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Exploring aspects of self-reported emotional mental imagery in patients with bipolar disorder

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ABSTRACT

Background and objectives: CBT for patients with bipolar disorder has modest effects. Across disorders, mental imagery has been used to update CBT to increase effectiveness. In order to enhance CBT for bipolar disorder with imagery techniques, research is needed into emotional imagery quality and, related appraisals of imagery and their relationships with mood instability and subsequent behaviour in bipolar disorder.
Methods: Patients with bipolar disorder ($n = 106$), unipolar depression ($n = 51$), creative imagery prone participants ($n = 53$) and participants without a history of a mood disorder ($n = 135$) completed the Dutch Imagery Survey (DImS), an online imagery survey, adapted from the Imagery Interview, assessing self-reported emotional imagery aspects. Imagery quality, appraisals and their self-perceived effects on emotion and behaviour were compared between groups. As unexpected differences within the bipolar group appeared, these were additionally explored.
Results: Imagery appraisals but not imagery quality discriminated between the patient groups and non-patient groups Imagery was perceived as an emotional amplifier in all groups, but this was specifically apparent in bipolar manic and bipolar depressed groups. Only in the bipolar group imagery was experienced to amplify behavioural tendencies.
Limitations: Results need to be replicated using a larger sample of patients with BD who are currently manic or depressed.
Conclusions: Not only quality of imagery, but especially appraisals associated with imagery are differentiating between imagery prone people with and without mood disorder. Imagery amplifies emotion in all groups, but only in those patients with bipolar disorder currently manic or depressed did this influence behaviour.

1. Introduction

Bipolar disorder is a severe mental illness, associated with relapse into mania and/or depression, ongoing mood instability between relapses (Leahy, 2007), high co-morbidity such as addiction (Albanese & Pies, 2004), anxiety (Deckersbach et al., 2014), and high suicide risk (da Costa et al., 2010), despite psychoeducation, psychopharmacotherapy, and/or cognitive behaviour therapy (CBT) (Ye et al., 2016). With small to medium overall effect sizes there is consensus for the need to increase the effectiveness of CBT (Geddes & Miklowitz, 2013; Leahy, 2007; Miklowits, 2008; Stratford et al., 2015). This could be effectuated by targeting precipitating and perpetuating factors for relapse or mood instability (Goodwin et al., 2016). Imagery-based techniques are suggested to influence these precipitating and perpetuating factors and increase the effectiveness of CBT by adding an imagery-based focus (Holmes et al., 2016). Traditionally, CBT focusses on thoughts that take the format of language-like formats (verbal thoughts). However, Holmes et al. (2016) stress that thoughts can also have image-like formats. Concurrently, CBT treatments for several disorders have been enhanced by adding imagery techniques (Ehlers et al., 2005; Hirsch & Holmes,

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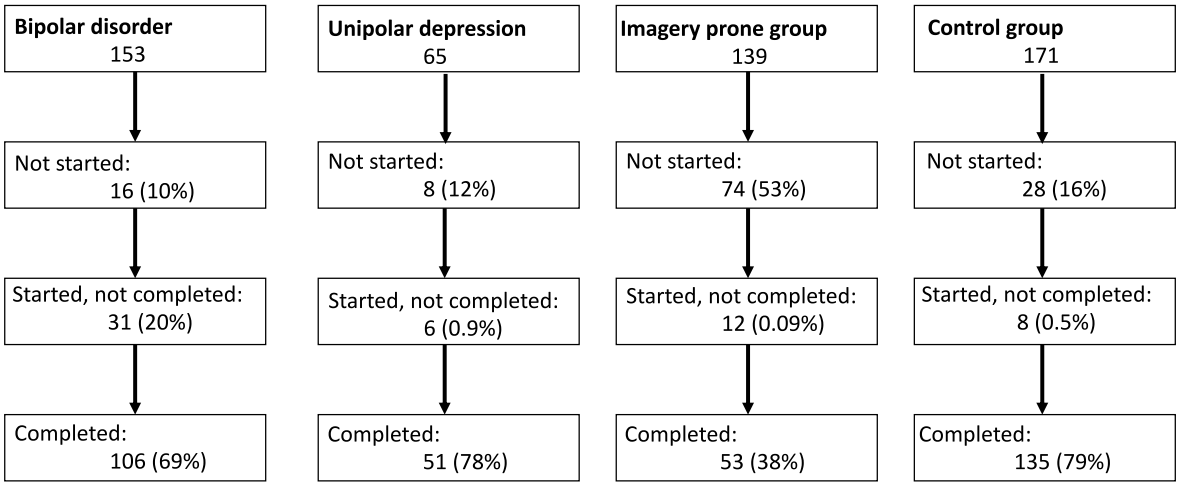

Fig. 1. Flow-chart of inclusion and completion.

2007; Wheatley et al., 2007; Wild & Clark, 2011). However, more research is needed into the relationship between imagery and mood instability during CBT.

Kosslyn and colleagues (Kosslyn et al., 2001) described mental imagery as: "representation and the accompanying experience of sensory information without a direct external stimulus". O'Donnell et al. (2020) differentiate emotional imagery (e.g., imagining a happy face) from non-emotional (e.g., mentally rotating an object). Only emotional imagery appears affected in patients with bipolar disorder, they experience more frequent and more intrusive prospective imagery with a higher impact on daily life and more vivid and "real" negative images (DiSimplicio et al., 2016). These emotional images influence the emotional features of bipolar spectrum disorders (DiSimplicio et al., 2016). Emotional imagery can either reflect a phantasy, real remembered events (flashback imagery), or imagined future events (flashforward imagery). Experimental studies on imagery have shown that emotional imagery, ranging from negative intrusive imagery, to neutral imagery and positive imagery, has a stronger effect on emotion than verbal thinking (Blackwell, 2019; Holmes & Mathews, 2010; Holmes et al., 2008; Moritz et al., 2014).

Emotional imagery appears a transdiagnostic feature in mental disorders, where mood instability is associated with more imagery (DiSimplicio et al., 2016; Moritz et al., 2014). This is particularly relevant for patients with bipolar disorders as they report more compelling and preoccupying prospective suicidal imagery than patients with unipolar depression (Hales et al., 2011) and more vivid, exciting and pleasurable flashforward imagery than patients with unipolar depression (Ivins et al., 2014). This effect is modulated by qualitative imagery properties (e.g., image vividness, perspective, compellingness) (Wilson et al., 2018) and cognitions, such as encapsulated beliefs ("I'm a bad person") (Wild & Clark, 2011) and metacognitions ("something bad will happen") (Morrison, 2001).

Holmes and others proposed that emotional imagery works as an emotional amplifier further influencing motivation and behaviour (Holmes et al., 2008; Ji et al., 2019). That is, imagery appears to amplify mood and in turn has the potential to enhance or decrease behavioural activation. People are more likely to act on those events people have simulated in imagination than on those they have considered verbally in patients with unipolar depression (Renner et al., 2017), in individuals without mental illness (Libby et al., 2007, 2014), and possibly in patients with bipolar disorder (Ivins et al., 2014). In addition, Hackmann et al. (2011) argued that imagery often seems to signal important things about the past, present or future, feels real and true and therefore frequently triggers behavioural responses in addition to their powerful effects on appraisals, emotion and behaviour. Evidence from neuro-imaging studies suggests that mental imagery has substantial overlap with perception in the brain (Pearson et al., 2015), which is believed to be at least in part responsible for the particular effect imagery-based cognition has on emotion and behaviour.

The traditional model of bipolar disorder is a bio-medical model suggesting a genetic or biological vulnerability where stress precipitates the full expression of manic and depressive episodes (APA, 2013). There are a few theory-driven psychological models of bipolar disorder but they are still at an early stage. The interpersonal and social rhythmes model suggests that a combined dysfunction in circadian social rhythms and interpersonal difficulties is key (Frank et al., 2000), and the integrated cognitive model suggests extreme appraisals of changes in internal state and their impact on behaviour provide a core mechanism in maintaining and escalating bipolar symptoms (Searson et al., 2012). However, either of these models explains relapse into mania or depression and inter-episode mood instability and anxiety (Stratford et al., 2015). The above mentioned emotional amplifier model (Holmes et al., 2008) seems more qualified. This model proposes that in patients with bipolar disorder mental imagery amplifies anxiety, mania and depression, which leads to increasing associated beliefs, goals and action-likelihood.

This emotional amplifier model (Holmes et al., 2008) might help to cast light on the specific relationship between imagery and mood instability in patients suffering from bipolar disorder and help choose which imagery intervention could enhance the effects of CBT. This is particularly relevant as there are different imagery interventions targeting different aspects of imagery. For example, some imagery interventions aim to reduce the frequency of imagery by playing Tetris (Holmes et al., 2010), others tax working memory to reduce valence of imagery (van den Hout et al., 2011; van den Hout & Engelhard, 2012). Still other imagery interventions consist of promoting positive imagery de novo (Blackwell & Holmes, 2017) and motivational imagery (Di Simplicio et al., 2020; Renner et al., 2019). Slofstra et al. (2016) differentiated between imagery interventions changing the perceptual aspects of imagery, such as metacognitive imagery interventions, and imagery interventions changing the meaning-related content, such as Imagery Rescripting (ImRs). ImRs aims to update associated appraisals (Holmes et al., 2019) while metacognitive interventions aim to reduce the emotional power of the images by adjusting perceptual qualities of imagery, for example changing the image into a cartoon, which in turn might make associated negative metacognitions, such as "this image means something bad will happen" less convincing. However, there are recent calls for more research (Petit et al., 2021; Slofstra et al., 2016), especially for the identification of aspects of imagery, relevant to particular psychopathological mechanisms such as those in trauma,

Table 1
Demographic characteristics per group.

	Bipolar disorder (*n* = 106)	Unipolar depression (n = 51)	Imagery prone group (n = 53)	Control group (n = 135)	Test statistic
Age (Mean, *sd*)	48.1 (*12.4*)	50.9 (*14*)	20.0 (*2.5*)	27.7 (*11.1*)	F (3, 316) = 109.72, p < .001*
Ethnicity (n, %)					χ^2 (3, 316) = 2.68, p = .047*
European	100 (94.3%)	47 (92.2%)	30 (56.6%)	129 (96.5%)	
Turkish, African, Asian	1 (0.01%)	0 (0%)	0 (0%)	1 (0.7%)	
North American,	1 (0.01%)	2 (3.9%)	1 (1.9%)	4 (3%)	
Other	2 (0.02%)	0 (0%)	1 (1.9%)	1 (0.7%)	
Missing	2 (0.02%)	2 (3.9%)	21 (39.6%)	0 (0%)	
Education level (*n*, %)					χ^2 (3, 337) = 58.01, p < .001*
Higher & academic	32 (30.2%%)	8 (15.7%)	43 (81.1%)	116 (85.9%)	
Middle	63 (59.4%)	37 (72.5%)	10 (18.9%)	12 (8.9%)	
Low	8 (7.5%)	6 (11.8%)	0 (0%)	2 (1.5%)	
Women (*n*, %)	71 (66.7%)	35 (68.6%)	11(50%)	113 (83.7%)	χ^2 (3, 367) = 6.32, p < .001*
Missing info	1 (0.9%)	1 (1.2%)	32 (60.4%)	0 (0%)	
Marital Status (n, %)					χ^2 (3, 342) = 0.5, p = .68
Single no children	18 (17%)	7 (13.7%)	27 (50.9%)	56 (41.5%)	
Single with children	16 (15.1%)	6 (11.8%)	0 (0%)	0 (0%)	
Partner no children	23 (21.7%)	11 (21.6%)	5 (9.4%)	33 (24.4%)	
Partner with children	44 (41.5%)	25 (49%)	0 (0%)	16 (11.9%)	
Other	5 (4.7%)	2 (3.9%)	21 (39.6%)	29 (21.5%)	
Missing info				1 (0.7%)	

Note. * significant difference. Alpha was .05.

social anxiety, or bipolar disorder.

The current study aims to assess a wider variety of aspects self-reported emotional imagery than has previously been considered. These include quality of imagery, appraisals of imagery (i.e., encapsulated beliefs and metacognitions) (Morrison, 2001; Wild & Clark, 2011), and the perceived effects of both on emotion and behaviour. Furthermore, by extending the online adaptation of the Imagery Interview developed by van den Berg et al. (2020), the impact of imagery on mood and behaviour was measured.

Participants were recruited from four groups: patients with bipolar disorder, patients with unipolar depression, imagery prone participants without history of a mood disorder, and participants without history of a mood disorder. Including patients with unipolar depression was one of the recommendations in a recent review article on imagery in bipolar disorder (Petit et al., 2021). In addition, several studies have found differences in emotional imagery between patients with bipolar and unipolar depression, suggesting more vivid and compelling flashforward suicidal imagery (Hales et al., 2011) and more vivid and compelling positive imagery in the bipolar group (Ivins et al., 2014). Similarly, comparing imagery in patients with bipolar disorder to imagery prone individuals without a history of mood disorder helps to identify aspects of imagery that are related to psychopathology and not just to imagery proneness itself.

It is important to note that the sample of patients with bipolar disorder in the present study included not only patients with bipolar disorder who are euthymic, but also patients who are currently manic or depressed. Including these groups is essential for understanding the relationship between imagery and mood instability in patients with bipolar disorder. For example, Hales et al. (2011) included patients with mild hypomanic and depressive symptoms and found indications of differences in mental imagery within the bipolar group. As previous studies found it often difficult to include patients in the active phase of mania or depression (Petit et al., 2021), we expected few patients with mania and depression symptoms and planned analyses treating the patients with bipolar disorder as one group. However, as we were fortunate enough to collect enough data to be able assess these patient groups, we include post-hoc analyses to compare imagery across mood states.

In sum, we compared aspects of self-reported emotional imagery (i.e. quality and appraisals of imagery and it's perceived effect on emotion and behaviour) in patients with bipolar disorder to those in patients with unipolar depression, creative imagery prone participants without history of a mood disorder, and participants who are not creative and are without history of a mood disorder. Based on previous studies we hypothesised that patients with bipolar disorder have stronger appraisals and more frequent, compelling, and vivid imagery; in addition, we expected stronger correlations between imagery and emotion and behaviour responses in patients with bipolar disorder than in patients with unipolar depression, creative imagery prone participants without history of a mood disorder or participants without history of a mood disorder.

2. Method

2.1. Participants

Four groups of participants were included: 1) patients with bipolar disorder; 2) patients with unipolar depression; 3) imagery prone participants without history of a mood disorder, and 4) participants without history of a mood disorder. For the first two groups, patients with a diagnosis of bipolar disorder or unipolar depression attending an outpatient psychiatric clinic of a large hospital in Eindhoven, a specialised centre for bipolar disorder in Utrecht or Eindhoven, were recruited through folders and posters in the clinics. Inclusion criteria were DSM-5 diagnosis of bipolar I or II disorder, cyclothymic disorder or bipolar disorder not specified, and unipolar depression. Patients' diagnoses were retrieved from patient records, as well as their co-morbid diagnoses, the number of episodes, and current medication. Exclusion criteria were current psychosis or current primary alcohol/drug misuse. Imagery prone participants without history of a mood disorder were recruited from a University for Industrial Design, using flyers and posters on campus. Those who identified as imagery prone were invited to participate. To check if this group was indeed imagery prone, their scores on the SUIS (see Table 3) was calculated. This group we shall henceforth refer to as the imagery prone group. A sample of students from Maastricht University and Radboud University were recruited through an online student platform and offered course credits in return for participation in this study. This group is referred to as control group. All participants in the imagery prone group and the control group were excluded if a licensed clinician had previously or currently diagnosed them with a mental illness.

2.2. Procedure

At inclusion participants in care for unipolar depression or bipolar

Table 2
Current mood and trait imagery per group: Means and standard deviations.

Measure	Bipolar Mean (*sd*) *n* = 122	Unipolar Mean (*sd*) n = 55	Imagery prone group Mean (*sd*) n = 58	Control group Mean (*sd*) n = 142	df	*H* statistic	*p*-value	eta^2	Post-hoc analyses		
									Comparisons	*z*-score	*adj. p*-value
ASRM	2.22 *(2.57)*	2.04 *(2.53)*	3.79 *(3.13)*	2.31 *(2.62)*	3	17.78	<.001*	.03	Imagery Prone > Bipolar	−3.71	.001
									Imagery Prone > Unipolar	−3.62	.0015
									Imagery Prone > Controls	−3.48	.002
PHQ-9	5.81 (*5.31*)	11.25 *(7.02)*	5.03 *(4.09)*	4.10 *(3.66)*	3	47.96	<.001*	.10	Unipolar > Bipolar	−4.90	<.001
									Bipolar > Controls	−2.43	.046
									Unipolar > Imagery Prone	−4.63	<.001
									Unipolar > Controls	−6.91	<.001
SUIS	35.64 *(10.83)*	34.31 *(9.55)*	37.59 *(7.71)*	32.96 *(9.29)*	3	11.75	.008*	.02	Imagery Prone > Controls	−3.13	.010

Note: ASRM is Altman Self-Rating Mania scale; PHQ is Patient Health Questionnaire; SUIS is Spontaneous Use of Imagery Scale; * Bonferroni corrected threshold value is alpha = .017. Only significant post-hoc comparisons using Holm's (1979) stepwise adjustment of p values are shown.

disorder were contacted face to face and invited to take part and given additional information if needed. After informed consent was signed, they were send an email with a link to the online questionnaire. The students (both creative control group and the student group) were contacted by mail and phone call to give additional information if needed and check inclusion criteria. They were subsequently sent an online informed consent form and questionnaire. The reliability of the DImS was assessed in a previous study (van den Berg et al., 2020), and found that online assessment was both reliable and feasible.

The Medical Research Ethics Committee (MEC-U) concluded that the current study did not apply to the Medical Research Involving Human Subjects Act (WMO, number: V·77435/W16.017). Local ethics committees from Catharina Hospital, GGzE, and Altrecht subsequently approved this study prior to the start of data collection.

2.3. Materials

The Altman Self-Rating Mania scale (ASRM) is a self-report measure of mania symptom severity. The ASRM consists of five items, each scored on a 5-point Likert scale ranging from 0 ('not more than usual') to 4 ('more than usual most of the time'). Previous research showed good psychometric properties, 85.5% sensitivity and 87.3% specificity, and good test-retest reliability ($r = 0.86$, $p < .001$) (Altman et al., 1997). Findings suggested that a cut-off score of 4 or less is indicative for full symptomatic remission of (hypo)mania (Berk et al., 2008), a score of 5.5 and higher is indicative for (hypo)mania (Altman et al., 1997).

The Patient Health Questionnaire (PHQ-9) is a self-report questionnaire to estimate level of depression. The PHQ-9 comprises nine items covering the diagnostic criteria for major depressive disorder of the DSM-IV. Items are rated from 0 ('not at all') to 3 ('nearly every day') according to increased frequency of experiencing difficulties in each area covered, with a maximum score of 27. Findings suggested that a cut-off score of <6 is indicative for full symptomatic remission of depression and a score of 10 or more is indicative of a moderate depression (Kroenke et al., 2001). The PHQ-9 has good psychometric properties, 73% sensitivity, 94% specificity, α = 0.86, test re-test reliability $r = 0.84$ (Applied Health Sciences Mental Health, 2011; Bajor et al., 2013; Kroenke et al., 2001).

The Spontaneous Use of Imagery Scale (SUIS) measures the general tendency to use visual mental imagery in daily life (non-emotional imagery). The SUIS consists of 12 items, each scored on a 5-point Likert scale with answers ranging from 1 ('never appropriate') to 5 ('always completely' appropriate). Although measuring non-emotional imagery, the SUIS has been used in previous research on imagery in patients with bipolar disorder (Deeprose et al., 2011; Hales et al., 2011; Hales et al., 2011) and at the time of this study no version was available for emotional imagery. The SUIS has a high internal consistency (α is 0.98) in a healthy English-speaking sample and concurrent validity was good when compared to the Vividness items of the Vivid Mental Imagery Questionnaire (Reisberg et al., 2003).

The Dutch Imagery Survey (DImS) measures self-reported emotional imagery and was adapted from the Imagery Interview of Hackmann et al. (1998) and the assessment interview of imagery in psychopathology (Hackmann et al., 2011). The DImS consists of five scales: (I) Imagery frequency, (II) Imagery quality, (III) Appraisals of imagery, (IV) Effect on emotion, and (V) Effect on behaviour. All items of the DImS were rated on a 9-point Likert scale, answers ranging from 1 ('not at all') to 9 ('all the time') to rate the degree to which an item is applicable to them. A full overview of all the items can be found in the supplementary materials (S1). The DImS was validated in a student population (van den Berg et al., 2020), finding a moderate internal consistency (α ranging from 0.71 to 0.84), and when the same image was used a high test-retest correlation (p ranging from .47 to .97).

2.4. Statistical analyses

All instruments in this study (i.e., ASRM, PHQ-9, SUIS) including the five different subscales of the DImS (i.e., Imagery frequency, Imagery quality, Appraisals of Imagery, and perceived Effect on emotion and behaviour), showed significant violations of normality. Therefore, instead of ANOVA analyses, the more conservative non-parametric Kruskal-Wallis ANOVA analysis was employed to compare means across groups. These tests were performed in R (version 3.6.3) using the stats package and the rstatix package (version 0.7.0).

For the measures that show significant effects of group in the omnibus Kruskal-Wallis tests, post-hoc non-parametric pair-wise comparisons between the four groups were performed following Dunn's procedure (Dunn, 1964). We controlled for multiple comparisons with Holm's (1979) stepwise adjustment of p values. Dunn's tests were performed in R using the rstatix package (version 0.7.0).

Due to a sufficiently large sample of manic, depressed, and euthymic groups within the patients with bipolar disorder we include post-hoc analyses that include these three groups and the original three comparison groups. The manic group was defined by an ASRM score of 5.5 or above; the depressed group by a score of 10 or more on the PHQ-9, and the euthymic group by a score of below 6 on the PHQ-9 or a score of 4 or less on the ASRM.

Non-parametric Spearman rank-ordered correlation analyses were

Table 2a
Current mood and trait imagery per group after splitting the bipolar group into three mood states: Means and standard deviations.

	Bipolar			Unipolar Mean (*sd*) n = 55	Imagery prone group Mean (*sd*) n = 58	Control group Mean (*sd*) n = 142	*df*	*H* statistic	*p*-value	eta^2	Post-hoc analyses		
	Euthymic Mean (*sd*) n = 75	Manic Mean (*sd*) n = 20	Depressed Mean (*sd*) n = 23								comparison	*z*-score	*adj. p*-value
ASRM	1.25 (*1.38*)	6.90 (*1.51*)	1.22 (*1.44*)	2.04 (*2.53*)	3.79 (*3.13*)	2.31 (*2.62*)	5	76.44	<.001*	.15	Bipolar Manic > Bipolar euthymic	−7.45	<.001
											Imagery Prone > Bipolar euthymic	−5.24	<.001
											Bipolar Manic > Bipolar Depressed	−6.13	<.001
											Bipolar Manic > Unipolar	−6.28	<.001
											Bipolar Manic > Imagery Prone	−3.70	.0019
											Bipolar Manic > Controls	−6.28	<.001
											Imagery Prone > Bipolar Depressed	−3.74	.0018
											Imagery Prone > Unipolar	−3.62	.0023
											Imagery Prone > Controls	−3.48	.0035
PHQ-9	3.65 (*2.79*)	4.00 (*2.72*)	14.70 (*4.28*)	11.25 (*7.02*)	5.03 (*4.09*)	4.10 (*3.66*)	5	101.61	<.001*	.21	Unipolar > Bipolar euthymic	−6.47	<.001
											Bipolar Depressed > Bipolar Manic	−5.32	<.001
											Unipolar > Bipolar Manic	−4.01	<.001
											Bipolar Depressed > Imagery Prone	−5.87	<.001
											Bipolar Depressed > Controls	−7.44	<.001
											Unipolar > Imagery Prone	−4.63	<.001
											Unipolar > Controls	−6.91	<.001
SUIS	34.87 (*10.45*)	36.85 (*13.07*)	37.13 (*10.19*)	34.31 (*9.55*)	37.59 (*7.71*)	32.96 (*9.29*)	5	13.03	.023	.01	ANOVA not significant		

Note:. ASRM is Altman Self-Rating Mania scale; PHQ is Patient Health Questionnaire; SUIS is Spontaneous Use of Imagery Scale; * Bonferroni corrected threshold value is alpha = .017. Only significant post-hoc comparisons using Holm's (1979) stepwise adjustment of p values are shown.

performed to further explore the relationship between the measures, comparing the five scales of the DImS (Fig. 2) in the bipolar group to the unipolar depressed group, imagery prone group and control group. Since many correlations were considered, the 95% confidence interval for each correlation was presented instead of reporting significance tests for each comparison. In all figures, correlations whose 95% confidence interval do not include a correlation of 0 have been highlighted in red. These confidence intervals were computed empirically based on 10,000 bootstrapped samples from the data using the psych package (version 2.1.3) in R.

Since there is not an appropriate tool to estimate power for a Kruskal-Wallis test, we ran simulated post-hoc experiments based on randomly sampling from the data we observed to estimate the power in our experiment. This suggests this study is powered adequately and there are sufficiently large samples in the sub-groups of the bipolar disorder group (see supplementary material S2).

2.5. Results

In total 345 participants expressed an interest in participating in this study and 65% completed the full package (see Materials section). An overview of participants and attrition per group is presented in Fig. 1. There were no major differences in compliance between the four groups, except for the imagery prone group who were more inclined to express an interest but not fully complete all instruments, χ^2 (3, 498) = 46.78, p < .001. The bipolar and unipolar groups were older and lower educated than the creative imagery prone group and the control group. Half of the information on gender in the imagery prone participants was missing (see Table 1).

2.6. Differences between groups for the self-reported mood measures

First, we evaluated if there were significant differences between the

Table 3
Imagery Aspects using the Dutch Imagery Survey (DImS) per Group.

DImS	Bipolar Mean (*sd*) *n* = 122	Unipolar Mean (*sd*) *n* = 52	Imagery prone group Mean (*sd*) n = 53	Control group Mean (*sd*) n = 137	*df*	*H* statistic	*p*-value	eta^2	comparison	Post-hoc analyses *z*-score	*adj. p*-value
Imagery frequency	5.27 *(2.55)*	4.77 *(2.29)*	6.62 *(1.90)*	5.03 *(1.91)*	3	24.91	<.001*	.05	Imagery Prone > Bipolar	−3.66	.001
									Imagery Prone > Unipolar	−4.28	<.001
									Imagery Prone > Controls	−4.59	<.001
Imagery Quality											
Compellingness	4.79 (*2.06)*	5.18 *(1.99)*	4.64 *(1.61)*	4.08 *(1.84)*	3	17.25	<.001*	.031	Bipolar > Controls	−3.13	.009
									Unipolar > Controls	−3.62	.002
Liveliness	6.36 *(2.44)*	6.55 *(2.18)*	6.14 *(1.48)*	6.01 *(1.83)*	3	10.17	.017	.015			
Appraisals of imagery											
Metacognitions:											
positive	3.78 *(1.97)*	4.28 *(2.09)*	3.46 *(1.84)*	3.59 (*1.77)*	3	5.25	.15	.005			
negative	1.71 (*1.40)*	1.98 *(1.74)*	1.13 *(0.31)*	1.28 *(0.84)*	3	15.73	<.001*	.027	Bipolar > Controls	−3.24	.007
									Unipolar > Controls	−2.71	.033
Encapsulated beliefs											
positive	3.52 *(2.11)*	3.30 *(2.15)*	3.67 *(2.02)*	3.47 *(2.11)*	3	1.16	0.76	−.004			
negative	2.10 *(1.56)*	2.29 *(1.95)*	2.01 *(1.48)*	1.90 *(1.47)*	3	1.52	0.68	−.003			
Effect on Emotion											
positive	4.21 *(2.83)*	4.13 *(2.96)*	4.22 *(2.79)*	4.40 *(2.67)*	3	0.75	.86	−.005			
negative	1.84 *(1.47)*	2.80 *(2.38)*	1.36 *(0.55)*	1.53 *(1.13)*	3	12.05	.007	.019			
Effect on Behaviour	3.84 *(2.56)*	4.11 *(2.57)*	3.33 *(1.96)*	3.60 *(2.35)*	3	2.11	.55	−.002			

Note. DImS is Dutch Imagery Survey consisting of: Frequency of imagery, Quality of imagery, Appraisals of imagery, Effect on emotion, and Effect on behaviour. * Bonferroni corrected threshold value is alpha = .005; Only significant post-hoc comparisons using Holm's (1979) stepwise adjustment of p values are shown.

four groups for each of the three mood and trait imagery scales. Table 2 presents the average ASRM, PHQ-9, and SUIS scores for the four groups. The imagery prone participants scored highest on mania, but below the cut off score for hypo mania, the unipolar depressed group on depression, and all groups scored higher on non-emotional imagery proneness than the control group.

Additional post-hoc analyses comparing three different mood states within bipolar group (euthymic, manic, and depressed) to the unipolar depressed group, imagery prone group and the control group are presented in Table 2a. The bipolar manic group scored highest on the ASRM mania scale, the bipolar and unipolar depressed groups highest on the PHQ-9 depression scale.

2.7. Differences between groups for the self-reported emotional imagery

We evaluated if there were significant differences between the original four groups for self-reported emotional imagery. Table 3 contains the average scores per group for each of the five DImS scales measuring self-reported aspects of emotional imagery.

Additional post-hoc analyses after splitting the bipolar group into euthymic, manic and depressed mood states, are reported in Table 3A.

2.7.1. Imagery frequency (DImS)

There was a significant difference between the original four groups for the mean Frequency scores, H (3) = 24.91, p < .001. Post-hoc comparisons revealed that images were reported to occur more frequently in the imagery prone group than in all other groups.

Additional post-hoc analyses after splitting the bipolar group into mood states, showed that the imagery prone group experienced imagery more frequently than the bipolar group who were currently euthymic, the control group, and the group with unipolar depression.

2.7.2. Imagery quality (DImS)

Although there were no significant differences between the original four groups for Liveliness of imagery, H (3) = 10.17, p = .02, significant differences for Compellingness scores appeared, H (3) = 17.25, p = .0006. Post-hoc comparisons revealed that images were reported to be experienced as more compelling in the bipolar group than in the control group, and in the group with unipolar depression compared to the control group.

Additional exploratory post-hoc analyses after splitting the bipolar group into mood states, showed that both the bipolar depressed and unipolar depressed groups experienced imagery as more compelling than the control group.

2.7.3. Appraisals of imagery (DImS)

There was a significant difference between the four groups for Negative metacognitions, H (3) = 15.73, p < .001. Post-hoc comparisons revealed that both the bipolar group and the group with unipolar depression reported more associated Negative metacognitions of their images than the control group. No significant differences for Positive metacognitions were found, nor for Positive and Negative encapsulated beliefs.

Additional post-hoc analyses showed that the bipolar depressed group experienced more associated negative metacognitions of their images than three groups: bipolar euthymic, imagery prone participants, and the control group. In addition, the bipolar manic group experienced more associated negative metacognitions than the control group.

2.7.4. Perceived effect on emotion (DImS)

There were no significant differences between the four groups for Negative emotions, H (3) = 12.05, p = .007, nor for Positive emotion, H (3) = 0.75, p = *.86*.

Additional post-hoc analyses with the bipolar group split indicate a significant difference for Negative effect on emotion, H (5) = 16.78, p = *<.001,* that images had a greater self-perceived effect on negative emotions in the group with unipolar depression than in the control group.

Table 3a
Aspect of imagery according to the DImS per Group after Splitting the Bipolar Group into 3 Different Mood states: Means and Standard Deviations.

DImS	Bipolar Mean (*sd*)			Unipolar Mean (*sd*) n = 52	Imagery prone group Mean (*sd*) n = 53	Control group Mean (*sd*) n = 137	df	H statistic	p-value	eta^2	Post-hoc comparison	Analyses *z*-score	*adj. p*-value
	Euthymic Mean (*sd*) *n* = 72	Manic Mean (*sd*) n = 18	Depressed Mean (*sd*) n = 20										
Imagery frequency	5.18 (2.32)	5.89 (3.02)	5.05 (2.89)	4.77 (2.29)	6.62 (1.90)	5.03 (1.91)	5	26.79	<.001*	.047	Imagery Prone > Bipolar Euthymic	−3.68	0.003
											Imagery Prone > Unipolar	−4.28	.0003
											Imagery Prone > Controls	−4.59	<.0001
Imagery Quality rowhead													
Compellingness	4.48 (1.95)	5.36 (2.32)	5.42 (2.06)	5.18 (1.99)	4.64 (1.61)	4.08 (1.84)	5	22.88	<.001*	.039	Bipolar Depressed > Controls	−3.04	.033
											Unipolar > Controls	−3.62	.005
Liveliness	6.28 (2.44)	6.50 (2.35)	6.50 (2.61)	6.55 (2.18)	6.14 (1.48)	6.01 (1.83)	5	10.41	.064	.012			
Imagery appraisals rowhead													
Metacognitions: rowhead													
positive	3.69 (1.90)	3.66 (2.12)	4.22 (2.12)	4.28 (2.09)	3.46 (1.84)	3.59 (1.77)	5	6.88	0.23	.004			
negative	1.35 (0.88)	2.09 (1.66)	2.68 (2.08)	1.98 (1.74)	1.13 (0.31)	1.28 (0.84)	5	35.84	<.001*	.066	Bipolar Depressed > Bipolar euthymic	−4.19	.0004
											Bipolar Depressed > Imagery prone	−4.50	<.0001
											Bipolar Depressed > Controls	−4.91	<.0001
											Bipolar Manic > Controls	−3.04	.028
Encapsulated beliefs rowhead													
positive	3.21 (1.90)	4.93 (2.45)	3.33 (2.13)	3.30 (2.15)	3.67 (2.02)	3.47 (2.11)	5	8.39	0.14	.007			
negative	1.74 (1.17)	2.59 (1.78)	2.97 (2.09)	2.29 (1.95)	2.01 (1.48)	1.90 (1.47)	5	9.19	0.10	.009			
Effect on Emotion rowhead													
positive	3.90 (2.79)	5.28 (3.03)	4.33 (2.68)	4.13 (2.96)	4.22 (2.79)	4.40 (2.67)	5	4.64	0.46	−.001			
negative	1.61 (1.20)	1.67 (0.96)	2.94 (2.26)	2.80 (2.38)	1.36 (0.55)	1.53 (1.13)	5	16.78	<.001*	.025	Unipolar > Controls	−3.30	.015
Effect on Behaviour	3.52 (2.46)	3.84 (2.74)	5.09 (2.59)	4.11 (2.57)	3.33 (1.96)	3.60 (2.35)	5	7.68	0.18	.006			

Note: DImS = DImS is Dutch Imagery Survey after splitting the bipolar group into 3 different mood states: consisting Frequency of imagery, Quality of imagery, Appraisals of imagery, Effect on emotion, and Effect on behaviour. * Bonferroni corrected threshold value is alpha = .005. Only significant post-hoc comparisons using Holm's (1979) stepwise adjustment of p values are shown.

2.7.5. Perceived effect on behaviour (DImS)

There were no significant differences between the four groups for perceived Effect on behaviour, H (3) = 2.11, p = .55.

Additional post-hoc analyses after splitting the bipolar group into the euthymic, manic and depressed mood states, revealed no significant differences between groups for self-reported Effect on behaviour, H (5) = 7.68, p = .18.

2.8. Correlations between DImS subscales

Fig. 2 presents the Spearman correlations between the perceived effect of imagery on behaviour, positive emotions, and negative emotions (as measured by the DImS scale) and other measures of imagery and mood for each of the four participant groups. Rather than conduct a large number of significance tests, the 95% bootstrapped confidence intervals are presented for an exploratory analysis.

Among the various relationships, a few are of note. Focusing first on perceived effect of imagery on behaviour, imagery compellingness and positive metacognitions about imagery showed reliable positive correlations with behaviour in all groups. However, image frequency, liveliness of imagery, and positive encapsulated beliefs about imagery showed reliable positive correlations with behaviour only for participants in the bipolar group. For the effect of imagery on positive and negative emotions, across all groups Positive appraisals (both Encapsulated beliefs and Metacognitions) about imagery correlated significantly with Positive emotions (note: exploratory analyses suggest that this correlation was especially high in the bipolar manic group, r = .64), and Negative Appraisals (both Encapsulated beliefs and Metacognitions) with Negative emotions, especially in the bipolar depressed group, r = .90. Other measures differed across groups.

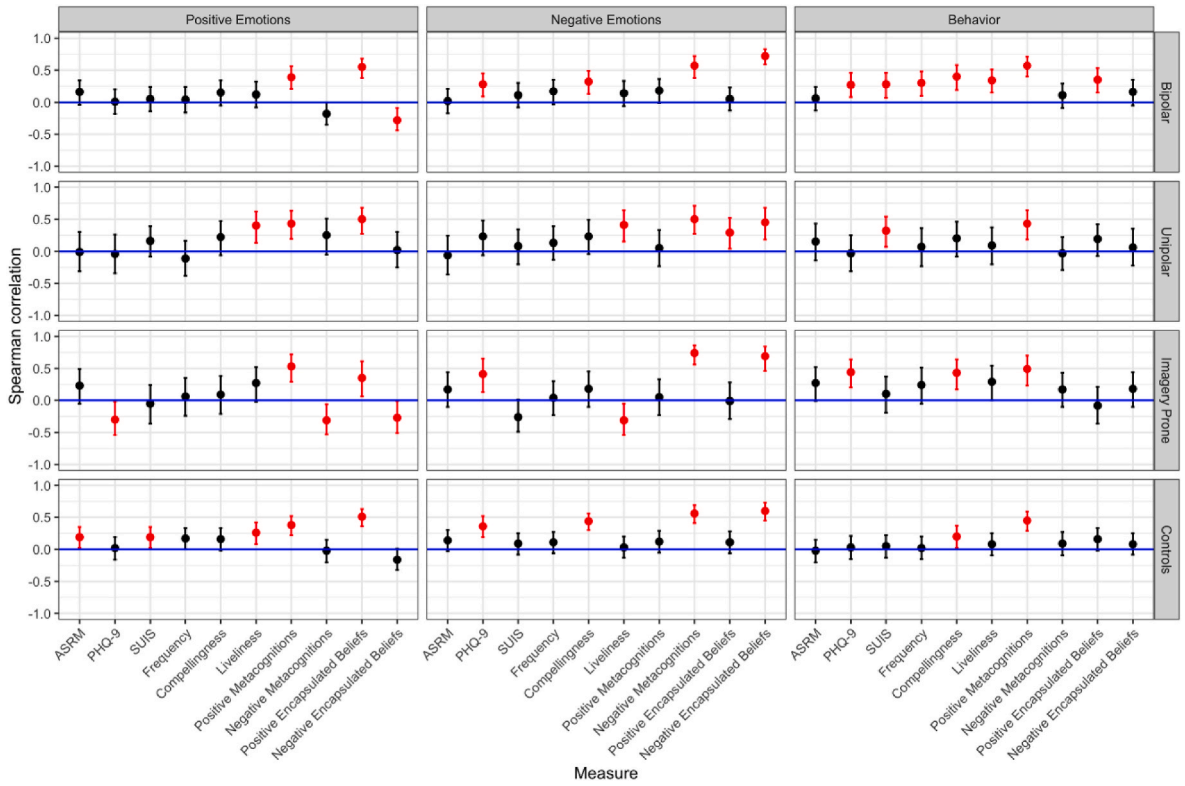

Fig. 2. 95% Bootstrapped Confidence Intervals for Spearman Rho Correlations between total scores on ASRM, PHQ and SUIS and DImS Imagery Characteristics, and DImS Scales Positive Emotions, Negative Emotions and Behaviour, separately for the four groups

Note. Spearman correlation between perceived effect of imagery on Behavior, Positive Emotions, and Negative Emotions (columns) and measures of Mania (ASRM), Depession (PHQ-9), Imagery (SUIS), as well as Imagery Frequency, Quality and Appraisals of imagery form the DImS (indicated along x-axis). Correlations are presented separately for the four participant groups (rows). A red point indicates a correlation whose confidence interval does not include 0. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3. Discussion

We explored aspects of self-reported emotional imagery in patients with bipolar disorder compared to patients with unipolar depression, creative imagery prone participants without current of history of mental illness, and controls without current of history of mental illness. Studies on imagery in bipolar disorder often exclude patients with mania or severe depression and only include participants who are euthymic and sometimes depressed or hypomanic. As this might influence findings, we included euthymic, but also presently manic or depressed patients with bipolar disorder in the present study. Initially we did not anticipate to be able to assess patients in an active mood state (mania or depression). However, we were fortunate to include a small group of such patients. We therefore added additional post-hoc analysis We will first discuss the comparisons between the original four groups, then we will discuss the additional post-hoc findings further differentiating our results per mood state within the bipolar group as a whole.

Our first cluster of findings concern the comparison of the original four groups. First, these findings suggest that patients with bipolar disorder are similarly prone to using non-emotional imagery (SUIS) as patients with unipolar depression, creative imagery prone participants and controls. Of the four groups, only the Imagery prone group disorder differed from the controls group. This general pattern is consistent with previous findings (DiSimplicio et al., 2016). When splitting the bipolar group into mood states we, again, found no differences in non-emotional imagery. Future studies might consider using the more recently developed E-SUIS (Donnell et al., 2020), PIT or IFIS (Di Simplicio et al., 2019), as these measures are better equipped than the SUIS for measuring emotional mental imagery proneness. They were not available, however, when we started our study.

Furthermore, our findings suggest that patients with bipolar and unipolar depression, rate their emotional imagery as more compelling than the control group. This is in line with studies suggesting that imagery can be considered a transdiagnostic feature and that higher psychopathology levels are associated with more compelling imagery (DiSimplicio et al., 2016; Hales et al., 2011; Moritz et al., 2017). However, the imagery prone group reported similarly compelling imagery as the bipolar (depressed) group and the group with unipolar depression. Therefore, imagery quality seems not to be the most critical imagery aspect differentiating psychopathology from healthy individuals. The present study shows that patients in the bipolar and unipolar depression groups do differ from imagery prone participants, in a higher level of negative metacognitions (for example, “having this image means that I will relapse”) but lower imagery frequency. So, although imagery quality (i.e., higher imagery compellingness) appears not a unique feature for psychopathology, some aspects of imagery do seem to interact with psychopathology, in the sense that more imagery-related negative appraisals co-occur with more severe psychopathological symptoms. This finding appears consistent with previous studies stressing the unique features of appraisals of internal states in bipolar disorder (Dodd et al., 2013; Jones et al., 2006).

Another important finding was that the bipolar group as a whole varied greatly in aspects of imagery which we further explored. Phasic differences appeared quite critical, therefore we added post-hoc additional analyses comparing euthymic, manic and depressed bipolar groups with our original control groups: the unipolar depressed group, imagery prone participants without history of mood disorder, and participants without history of a mood disorder. We found that, despite the imagery prone group having more frequent imagery, the bipolar euthymic group was not significantly different from imagery prone

participants in other imagery related aspects. However, when manic or depressed, bipolar patients experienced more compelling imagery, with more negative appraisals and, when depressed, perceived more effects of imagery on negative emotions and especially behaviour than the control group.

In hindsight, it would have been preferred to use pre-specified sub-groups to explore differences in mental imagery within the bipolar group. In addition, the findings of these sub-groups need to be replicated using larger sample sizes of patients who are currently depressed and or manic, as current cell sizes for the bipolar groups that are currently manic and depressed were quite small (20 and 23 respectively). However, our preliminary findings suggest that future studies that compare bipolar patients to other groups, need to be sensitive to bipolar mood states. Generalising from results using only bipolar euthymic patients might eventually prove to produce inconclusive findings.

Another important finding concerns the impact of emotional mental imagery on emotion and behaviour. We found that self-reported emotional imagery was correlated with a perceived effect on emotional experiences in all groups. To put this in other words, all groups experience imagery as amplifying their emotional state. This seems in contrast with several studies (Hales et al., 2011; Hales et al., 2011; Ivins et al., 2014) that found a greater emotional impact of imagery in patients with bipolar disorder compared to unipolar and healthy control groups. That was not the case in our study. However, our exploratory analyses indicated that within the bipolar group the bipolar patients in a depressed and manic state experienced this mood amplifying effect stronger than the other participants in our study. This supports previous research findings by O'Donnell et al. (2017) that engaging in imagery amplified mood in participants scoring higher on hypomanic-like experiences. All in all, the associations we found are in line with Holmes' model (Holmes et al., 2008) that imagery has a special role amplifying mood in bipolar disorder, but our study adds that this is foremost apparent in the bipolar patients in a manic or depressed state. As put before, additional research is essential as this conclusion is based on exploratory analyses.

Finally, where all groups indicated a relationship between imagery and its impact on people's emotional states, only patients with bipolar disorder, reported imagery to also impact their subsequent behaviour (for example, "having this image of a BMW, makes me more likely to want to buy one"). Although levels of perceived effect on behaviour did not differ across groups, when looking at associations between aspects of imagery and effect on behaviour, in the bipolar group, imagery is not only experienced as an enhancer of mood but also appears to be experienced as amplifying behavioural tendencies. These effects of imagery on subsequent behaviour are also reported in previous research with patients suffering from bipolar disorder. For instance, Ivins et al. (2014) described that patient with bipolar disorder reported more flashforward imagery than patients with unipolar depression. This flashforward imagery was experienced as signs that positive outcomes would actually happen in life and, quite strikingly, were often followed by participants' determination to enact the imagined scenario. This idea resonates with clinicians' experiences of patients suffering from bipolar disorder, especially when manic, who act on images such as buying several expensive cars or handing out presents. A similar relationship with imagery and behaviour was described by Hales et al. (2011) who reported that patients suffering from bipolar disorder reported more compelling and preoccupying prospective suicidal imagery than unipolar depressed patients and were more inclined to act on their suicidal images.

While refraining from over-interpreting current findings, an outlook on clinical implications seems relevant. As imagery quality did not differentiate between healthy imagery prone individuals and the bipolar group, interventions on imagery quality may not be the best way to enhance CBT in patients with bipolar disorder. CBT for this group could better focus on imagery-related negative appraisals and on the mood and behaviour amplifying effects of imagery, especially in patients in a depressed or manic state.

A number of strengths and weaknesses of the present study have to be mentioned. Strengths include the following: 1) multiple control groups linked by mood and imagery proneness in addition to a standard control group without mental illness; 2) use of an online adaptation of an idiosyncratic interview, the Imagery Interview, allowing for a larger sample size; 3) inclusion of patients with both mania and depression which were often excluded in previous studies, and 4) stringent statistical testing, using non-parametric tests with Bonferroni corrections and bootstrapping with reliability intervals. A weakness of the study is that the groups were not equal in size and there were large differences in demographics such as age and education level. Moreover, over a third of the demographic ethnicity and gender data in the Imagery prone group is missing. Following, the findings need replication using better controlled groups, including formal screening for psychopathology in the control groups. Furthermore, the current study investigated cross-sectional relationships, so causality between variables was not explored. Imagery and pathology are probably two dimensions, where more pathology is transforming self-reported emotional imagery into pathological imagery, but the causal relationships have to be investigated experimentally. In addition, our imagery group scored highest on mania symptoms. Therefore, future studies need to check for other confounding variables, i.e. other pathology than the one screened for in this study, explaining the differences between groups. Importantly, the post-hoc analysis looking at differences within the bipolar group need to be replicated using larger samples in a study using pre-specified sub-groups. Last, additional research is needed into the validity of the DImS and its stability over periods of time. Participants might have experienced different images with various valences over the week prior to one selected for the DImS.

Although further research is needed to replicate these findings, the present study increases our understanding of the role imagery plays in mood instability. The results show that imagery *quality* appears not to be a unique feature to bipolar disorder or psychopathology. The major difference between psychopathology or no psychopathology in imagery prone people, are immediate *appraisals* of imagery. Moreover, we could although exploratory, identify imagery aspects specific for bipolar patients. That is, where imagery acted as an emotional amplifier in all groups, this was specifically apparent in bipolar patients in a manic or depressed state. Moreover, only patients in the bipolar group experienced imagery to amplify behavioural tendencies. These findings, when replicated, have implications for imagery focused CBT applications in bipolar disorder. In addition to updating appraisals of imagery, targeting the effect of images on mood and subsequent behaviour could enhance effects of CBT.

CRediT authorship contribution statement

K.C. van den Berg: first author, participated in the concept, Conceptualization, design, analyses, Formal analysis, writing and revision of the document, Writing – review & editing. **M. Voncken:** participated in the concept, Conceptualization, design, writing and revision of the document, Writing – review & editing. **A.T. Hendrickson:** participated in the analyses, Formal analysis, writing, Writing – original draft, revisions of the document, Writing – review & editing. **M. Di Simplicio:** participated in the revisions of the article, Writing – review & editing. **E.J. Regeer:** participated in the revisions of the article. **L. Rops:** participated in the revisions of the article, Writing – review & editing. **G.P.J. Keijsers:** participated in the concept, Conceptualization, design, analyses, Formal analysis, writing and revision of the document, Writing – review & editing.

Declaration of competing interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants;

participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2023.101861.

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