Mental Imagery in Depression: Phenomenology, Potential Mechanisms, and Treatment Implications

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Abstract

Mental imagery is an experience like perception in the absence of a percept. It is a ubiquitous feature of human cognition, yet it has been relatively neglected in the etiology, maintenance, and treatment of depression. Imagery abnormalities in depression include an excess of intrusive negative mental imagery; impoverished positive imagery; bias for observer perspective imagery; and overgeneral memory, in which specific imagery is lacking. We consider the contribution of imagery dysfunctions to depressive psychopathology and implications for cognitive behavioral interventions. Treatment advances capitalizing on the representational format of imagery (as opposed to its content) are reviewed, including imagery rescripting, positive imagery generation, and memory specificity training. Consideration of mental imagery can contribute to clinical assessment and imagery-focused psychological therapeutic techniques and promote investigation of underlying mechanisms for treatment innovation. Research into mental imagery in depression is at an early stage. Work that bridges clinical psychology and neuroscience in the investigation of imagery-related mechanisms is recommended.

Contents

INTRODUCTION

Mental Imagery

Definition and some history. Mental imagery allows us to relive the past, prelive the future, and make decisions, comprising a key part of our everyday mental life. It involves seeing with the mind's eye, hearing with the mind's ear, and so forth (Kosslyn et al. 2001), that is, mental imagery is an experience like perception but in the absence of a percept. Evidence indicates that in many ways mental imagery is like "weak perception" (Pearson et al. 2015). It is part of our autobiography—memories from our childhood can flash back to mind as vivid sensory imagery (e.g., a scene from the first day at school). We can also simulate future events (e.g., an upcoming holiday). Yet despite its centrality, the study of mental imagery has seen more fluctuation in scientific respectability than almost any other aspect of cognitive psychology (Baddeley & Andrade 2000). The equivalent might be said about its therapeutic application (Edwards 2007). It is perhaps no wonder then that mental imagery has been relatively neglected, both in the etiology and maintenance of depression and in terms of its implications for psychological treatment.

To move forward, it can help to look back. Mental imagery was studied in the early days of psychology by Galton (1883), who began by investigating individual differences in imagery ability. In "cases where the faculty is very high," mental imagery was described as brilliant or dazzling, e.g., "thinking of the breakfast table this morning, all the objects in my mental picture are as bright as the actual scene" (Galton 1883, p. 62; see also sidebar, Imagine Your Breakfast Table). In "cases where the faculty is at the lowest," participant reports included, "I recollect the breakfast table but do not see it" (p. 64). Galton notes the challenges to mental imagery as a subject of scientific inquiry, observing at the onset of his investigations that those research participants who were scientists "looked on me as fanciful and fantastic" and "had no more notion of its [mental imagery's] true nature than a color-blind man" (p. 58). His writing also includes observations

IMAGINE YOUR BREAKFAST TABLE

The following is adapted from Galton (1883).

Think of some definite object—suppose it is your breakfast table as you sat down to it this morning—and consider carefully the picture that rises before your mind's eye.

1. Illumination: Is the image dim or fairly clear? Is its brightness comparable to that of the actual scene?
2. Definition: Are all the objects pretty well defined at the same time, or is the place of sharpest definition at any one moment more contracted than it is in a real scene?
3. Coloring: Are the colors of the china, of the toast, bread-crust, mustard, meat, parsley, or whatever may have been on the table, quite distinct and natural?

Below are some of the comments received by Galton—which of these is closest to your experience?

1. High imagery ability: "The mental image appears to correspond in all respects with reality. I think it is as clear as the actual scene."
2. Mediocre imagery ability: "Fairly clear as a general image; details rather misty."
3. Low imagery ability: "My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the breakfast table but do not see it."

that mental imagery can be associated with psychopathology—it "supplies the material out of which dreams and the well-known hallucinations of sick people are built" (p. 58). He describes an example in which imagery appears to create difficulties in giving a speech: "One statesman has assured me that a certain hesitation in utterance which he has at times, is due to his being plagued by the image of his manuscript speech with its original erasures and corrections. He cannot lay the ghost, and he puzzles in trying to decipher it" (p. 67). This is an example of one type of the intrusive negative images associated with psychopathology; we argue that such negative images are also associated with depression.

Imagery and perception draw on shared neural mechanisms, and mental imagery is distinct from verbal language (Kosslyn et al. 2001, Pearson et al. 2015). This distinction between imagery and verbal language is an important one for therapy: The content of a thought is what information it conveys, whereas the format is the nature of the code used to represent this information. We think in multiple ways. Thus, we can think by using picture-like depictive formats (mental images) in addition to language-like descriptive formats (verbal thoughts). Although all formats of a patient's thoughts deserve investigation, in clinical assessment imagery is often neglected and the focus instead is on verbal thoughts.

If we return to Galton's observations, although individuals with depression may do equally well as their nondepressed counterparts at conjuring up an image of their usual breakfast table, we suggest that depressed individuals would typically do less well if asked to recall a particular (e.g., most recent birthday) breakfast table, that is, they may struggle to generate imagery of a specific memory. Further, we suggest that individuals with depression may have particular difficulties with generating vivid and compelling imagery of positive events. Negative memories and images, in contrast, may come to mind all too readily.

Depression

Definition. The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; Am. Psychiatr. Assoc. 2013) defines major depressive disorder (MDD) as a potential diagnosis when someone experiences one or more major depressive episodes. To meet criteria for a major depressive episode,

individuals must experience five or more symptoms for at least two weeks, to the extent that they suffer clinically significant distress or impairment. These symptoms must include at least one of the two core symptoms of depression: depressed mood and markedly diminished interest or pleasure in activities (anhedonia). Other possible symptoms include significant weight changes or changes in appetite; insomnia or hypersomnia; psychomotor agitation or retardation; fatigue or loss of energy; feelings of worthlessness or excessive or inappropriate guilt; diminished ability to think or concentrate, or indecisiveness; and recurrent thoughts of death, suicidal ideation, or a suicide attempt.

Global burden and current statistics. Depression is common, with lifetime prevalence estimates ranging from 16.6% (Kessler et al. 2005) to 30% for men and 40% for women (Andrews et al. 2005). Correspondingly, depression is a leading cause of global disease burden, with recent estimates placing it second among all illnesses in terms of years lived with disability (Vos et al. 2012). Depression also commonly co-occurs with chronic physical health problems such as angina and diabetes and contributes to significantly worse outcomes (Moussavi et al. 2007). Psychological and pharmacological interventions for depression appear equally effective in meta-analyses (Cuijpers et al. 2013), although when compared directly, some evidence indicates that psychological treatment has a longer-lasting impact than pharmacological treatment (Hollon et al. 2006). However, approximately 50% of patients with depression do not respond to treatment (Cuijpers et al. 2014, Hollon et al. 2006). In addition, about half of those who suffer a first episode will experience a second, and after three episodes, the risk of further episodes is 90% (see, e.g., Bockting et al. 2015). Given the global scale of depression and limits of current treatments, there is a great and urgent need for treatment innovations of all sorts, including psychological treatments.

Why Investigate Mental Imagery in Depression?

There are three key reasons why we need to consider mental imagery in depression. One is to more fully understand the mental landscape of patients in a clinical assessment. The second is to make more effective use of psychological therapy, that is, to use imagery as well as verbal techniques. The third is to learn more about the cognitive and neural mechanisms underlying the relationship between mental imagery and depression and to use this information to aid future treatment innovation.

Imagery has been relatively neglected in both assessment and therapy for depression. The translation of cognitive models into clinical practice in cognitive behavioral therapy (CBT) has included a focus on negative automatic (verbal) thoughts (Beck et al. 1979); on rumination ("behaviors and thoughts that passively focus one's attention on one's depressive symptoms and on the implications of these symptoms"; Nolen-Hoeksema 1998, p. 239), which is a predominantly verbal process (Fresco et al. 2002); and on the phenomenon of overgeneral memory (OGM) when asked to deliberately recall events (Williams et al. 2007) in informing mindfulness. All such work has led to great strides in CBT for depression—a leading treatment (e.g., Natl. Inst. Health Clin. Excell. 2009). However, additionally incorporating a greater focus on imagery in clinical practice may have advantages, opening the doors to wider information than is obtained by just asking about verbal thoughts. Indeed, we now know that thoughts based on sensory imagery are common in depression (e.g., Moritz et al. 2014), and these represent a potential, and additional, treatment target.

Mental imagery is essential to our mental life, enabling us to remember the past, simulate and pre-experience the future, and make decisions (Schacter et al. 2012). Almost any behavior that might gain from sensory simulation may use mental images, from avoiding threats (e.g., failures)

or seeking rewards (e.g., future successes) to solving problems and completing tasks (e.g., everyday activities). Thus, disruptions to imagery-based representations of emotional information in any of these areas may be important in understanding and treating emotional disturbance in depression.

MENTAL IMAGERY IN DEPRESSION AND OTHER DISORDERS

Intrusive, Emotional Mental Imagery Across Psychological Disorders

Although it may generally be advantageous to clearly remember the details of past situations when confronted with reminders, in psychopathology intrusive, emotional mental imagery of past negative events can become overwhelming and uncontrollable, driving the maintenance of a disorder within a cognitive therapy formulation. The past decade has seen a proliferation of studies grounded in CBT examining intrusive, emotional mental images across a wide range of psychological disorders (special journal issues include Hagenaars & Holmes 2012, Holmes & Hackmann 2004, Holmes et al. 2007a, Krans 2011, Stopa 2011).

Negative intrusive memories of traumatic events comprise the hallmark feature of posttraumatic stress disorder (PTSD; Am. Psychiatr. Assoc. 2013), and such imagery is core to its successful assessment and treatment (Natl. Inst. Health Clin. Excell. 2005, 2013). Images of oneself performing badly in social situations (see the previous example from Galton of the statesman's speech) have been shown to be causal in social phobia (Hirsch et al. 2003), and imagery techniques are key in its treatment (Wild et al. 2007). Intrusive imagery has been reported in eating disorders, obsessive-compulsive disorder, spider phobia, body dysmorphic disorder, schizophrenia, bipolar disorder, and so forth (for examples, see Hagenaars & Holmes 2012, Holmes & Hackmann 2004, Holmes et al. 2007a, Krans 2011, Stopa 2011). Although pioneering and influential work (by, for example, Lang 1977; for a recent review, see Ji et al. 2015) has perhaps led to an emphasis on anxiety-related disorders, it is now timely to bring depression into focus. The idea of negative, intrusive image-based memories as seen in PTSD—that is, problematic autobiographical memories—has relatively recently been extended to depression (e.g., Birrer et al. 2007), as noted in recent reviews (e.g., Brewin et al. 2010, Holmes & Mathews 2010, Weßlau & Steil 2014).

What Does Dysfunctional Mental Imagery Look Like in Depression?

Depression is characterized by a range of mental imagery dysfunctions. Being aware of these dysfunctions may not only inform research into treatment development and mechanisms but also guide clinical assessment, because many patients will not report mental images or their characteristics unless explicitly asked about them (e.g., Beck et al. 1979, Bell et al. 2015, Hales et al. 2014).

Excess of intrusive negative imagery. At least two types of intrusive negative imagery have been described in depression: imagery of past negative events, and suicidal imagery of the future. Pioneering studies indicated the presence of intrusive negative memories of childhood trauma during depressive episodes, with higher levels of intrusions associated with more severe depression (Kuyken & Brewin 1994) (see **Figure 1**). Depressed individuals show higher levels of emotional distress and avoidance of negative intrusive memories when compared to never-depressed individuals, despite similar levels of self-reported intrusive memory frequency (Newby & Moulds 2011a). Importantly, greater avoidance of such memories is associated with more OGMs in response to positive and negative cues (Kuyken & Brewin 1995) (see Overgeneral Memory section below). Interestingly, although intrusive memories are more common in PTSD than in depression, their

Figure 1

Negative intrusive imagery in depression. Many people with depression experience negative intrusive images, that is, distressing images of memories or imagined events that intrude into awareness involuntarily. These could include, for example, intrusive images of rejection, social isolation, or interpersonal conflict, and are often accompanied by intense negative emotions such as sadness, anxiety, and guilt. Traditionally, CBT for depression has focused on negative verbal thoughts; negative images may also be a useful target for treatment. Photograph reproduced by kind permission of Newscast Archives.

features are similar in each disorder—for example, in terms of vividness and the range of emotions they may evoke, such as sadness, fear, anger, and guilt (Reynolds & Brewin 1999). Patel and colleagues (2007) found that almost half of a depressed sample reported frequent distressing intrusive images of memories or imagined events. Clinical examples of negative intrusive imagery in depression include scenes of past childhood physical or sexual assault and images of humiliation (e.g., being bullied at school), failure (e.g., being sacked from work), and overwhelming sadness (e.g., losing a loved one).

Future-oriented intrusive mental images of suicide, also known as flash-forwards, have been reported in depression and are associated with suicidal ideation (Holmes et al. 2007b). For example, an inpatient with depression described her flash-forwards as seeing herself on a platform, and then throwing herself in front of a train, which brought about a sense of calm at the time of despair,

Figure 2

Lack of positive imagery in depression. Mental imagery allows most people to simulate and pre-experience possible future events, whereas depressed individuals often struggle to imagine positive events happening in their future. Specifically, the images they generate are less vivid than those generated by people who are not depressed. Photograph reproduced by kind permission of Newscast Archives.

allowing her to simulate whether she was prepared to complete the action (see also Crane et al. 2012, Hales et al. 2011). Relatedly, daydreaming with violent, imagery-based content has been associated with emotional dysregulation in suicidality (Selby et al. 2007). We note that, far from being seen as "positive," the feeling of calm/relief associated with such suicidal imagery would be of clinical concern in cases where suicidal acts are formulated as an escape from current difficulties.

Impoverished positive imagery. We suggest that depression is characterized not only by an excess of negative imagery but also by impoverished positive imagery (see **Figure 2**). This impoverishment is reflected in the qualities of the positive mental imagery experienced and in difficulties in using emotionally rich imagery-based processing to experience positive affect.

Reduced vividness. Initial evidence suggests that when people are depressed, they may find it hard to generate vivid future- or past-oriented positive mental images. Future-oriented imagery has been assessed using the Prospective Imagery Test (PIT; Stöber 2000), in which participants generate mental images from brief descriptions of hypothetical positive and negative future events (e.g., "You will achieve the things you set out to do") and rate their characteristics (e.g., vividness). Using the PIT, Stöber (2000) found that participants with higher scores on questionnaire-measured depressive symptoms scored lower on a combined imagery metric comprising speed, vividness, and level of detail for positive, but not negative, future events. Similarly, reduced imagery vividness for positive, but not negative, future events has been found for dysphoric compared

to nondysphoric participants (Holmes et al. 2008b) and for depressed participants compared to healthy controls (Morina et al. 2011). Anderson & Evans (2015) similarly found that dysphoric participants reported reduced vividness for images of positive self-generated future events compared to nondysphoric participants. Szőllősi et al. (2015), using an unselected sample, found that participants with higher questionnaire-rated depressive symptoms reported less vivid positive future images but more vivid negative future images in response to single-word cues. Given the function of mental imagery in simulating future events, selectively impoverished positive (relative to negative) mental imagery could significantly limit the ability to imagine a positive future.

In relation to past-oriented imagery, Werner-Seidler & Moulds (2011) found that positive memories recalled in response to word cues following a sad mood induction by formerly depressed (i.e., currently euthymic) individuals were less vivid than those of never-depressed controls. In contrast, negative memories were equally vivid across groups. However, when asked to recall positive self-defining memories, i.e., memories of highly significant personal events, formerly depressed participants rated their memories as equally vivid to those of never-depressed controls (Werner-Seidler & Moulds 2012a), suggesting that vividness may be preserved for certain kinds of memories. In the context of dysphoria, Anderson & Evans (2015) found no difference in the vividness of memories for positive past events between dysphoric and nondysphoric participants.

Other studies using different methodology and types of imagery report no difference in positive imagery vividness between dysphoric and nondysphoric (Benvenuti et al. 2015) or depressed and nondepressed (Patron et al. 2015) groups. These studies used extended imagery tasks, in which participants listened to a detailed script containing information about emotional and physiological states, and had 90 seconds to create an image. This suggests that depressed individuals may be able to generate vivid positive imagery if given appropriate scaffolding (cf. guided imagery, e.g., Lang 1979) but perhaps not in response to brief written cues. It is also worth noting that the studies above have focused exclusively on the characteristics of deliberately generated imagery, and investigation of differences in the characteristics of deliberately generated versus involuntary spontaneous positive mental imagery is required.

Mood deterioration in response to positive information. Thinking about something positive does not necessarily make you feel better. In fact, certain ways of thinking about positive information can make you feel worse, and such thinking styles may predominate in depression. Joormann et al. (2007) investigated the effect of recalling positive memories on mood in never-depressed, formerly depressed, and currently depressed participants. Mood improved in never-depressed participants, did not change in formerly depressed participants, and in fact worsened in currently depressed participants.

The authors suggested that one possible mechanism for the worsening of mood in response to positive information for depressed participants was the use of a ruminative, verbal, comparative processing style (e.g., thinking "I used to be happy back then, now I just feel awful all the time. . .") rather than vividly reexperiencing a past positive event via imagery. Consistent with this, experimental studies have found that using concrete or imagery-focused processing when retrieving a positive memory leads to greater improvement in mood than does an abstract, verbal style (Nelis et al. 2015, Werner-Seidler & Moulds 2012b). Similarly, instructions encouraging verbal processing of positive hypothetical scenarios can result in no improvement in, or even a worsening of, mood (e.g., Holmes et al. 2006, 2009b). Torkan et al. (2014) found that in the absence of instructions to use any specific processing mode (e.g., imagery), depressed outpatients experienced no improvement in depressive symptoms over the course of one week in which they listened to descriptions of several hundred positive scenarios. Debriefing suggested that these participants had tended to use a verbal, comparative processing style. However, whether depression

is in fact associated with individual differences in the tendency to use an imagery (e.g., as opposed to a verbal) processing style, and in particular whether this may be different for positive versus negative information, needs to be examined.

Observer perspective. Imagery perspective, or vantage point, has been investigated in depression. An event can be imagined from a field, or first-person, perspective or from an observer, or third-person, perspective (Nigro & Neisser 1983). The former refers to the experiencing of an event as if seeing it through one's own eyes; the latter perspective refers to the position of an onlooker or bystander, seeing oneself "from the outside" or as a "fly on the wall" (Nigro & Neisser 1983, pp. 467–468). Observer-perspective imagery, at least in the case of autobiographical memory, has been associated with reduced emotional impact compared to field-perspective imagery, both in the context of PTSD (e.g., McIsaac & Eich 2002, 2004) and nonclinical studies (Nigro & Neisser 1983).

A growing body of evidence from observational studies indicates that depression is associated with a tendency to recall memories from an observer perspective and that this may be associated with lower levels of affective content (e.g., Kuyken & Howell 2006; Kuyken & Moulds 2009; Williams & Moulds 2007, 2008). This has mostly been investigated with regard to negative memories, for which it has been argued that the observer perspective is a form of cognitive avoidance (Williams & Moulds 2007). However, this bias for observer perspective may also extend to positive imagery, which could reduce its positive emotional impact. Lemogne et al. (2006) found that depressed individuals are more likely to recall positive memories from an observer perspective than are never-depressed controls. The same pattern has been observed in formerly depressed individuals (Bergouignan et al. 2008), although not consistently (Werner-Seidler & Moulds 2011). In a student sample, dysphoric individuals were more likely to use an observer perspective for positive memories compared with negative memories, whereas nondysphoric students did not show this differential pattern (Nelis et al. 2013).

Experimental evidence for the impact of perspective on the emotional impact of imagery is more mixed: Holmes et al. (2008a) found that using a field perspective when imagining positive scenarios resulted in a greater increase in positive affect than using an observer perspective, but Nelis et al. (2012) did not find such an effect. Studies manipulating imagery perspective for negative intrusive imagery (Williams & Moulds 2008) or positive memories and future projections (Vella & Moulds 2013) have found that shifting from field perspective to observer perspective reduces vividness and associated emotion, but shifting from observer to field perspective does not consistently lead to increases in such characteristics.

Slow to generate mental imagery. Although the above sections focus on the experience of emotionally valenced mental imagery, some evidence suggests that depression is associated with more basic problems in mental imagery generation and manipulation. Cocude et al. (1997) found that depressed participants were slower than nondepressed control participants to generate images in response to cue words (emotionally neutral nouns) and were sometimes unable to generate an image at all. Chen et al. (2013b) found that people with MDD showed slower mental rotation (of images of hands and letters) relative to healthy controls, and Chen et al. (2013a) further found that slower mental rotation was positively related to the number of depressive episodes. However, because nonimagery control tasks were absent in these studies, results may not apply specifically to mental imagery generation and manipulation but instead may reflect generalized cognitive slowing in depression (see, e.g., Zarrinpar et al. 2006). Additionally, the studies have examined only neutral (as opposed to emotional) imagery. Nevertheless, if depressed individuals are slower to generate and manipulate mental images, this may have implications for understanding mental

imagery in depression and using it in treatment. For example, patients with depression might need more guidance in generating imagery, and this could be useful to consider in therapy.

Overgeneral memory. OGM has been extensively studied in depression. Although the term suggests that it pertains to a memory deficit rather than an imagery problem, the memory problem or deficit is in essence also about difficulty generating specific mental imagery (Raes et al. 2006, Sumner et al. 2014, Williams et al. 2007). A quote from the basic memory literature states: "When people remember, they imagine, and when they imagine, they use memory" (Conway & Loveday 2015, p. 574). Conway & Pleydell-Pearce (2000) conclude that many scholars have rightly ascribed a central role for imagery or image-based processes in remembering (specific) autobiographical events (see also Rasmussen & Berntsen 2014). We first explain what OGM is and its (intrinsic) link with imagery (dysfunction). Next, we discuss why it is likely not a trivial aspect of cognition in depression.

OGM refers to a difficulty in voluntarily retrieving specific autobiographical memories. OGM, or the specificity of one's retrieval style, is typically assessed using a cue-word task, known as the Autobiographical Memory Test (AMT; Williams & Broadbent 1986). The AMT consists of positive and negative (sometimes also neutral) cue words (e.g., happy, disappointed). In response to each cue, respondents are instructed to retrieve a specific memory, defined as a particular event that occurred at a particular place and time and that lasted for less than one day. An example of a specific memory retrieved in response to the cue word "happy" would be: "Last month, my partner turned 38, and we celebrated the occasion with a day trip to Blankenberge at the Belgian sea coast with our family."

The link between memory specificity and imagery has been demonstrated in experimental studies. In comparison with high-imageable cues, low-imageable cues typically lead to less specific memories being recalled in the AMT (Anderson et al. 2012, Eardley & Pring 2006, Hauer et al. 2008, Rasmussen & Berntsen 2014, Williams et al. 1999). Reciprocally, an experimentally induced specific retrieval style increases the ability to imagine (more detailed) future events compared to induction of a more general retrieval style (e.g., Madore et al. 2014, Williams et al. 1996). Further, neuroimaging studies indicate that remembering memories and imagining possible future events show marked overlap in brain activity (e.g., Addis et al. 2007; for reviews and extended discussion, see Schacter & Addis 2007, Schacter et al. 2012, Stawarczyk & D'Argembeau 2015) and that specific memory recall relies on imagery-related processes and brain areas (e.g., medial parietal regions; for a review, see Hach et al. 2014). In summary, imagery (in particular, but not exclusively, visual imagery) appears to facilitate the retrieval of specific memories, and a specific retrieval style in turn promotes imagery-based representations.

A large body of studies using the AMT over the past three decades has demonstrated that depressed patients tend to retrieve less specific memories and/or more OGMs compared with nondepressed controls (for a review, see Williams et al. 2007; for a recent replication of the basic phenomenon, see Haque et al. 2014). Examples of such overgeneral (or "categoric") memories would be "going out with the family or friends" (in response to "happy"). OGM is not just a trivial symptom or concomitant of depression but is clinically relevant as indicated, for example, by the following empirical observations. OGM is negatively associated with problem-solving skills: A less specific (or more overgeneral) retrieval style is associated with ineffective problem solving of (hypothetical) interpersonal problems (e.g., Raes et al. 2005). This may be one mechanism by which OGM contributes to depression. This correlational evidence (e.g., Raes et al. 2005) is also supported by experimental work showing that the induction of a specific (versus general) memory retrieval style leads to better problem-solving skills (e.g., Madore & Schacter 2015, Williams et al. 2006). Another finding that highlights the potential clinical importance of OGM is that it often

remains present in patients regardless of recovery or remission (e.g., Spinhoven et al. 2006; but see Williams et al. 2005 for a nonreplication). This suggests that OGM is indeed not just a symptom of depression but could be a vulnerability marker that remains present in asymptomatic periods. Furthermore, prospective studies have shown that OGM has predictive value, in that higher levels of OGM predict higher prospective levels of self-reported depression (see section below titled Do Imagery Dysfunctions Play a Role in the Onset or Maintenance of Depression?).

Mental imagery in depressed phases of bipolar disorder. Scott et al. (2000) have shown that individuals with bipolar disorder also exhibit OGM when depressed, a finding replicated by Mansell & Lam (2004). Further, in bipolar disorder, as in unipolar depression, periods of suicidality appear to be associated with the presence of intrusive flash-forward imagery of events related to suicide (e.g., jumping off a cliff) (Hales et al. 2011). Suicidal imagery was rated as more vivid and compelling in a group of patients with bipolar disorder than in those with unipolar depression (Hales et al. 2011). Positive imagery is also rated as more vivid in individuals with bipolar disorder compared to those with unipolar depression (Ivins et al. 2014), though this would likely typically be associated with the euthymic or manic rather than the depressed phase of the disorder.

Comorbidity of depression in other disorders and related mental imagery. The kinds of dysfunctional mental imagery described above may also be present when depression is comorbid with another disorder or physical illness. For example, more severe depression has been found among pain suffers who report experiencing mental imagery (Gosden et al. 2014). Among patients with cancer, those with depression have been found to experience higher prevalence of negative intrusive images, with these linked to maladaptive coping (Brewin et al. 1998). Where disorders overlap with depression in terms of symptoms (e.g., depressed mood), there may also be overlap in related mental imagery phenomena. For example, reduced specificity for both autobiographical memory and future events has been associated with PTSD (Kleim et al. 2014a) and complicated grief (Maccallum & Bryant 2011, Robinaugh & McNally 2013), in particular for imagined future events including the deceased (Robinaugh & McNally 2013). These comorbidities and overlaps of mental imagery phenomena highlight the importance of assessing mental imagery where depressed mood may be a problem, regardless of whether this is the primary complaint.

Mental imagery and biased information-processing accounts. Many cognitive processes have been implicated in depression (Beck & Haigh 2014, Gotlib & Joormann 2010), and imagery needs to be considered within this scope. The mental imagery phenomena described above do not occur in isolation but rather in the context of other negative biases in, for example, attention, memory, and interpretation. These processes may interact with and exacerbate each other (Everaert et al. 2012, Hirsch et al. 2006, Holmes et al. 2009a). For example, when thinking about an upcoming event, not only may a depressed individual be less likely to think of positive possibilities, but if they do, these possibilities will be less vivid, or dimmer in their mind's eye, reducing their believability or motivational power (cf. D'Argembeau & Van der Linden 2012, Szpunar & Schacter 2013). Mental imagery may therefore exacerbate and amplify other maladaptive processes in depression (Holmes et al. 2009a).

Do Imagery Dysfunctions Play a Role in the Onset or Maintenance of Depression?

The previous sections reviewed evidence for differences in the experience of mental imagery in depressed individuals relative to healthy controls. In this section, we consider whether mental

imagery may prospectively account for changes in depression symptoms over time. Our focus is on evidence pertaining to intrusive imagery, lack of positive imagery, and OGM.

Limited evidence suggests that intrusive memories may predict future depression. Brewin et al. (1999) found that the frequency of intrusions of stressful memories predicted self-reported depression scores at six-month follow-up in 62 depressed patients. In a community sample of 33 individuals who reported an intrusive memory at baseline, Newby & Moulds (2011b) found that greater intrusiveness predicted higher levels of depression at a six-month follow-up.

Indirect evidence that positive imagery protects against depression comes from experimental studies showing that positive mental imagery promotes cognitive, emotional, and behavioral responses that run counter to depression. Holmes et al. (2009b) found that, among healthy volunteers, engaging in positive imagery (compared to verbal processing of the same positive material) led to a greater positive interpretive bias and increases in positive mood, and was protective against a subsequent negative mood induction. Further, within a dysphoric sample, Pictet et al. (2011) found that engaging in positive, as opposed to negative or mixed-valence, imagery led to a greater positive interpretive bias, increased positive mood, and increased goal-directed behavior on a laboratory task. Finally, Torkan et al. (2014) found that repeated imagery of positive scenarios (versus just listening to the same scenarios) over one week resulted in decreased depressive symptoms and reduced negative interpretive bias in participants with depression.

A prospective study in medical interns found that a bias to generate positive, rather than negative, mental images when imagining ambiguous scenarios (but not imagery vividness) was predictive of lower levels of future depressive symptoms over six months (Kleim et al. 2014b). However, this study does not differentiate this imagery-based bias from a general (i.e., unrelated to imagery) negative interpretive bias. Further prospective studies are needed to examine whether imagery-related interpretation biases specifically are predictive of future depression, and the prospective role of imagery vividness remains to be explored. Future studies should investigate the unique contribution of the representational format (i.e., imagery versus verbal) of impoverished positive cognition (and intrusive negative cognitions) to the onset or maintenance of depression.

Several studies have investigated the potential role of OGM in the onset and maintenance of depression. A meta-analysis of 15 studies concluded that OGM is a predictor of an unfavorable course of depressive symptoms, particularly in those with clinical depression (Sumner et al. 2010). More recent studies have generally confirmed that conclusion. For example, Van Daele et al. (2014) showed that OGM was associated with a linear increase in self-reported depressive symptoms over 18 months in a community sample. Other studies have qualified the general conclusion, for example, by showing that OGM interacts with stress in predicting higher future levels of depressive symptoms (Anderson et al. 2010). Results in younger age groups, however, are less consistent, with some studies reporting a positive association between OGM and prospective depressive symptoms in (high-risk) adolescents (e.g., Hipwell et al. 2011), whereas others have not found such an association (e.g., Crane et al. 2016).

The value of OGM in predicting depressive diagnostic status has been examined far less thoroughly, and results are more mixed than is the case for OGM predicting prospective symptom levels. Kleim & Ehlers (2008) found that OGM predicted greater likelihood of diagnosis of MDD at 6-month follow-up in assault victims. Sumner et al. (2011) found that OGM predicted depressive relapse over a 16-month follow-up period in adolescents in remission from MDD or minor depressive disorder, albeit only among those participants experiencing high levels of chronic interpersonal stress. Spinhoven et al. (2006), however, found no predictive association between OGM in formerly depressed patients and recurrence of a major depressive episode over a two-year follow-up. Finally, no study to date has tested whether OGM predicts first onset of depression.

Taking a Developmental Perspective on Mental Imagery in Depression

Developments during childhood and adolescence in cognitive abilities, emotional processing, and social interactions are thought to impact mental health risk (Davey et al. 2008, Steinberg 2005). Understanding how these processes relate to mental imagery phenomena relevant to depression and their potential implications for treatment strategies is of interest for addressing depression in individuals of different ages; it may also shed light on the etiology of depression symptoms. Ultimately, it is only by taking a longitudinal, developmental perspective that we can begin to disentangle causal and vulnerability risk factors from maintenance and compensatory strategies and downstream effects of symptoms. Adolescence and young adulthood is arguably the major period of life for the onset of mental health problems (Kessler et al. 1994, Ormel et al. 2014, Paus et al. 2008). Vulnerability to adult psychological disorders is thought to be traceable to childhood factors (Caspi et al. 1996, Gregory & Eley 2007, Rutter 1984). However, still, the majority of mental health research is conducted with adults.

Developmental research has revealed a number of findings that are potentially relevant to understanding and using mental imagery across development (Burnett Heyes et al. 2013). Mental imagery is a preferred mode of processing from early childhood (Harris 2000) and can be harnessed to aid performance in cognitive tasks (Joh et al. 2011, Mischel et al. 1989). The continued development throughout childhood and adolescence in aspects of cognitive control (Anderson et al. 2001, Luna et al. 2004, Weil et al. 2013) may impact the degree to which individuals have control of and/or insight into mental imagery. This may have implications for understanding the lifetime increase in risk for depression during adolescence (Kessler et al. 1994, 2012). Emerging cognitive abilities may make child and adolescent patients more vulnerable to intrusive, unhelpful mental imagery. At the same time, greater cognitive flexibility, particularly in adolescence, could mean that interventions delivered during this time will have lasting impact (Hauser et al. 2015, Stevenson et al. 2014, van der Schaaf et al. 2011). More research is needed on the interplay between mental imagery, psychopathology, and cognitive abilities during development. In addition, investigators need to examine whether individuals of different ages are differentially vulnerable to distinct mental imagery phenomena and, conversely, whether they may benefit from distinct mental imagery–based treatment strategies.

Does Adaptive Mental Imagery Contribute to Resilience?

The above sections have described ways in which various aspects of mental imagery have been linked to depression. Taken together, the evidence reviewed in these sections implies that mental imagery in depression differs from that associated with healthy functioning. A further, related possibility is that certain kinds of mental imagery are in fact protective against depression and contribute to resilience. Resilience, the ability to adapt well to or "bounce back" from adversity or trauma (e.g., Southwick & Charney 2012), has been considered in terms of genetic, environmental, and cognitive factors, among others. If any aspects of adaptive or helpful mental imagery contribute to resilience, then these could potentially be targets for preventive interventions.

One factor associated with resilience that has been linked to mental imagery is optimism. Optimism, the tendency to have a generalized positive expectation about the future, appears to confer resilience to a variety of stressors (Carver & Scheier 2014, Carver et al. 2010) and may be related to future-oriented mental imagery. Sharot et al. (2007) carried out a functional magnetic resonance imaging (fMRI) study in which healthy volunteers generated future- and past-oriented mental images in response to positive, negative, or neutral word cues. The more optimistic participants were, the greater their sense of pre-experiencing and the closer in the future

they imagined the positive relative to negative future-oriented images. In a community sample of 237 adults, Blackwell et al. (2013) found that higher levels of optimism were associated with more vivid positive future-oriented mental imagery (measured using the PIT). This relationship remained significant when controlling for sociodemographic factors and everyday imagery use. Although it is not possible to draw conclusions about causality from such correlational data, together these results suggest that the extent to which people are optimistic about their future relates to the qualities (such as vividness) of their future-oriented mental imagery.

Could positive mental imagery–based interventions be used to increase optimism and thus resilience? Meevissen et al. (2011) asked healthy volunteers to practice a "best possible self" (BPS) imagery exercise every day for two weeks. The BPS exercise involved imagining a future self in which everything had turned out in the best possible way. Compared to a control condition (imagining activities of the previous day), participants in the BPS imagery condition showed a significant increase in self-reported optimism over the intervention. However, the precise mechanism for the increase in optimism, for example, whether the BPS exercise led to increased vividness of positive future imagery, is not clear. Future research should examine the mechanisms linking functional mental imagery to optimism and whether inducing increases in optimism via mental imagery confers benefits for resilience.

Other ways in which adaptive mental imagery could contribute to resilience are via its use in emotion regulation. For example, positive affect has been linked to resilience (Fredrickson & Joiner 2002), and mental imagery provides one way in which positive affect can be generated. Mental imagery can also be used to self-soothe and generate a sense of safety; for example, an image of a "perfect nurturer" can be created to help an individual generate a sense of safeness and experience feelings of warmth and kindness toward themselves (Lee 2005; see also Gilbert 2009).

MODIFYING MENTAL IMAGERY IN DEPRESSION

Implications of Mental Imagery for Cognitive Behavioral Interventions in Depression

In comparison to verbal cognition, imagery appears to have been relatively neglected in evidence-based psychological treatments for depression, such as CBT. However, in practice, psychological treatment techniques have long been associated with mental imagery, including Janet's work on imagery substitution in the late-nineteenth century and Jung's work on active imagination in the early-twentieth century (discussed in Edwards 2007). CBT has primarily considered imagery in the context of anxiety (Beck et al. 1974), and thus techniques to specifically tackle negative intrusive imagery in depression have only evolved more recently.

Excess of negative imagery. In their manual describing cognitive therapy for depression, Beck et al. (1979) refer to both "thoughts and visual images" (p. 8) as cognitions of relevance and note some specific uses and features of imagery relevant to the treatment of depression. For example, they suggest that imagery of unpleasant and pleasant situations can be used to highlight the influence of cognitions on mood, that imagery of pleasant scenes can be used to alleviate dysphoria, and that imaginal rehearsal can be used as "stress inoculation" against future crises. Discussing anxiety-inducing images, Beck et al. (1979) note that patients might not report mental imagery unless the therapist specifically inquires about it (as previously noted), but that once elicited, images can be controlled by changing the visual content (similar to imagery rescripting, discussed below). Research into methods to modify negative intrusive imagery in depression is more recent. Techniques range from imaginal exposure to the problematic images (Kandris & Moulds 2008)

to transforming the content of the imagery via imagery rescripting (Brewin et al. 2009, Patel et al. 2007, Wheatley et al. 2007). Another approach could be to change maladaptive appraisals about having intrusive imagery (Lang et al. 2009, Wells et al. 2009). Although promising, this work is at an early stage and requires further treatment studies. It is of use, however, to consider the larger literature on such techniques for intrusive imagery in other disorders, such as PTSD.

Mental imagery techniques also form part of schema therapy (ST), an integrative treatment approach to chronic and lifelong problems combining cognitive-behavioral, interpersonal, experiential, and psychodynamic techniques (Young et al. 2003). In ST, mental imagery is used to explore maladaptive schemas in patients and to change the emotional experiences associated with these schemas. For example, imagery of traumatic childhood experiences can be used in ST to help the patient reexperience aspects of traumatic events in a safe setting, in order to thereby decrease the emotional impact of the traumatic memory. Although ST has primarily been applied to the treatment of personality disorders, more recently a schema therapy model for (chronic) depression has been described (Renner et al. 2013). Initial evidence from single-case series suggests that ST could be an effective treatment for chronic depression (Malogiannis et al. 2014, Renner et al. 2015).

Impoverished positive imagery. Enhancing/boosting positive mental imagery may provide a useful adjunctive approach for cognitive-behavioral approaches to depression, which have tended to focus on negative information processing (e.g., Dunn 2012, MacLeod & Moore 2000). In particular, given the studies discussed previously, it could be useful to encourage vivid, field-perspective, positive mental imagery and to promote imagery-based processing of positive information.

One possibility starting to be explored is the potential to enhance positive mental imagery in depression via simple computerized cognitive training methods. Positive imagery cognitive bias modification (CBM) involves repeated practice in generating positive mental imagery, in the context of initially ambiguous training stimuli, to create a more positive imagery bias. For example, in one version of the training, participants listen to brief descriptions of everyday situations that are structured so that they are initially ambiguous but always resolve positively. Participants are instructed to vividly imagine themselves in the scenarios as they unfold, as if actively involved in the situations described, and thus they practice generation of vivid, field-perspective, positive mental imagery. Imagery CBM was developed via experimental work with healthy volunteers (e.g., Holmes et al. 2009b), and clinical studies subsequently started to investigate its potential role as a treatment tool in depressed individuals (Blackwell & Holmes 2010, Lang et al. 2012, Torkan et al. 2014).

Focusing on a relatively neglected cognitive aspect of depression, positive mental imagery, allows the possibility of treating additional targets that conventional treatments struggle to address. Recent research (also discussed below) raises the possibility that imagery CBM may be useful in tackling a specific aspect of depression that poses a challenge to current treatments and predicts poor treatment response, namely anhedonia (Blackwell et al. 2015). Anhedonia, the loss of interest in or enjoyment from activities, is one of the core symptoms of depression (Am. Psychiatr. Assoc. 2013), and its characterizations include a deficit in positive affectivity and both reduced anticipation and experience of pleasure (Pizzagalli 2014). The positive affect generated during imagery CBM and repeated simulation of positive outcomes from everyday activities provides potential mechanisms for reducing anhedonia.

As a computerized intervention, imagery CBM can be delivered remotely and/or in combination with other Internet-delivered treatments such as Internet-delivered CBT (Williams et al. 2013, 2015). However, research in imagery CBM as an intervention is at an early stage, and findings are mixed. Despite promising findings in initial small-scale clinical studies testing a one-week

intervention (Blackwell & Holmes 2010, Lang et al. 2012, Torkan et al. 2014), when scaled up to a four-week intervention in a randomized controlled trial (RCT) with 150 currently depressed participants, Blackwell et al. (2015) found that, overall, imagery CBM resulted in no greater reduction in symptoms of depression than a control sham CBM intervention. Furthermore, although Blackwell et al. (2015) found greater reduction in anhedonic symptoms of depression over the imagery compared to control intervention, this analysis was posthoc, and thus these findings need replication. If successfully developed, imagery CBM could be used as an adjunct to treatments that do not incorporate a positive imagery focus, such as conventional CBT for depression.

Training mental imagery as a mode of processing could also provide a route to enable depressed individuals to experience an improvement in mood in response to positive information (see the section above titled Mood Deterioration in Response to Positive Information). For example, Werner-Seidler & Moulds (2012b) found that both currently and recovered depressed individuals experienced an increase in positive mood after recalling a positive memory if they were instructed to use a "concrete" processing mode that focused on generating rich mental imagery (as opposed to an abstract, verbal processing mode). The exact parameters by which depressed individuals can use positive memories to improve their mood need further investigation (Werner-Seidler & Moulds 2014). Generating positive imagery may also have beneficial effects on implicit affective processing (Görgen et al. 2015). One fruitful avenue for future treatment innovation might be to focus on techniques for boosting physiological response during mental imagery, a method developed by Peter Lang and colleagues for anxiety (Lang et al. 1980, Miller et al. 1987). Overall, providing instructions and training in using mental imagery may increase the ability of individuals with depression to carry out mood repair effectively.

Overgeneral memory. As reviewed above, accumulating evidence suggests that OGM plays an important role in increased vulnerability to emotional disorders (depression and PTSD in particular). Therefore, reducing or remediating OGM is a compelling target for therapeutic intervention.

A first exploration into this potential translational treatment for depression was conducted by Raes et al. (2009), who developed the group-based MEmory Specificity Training (MEST) program to train specific retrieval of personal memories in order to counter OGM. MEST consists of four weekly one-hour group sessions. The main component is repeated practice in recalling specific memories in response to both neutral and emotional (positive and negative) cue words. During practice, patients are encouraged to recall as much contextual and sensory-perceptual detail as possible in the process of generating and describing specific memories. For each memory that is retrieved, patients are invited to generate a vivid and detailed image of their specific memories and to imagine the event as vividly and clearly as possible. The program further includes psychoeducation (about memory problems in depression more generally) and homework exercises (for more details, see Raes et al. 2009). In an uncontrolled pilot study of 10 depressed inpatients, memory retrieval style indeed became significantly more specific over the four-week intervention (Raes et al. 2009). Furthermore, the observed improvements in memory specificity were significantly associated with improvements in problem-solving skills, cognitive avoidance, and rumination, all variables that are hypothesized to mediate the impact of memory specificity on the course of depression. A recent uncontrolled study found that MEST also resulted in increased specificity of memory retrieval in 32 depressed outpatients (Eigenhuis et al. 2015).

The uncontrolled pilot of Raes et al. (2009) was followed by an RCT comparing five sessions of MEST to a control condition (with no additional contact) in 23 depressed adolescents (Neshat-Doost et al. 2012). Repeated practice in retrieving specific memories was again the main component of the program. For the group receiving MEST, but not the control group, there was a significant increase in memory specificity and a significant decrease in depressive symptoms at follow-up.

Improvements in depressive symptoms in the MEST group were mediated by changes in memory specificity.

The results of these pilot trials suggest that MEST indeed holds promise as a relatively simple therapeutic intervention for depression. As a logical next step, MEST is currently being compared to an active (education and support) control condition in a Phase II RCT in 60 depressed adults (Dalgleish et al. 2014). From a basic science perspective, Schacter (2013) recently referred to MEST as an illustration of how basic research findings may be usefully applied or translated to daily life in general or to clinical practice more specifically. The ongoing Phase II trial and other future studies will determine whether MEST can live up to its promise as an effective depression intervention.

A recently developed intervention that also aims to ameliorate depression via intensively training individuals to become more specific in their thinking is concreteness training (CNT; Watkins et al. 2009). Whereas MEST is mainly a clinical translation of theoretical and experimental work on OGM, CNT explicitly builds on the wider literature on overgeneralized thinking (including OGM) and rumination in depression, where rumination is conceptualized as an abstract (antithetical to a more helpful concrete) thinking style.

Participants undergoing CNT work with standardized events (scenarios) in addition to personal events (specific autobiographical memories) and are trained to process those events in a concrete fashion (using mental imagery, focusing on sensory details and promoting so-called how thinking as opposed to abstract-ruminative why thinking). Following initial proof-of-principle studies in dysphoric individuals (Watkins & Moberly 2009, Watkins et al. 2009), Watkins et al. (2012) conducted a Phase II RCT in which clinically depressed individuals were randomized to treatment as usual (TAU), TAU + CNT, or TAU + relaxation training (RT). TAU + CNT resulted in greater increases in concreteness and greater decreases in rumination and overgeneralization in comparison with both control groups. TAU + CNT resulted in significantly greater decreases in self-reported depressive symptoms in comparison with TAU but not with TAU + RT.

To test whether CNT exerts a beneficial effect on depressive symptoms through an improvement in the hypothesized mechanism of concrete processing or alternatively via nonspecific factors, Mogoaşe et al. (2013) focused on CNT's essential component, that is, concrete processing training, in the absence of a therapeutic context (no contact with a trainer, and not presented as a depression intervention). This "pure" CNT was delivered for seven consecutive days via the Internet to dysphoric students ($N = 42$), and its effects were compared to a no-intervention control. The process differed from previous CNT studies in that participants practiced using only standardized scenarios and not personal autobiographical memories. Autobiographical memory specificity was assessed using the AMT. Results showed that, as in the previous studies (Watkins et al. 2009, 2012), the students who received CNT had significantly greater increases in concreteness than did the control group, but the increases did not lead to greater memory specificity or to a reduction in depressive symptoms or rumination. As such, questions regarding the key therapeutic ingredient of CNT remain outstanding.

Both MEST and CNT can be regarded as forms of CBM interventions. The bias in this case is OGM recall, or more broadly, overgeneralized (abstract) thinking. The work conducted so far with MEST and CNT suggests that these are promising interventions. Yet, we agree with Cristea et al. (2015, p. 15) that what is sorely needed are sufficiently powered randomized trials in clinical participants, using adequate (e.g., common factors) control groups, and conducted by independent research groups. Meanwhile, we also note that where further development is needed in CBM (and contrary to Cristea and colleagues' conclusions), we believe small experimental studies will be valuable in science-driven treatment innovation and for understanding the underlying mechanisms, such as imagery.

Other memory and imagery-related approaches. The broader literature on mental imagery suggests additional ways in which mental imagery could be used to enhance cognitive-behavioral interventions for depression (Holmes & Mathews 2010). For example, the method-of-loci strategy, in which mental imagery is used to associate to-be-remembered information with locations along a familiar route, has been suggested as a means to facilitate recall of positive memories in depression (e.g., Dalgleish et al. 2013, Dalgleish & Werner-Seidler 2014).

Mental imagery could also potentially be of benefit in behavioral activation (BA) interventions for depression. Different forms of BA interventions for depression have been proposed, but the basic assumption is that depression occurs when a person engages in avoidance behavior and engages less frequently in pleasant, potentially rewarding activities (Martell et al. 2010). The aim of BA interventions is to increase engagement in reinforcing activities through activity scheduling, thereby enabling the person to experience reward and positive reinforcement. What role can mental imagery play in BA for depression? Mental imagery allows us to simulate possible (rewarding) events in the future. It has been shown that mental imagery of future behaviors increases the chances of actually acting out this behavior.

Loft & Cameron (2013) found that participants who engaged in a two-minute imagery exercise twice each day for 21 days involving visualizing the steps to prepare for quality sleep experienced improvements in sleep behaviors, sleep quality, and time to sleep when compared with participants in an active control condition (arousal reduction) and participants in a neutral imagery control condition. Similar imagery exercises have also been shown to increase motivation for physical exercises (Duncan et al. 2012) and to promote engagement in physical activities (Chan & Cameron 2012). Such imagery instructions could perhaps also be used in combination with BA principles to help individuals with depression engage in rewarding and reinforcing activities. Although this hypothesis has not been tested so far, it has been shown that dysphoric individuals who were instructed to generate positive images in response to picture-word cues experienced more positive affect and performed better on a subsequent behavioral laboratory task when compared with participants who were instructed to generate negative images or participants in a mixed valence (control) condition (Pictet et al. 2011). Studies unrelated to psychopathology have also used imagery to increase behavior, for example, to increase consumption of healthy fruit (Knäuper et al. 2011). Together, these studies suggest that mental imagery can have a behavior-enhancing effect, which when combined with BA principles could potentially tackle depression through increased reward and positive reinforcement experiences. However, further research is needed.

MECHANISMS OF MENTAL IMAGERY IN DEPRESSION

Can Investigating Mental Imagery Help Us Better Understand the Mechanisms Underlying Depression?

What do we mean by the term mechanism? Mechanisms of psychological change, for example, those brought about by treatment, are defined as "The basis for the effect, i.e., the processes or events that are responsible for the change; the reasons why change occurred or how change came about" (Kazdin 2007, p. 3). More broadly, an understanding of mechanisms provides the essential causal link in revealing how processes interact to yield phenomena of interest (Bechtel 2009). Mechanisms underlie causal inference and causal explanation and are an important consideration in any attempt to modify observed phenomena. In addition to treatment (or, conversely, maintenance) mechanisms, etiological or "risk" mechanisms are also defined (Kraemer et al. 1997). Typically, psychological treatments target mechanisms hypothesized to be involved in the

maintenance of clinical symptoms, whereas basic science disciplines often seek to understand mechanisms of etiology or risk. It is clear that we do not fully understand mechanisms of mental imagery in depression risk, maintenance, or treatment. Ultimately, we need to consider mechanisms at all levels of explanation—behavioral, cognitive, emotional, neural, and molecular; their interrelations; and their interactions with the environment (Morton & Frith 1995) (see **Figure 3**). The US National Institute of Mental Health has called for a focus on mechanisms in clinical research identifying disease and treatment targets, noting, "The term 'target' refers to a hypothesized mechanism of action and its ability to modify disease, behavior, or functional outcomes" (Natl. Inst. Ment. Health 2014). Targets can range from molecular- and circuit-level mechanisms proposed for pharmacologic agents, to neural systems and cognitive processes for psychosocial behaviors, to the decision-making or organizational behaviors of a service providing an intervention (Natl. Inst. Ment. Health 2014). One example of studying mechanisms at a particular level of explanation is to consider the cognitive neuroscience of mental imagery in depression.

How might investigating mental imagery and neural mechanisms help? Can understanding neural mechanisms advance our understanding of depression and promote treatment innovation? Recently, it has been argued that for future mental health treatment innovation, neuroscience findings should be better integrated into mainstream clinical research (Holmes et al. 2014, Roiser 2015).

A wealth of neuroscientific evidence suggests that memory, imagery, and perception draw on both shared and distinct neural components (Kosslyn et al. 2006). For example, episodic mental imagery of past and future events recruits medial temporal lobe structures that are involved in autobiographical memory, such as the hippocampus, with fMRI activity levels in healthy controls correlated with imagery vividness and detail (Addis & Schacter 2008). A recent meta-analysis concluded that brain structures in the default network, specifically the medial prefrontal cortex, are involved in both personal episodic future imagery and spontaneous mind-wandering (Stawarczyk & D'Argembeau 2015). In a study comparing depressed and nondepressed participants, past and future episodic imagery was generated during fMRI in response to cue words referring to commonly experienced events (Hach et al. 2014). During the relatively smaller number of trials for which depressed participants were able to recall a detailed, specific autobiographical memory, participants showed underrecruitment of brain regions supporting memory specificity (e.g., hippocampus). Nevertheless, the same basic brain regions were recruited by both groups of participants. This finding could be leveraged to shed light on how, why, and for whom imagery-based treatments work. For example, does imagery training enhance the ability and tendency to generate imagery, and are these changes associated with normalized neural activity in the critical episodic imagery network? Can investigation of differences in neural response to autobiographical memory generation be used to develop methods for identifying treatment responders (cf. Roiser et al. 2012)?

Cognitive neuroscience findings could potentially be used to optimize treatment for individual patients via neurofeedback. In this procedure, neuroimaging data are relayed to participants in real time for use as a training signal to regulate brain activity. Conceptually, this is analogous to giving participants detailed verbal feedback on a trial-by-trial basis during a cognitive intervention. In one study, depressed participants used fMRI neurofeedback to regulate activity in brain regions responsive to emotionally positive (versus neutral) visual stimuli, including the anterior insula, hippocampus, and a number of prefrontal regions (Linden et al. 2012). During debriefing, participants reported that they had gradually learned to adopt a positive mental imagery strategy to regulate brain activity, with beneficial impact on mood and clinical symptoms. Clearly, these are

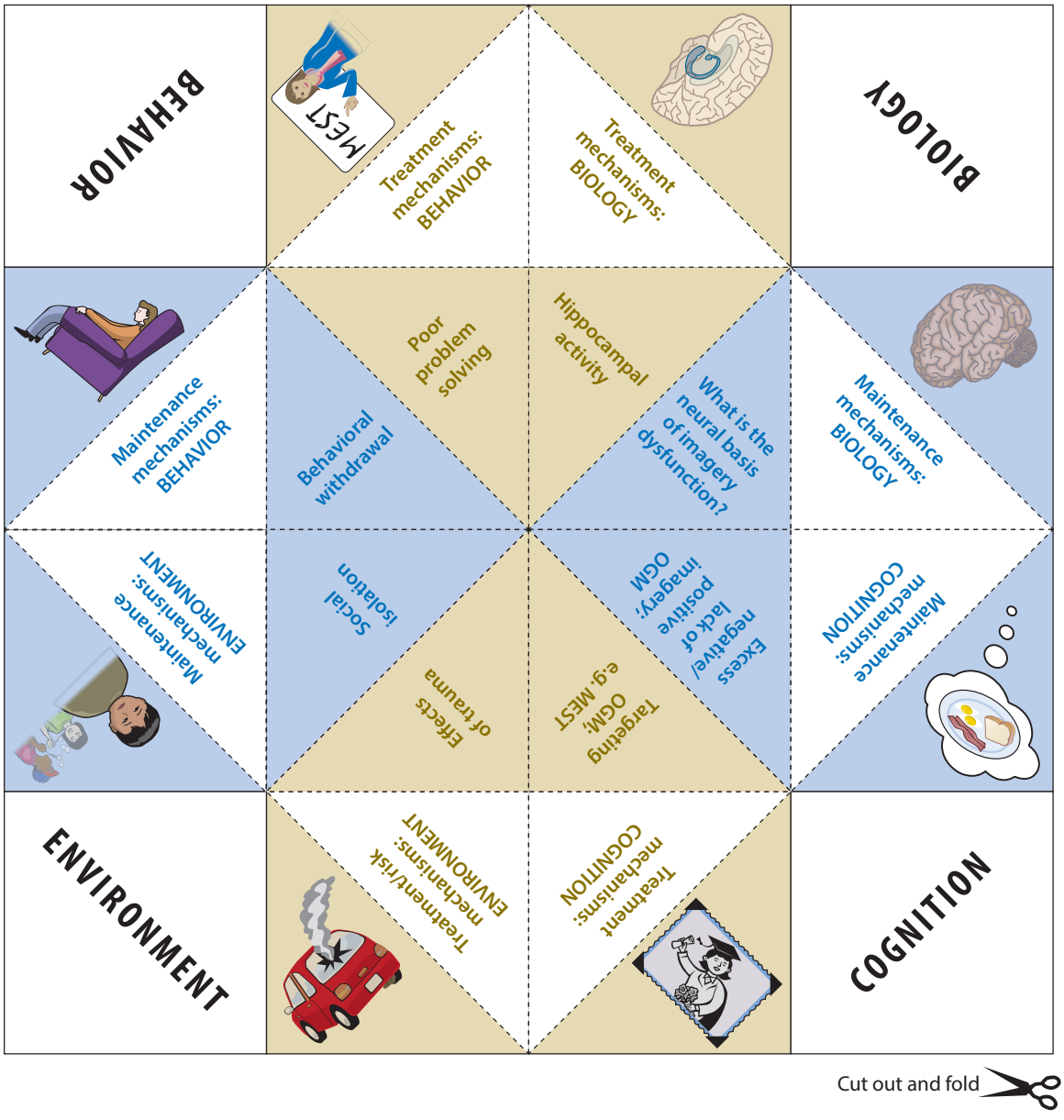

Figure 3

A "chatterbox" origami model to show in 3D the mechanisms of depression at behavioral, cognitive, biological, and environmental levels of explanation. The figure can be cut out and assembled along the dotted lines (search "how to make a chatterbox" online for instructions). The entire model represents an individual with depression. Move apart the four apices to reveal examples of either maintenance (*blue*) or treatment target (*brown*) observations and hypothesized mechanisms. Behavioral observations constitute directly observed experimental and clinical variables; for example, fewer specific details recalled during an autobiographical memory task or clinical observations of reduced spontaneous activity. At the cognitive level are the mental processes hypothesized to result in these behavioral observations; these are unobservable directly but must be inferred on the basis of controlled experiments. At the biological level are molecular or systems neuroscience mechanisms thought to underlie cognitive and behavioral phenomena. Finally, at the environmental level are environmental risk factors and factors thought to exert a broad impact on an individual. All levels are relevant for understanding depression in an individual person. Abbreviations: MEST, MEmory Specificity Training; OGM, overgeneral memory.

early days, but such studies illustrate the potential for cross talk between cognitive neuroscience and clinical psychopathology research.

Moving mechanisms forward: bridging cognitive science, mental imagery, and emotion. In order to more fully understand the neural mechanisms of mental imagery in depression, a more fine-grained approach at the cognitive level of explanation is needed. Over several decades, research led by Kosslyn has delineated a set of tools for investigating the cognitive operations recruited during mental imagery tasks. Four key components are identified (Kosslyn 1996, Kosslyn et al. 2006): (*a*) image generation, or the formation of an image in the "mind's eye"; (*b*) image inspection, or the shifting of attention to a particular aspect of an image; (*c*) image maintenance, or the retention of an image; and (*d*) image transformation, for example, mentally rotating imagined objects (for the relation of these concepts to clinical psychology, see Pearson et al. 2013). Each of these four processes may be recruited to a greater or lesser extent in a given mental imagery task, and each can in turn be subdivided into more basic, domain-general cognitive components, such as autobiographical memory retrieval, working memory maintenance, and attentional selection (Kosslyn et al. 1984, 2006). This basic cognitive science framework highlights cognitive subcomponents of mental imagery, which is a useful basis for designing well-controlled experimental tasks. However, there is still a gulf between this fundamental research and imagery of meaningful and emotion-laden events, and more research that speaks directly to the links between mental imagery, emotion, and clinical symptoms is required.

Experimental work has demonstrated that compared to verbal processing, imagery has a more powerful impact on emotion (Holmes & Mathews 2005; Holmes et al. 2006, 2008c; Nelis et al. 2012). The impact on emotion is not just for fear, but for emotions also highly relevant in depression—positive and negative affect. Holmes & Mathews (2010) have suggested that the impact of imagery on emotion is brought about in several ways, such as by the similarity between imagery and actual perception and by imagery's close link to autobiographical memory (see **Figure 4**). We suggest that it will be important to better illuminate the mechanisms underlying mental imagery and emotion both to ameliorate negative affect in depression and to boost positive affect.

CONCLUSIONS

This review highlights the potential importance of mental imagery in depression as well as the fact that this research is at a very early stage. Exciting gaps persist in our understanding of the potential role of mental imagery in the etiology, maintenance, and treatment of depression, and outstanding questions for future research remain, as we have highlighted throughout. A focus on mechanisms (Craske 2014, Holmes et al. 2014), in relation to both dysfunctional imagery and psychological techniques to target it, may be particularly useful. Such a focus could enable better links to be made between different levels of explanation, such as those addressing forms of imagery and memory at a neural level (e.g., Clark et al. 2014, 2016; Hach et al. 2014; Ramirez et al. 2015) (see **Figure 3**). It could also facilitate links between a psychopathology lens (e.g., specific imagery dysfunctions such as difficulty generating positive future-oriented images) and an understanding of the importance that adaptive imagery may play in our everyday lives (such as in mental simulation and anticipation of actions).

In this review, we have suggested that people with depression may suffer from an excess of intrusive involuntary negative mental imagery yet also experience impoverished positive imagery, and further may have difficulty voluntarily generating specific images of the past or future. Focusing on mental imagery in depression provides the opportunity to understand an important yet relatively

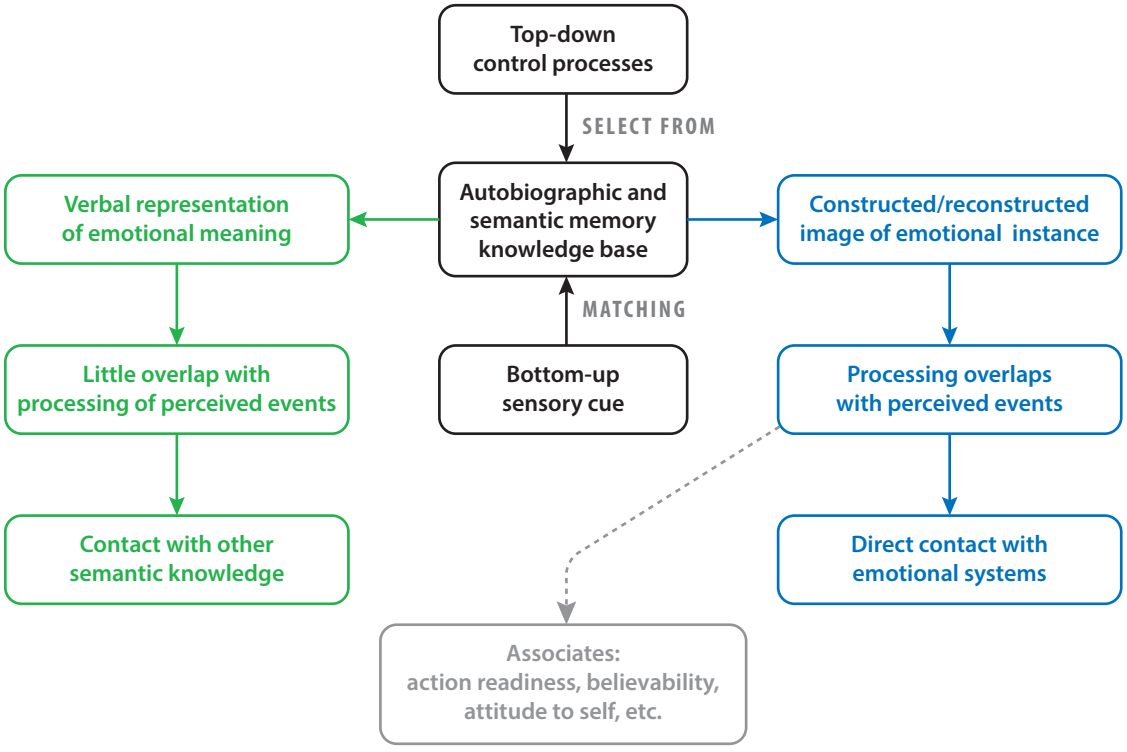

Figure 4

Bridging cognitive science, mental imagery, and emotion: the construction of imagery versus verbal representations, and their relative impact on emotion. See also (Holmes & Mathews 2010).

neglected aspect of cognition that has a powerful emotional impact and numerous roles in our everyday life. This adds color to our understanding of underlying mechanisms in depression and may help develop more effective and adjunctive treatment techniques for this common and disabling disorder.

SUMMARY POINTS

1. Dysfunctional mental imagery plays a potentially important role in depression, but research is at an early stage.
2. Imagery dysfunctions in depression include an excess of intrusive mental imagery, impoverished positive imagery, observer perspective imagery, and overgeneral memory (in which specific imagery is lacking).
3. Emerging evidence indicates that intrusive negative imagery and overgeneral memory may prospectively account for changes in depression symptoms over time.
4. Imagery dysfunctions in depression may add a useful target for treatments, including psychological interventions, such as forms of cognitive behavioral therapy or memory specificity training, and emerging cognitive training paradigms.

FUTURE ISSUES

1. Future studies are needed to advance our knowledge of mechanisms underlying mental imagery and emotion in depression, both to ameliorate negative affect and to boost positive affect.
2. The contribution of dysfunctional mental imagery to the onset or maintenance of depression needs further investigation, including the unique contribution of the representational format (i.e., imagery versus verbal) of intrusive negative cognitions and of impoverished positive cognitions.
3. The potential role of adaptive mental imagery in contributing to boosting optimism and resilience needs further investigation targeted at understanding underlying mechanisms and developing new treatment approaches.
4. Future studies should explore new applications of how imagery may enhance current treatments for depression, for example, by helping patients with depression to engage in potentially rewarding behavioral activities.
5. Interdisciplinary work, for example, work bridging clinical psychology and neuroscience in the investigation of imagery-related mechanisms in depression psychopathology, is highly recommended.

DISCLOSURE STATEMENT

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