Using computers to teach people with intellectual disabilities to perform some of the tasks used within cognitive behavioural therapy: a randomised experiment

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ABSTRACT

Aims: Training has been shown to improve the ability of people with intellectual disabilities (IDs) to perform cognitive behavioural therapy (CBT) tasks. This study used a computerised training paradigm with the aim of improving the ability of people with IDs to: a) discriminate between behaviours, thoughts and feelings, and b) link situations, thoughts and feelings.

Methods: Fifty-five people with mild-to-moderate IDs were randomly assigned to a training or attention-control condition in a single-blind mixed experimental design. Computerised tasks assessed the participants' skills in: (a) discriminating between behaviours, thoughts and feelings (separately and pooled together), and (b) cognitive mediation by selecting appropriate emotions as consequences to given thoughts, and appropriate thoughts as mediators of given emotions.

Results: Training significantly improved ability to discriminate between behaviours, thoughts and feelings pooled together, compared to the attention-control condition, even when controlling for baseline scores and IQ. Large within-group improvements in the ability to identify behaviours and feelings were observed for the training condition, but not the attention-control group. There were no significant between-group differences in ability to identify thoughts, or on cognitive mediation skills.

Conclusions: A single session of computerised training can improve the ability of people with IDs to understand and practise CBT tasks relating to behaviours and feelings. There is potential for computerised training to be used as a "primer" for CBT with people with IDs to improve engagement and outcomes, but further development on a specific computerised cognitive mediation tasks is needed.

KEYWORDS: Cognitive Behavioural Therapy, Training, Learning Disabilities, Cognitive Mediation, Skills, Neurodevelopmental Disorders

Background

The last decade has seen an increase in research evaluating the efficacy of psychological therapies for people with intellectual disabilities (IDs), especially cognitive behavioural therapy (CBT) of anger regulation problems. Meanwhile, the proportion of case studies and single-armed trials has decreased, with more large-scale multi-site randomised controlled trials (RCTs) being completed (Brown, Duff, Karatzias, & Horsburgh, 2011; Vereenooghe & Langdon, 2013). This increase in the methodological quality of intervention studies enabled Vereenooghe and Langdon (2013) to complete a meta-analysis reporting moderate to large effect sizes for CBT of both anger regulation problems and depression.

The efficacy of psychological treatments is of particular importance given the high prevalence rates of mental health problems in this population. It is estimated that up to forty per cent of people with IDs suffer from mental health problems (Cooper, Smiley, Morrison, Williamson, & Allan, 2007), many of which may be associated with the higher occurrence of negative life events (Biswas & Furniss, 2009; Hulbert-Williams & Hastings, 2008). In spite of this, access to psychological therapies for people with IDs is still limited, in particular for young adults and people with mild to moderate IDs who often do not receive psychiatric assessments (Bhaumik, Tyrer, McGrother, & Ganghadaran, 2008).

Various barriers, both before and during therapy, may contribute to the lack of adequate provision in psychological therapies. Initial problems may arise in the assessment phase when mental health problems are not recognised as distinct from the IDs (Reiss, Levitan, & Szyszko, 1982) or misdiagnosed as challenging behaviour (Azam, Sinai, & Hassiotis, 2009). For those who continue to receive psychological therapy, being uninformed about the grounds for their referral may negatively impact upon their motivation to engage in therapy; hence, affecting treatment outcomes (Willner, 2006). Likewise, difficulties in establishing a therapeutic alliance may lead to clients engaging in a dependency-inducing relationship rather than taking ownership of the therapeutic process (Brechin & Swain, 1988; Jahoda et al., 2009). Furthermore, the perceived level of cognitive functioning may pose an additional barrier when therapists are more likely to use the cognitive aspects of CBT with more abled clients only (Willner, 2006).

The assumption that cognitive and verbal skills affect the ability of people with IDs to engage in and benefit from psychological therapy has since been widely investigated. Taylor et al. (2008) reviewed the evidence regarding the impact of full scale IQ and verbal IQ on therapy outcomes, reporting that while some studies reported better outcomes for clients with a higher verbal IQ (Rose, Loftus, Flint, & Carey, 2005; Willner, Jones, Tams, & Green, 2002), others reported greater improvements from pre-intervention to follow-up for clients with lower full scale IQ scores (Taylor, Novaco, Gillmer, Robertson, & Thorne, 2005). This discrepancy could be associated with mode of delivery, individual versus group-based treatments, and intensity or frequency of sessions (Taylor et al., 2008). Meta-analytic evidence supports the first assumption, with both Prout and Nowak-Drabik (2003) and later Vereenooghe and Langdon (2013) affirming greater therapy efficacy for individual rather than group therapy.

In addition to verbal ability, other skills may be desirable or required to participate in CBT successfully, some of which are likely to be related to general intellectual functioning. The Suitability of Short-term Cognitive Therapy (SSCT) scale identifies ten skills that would determine a person’s suitability for therapy (Safran, Segal, Vallis, Shaw, & Samstag, 1993), including compatibility with the cognitive rationale and potential to form a therapeutic alliance. Our study targeted two of the four skills of the SSCT scale that are associated with capacity for participation in CBT and are predictive of therapy outcome for anxiety and depression: accessibility of automatic thoughts and awareness and differentiation of emotions (Renaud, Russell, & Myhr, 2014).

Suitability for CBT in terms of cognitive skills

Various cognitive, interpersonal and motivational factors have been identified that may affect therapy outcomes. The cognitive aspects, linked to the cognitive rationale of CBT, have been determined by the antecedent-belief-consequence model (ABC-model; Ellis, 1977) of rational-emotive therapy. The ABC-model explains behaviour and emotions as consequences, C, to how a situation or antecedent, A, has been interpreted or mediated by beliefs, B. Assessments derived from this model focused on identifying various emotional states, linking situations to feelings (Antecedent and Consequence components), linking thoughts to feelings (Belief and Consequence components), differentiating between thoughts, feelings, and behaviours (Belief and Consequence components), and understanding of how thoughts mediate the relationship between situations and consequential emotions, a process known as cognitive mediation (Antecedent, Belief and Consequence components).

Identifying emotional states, particularly your own, is essential to engaging in meaningful discussions about the causes and consequences that led to them. Many researchers have focused on whether people with IDs are able to successfully identify emotional states. However, the evidence indicates that differentiation between various positive and negative emotional states, other than happy and sad, is sometimes problematic for people with IDs (Dagnan & Chadwick, 1997; Joyce, Globe, & Moody, 2006; McKenzie, Matheson, McKaskie, Hamilton, & Murray, 2001).

In addition, performance on emotion recognition assessments has been associated with the type of assessment and stimuli used (McKenzie, Matheson, McKaskie, Hamilton, & Murray, 2000; McKenzie et al., 2001). For example, labelling emotions appears more difficult than identifying a given emotion from multiple stimuli, in which accuracy rates can be increased by reducing the range of forced-choice stimuli from six to two. Emotion recognition ability is also higher for photographs with more contextual information than line drawings when there are a greater number of stimuli presented. The value of photographs over line drawings tends to reduce, however, when fewer stimuli are presented.

While identifying emotional states is important for psychological therapies, the ability to link situations, or antecedents, to feelings, or consequences is also important. Reed and Clements (1989) examined this ability with adolescents and young adults who have IDs, and approximately two thirds of their sample showed substantial levels of emotional awareness as determined by errorless performance in linking happy and sad faces to six different pictured scenarios, leading them to report that an age equivalent score of 4 years and 5 months on the British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Pintillie, 1982) was necessary to complete the task successfully.

Replications of this task led to similar findings with pass rates ranging from fifty to seventy-five per cent (Dagnan, Chadwick, & Proudlove, 2000; Joyce et al., 2006), indicating that most people with IDs can determine the appropriate emotional response in various situations provided they demonstrate substantial verbal comprehension skills.

Next, Dagnan and Chadwick (1997) assessed cognitive mediation skills by verbally describing brief scenarios and presenting facial expressions of consequential emotions. All participants generated at least one thought that would mediate the association between the presented situation and emotion, although the task was considered difficult by some.

In a subsequent study, the cognitive mediation assessment was subdivided in two tasks focusing on different aspects of cognitive mediation (Dagnan et al., 2000). The 'If A and B, choose C' task presented participants verbally with a scenario comprising an antecedent, A, and a belief, B, and prompted participants to identify whether they would feel happy or sad (emotional consequence, C). Likewise, for the 'If A and C, choose B' task, participants had to select an appropriate mediating belief, B, for scenarios comprised of an antecedent, A, and its positive or negative emotional consequence, C. Respectively, ten and twenty-five per cent of participants managed to pass each task, a grade awarded to scores of eight out of ten or higher, and no differences were found in level of difficulty between the two tasks.

The above findings were replicated by Joyce et al. (2006) and again by Oathamshaw and Haddock (2006) in people with IDs and psychosis. Most of the above studies reported a significant correlation between cognitive mediation ability and level of verbal comprehension, but it is important to bear in mind that participants with limited verbal skills were excluded from these studies. More recently, Vereenooghe, Reynolds, Gega, and Langdon (2015) did not employ exclusion criteria based on verbal skills, but reported substantially higher pass-rates on these tasks using an adapted and computerised version of the tasks.

Turning to the ability to differentiate between the various components of the ABC model, Oathamshaw and Haddock (2006) adapted the Behaviour, Thought, Feeling Questionnaire (BTFQ; Greenberger & Padesky, 1985) for use with people with IDs and psychosis. A list of twenty-four items, one of which was omitted from the analyses, were read to 50 participants who had to identify each item as a behaviour, a thought or a feeling. On average, 67% and 52% of participants were able to identify at least 6 out of 8 behaviours and feelings, respectively, and 19% were able to identify at least 5 out of 7 thoughts correctly.

Finally, two studies evaluated training programmes aimed to improve some of the necessary CBT skills for people with IDs. Within the first study (Bruce, Collins, Langdon, Powlitch, & Reynolds, 2010), using an experimental methodology comparing a training programme to a relaxation condition, participants' ability to link thoughts to feelings significantly improved, but training had no significant effect on ability to discriminate between behaviours, thoughts and feelings. In another experimental study, Vereenooghe et al. (2015) used a computerised training programme which was based on the Reed and Clements

(1989) assessment, which led to improvements in ability to identify appropriate emotional consequences in a cognitive mediation task of the type ‘AB, choose C’. However, when compared to an attention-control condition, no training effect was found for the ability to identify appropriate mediating beliefs for a cognitive mediation task of the type ‘AC, choose B’.

The findings of both Bruce et al. (2010) and Vereenooghe et al. (2015) are encouraging and potentially offer a new approach to prepare people with IDs prior to accessing CBT, in addition to adaptations to the content and delivery of CBT itself (Whitehouse, Tudway, Look, & Stenfert-Kroese, 2006). Building on this, the current study developed and evaluated a computerised training programme to help people with IDs learn some of the component skills of CBT: i.e. differentiating between behaviours, thoughts and feelings, and identifying thoughts as mediators of emotions (cognitive mediation skills). Using a 2 (Group: Training or Attention-Control Condition) x (2 (Pre- or Post-Test) x *S*) experimental design, we predicted that training, when compared to an attention-control condition, would improve the ability of people with IDs to: 1) discriminate between, (a) behaviours, (b) thoughts and (c) feelings, separately and (d) pooled together, 2) understand cognitive mediation through the selecting of (a) appropriate emotions as consequences to given thoughts, and (b) appropriate thoughts as mediators of given emotions.

METHODS

Participants

We recruited 56 participants, of which one participant dropped out pre-randomisation (Figure 1). Table 1 presents some demographic information for the 55 (17 men, 38 women) participants randomised to the training (n=26) or attention-control condition (n=29). The groups were well-matched on age, t (47)=-.641 (p=.525) and IQ, Mann-Whitney U=368.5

(p=.886), but there were proportionally fewer women in the training group. Two participants were lost to follow-up before completing post-test assessment tasks, whereas 4 people dropped out before completing all post-test assessments. Participants who dropped out indicated that they were not interested in continuing with the research tasks in addition to their other scheduled regular activities for that day. Seven participants were excluded from the BTFQ analysis, and 5 from the cognitive mediation tasks analysis because they could not perform the tasks independently. We included 42 participants (training: n=17; attention control: n=25) in the analysis of the BTFQ scores and 44 (training: n=19; attention control: n=25) in the analysis of cognitive mediation skills scores.

We recruited participants from six organisations providing social, recreational and vocational day services for people with learning disabilities in the East of England. Managers gave permission for recruitment and staff signposted their users to the study. Service users were eligible to participate if they (a) were 18 years old or above, and (b) fulfilled the criteria for IDs in terms of limitations in intellectual and adaptive functioning. The Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-II; Wechsler, 2011) was used to provide an estimate of intellectual functioning and participants were included if they had an estimated full-scale IQ below 70. The criterion of limitations in adaptive functioning was considered to be met when the person was in receipt of publically funded social care interventions, specifically for people with IDs. All potential participants who were approached for this study met these criteria. Participants were not eligible for this study if they had a diagnosis of a pervasive developmental disorder, acute psychosis, or if they were receiving CBT at the time. Service users with additional sensory impairments were eligible in so far that the degree of the impairment enabled them to complete the tasks independently. For example, service users could take part if they wore glasses or a hearing aid.

Design

The study used a randomised controlled comparison with a 2 (Group: Training or Attention-Control Condition) x (2 (Pre- or Post-Test) x *S*) single blind design. Participants' intelligence was assessed before randomisation, to allow for stratification by full-scale IQ. Masked randomisation was achieved through a computer script, written in PsychoPy (Peirce, 2007), that prompted the researcher to enter participants' full scale IQ at the start of the intervention. Randomisation was completed using matched-pairs, based on IQ, and group assignment was hidden from the researcher. The researcher was not able to see the computer screen while the participants were taking part in the study, although was able to offer assistance for the first few items of the assessment tasks without compromising masking.

Participants were not explicitly told the condition to which they were assigned. Assessments at pre- and post-test evaluated participants' performance on three CBT component skills by measuring their ability to: (a) differentiate between behaviours, thoughts, and feelings (b) identify emotions as consequences of thoughts, and (c) identify thoughts as mediators of emotions. We refer to the last two skills as 'cognitive mediation' skills.

Measures

WASI-II. The Wechsler Abbreviated Scale of Intelligence – 2nd edition (WASI-II; Wechsler, 2011) provides a reliable estimate of Full Scale IQ based on verbal comprehension and perceptual reasoning subscales. It can be used with people aged from 6 – 89 and takes approximately 30 minutes to complete. The WASI-II has good reliability and validity (Wechsler, 2011).

Behaviour-Thought-Feeling Questionnaire (BTFQ). Originally developed by Greenberger and Padesky (1985), the BTFQ was adapted for use with people with IDs by Oathamshaw and Haddock (2006). The measure consists of 24 items with equal numbers of behaviours, thoughts and feelings. Examples of behaviour items are *'Making a cup of tea'* and *'Working'*, examples for thoughts are *'I'm missing my friend'* and *'I'm a good person'*, and examples of feelings are *'Frustrated'* and *'Frightened'.*

The present study adapted the BTFQ so that its items were presented in coloured line-drawings and large print text (figure 2). The items appeared in screen in random order and the participants had 50 seconds to determine whether the item should be identified as a behaviour, a thought, or a feeling.

As illustrated in Figure 2, participants gave their answer by pressing a button on their response box which corresponded to the colour of their selected on-screen option: i.e. pressing the black button if the answer was 'behaviour', a yellow button for a 'feeling', and a blue button for a 'thought'. The response options and pictures were introduced prior to the assessment as follows: (a) for behaviours: 'These are things you can do. For example, you can walk, you can talk, or you can wave. Behaviours go in the black box.'; (b) for feelings: 'They describe how we are feeling. For example, you can feel happy, you can feel sad, or you can feel angry. Feelings go in the yellow box.'; (c) for thoughts: 'They describe what we are thinking. For example, you can think that you are strong, you can think that you are not sure about something, or you can think that someone likes you. Thoughts go in the blue box.'

Assessment Tasks for Cognitive Mediation Skills. Drawing on materials by Dagnan et al. (2000), which have been adapted for computerised delivery in a previous study by Vereenooghe et al. (2015), we used two assessment tasks to evaluate cognitive mediation skills: the 'AB, choose C' task assessed the ability to recognise emotions as consequences of thoughts, and the 'AC, choose B' task assessed the ability to recognise thoughts as mediators of emotions.

Each assessment comprised 12 items based on 6 different situations (Antecedent, A). Antecedents could be neutral or positively valenced, for example, 'You're sitting at the table. You are painting a picture for a friend' or 'It is winter. It has just started to snow', or negatively valenced, for example, ‘You see two of your friends. They don’t say hello’ or ‘You walk into a room. Your friends are laughing.’

In the ‘AB, choose C’ task each antecedent was paired once with a positive belief (B+), and once with a negative belief (B-). For example, the antecedent ‘Painting a picture for a friend’ was paired with both ‘You think your friend will hang it up the wall’ and with ‘You think your friend will put it in the bin.’ Participants were then shown pictures of a happy face as a positive feeling or consequence (C+) and a sad face as a negative feeling or consequence (C-). They were prompted to identify how they would feel in the scenario by pressing the corresponding button of the happy or sad face on an external response box.

In the ‘AC, choose B’ task, the same antecedents were paired once with a positive feeling (C+, i.e. happy face) and once with a negative feeling (C-, i.e. sad face). Participants then chose the appropriate mediating belief, having been given the choice between a positive and a negative belief (B+ and B-), by pressing the corresponding button on the response box. For example, when presented with the antecedent ‘You walk into a room. Your friends are laughing’ and the consequence ‘You feel happy’, the programme would ask participants ‘Would you feel happy if you thought your friends were happy to see you? Or would you feel happy if you thought your friends were laughing at you?’

Figure 3 illustrates the timeline of how the components of each task appeared on screen. Antecedents were presented as two consecutive pictures, whereas beliefs and consequences were presented as a single picture. Appearance of the pictures on screen was accompanied with audio narratives, so that the participants could see and hear what was happening in the scenario.

Intervention and Attention Control Conditions

Training Intervention. The Thought/Feeling/Behaviour card sorting task (TFB task; Quakley, Reynolds, & Coker, 2004) was originally developed to assess children’s ability to discriminate between thoughts, feelings, and behaviours. It has since been used with people with IDs (Bruce et al., 2010; Sams, Collins, & Reynolds, 2006), in which participants were presented with six stories revolving around one main character, three of which were mildly positively valenced and three mildly negative. Stories consisted of three sentences, each representing a thought, a feeling or a behaviour, read out to participants who then identified each sentence as a thought, feeling or behaviour.

This study adapted the TFB task for computerised delivery and for the purposes of training people with IDs in CBT component skills. The computerised training version of the TFB task presented the original six stories (Quakley et al., 2004) in pictures. The presentation order of the stories was random. While an audio recording narrated the stories, a picture was presented for each sentence. After the story had been presented, three coloured boxes appeared at the bottom of the screen, depicting a sample thought (blue box, ‘you think you are strong’), a feeling (yellow box, ‘you feel happy’), and a behaviour (black box, ‘you are walking’). The sentences describing the story were then highlighted one by one, accompanied by a voice recording, and participants were asked:

‘Is this something you can do, how you can feel, or what you can think? If you think [… insert sentence…] is something you can do, then press black. If you think […insert sentence…] is how you can feel, then press yellow. If you think […insert sentence…] is what you can think, then press blue.’

Figure 4 illustrates a screenshot of a task item. Participants had 60 seconds to press the coloured button that corresponds with their answer. The depicted sentence and accompanying picture then moved across the screen towards their chosen box at the bottom of the screen. The response was then either confirmed as correct, or incorrect, in which case the sentence and picture moved towards the appropriate box on the screen, demonstrating the correct response (Figure 4).

Attention-Control Intervention. Participants in this condition were presented the six stories of the TFB task (Quakley et al., 2004), in the same way as they were presented to participants in the training task; however, when sentences and pictures were highlighted after the story had been presented, factual questions were posed about the story. For example, if a sentence read ‘Mary went shopping with her mum’, the corresponding question was ‘Did Mary go shopping with her mum?’. The three response options in coloured boxes at the bottom of the screen were: ‘yes’ (black box), ‘no’ (yellow box), and ‘not sure’ (blue box). Participants had 60 seconds to respond; upon pressing a response button the pictured sentence moved across the screen towards the respective coloured box. Again, the answer was confirmed as correct or incorrect, with incorrect responses being corrected by moving the pictured sentence towards the correct coloured box.

Procedures

At baseline before randomisation, the WASI-II was completed. Participants then sat in front of a laptop and completed the BTFQ and both cognitive mediation tasks. The order of presentation of these tasks was counterbalanced between participants and the researcher could give participants assistance for the first six items of each task to ensure they understood the task instructions and were able to independently provide their answers. Following randomisation, participants completed the computerised intervention task. At post-test, participants completed again the BTFQ and two cognitive mediation tasks in the same order as they did at pre-test. Participants could opt for a break between tasks.

The BTFQ and assessment tasks for cognitive mediation skills, as well as the training and attention-control tasks, were all computerised and delivered on a Toshiba TECRA R850-119 laptop with a Windows 7 operating system running PsychoPy, v1.76.00, software (Peirce, 2007). The computerised line-drawings of task components were generated using Pixton® Comic Software (2013). An external USB numeric keypad, Targus AKP10EU, modified with coloured buttons, served as the response box. A picture of the response box appeared on screen next to every response option with the corresponding button highlighted in the picture.

Ethical Approval

A favourable ethical opinion was obtained from a National Health Service (NHS) Research Ethics Committee. All study information for participants was presented in an easy to read format and explained until they fully understood the consequences of agreeing to participate in the study, with particular attention given to issues surrounding confidentiality, right to withdraw, right to consult a third party for an independent opinion, and informed consent. Organisation staff were consulted to provide information regarding a potential participants' ability to consent. All participants were judged to be able to give informed consent.

Analysis

We excluded participants from the analysis if they were unable to understand and perform the required computerised tasks independently, as evidenced by: (i) pressing a single response button only, (ii) requiring continuous assistance to highlight the response options and clarify response procedures, or (iii) pressing buttons seemingly at random in between task items.

Each correct answer on the BTFQ was awarded 1 point with a maximum score of 24 for the overall task and a maximum score of 8 for the identification of the behaviours, thoughts, and feelings respectively. Each correct response on the assessment tasks for cognitive mediation skills was awarded 1 point with a maximum total score of 12 per task.

In accordance with previous studies, we calculated the "pass" grade for each assessment task by estimating the cut-off score that could be obtained by chance with a probability of less than 0.05. For the BTFQ, a "pass" was a cut-off score of 6 or higher for each component and 12 or higher for the overall task, whereas for the cognitive mediation tasks, the same cut-off score was 10 out of 12.

Scores on the pre-test and post-test assessments were converted to percentages. We also calculated the percentage of participants who "passed" each assessment task. The converted pre- and post-test scores were assessed for normality and homogeneity of variances. Where residuals were normally distributed and assumptions for multicollinearity and homogeneity of regression slopes were not violated, parametric tests (e.g. independent t-tests) and linear regression analysis were conducted, otherwise non-parametric analyses were performed. We intended to conduct linear regression analyses with three predictors: pre-test performance, IQ and intervention group. An a priori power calculation, using G*Power 3.1 (Faul, Erdfelder, Buchner & Lang, 2009), for an expected medium effect size, $f^2 = .15$, alpha = .05 and power $(1 – \beta) = .80$ yielded a required sample size of 55 participants.

RESULTS

Objective 1: Computerised training improves the ability to differentiate between behaviours, thoughts, and feelings, when compared to an attention-control intervention

1a. Effects of training vs. attention-control on ability to identify behaviours

The mean score for correct responses increased from 71 % (SD=28), at pre-test to 83 % (SD=25) at post-test for the training condition, but remained unchanged for the attention-control group (pre-test: 57 %, SD=33; post-test 57 %, SD=35). The proportion of participants who achieved a "pass" on identifying behaviours was much lower in the attention-control than the training group post-test (36% vs. 82%), although participants in the attention-control group had started with a disadvantage because their pass rate was much lower than that of the training group at baseline (44% vs. 71%). A linear regression analysis found a significant effect of pre-test performance (β=.627, t=4.688, p < .001), and a trend for a positive effect of training (β=.237, t=1.916, p=.06) on post-test performance (see Table 2).

1b. Effects of training vs. attention-control on ability to identify thoughts

The training group correctly identified 25 % of thoughts at both pre-test (SD=19) and post-test (SD=15), whereas for the attention-control group these were 32 % (SD=24) and 29 % (SD=21) pre- and post-test respectively. Linear regression analysis yielded no significant effect of training on post-test identification of thoughts (see Table 2). Similarly, pre-test performance and IQ were not found to be substantial predictors of post-test performance. Notably, "pass" rates for correctly identifying thoughts were very low. Only one participant passed the pre-test and two the post-test assessment, all of whom were assigned to the attention-control condition.

1c. Effects of training vs. attention-control on ability to identify feelings

Participants' performance on correctly identifying feelings in the training condition increased from 74% (SD=21) to 80% (SD=26). Performance in the attention-control condition remained level with 63% (SD=29) and 64% (SD=33) at pre- and post-test, respectively. In relation to "pass" rates, 44% of participants in the attention-control condition passed the task at both pre- and post-test, as opposed to 65% pre-test and 77% post-test of those in the training condition. In a subsequent linear regression analysis, only pre-test performance, and not group allocation, significantly contributed to the post-test performance (β=.781, t=7.297, p < .001) (see Table 2).

1d: Effects of training vs. attention-control on collective ability to identify behaviours, thoughts, and feelings

Taking into account the aggregate scores of the BTFQ, the percentage of participants who "passed" the task at baseline was much higher for training group (71%) than the attention-control group (48%). At post-test, 82% of participants from the training group passed the task compared to 44% in the attention-control group. The average percentage of correct responses increased in the training condition from 57% (SD=16) to 63% (SD=14), whereas it remained unchanged in the attention-control group with average scores of 50% (SD=19) at pre-test and 50% (SD=17) at post-test. When controlling for pre-test scores and IQ, a linear regression yielded a significant effect of training on the participants' ability to collectively identify behaviours, thoughts and feelings (β=0.2, t=2.1, $p < .05$) (Table 2). This linear regression model explained 58% of the variance in outcome scores, adjusted $R^2 = .580$ (Table 2).

Objective 2: Computerised training improves cognitive mediation skills compared to an attention-control condition

2a. Effects of training vs. attention-control on ability to select an emotion as a consequence to a given thought

Performance on the 'AB, choose C' task is presented in Table 3. Non-parametric analyses on change scores (post-test – pre-test) were performed due to the non-normal distribution of the pre-test scores and residuals in a regression analysis. The mean change score for the training condition was 6% (SD=11) compared to 2% (SD=15) for the attention-control group; however, this difference was not significant, Mann-Whitney U=211 (p=.517).

In spite of this, we observed a significant within-group difference for the training group only using the Wilcoxon Signed Ranks (z=1.97, p=0.05). The proportion of participants who "passed" the task pre- to post-test was stable at 74% in the training group and increased from 52% to 72% in the attention-control group.

2b. Effects of training vs. attention-control on ability to select a mediating thought for a given emotion

Table 3 presents the median scores for the training and attention-control group at pre- and post-test. There was no significant difference in mean change scores between the training group (mean change=4%, SD=19) and the attention-control group (mean change=9%, SD=21): Mann-Whitney U=221, p=.692. Turning to the proportion of participants “passing” the task at pre- and post-test respectively, there was a slight increase for the training group from 58% to 63%, but no change for the attention-control group with 48% passing the task at both pre- and post-test.

Additional Analyses

Spearman correlations tested for associations between IQ and baseline performance on the BTFQ (three subtasks and aggregate scores). The analyses indicated that full-scale IQ had a strong positive association with aggregate scores of the BTFQ (r=.565, $p < .001$) and the behaviours (r=.468, $p < .05$) and feelings (r=.345, $p < .05$) subtests, but not the thoughts subtest. Between-task correlations were observed between the ‘AC, choose B’ task and both the aggregate BTFQ scores (r=.341, $p < .05$) and the feelings subtest (r=.394, $p < .05$).

Further analyses of the response patterns for the BTFQ revealed that, on average, participants correctly identified 5 behaviours at pre-test and misidentifications were biased towards feelings. Similarly, when asked to identify feelings, participants correctly identified 5 feelings, on average, and misidentifications were biased towards thoughts. Thoughts, however, were more likely to be identified as feelings or behaviours, as only 2 thoughts were correctly identified.

Turning to the cognitive mediation tasks and the relative difficulty of individual task items, it was found that participants had least difficulty with linking the antecedent ‘You paint a picture for friend’ and the belief ‘Your friend will hang it up the wall’ to a consequential emotion, with 45 out of 46 participants choosing happy as the appropriate response. Likewise, 42 participants could link this antecedent and a happy face to the appropriate mediating belief. For the ‘AB, choose C’ task, participants had most difficulty with the antecedent-belief combination ‘You see two of your friends. They don’t greet you.’

Followed with the belief ‘You think they may not have seen you. They will come back and chat’. Only two thirds of participants (29 out of 46) correctly identified the happy face as the appropriate consequential emotions for the given belief. The most difficult item of the ‘AC, choose B’ task was the antecedent ‘It is winter. It just started snowing.’ when paired with a happy face, with only 28 participants identifying the appropriate mediating belief

DISCUSSION

Our results suggest that computerised training using CBT-related scenarios can improve the ability of people with IDs to identify behaviours, thoughts and feelings, when these are pooled together, compared to an attention-control task (objective 1d). When examining behaviours, thoughts, and feelings separately (objectives 1a, 1b, and 1c), we observed that participants in the training group performed better than those in the attention-control group at identifying behaviours and feelings (and not thoughts), but we were not able to detect a significant between-group difference. This was possible for two reasons. First, the sample size in our analysis was smaller than we anticipated due to attrition and participants being excluded from the analyses. Although we found a large training effect for overall BTFQ task performance, which was confirmed by the R^2 of .580 for the linear regression model that included pre-test scores, IQ and intervention as predictors, the training effect was less pronounced for the three BTFQ subtests and our the sample size in these analyses was too small to detect a medium effect size. Second, the control group started with lower scores at baseline performance compared to the training group and we found that baseline performance was a significant confounder for post-test performance.

Participants’ cognitive mediation skills, (objectives 2a and 2b) were similar between the training and control groups both at pre- and post-test. This means that training in discriminating between behaviours, thoughts and feelings may not generalise to making links between them. This finding is similar to other studies that evaluated training in CBT skills with people with IDs. Both Bruce et al. (2010) and Vereenooghe et al. (2015) reported specific training effects that did not generalise to other CBT-related skills. Further research should clarify whether component skills should be trained separately, or whether people would benefit more if multiple CBT skills were integrated in a single training intervention.

The pass rates for the computerised cognitive mediation assessments in this study were around or above 50%, similar to Vereenooghe et al. (2015), whereas previous studies reported pass rates for similar non-computerised tasks closer to 10% (Dagnan et al., 2000; Joyce et al., 2006; Oathamshaw & Haddock, 2006). For the BTFQ, by contrast, pass rates in this study were remarkably lower than those reported by Oathamshaw and Haddock (2006). It should be noted that some participants who did not pass the post-test assessment did show considerable improvements following training, but remained under the cut-off score for a pass grade, whereas some participants in the attention-control condition may have shown non-significant improvements that pushed them above the cut-off score for a “pass”.

The strengths of the study lie in the use of a novel computerised training intervention, computerised assessment tasks and an appropriate computerised control task, the concealed allocation to each condition, and the masked assessment of outcomes. As already mentioned, the study had two main limitations: participant attrition and between-group differences in baseline performance. Some participants were excluded from the analysis because they were unable to perform the tasks independently or dropped out without giving post-test data. A possible explanation for this attrition is the inclusion of people with moderate level of IDs in our study as opposed to previous studies that mainly included mild IDs. This might have also lowered the observed strength of training effect; the negative impact of lower intellectual functioning on performance has been previously reported by Oathamshaw & Haddock (2006) and was supported by the strong correlation we found between IQ and performance on all assessment tasks.

The finding that IQ negatively affected BTFQ performance for participants who had received the training intervention, may be in line with the expectation that people with lower IQs benefit more from high-intensity approaches than people with higher IQs (Taylor et al., 2008). However, a note of caution is needed; while we used the WASI-II to assess general intellectual functioning, there is some evidence to indicate that this intelligence test is associated with high subtest variability, and potentially misleading results (Axelrod, 2002). Hence, further research is necessary to examine the potentially differential impact of IQ on training efficacy, as it might be associated with therapy efficacy, as well.

From a theoretical perspective, suitability for CBT would require the ability to both link and discriminate between the components of the A-B-C model. Hence, it would be expected that the ability to link situations and mediating thoughts to feelings (AB-C link) would be associated with the ability to discriminate between thoughts and feelings. This would lead to the contrasting hypotheses that either (a), training in one particular skill would also affect associated skills, or (b) that to improve a particular skill a more holistic approach incorporating all or some of the associated skills may be required. The findings of this and previous studies (Bruce et al., 2010; Vereenooghe et al., 2015) do not support the first hypothesis, whereas more research is needed to test the second hypothesis.

While there seems to be agreement on which CBT skills are essential in CBT, it is less clear how these skills should be assessed, and in particular cognitive mediation skills. On the one hand, in experimental studies, a forced-choice task that asks participants to select between two given beliefs or emotions has advantages in terms of experimental control, scoring and standardisation. On the other hand, in clinical practice, patients may find tasks relating to their lived experiences more meaningful and subsequently more helpful.

The literature suggests that people with IDs find it easier to identify thoughts for situations they have experienced and are recalling as part of a cognitive-emotive interview rather than when asked to identify appropriate mediating beliefs for situations proposed by a researcher (Hebblethwaite, Jahoda, & Dagnan, 2011). In two studies that used open-ended questions and prompted participants to formulate their own thoughts, rather than to choose between given thoughts, people with IDs were able to provide appropriate mediating thoughts for approximately half of the scenarios of the ‘AC, choose B’ type (Dagnan & Chadwick, 1997; Dagnan, Mellor, & Jefferson, 2009). This performance was better than that of a paper-based forced-choice task (Dagnan, Chadwick, & Proudlove, 2000); however, a computer-based forced-choice task outperformed all the above (Vereenooghe, Reynolds, Gega, & Langdon, 2015).

Furthermore, the choice of stimuli may also have affected task performance. While the emotions presented in the cognitive mediation tasks were accompanied by contextual information provided by the antecedent pictures, there was no contextual information for the feelings pictured in the BTFQ, which may have affected emotion identification skills in this task (see also McKenzie et al., 2001). It is possible that richer imagery may have led to improved outcomes.

These findings suggest that a computer-based training programme which includes items relevant to participants’ experiences could maximise the ability of people with IDs to develop cognitive mediation skills in preparation for, or alongside, mainstream CBT. This does not preclude the use of standardised, forced-choice tasks by presenting a menu of different scenarios to participants and asking them to point out which scenarios remind them of situations that happened to them, or which scenarios make them feel sad or stressed.

This would be in line with recent findings by Barrowcliff, Jones, Oathamshaw and McConachie (2013) who reported that understanding of cognitive mediation and ability to discriminate between behaviours, thoughts and feelings of people with IDs improved during therapy. Furthermore, a review of the potential mediating effects of CBT skills on therapy outcome in people without IDs found that while the use of certain CBT skills, such as behavioural activation and cognitive restructuring, increased during therapy, it was the quality of these skills in the second half of therapy that predicted therapy outcome for people with depression (Hundt, Mignogna, Underhill, & Cully, 2013). By implication, interventions that improve quality of CBT skills for people with IDs are likely to mediate better outcomes.

The clinical implications of a shift towards computerised assessments and training programmes have yet to be examined, together with the more practical and conceptual concerns clinicians may have about implementing such programmes in practice. Although the computerised approach appears feasible, clinical expertise cannot be replaced by a computer, and is desirable, especially when working with clients with complex presentations. It would be of particular importance to assess whether gains made in training can generalise to situations experienced outside of therapy, as this will be essential for people in developing effective coping strategies when therapy ends. It would be helpful to have a package of adjunctive interventions that could be used by clinicians when working with people with IDs to help adapt and improve the accessibility of psychological therapies.

Considerably more research is needed to establish an evidence-base regarding the short and long-term effects of computerised training and its feasibility for use prior to, or during, therapy with people with IDs, especially with reference to improved engagement and outcomes. For a population with high rates of mental health problems but limited access to evidence-based treatments, we can use technology to maximise the chances of people of IDs enjoying positive mental health.

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Figure 1. CONSORT diagram of participant flow through the study.

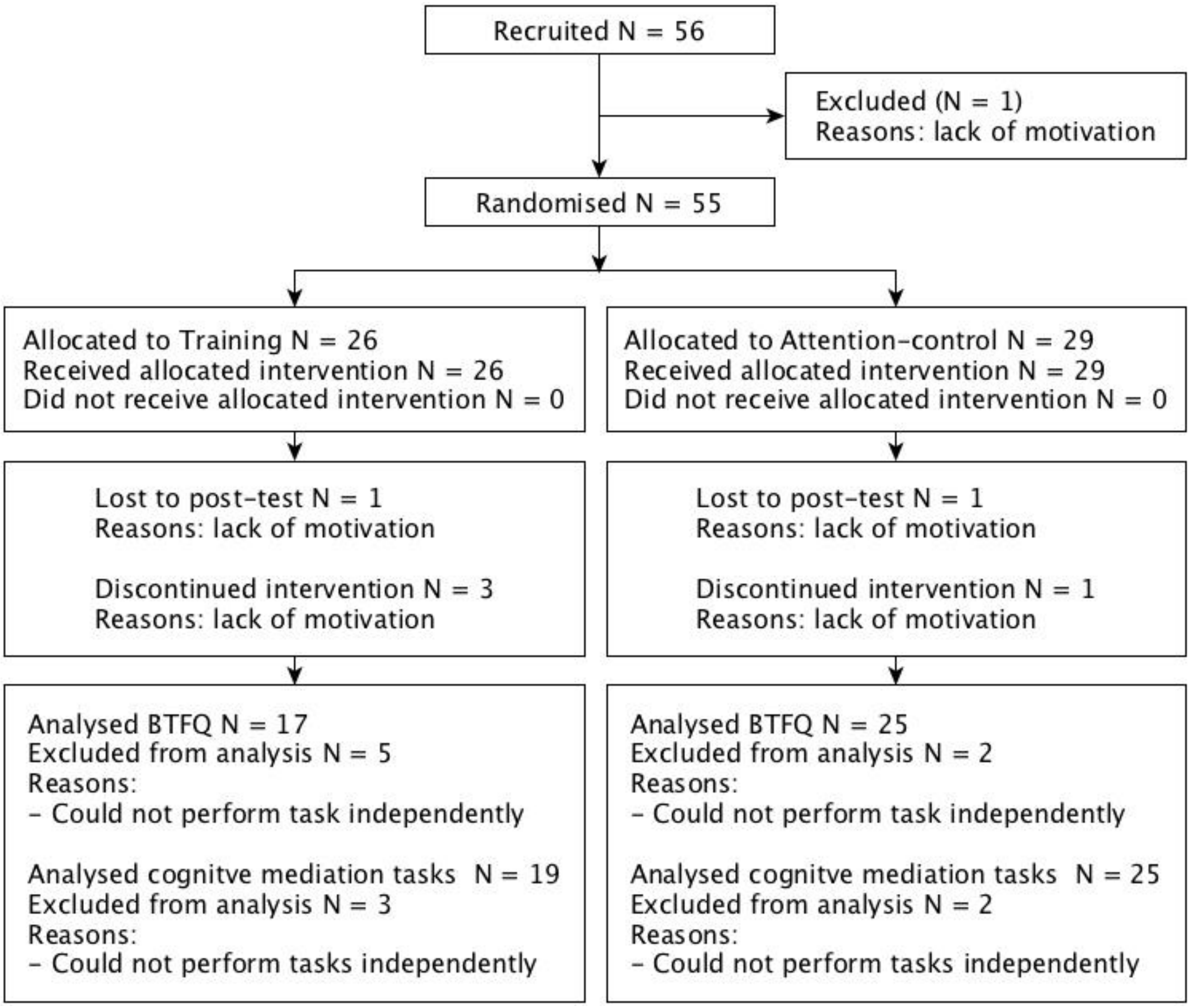


Table 1. Demographic information for participants randomised to the training and attention-control condition.

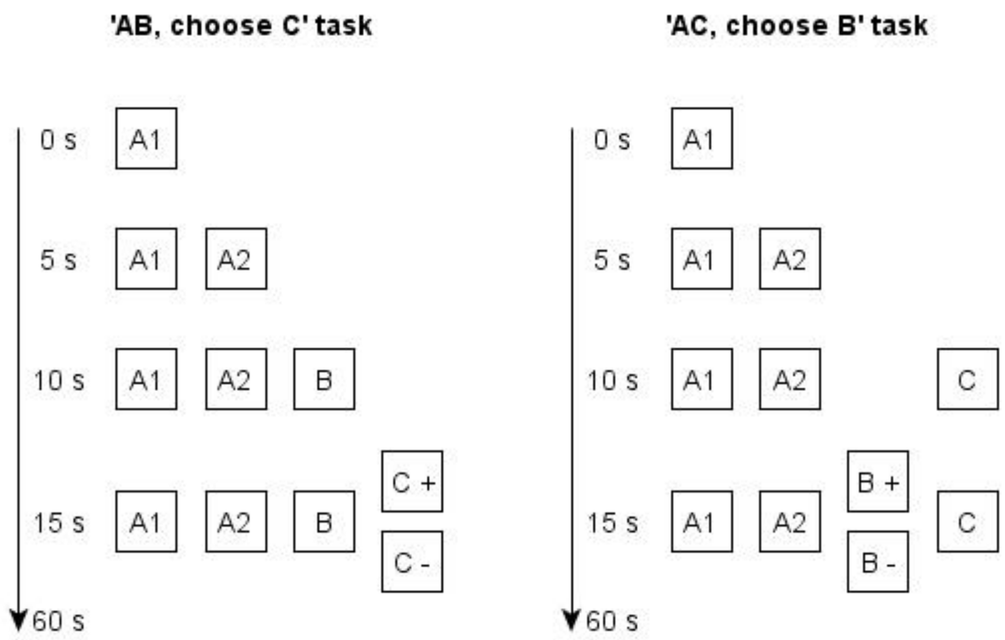
	Training condition (*N*=26)	Attention-control condition (*N*=29)
Male / female ratio	11/15	6/23
Age	41 (14)	36 (13)
IQ	50 (40 - 69)	50 (40 - 67)

Note. Age, mean age in years (SD); IQ, median WASI-II full-scale IQ (range)

Figure 2. BTFQ sample item as presented to participants on screen.

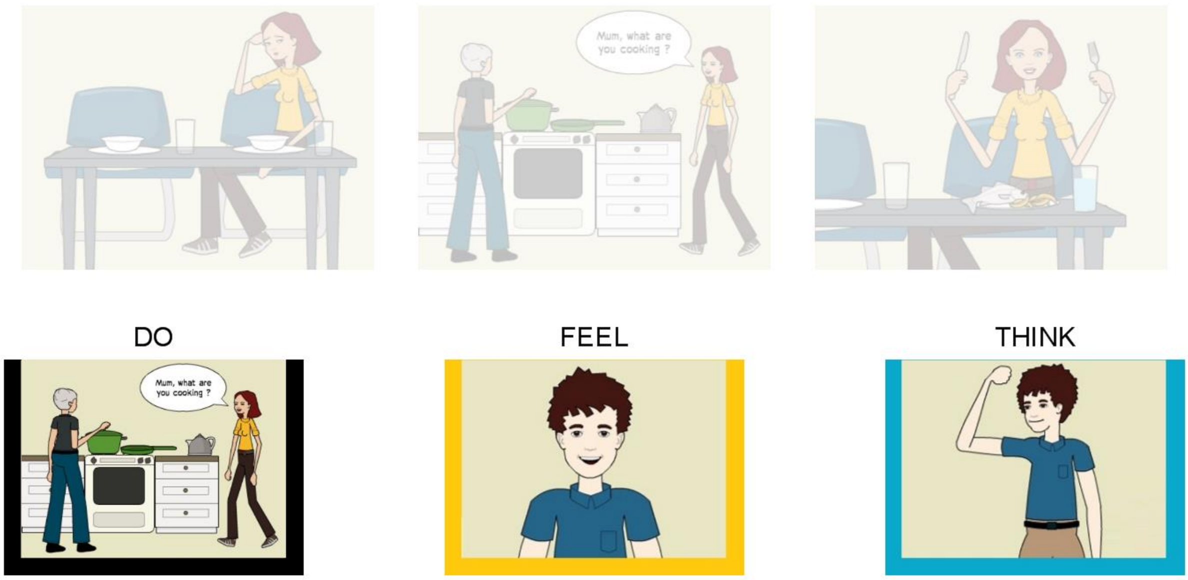
Note. Task item ‘Making a cup of tea’ presented on top of screen first, followed after 5 seconds by the black, yellow, and blue boxes depicting behaviours (e.g. ‘You can walk’), feelings (e.g. ‘You feel happy’) and thoughts (e.g. ‘You think you are strong’). The small black boxes at the bottom represent the response box and highlight the button participants should press to select this response. Printed with permission of Pixton ®.

Figure 3. Schematic illustration of how cognitive mediation tasks were presented on screen.



Note. A1, A2: Antecedents; B+, B-: positive and negative belief; C+, C-: happy and sad. Sample item ‘AB, choose C’ task: A1, ‘You walk into a room’; A2, ‘Your friends are laughing’; B, ‘You think they are laughing at you’; C+, ‘Would you feel happy?’; C-, ‘Or would you feel sad?’. The vertical line presents the time from presentation of the first picture, at time 0 s, to the end of a task item, at 60 s.

Figure 4. Training intervention sample item as presented to participants on screen.



Note. Sample item ‘Mary wonders what mum is cooking. She shouts into the kitchen to find out. Mary is very glad to hear she’s having chips, her favourite.’ In this example, the participant has pressed ‘black’ indicating that ‘Mary shouts into the kitchen to find out.’ is something Mary does, and thus a behaviour. The picture then gradually moved from its top centre position into the black box. Printed with permission of Pixton ®.

Table 2. Regression analyses evaluating the effects of training on BTFQ performance.

	B (St. Error)	β	*t*	Adjusted R^2
Thoughts Subtest				
Intercept	20.975 (9.875)	-	2.124*	
Pre-test Thoughts	.166 (.138)	.195	1.204	
IQ	1.878 (6.069)	.050	.310	.000
Intervention	-2.673 (6.049)	-.071	-.442	-.021
Feelings Subtest				
Intercept	16.304 (11.168)	-	1.460	
Pre-test Feelings	.910 (.125)	.781	7.297***	
IQ	-6.376 (6.506)	-.103	-.980	.590
Intervention	4.886 (6.469)	.079	.755	.586
Behaviours Subtest				
Intercept	32.517 (12.750)	-	2.550*	
Pre-test Behaviours	.666 (.142)	.627	4.688***	
IQ	-9.494 (8.756)	-.141	-1.084	.394
Intervention	15.883 (8.289)	.237	1.916	.433
BTFQ Total				
Intercept	21.152 (6.345)	-	3.334**	
Pre-test BTFQ	.737 (.112)	.759	6.577***	
IQ	-5.852 (3.949)	-.169	-1.482	.543
Intervention	7.589 (3.635)	.219	2.088*	.580

Notes. IQ, split at mean of 53.10 and categorised as low or high; *, $p < .05$; **, $p < .01$; ***, $p < .001$; R^2, applies to regression model that includes this predictor and all of the above.

Table 3. Pre- and post-test performance on the assessment tasks of cognitive mediation skills

	Training condition (*N*=19)	Attention-control condition (*N*=25)
AB, choose C		
Pre-test	83 (58-100)	83 (50-100)
Post-test	83 (67-100)	92 (41-100)
AC, choose B		
Pre-test	92 (50-100)	75 (33-100)
Post-test	83 (50-100)	92 (42-100)

Note. Median percentage correct responses (Min-Max).