Key words: imagery, bipolar disorder, assessment, psychometric characteristics, mood

Highlights

- DImS was valid and reliable in detecting quality and appraisals of imagery and it's perceived effect on emotion and subsequent behaviour
- DImS was suitable for further research exploring imagery in mental disorders
- Participants were healthy, female, high educated students
- Findings need to be replicated in a clinical population

Data is available from first author.

Abstract

Objective: Imagery appears to play an important role in mood variability, a core symptom of patients suffering from bipolar disorder. The present study aimed to explore the validity and reliability of an online self-report measure of imagery, the Dutch Imagery Survey (DImS). The DImS is an adaptation of the Imagery interview used in research on imagery in mental disorders. The present study additionally explored the ability of the DImS to detect relationships between self-reported imagery and subsequent mood and subsequent behaviour.

Method: 135 students completed the DImS and additional mental imagery and mood questionnaires. For re-test reliability, 42 students completed the survey again within two days.

Results: Internal consistencies and test-retest scores of the five scales of the DImS were reasonable. Imagery Quality correlated with Emotions, and to a lesser degree with Behaviour. Positive Appraisals correlated with Positive Emotions, Negative Appraisals with Negative Emotions, and Positive appraisals with Behaviour. Frequency of Imagery, Imagery Quality and Positive Appraisals correlated with elevated mood. Imagery Quality and Negative Appraisals correlated with low mood. The DImS took approximately 15 minutes to complete.

Limitations: Re-test reliability was limited due to participants changing their dominant image. Results need to be replicated in a clinical sample.

Conclusions: Psychometric findings with the DImS appeared reasonable and consistent and showed that, in line with other recent studies, imagery is related to current mood and to both self-perceived emotion and subsequent behaviour. These findings suggested that the DImS is suitable to study the role of imagery in bipolar mood variability.

Image Qualities and Mood Variability: Evaluating the Utility of an Imagery Survey for Bipolar Disorder

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Limitations: Re-test reliability was limited due to participants changing their dominant image. Results need to be replicated in a clinical sample.

Conclusions: Psychometric findings with the DImS appeared reasonable and consistent and showed that, in line with other recent studies, imagery is related to current mood and to both self-perceived emotion and subsequent behaviour. These findings suggested that the DImS is suitable to study the role of imagery in bipolar mood variability.

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Practitioner Points

- DImS is valid and reliable in detecting quality and appraisals of imagery and its effects on both emotion and subsequent behaviour
- DImS appears suitable for further research exploring imagery in mental disorders
- Participants were healthy, female, highly educated students; findings need to be replicated in a clinical population

Data are available from first author.

1. Introduction

The DSM 5 defines bipolar disorder as a chronic and severe condition characterised by episodes of extreme moods, mania (or hypomania) and depression (American Psychiatric Association, 2013). Bipolar disorder afflicts 1.9% to 2.4% of the general population (Regeer et al., 2004; Ten Have et al., 2002). This disabling disorder is associated with high inter-episode distress and with ongoing mood swings (mood variability), high suicide risk, and high co-morbidity with other mental health problems especially anxiety (McElroy et al., 2001; Simon et al., 2004). Current standard interventions focus on managing symptoms and consists of pharmacotherapy and psychological interventions, predominantly psycho-education and cognitive behaviour therapy (Goodwin et al., 2016; Kupka et al., 2015; Nice, 2018). Despite these interventions, 50% of patients do not recover within one year, only 25% achieve full recovery (Leahy, 2007), and 60% relapse again within two years (Geddes and Miklowitz, 2013). There is a consensus for the need to update cognitive behavioural interventions for patients suffering from bipolar disorder, and increase their effectiveness, aiming at not only managing symptoms, but also at targeting perpetuating or precipitating factors (including symptoms).

One such perpetuating or precipitating factor of mood variability in bipolar disorder might be mental imagery (Holmes et al., 2011). Pearson and colleagues (Pearson et al., 2015) describe mental imagery as: “representation and the accompanying experience of sensory

information without a direct external stimulus". This representation can either reflect a phantasy, real remembered event (flashbacks) or imagined future even (flashforward imagery).

Mental imagery appears a transdiagnostic feature in mental disorders, and is associated with mood variability across clinical and non-clinical populations (DiSimplicio et al., 2016) and several studies suggest this might be particularly relevant for bipolar disorders. That is, bipolar disorder is associated with more vivid imagery, higher trait imagery, and greater impact of intrusive imagery of future events as compared to healthy controls (Holmes et al., 2011). Higher mood instability in patients with bipolar disorder was associated with greater impact of prospective or flashforward imagery. In addition, patients suffering from bipolar disorder report more compelling and preoccupying prospective suicidal imagery than unipolar depressed patients (Hales et al., 2011) and more vivid, exciting and pleasurable flashforward imagery than patients with unipolar depression (Ivins et al., 2014). Results of a recent experimental study by O'Donnel, Di Simplico, Brown, Holmes and Burnett Heyes (2017) indicate that mental imagery also plays a causal role in mood changes in in people with subclinical hypomanic features.

All in all, the above findings support the theory of Holmes and colleagues that mental imagery acts as an "emotional amplifier", thus driving mood changes (Holmes et al., 2008a; Ng et al., 2016). Holmes et al. and Ng at al. argue that positive imagery amplifies positive mood, and intrusive negative imagery amplifies negative mood through a direct effect on emotion, as well as through instant interpretations of images, driving further associated beliefs, goals and action likelihood (all strengthened by imagery). Indeed, symptom severity in bipolar disorder (and also in several other mental disorders) has been linked to increased trait imagery, more vivid prospective imagery (Holmes et al., 2011; Moritz et al., 2017).

Not only in bipolar disorder also several other mental disorders appear linked with specific aspects of imagery. Studies on imagery and mental disorder range from studying general imagery processing to studying intrusive target imagery for treatment. All considered to amplify emotion. For example, depression is linked with more intrusive retrospective imagery and less positive imagery (Holmes et al., 2016), trauma is associated with vivid intrusive retrospective imagery (Ehlers and Steil, 1995), social anxiety with flashforward imagery with encapsulated beliefs (Wild and Clark, 2011), and obsessive compulsive disorder with vivid and compelling imagery with metacognitions (Brewin et al., 2010). Therefore, mental imagery is considered a transdiagnostic feature of mental disorders (Brewin et al., 2010; DiSimplicio et al., 2016; Holmes et al., 2007). In a variety of mental disorders added imagery interventions are proposed to enhance the effectiveness of cognitive behavioural (CBT) interventions. For example updating appraisals of imagery has helped improve effectiveness of CBT for social phobia (Wild and Clark, 2011), targeting vividness of imagery during exposure and Eye Movement Desensitisation and Reprocessing (EMDR) helped improve CBT treatment in patients suffering from Post-Traumatic Stress Disorder (PTSD) (Ehlers et al., 2005).

Variations in imagery between mental disorders allow for different possibilities for enhancing the effect of CBT. This is particularly relevant in bipolar disorders, where imagery might play a pivotal role in mood variation, and might be different in manic, depressed or stable mood states. It warrants further exploration of what imagery aspects (e.g., quality or appraisals) are correlated with elevated and low mood in bipolar disorder, allowing for finetuning imagery interventions. More specifically, we need to study how much of the amplification of emotions and associated behaviour in patients with bipolar disorder is related to the *quality* of the image itself (e.g., vividness and compellingness) and how much is related to the instant *appraisals* (e.g., encapsulated beliefs, metacognitions) of the imagery.

Di Simplico and colleagues (DiSimplicio et al., 2016) offer a comprehensive overview of imagery assessments used with patients suffering from bipolar disorder. Imagery assessments vary between non-emotional imagery, (neuropsychological assessments); subjective domain measures, (such as measures of imagery vividness, impact of imagery) and interviews identifying target imagery for treatment. The Imagery interview, devised by Hackmann, Surraway and Clark (Hackmann et al., 1998) is the most used tool for target imagery assessment. Although it aims to identify a specific target image for treatment purpose, it assesses all relevant imagery aspects and its impact on emotion and subsequent behaviour relevant when studying the role of imagery on mood variability in patients suffering from bipolar disorder (Day et al., 2004; Hackmann et al., 2000; Laing et al., 2016; Lockett et al., 2012; Morrison et al., 2002; Ritter and Stangier, 2016; Schulze et al., 2013). The Imagery interview has been used in research in various mental disorders and has been adapted multiple times (Pearson et al., 2013). In general, studies start the Imagery interview after explaining the definition of imagery using several examples. Participants are asked during the interview to recall a recurrent image from when they last felt anxious and to describe the imagery properties (e.g., frequency of image, modality e.g. visual, auditory etc., viewpoint: field perspective and/or observer perspective) and its emotional valence. Latter studies (Day et al., 2004; Laing et al., 2016; Morrison et al., 2002; Ritter and Stangier, 2016; Schulze et al., 2013) added questions about appraisals of imagery. For instance, items on encapsulated beliefs were added to the Imagery interview by asking participants what meaning they thought the image revealed about themselves, others and the world and metacognitions were explored by asking participants for instance if they thought keeping the image in mind influenced subsequent events. Most Imagery interview studies used experienced clinical psychologists to rate the answers. Typically, interviews varied in duration from 30 minutes to 120 minutes and studies' number of participants varied between

seven and 30. Studies using the Imagery interview and subsequent adaptations, examined amongst others, imagery in social phobia, agoraphobia, body dysmorphic disorder, psychosis, and schizophrenia. The psychometric properties of the Imagery interview have not been formally tested, however findings from Osman and colleagues (Osman et al., 2004) offered preliminary indications of adequate test re-test reliability. Recently, an Experience Sampling Method was used to explore spontaneous visual related imagery-based processing and its perceived effect on emotion (Slofstra et al., 2018). This study did not explore all different aspects of imagery and its relationship with mood variability and effect on subsequent behaviour like the Imagery interview, but explores general spontaneous imagery-based processing and its relationship with emotion.

In order to increase our understanding of the impact of imagery aspects on mood variability in bipolar disorder, there is a call for quantitative analyses exploring the role of imagery using larger samples (Osman et al., 2004), allowing for more reliable comparisons between aspects of imagery in different mood states in bipolar disorders in larger numbers of participants. Although the Imagery interview is clinically very useful in individual case formulation, it is relatively time-consuming and resource heavy when used in research with a larger number of participants. In line with Sloftra and colleagues (Slofstra et al., 2018), the present study aimed to investigate general self-reported imagery-based processing, exploring all aspects of imagery and their relationships with both emotion and subsequent behaviour similar to the Imagery interview. The Dutch Imagery Survey (DImS) was developed based on the Imagery interview and its subsequent multiple adaptations (Day et al., 2004; Hackmann et al., 2000; Laing et al., 2016; Lockett et al., 2012; Morrison et al., 2002; Ritter and Stangier, 2016; Schulze et al., 2013), including the comparable assessment interview described by Hackmann, Bennt-Levy, and Holmes in 2011. The aim of the DImS was to explore general aspects of imagery in bipolar disorder and its relationships with both, mood

and subsequent behaviour. In line with the Imagery interview, the DImS measures five aspects of general imagery: imagery frequency, imagery quality, appraisals of imagery, perceived effect on emotion and perceived effect on subsequent behaviour. The present study first evaluated the feasibility of the DImS in a student population. Students are relatively easy to recruit, and allows avoiding unnecessary burdening of patients. Based on the studies reviewed we hypothesised that the DImS reliably and consistently measures aspects of general imagery and its perceived effect on both emotion and behaviour. In addition, we hypothesised that current high and low mood correlates with aspects of general imagery, and that both quality of imagery and appraisals of imagery correlate with self-reported effect on both emotion and subsequent behaviour. Finally, we hypothesised that administering the DImS is less time consuming than administering the Imagery interview.

2. Methods

2.1 Participants

The study was advertised on the online student platform SONA. Dutch speaking students from Maastricht University and Radboud University were invited to send an email when they were interested in participating in a survey on imagery in return for course credit. They were subsequently sent an invitation with a link using Research Manager. Research Manager is a software tool for collecting data via a secure email server conform guidelines of Good Clinical Research Practice. Surveys were filled in anonymously. A total of 171 students expressed interest, of which 142 filled in the survey and 135 students completed all instruments. Most participants were female (84%), white European (96%) with higher vocational and academic education (86%), with a mean age of 28 year (*SD* = 11). After completion, all participants were invited to fill in the DImS a second time within two days. Forty-two students did so.

In order to get some additional anecdotal information on feasibility of the online administration of the DImS, six participants were randomly approached for a telephone interview administration of the DImS. This took place within the first two months of data collection.

2.2 Materials

2.2.1 Dutch Imagery Survey (DImS)

The DImS consisted of five scales: (I) Imagery Frequency, (II) Imagery Quality, (III) Appraisals of Imagery, (IV) Effect on Emotion, and (V) Effect on Behaviour. The DImS started with an elaborate definition of imagery based on the instructions used in a previous imagery study (Hales et al., 2011) and used text, pictures and a small film to explain and illustrate imagery. Participants were subsequently asked to recall and describe an example of an image that is typical of the imagery they have experienced over the previous fourteen days. Similar to the Imagery interview, the participants were instructed to recall this image and keep this image in mind while answering the subsequent questions regarding imagery.

All items of the DImS were in Dutch and 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. The Imagery Frequency scale (I) comprised one item. Participants were asked to rate how frequently they thought in images during the previous fourteen days. The Imagery Quality scale (II) consisted of 12 items. Five items concerned image properties, i.e. the degree in which the image was a fantasy, a flashback, or a flashforward, the degree in which the image was seen through my own eyes’ or ‘as an observer’. The remaining seven items consisted of questions relating to image vividness and compellingness, asking participants to rate how vivid, real and compelling the image felt. The Appraisals of Imagery scale (III) consisted of 14 items and comprised two subscales. The Encapsulated Beliefs

subscale (IIIa) consisted of six items exploring in what degree participants feel that the image means something positive or something negative about themselves, about others or about the world. The Metacognitions subscale (IIIb) consisted of eight items exploring how likely participants feel that the image reflects future events (either positive or negative), or reflects consequences for their self-value or their actions (again either positive or negative). The Effect on Emotion scale (IV) consisted of six items, exploring if participants feel sad, happy, anxious, angry, or ashamed due to holding the image in mind.

The Effect on Behaviour scale (V) consisted of five items, three items exploring to what degree the image encouraged any plans for behaviour or has actually influenced their behaviour. The remainder two items were open-end, and asked participants to give an example of these. A full overview of all the items can be found in the supplementary materials.

2.2.2 Spontaneous Use of Imagery Scale (SUIS)

The SUIS (Reisberg et al., 2003) was used to measure the general tendency to use visual mental imagery in daily life. The SUIS consisted of 12 items, each scored on a 5-point Likert scale with answers ranging from 1 ('never appropriate') to 5 ('always completely' appropriate). The SUIS has a high internal consistency (α is .98) in a healthy English speaking sample and concurrent validity was good when SUIS scores were compared to the Vividness items of the Vivid Mental Imagery Questionnaire (Reisberg et al., 2003). Andrade and colleagues (Andrade et al., 2014) reported similar findings in a sample of 419 healthy English speaking participants. Internal consistency of the Dutch adaptation was satisfactory also (Nelis et al., 2014). The SUIS has been used in previous research on imagery in patients with bipolar disorder (Deeprose et al., 2011; Hales et al., 2011; Holmes et al., 2011).

2.2.3 The Altman Self-Rating Mania scale (ASRM)

The ASRM is a 5-item self-report measure of mania symptom severity, often used in research on bipolar disorder. The ASRM consists of five items, each scored on a 5-point Likert scale with answers ranging from 0 ('not more than usual') to 4 ('more than usual most of the time') each tailored to the item. Previous research showed good psychometric properties and good test-retest reliability for the ASRM (Altman et al., 1997). Recent findings suggested that a cut-off score of < 4 is indicative for full remission from bipolar disorder (Berk et all., 2008).

2.2.4 The Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a self-report questionnaire used to estimate level of depression. The PHQ-9 is the self-report version of the PRIME-MD. 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. The PHQ-9 has good psychometric properties (73% sensitivity, 94% specificity, $\alpha = .86$, test re-test reliability $r = .84$) suggesting this is a reliable instrument for measuring severity of depression (Applied Health Sciences (Mental Health), 2011; bajor et al., 2013; Kroenke et al., 2001).

2.3 Completion time

Research Manager recorded the time needed to complete the DImS, SUIS, ASRM and PHQ-9.

2.4 Statistical analysis

Internal reliabilities were calculated with Cronbach's coefficient α and test-retest reliabilities were established using Pearson correlation coefficient. These were calculated with and without outliers to assess how these outliers effected the findings. Most studies on imagery consider frequency, quality of imagery and appraisals of imagery as separate aspects of imagery (Andrade et al., 2014; Burnett Heyes et al., 2013; DiSimplicio et al., 2015;

Wesslau et al., 2015). Therefore, the five scales of the DImS were considered as separate aspects of imagery. Principal Component Analyses with varimax rotation were applied for the scales Imagery Quality, Encapsulated Beliefs, Metacognitions and Effect on Emotion separately in order to investigate their factorial structures and identify their components. In the present study, the DImS scales Effect on Emotion and Effect on Behaviour were considered as dependent variables. Pearson correlation coefficients were used to calculate scale inter-correlations and correlations between different questionnaires. We adjusted for multiple tests within each scale by dividing the alpha of .05 by the number of subscales within that scale. Specifically, for Quality of Imagery, significance level was set to .05/2=.025. For Appraisals of Imagery significance level was set to .05/4=.0125 (for Frequency of Imagery there was no correction as there were no subscales). Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess normality. But, following Rose, Spinks and Canhoto (2015), Field (2013), Pallant (2013) and Ghasemi and Zahediasl (2012) comments, we decided to permit a more lenient criterion for accepting normality assumptions in smaller sample sizes: mean skewness and kurtosis of a variable divided by the standard deviation of both skewness and kurtosis should fall within the range of -2.85 to 2.85.

3 Results

3.1 Psychometric findings

The average score of the SUIS (M = 33.0, SD = 9.3, N =133) was slightly lower to those found in other studies using a healthy Dutch population (Nelis et al., 2014). The internal consistency of the SUIS in the current study was good (α = .83), as was the test re-test correlation (n = 45, r = .83, p < .001). Scores on the ASRM were positively skewed (skewness = 1.47, kurtosis = 2.06; Kolmogorov-Smirnov p < .001), as one would expect in a predominantly healthy population. Internal consistency in the present sample was fair (α =

.78), but test re-test reliability was moderate to fair (r = .6, p < .001). The average scores were 2.33 (SD = 2.64) on the ASRM and 4.13 (SD = 3.77) on the PHQ-9 (Table 1) in the present sample, fitting for a predominantly healthy population. Again, results were not normally distributed (skewness 1.42, kurtosis 1.9, Kolmogorov-Smirnov p < .001) but positively skewed as one would expect in a predominantly healthy population. Test re-test reliability was good (r = .81, p < .001) as was the internal consistency (α =.80).

Insert Table 1 here

Applying the Kolmogorov-Smirnov and Shapiro-Wilk tests, the five DImS scales did not show normal distributions (all p's < .05), but using the more lenient criterion for normality distributions (see statistical analysis section), normality of all the scales' sum scores except for Metacognitions, were acceptable (range between -1.91 and 2.45). Imagery Quality (n =1), Metacognitions (n = 3), and Effect on Emotion (n =3) contained several outliers, that is, scores larger than two standard deviations from the mean. Analyses calculating internal consistency, test-retest reliability and normality were performed with and without these outliers. Exclusion of the outliers did not influence the statistical analyses significantly. Therefore, the outliers were maintained in all further analyses (see Aguinis et al., 2013). Table 1 offers a detailed overview of the psychometric findings of the five imagery scales (see Table 1). Using component analysis and varimax rotation with scree plot analysis, two components could be identified for Imagery Quality, together explaining 70% of the scale's variance. Based on the content of the items and its loadings, the first component was named 'Vividness', and the second component 'Compellingness'. One item of the Vividness subscale ("how far removed from the present did the image appear") was omitted, improving

α from .82 to .84. Using the same statistical analyses, we also identified two components in the Encapsulated Beliefs subscale, together explaining 71.7% of the subscale's variance, and for the Metacognition subscale, together explaining 57.9% of the variance. Based on the content of the items and on the factor loadings, the components were named Positive and Negative Encapsulated Beliefs, and Positive and Negative Metacognitions. Similarly, using component analysis and varimax rotation with scree plot analysis, two components could be identified for the scale Effect on Emotion, together explaining 70.8% of the variance of the scale. Again, based on the content of the items and the factor loadings, they were named Positive and Negative Effect on Emotion. For Effect on Behaviour no underlying components could be identified.

The scale scores were consistent over time, when participants selected the same image when completing the DImS a second time within two days (see Table 1). In total, 135 participants completed the DImS, 42 participants filled in the survey a second time, 31 of which used another dominant current image and 11participants used the same image. Only for Negative metacognitions (r = .47), the test-retest correlation was moderate.

Some of the typical example images mentioned by the participants, were memories of holidays, thinking of exams that were pending, some remembered things that reminded them of diseased relatives. Some were elaborate stories, some were very brief.

3.2 Correlations

3.2.1 Inter-correlations between the DImS scales

Table 2 summarizes the correlations between Imagery Frequency, Imagery Quality and Appraisals of Imagery and Effect on Emotion and Effect on Behaviour.

Insert Table 2 here

Negative appraisals (both Encapsulated Beliefs and Metacognitions) correlated highly with Negative Effect on Emotion, and Positive Appraisals (both Encapsulated Beliefs and Metacognitions) with Positive effect on Emotion. Compellingness scores and Positive Metacognitions correlated with Effect on Behaviour.

Table 3 summarises the inter-correlations between current mood according to self-report mood scales and the five imagery scales.

Insert Table 3

Higher symptom levels (PHQ-9 and ASRM) correlated with higher total Image Quality and stronger Appraisals of Imagery. However there appeared a slightly stronger relationship between elevated mood and Imagery Quality than between low mood and Imagery Quality. In addition, there were no significant correlations between elevated mood (ASRM) and Imagery Frequency nor with low mood (PHQ-9) and Imagery Frequency. As expected, elevated mood and Positive Appraisals (Positive Encapsulated Beliefs and Positive Metacognitions) correlated significantly, as were the correlations between low mood and Negative Appraisals (Negative Encapsulated Beliefs and Negative Metacognitions). Moreover, in line with expectations the trait imagery measured using the SUIS correlated with Frequency of Imagery and Quality of Imagery, and Positive Metacognitions.

3.3 Completion time

Time necessary to complete all questionnaires according to Research Manager, was established after removing three outliers. The outliers were removed as the time Research

Manager was open was so long (almost one hour) it was most likely due to other reasons than completion time. The average time it took participants to complete all the questionnaires, that is 69 items of which 41 from the DImS, was 16.5 minutes (*SD* 8.4 minutes). Six participants were administered the online questionnaire using a telephone interview within two days after their online completion of the DImS. These participants had been randomly selected. The duration of the telephone interview was 15 minutes on average, including questions on feasibility. The results of the DImS using the telephone were similar to those from the online administration with only very minor differences in answers. In addition, participants reported that although the extra direct support of the telephone interview was pleasant, they felt no substantial differences in difficulty or feasibility completing the DImS online.

4. Discussion

The present report aimed to enable further research into general imagery in patients suffering from bipolar disorder by evaluating an online imagery survey, which would be less time consuming, allow for more participants and reliable comparison when compared to face-to-face administrations. We therefore adapted the Imagery interview (Hackmann et al., 1998) and its subsequent adaptations (Day et al., 2004; Hackmann et al., 2000; Laing et al., 2016; Lockett et al., 2012; Morrison et al., 2002; Ritter and Stangier, 2016; Schulze et al., 2013), including the similar assessment interview described by Hackmann, Bennt-Levy, and Holmes (Hackmann et al., 2011) to assess general self-reported imagery-based processing and its perceived effect on both emotion and subsequent behaviour using an online imagery survey, called DImS. The DImS has five separate scales and evaluated if aspects of general imagery and their relationship with perceived effect on both emotion and subsequent behaviour could be reliably measured using this online self-report survey.

Our findings of the survey and the modest pilot, suggest a large overlap between the five scales of the DImS and the five aspect of imagery described in the Imagery interview. Three out of five scales of the DImS could be divided into subscales (Appraisals of Imagery into Positive and Negative Appraisals of Imagery, Effect on Emotion into Positive and Negative Effect on Emotions, and Imagery Quality into Vividness and Compellingness). All scales appeared to have good internal consistencies. Consistency over time is good, when participants were using the same image filling in the survey for a second time.

In addition, the DImS was able to show statistically significant correlations between Quality of Imagery (Vividness and Compellingness) and Effect on Positive Emotion, and between Compellingness and Effect on Negative Emotions. Positive Appraisals of Imagery correlated with perceived Effect on Positive Emotions, and Negative Appraisals of Imagery with perceived Effect on Negative Emotions. Only Compellingness and Positive Metacognition correlated significantly with perceived effect on behaviour. Elevated mood correlated significantly with Quality of Imagery and Positive Appraisals, low mood correlated significantly with Compellingness and Negative Appraisals.

In line with suggestions of previous research reports (Holmes et al., 2008b; O'Donnell et al., 2017) higher Imagery Quality and stronger Appraisals of Imagery were correlated with the experience of stronger emotions and to some extent with behaviour. In addition, and again in line with previous findings (Holmes et al., 2008c; Moritz et al., 2017), higher symptoms levels (PHQ-9, ASRM) correlated with higher total Image Quality, and stronger Appraisals of Imagery. Imagery Quality correlated more strongly with elevated mood and Appraisals of Imagery more with low mood. Similar to studies of Holmes (Holmes et al., 2008b), (DiSimplicio et al., 2016), O Donnell (O'Donnell et al., 2017), and Mortiz' (Holmes et al., 2008c; Moritz et al., 2017) our findings showed a strong link between imagery and current mood and between imagery aspects (frequency, quality and appraisals of imagery) and

self-perceived effect on emotion and to a lesser degree with subsequent behaviour. These correlations have been described as a transdiagnostic feature. In future studies, we would be interested to see if the current observations can be replicated, especially the stronger link between quality of imagery and positive emotions, and the relatively weaker link between imagery and behaviour.

Although the psychometric properties of the DImS appear promising, there is a need to replicate these findings, foremost, including in a clinical population. Patients with bipolar disorder might find the online questions more difficult to answer, or take considerably more time. A limitation of the present study was that most participants changed their example imagery when completing the DImS for a second time. When examining test-re-test reliability, it is relevant to ask participants to hold the same image in mind. Participants in this study chose their example image, typical of their recent self-reported emotional imagery, thinking of the previous two weeks. As the most pressing image would depend on current mood state, and as this is a general population (non-clinical sample), we would not expect to get focused recurrent intrusive imagery as you would expect in people suffering from PTSD or social anxiety for example. Furthermore, this study aimed to develop this tool as a self-report measure of general imagery aspects in patients suffering from bipolar disorder to further explore the Imagery as Emotional Amplifier theory, rather than identify target imagery for treatment. As mood might fluctuate within the previous two weeks, in future studies with patients suffering from bipolar disorder, it might be better to ask participants to hold an example image in mind typical of last week, rather than previous two weeks.

The present study suggests that the DImS is less time consuming than the Imagery interview. Studies using the Imagery interview reported 30-120 minutes administration time; whereas in the present study the average time to complete all three questionnaires including the DImS was 16.5 minutes. It can be safely assumed that it takes less than 15 minutes on

average to complete the DImS, although one should keep in mind that the present data are based on a student sample. As the interview is an online self-report instrument, there is no need for qualified assessors, which would make this measure more accessible to a larger group of participants. The items of the DImS are scored on a 9-point Likert scales, allowing for reliable quantitative comparisons of imagery aspects and its effects on both perceived emotion and behaviour in larger groups of participants. The anecdotal information from speaking to six participants in the pilot part pilot confirmed that the DImS is straightforward and relatively easy to fill in.

Concluding, findings with the DImS appeared reasonable and consistent and showed that general imagery is related to current mood and to both self-perceived effects on emotion and on subsequent behaviour, in line with findings from other recent studies, and is easy and fast to administer. The present study is the first step in the development of an online quantitative tool measuring self-reported general imagery aspects and its perceived effect on emotion and behaviour in patients with bipolar disorder. Although, the DImS first needs to be tested in a sample of patients suffering from bipolar disorder, these present promising findings might allow further research into the working mechanisms of mood variability and its relationship to general imagery in patients suffering from bipolar disorder. This in turn would aid further enhancement of CBT for bipolar disorders using imagery techniques, tailoring interventions aimed as specific imagery aspects to reduce mood variability.

Disclosure

Ethics

The Medical Research Ethics Committee (MEC-U) concluded this study did not apply to the Medical Research Involving Human Subjects Act (WMO, number: V.77435/W16.017).

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Table 1

Internal Consistency, Subscales Identified, Variance Explained, Mean Scores and Standard Deviations and Test-Retest Analysis for Mood Questionnaires, ASRM and PHQ-9, SUIS and Imagery subscales DImS.

	Cronbach Alpha	**Subscales identified**	**Factor loading varimax**	**Variance explained**	**Kaiser-Meyer-Olkin value**	**Mean (SD)**	**Test re-test Pearson *r* correlation n = 45 (same image n = 11)**	**Number of items:**
ASRM	.78				-	2.3 (2.6)	.60, $p < .001$ (.92, $p < .001$)	5
PHQ-9	.80				-	4.1 (3.7)	.81, $p < .001$ (.95, $p < .001$)	9
SUIS	.83				-	33 (9.3)	.83, $p < .001$ (.72, $p = .01$)	12
DImS:								
I: Frequency		0	-	-	-	5.03 (1.91)	.64, $p < .001$ (.69, $p = .02$)	1
II: Quality				70%	.766			
Vividness	.84		.89 to .90			6.01 (1.83)	.63, $p < .001$ *(.75, $p = .01$)*	2
Compellingness	.80	2	.57 to .88			4.01 (1.84)	.63, $p < .001$ (.63, *$p = .04$)*	5
III: Appraisals								
- *Encapsulated Beliefs*				71.7%	.653			
Positive	.77		.73 to .89			3.47 (2.11)	.51, $p < .001$ (.84, $p < .001$)	3
Negative	.82	2	.75 to .91			1.91 (1.47)	.58, $p < .001$ (.91, $p < .001$)	3
-Metacognitions				57.9%	.753			
Positive	.75		.54 to .82			3.59 (1.77)	.71, $p < .001$ (.92, $p < .001$)	5
Negative	.79	2	.79 to .84			1.29 (.84)	. 33, $p = .03$ (.47, $p = .15$)	3
IV: Effect on emotion				70.8%	.761			
Positive	.71		.84 to .91			4.40 (2.67)	.41, $p = .01$ (.86, $p < .001$)	1
Negative	.87	2	.66 to .89			1.53 (1.13)	.73, $p < .001$ (.97, $p < .001$)	5
V: Effect on	.84	0	-	-		3.60 (2.35)	.42, $p = .01$ (.55, $p = .08$)	3

behaviour	-

Notes: *N*=135. ASRM is Altman Self-Rating Mania scale; PHQ is Patient Health Questionnaire; SUIS is Spontaneous Use of Imagery Scale.

Table 2

Pearson Correlations between Current Reported Imagery (subscales DImS) with Self-Perceived Effect on Emotions and Behaviour (subscales DImS)

	IV: Effect on Emotions		**V: Effect on Behaviour**
	Positive Emotions	*Negative Emotions*	
DImS:			
I: Frequency of Imagery	.09, $p = .59$	.09, $p = .28$	.04, $p = .66$
II: Quality of Imagery			
- *Vividness*	.46, $p = .002$	.06, $p = .49$	.08, $p = .35$
- *Compellingness*	.02, $p = .90$	.29, $p < .001$	.22, $p = .01$
III: Appraisals of Imagery			
- *Positive Encapsulated Beliefs*	.43, $p = .01$	.04, $p = .67$	.15, $p = .09$
- *Negative encapsulated Beliefs*	.01, $p = .96$	.61, $p < .001$	-.01, $p = .95$
- *Positive Metacognitions*	.44, $p = .01$	.13, $p = .13$	.46, $p < .001$
- *Negative Metacognitions*	.03, $p = .88$	.59, $p < .001$	.09, $p = .31$

Note: N = 135. Significance levels after Bonferroni correction: I: $p < .05$; II: $p < .025$; III: $p < .0125$

Table 3

Pearson Correlations between Current Mood According to Self-Reported Mood and Trait Imagery, and Self-Reported Imagery and its Perceived Effect on Emotion and Subsequent Behaviour in Last Two Weeks (scales of DImS)

	ASRM	PHQ-9	SUIS
DImS:			
I: Frequency of Imagery	.18, $p = .04$	.14, $p = .11$	*.66, $p < .001$*
II: Quality of Imagery			
- *Vividness*	.25, $p < .001$	.03, $p = .77$	.44, $p < .001$
- *Compellingness*	.26, $p < .001$	.21, $p = .01$	.27, $p = .001$
III: Appraisals:			
- *Positive Encapsulated Beliefs*	.20, $p = .02$	-.04, $p = .67$	.01, $p = .88$
- *Negative Encapsulated Beliefs*	.09, $p = .31$	.28, $p < .001$	.01, $p = .89$
Appraisals:			
- *Positive Metacognitions*	.23, $p = .01$	.05, $p = .59$	.22, $p = .01$
- *Negative Metacognitions*	.12, $p = .17$	.29, $p < .001$	.02, $p = .77$

Notes: N=135. ASRM is Altman Self-Rating Mania scale; PHQ is Patient Health Questionnaire; SUIS is Spontaneous Use of Imagery Scale. Significance levels after Bonferroni correction: I: $p < .05$; II: $p < .025$; III: $p < .0125$

Conflicts of Interest Statement

Manuscript title: Image Qualities and Mood Variability: Evaluating the Utility of an Imagery Survey for Bipolar Disorder

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.

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Karin van den Berg, Marisol Voncken, Saskia Houterman and Ger Keijsers have no conflicting interests. Karin van den Berg, Marisol Voncken and Ger Keijsers wrote the protocol, designed study and analysed the data. Karin van den Berg conducted the data collection. Saskia Houterman was involved in the statistical analysis and provided comments on the different drafts of the document. All authors have contributed to and have approved of the final article. There are no further acknowledgments.

Ethics

The Medical Research Ethics Committee (MEC-U) concluded this study did not apply to the Medical Research Involving Human Subjects Act (WMO, number: V.77435/W16.017).

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Rino Zuid Clinical Psychology Training Course provided Karin van den Berg with a subsidy in support of her PhD.

Dutch Imagery Survey: DImS

The present (march 2017) study:

The present study has been approved by the Medical Research Ethics Committees United. Your contribution to this study is voluntary, you are not obliged to anything and can stop without consequences at any time. Your answers will be stored anonymously. Your answers do not result in a medical or psychiatric diagnosis. There will be no individual feedback over the questions you filled in. You can however, if you are interested get informed of the outcome of this study in general.

If you have any questions about this study, please contact:
Contact address

What is this study about?
Introduction explaining imagery (based on the Imagery Interview of Hales et al., 2011)

We are interested in the *different types* of thoughts that can run through our minds and the *form* that these thoughts can take.

Sometimes we think in the form of *words* and *phrases* ('**verbal thoughts**'). Sometimes we think more in '**mental images**'.

What is a verbal thought?

When we think in verbal thoughts, we think using verbal language of the sort we would use when we speak. A verbal thought about this survey might be, "**there are so many questions!**". This thought would run through your mind as words.

What is a mental image?

When we think in mental images, we imagine pictures in our mind's eye. A mental image about filling in this survey might be picturing in your mind's eye what your computer looks like when you are filling this in.

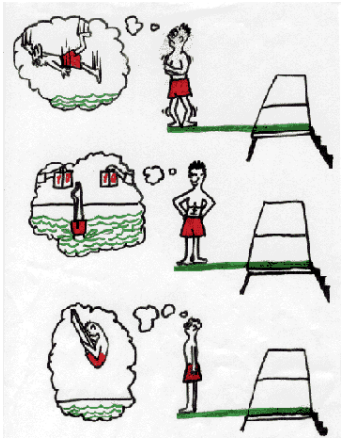
Although mental images often take the form of pictures they can actually include any of the five senses (sight, sound, taste, touch, smell). For example, you could hear the sound of your computer starting up.

Images can be clear or fleeting, weak and unclear, more like a felt sense. When we talk about '**mental images**' we are referring to **all** of these types of 'imagining'.

Here is an example: close your eyes and imagine holding and slicing a lemon, smell the lemon and touch it.

Short film explaining imagery: (link)

Here is another example, this time using graphics:



The following questions are about imagery (sight, sound, taste, touch, smell) that is typical of the way you have experienced this in the past two weeks.

VBBD: Now try and think of an example of a mental image (sight, sound, taste, touch, smell) that is typical for the kind of imagery that you have experienced in the past two weeks.
Can you describe this image in one or a few sentences?

Answer the following questions keeping this image in mind:

FREQBD: How often did you find yourself thinking in an image just like this?

1	2	3	4	5	6	7	8	9
Not at all time				half the time				the whole

QUAL1: Was this image (sight, sound, taste, touch, smell) mainly a phantasy?

1	2	3	4	5	6	7	8	9
No phantasy				partial				completely

QUAL2: Was this image (sight, sound, taste, touch, smell) based on a real memory? Something you experienced in the past?

1	2	3	4	5	6	7	8	9
Not at all				partially				completely

QUAL3: Was this image (sight, sound, taste, touch, smell) an imagined event in the future?

1	2	3	4	5	6	7	8	9
Not at all				partially				completely

QUAL4: Was this image (sight, sound, taste, touch, smell) orientated in the past?

1	2	3	4	5	6	7	8	9
Not at all				partially				completely

QUAL5: From what perspective did you view this image? Through your own eyes, or observing yourself from an external point of view?

1	2	3	4	5	6	7	8	9
Completely through my own eys				Mixed				Observing myself from an external view

QUAL6: How vivid was this image (sight, sound, taste, touch, smell)?

1	2	3	4	5	6	7	8	9
Not at all				partially				very much

QUAL7: How clear and lively was this image (sight, sound, taste, touch, smell)?

1	2	3	4	5	6	7	8	9
Not at all				partially				very much

QUAL8: Did it feel like something that was really happening (rather than just something going through your mind)?

1	2	3	4	5	6	7	8	9
Not at all				partially				completely

QUAL9: How far away from the present did this image appear?

1	2	3	4	5	6	7	8	9
Far in the past				present				far in the future

QUAL10: To what extent did this image occupy your mind?

1	2	3	4	5	6	7	8	9
Not at all				partially				completely

QUAL11: How important did this image (sight, sound, taste, touch, smell) feel?

1	2	3	4	5	6	7	8	9
Not at all				moderately				very much

QUAL12: How convincing (powerful, irresistible, wanting to act on it) was this image sight, sound, taste, touch, smell)?

1	2	3	4	5	6	7	8	9

Not at all moderately very much

QUAL13: To what extent did this image (sight, sound, taste, touch, smell) feel real, like something that is happening now?

1	2	3	4	5	6	7	8	9

Not at all moderately very much

ENCAP1: To what extent did this image (sight, sound, taste, touch, smell) say something positive about yourself?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

ENCAP2: To what extent did this image (sight, sound, taste, touch, smell) tell you something negative about yourself?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

ENCAP3: To what extent did this image (sight, sound, taste, touch, smell) tell you something positive about others?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

ENCAP4: To what extent did this image (sight, sound, taste, touch, smell) tell you something negative about others?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

ENCAP5: To what extent did this image (sight, sound, taste, touch, smell) tell you something positive about the world?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

ENCAP6: To what extent did this image (sight, sound, taste, touch, smell) tell you something negative about the world?

1	2	3	4	5	6	7	8	9

Nothing at all moderately very much so

META1: To what extent did you believe this might happen now you thought about it?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META2: To what extent did you feel you could go mad, or lose control keeping this image in mind?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META3: To what extent did you feel that keeping this image in mind would make something bad happen?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META4: To what extent did you feel that keeping this image in mind would make something nice or good happen?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META5: To what extent did you feel this image was a prediction of what might happen?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META6: To what extent did you feel that keeping this image in mind would make something happen?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META7: To what extent did you feel that keeping this image in mind makes you a bad person?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META8: To what extent did you feel that keeping this image in mind makes you a good person?

1	2	3	4	5	6	7	8	9

Not at all partially completely

META9: To what extent did you feel that keeping this image in mind helps you to make better decisions?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO1: To what extent did this image influence your mood?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO2: To what extent did this image make you feel anxious?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO3: To what extent did this image make you feel sad?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO4: To what extent did this image make you feel angry or irritable?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO5: To what extent did this image make you feel happy?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO6: To what extent this this image make you feel guilty?

1	2	3	4	5	6	7	8	9

Not at all partially completely

EMO7: To what extent did this image make you feel ashamed?

1	2	3	4	5	6	7	8	9

Not at all partially completely

BEHAV1: Did you have the feeling that this image encouraged you to make plans to do something (such as making plans to start doing something new, or planning to avoid doing something you dread)?

1	2	3	4	5	6	7	8	9

Not at all partially completely

BEHAV2: please write down what?

BEHAV3: Did you feel this image encouraged you to really do something (such as buying something, going somewhere or avoiding a difficult situation)?

1	2	3	4	5	6	7	8	9

Not at all partially completely

42: To what extent is what you did right after thinking of this image influenced by this image?

1	2	3	4	5	6	7	8	9

Not at all partially completely

BEHAV: please write down what?
