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Can a computerised training paradigm assist people with intellectual disabilities to learn cognitive mediation skills? A randomised experiment

Leen Vereenooghe
University of East Anglia

Shirley Reynolds
University of Reading

Lina Gega
University of East Anglia

Peter E Langdon
University of Kent and
Hertfordshire Partnership University NHS Foundation Trust - Norfolk

Author Note

Leen Vereenooghe, Department of Psychological Sciences, Norwich Medical School, University of East Anglia, UK; Shirley Reynolds, Charlie Waller Institute, University of Reading, UK; Lina Gega, Department of Psychological Sciences, Norwich Medical School, University of East Anglia, UK; Peter E. Langdon, Tizard Centre, University of Kent, UK and Broadland Clinic, Hertfordshire Partnership University NHS Foundation Trust - Norfolk, UK

Correspondence concerning this article should be addressed to Dr Peter E Langdon, Tizard Centre, University of Kent, Canterbury, CT2 7LR. Email: P.E.Langdon@kent.ac.uk (+44 1603) 711178

ABSTRACT

Aims: The aim was to examine whether specific skills required for cognitive behavioural therapy (CBT) could be taught using a computerised training paradigm with people who have intellectual disabilities (IDs). Training aimed to improve: a) ability to link pairs of situations and mediating beliefs to emotions, and b) ability to link pairs of situations and emotions to mediating beliefs.

Method: Using a single-blind mixed experimental design, sixty-five participants with IDs were randomised to receive either computerised training or an attention-control condition. Cognitive mediation skills were assessed before and after training.

Results: Participants who received training were significantly better at selecting appropriate emotions within situation-beliefs pairs, controlling for baseline scores and IQ. The ability of those who received training to correctly select intermediating beliefs for situation-feelings pairings did not significantly improve in comparison to those assigned to the attention-control condition.

Conclusions: The findings indicated that computerised training led to a significant improvement in some aspects of cognitive mediation for people with IDs, but whether this has a positive effect upon outcome from therapy is yet to be established.

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

Can a computerised training paradigm assist people with intellectual disabilities to learn cognitive mediation skills? A randomised experiment

Prevalence rates of mental health problems among people with intellectual disabilities (IDs) vary widely depending on the diagnostic criteria and assessments used (Emerson & Hatton, 2007). Estimates suggest between ten and forty percent of people with IDs experience mental health problems (Borthwick-Duffy, 1994; Deb, Thomas, & Bright, 2001). The high prevalence rates, when compared to the general population, can partly be explained by the genetic vulnerability of people with IDs, and disadvantageous life events such as stigmatisation and isolation (Clarke, 2003; Emerson & Hatton, 2007; Hulbert-Williams & Hastings, 2008; Reiss & Benson, 1984).

Even though people with IDs have an elevated risk of developing mental health problems, the evidence regarding the efficacy of psychological therapies for this population has only been emerging slowly. A recent meta-analysis concluded that cognitive behavioural therapy was at least moderately effective for the treatment of anger regulation problems and depression (Vereenoghe and Langdon, 2013), and previous reviews have also supported the potential benefits of cognitive-behavioural therapy (CBT) for anger management (Hamelin, Travis and Sturmey, 2013; Nicoll, Beail and Saxon, 2013). However, there is insufficient evidence to conclude that psychological treatments for mental health problems amongst people with IDs are empirically validated (Vereenoghe & Langdon, 2013). One of the reasons for this is that people with IDs are thought to have difficulty grasping some of the concepts presented within CBT (Stenfert-Kroese, Dagnan, & Loumidis, 1997), and while suitability criteria for CBT have been described in terms of the potential to form a therapeutic alliance, motivation for change, ability to remain problem-focused, accessibility of (negative) automatic thoughts, ability to differentiate between emotional states and general

affinity with the cognitive rationale (Safran, Segal, Vallis, Shaw, & Samstag, 1993; Safran, Vallis, Segal, & Shaw, 1986), there has been little work looking at these variables within therapy for people with IDs.

In an attempt to deal with these issues and to improve accessibility, and thereby maximise treatment effects, many researchers and clinicians have tried to adapt psychological therapies to meet the specific needs of people with IDs. These adaptations include simplifying therapeutic methods and increasing the use of both directive and flexible methods (Whitehouse, Tudway, Look, & Stenfert-Kroese, 2006). Over ten years ago, Hurley, Tomasulo and Pfadt (1998) suggested that the use of simple language, picture symbols and easy-read versions of homework assignments could facilitate therapy for people with limited verbal skills. However, while many intervention studies make adaptations for people with IDs (Hamelin et al., 2013; Nicoll et al., 2013; Prout & Nowak-Drabik, 2003; Vereenoghe & Langdon, 2013), whether any of these are actually helpful remains unclear.

The antecedent-belief-consequent (A-B-C) model (Ellis, 1977; Trower, Jones, Dryden, & Casey, 2011) is one which has helped inform clinicians about the necessary skills that are needed in order to successfully take part in cognitive-behavioural therapy. The model asserts that emotional and behavioural responses or consequences (C) to an activating event or antecedent (A) are shaped by the person's interpretation or beliefs (B). These three components reflect three component skills needed in order to take part in CBT: (a) accessibility of automatic thoughts, (b) ability to differentiate emotions, and (c) understanding of the cognitive rationale (Safran et al., 1993; Safran et al., 1986). Accessibility of automatic thoughts corresponds with the belief component, while differentiation of emotions corresponds to the consequences component, and the cognitive rationale is reflected within the cognitive mediation process, which hypothesises that the relationship between situations and emotions are mediated by cognition.

Several authors have examined whether people with IDs have difficulties with some of the component skills needed to take part in CBT. Reed and Clements (1989) examined whether people with IDs could link situations and feelings using six simple pictured scenarios and pictures of a happy face and a sad face. Approximately two thirds of participants made correct links for each scenario; incorrect responses were associated with lower levels of verbal comprehension. This task has since been used by Dagnan, Chadwick and Proudlove (2000), Joyce, Globe and Moody (2006) and Oathamshaw and Haddock (2006) with people with IDs, yielding very similar results.

Oathamshaw and Haddock (2006), rather than just focus on emotions, assessed the ability of people with IDs and psychosis to differentiate between emotions, thoughts, and behaviours, reporting that behaviours and feelings were more easily identified than thoughts. A similar finding was reported by Quakley, Reynolds & Coker (2004) in relation to the abilities of young children to learn the skills required for CBT. Dagnan and Chadwick (1997) assessed the cognitive mediation ability of people with IDs by presenting six simple scenarios paired with an emotion, which was a picture of a sad or angry face. They prompted participants to formulate a mediating belief which linked the given situation and emotion. Twenty percent of participants were able to supply mediating beliefs which could be classified as inferential beliefs, or situation-specific hypotheses. However, it could be argued that inferential beliefs may be part of the situation, rather than the interpretation of the situation, and therefore may not entirely reflect an understanding of cognitive mediation. The open-ended questions used within this study may well reflect dialogue in therapeutic practice, which is more challenging than being asked forced-choice questions in an experimental context.

In a subsequent study, Dagnan, Chadwick and Proudlove (2000) introduced forced-choice responding in a revised assessment of cognitive mediation skills, incorporating evaluative beliefs, as opposed to what could be construed as interpretations about a situation (Dagnan & Chadwick, 1997). Five scenarios were presented twice, once with a belief or emotion that matched or was congruent with the situation, while at other times the belief or emotion did not match the situation, i.e., was incongruent. It was hypothesised that incongruent pairings would rely more on cognitive mediation than congruent pairings because they could not be derived by merely evaluating the situation. The findings indicated that people with IDs found incongruent pairings more difficult, and others have reported similar findings (Oathamshaw and Haddock (2006) and Joyce, Globe and Moody (2006)).

To examine if training improved the cognitive mediation skills of people with IDs, Bruce, Collins, Langdon, Powlitch and Reynolds (2010) randomised people with IDs to a graded training programme in CBT skills or a relaxation intervention. Training led to improvements in the ability to link thoughts and feelings, as measured by the Thought to Feeling task (Doherr, Reynolds, Wetherly, & Evans, 2005) but participants' ability to distinguish amongst thoughts, feelings and behaviours did not improve, as measured using the Thought-Feeling-Behaviour discrimination task (Quakley et al., 2004).

Together, these studies suggest that people with IDs have some understanding that emotions are linked to situations, but find it harder to understand how cognitions mediate this connection. However, it has been suggested that understanding the A-B-C model is directly linked to the effectiveness of CBT (Willner, 2006). Furthermore, various studies have shown strong links between verbal ability, and both readiness for CBT (Dagnan et al., 2000; Dagnan

& Chadwick, 1997; Joyce et al., 2006; Reed & Clements, 1989; Sams et al., 2006), as well as therapeutic gains (Willner, Jones, Tams, & Green, 2002). The currently available assessments and training methods (Dagnan et al., 2000; Joyce et al., 2006; Reed & Clements, 1989) rely heavily on verbal comprehension and may be too difficult for some people with moderate IDs. They also use abstract symbols of emotions that do not conform to the recommendations of McKenzie et al. (2000). Hence, there is scope to make further adaptations to existing assessment and training methods which aim to improve CBT skills. This may improve the accessibility of therapy (Vereenoghe & Langdon, 2013) for a population with a high prevalence of mental health problems (Clarke, 2003; Emerson & Hatton, 2007; Hulbert-Williams & Hastings, 2008; Reiss & Benson, 1984).

The present study evaluated cognitive mediation training for people with IDs skills using a computer-based paradigm. The specific objective compare the effects of training cognitive mediation skills compared to an attention-control intervention. It was hypothesised that:

1. Training in linking situation to feelings, and vice versa, would significantly improve ability to (a) link pairs of situations and mediating beliefs to appropriate emotional responses, whereby (b) congruent items, but not incongruent items, will be significantly associated with this ability to link pairs of situations and mediating beliefs to appropriate emotional responses.
2. Training in linking situation to feelings, and vice versa, would significantly improve ability to (a) link pairs of situations and emotions to appropriate mediating beliefs, whereby (b) congruent items, but not incongruent items, will be significantly associated with this ability to link pairs of situations and emotions to appropriate mediating beliefs.

METHODS

Participants

Twenty-three men and 42 women, were recruited and randomly assigned to the training or attention-control condition, stratified by general intellectual functioning. The specific inclusion criteria were (a) minimum age of 18 years old, (b) IQ below 70. The exclusion criteria were (a) additional sensory impairments, (b) pervasive developmental disorder, (c) acute psychosis, or (d) currently receiving CBT. A flowchart depicting participant flow through the study is shown in Figure 1. Seven people were not retained until post-test assessment: two participants lost interest during the WASI-II assessment, one participant left on holiday before pre-test assessments were administered, three participants did not want to continue the pre-test assessments, and one participants had become frustrated during the intervention and eventually dropped out of during post-test assessments. Three were unable to take part in the computer task without significant assistance. Mann-Whitney tests yielded no significant difference between the training and attention-control groups on age, $U = 506.000$, $p = .773$; sex, $U = 517.500$, $p = .868$. Similarly, a one-way ANOVA showed no group differences for IQ, $F(1, 63) = .132$, $p = .717$, indicating that the groups were well matched (Table 1).

Design

A 2 (Group: training or attention-control) x (2 (Time: 1 or 2) x *S*) mixed experimental design was used to evaluate whether training improved ability to link situations to feelings on two tasks of cognitive mediation skills. Randomisation was masked and allocation was concealed from the researcher. This was achieved by using a randomisation script, written in PsychoPy (Peirce, 2007), and run at the start of the intervention. The researcher entered the

participants' Full Scale IQ into the computer, and the participant was assigned to one of the two group using matched-pairs randomisation. Randomisation was stratified based on IQ. There was no information regarding allocation presented to the researcher or the participant, and the researcher did not have sight of the computer once the IQ had been entered. Participants completed computerised pre- and post-training assessments of cognitive mediation skills.

Measures

Intellectual and Verbal Functioning. The Wechsler Abbreviated Scale of Intelligence – 2nd edition (WASI-II; Wechsler, 2011) was used to provide 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).

Cognitive Mediation Skills. Two computer based tasks were used to assess different types of cognitive mediation skills: the 'AB, choose C' task and the 'AC, choose B' task. This was based on materials developed by Dagnan and Chadwick (1997) and Dagnan et al. (2000). These tasks were counterbalanced between participants and were used as measures of performance at pre- and post-training. Figure 2 illustrates how task items were presented. Pictures were created using an online computer package called Pixton Comics (2013). Task items of the 'AB, choose C' task started with the presentation of picture A1, and after 5 seconds, picture A2. Pictures A1 and A2 depicted the situation, or antecedent (A). Next, a picture of a belief (B in Figure 2) was presented, followed five seconds later, by a picture of a positive emotion, or consequent (C +), and then a negative emotion, or consequence (C -).

The presentation of each picture was accompanied by audio telling the participant what was happening in each picture. Figure 3 presents a sample task item.

For example, one scenario involved pictures of a person walking into a room where some friends were located. The presentation of pictures A1, accompanied by the audio, 'You walk into a room' was initially presented; picture A2 is then presented, where a group of people are laughing, accompanied by the speech, 'Your friends start to laugh'; picture B is then presented accompanied by, 'You think your friends are laughing at you'; and finally, picture C +, a happy face, and C -, a sad face is presented. Participants were asked how the situation and thought would lead them to feel and used the external response box to select either C +, or C - as their response.

For the 'AC, choose B' task a situation was presented using both the A1 and A2 pictures, followed by the presentation of a feeling, C+ or C-, where a person's positive or negative facial expression was depicted, and the audio description told the person how the character was feeling. Participants were then asked to select one of two mediating beliefs, B+ or B-. For example, in the above described item 'Your friends start to laugh', B+ was 'You think your friends are happy to see you', and B- 'You think your friends are laughing at you'. Items were presented for a maximum duration of sixty seconds. Participants could respond after the two response options (C+ and C- , or B+ and B-, depending on the task) were presented. Hence, participants were given 45 seconds to respond.

Each task comprised twelve items. Items were created using six situations paired once with a positive belief, or feeling, and once with a negative belief, or feeling. Hence, congruent and incongruent situation-belief (AB) and situation-feeling (AC) pairs were

created. The maximum score on each task was 12; scores were converted to percentages for data analyses. In addition, scores of 10 or more were designated as 'pass'; this score is associated with a probability of being obtained by chance of .016.

Two scenarios were replaced because they were difficult to unambiguously present in pictures ('being asked to meet the day centre manager', and 'the first day of a new job'). These were replaced with the new situations of 'You are sitting in the waiting room. You have to see the dentist', and 'You are sitting at the table, painting a picture for a friend'. From the Dagnan et al. (2000) tasks, the forced choice responding and formation of congruent and incongruent items were adopted. It was anticipated that forced choice responding could potentially reduce the impact of verbal ability associated with the original open ended questions (Dagnan & Chadwick, 1997).

Training and Control Interventions

Training tasks comprised a maximum of three training rounds. In round one, all six items were presented. Any items with incorrect responses were then randomised and presented again in round 2. Again, an incorrect response was followed by a third and final presentation of the task item(s) in round 3. Participants were given feedback after each response in rounds two and three. It was anticipated that improved understanding of the connection between situations and feelings would enhance participants' ability to understand cognitive mediation when the belief component was re-introduced during post-test assessments.

Attention Control Task. The control task comprised an attention-control task requiring interaction with the computer programme. Participants were presented with twelve scenarios

consisting of two images picturing a situation, A1 and A2, and one image of an emotion, C. The six scenarios were identical to the task items of the 'A, choose C' training items, whereas six new scenarios were added for the control task. Each scenario was presented in three steps: picture A1, followed after five seconds by picture A2, followed after an additional five seconds by picture C (see Figure 4). The scenarios included audio descriptions, but did not include any questions and at no point were participants required to make a decision regarding which situation would elicit a given emotional response or how a given situation would make them feel. However, to ensure that the duration of the task would match that of the training intervention participants were given the option to press a button to have a scenario repeated. Scenarios could be repeated up to five times.

Ethical Considerations

A favourable ethical opinion for the study was given by a National Health Service (NHS) Research Ethics Committee and the study protocol was registered with ClinicalTrials.gov, registration number NCT01652963. Study information sheets and consent forms were presented in an easy to read format and explained to potential participants. Participants were encouraged to discuss their participation with staff and carers. Particular attention was given to the right to withdraw, confidentiality and consent. Ability to give informed consent was assessed through consultation with service staff and by asking yes or no questions about the study information sheets. All participants were judged to have capacity to make a decision as to whether they would like to take part or not.

Procedure

Six local authority and charity organisations that provided activities for people with IDs in Norfolk and Suffolk supported the recruitment process. Staff were informed about the

study and were asked to suggest potential participants. At pre-test, participants completed the WASI-II and both cognitive mediation tasks. Randomisation was computerised using matched pairs and stratified based on IQ-score. After the intervention, the cognitive mediation tasks were presented again. Breaks of maximum half an hour were given between the tasks. All assessments and intervention tasks were programmed and presented using PsychoPy2, v1.74.00, software (Peirce, 2007) and responses were recorded with an external response box, DirectIN Button Box (Empirisoft). Task components – pictures of situations, thoughts, and emotions – were presented visually in coloured line drawings created with Pixton® Comics (2013). A Toshiba TECRA R850-119 laptop with Windows 7 operating system was used for this study. A qualified speech and language therapist recorded voice commands to provide task instructions and support. The researcher provided assistance for the first six items during pre-test to ensure participants understood the task requirements and were able to perform the response procedures independently.

Data-collection and Analysis

Pre-test scores were inspected for normality and found to be negatively skewed for both cognitive mediation tasks. Participants whose scores had reached ceiling level at pre-test (100 % accuracy) were excluded from the data-analysis as they could no longer benefit from a potential training effect. The main effect of training was investigated using regression analyses after pre-test scores and IQ were controlled. Additional regression analyses were performed for congruent and incongruent items of each task separately. Multicollinearity between predictors, homogeneity of regression slopes, and the distribution of residuals were assessed for each analysis and all met the assumptions for linear regression analysis. The association between verbal ability and cognitive mediation skills was assessed at pre-test

using spearman correlations. In addition, a linear regression model was fitted to examine the impact of verbal skills on pre-test scores.

RESULTS

Hypothesis 1a: Training in linking situation to feelings, and vice versa, will significantly improve ability to link pairs of situations and mediating beliefs to appropriate emotional responses

The average percentage of correct responses in the training group and the control group at pre-test was 82.55 percent, $SD = 15.7$, and 77.53 percent, $SD = 14.4$, respectively (Table 2) for the 'AB, choose C' task; this was not significant, Mann-Whitney $U = 397.000$, $p = .080$ (Figure 5).

Table 3 shows the results of the regression analysis of post-test scores. Eight participants were excluded from this analysis: three participants in the control group and five in the training group reached 100 percent accuracy level at pre-test and hence could not benefit from training. Pre-test performance: $\beta = .330$, $p = .005$; IQ: $\beta = .347$, $p = .003$, and training: $\beta = .299$, $p = .005$, made significant contributions in predicting post-test performance and together, explained 42 percent (i.e. adjusted R square) of the variability in performance after the intervention. These results indicate that training significantly improved participants' ability to correctly identify emotions associated with situation-belief pairs.

Hypothesis 1b: Congruent items, as opposed to incongruent items, will be significantly associated with ability to link pairs of situations and mediating beliefs to appropriate emotional responses following training.

Regardless of intervention group, overall post-test performance was correlated with pre-test performance on the congruent items, $r(32)_{\text{Training}} = .538, p = .001$; $r(33)_{\text{Control}} = .618, p < .001$), but not on incongruent items $r(32)_{\text{Training}} = .334, p = .062$; $r(33)_{\text{Control}} = -.084, p = .642$. Separate regression analyses of congruent items indicated that their respective pre-test scores: $\beta = .384, p = .001$; IQ: $\beta = .314, p = .006$, and training: $\beta = .312, p = .003$, predicted post-test performance. Performance on incongruent items, however, was only predicted by IQ: $\beta = .268, p = .040$, and not by pre-test performance: $\beta = .146, p = .254$; or training: $\beta = .227, p = .077$. These results indicate that training significantly improved participants' ability to correctly identify emotions associated with situation-belief pairs, but only for congruent items.

Hypothesis 2a: Training in linking situation to feelings, and vice versa, will significantly improve ability to link pairs of situations and emotions to appropriate mediating beliefs.

Pre-test performance of the training group $M\% = 80.99, SD = 16.2$, and control group $M\% = 76.26, SD = 15.6$, did not differ significantly for the 'AC, choose B' task: Mann-Whitney $U = -431.500, p = .199$.

A linear regression analysis of post-test performance excluding participants with perfect pre-tests scores (Control group, $n = 3$; Training group, $n = 7$) was conducted. Pre-test scores: $\beta = .296, p = .027$; IQ: $\beta = .226, p = .088$; and training: $\beta = .147, p = .246$, were entered as predictors, adjusted $R^2 = .157$. However, within-group changes were tested using Wilcoxon signed rank tests and a significant change in cognitive mediation skills was found for the training group $z = -2.600, p = .009$, but not for the attention control group, $z = -1.207, p = .227$ (Figure 4).

Hypothesis 2b: Congruent items, as opposed to incongruent items, will be significantly associated with ability to link pairs of situations and emotions to appropriate mediating beliefs.

Congruency of task items had little impact on task performance of the control group with no association found between pre-test congruent, $r(33)_{\text{Control}} = .119, p = .511$, and incongruent items $r(33)_{\text{Control}} = .332, p = .059$, and overall post-test performance. For the training group, however, pre-test performance on both congruent, $r(32)_{\text{Training}} = .527, p = .002$, and incongruent items $r(32)_{\text{Training}} = .454, p = .002$, was associated with overall post-test performance. Separate regression analyses for congruent items showed only pre-test performance on congruent items to be a significant predictor of their respective post-test performance, $\beta = .368, p = .006$. No significant predictors could be identified for post-test performance on incongruent items.

Additional Analyses

The computer based assessment tasks, though adapted from earlier tasks developed by Dagnan and Chadwick (1997) and Dagnan et al. (2000), are nevertheless novel. Additional analyses were performed to examine whether performance on each task was close to floor-level or ceiling-level, and to what extent intellectual or verbal functioning was associated with performance.

Baseline ability to link situations, thoughts and feelings. A Wilcoxon Signed Rank test revealed no differences in pre-test performance between the two cognitive mediation tasks, indicating they had similar difficulty levels, $z = -.795, p = .427$. Fifty nine percent of participants passed the ‘AB, choose C’ task and 45 % passed the ‘AC, choose B’ task.

Ability to link situations to feelings. Data were available for 33 participants allocated to the training group. Average accuracy rates at the first presentation of the training tasks (or Time 1) were 89.4 for the 'A, choose C' and 82.3 percent for the 'C, choose A' task. The Wilcoxon signed rank test indicated this was a significant between-task difference: $z = -2.523, p < .012$. Training progress is illustrated in Figure 6. At Time 1 of training, 64% of participants made no mistakes on the 'A, choose C' task. After one set of training (i.e. Time 2) 88% of participants made no mistakes and after two sets of training (i.e. Time 3) 100% of participants made no mistakes. For the 'C, choose A' task, 45.5 % of participants performed errorless at Time 1, leading up to 78.8 % and 87.9 % of participants at Time 2 and Time 3, respectively.

Association of intellectual and verbal functioning with CBT skills. Spearman correlations were slightly higher between IQ and cognitive mediation tasks involving the selection of emotions, $r(65) = .392, p = .001$, than between IQ and cognitive mediation tasks involving the selection of beliefs, $r(65) = .320, p = .009$. The verbal comprehension index of the WASI –II correlated significantly with performance on the congruent items, $r(65) = .578, p < .001$, but not the incongruent items, $r(65) = .172, p = .170$, on the 'AB, choose C' task. However, verbal comprehension correlated significantly with the incongruent items, $r(65) = .350, p = .004$, but not the congruent items, $r(65) = .147, p = .242$, of the 'AC, choose B' task.

DISCUSSION

The results of this study suggest that training in linking situations to feelings may improve some aspects of cognitive mediation skills for people with mild to moderate IDs. Training effects were found for the ability to select appropriate emotional responses for situation-belief pairs, when compared to an attention-control intervention (Hypothesis 1a).

This effect remained when controlling for variability in baseline scores and IQ. However, congruency of situations and beliefs is a determining factor, with congruent, but not incongruent, items improving significantly following the training intervention (Hypothesis 2a). The findings do not support the hypothesis that training improves the ability to select appropriate mediating beliefs when being presented with a situation and feeling (Hypothesis 1b), regardless of congruence levels (Hypothesis 2b).

The findings of the study are consistent with Dagnan et al. (2000) who found no differences in difficulty between the two cognitive mediation tasks. It also confirms the association between verbal ability and task performance for both the cognitive mediation assessments and the adapted Reed and Clements (1989) task (Dagnan et al., 2000; Joyce et al., 2006; Oathamshaw & Haddock, 2006). However, baseline performance far exceeded previously reported pass-rates of 10 and 25 percent (Dagnan et al., 2000), 12 and 13 percent (Joyce et al., 2006), and 12 and 10 percent (Oathamshaw & Haddock, 2006) for the 'AB, choose C' task and 'AC, choose B' tasks respectively. It is unlikely that the higher pass-rates reported in this study are a result of sampling, because no cut-off scores for verbal comprehension skills were applied to exclude participants, as has been used in some previous studies (Joyce et al., 2006; Oathamshaw & Haddock, 2006).

A possible explanation for the higher pass-rates in this study is the use of inferential rather than evaluative beliefs in the cognitive mediation tasks. Indeed, Dagnan and Chadwick (1997) found that people with IDs are more likely to respond with inferential beliefs when asked what they could be thinking in a given situation-feeling pair, and later reported that inferential beliefs are expected to have more clinical utility than evaluative beliefs (Dagnan et al., 2009). Alternatively, the visualisation of task items and of instructions may have facilitated understanding. Observations and feedback from participants suggest that they

experienced the study as engaging and fun, which may have increased their motivation, and thus resulted in better attendance and performance.

Participants' engagement with the computerised tasks may reflect their accessibility to people with mild and moderate IDs. The accessibility of the task was demonstrated by relatively good performance of participants at baseline. In addition, all participants successfully passed the control questions prior to the baseline tasks, and very few (4 %) could not complete the tasks independently. Furthermore, across all participants and task items, only four missing data points, due to responding out of time, were identified. Three of these occurred during the 'AC, choose B' task.

Turning to the training of CBT skills, both Bruce et al.'s (2010) and the present findings indicated that some CBT skills can be trained and further diversification and development of training interventions is desirable. In the current study participants completed the study in one day rather than over two weeks as in Bruce et al., (2010). This quick succession of tasks, and familiarisation with the computer, may explain the improved performance noted within the control group. However, we did not examine if any gains were maintained over time or if learning generalised to new items.

A more considerable limitation of the present study was the absence of cognitive components in the training intervention, and this may be why the ability to correctly choose mediating beliefs did not improve. Indeed, the use of Reed and Clements (1989) task taught participants to link situations to feelings, and vice versa, but did not actively target the mediating role of cognitions. While the 'C, choose A' task involved some degree of perspective taking, it is likely that this was insufficient to led to substantial improvements on the 'AC, choose B' task.

This study has a number of strengths. The use of an experimental design, including concealed allocation and masked assessment, allows for an examination of causation. The

participants were representative of the population and the stratification ensured that they were well matched in terms of IQ. Similar and further research will hopefully lead to the development of effective training programmes that can be used with people with IDs before they begin therapy. Furthermore, some recent findings suggest that patients' understanding of cognitive mediation and ability to identify thoughts, feelings and behaviours improves during therapy (Barrowcliff, Jones, Oathamshaw & McConachie, 2013). However, more research is needed to understand how CBT skills link to therapeutic success in people with IDs. This is urgent and important because of the extremely high rates of mental health problems amongst this population and their relatively poor access to evidence based treatments.

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Figure 1. Flowchart of participants in the study

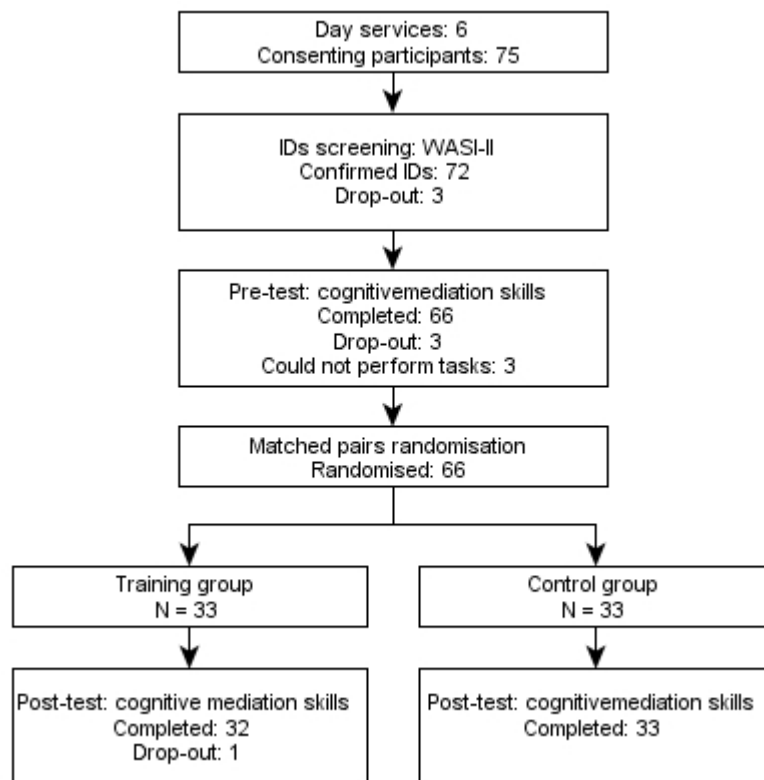
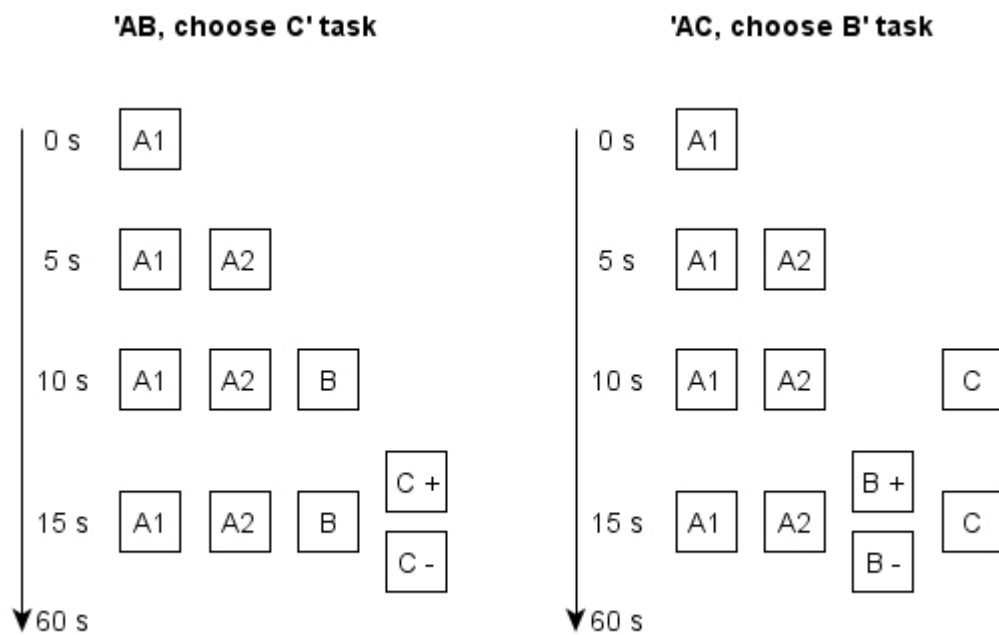


Table 1. Participant characteristics per group.

	Training group	Control group
	<i>N</i> = 32	<i>N</i> = 33
Gender	11 Male, 21 Female	12 Male, 21 Female
Age	38.53 (12.0)	38.15 (14.1)
WASI FSIQ	53.3 (8.4)	52.5 (8.5)
WASI VCI	56.6 (9.3)	56.0 (7.7)
WASI PRI	55.9 (8.3)	55.0 (10.3)

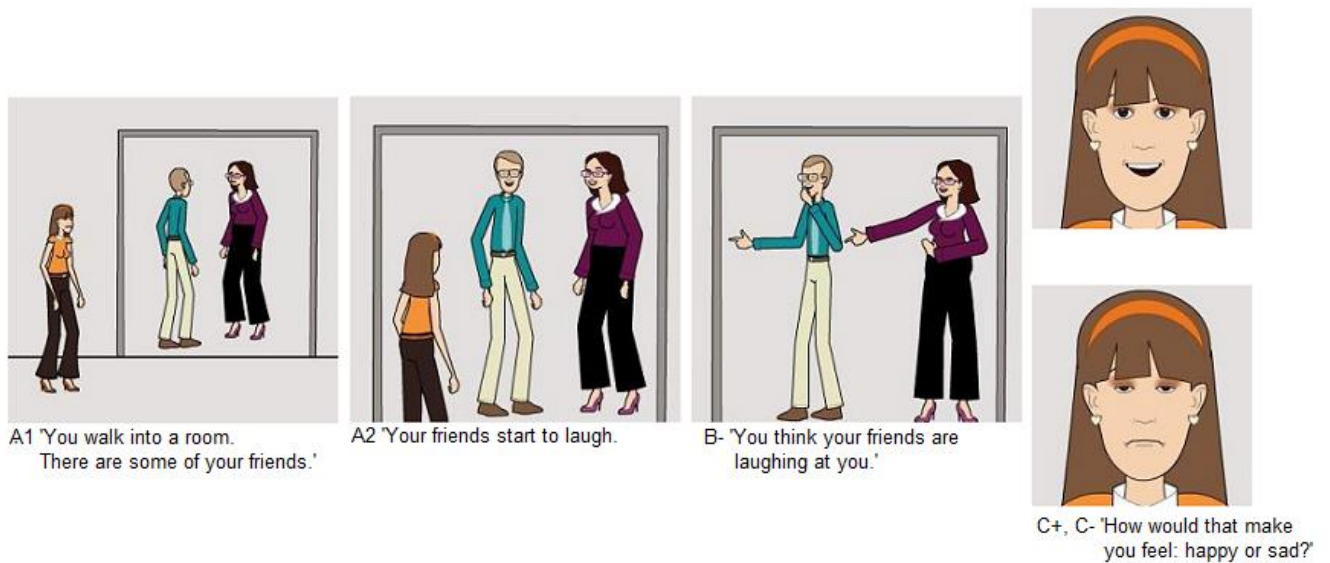
Note. Mean (SD) scores for Wechsler Abbreviated Scale of Intelligence – II Full Scale IQ (WASI FSIQ), Verbal Comprehension Index (WASI VCI) and Perceptual reasoning Index (WASI PRI).

Figure 2. Schematic presentation of a single item of the cognitive mediation tasks



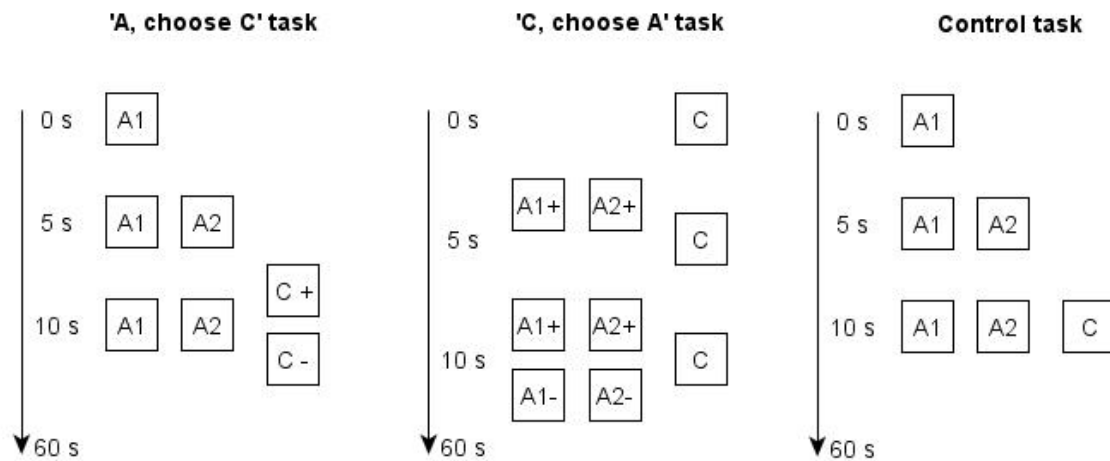
Note. A = antecedent, B = belief, C = consequence. A1 and A2 present different elements of the antecedent. B + and B – are positive and negative beliefs, respectively. C + and C – are a happy and a sad face, respectively. The vertical line presents the time from presentation of the first picture, at time 0 s, to the end of the task item, at 60 s.

Figure 3. Sample item 'AB, choose C' task



Note. The text under each picture indicates whether it present the antecedent, belief or consequence; as well as the description of each component as it was recorded in the programme. These pictures were created using Pixton® (www.pixton.com).

Figure 4. Schematic presentation of a single item of the training tasks and control task.



Note. A = antecedent, C = consequence. A1 and A2 present different elements of the antecedent. C + and C – are a happy and a sad face, respectively. The vertical line presents the time from presentation of the first picture, at time 0 s, to the end of the task item, at 60 s.

Table 2. Pre-test and post-test cognitive mediation skills

	Pre-test	Post-test
Training group		
AB, choose C	82.55 (15.7)	90.36 (11.2)
AC, choose B	80.99 (16.2)	87.76 (14.2)
Control group		
AB, choose C	77.53 (14.4)	78.54 (16.8)
AC, choose B	76.26 (15.6)	80.05 (16.6)

Note. Mean percentage correct responses (SD) for training group ($N = 32$) and control group ($N = 33$).

Table 3. Regression of pre-test performance, IQ and intervention on ‘AB, choose C’ task scores (N = 57).

	B (St. Error) ^a	beta ^a	t ^a	Adjusted R square ^b	Change R square ^b
‘AB, choose C’ task: total ^a					
Intercept	17.326 (11.038)	-	1.570	-	-
Pre-test	.365 (.125)	.330	2.920**	.256	.269**
IQ	.625 (.202)	.347	3.096**	.340	.095**
Intervention	9.208 (3.165)	.299	2.909**	.420	.088**
‘AB, choose C’ task: congruent items ^a					
Intercept	-.075 (.770)	-	-.097	-	-
Pre-test: congruent	.394 (.112)	.384	3.508**	.271	.284***
IQ	.044 (.015)	.314	2.875**	.345	.084*
Intervention	.754 (.243)	.312	3.097**	.435	.097**
‘AB, choose C’ task: incongruent items ^a					
Intercept	2.394 (.678)	-	3.533**		
Pre-test: incongruent	.120 (.104)	.146	1.154	.011	.029
IQ	.023 (.011)	.268	2.109*	.071	.076*
Intervention	.331 (.184)	.227	1.801	.108	.052

Note. *, $p < .05$; **, $p < .01$; ***, $p < .001$; ^a, regression model includes all predictors; ^b,

model includes this predictor and all predictors above.

Figure 5. Change in cognitive mediation skills for 'AC, choose B' task (left panel) and 'AB, choose C' task (right panel).

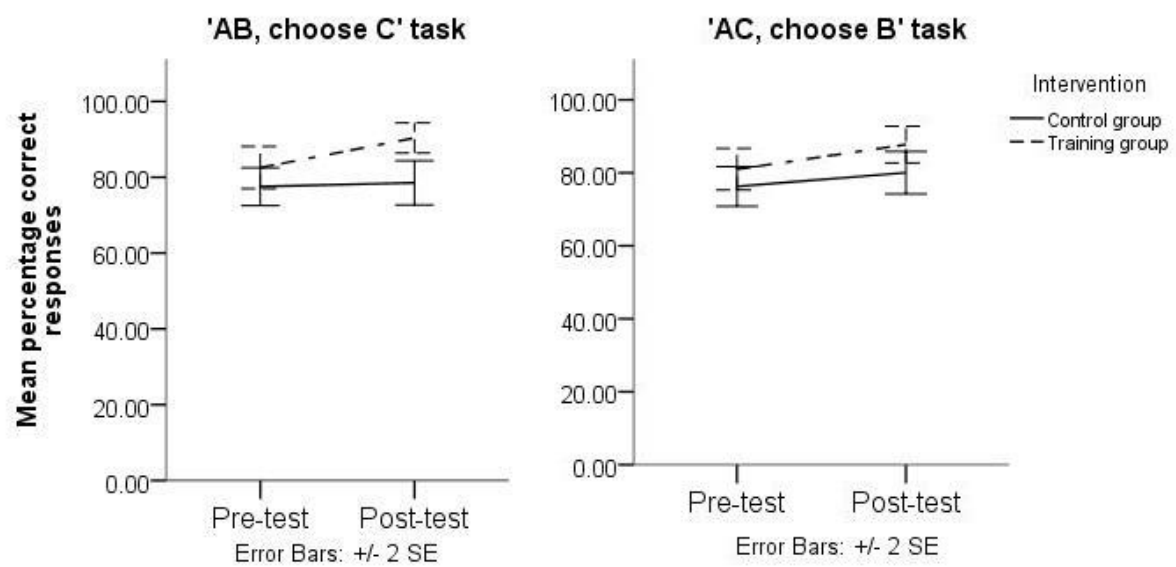


Figure 6. Progressive performance of training group ($n = 33$) on training tasks.