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Predictors of Symptom Outcome in Interpretation Bias Modification for Dysphoria

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Interpretation Bias Modification (IBM) interventions have been effective in reducing negative interpretation biases theorized to underlie depressive psychopathology. Although these programs have been highlighted as potential short-term interventions for depression, mixed evidence has been found for their effects on depressive symptoms. There is a need to examine attitudes towards training as well as individual difference factors that may impact symptom outcomes for IBM depression interventions. Seventy-two dysphoric young adults were randomly assigned to receive either an IBM targeting negative interpretation bias in personal evaluations or interpersonal situations or a healthy video control (HVC) condition. Compared to those who received HVC, participants in the IBM condition reported lower negative interpretation bias at posttreatment. No differences between conditions were found for symptom outcomes. Greater perceived treatment credibility and expectancy were associated with better treatment outcomes for both the IBM and HVC groups. Within the IBM group, a greater tendency toward assimilation with treatment scenarios was significantly associated with better treatment outcomes for both depressive and anger symptoms. This effect was unique from treatment credibility and expectancy. Pretreatment psychological reactance did not predict treatment response for either condition. Implications and future research directions are discussed.

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Interpretation Bias in Dysphoria and Depression

Negative interpretation bias in the context of depression is conceptualized as the tendency toward inferring ambiguous information to be negative. According to cognitive theories of depression, such biases function to promote exaggerated processing of negative information, thereby increasing emotional distress (Beck, Rush, Shaw, & Emery, 1979; Cropley & MacLeod, 2003; Eysenck, Mogg, May, Richards, & Mathews, 1991; Holmes, Lang, Moulds, & Steele, 2008; Lawson, MacLeod, & Hammond, 2002; Mathews & MacLeod, 2005; Mogg, Bradbury, & Bradley, 2006; Reardon & Williams, 2007; Richards & French, 1992). Indeed, a wealth of research exists that points to negative interpretation bias as an important factor in the etiology and maintenance of depression symptoms, and this cognitive theory is at the core of many evidence-based psychotherapies for depression (e.g., cognitive-behavior therapy; Gelenberg et al., 2010).

Interpretation Bias Modification (IBM) training programs, which aim to alter negative cognitive biases, have gained attention in the literature as possible stand-ins or augmentations for treatment of a range of psychological presentations (Cristea, Kok, & Cuijpers, 2015; Mathews & Mackintosh, 2000). IBM programs for depression and dysphoria have aimed to target the depressive and/or hostile interpretation biases that theoretically characterize

depression (Smith, Dillon, & Cougle, 2018). One meta-analysis examining IBM effects on cognitive biases, mood states, and emotional reactivity found that, on average, IBM resulted in greater positive interpretation bias and decreased negative mood state but did not affect emotional reactivity (Menne-Lothmann et al., 2014). The authors also noted that the reported effects were not consistently significantly different between the active training and the control condition.

Available meta-analyses investigating the effects of IBM intervention on depressive symptoms have shown mixed effects on symptom outcomes. For example, one meta-analysis reported a small effect size for IBMs on depression symptoms (Hallion & Ruscio, 2011), whereas another meta-analysis found a medium effect size that was rendered null after outliers were eliminated (Cristea et al., 2015). The differences between these meta-analyses could be attributed to Cristea and colleague's inclusion of randomization and study quality (i.e., low risk for bias) as selection criteria. There are more recent experimental trials showing promising results for IBMs targeting depression that are not included in these meta-analyses. For example, one study tested a 4-session intervention for dysphoria in a large sample of French-speaking individuals who endorsed depressive symptoms (Pictet, Jermann, & Ceschi, 2016). Participants were randomized to receive either the positive IBM training, a 50% positive/50% negative IBM sham condition, or a waitlist control condition and were informed that the purpose of the experiment was to practice generation of vivid imagery. Results from this study showed the positive IBM condition outperforming both the sham and waitlist control conditions in reduction of depressive symptoms. One recent study randomized depressed and anxious adolescents to receive eight sessions of either an IBM scenario training, an IBM picture-word training, or a neutral scenarios control condition (de Voogd et al., 2017). This study saw no differences between groups on symptom outcome measures for depression and anxiety symptoms; rather, they found depression and anxiety decreased across groups, regardless of condition. Notably, the IBM scenarios training condition did show greater reductions in negative interpretation bias than other conditions, which is consistent with existing IBM literature. Collectively, IBM for depression has demonstrated efficacy in reducing negative interpretation biases, however, it has not reliably affected depressive symptomatology.

Such variability in the success of IBM for depression points to the importance of examining factors that could affect IBM outcome. Treatment outcome literature regularly considers factors that impact the individual's reaction to and perception of treatments, yet such factors have yet to be thoroughly examined in connection with IBM treatment outcome trials. In the current study, we focus on three factors that have the potential to impact response to IBM.

TREATMENT CREDIBILITY AND EXPECTANCY

Early patient "buy-in" to psychotherapy is widely considered to be an important predictor of successful treatment outcomes (Greenberg, Constantino, & Bruce, 2006). Treatment credibility and expectancy refer to how believable and trustworthy a treatment is perceived to be and an individual's anticipated treatment response. It is common practice in the literature to include measures assessing these constructs in randomized controlled trials (RCTs) for the purpose of establishing equivalence of treatment perception across conditions being examined (Devilly & Borkovec, 2000). To date, there has been little exploration of these constructs as predictors of treatment outcome in IBM studies. Recently, one study compared an IBM targeting hostile interpretation bias to a credible psychoeducational health-related video placebo condition in a clinically depressed sample (Smith et al., 2018). The authors found no differences between conditions in their effects on depressive symptoms, though the IBM group reported greater improvements in anger control at posttreatment and 2-week follow-up assessments. Additionally, expectancy of treatment success significantly predicted improvement in depression symptoms for IBM, such that at high levels of treatment expectancy, IBM led to greater reductions in depressive symptoms than the control group. In a study examining credibility and treatment expectancy in attention and interpretation bias modification for social anxiety disorder (Beard, Weisberg, & Amir, 2011), greater credibility ratings at baseline were associated with greater reductions in social anxiety symptoms from pre- to posttreatment. Greater expectancy of treatment success was also correlated with greater reductions in anxiety symptoms at a trend level. The findings above indicate the need for more research on the influence of treatment perceptions in IBM-type interventions.

A majority of the multisession RCTs that have shown main effects of IBM on dysphoric symptoms have utilized waitlist or sham control conditions (i.e., neutral scenarios training or 50% negative/50% positive scenarios training). Although sham conditions are widely used as rigorous and well-matched control conditions for experimental IBM trials, there is some data to suggest that these conditions are perceived by participants to be less credible as psychological treatments than IBM intervention (e.g., Blackwell et al., 2015; Watkins,

Baeyens, & Read, 2009). For example, Watkins and colleagues (2009) reported a trending effect suggesting their concreteness IBM training was perceived to be more credible ($p = .06$, $\eta^2 = .09$) and had more positive expectations for treatment success ($p = .06$, $\eta^2 = .09$) than their 50% negative/50% positive sham control. The authors noted that this trending effect was not surprising due to the face validity of the IBM task. Face validity of the sham task may be lower than the active task because it appears to train contradicting biases (i.e., 50% positive, 50% negative), whereas the IBM training promotes benign or positive responses to ambiguous scenarios. Relatedly, and as noted above, Beard and colleagues (2011) assessed treatment credibility for both their active attention and interpretation bias modification for social anxiety disorder and their matched neutral placebo control. The authors found that the placebo condition, which presented neutral (as opposed to disgust faces) and superficially related words (as opposed to socially related words) in the word-sentence relatedness task, was perceived to be less credible as a treatment compared to their active intervention, despite presenting participants with identical rationale to the active treatment condition. Authors reported that during the exit questionnaires, approximately 75% of participants in the active treatment group believed they had received the active treatment, compared to 36% in the control condition. Such findings suggest that noncredible placebo comparison conditions may inflate the perceived efficacy of IBMs. On the other hand, Blackwell and colleagues (2015) assessed treatment expectancy of both their intervention and control condition in a large-scale IBM treatment trial and found comparable expectancy across conditions and no main effect of condition on symptoms of depression. The authors did not report on effects of perceived treatment credibility. Taken together, there is evidence to suggest that the IBM treatment literature may benefit from comparing IBM to equally credible placebo conditions in order to rule out attribution of IBM findings to placebo effect. In the present study, we address this gap in the literature by comparing our IBM intervention to a healthy video control (HVC; see description in Methods below), which has been perceived to be a credible intervention in previous studies (e.g., Keough & Schmidt, 2012; Schmidt, Capron, Raines & Allan, 2014; Smith et al., 2018).

PSYCHOLOGICAL REACTANCE

Psychological reactance is a term that represents the resistance that occurs when an individual's choice is eliminated or threatened with elimination (Brehm & Brehm, 1981). Elevations in the tendency to experience reactance have been linked to greater nonadherence to mental health psychotherapy and pharmacological interventions (De Las Cuevas, Peñate, Betancort, & de Rivera, 2014; Fogarty & Youngs, 2000; Moore, Sellwood, & Stirling, 2000). Additionally, psychological reactance has been linked to angry and hostile cognitions (Quick & Stephenson, 2007), which are also elevated in depressed samples (Smith, Summers, Dillon, Macatee, & Cougle, 2016). This individual difference variable is potentially relevant for IBM research in particular due to forced choice and repeated instruction to adopt benign interpretations that are inherent in scenario training, which highly reactant individuals may resist. Additionally, IBM interventions may be seen as tedious and as such may promote resistance or feelings of annoyance (e.g., Beard, Weisberg, & Primack, 2012). Psychological reactance may be especially relevant for IBM studies targeting depression due to the co-occurrence of problematic anger in depression (e.g., Judd, Schettler, Coryell, Akiskal, & Fiedorowicz, 2013; Perlis et al., 2009). Despite this, no studies to date have examined the impact of psychological reactance on IBM treatment outcomes.

SOCIAL COMPARISON STYLE: SCENARIO ASSIMILATION AND CONTRAST

The issue of whether participants identify with IBM stimuli has become an area of increasing interest in the IBM literature as a potential predictor of training and intervention outcomes. Standage and colleagues (2014) published a study examining the impact of how a participant approaches IBM stimuli on the induction of bias change and emotional outcomes. Specifically, they used the Social Comparison Style Questionnaire (SCSQ; Standage et al., 2014) to examine whether participants approached IBM stimuli with a tendency to assimilate with or relate to (e.g., "To what extent did you feel the scenarios reflected your own social experiences?") or contrast one's own experience with training scenarios (e.g., "To what extent did you have difficulty relating to the scenarios?"). The authors discovered that, in response to positive bias training, individuals reporting greater assimilation with scenarios experienced improvement in interpretation bias, though those reporting less assimilation with scenarios experienced no such change. Individuals with greater scenario assimilation also reported reduced emotional response to a subsequent stressor compared to those with low assimilation ratings. Thus, tendencies to personally relate to/assimilate with scenario content may be a very important predictor in determining who could benefit from IBM.

CURRENT STUDY

The current study sought to examine the potential importance of perceived treatment credibility and expectancy, psychological reactance, and scenario relatability in predicting treatment outcome in IBM. Dysphoric individuals were assigned to a four-session IBM intervention, designed to target depressive interpretation biases or a healthy videos control condition (HVC). Notably, the IBM developed for this study targeted negative interpretation biases related to self and others (i.e., the hostile interpretation bias), given the relevance of each bias to depression (Mogg et al., 2006; Moreno, Fuhriman, & Selby, 1993; Smith et al., 2016). We also included anger symptoms as an outcome, given the well-established co-occurrence of depression and problematic anger in the literature (Benazzi & Akiskal, 2005; Fava et al., 2010; Judd et al., 2013; Perlis et al., 2009). We hypothesized that, compared to individuals assigned to HVC, IBM would lead to less negative interpretation bias at posttreatment. Based on literature showing no group differences in symptom outcomes between IBM for depression and other active interventions (e.g., de Voogd et al., 2017; Smith et al., 2018), we hypothesized that there would be no differential effects of condition on depression and anger symptoms at posttreatment or 2-week follow-up assessments. We hypothesized that individuals with higher expectations of treatment success and greater perceived credibility ratings would show greater reductions in anger and depression symptoms. Additionally, we hypothesized that greater psychological reactance would predict poorer treatment outcome in the IBM condition. Further, we hypothesized that individuals who reported greater personal assimilation with IBM treatment scenarios would show greater reductions in negative depressive bias, depressive symptoms, and anger symptoms. We additionally expected these hypothesized effects to persist at 2-week follow-up.

Method

PARTICIPANTS

Participants included 72 undergraduate students (aged 18 to 22 years; M = 19.13), who were recruited at a large southeastern university. The sample was predominantly female (80.6%) and White (not Hispanic) (68.1%). Other ethnicities represented included Hispanic (12.5%), Black (not Hispanic) (11.1%), and Asian/Pacific Islander (8.3%). Interested participants requested a link to the online eligibility screener from the principal investigator via email. Participants who endorsed mild to severe depressive symptoms on a depression screener (a score of 5 or more on the Patient Health Questionnaire [PHQ-9] with an impairment score rated to be "somewhat difficult" or greater) were brought into the lab for an assessment of current mood-related psychopathology including major depressive episode (MDE), persistent depressive disorder, and bipolar disorders. Current dysphoric symptoms were confirmed through the MDE module of the Mini International Neuropsychiatric Interview. Participants who endorsed distressing current depressed mood or anhedonic symptoms of an MDE for at least half of the time in the past 2 weeks were randomly assigned to IBM (n = 36) or HVC (n = 36) via block randomization. These criteria are consistent with other studies recruiting for dysphoria and mild to moderate symptoms of depression (e.g., Watkins Baeyens, & Read, 2009). A majority of participants (n = 56 or 77.8%) met criteria for current MDE at time of study enrollment and the remainder presented with subthreshold depressive episode symptoms (n = 16). Students were able to earn up to three course research credits as compensation for their participation.

INTERVIEW AND MEASURES

Mini International Neuropsychiatric Interview

The Mini International Neuropsychiatric interview (MINI) was administered to assess lifetime and current mood symptoms (Sheehan et al., 2006). The MINI modules for major depressive episode, persistent depressive episode (dysthymia), and (hypo)mania were administered to each participant by undergraduate research assistants who underwent training by an advanced graduate student to assess for current mood disorder status at the pretreatment visit. A random subsample of interview recordings (n = 10) was reviewed by the principal investigator for reliability. Interview reliability was acceptable (agreement = 85%).

Patient Health Questionnaire-9

The Patient Health Questionnaire-9 (PHQ-9) is a 9-item depression diagnostic and severity measure (Kroenke & Spitzer, 2002). Seven symptom items and the severity item from this measure were used as a screener for prospective participants. The item regarding suicidality was not included during the prescreening process. Internal consistency for this measure (without the suicide item) was good (α = .85).

Beck Depression Inventory-II

The Beck Depression Inventory-II (BDI-II) is a 21-item questionnaire that was used to assess the presence and degree of impairment associated with symptoms of MDD (Beck, Steer, & Brown, 1996). The BDI-II is a widely used inventory that has strong validity (Beck et al., 1996). Internal consistency for the current study was good (α = .87). This measure was administered during each assessment.

Beck Anxiety Inventory
The Beck Anxiety Inventory (BAI) is a 21-item questionnaire (Beck, Epstein, Brown, & Steer, 1988) that was used to assess the presence and severity of anxiety symptoms for the purpose of examining specificity of the present intervention to mood and anger-related symptoms. The BAI is commonly used and has strong validity. Internal consistency for the current study was good (α = .92). This measure was administered during baseline, post-treatment, and follow-up assessments.

Clinical Anger Scale
Symptoms and severity of anger were assessed using the Clinical Anger Scale (CAS), which is a 21-item inventory that asks participants to read groups of statements (4 statements per group) and select the statement that best represents how they feel (Snell, Gum, Shuck, Mosley, & Hite, 1995). This measure has been shown to correlate with other measures of anger-related constructs. In the current study, internal consistency was good (α = .86). This measure was administered at each assessment.

Word Sentence Association Paradigm for Depression
The Word Sentence Association Paradigm for depression (WSAP-D; author constructed) was based on the similarity ratings task from Kuckertz and colleagues (2013) and the WSAP-H from Dillon and colleagues (2015), which use a Likert-type similarity rating scale from 1 (*not at all similar*) to 6 (*extremely similar*) for word sentence pairs. The WSAP-D was used to assess depressive interpretation bias including both self-focused (e.g., "You are feeling unmotivated on a problem that doesn't interest you.") and interpersonally themed scenarios (e.g., "Your friend looks at their phone while you're telling them a story."). In this computer-administrated measure, participants were presented with 34 ambiguous scenarios presented twice nonconsecutively, alternatively paired with a benign word or a negative word (e.g., "You struggle to complete an assignment" paired with "Challenging" and "Incompetent"). In data from an unselected student sample in our laboratory (n = 65), the negative subscale was positively correlated with BDI-II scores (r = .44, p < .001) while the benign subscale was marginally negatively related to depressive symptoms (r = -.21, p = .09). In the current study, internal consistency was good for both negative (α = .91) and benign (α = .82) subscales. This assessment was administered at baseline and posttreatment assessments.

Credibility/Expectancy Questionnaire
The Credibility/Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000) is a 4-item questionnaire that assesses the degree of symptom change participants expect following an intervention and the perceived credibility of that intervention. This assessment was only administered following the first session and rationale provision of both IBM and HVC (see Smith et al., 2018, for detailed rationale). Per Devilly and Borkovec (2000), this measure was scored as two standardized composite scores representing "credibility" and "expectancy." Internal consistency for these scales was good in the present sample (credibility: α = .83; expectancy: α = .80).

Hong Psychological Reactance Scale
The Hong Psychological Reactance Scale (HPRS; Hong & Faedda, 1996) is a 14-item scale that assesses an individual's proneness to react to third-party suggestion as though it threatens personal liberties and agency (e.g., "I resist the attempts of others to influence me," "Advice and recommendations induce me to do the opposite"). These items are rated using a 5-point Likert-type scale ranging from strongly disagree to strongly agree, with higher scores reflecting greater levels of reactance. In this study, internal consistency was good (α = .82).

Social Comparison Style Questionnaire
The original Social Comparison Style Questionnaire (SCSQ; Standage et al., 2014) is an 8-item self-report questionnaire that assesses the degree to which a participant identifies with or contrasts their own experience with the scenarios used in an IBM intervention. Higher scores on this measure are associated with a greater tendency to assimilate with or relate to IBM scenarios. For this study, we eliminated three items from the scale that had poor item-total correlation (r's < .30) and contributed to low internal consistency (α = .62) in favor of items that loaded well together. The revised 5-item scale had good internal consistency (α = .80). This measure was administered following completion of the first IBM session.

INTERVENTIONS

Interpretation Bias Modification
The IBM intervention used in this study is an author-constructed training that was modeled after scenario-based cognitive bias modification trainings. Specifically, this intervention combined 128 interpersonally themed scenarios from an existing IBM intervention for hostile interpretation bias (Cougle et al., 2017; Smith et al., 2018) with 128 novel, self-focused scenarios designed to target depressogenic interpretations. Essentially, this intervention focused on encouraging participants to give oneself and others the benefit of the doubt.

Participants completed four 15-minute sessions twice per week for 2 weeks. Participants randomly

assigned to the IBM group were given a rationale, which presented the treatment as a training that "changes mental habits" that promote sadness and emotional upset. Participants were asked to read and mentally picture one-sentence ambiguous scenarios presented on their computer screen. Once each scenario was presented, participants were given a benign resolution to each scenario. After each resolution was given, a comprehension question followed. Each session consisted of 64 treatment scenarios related to themes relevant to depression and anger (e.g., failure, rejection, perceived hostility from others). For example, a participant would be presented with the following scenario: "Your supervisor tells you that you can do better." The next screen would provide a benign interpretation of the scenario including a word fragment (e.g., "Your supervisor is trying to moti_ate you"). The participant is then instructed to type in the missing letter ("v" in this example). On the next screen a comprehension question was displayed, for example, "Does this mean you are a loser?" and the participant was instructed to select "yes" or "no" based on the information provided. If the participant answered incorrectly, they were instructed to correct their error.

Healthy Video Control

The HVC condition is a time-matched psychoeducational video series based on protocols used by other researchers as a placebo intervention (e.g., Keough & Schmidt, 2012; Schmidt et al., 2014). Participants assigned to the control condition watched four 15-minute videos discussing healthy habits and self-care, twice per week. Control participants were provided with a rationale for this condition, which was presented as psychoeducation "promoting healthy habits as a way to improve overall well-being and change automatic responses to everyday situations in life." Videos covered the topics of nutrition, sleep, exercise, and personal hygiene. The literature reflects that this psychoeducational control is perceived as credible. For example, in a recent study, HVC was rated to be even more credible than IBM for hostility in a depressed sample (Smith et al., 2018).

Procedure

BASELINE ASSESSMENT

Participants were informed that they were taking part in a study testing an experimental computerized treatment for depression. After signing informed consent, the MINI was administered to determine eligibility and to confirm current depressed mood and/or anhedonia. Eligible participants were then asked to complete depressive interpretation bias assessments along with a self-report battery administered via computer. Participants were then randomized to either the IBM or HVC condition.

TREATMENT SESSIONS

While in the lab, participants were administered the first of four sessions via computer and were given instructions detailing how to complete the remaining sessions at home, online. Participants then completed three treatment sessions online from their personal computers over the course of the following 2 weeks (two sessions/week). Participants were instructed to complete the 15-minute treatment sessions on nonconsecutive days. Web links for each session were individually emailed to participants on the scheduled session day. Participant compliance was monitored remotely through the use of Qualtrics.com, and reminder emails were sent between sessions.

POSTTREATMENT ASSESSMENT

One week following the final treatment session, participants completed posttreatment self-report questionnaires and the depressive interpretation bias assessment online from home.

FOLLOW-UP ASSESSMENT

Two weeks following the posttreatment session, participants were asked to complete the battery of self-report questionnaires online from home.

Results

STATISTICAL ANALYSIS

Based on power calculations (alpha set at .05, power at .80) using a between-group effect corresponding to medium to large effect size for main effects of condition on outcome measures (Hedges's g = .66), the minimum sample size for each group was estimated to be 29. To account for possible participant dropout, we overrecruited by approximately 25%, which yielded a sample size of 72. These numbers are consistent with other IBM treatment outcome trials in the literature (e.g., Lang, Blackwell, Harmer, Davison, & Holmes, 2012; Williams et al., 2015). For regression-oriented analyses, our sample size was guided by Green's (1991) "rule of thumb" for analyses examining relationships between variables (i.e., regression, correlation), suggesting at least n = 10 per predictor (VanVoorhis & Morgan, 2007). Three predictors (including condition and baseline scores of outcome measures) were included for analyses examining possible interactions between predictors and condition on outcome measures (e.g., credibility and expectancy). Two predictors (including baseline scores of outcome measures) were included for other regression analyses. Analyses investigating social comparison style were conducted using only data from the IBM condition and included two predictors (including baseline scores of outcome measures).

Table 1
Descriptives of Study Variables

	IBM	HVC	IBM Post-treatment Mean (*SD*)	HVC Post-treatment Mean (*SD*)	IBM Follow-up Mean (*SD*)	HVC Follow-up Mean (*SD*)
	Baseline Mean (*SD*)	Baseline Mean (*SD*)				
Age	19.31 (1.50)	18.94 (1.19)	–	–	–	–
WSAP-D negative	3.26 (.93)	3.58 (.75)	2.66 (.92)	3.20 (.68)	3.70 (.33)	3.72 (.44)
WSAP-D benign	4.36 (.58)	3.86 (.47)	4.52 (.78)	3.88 (.75)	3.56 (.35)	3.65 (.54)
BDI-II	25.69 (9.33)	25.01 (9.04)	17.10 (13.10)	18.67 (12.78)	18.37 (13.98)	16.10 (12.16)
CAS	13.04 (7.66)	12.30 (6.32)	9.71 (11.12)	9.77 (8.55)	11.00 (13.71)	8.58 (7.46)
BAI	20.33 (11.82)	18.31 (9.22)	14.42 (12.85)	15.42 (10.85)	15.19 (15.21)	14.65 (10.58)
Treatment Expectancy	-.03 (2.05)	.03 (1.59)	–	–	–	–
Treatment Credibility	-.07 (2.11)	.07 (1.57)	–	–	–	–
HPRS	44.10 (6.92)	45.22 (7.91)	–	–	–	–
Social Comparison Style	19.36 (4.76)	–	–	–	–	–
	N (%)	N (%)				
Female	30 (83.3%)	28 (77.8%)	–	–	–	–
Male	6 (16.7%)	8 (22.2%)	–	–	–	–
White	24 (66.7%)	25 (69.4%)	–	–	–	–
Black	2 (5.6%)	6 (16.7%)	–	–	–	–
Hispanic	5 (13.9%)	4 (11.1%)	–	–	–	–
Asian or Pacific Islander	5 (13.9%)	1 (2.8%)	–	–	–	–
Current MDE	28 (77.8%)	30 (83.3%)	–	–	–	–

Note. IBM = Interpretation Bias Modification; HVC = Healthy Video Control; WSAP-D = Word Sentence Association Paradigm for Depressive interpretation bias; BDI-II = Beck Depression Inventory – 2nd edition; CAS = Clinical Anger Scale); BAI = Beck Anxiety Inventory; HPRS = Hong Psychological Reactance Scale.

Analyses included intent to treat (ITT) multiple regression models using Mplus 7 software for the purpose of handling missing data utilizing Full Information Maximum Likelihood Estimation (FIML). With this method, Mplus estimates parameters using all data available, which allows for inclusion of participants who provided data for predictor variables but were lost to posttreatment or follow-up assessments. Multiple regression was selected based on literature suggesting it as a superior method to repeated measures ANOVA for treatment outcome trials due to greater power and its resistance to spurious results produced by regression to the mean (Vickers & Altman, 2001). In each of the main effects analyses, a term representing the baseline value of the outcome variable was included for statistical control.

To assess normality of distribution in our baseline variables, we examined Kolmogorov-Smirnov statistics and found nonsignificant values (p's > .19), which reflects acceptable normality. Additionally, no scores on baseline variables were assessed to be extreme outliers as no participants had scores falling above or below two standard deviations from the mean on these measures, therefore all participant data was included in analyses.

SAMPLE CHARACTERISTICS

We conducted independent samples t-test to assess for group differences at baseline. No group differences were found between conditions in age, diagnostic status, or ethnicity (p's > .11). We assessed for differences between groups on baseline outcome measures.[1] Significant group differences were found for WSAP-D benign bias, with IBM scoring greater than HVC, F (1, 70) = 2.03, p <.001, η^2 = .18 (see Table 1 for descriptives). Notably, including this covariate did not affect between-group effects on interpretation bias, depression, anger, or credibility and expectancy. No baseline differences were found on the depression outcome measure (BDI-II), anger symptoms (CAS), anxiety (BAI) or WSAP-D negative bias scores (p's > .12). There were no significant group differences in expectancy of treatment effects or perceived treatment credibility (p's > .74). Regarding session adherence and subject dropout, there were no group differences in number of sessions completed or number of participants who did not complete post-treatment or 2-week follow-up assessments (p's > .38). See Table 2 for correlations between baseline measures and Figure 1 for study CONSORT diagram.

To assess engagement in treatment sessions we calculated the mean accuracy rate for comprehension questions in IBM (first yes/no response to up to 256 questions) and HVC (up to 12 questions or 3 per session). We found excellent response accuracy in the IBM group (96.98%; *SD* = 3.93).

[1] T-tests were conducted to compare means of trial completers and participants lost to follow-up on baseline variables no significant differences between these groups were found (p's > .43).

Table 2
Correlations Between Baseline Study Variables

Variables	1	2	3	4	5	6	7	Social Comparison Style (IBM group only)
1. WSAP-D Benign	–							.16
2. WSAP-D Negative	-.29*	–						-.09
3. BDI-II	-.02	.23*	–					.24
4. CAS	-.002	.19	.48**	–				.18
5. HPRS	-.04	.23	.18	.53**	–			-.01
6. Treatment Credibility	.42**	-.18	-.23	-.12	-.18	–		.29
7. Treatment Expectancy	.17	-.01	-.16	-.16	-.12	.75**	–	.28

* $p < .05$, ** $p < .01$.
Note: WSAP-D = Word Sentence Association Paradigm for Depressive interpretation bias; BDI-II = Beck Depression Inventory – 2nd edition; CAS = Clinical Anger Scale; HPRS = Hong Psychological Reactance Scale.

Participants in the HVC condition also had high rates of accuracy on post-video comprehension quizzes (90.45%; *SD* = 5.2).

EFFECTS OF TREATMENT

We examined the effect of condition on depressive interpretation bias, and depression symptoms, anger symptoms, and anxiety. As expected, IBM participants showed lower negative depressive interpretation bias ratings at posttreatment compared to those in the HVC condition. Contrary to hypotheses, condition did not predict posttreatment WSAP-D benign bias scores. As hypothesized, condition did not significantly predict depression symptom scores at posttreatment or follow-up. Condition also did not predict anger symptoms at posttreatment or follow-up assessments. See Tables 3, 4, and 5 for regression results of the effects of treatment on depressive bias, depression symptoms, and anger symptoms.

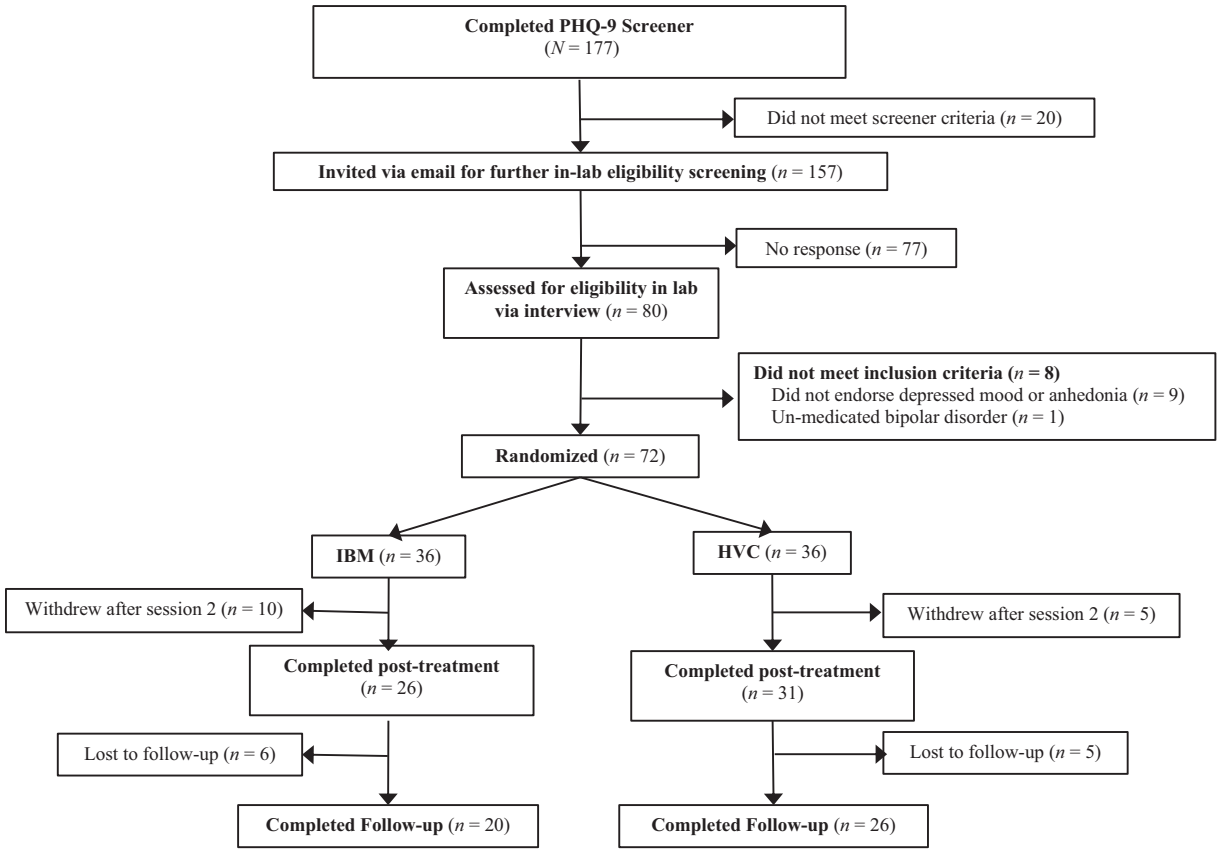

FIGURE 1 Participant progress through stages of the study. IBM = Interpretation Bias Modification; HVC = Healthy Video Control.

Table 3
Predictors of Interpretation bias at Posttreatment

	WSAP-D Benign Bias				WSAP-D Negative Bias			
	β	*p*	95% CI	sr^2	β	*p*	95% CI	sr^2
Condition	-.17	.13	-.35 – .01	.03	.30	.01	.13 – .47	.09
HPRS	-.20	.30	-.29 – .03	.02	.23	.17	.06 – .40	.06
Social comparison style*	.03	.87	-.23 – .29	.0001	-.04	.67	-.11 – .03	.01

Note: For each separate analysis, the predictor variable and baseline outcome variable (WSAP-D positive or negative bias) were entered into the model. WSAP-D = Word Sentence Association Paradigm for Depressive interpretation bias, HRPS = Hong Psychological Reactance Scale; * = These analyses were only run in the IBM group.

Table 4
Predictors of Depression at Posttreatment and Follow-up

	Post-treatment BDI-II				Follow-up BDI-II			
	β	*p*	95% CI	sr^2	β	*p*	95% CI	sr^2
Condition	.09	.38	-.08 – .26	.01	-.01	.92	-.21 – .19	.0001
Treatment Expectancy	-.31	.003	-.49 – -.17	.09	-.27	.03	-.46 – -.09	.07
Treatment Credibility	-.23	.03	-.41 – -.06	.05	-.23	.06	-.41 – -.05	.05
HPRS	.02	.10	.01 – .12	.0004	.20	.07	.03 – .65	.04
Social comparison style*	-.49	< .001	-.87 – -.36	.21	-.61	< .001	-.87 – -.36	.32

Note: For each separate analysis, the predictor variable and baseline BDI-II were entered into the model. BDI-II = Beck Depression Inventory – 2nd edition; HPRS = Hong Psychological Reactance Scale; * = These analyses were only run in the IBM group.

TREATMENT EXPECTANCY AND PERCEIVED CREDIBILITY

Consistent with our hypotheses, treatment expectancy and perceived credibility significantly predicted posttreatment depressive symptom scores across conditions such that higher ratings of expectancy and credibility predicted lower posttreatment BDI-II scores. Neither of these variables interacted with condition to predict treatment outcomes. The effect of expectancy remained significant in predicting depressive symptom scores at follow-up, and the effect of credibility somewhat diminished in predicting follow-up depression symptoms, although the effects were trending in the same direction. Treatment expectancy and perceived credibility also predicted posttreatment anger symptoms. At follow-up, the effect of credibility remained significant in predicting anger symptoms and the effect of expectancy was rendered nonsignificant. See Tables 4, and 5 for results of FIML regression showing the effects of treatment expectancy and credibility on depressive and anger symptoms.

PSYCHOLOGICAL REACTANCE

Contrary to hypotheses, psychological reactance did not significantly interact with condition to predict posttreatment or follow-up symptom measures (*p*'s > .08). There were also no main effects of reactance on posttreatment depressive interpretation bias or symptom measures at posttreatment or follow-up. See Tables 3, 4, and 5 for results of FIML regression showing the main effects of psychological reactance

Table 5
Predictors of Clinical Anger at Posttreatment and Follow-up

	Post-treatment CAS				Follow-up CAS			
	β	*p*	95% CI	sr^2	β	*p*	95% CI	sr^2
Condition	-.05	.67	-.25 – .15	.003	-.004	.97	-.20 – .20	.00002
Treatment Expectancy	-.36	.003	-.54 – -.19	.13	-.27	.03	-.42 – -.08	.04
Treatment Credibility	-.32	.01	-.51 – -.14	.10	-.21	.10	-.39 – -.02	.07
HRPS	-.12	.39	-.35 – .12	.01	.05	.70	-.23 – .37	.003
Social comparison style*	-.50	<.001	-.69 – -.31	.23	-.57	.001	-.86 – -.30	.28

Note: For each separate analysis, the predictor variable and baseline CAS were entered into the model. CAS = Clinical Anger Scale; HPRS = Hong Psychological Reactance Scale; * = These analyses were only run in the IBM group.

on depressive interpretation bias, depression symptoms, and anger symptoms.

SOCIAL COMPARISON STYLE

In line with our hypotheses, greater tendency to assimilate with IBM treatment scenarios was a significant predictor of lower posttreatment depression and anger symptoms in the IBM group. These effects remained significant at follow-up for both depression and anger. Contrary to hypotheses, social comparison style did not significantly predict posttreatment interpretation bias scores. Social comparison style was also unrelated to anxiety symptom scores at posttreatment and follow-up. See Tables 3, 4, and 5 for these results. Social comparison style was not significantly related to treatment expectancy ($r = .28$, $p = .11$) or perceived credibility (see Table 2; $r = .29$, $p = .09$) and the effect of social comparison style remained with the outcomes described above when credibility or expectancy were entered into the model, with some exceptions. When expectancy and credibility were included in the models, social comparison was only marginally associated with posttreatment and follow-up depression symptoms (p's > .06), though it remained associated with anger symptom scores. These findings suggest that social comparison style was mostly independent of treatment perceptions in its predictive value for these outcomes.

We also examined whether low assimilation ratings may have had iatrogenic effects and led to a worsening of depressive symptoms in some individuals. Among those who completed the posttreatment assessment, six (16.7%) participants in the IBM group showed either no change ($n = 1$) or an increase in depressive symptoms from pre- to posttreatment. For this group, social comparison scores were significantly lower ($M = 16.8$, $SD = 4.1$) than those who reported decreased depressive symptoms at posttreatment ($n = 20$, $M = 21.3$, $SD = 3.0$; $t = 2.67$ $p = .01$, $d = 1.24$).

Discussion

The current study examined the association between specific attitudes about and approaches to IBM interventions and depression and anger outcomes. We also evaluated the efficacy of an IBM program designed to target depressive interpretation bias in a dysphoric sample. Our findings are consistent with other multi-session IBM RCTs in that they suggest that the IBM training was successful in reducing depressive interpretation bias, as measured by the negative subscale of the WSAP-D. The pre-post effect size on depressive interpretation bias in our IBM group ($d = .65$) was comparable to that produced by other IBM protocols in the literature (e.g., Micco, Henin, & Hirshfeld-Becker, 2014). Contrary to predictions, there was no effect of condition on the benign subscale of depressive interpretation bias. Our data from this measure of interpretation bias indicated negative interpretation bias was more strongly related to depressive symptomatology while benign bias was not. Thus, negative bias may be a more meaningful outcome in our analyses. We saw no significant differences between IBM and HVC conditions on depressive and anger symptom outcome measures. This disconnect between bias change and symptom reduction may be due to a lack of meaningful change in bias and rather a change in how participants respond to the bias assessment task. Interpretation bias assessments such as the WSAP-D task have been criticized due to their potential for imposing response bias and possible demand effects (Cristea, Kok, & Cuijpers, 2016).

These null findings add to the growing literature showing mixed effects of IBM for depression (Cristea et al., 2015; Hallion & Ruscio, 2011; Micco et al., 2014). IBM treatments have demonstrated a great deal of early promise; however these mixed findings suggest that IBM may not reliably reduce depressive symptoms. IBM treatments have also been discussed as potentially potent adjunctive or preventative treatments that may promote healthy reactions to stressful situations in at-risk populations (e.g., Beard et al., 2011). All considered, the literature demonstrates that future research needs to look at factors that affect IBM treatment outcomes in order to best deliver on the promise of these interventions.

Across treatment groups, greater perceived credibility and expectations of treatment were associated with greater reductions in depressive and anger symptoms at posttreatment and 2-week follow-up assessments. There was no significant interaction effect of treatment condition with credibility or treatment expectancy; therefore, these factors appear to be generally related to improved symptom outcomes. These findings echo those highlighted in other studies (Beard et al., 2011; Smith et al., 2018) and further emphasize the importance of early treatment buy-in to bolster success for psychotherapeutic interventions. These results also raise the possibility that these findings are attributable to a placebo effect. Future research should consider factors related to expectancy and credibility in developing rationale and scenario content for IBM interventions. For example, researchers may enhance rationale by presenting evidence in lay terms that depict IBM as effective in reducing negative interpretation bias and may thereby theoretically impact thinking patterns that maintain depression.

Within the IBM group, greater reported tendency toward assimilating with treatment scenarios (i.e.,

higher social comparison style score) was associated with significantly lower levels of post-treatment depressive and anger symptoms. Notably, social comparison style was unrelated to perceived credibility and expectancy of treatment. Social comparison style did not predict changes in interpretation bias, which is contrary to expectation based on previous literature (Standage et al., 2014). Nevertheless, our findings extend the literature on social comparison style in IBM interventions, suggesting that individuals who relate more easily with treatment scenarios may benefit more from IBM than those who do not. Additionally, we found that individuals who reported no improvement or worsening of depressive symptoms also showed lower tendency toward assimilating with scenarios at pretreatment. Although social comparison style is conceptualized as a trait or tendency, it is possible that the measure serves as a broad indicator of how relatable IBM scenarios are to their audience. This considered, future research may benefit from piloting treatment scenarios to enhance their relatability with depressed or dysphoric individuals. Alternatively, considering tendency to assimilate with or relate to treatment scenarios among inclusion criteria may prove beneficial for future IBM studies.

Notably, psychological reactance did not predict treatment outcome in our IBM group. This suggests that the forced-choice aspect of this scenario training did not negatively contribute to treatment outcomes in a dysphoric sample, as we had anticipated. Existing literature suggests considerable overlap between psychological reactance and problematic anger (Quick & Stephenson, 2007). Relatedly, there is evidence to suggest that problematic anger can stand as a barrier in psychotherapy for a range of presenting problems as it may interfere with therapeutic alliance and participation in treatment components (Chemtob et al., 1997; Forbes et al., 2008). It is possible that because this IBM intervention is completed by computer and ostensibly without reliance on therapeutic alliance that reactions of anger and frustration with treatment instructions were diminished.

The findings of the present study should be interpreted considering several limitations. First, our sample consisted of non-treatment-seeking undergraduates who likely differ on a range of characteristics from treatment-seeking individuals in the community. Our sample may have been less motivated for treatment and less engaged than a community sample. Relatedly, participants completed three of four treatment sessions on their personal computers. Although this method contributed to the feasibility and accessibility of this trial and participants, overall, showed good engagement as assessed through response correctness, it still reduces experimental control over treatment engagement. Another limitation is the absence of a wait-list condition in our study design. Future studies should include a wait-list condition to control for change in study outcomes attributable to the passage of time. It should also be noted that there was substantial dropout by the follow-up assessment, especially in the IBM condition (though this was not significantly different than HVC); this may affect interpretation of our findings. It is possible that this dropout occurred as a consequence of recruiting a non-treatment-seeking student sample and that receipt of credit in their psychology course was not sufficiently motivating to complete participation. Future researchers may use treatment-seeking samples and monetary compensation to reduce attrition.

IBM researchers have raised questions in an effort to pinpoint what features of IBM are therapeutic. Issues of optimal dosage of training and enhancing training instruction (e.g., mental imagery) have been examined (e.g., Lang et al., 2012); however, no firm conclusions have been reached. This trial highlights the power of perceived credibility and expectancy on treatment outcomes, such that many of the symptom improvements presented here may be attributable to placebo effect. However, the current trial also raises questions related to the importance of scenario relatability, which was shown to be distinct from credibility and expectancy in predicting depression and anger symptom outcomes in IBMs. Although we have provided evidence that high scenario relatability may be an indicator of better treatment outcome in IBM, it is uncertain which aspect of training (scenario, resolution, or comprehension question with feedback) is more important in this equation. Additionally, it is possible that an individual's tendency to assimilate with scenarios may be an indicator of improvement independent of the dosage or amount of intervention. As such, future research would benefit from examining the construct of assimilative social comparison style and how it and treatment dosage affect IBM treatment outcomes.

In conclusion, the current study offers several potentially important contributions to the IBM literature. First, we replicated findings showing a strong association between perceived credibility and expectancy of treatment and better outcomes in response to IBM. Additionally, we provided evidence that proneness toward psychological reactance may not be a barrier to success in IBM interventions for depression. Further, we identified the degree to which someone relates to or assimilates with IBM treatment scenarios as a powerful indicator of treatment response for both depressive and clinical anger symptoms. This trial also aligns with existing

literature showing null effects for IBM for depression symptoms, which further emphasizes the importance of phenomena related to perception and reaction to IBM interventions that may predict treatment response. To further address the question of who could benefit from these interventions, future research may aim to improve treatment credibility and expectancy as well as enhance the relatability of treatment scenarios in order to promote the success of IBM interventions for depression.

Conflict of Interest Statement

The authors declare they have no conflict of interest.

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