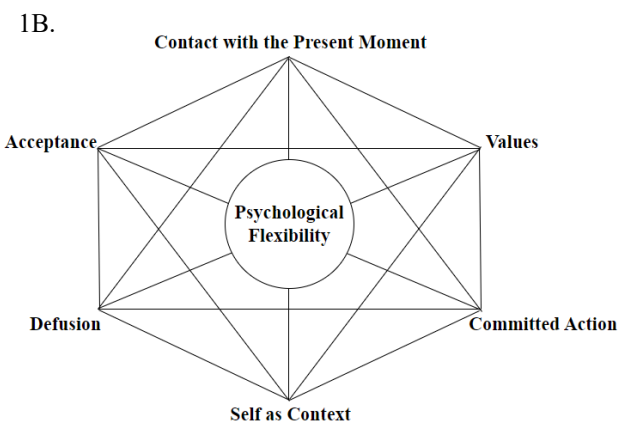
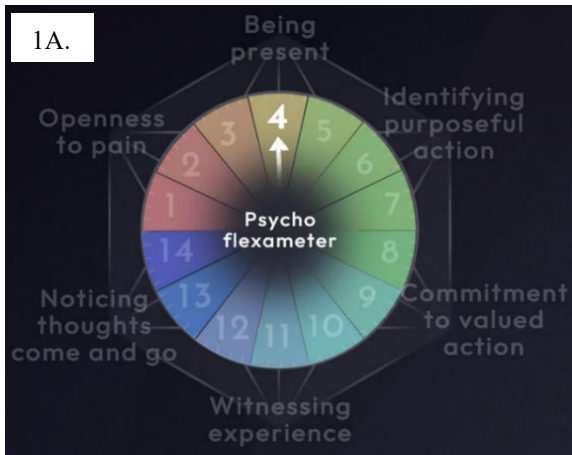
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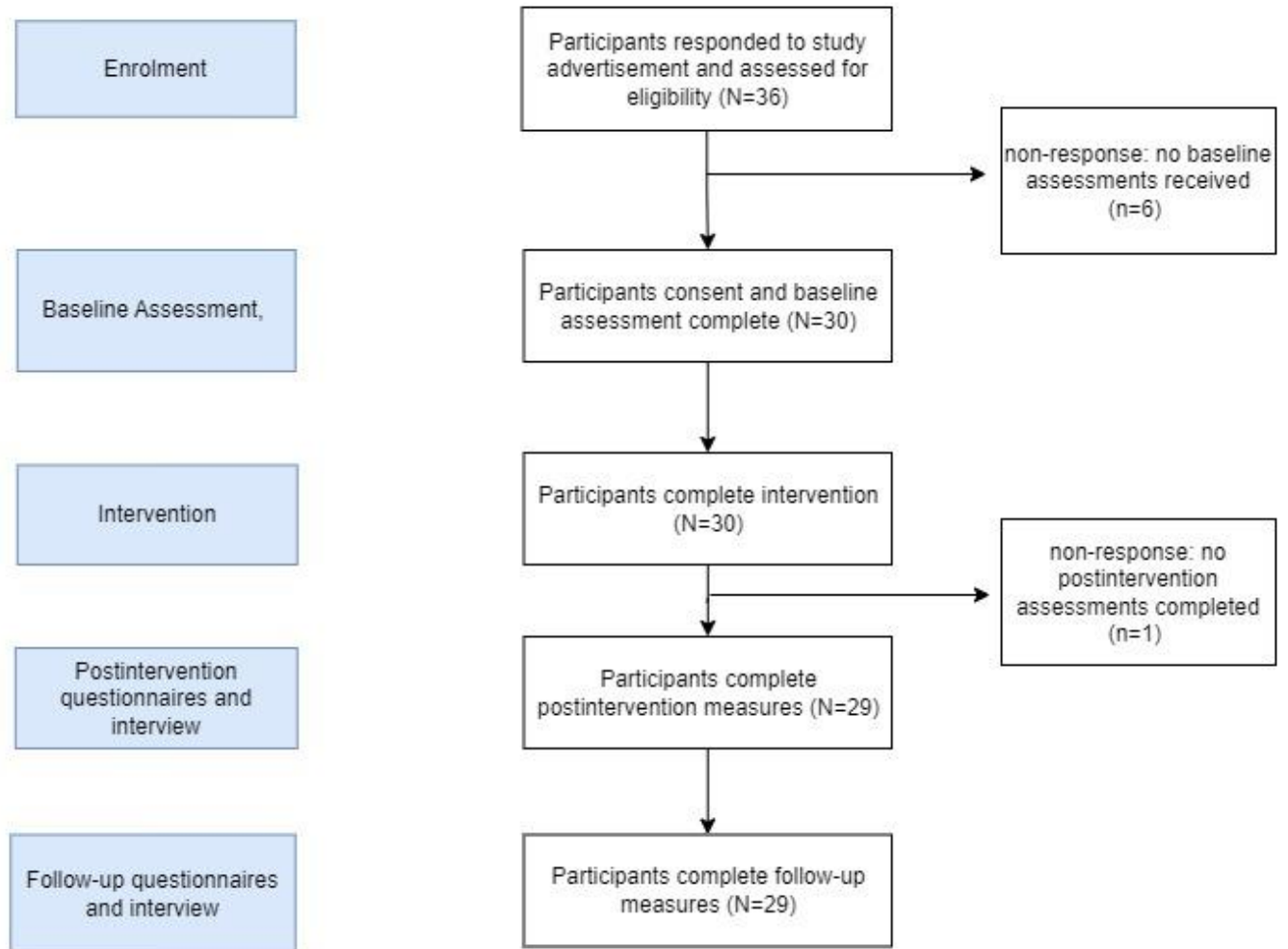
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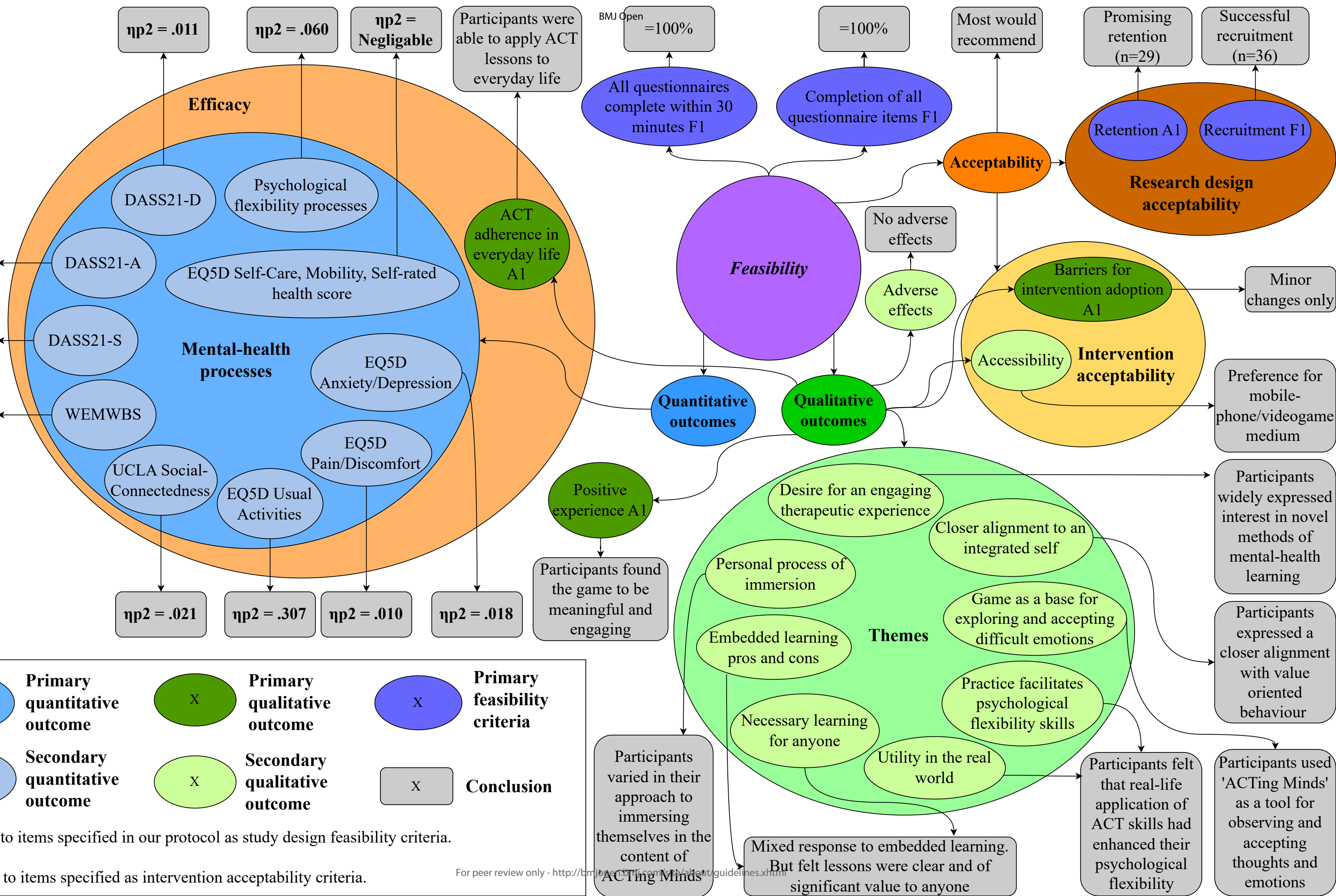




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# BMJ Open A novel ACT-based video game to support mental health through embedded learning: a mixed-methods feasibility study protocol

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## ABSTRACT

**Introduction** In recent years, serious video games have been used to promote emotional regulation in individuals with mental health issues. Although these therapeutic strategies are innovative, they are limited with respect to scope of treatment, often focusing on specific cognitive skills, to help remediate a specific mental health disorder.

**Objective** Here, we propose a protocol for assessing the feasibility of a novel acceptance and commitment therapy (ACT)-based video game for young adults.

**Methods and analysis** The Medical Research Council (MRC) framework will be used for developing a complex intervention to design and test the feasibility of an ACT-based video game intervention using a mixed-methods approach involving qualitative and quantitative data. The primary outcomes will include feasibility testing of recruitment processes and the acceptability of the intervention through qualitative interviews, attendance and rates of attrition. Secondary outcomes will involve a series of quantitative questionnaires to obtain effect sizes for power analysis, allowing for the ideal sample size for an appropriately powered, randomised controlled trial to be determined.

**Ethics and dissemination** This study has been approved by the Psychology Department Research Ethics Committee (2020-4929-3923) at Swansea University in the UK. Dissemination activities will involve publications in peer-reviewed journals, presentations at local and national conferences and promotion through social media.

**Trial registration number** NCT04566042.

## INTRODUCTION

Mental health issues such as anxiety and depression are a global problem of increasing concern, imposing considerable burden on society. The Global Burden of Disease project<sup>1</sup> has identified mental health disorders as a leading cause of disability globally, and suggest that there are 266 million cases of anxiety, and 253 million cases of major depressive disorder globally.

Unfortunately, the demand for mental health services far exceeds the available human resources able to meet this need in high-income and low-income

## Strengths and limitations of this study

- Mixed-methods approach to build a rich dataset on which conclusions will be drawn.
- Protocol follows established Medical Research Council (MRC) guidelines.
- In line with MRC guidelines and stage of game development, randomisation is not a component of this study.
- Aims are to assess feasibility, an important step in the development of complex interventions, although limiting conclusions able to be drawn.

and middle-income countries. This includes ever-growing treatment gaps<sup>2</sup> and lags.<sup>3</sup> These alarming increases have prompted the 2018 Lancet commission on global mental health to suggest that universal health coverage should include efforts to ensure the sustainable development of mental health.<sup>4</sup> Innovations to promote accessibility to mental health treatments include technology such as telephone, internet and smartphone devices, augmenting the psychotherapeutic toolkit.<sup>5</sup>

Innovations in video gaming for remedial mental health issues have wide potential application. In the USA, over 164 million adults play video games, and at least three-quarters of all American families have at least one person who video games regularly.<sup>6</sup> In the EU, 54% of the population play video games between the ages of 6 and 64, where the average age of video gamers is 31, and with a distribution of 46% female and 54% male. Of these, 77% play at least 1 hour per week, 16% play 1 hour per month, while only 7% play 1 hour per year.<sup>7</sup> Given that such a large proportion of the Western population play video games, developing mental health training in the form of psychoeducation may have great potential for building psychological resilience and



1 helping to better manage depression, anxiety and other  
2 forms of distress.

3 Technological developments for tackling such chal-  
4 lenges include the exploitation of gamification.<sup>8</sup> This  
5 involves the application of behavioural principles for  
6 controlling and modifying human behaviour, in which  
7 game design elements are used to increase human inter-  
8 action with or without technology.<sup>9</sup> Some examples of  
9 gamification include gamifying the development of  
10 cognitive skills and emotional regulation by rewarding  
11 the completion of relevant tasks within complex video  
12 games<sup>10–13</sup> in order to promote mental health.

13 When mental health-related video games are designed  
14 well, they have been shown to elevate self-esteem, self-  
15 efficacy, knowledge and awareness of illness, adherence  
16 to treatment and problem-solving skills, while lowering  
17 aggression.<sup>14</sup> One of the most successful in the facilitation  
18 of mental health improvement is a serious video game—a  
19 complex game with multiple levels and settings—called  
20 PlayMancer (PM), which targets emotional regulation and  
21 was specifically designed to help manage impulse control  
22 disorders.<sup>11 13</sup> The objective of the PM game is to develop  
23 emotional and cognitive skills, while reducing impulsivity.  
24 The game has been shown to help treat bulimia nervosa  
25 by improving emotional regulation.<sup>15 16</sup>

26 PM also uses biofeedback (heart rate and heart rate  
27 variability) to model physiological and emotional reac-  
28 tions, feeding this information back to the participant.  
29 Some research has shown that facilitating awareness of  
30 one's own physiology (such as brain activity or cardiac  
31 function) enhances the treatment effects of mental health  
32 disorders (such as anxiety disorder, depression, obsessive-  
33 compulsive disorder (OCD) and schizophrenia) via self-  
34 regulation.<sup>17</sup> Biofeedback has also been shown to improve  
35 impulse control difficulties, and attentional difficulties  
36 in bulimia nervosa and attention deficit hyperactivity  
37 disorder,<sup>15 16 18</sup> as well as symptoms of stress, anxiety and  
38 anger.<sup>19</sup> The focus on physiological data in the psycho-  
39 therapeutic context is gaining traction<sup>20–22</sup> and has strong  
40 theoretical underpinnings.<sup>23–25</sup>

41 Within PM, there are three mini-games: 'The face of  
42 Cronos'; 'Treasures of the sea' and 'Sign of the Magupta'.  
43 Each of these mini-games were designed to train different  
44 skills, for example, 'The face of Cronos' and 'Treasures of  
45 the sea' develops planning skills, impulse control, coping  
46 skills, stress management and emotional self-regulation,  
47 while 'Sign of the Magupta' was designed to train relax-  
48 ation, breathing techniques and improve physiological  
49 and emotional awareness. However, in the study<sup>15</sup> PM  
50 was combined with sessions of cognitive behavioural  
51 therapy (CBT) and without a control measure (eg, CBT  
52 only) so the game was developed as an adjunct to tradi-  
53 tional mental health training, and there is no real way  
54 of knowing the direct benefits of the game as opposed  
55 to training in CBT. In another study—a case study of a  
56 single participant playing PM—anxiety and impulsivity  
57 decreased prior to CBT.<sup>16</sup> However, as this study was  
58 based on a single case, further studies using a randomised

controlled trial (RCT) approach are needed to support  
and provide confidence to these findings.

Another game, Dojo,<sup>26</sup> develops emotional regulation  
in adolescents with anxiety. It uses biofeedback (heart rate  
variability) and trains breathing techniques, muscle relax-  
ation, positive thinking and guided imagery to attempt to  
reduce anxiety in adolescence. It also uses instructional  
videos and then engages players through immersive and  
emotionally evocative puzzles that challenge players to  
use newly acquired emotion regulation skills. However,  
a pre-post RCT with 1347 participants, compared with  
a standard 'off the shelf' commercial game 'Rayman 2'  
(whereby Rayman 2 was the control), reported no differ-  
ence between Dojo and the control condition at reducing  
anxiety. As both of these games significantly reduced  
anxiety, it is possible that the reduction in anxiety was due  
distraction from anxiety-provoking thoughts, rather than  
developing psychoeducational skills per se. The authors  
concluded that crucial design issues need to be carefully  
thought through, which include a clear theoretical and  
therapeutic foundation. This includes appropriate meth-  
odology that can assess the causes of improvement, before  
developing and testing a serious video game for the treat-  
ment of mental health issues such as anxiety.

Commercial games (such as Rayman 2) have been  
explored in their unmodified forms for their effective-  
ness in helping with social skills training for autism, and  
cognitive distraction for anxiety and nausea for patients  
undergoing chemotherapy,<sup>27</sup> with limited success.  
Evidence of generalisability of these games beyond game-  
playing is limited,<sup>28</sup> and this may be because they act as  
simple distractions rather than therapeutic psychoeduca-  
tion applicable to participant's everyday lives. Another  
issue with many of these studies is that they often lack  
appropriate and rigorous methodology such as longitu-  
dinal follow-up,<sup>29</sup> and a mixed-methodological approach  
that can assess the feasibility and acceptability of such  
interventions.

Given these issues, it is important to emphasise that the  
underlying theoretical basis for PM and Dojo relates to  
the development of emotional regulation skills. While  
emotional regulation has transdiagnostic application<sup>30</sup> (ie,  
an intervention designed to treat multiple mental health  
conditions), these applications are not underpinned by  
theoretical frameworks that relate to formal psychother-  
apeutic interventions. Our proposed game is designed to  
be a comprehensive transdiagnostic intervention that will  
integrate a third wave behavioural therapy—as opposed  
to an adjunct to—acceptance and commitment therapy  
(ACT).<sup>31 32</sup> It will therefore be a comprehensive strategy  
for managing many common mental health issues such  
as depression and anxiety and focus on developing clear  
psychoeducational skills in the form of psychological flex-  
ibility, well-being and resilience more generally.<sup>33</sup>

Given this comprehensive transdiagnostic focus on  
psychological flexibility through ACT—a fundamental  
component of general health and well-being<sup>34</sup>—our  
online video game may have much greater reach and





1 impact than other serious video games such as PM,  
2 Dojo and many of the commercial games which are not  
3 based on third wave psychotherapy. Greater accessibility  
4 and impact have important implications for reducing  
5 treatment gaps and lags by making more mental health  
6 services available to those who need them.

7 One reason for choosing ACT in the game development  
8 process was pragmatism. For instance, researchers and  
9 clinicians may access freely available materials through  
10 the Association of Contextual Behavioural Science  
11 website (<https://contextualscience.org/>), and it does not  
12 require formal clinical training or accreditation to practice<sup>35</sup> which has important implications for translation to  
13 video game platforms. Another reason for choosing ACT  
14 as the basis for the game, is that it has a strong evidence  
15 base, and meta-analysis has found it to be efficacious for  
16 improving chronic pain, depression, psychotic symptoms,  
17 mixed anxiety, OCD, drug abuse and stress at work.<sup>36</sup> This  
18 means it is an ideal general purpose therapeutic tool as  
19 opposed to restricted focus on for example impulsivity  
20 control such as the PM application<sup>11 13</sup> or simple relaxation  
21 skills for adolescence with anxiety, as is the focus of  
22 the Dojo game.<sup>26</sup>

23 ACT principles are designed to undermine the trap-  
24 pings of language in the form of difficult thoughts and  
25 associated feelings, and promotion of psychological flexi-  
26 bility.<sup>37</sup> Language trappings can get individuals entangled  
27 and can prevent them from engaging with what is truly  
28 meaningful to them. The development of psychological  
29 flexibility through ACT is important because it is consid-  
30 ered to be a fundamental component of well-being.<sup>34</sup>

31 The six ACT processes are: (1) the act of being in the  
32 here and now, present and mindful<sup>32 38</sup>; (2) acceptance,  
33 the act of being aware and open to painful thoughts; (3)  
34 cognitive fusion, the act of recognising that thoughts are  
35 just thoughts and not to buy into them (the process of  
36 cognitive defusion)<sup>39</sup>; (4) identifying values, values act  
37 as a life compass and direct us towards a life filled with  
38 purpose; (5) commitment to values orientation, which is  
39 the act of continually working towards a values orienta-  
40 tion, even when an individual goes off track; (6) self as  
41 context (also called the transcendental self), is flexible  
42 and transcendent form of self. This involves the aware-  
43 ness of thoughts and feelings but the complete detach-  
44 ment from the literal meaning of thoughts.<sup>34</sup>

45 ACT has been usefully applied to many forms of mental  
46 health issues and has been applied in many different  
47 forms of delivery. This includes web-based interven-  
48 tions,<sup>40-42</sup> teleconference<sup>43</sup> and a downloadable app for  
49 smartphones.<sup>44 45</sup> So, given the fact that video games can  
50 have positive well-being benefits,<sup>46 47</sup> and are applicable  
51 for therapeutic purposes,<sup>28 48</sup> a transdiagnostic ACT  
52 serious video-game may have great potential for similar  
53 reasons.

54 As ACT is a comprehensive transdiagnostic model and  
55 formal third wave cognitive behavioural approach, then  
56 its reach and impact in the form of a video game may be  
57 greater than that of PM or Dojo which were focused on

58 simpler emotional skills development and biofeedback.  
59 For these reasons, we are proposing an ACT-based video  
60 game called 'ACTing Mind' as an innovative and acces-  
sible intervention to help individuals who struggle with  
anxiety, depression, stress and other forms of distress.

## Aims

The research goals of this proposal are to determine the feasibility and acceptability of a novel ACT-based video game intervention for individuals with mental distress, in line with methodology described in the Medical Research Council (MRC) framework.<sup>49 50</sup> This proposal lays the foundation for which a pilot and full-scale RCT will be conducted to determine clinical effectiveness, and ultimately the recommendations of the importance of such innovations in primary care mental health policies and practices.

## METHODOLOGY

This protocol has been developed following the Template for Intervention Description and Replication of Studies<sup>51</sup> (see online supplemental appendix 1), as well as the MRC guidelines for the development of complex interventions.<sup>49 50</sup> This includes five stages of development for a complex intervention including: (1) preclinical, involving a theoretical review of the literature (provided here), justifying the need for such an intervention for the proposed population; (2) phase I, modelling, involving the use of evidence to determine the components for underlying mechanisms. For this, we propose a qualitative element involving thematic analysis to enable us to understand what would be most beneficial to a general population with anxiety and depression; (3) phase II, conducting an exploratory pilot study (outlined here) to determine the feasibility of the methodology and design where some initial data can be collected; (4) phase III, an RCT to test the efficacy of the proposed intervention (in subsequent work); (5) phase IV, long-term follow-up to assess replicability.

## Public and patient involvement

Key stakeholders were consulted and involved in the development of this protocol. The Patient Experience and Evaluation in Research (Patient Experience and Evaluation in Research (PEER): <https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/>) group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students and staff members, several of whom reported that they had experienced depression, anxiety or stress at some point in their lives and emphasised the need for innovative approaches of the delivery of mental health support. The feasibility design was explained to them, and they gave positive feedback about the nature of the design, intervention and outcome measures.



## Study design

This is a mixed-methods study which is designed to determine the feasibility and acceptability of an ACT-based video game for individuals with anxiety, depression and stress, and to increase psychological flexibility.

## Study setting

The study will be conducted entirely online including the game and assessment (via the Qualtrics platform), and qualitative interviews (via the Zoom platform). Thus, potential participants will be able to access this study without restrictions, an important consideration for ongoing local lockdowns associated with the COVID-19 pandemic. Strict recommendations will require participants to ensure they are in a quiet room and without disruption for the duration of the study.

## Recruitment and consent

We will recruit participants (n=36) using purposive sampling, focusing on—unlike an opportunity sample—the types of participants needed for a full-scale RCT (ie, individuals with depression, anxiety and stress). The sample size is justified on the basis of past research reporting the median numbers of participants recruited for similar types of feasibility studies,<sup>52</sup> incorporating both quantitative and qualitative elements.

## Eligibility criteria

Participants will be recruited through general public mental health forums, social media and student populations. Thirty-six participants will take part in the study and they will be aged 18 years or older, be experiencing ongoing depression, anxiety and stress, and be able to read, write and speak English.

## Intervention

This ACT-based video game intervention called 'ACTing Mind', developed and designed solely by DE, will involve students and members of the public attending five 1 hour sessions of an ACT-based video game. Each session will involve a different chapter of the video game, and each chapter will explore a different key component of ACT, with there being six in total (see [table 1](#) for the different chapters and sessions involved).

These various components and principles of ACT<sup>31 32</sup> will be taught within the different chapters of the game and through embedded learning. For example, the player will gain ACT skills while completing objectives within the game and without directly being taught these skills, but rewarded indirectly through points and progress awards. For instance, in one scene (see [table 1](#)) the character is confronted by painful memories, and the player has two choices: (1) to destroy the painful memories or (2) to accept these memories. If the player chooses to destroy the memories (avoidant-based strategies), the world becomes distorted and barriers form making the chapter impossible to complete. Alternatively, if the player chooses acceptance-based strategies they will be able to continue

the game (hence in this scene they learn that acceptance is functionally better than avoidance).

The game will start with a depressed individual who has recently lost his wife in an accident, and is feeling depressed, isolated and lonely (see [figure 1](#) as an example of this scene). Each chapter will reward ACT consistent behaviour with points on a 'psychoflexameter'. This is a dial on the border of the screen which indicates increased psychological flexibility as the player completes ACT-based tasks such as acceptance (chapter 1), being present (chapter 2), values and commitment (chapter 3), defusion (chapter 4) and self as context (chapter 5). ACT uses metaphors to help clients visualise the key processes of ACT. In the game, these metaphors are real representations, such as the 'sinking sand' game, 'dropping the rope' game, the 'chessboard game', the 'unwanted monster' game, the 'leaves on a stream' game (see [table 1](#)).

Within the game, the character will have to enter his own mind through a 'mind escape machine' (see [figure 2](#) of this as an example of the character in his own mind). At the start of the game, it is explained through a brief historical story that he develops this machine to destroy and suppress his unwanted painful thoughts and memories about his wife and loss. Once in his mind, he will learn that destroying or suppressing thoughts creates barriers in his mind which prevents him from continuing the game. So, learning acceptance is crucial throughout this game and the character is rewarded for this through points and progress awards. Also, within the game, psychoeducation components explain thoughts as trappings of language which can often get people stuck in life, and prevent them from value consistent living, as well as the various emotional regulation strategies such as avoidance and acceptance.

As part of the study, in addition to playing the video game, participants will be asked to record events on a weekly basis, aspects of application of the ACT principles learnt in an everyday life in a journal. It is anticipated that greater adherence to the intervention in everyday life, and engagement with the journal will lead to greater success of the intervention (greater psychological flexibility).

## Data collection and management

MSc students will have the opportunity to be involved in this study and will collect and process the data under supervision by project leads, DJE and AK. Questionnaires will be completed online through Qualtrics which will store raw data copies, and also be held on an encrypted university server. Names and other personally identifiable information will not be stored, and consent form information will not be associated with the raw or processed data, instead each participant will be given a unique identifier code. Similarity recorded interviewer transcripts will use identifier codes as opposed to personal information (eg, names). The project leads (DJE, AHK) will frequently audit all processes in data collection and processing to ensure that the procedures stated in this protocol are adhered to.



**Table 1** Overview of the ‘ACTing Mind’ intervention and everyday journal instructions

Session 1 (week 1): acceptance and openness to pain	<ul style="list-style-type: none"> <li>▶ Chapter 1—Acceptance</li> <li>▶ Introducing participants to the video game and ACT in everyday journal.</li> <li>▶ A brief overview of the purpose of the programme and the content of each session.</li> <li>▶ Explaining basic ACT tenets through introduction text of journal.</li> <li>▶ Explaining the nature of painful thoughts and memories and getting caught up in the struggle explained through journal.</li> <li>▶ Basic story context about the character being depressed and why, at start of video game.</li> <li>▶ Explaining the objective of the video game, that is, to transcend from psychological inflexibility to psychological flexibility.</li> <li>▶ Exercise, within the game there are choice, either to suppress, and break thoughts, or to accept and be open to them.</li> <li>▶ Acceptance and openness are rewarded by psychological flexibility points on the ‘psychoflexameter’ and game progression, while suppression actions (breaking or suppressing painful memories) are punished with physical barriers, and sinking sand, which prevent the player from progressing in the game.</li> <li>▶ A monster pulls against the player to prevent progress, but if the player fights with the monster, they get even more stuck (analogous to the drop the rope and sinking sand metaphor). Again, acceptance is important and must be learnt here.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 2 (week 1): being present (mindfulness)	<ul style="list-style-type: none"> <li>▶ Chapter 2—Being present (mindfulness)</li> <li>▶ Some instructions from the journal about being present and mindful is given, why it is useful and how to go about achieving with breathing exercises.</li> <li>▶ The character is approached by monsters in the game in the past and future making him worry excessively about imaginary dangers, and reminding him of painful events.</li> <li>▶ The game (in the form of the character’s wife’s ghost) instructs the player to be present, to focus on your breathing for 10 min.</li> <li>▶ As the participant learns and completes relevant psychological flexibility tasks psychological flexibility on the ‘psychoflexameter’ will increase, which rewards the player for being present.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 3 (week 2): values identification and commitment	<ul style="list-style-type: none"> <li>▶ Chapter 3—Values identification and commitment</li> <li>▶ Instructions about what are values (a life compass) explained through the journal.</li> <li>▶ Acceptance and commitment to values orientation as opposed to avoidance behaviour is rewarded.</li> <li>▶ There are challenges to reach goals which are linked to the character’s values, such as scary weather and monsters.</li> <li>▶ Psychological flexibility on the ‘psychoflexameter’ and game progress, will increase with values consistent behaviour which rewards the player for committing to values.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
Session 4 (week 2): defusion	<ul style="list-style-type: none"> <li>▶ Chapter 4—Defusion</li> <li>▶ Instructions about what is cognitive fusion and defusion (holding self-stories lightly) explained through journal.</li> <li>▶ The character goes back into the ‘Mind Escape’ machine but this time there is a flowing river with leaves (analogous to leaves on a stream metaphor).</li> <li>▶ Some of the character’s painful memories will beg the player to help them, but if the player interacts, barriers and quicksand appear, punishing the player and preventing them from progressing in the game (analogous to the sinking sand metaphor).</li> <li>▶ The ghost of the character’s wife eventually instructs the player to put the memories and thoughts onto the leaves and watch them flow down the river, without interacting with them, and to simply observe.</li> <li>▶ Psychological flexibility on the ‘psychoflexameter’, will increase when all of the memories and thoughts as left to go down the stream, hence the player is rewarded for defusing.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>

Continued



**Table 1** Continued

<p>Session 5 (week 3): self as context</p>	<ul style="list-style-type: none"> <li>▶ Chapter 5—Self as context</li> <li>▶ Instructions about what is self as context (being the observer of your thoughts and not your thought) are explained through journal.</li> <li>▶ The world starts to fall apart and becomes abstract, like a chess board.</li> <li>▶ The player realises that they are the white pieces on the chessboard (analogous to chess board metaphor).</li> <li>▶ The player is compelled by the game to beat the black pieces in the chess game.</li> <li>▶ But the more the players fights against the black pieces, the more they lose points on the ‘psychoflexameter’ and cannot progress in the game.</li> <li>▶ The player must let the battle play out, once they do, they become aware that they are the chess board (they become it) and realise they do not need to be part of the never-ending battle between the opposing forces.</li> <li>▶ Finally, a bus arrives, memories of the character’s wife beg the player to stay, and the monsters pull on player.</li> <li>▶ The player needs to get onto the bus with the monsters to move towards their values, a new beginning (analogues to bus metaphor).</li> <li>▶ Finally, the player has a choice, go back and change the events that led to your wife’s death, or stay on the bus with the monsters.</li> <li>▶ Trying to change events leads to a loss in points and prevents game progression.</li> <li>▶ Only staying on the bus, towards values, and accepting the monsters allows the player to complete the game successfully.</li> <li>▶ Reflecting in the journal about how this might be applied in life, and when this has occurred throughout the week daily.</li> </ul>
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### Outcome measures

Questionnaires will be collected at three points in time (baseline, immediate postintervention and 3-month follow-up). Interview data will be collected immediate postintervention only.

### Demographic data

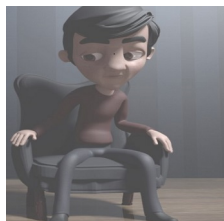
Demographic measures will include age, sex, medication use, which will all be recorded through Qualtrics and assessed by DJE and AHK.

### Primary outcome measure

The primary outcomes for feasibility are determined using MRC framework measure for developing a complex intervention.<sup>49 50</sup> As this is a feasibility study, the primary outcomes (in accordance with the MRC framework) will include the acceptability of the ACT-based video game intervention, the feasibility of the recruitment, outcome measures and intervention adherence.

### Acceptability

- ▶ Number of people dropping out.



**Figure 1** First scene in ‘ACTing Mind’, the character, Steve, is depressed and alone.

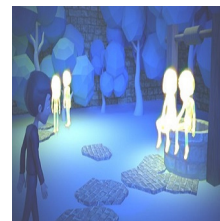
- ▶ Barriers for adoption of intervention as assessed through interviews.
- ▶ Number of sessions attended.
- ▶ Time dedicated to home journal.
- ▶ ACT principles adherence in everyday life setting (as recorded in journal and expressed through interviews).
- ▶ Experience, identifying whether participants had positive experience with the intervention and whether they wanted to continue to be part of the intervention.

### Feasibility

- ▶ Number of participants who are willing to take part.
- ▶ Time taken to complete questionnaires.
- ▶ Number of complete and incomplete questionnaires.

### Secondary outcome measures

Warwick-Edinburgh Mental Well-Being Scale<sup>53</sup>: a measure of mental well-being with a focus on positive aspects of mental health. This measure has good internal



**Figure 2** An example scene, where the character ‘Steve’ is in his own mind, and can see his own memories, through his Mindscape machine.





consistency with a Cronbach's alpha coefficient of 0.89 (student sample) and 0.91 (general population sample).

Depression Anxiety Stress Scales: a short version of this measure and a measure of general psychological distress with good construct validity (confirmatory factor analysis of 0.94). It has good internal reliability as measured through Cronbach's alpha coefficients, which are 0.88 for depression, 0.82 for anxiety, 0.90 for stress and 0.93 for the total scale.<sup>54</sup>

Social connectedness (adapted from Russell's (1996) UCLA Loneliness Scale<sup>55</sup>: this measure involves two questions: (1) "During social interactions, I feel 'in tune' with the person/s around me", and (2) "During social interactions, I feel close to the person/s". The Cronbach's alpha coefficients for these two items ranged from 0.80 to 0.98 (M=0.94, SD=0.03).<sup>55</sup>

EuroQol five dimensions (EQ5D): the EQ5D is a measure for health-related quality of life. There are five components within this measure which assess mobility, self-care, usual activities, pain, discomfort and anxiety. It also has a visual analogue scale (VAS) for measuring current health status. Scores for these will be calculated for each of these five subsections as well as including the VAS and total EQ5D score of all five subsections. The EQD5 correlates well with other health-related questionnaires such as the 36-Item Short Form Survey ( $r=0.61$ ,  $p<0.0001$ ) and Parkinson's Disease Questionnaire (PDQ)-39 ( $r=-0.75$ ,  $p<0.0001$ ).<sup>56</sup>

Acceptance and Action Questionnaire-second version: this is a seven-item scale developed by Bond *et al*<sup>57</sup> to measure psychological inflexibility, which involves the ability to accept and be open to difficult thoughts and feelings as well as to engage in valued behaviour in the presence of the difficult thoughts and feelings. A higher score indicates higher psychological inflexibility. The measure has good construct validity with a Cronbach's alpha coefficient of 0.84.<sup>57</sup>

### Adherence to the intervention measure and trial

Adherence will be measured in a variety of ways such as intervention feedback, treatment adherence through attrition rates as well as meta-data of relating to game log-in and log-out, as well as how long the game was played for and what sessions of the game were completed for each participant. Similar information can be recorded in Qualtrics for ensuring questionnaires are completed carefully. This includes length of times completing the questionnaire, and paying attention to reverse-scored questions.

### Sample size and statistical analysis

Sample size recruited will help us determine whether it is possible to recruit sufficient numbers of participants to manage a full-scale RCT at a later date.

Quantitative data analysis: analysis will focus on descriptive statistics and feasibility outcomes of the questionnaires. While clinical effectiveness will not be formally evaluated at this stage, effect sizes will be explored for

early evidence that the intervention shows promising signs (including ACT-related process measures). It is predicted that outcomes will improve, and any improvement will be identified using a one-way analysis of covariance with a single within-subjects factor (time). The effect sizes will also allow for a power calculation to be made which will allow for an approximation for a sample size required in a future trial (if indicated).

Qualitative data analysis: transcripts of focus group interview data will be generated from digital audio-recordings of in-depth, face-to-face semi-structured interviews (all online and via a password-protected room in Zoom). In-depth semi-structured interviews will form the core topics to be discussed (see table 2), while leaving space and scope for the identification and exploration of unforeseen information that may emerge. Insights from this will allow for further development and improvement of the intervention, along with the quantitative data in line with the MRC guidelines.<sup>49 50</sup>

Thematic analysis will then be conducted which will explore key overarching themes that may emerge from the focus group interviews following standardised guidelines.<sup>58</sup> The interview questions are based on other novel ACT-based protocols.<sup>40 59</sup> The data will be analysed after the study has been completed. We will follow the inductive and deductive code development as outlined by Fereday and Muir-Cochrane<sup>60</sup> to ensure necessary rigour. Any key overarching themes identified which relate to feasibility of the study design of the acceptability of the intervention, as well as potential adverse effects, will be explored and reported.

The focus groups will comprise 4 to 6 groups with 6 to 10 individuals in each group as has been suggested as optimal in other studies.<sup>61</sup> The interview will take place at the end of the intervention (week 3). It will explore various aspects of the intervention such as perceived process of change, barriers to intervention adherence, trial process and any adverse effects, which help supplement the quantitative approach. Process of change questions indicate whether the participant learnt anything about ACT, and felt any positive change in their life due to participating in the intervention. The question relating to barriers explores any problems and difficulties they had with the intervention. Another question will be asked to elicit suggestions for improvement relating to game or study design. Acceptability questions and process of change in one's life relate to whether the participant accepted the intervention and used skills they learnt through the intervention in daily life. The question relating to the trial process will determine whether there were any difficulties or limitations of the trial itself such as whether the instructions were clear and how it could be improved. Finally, the question on adverse effects explores whether there were any potential unforeseen negative consequences of the intervention.

### Limitations of the study

This study protocol has limitations. First, while physiological measures would ideally be collected to measure

**Table 2** Qualitative interview protocol for the focus groups

Acceptability and feasibility	How would you describe your experience of taking part in 'ACTing Mind' video game programme?
Accessibility of intervention	If this intervention were rolled out as a video game app, do you think you would download it? Would you appreciate the accessibility?
Process of change	What did you learn from this programme?
Acceptability	What was the aspect of the programme that you liked the most? What was your favourite activity within the game (or applied to your everyday life)?
Suggestions for further improvement	What did you least like about the intervention? What do you think could be improved?
Barriers	Were there any difficulties to taking part?
Implementing change in everyday life	Do you practice mindfulness, acceptance, defusion and values? How often? Could you apply what you have learnt through video game intervention to the real world in everyday events? Will you apply this new knowledge to everyday events?
Process of change	Have you noticed any differences in your life as a result of taking part in 'ACTing Mind'? If 'yes', what are these differences?
Acceptability	Would you recommend this intervention to someone you care about? Did you like the theoretical concepts central to the ACT intervention? How did you feel about its delivery? Was any of it too abstract or difficult to understand?
Processes of the trial	Was there anything you liked, or disliked about the study? How could we improve this study? Were all the instructions clear?
Adverse effects	Did you feel that any aspect of the intervention may have made worse any aspect of your anxiety, depression or stress? Were there any adverse effects that you can recognise due to the intervention?

variables such as heart rate variability, the COVID-19 pandemic limits our capacity to do this. However, the present study will provide important data on which such measures could be collected, analysed and interpreted in a future trial. Second, it could be questioned why there is no control condition in this study. Our response to this potential criticism is that the aim of the present study is to assess feasibility and—in line with the MRC guidelines<sup>49 50</sup>—has not been designed to be a full-scale RCT given the current research phase. Once the feasibility component is completed, a control condition will be introduced, which allow for the intervention condition to be compared with control, and as part of a full trial. Finally, although we would like to have ability to monitor the participant more directly, to ensure adherence to the intervention, we are sensitive to privacy issues associated with, for example, capturing participants' identity from the computers video camera. To mitigate this limitation, we have opted for less invasive procedures for measuring intervention adherence that will include logging metadata of the game such as log in and out times, as well as completion of game sections. Several questions in the questionnaire are also reverse scored to ensure participants are paying attention.

### Protocol amendments

If the protocol is amended in any way, it will be communicated to relevant parties immediately, such as to participants, journal and ethics committee.

### Ethics and dissemination

This study has received ethical approval from Swansea University Psychology Department ethics committee (2020-4920-3923). Participants will be informed of their rights to confidentiality and to leave the study at any time and without penalty. Both qualitative and quantitative data will be held on a password-protected computer accessible only to researchers DJE and AHK. The data will be anonymised with a unique identifier code, and any personally identifiable information will be removed.

Dissemination will involve peer-reviewed journals; leading national and international conferences, social media and public events and through general public health engagement such as talks at schools, the Welsh Government and engagement with annual science festivals including 'a pint of science'.

### Impact of intervention

The potential impact of this study is far reaching as it will add to the growing set of online resources which support psychological resilience, flexibility and well-being. These resources are designed to be easy to access and are ideal for situations where travel is limited due to physical (disability) or situational (coronavirus) immobility. Such interventions can help alleviate widely reported mental health treatment gaps<sup>2</sup> and lags,<sup>3</sup> associated with the widely reported scarce human resources needed to provide mental health support for the many individuals who need it. The 2018 Lancet commission on global mental health argued that sustainable development



of mental health should be an essential component of universal health coverage.<sup>4</sup> Technological innovation of mental health support services, in the form of video games, may be one means to achieve this sustainability and a reduction in the treatment gap and lag.

### Ancillary and poststudy care

Postintervention care has not been anticipated given this is a low-level (low-risk) intervention. Of course, all participants will be given a debrief form which will signpost individuals to the relevant free well-being services such as the Samaritans.

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**Contributors** DJE developed the intervention. DJE and AHK agreed on a set of outcomes. DJE wrote the first draft of the protocol and DJE and AHK then revised the subsequent drafts of the protocol. Both authors helped to revise the manuscript for intellectual content and agreed on the final version prior to submission for peer review.

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**Competing interests** At the time of writing this, DJE is discussing with Agor IP at Swansea University the potential to commercialise the described video game as a mobile application; however, at this time no agreements have been made or signed. AHK has no competing interests.

**Patient consent for publication** Not required.

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## PARTICIPANT INFORMATION SHEET

### **A novel ACT-based video game to support mental health through embedded learning**

You are being invited to take part in some research. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please read the following information carefully.

#### **What is the purpose of the research?**

The aim of the research project is to gain insight into whether exposure to a novel-acceptance and commitment therapy (ACT) video game can improve various outcome measures of depression, anxiety, stress, and other measures relating to wellbeing.

If you are above the age of 18 and are currently experiencing ongoing mild to moderate levels of depression, anxiety, or stress you are welcome to participate in this study. For those individuals who present with high levels of depression and anxiety, we will advise the participant to consult either with a GP or with a therapist if they have one, in relation to participating in this experiment.

Participation in this study will take approximately 3 hours over three weeks. Which is broken down into 1 hour for the intervention (the video game itself); 1 hour for online one-on-one qualitative audio interviews via Zoom after completing the game, and after a 3-week follow-up; and 1 hour for the three-questionnaire assessments at baseline (pre-intervention), immediate post-intervention, and after a 3-week follow-up.

#### **Who is carrying out the research?**

The data are being collected by Prof. Andrew Kemp and research assistant Tom Gordon of the Psychology Department within the College of Human and Health Sciences at Swansea University, as well as Dr. Darren Edwards of The Department of Public Health, Policy, and Social Sciences. The research has been approved by the Department of Psychology's Research Ethics Committee.

#### **What happens if I agree to take part?**

If you are happy to take part in this research project, please click "accept" at the bottom of the consent section below, which will then allow you to complete a baseline questionnaire assessment. The questionnaire assessment includes a range of multiple-choice questions. These questions cover a range of factors including depression, anxiety, stress, and wellbeing. There are three questionnaire assessments to complete, the first of which is a baseline assessment prior to the intervention commencing, the second will be completed following the intervention, and a follow-up assessment 3 weeks following the baseline assessment. All of the questionnaires ask the same questions with the addition of demographic questions at baseline assessment, and the second also asking about adherence to the intervention.

The intervention will consist of completing a one-hour session of playing an ACT-based video game, followed by completion of a short reflection workbook. The game itself will be completed by the participant at home, using a mobile phone or any iOS device. This is an adventure game that will teach you about psychological resilience. In the game, you will control the character Steve as he embarks on a journey into his own mind, you will help as he confronts painful past memories and learns how to cope with his full potential.

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6 You will also be interviewed, which will be conducted online via zoom, regarding your experiences of  
7 the game, focusing on what you felt did and did not work. The interviews will be conducted at two  
8 points during the study, post-intervention, and after a 3-week follow-up. Interview audio will be  
9 recorded and transcribed, following which the recordings and any personal information will be  
10 immediately deleted.  
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### 12 13 **Are there any risks associated with taking part?** 14

15 We are not aware of any significant risks associated with participation. While some of the questions  
16 will ask about existing states of mental health (e.g., levels of current anxiety and depression) – which  
17 some people may find uncomfortable – the video game has developed in accordance with recent  
18 developments in psychological science to help you manage these, and we expect that participation in  
19 this study will help to ameliorate these feelings.  
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21 If you feel affected by any issues raised by this research and would like to discuss any concerns,  
22 please contact the principal investigators of this study as indicated in the contact details at the bottom  
23 of this information sheet. If you feel that you would benefit from further psychological or psychiatric  
24 support, we advise you to contact your GP (family doctor) in the first instance. Further information on  
25 mental wellbeing can be found at <https://www.mind.org.uk/>. Additional mental health information can  
26 be found at <https://www.nhs.uk/mental-health/>.  
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30 This research has been approved by the Department of Psychology's Research Ethics Committee.  
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### 32 **Data Protection and Confidentiality**

33 Your data will be processed in accordance with the Data Protection Act 2018 and the General Data  
34 Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly  
35 confidential. Your data will only be viewed by the researcher/research team.  
36

37 Standard ethical procedures will involve you providing your consent to participate in this study by  
38 ticking the consent box in the consent section  
39

40 All electronic data will be stored on password-protected computers.  
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42 Please note that the data to be collected for our study will be made anonymous once you have  
43 completed all stages of the research, and your response data will not hold any personally identifiable  
44 information. We will allocate you with an identifier code, and keep your email information for the  
45 duration of the study, so that we can communicate with you at the time points. We will delete contact  
46 emails at the end of the study.  
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48 All data deposited in Swansea University's OneDrive for Business service is stored within Microsoft's  
49 data centres located in the EU. Swansea University retains full ownership and control over the data  
50 and is satisfied that the data is properly secured and protected.  
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52 The contractual agreements between Microsoft and Swansea University have been negotiated by the  
53 JISC on behalf of the UK HE sector and abide by all relevant UK and European legislation. In  
54 addition, the UK Government has granted Microsoft Azure and Microsoft Office 365 "OFFICIAL"  
55 accreditation. This means that they are accredited to hold or transact public sector data for business  
56 conducted at the OFFICIAL level of Security Classification.  
57

### 58 **What will happen to the information I provide?** 59 60

Version 4 4 November 2022



An analysis of the information will form part of our report at the end of the study and may be presented to interested parties and published in scientific journals and related media. *Note that all information presented in any reports or publications will be anonymous and unidentifiable.*

### **Is participation voluntary and what if I wish to later withdraw?**

Your participation is entirely voluntary – you do not have to participate if you do not want to. If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty (simply close your web browser). All identifying information will be stripped from collected data once you have completed all phases of the study. If you wish to withdraw at any time during the study, all personal information will be immediately deleted.

### **Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data, and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet. Standard ethical procedures will involve you providing your consent to participate in this study by ticking the consent box on the consent page.

The legal basis that we will rely on to process your personal data will be processing in line with public interest, scientific and statistical purposes.

### **How long will your information be held?**

Anonymised data will be preserved and accessible online, as is encouraged by developments in open science.

### **What are your rights?**

You have a right to access your personal information, to object to the processing of your personal information, to rectify, to erase, to restrict and to port your personal information. Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)  
Vice-Chancellor's Office  
Swansea University  
Singleton Park  
Swansea  
SA2 8PP  
Email: [dataprotection@swansea.ac.uk](mailto:dataprotection@swansea.ac.uk)

### **How to make a complaint**

If you are unhappy with the way in which your personal data has been processed you may, in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,  
Wycliffe House,





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7 Wilmslow,  
8 Cheshire,  
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10 www.ico.org.uk  
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### 13 **What if I have other questions?**

14 If you have further questions about this study, please do not hesitate to contact us:  
15

16 Tom Gordon  
17 Research Assistant  
18 Swansea University  
19 tom.gordon@swansea.ac.uk  
20

21 Prof. Andrew Kemp  
22 Department of Psychology  
23 Swansea University  
24 a.h.kemp@swansea.ac.uk  
25

26 Dr. Darren Edwards  
27 Department of Public Health, Policy,  
28 and Social Sciences.  
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Swansea University  
Prifysgol Abertawe

## Participant Consent Form

Project title: **A novel ACT-based video game to support mental health through embedded learning**

You must be age 18 or over to complete this online survey.

Name and Contact details of the principal researchers: Tom Gordon [tom.gordon@swansea.ac.uk](mailto:tom.gordon@swansea.ac.uk), Prof. Andrew Kemp [a.h.kemp@swansea.ac.uk](mailto:a.h.kemp@swansea.ac.uk), Dr. Darren Edwards [d.j.edwards@swansea.ac.uk](mailto:d.j.edwards@swansea.ac.uk).

This study is being conducted by Swansea University, Faculty and life sciences.

- I (the participant) consent to participate in the study
- I confirm that I have read and understand the information provided in relation to this study.
- I understand that this study will involve three phases, taking place over a period of three weeks. Within which I will complete a 1-hour therapy-based mobile phone videogame at home, that includes potentially upsetting themes relating to mental health.
- I understand that partaking in this study involves one-on-one online interviews using Zoom audio, and that any identifiable personal information will be immediately deleted following transcription.
- I understand that I have the option of undergoing electrocardiograph recording at three stages during the study, which will take place at Swansea University.
- I understand that my participation is voluntary. I understand that I am free to withdraw at any time during the study but once I have completed all phases of the study, withdrawal will not be possible because data will be completely anonymised.
- I understand what my role will be in this research, and all my questions have been answered to my satisfaction.
- I have been informed that the information I provide will be safeguarded.
- I am happy for the information I provide to be used (anonymously) in academic papers and other formal research outputs, however my name will not be published so anonymity is ensured.

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- I agree to the researchers processing my personal data in accordance with the aims of the study described in the participant information.
  - I am age 18 years or above.

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If you agree with all statements listed above, click **YES** (I consent).

If you disagree with any of the statements above, click **NO** (I do not consent).

For peer review only

## DEBRIEF FORM

Title of project: **A novel ACT-based video game to support mental health through embedded learning**

Thank you for taking part in our research. Now that your contribution has finished, let us explain the rationale behind this work.

We are interested in how a video game based on recent developments in clinical psychology might enable learning of psychological resilience skills through play. Typically, psychotherapeutic interventions are delivered through face to face sessions, but there is an increasing need for psychological support that is delivered through an online medium such as the video you have been playing in our study.

This work therefore builds on previous efforts to teach people important skills in psychological resilience through psychoeducation and embedded learning. Specifically, the game is designed to build psychological flexibility, which is a key outcome of an ACT intervention. Psychological flexibility within ACT refers to the promotion of positive mental health, contact with present emotions, wellbeing, and positive emotions. We hope that information gained from this study will be useful for further developing our ACT-based video game and expanding further research in this area.

If you feel affected by any issues raised by this research and would like to discuss any concerns, please contact the principal investigators of this study as indicated in the details provided below. If you feel that you would benefit from further psychological or psychiatric support, we advise you to contact your GP (family doctor) in the first instance. Further information on mental wellbeing can be found at <https://www.mind.org.uk/>. Further information regarding mental health can be found at <https://www.nhs.uk/mental-health/>.

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## CONSORT 2010 checklist of information to include when reporting a pilot or feasibility trial\*

Section/Topic	Item No	Checklist item	Reported on page No
<b>Title and abstract</b>			
	1a	Identification as a pilot or feasibility randomised trial in the title	1
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT abstract extension for pilot trials)	2/3
<b>Introduction</b>			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	4-9
	2b	Specific objectives or research questions for pilot trial	8-9
<b>Methods</b>			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	9
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	8
Participants	4a	Eligibility criteria for participants	10
	4b	Settings and locations where the data were collected	10
	4c	How participants were identified and consented	10
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	12
Outcomes	6a	Completely defined prespecified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	10-12
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	N/A
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	N/A
Sample size	7a	Rationale for numbers in the pilot trial	10
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	N/A
	8b	Type of randomisation(s); details of any restriction (such as blocking and block size)	N/A
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	N/A

Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	N/A
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	N/A
	11b	If relevant, description of the similarity of interventions	N/A
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	14-17
<b>Results</b>			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were approached and/or assessed for eligibility, randomly assigned, received intended treatment, and were assessed for each objective	17
	13b	For each group, losses and exclusions after randomisation, together with reasons	17
Recruitment	14a	Dates defining the periods of recruitment and follow-up	17
	14b	Why the pilot trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	30
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be by randomised group	17
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	30
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	17-29
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	N/A
	19a	If relevant, other important unintended consequences	N/A
<b>Discussion</b>			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	33-34
Generalisability	21	Generalisability (applicability) of pilot trial methods and findings to future definitive trial and other studies	31
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms, and considering other relevant evidence	31-35
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	34-35
<b>Other information</b>			
Registration	23	Registration number for pilot trial and name of trial registry	3
Protocol	24	Where the pilot trial protocol can be accessed, if available	35
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	35
	26	Ethical approval or approval by research review committee, confirmed with reference number	36



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Citation: Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *BMJ*. 2016;355. This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 3.0) license (<http://creativecommons.org/licenses/by/3.0/>), which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited.

\*We strongly recommend reading this statement in conjunction with the CONSORT 2010, extension to randomised pilot and feasibility trials, Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up-to-date references relevant to this checklist, see [www.consort-statement.org](http://www.consort-statement.org).

For peer review only



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