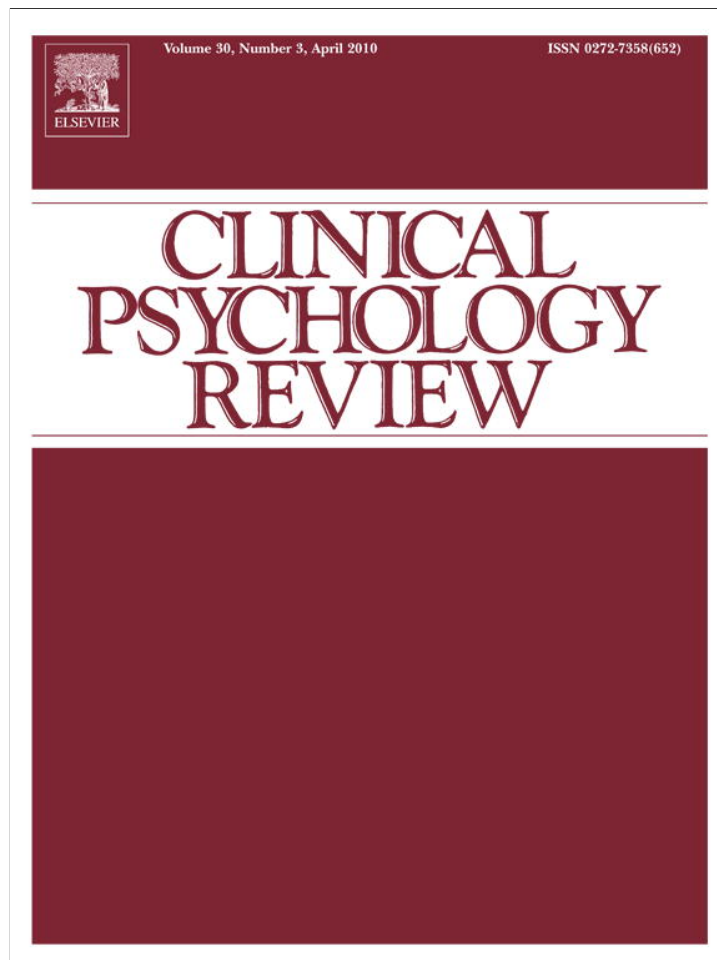


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Mental imagery in emotion and emotional disorders

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ABSTRACT

Mental imagery has been considered relevant to psychopathology due to its supposed special relationship with emotion, although evidence for this assumption has been conspicuously lacking. The present review is divided into four main sections: (1) First, we review evidence that imagery can evoke emotion in at least three ways: a direct influence on emotional systems in the brain that are responsive to sensory signals; overlap between processes involved in mental imagery and perception which can lead to responding “as if” to real emotion-arousing events; and the capacity of images to make contact with memories for emotional episodes in the past. (2) Second, we describe new evidence confirming that imagery does indeed evoke greater emotional responses than verbal representation, although the extent of emotional response depends on the image perspective adopted. (3) Third, a heuristic model is presented that contrasts the generation of language-based representations with imagery and offers an account of their differing effects on emotion, beliefs and behavior. (4) Finally, based on the foregoing review, we discuss the role of imagery in maintaining emotional disorders, and its uses in psychological treatment.

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“Imagination is more important than knowledge”: Albert Einstein
 “Everything you can imagine is real”: Pablo Picasso

1. What is mental imagery?

We all know what it is like to experience mental images. Images range from sudden memories of past events that intrude into our awareness uninvited, to daydreams in which possible future events are deliberately produced by our own efforts. Whatever their source, images seem to be characterized by their subjective resemblance to sensory impressions, as if “seeing with the mind’s eye or hearing with the mind’s ear” (Kosslyn, Ganis, & Thompson, 2001, p. 635). This should not be taken as implying that images resemble “pictures in the brain”, anymore for that matter than do percepts themselves, but rather that both are neural representations constructed from more elemental sensory information. Although visual images of simple objects have been the focus of much experimental work in general psychology, in reality, and strikingly in studies of cognition in psychological disorders, imagery can involve multiple sensory modalities, including bodily sensations and feelings, and can represent complex actions and events that change over time.

The question of whether images are encoded in the form of propositions or in a form that is analogous with spatial and other perceptual properties has been fully discussed elsewhere (Kosslyn, Thompson, & Ganis, 2006; Pylyshyn, 2006) and is thus not considered further here. Regardless of how images are actually encoded, recent neuro-imaging evidence has left little doubt, however, that mental images are indeed accompanied by processes similar in some respects to those involved in the initial perception of sensory events, and in their recall from autobiographical memory, as will be discussed in greater detail below.

2. Why is imagery important to clinical conditions and their treatment?

Images can powerfully evoke emotional states. Imagery is the hallmark of post-traumatic stress disorder (PTSD; American Psychiatric Association, 2000) powerful emotions can be evoked by imagery in the form of ‘flashbacks’ to the original traumatic event. Imagery also occurs in many other forms of psychopathology. For example, in people with substance dependencies, related images (e.g. of smoking marijuana) may induce desire or craving for the desired substance (Kavanagh, Andrade, & May, 2005). Repeated concern-related images are often reported by those with emotional disorders such as PTSD or social phobia, for reviews see Hackmann and Holmes (2004), Hirsch and Holmes (2007) and Holmes, Arntz, and Smucker (2007). Such images are widely believed to contribute to the onset or maintenance of those disorders (e.g. Clark & Wells, 1995; Ehlers & Clark, 2000). In other disorders, images are notable by their absence—that is, by attempts to remove them from mind. For example, it has been proposed that avoidance of the excessive anxiety associated with images of possible aversive outcomes by thinking about them in verbal form is a contributory factor in pathological worry (Borkovec, Lyonfields, Wisner, & Deihl, 1993). Emotional imagery-avoidance may also occur in depressive rumination, which is similarly verbal in nature (Fresco, Frankel, Mennin, Turk, & Heimberg, 2002).

Consistent with this belief in the emotional power of imagery, clinicians using a range of therapeutic approaches have incorporated the manipulation of mental images related to emotional concerns into

psychological treatment. In the systematic desensitization treatment of phobias, images of feared objects are repeatedly brought to mind until anxiety subsides (Wolpe, 1958). Intriguingly, the greater the initial anxiety response to such images, and the more marked the decline of this emotional response, the better the eventual outcome (Lang, Melamund, & Hart, 1970). More recently, “imagery rescripting” techniques—that is, directly modifying the content of emotion-inducing imagery—have been employed in the treatment of disorders such as PTSD, social phobia and snake phobia (e.g. Arntz & Weertman, 1999; Hackmann & Holmes, 2004; Holmes, Arntz, et al., 2007; Hunt & Fenton, 2007; Ohanian, 2002; Smucker, Dancu, Foa, & Niederee, 1995; Wild, Hackmann, & Clark, 2007).

In summary, a key reason for thinking that mental imagery is critical in psychopathology is its powerful impact on emotion. This impact can both cause distress and contribute to the maintenance of various disorders (as we shall discuss in further detail later), but conversely, this same property of imagery can be harnessed in treatment.

3. Why does imagery have a powerful impact on emotion?

There are several reasons why images should have a particularly powerful affective impact, and a number of mechanisms that provide links between imagery and emotion. We review literature that imagery can evoke emotion in at least three ways: a direct influence on emotional systems in the brain that are responsive to sensory signals; overlap between processes involved in mental imagery and perception which can lead to responding “as if” to real emotion-arousing events; and the capacity of images to make contact with memories for emotional episodes in the past.

3.1. Imagery, psychophysiology and basic emotional systems in the brain

The proposal that images have special links to emotion is not a new one, and is central to the bio-informational theory of emotional imagery proposed by Lang (1979). In this view, images are supposed to be particularly effective in provoking emotion when the images include “response propositions”: that is, information pertaining to associated autonomic or behavioral responses. In one often-cited investigation, Vrana, Cuthbert and Lang (1986), manipulated the amount of information about physiological and behavioral responses in fear-related or neutral events that were first described aloud in script form and then imagined. For example, one description of giving a speech included statements such as “your heart is pounding”, while the other omitted such statements. However, in this study, inclusion of such response information did not have a significant effect on actual heart rate. Nonetheless, heart rate was higher when fearful rather than neutral situations were imagined, and this difference was more marked for imagery than when participants verbally rehearsed the description. Relatedly, participants reporting ‘good’ rather than ‘poor’ mental imagery ability exhibited greater physiological activity when imagining emotional scripts (Miller et al., 1987). Interpretation of these results is complicated, however, by the fact that descriptive verbal information was necessarily always presented prior to the imagination phase, rather than being counterbalanced for order. Whether emotional response due to imagery is really greater than that due to reading verbal scripts is thus difficult to determine, because of possible cumulative or order effects.

While this evidence is thus not conclusive, it seems plausible that emotional systems in the brain might be particularly sensitive to

imagery because basic emotions such as fear evolved relatively early in our evolutionary history, to facilitate responding to sensory events signaling danger (or reward). Sensory cues can elicit rapid responses from brain areas implicated in emotion, such as the amygdala, bypassing the need for higher level processing by other cortical areas (LeDoux, 2000). Drawing on this and other evidence showing that emotional responses can be elicited by stimuli presented out of awareness, Öhman and Mineka (2001) have argued that emotional responses such as fear arise from modular systems that are relatively isolated from the influence of higher level conscious processes, such as those involving language. Evidence to support this position includes the finding that emotional stimuli (e.g. pictures of angry faces) can activate the amygdala when presented outside of attention, or even when masked to prevent awareness. Contrary to this view, however, other evidence shows that instructions to think about fear-related pictures in different ways can significantly reduce, if not eliminate amygdala activation, so that at least in some situations top-down conscious control is possible (e.g., Mathews, Yiend, & Lawrence, 2004).

Nonetheless, it remains possible that some basic emotional systems in the brain, which evolved prior to the development of language, may store and respond primarily to information in sensory form and so be less directly responsive to information represented in more abstract and arbitrary symbolic form. Mental images (in all sensory modalities) are primarily sensory-perceptual representations, and the brain areas activated during imagery overlap very considerably with those involved in processing the equivalent sensory and perceptual events (see the next section). It thus seems plausible that mental images could activate brain systems underlying emotion more directly than can symbolic representations not using sensory codes. For example, examples of apparently direct re-activation of emotion occurs during 'flashbacks' in PTSD, in which patients can respond as if the trauma is actually happening again, by exhibiting signs of terror, autonomic symptoms (such as sweating) and even invoking corresponding behavior (e.g. ducking as if to avoid a blow).

3.2. *The mind's eye: imagery and perception*

A second way in which imagery can impact emotion is via its link to directly perceiving the world. There is a degree of competition between mental imagery and perceptual processes when they share the same sensory modality. Holding a visual image selectively interferes with detection of a faint visual signal, and likewise, auditory images interfere with the detection of auditory stimuli (Segal & Fusella, 1969). The reverse relationship also holds: vividness of visual imagery is selectively reduced by simultaneous performance of a visuo-spatial task, and auditory image vividness by counting aloud (Baddeley & Andrade, 2000). This mutual interference strongly suggests that both imaginal and perceptual processes draw to some extent on overlapping cognitive resources.

Neuro-imaging research has shown that visual mental imagery can activate areas in early visual cortex (Kosslyn & Thompson, 2003) e.g. when making comparative judgments of imagined shape. On the basis of substantial correlations between visual cortex activation and subjective ratings of visual imagery vividness, it has even been claimed that vividness can be objectively measured (Cui, Jeter, Yang, Montague, & Eagleman, 2007). Visual cortex is not the only brain area revealing overlap between the activation associated with imagery and perception; rather the areas activated depend on the type of imagery involved. In a whole brain study of activation, Ganis, Thompson, and Kosslyn (2004) concluded that visual imagery and perception draw on similar neural machinery, with considerable overlap in frontal and parietal areas, and some, albeit less complete, overlap in temporal and occipital areas. Strikingly, when the perception of different types of objects activates different processing areas, imagination of those objects does too. Thus the perception of faces selectively activates one region (the fusiform face

area) and perception of places activates another (the parahippocampal place area), but not vice versa. Precisely the same selective activation pattern emerges when people simply imagine familiar faces or places, albeit at lower levels of intensity (O'Craven & Kanwisher, 2000). Similar distinctive activation for both perceived or imagined faces and houses was reported by Ishai, Ungerleider and Haxby (2000). Other areas in the parietal and frontal cortex were more active during imagery regardless of content, interpreted as reflecting top-down processes necessary to retrieve information from long-term memory.

Mental imagery of one's own hand (rather than that of another person) speeds responses to questions about finger location, and repeatedly imagining a finger movement sequence (as in piano playing) not only improves performance but is reflected in corresponding changes in motor cortex (Pascual-Leone et al., 1995; Sirigu & Duhamel, 2001). Thus, imagery selectively activates those areas involved in processing related sensory information in reality, or in producing similar responses and actions.

Although less extensively documented, similar conclusions apply to the perception and imagination of emotional scenes. Looking at faces with negative emotional versus neutral expressions activates several different brain areas, but particularly the amygdala. This pattern is also seen when facial expressions are simply imagined (Kim et al., 2007). The imagination of future emotional events, as well as the recall of past emotional episodes, similarly activates the amygdala (Cabeza & St Jacques, 2007; Sharot, Riccardi, Raio, & Phelps, 2007). Imagination of simulated emotional events can thus be used to anticipate one's own reactions to such events in the future and to decide whether to approach or avoid them (as will be discussed in a later section).

In sum, it can be concluded that imagery activates many of the brain systems involved in equivalent forms of perception, and—when the imagery is emotional in content—brain systems involved in processing emotional information, in much the same way as with perceived or remembered events.

3.3. *Looking back and looking forward: imagery and autobiographical memory*

A third link between imagery and its impact on emotion relates to autobiographical memory. The proposal that imagery is central to autobiographical memory is not new and the history of this idea has been extensively reviewed elsewhere (e.g. Conway, 1990). In a detailed re-examination of earlier introspective observations, Brewer (1996) found that people reported images in most forms of remembering. Images were almost universal when people were prompted to recollect recent personal events (e.g. who was the last person you talked to before me?), and less frequent—although still quite common—when recalling semantic information (e.g. what is the capital of France?). It seems, therefore, that imagery may be particularly relevant to the recall of specific episodes from autobiographical memory, something Conway (2001) has termed 'sensory-perceptual episodic memory'. Conway, Meares and Standart (2004) link such autobiographical images to self goals. Conway and Holmes (2005) argued that intrusive images in psychological disorders are a form of autobiographical memory in distress. Stopa (2009a,b) has further developed this notion for psychopathology in terms of imagery and the 'threatened self'.

In their theory of autobiographical memory, Conway and Pleydell-Pearce (2000) argue that anomalies such as confabulation and other forms of false memory demonstrate that personal recollection processes cannot be accounted for in terms of direct access to a veridical and complete record of events. Rather, control processes actively guide the assembly of autobiographical memories from fragments within a general knowledge base. The same processes that are involved in re-generating memories of past events may be employed when generating new mental images, (a proposition endorsed by Schacter, Addis, & Buckner, 2007). Indeed, Conway and

Pleydell-Pearce (2000) note that some amnesic patients who had suffered extensive damage to the occipital lobes and consequently experienced difficulty in producing personal visual images were also unable to retrieve personal events from the period prior to the damage, unless they were non-visual in nature, such as listening to music. Amnesic patients with hippocampal damage appear to be similarly unable to imagine possible future personal events, despite being able to imagine the shapes of objects (Hassabis, Kumaran, Vann, & Maguire, 2007; Schacter & Addis, 2007).

Arguments for overlapping mechanisms when remembering episodes from the past or imagining them in the future have also been advanced by D'Argembeau and Van der Linden (2006), who found that people with higher scores on questionnaire measures of imagery vividness reported more sensory details both when they were remembering autobiographical events and imagining future events. Lower levels of detail in both memories and images were associated with habitual avoidance of emotional expression, suggesting that individual differences in emotional processing operate equally to influence clarity of both retrieval from memory and the generation of images.

The implications of the striking parallel between the cognitive operations involved in remembering the past and imagining the future have been discussed extensively by Schacter, Addis, and Buckner (2007) who argue that both are mediated by a common "core brain system". Neuro-imaging studies that directly compared remembering and imagining personal events have revealed that they both activate prefrontal and medial temporal regions, together with posterior activation in areas such as the precuneus and visual cortex (e.g. Addis, Wong, & Schacter, 2007; Szpunar, Watson, & McDermott, 2007). There are also some activation differences between remembering the past and imagining the future. For example, there is greater early activation in frontal areas when future events were imagined than when remembering past events (Okuda et al., 2003), supposedly due to the greater need for initial top-down control in future imagery. Imagining distant future events also involves more frontal activation than imagination of events in the near future (D'Argembeau, Xue, Lu, Van der Linden, & Bechara, 2008), perhaps for the same reason. These differences apart, the striking degree of similarity between the brain areas activated in recall and future imagery led Schacter et al. (2007) to speculate that the crucial adaptive advantage arising from this overlap in reconstructive operations is that information in memory could then be utilized in simulating future events.

While most of the above studies of autobiographical memory do not focus on emotion per se, we propose that the common core systems hypothesis suggests another reason why image representations might be particularly likely to evoke emotion. If the generation of images draws on information in autobiographical memory, then to the extent that the memories accessed include feelings experienced during prior episodes, the constructed image is likely to reinstate the same emotion. Indeed, Conway and Pleydell-Pearce (2000) propose that autobiographical memory for emotional events may be stored in a form resembling images, so that the newly reconstructed image would be likely to contain elements of these personally significant emotional image-memories. Consistent with this possibility, in a series of experiments contrasting retrospection with anticipatory mental simulations, Van Boven and Ashworth (2007) found evidence that feelings experienced at the time of recall or imagination were predicted by the remembered or predicted emotional intensity associated with the event, as well as by the extent of involvement with the simulation (e.g. vividness). This suggests that the emotional response to image-memories may be evoked in two ways; by recapitulation of feelings already associated with that event in memory as well as by feelings generated *de novo* by the perceptual content of the constructed image itself.

3.4. Summary of the ways in which imagery influences emotion

The evidence discussed above suggests that there are at least three possible ways that mental imagery can evoke emotion: a direct influence on emotional systems in the brain that are responsive to specific sensory signals, including those generated by images; a (possibly less direct) effect in which images are interpreted as being similar to real emotion-arousing events due to overlapping activation patterns between imagery and perception; and finally, the capacity of images to make contact with memories for emotional episodes in the past and reactivate related feeling states. For example, seeing a snake approaching can rapidly activate a fear response, while just imagining a snake approaching can also activate fear, and further remembering escaping from a snake can also evoke emotions felt at the time.

Clearly these options are not mutually exclusive possibilities, and indeed there are obvious connections among them. For example, as the episodic memory knowledge base contains sensory information that can be incorporated into newly constructed images, this could provide a partial explanation for the ability of images to activate perceptual processing areas. Consequently, the overlap between perceptual processing and imagery may be the reason that images generate the type of signals to which basic emotional systems are supposed to be responsive. Thus, rather than competing alternatives, the possibilities discussed above may all be part of a more complete account.

4. Emotional effects of imagery versus language: new evidence from our laboratories

We have assumed that the emotional images reported by patients, so striking in clinical practice, require understanding and explanation. However, clinical psychology has come under fire for making unproven assertions about a special relationship between mental imagery and emotion. For example, Watts has argued that the relative impact of imagery on eliciting emotion may merely be "clinical anecdote" (Watts, 1997) unsubstantiated by empirical evidence. Indeed, our earlier literature search for research supporting the assumption of a special effect of imagery on emotion produced essentially no convincing results, mostly due to the lack of any appropriately designed studies comparing emotional imagery with an alternative (language-based) representational forms (Holmes & Mathews, 2005). Consequently, we will now review a series of studies that was specifically designed to resolve this issue (Holmes & Mathews, 2005; Holmes, Mathews, Dalgleish, & Mackintosh, 2006; Holmes, Mathews, Mackintosh, & Dalgleish, 2008).

The first such experiments were based on prior findings that inducing consistent negative or benign interpretations of ambiguous descriptions led to congruent changes in anxiety (e.g. Mathews & Mackintosh, 2000). In these studies, participants were instructed to read and then imagine themselves in the situations described. To test if these imagery instructions were critical to the elicitation of emotion, Holmes and Mathews (2005) allocated participants randomly to either imagination instruction condition, or to a comparison condition in which they were instructed instead to focus on the meaning of the words. Both groups then listened to 100 initially ambiguous event descriptions that were eventually resolved in a negative direction. The different instructions given to groups were reinforced by asking questions after each description that either emphasized the perceptual or semantic attributes of the event (e.g. "Can you see smoke from the fire when you get to the exit?" versus "Did you discover the fire before you got to the exit?") depending on group allocation. Results were clear cut: state anxiety increased significantly over time in the group given imagery instructions, but not in the verbal meaning focus group.

These results were replicated in a second experiment, in which imagination instructions again led to greater anxiety increase than did verbal focus instructions. This second study included two additional

conditions in which similar descriptions always ended in benign (rather than negative) resolutions, again with either imagery or verbal focus instructions. In these benign-resolution groups, as predicted, the direction of anxiety change differences tended to be reversed (less increase in the imagination group) but this apparent difference was not statistically significant. One possible explanation for this lack of a significant difference is that, although imagining negative events does increase anxiety, imagining merely benign outcomes to potentially negative events is not sufficient to decrease anxiety.

This issue was addressed in a subsequent experiment (Holmes et al., 2006) in which new descriptions were created that did not merely resolve ambiguously negative events in a benign way but were designed to be unambiguously positive. For example, “you are at home alone, and hear a sudden noise and realize with relief it is your friend arriving” or “it’s your birthday, your partner reaches over with a present, which is wonderful”. Furthermore, rather than rely on measures of state anxiety alone, mood was also assessed using the positive affect scales of the PANAS (Watson, Clark, & Tellegen, 1988). Otherwise, the procedure was similar to that described earlier, in that participants were either instructed to imagine the events described, or to focus on the verbal meaning of these same descriptions. In this study there was a significant difference between groups in state anxiety change, with trends for anxiety to decrease in the imagination group and increase in the verbal focus group. Differential changes in positive affect were clearer, with a significant increase in the imagery group and (more surprisingly) a significant decrease in the verbal group. This pattern of results has been replicated (Holmes, Lang, & Shah, 2009). Overall, these results suggest that the more marked effect on anxiety of negative images (compared with focusing only on verbal meaning) is not unique: parallel effects emerged when positive events were imagined, with greater increases in positive emotion following imagery than following verbal processing of the same events. Thus images appear to act as ‘emotional amplifiers’ for both positive and negative information.

These results do raise a number of questions, however. One question arising is whether the effects on the self-report measures of affect used might not be due to some form of expectancy effect or experimental demand. In post-experimental questionnaires, participants tended to rate imagery as being in general more likely to influence emotions than a verbal focus. However, in no case was there a significant correlation between these ratings and the actual change in emotion, making demand a less plausible explanation.

Other questions arise from the unpredicted decrease in positive affect for the positive verbal condition, a finding that has since been replicated (Holmes, Lang, & Shah, 2009; experiment 1). It may be that this was an incidental artifact of task differences; for example, if the verbal instructions were actually more arduous to implement, despite there being no differences in subjective ratings of task difficulty. Alternatively, it may be that verbal processing can sometimes undermine affective experience, perhaps by promoting access to conflicting information from semantic memory. This latter possibility was supported by the findings from a subsequent study, in which positive affect decreased when verbal comparisons between the positive stimulus information and the participants own experience were prompted, but not when the opportunities to make verbal comparisons were minimized (Holmes, Lang, & Shah, 2009; experiment 2).

A potentially more problematic issue arises from the fact that all participants must first read or listen to the event descriptions before going on to either produce a mental image, or to focus on verbal meaning. It could thus be argued that in the imagery condition emotion resulted from the summed effect of *both* verbal processing (during reading or listening to the scenarios) and the subsequent image, whereas in the comparison condition emotion could result *only* from verbal processing (Baddeley, 1979; Craik & Lockhart, 1972). This argument would suggest that, rather than using verbal descriptions alone as stimuli, presenting both picture and verbal cues together and

requiring participants to combine them using either an image or a verbal statement would yield a stronger comparative test. If both pictures and captions were relatively neutral when presented singly but became valenced when combined (e.g. a picture showing the view from a high bridge, with the caption “leap”), then any differential emotional response must be attributed to the method used to integrate them.

In an initial naturalistic study using such picture/caption cues (Holmes, Mathews, et al., 2008, experiment 1), participants were instructed to combine each picture/caption pair into a meaningful whole, but without being constrained as to what method to use (i.e. imagery and/or verbal). They were then asked to make a number of judgments, including rating on how emotional each combination was for them; the extent to which it involved a mental image, or a verbal representation; and whether it was based on memory for a real event. Higher ratings of emotion, and for memories, were significantly correlated with extent of imagery use, but not with the extent of verbal representation. Furthermore, regression analyses indicated that this emotional effect of imagery was partially mediated by the more frequent occurrence of autobiographical memories.

Stronger evidence that the association between imagery and emotion might be causal emerged from a second experiment (Holmes, Mathews, et al., 2008, experiment 2) in which participants were instructed to either produce an image or a verbal sentence to integrate each picture with its caption, within alternating experimental blocks of negative or benign meaning combinations. Compared with the verbal condition, state anxiety scores in the imagery group increased more across negative combination blocks, but decreased more across benign blocks. Rated liking for pictures when displayed alone at the beginning and end of the experiment revealed an expected decrease in liking for pictures that had been in negative (rather than benign) combinations, and this difference was significantly greater in the imagery group. These results not only confirm the greater emotional effect of imagery, but also suggest that this effect can transfer to feelings towards associated stimuli, since imagery enhanced the basic evaluative learning effect.

In a final experiment (Holmes, Mathews, et al., 2008, experiment 2b content analysis sample) different groups assigned to the two conditions were asked to describe their image, or describe their descriptive sentence, for later content analysis by independent raters. Self-reported emotional changes replicated the greater effect of imagery seen in earlier experiments. In addition, there were a number of striking differences in reported content as rated by observers; specifically, that images were rated as being more likely to involve the self, to include more specific events, and use more words describing emotions and sensations. For example, a typical image description, cued by a picture of metal rungs with the caption ‘slip’, was “Climbing the ladder, losing my footing and slipping down, trying to cling on”, whereas a typical sentence elicited by the same cue was “The instructor told the man not to slip when climbing up the frame”. Content analysis thus extended the earlier finding that access to autobiographic memories may partially mediate the emotional effects of imagery, and confirmed that the content of imagery is more likely to include specific personal events, together with associated sensory information. In contrast, verbal sentences often seemed to be constructed on the basis of generic semantic knowledge, having less personal and emotional impact. This again suggests that the reason verbal processing can sometimes elicit apparently incongruent effects is because it allows access to inconsistent semantic knowledge.

4.1. Summary of experimental evidence

In sum, results across all the experiments reported in this section provide the first convincing support for the widely held assumption that imagery has more powerful emotional consequences than does the verbal representation of equivalent events, and also show that this applies to both negative and positive emotions. In his recent book

Pylyshyn (2006) wrote that “it is true that if I think the sentence “I am about to be hit by a falling brick” I am not nearly as moved to action, or to emotion, as I am if I visualize a brick is falling down on me. *There has not been a great deal of emphasis placed on this aspect of mental imagery, but it is surely important*” (p.471; italics added). We note that our recent work has indeed placed emphasis on this aspect of mental imagery, confirming that it is both theoretically and clinically important, and support the supposition that imagery acts as an emotional amplifier.

5. Imagery perspective: not all images have an equal impact on emotion

Before reviewing other aspects of imagery important to cognition in psychological disorders, we need to note that the nature of some images makes them more emotional than others. Emotionality is influenced by the perspective from which an image is viewed, and this property has clear relevance to particular psychological disorders. Visual images are typically described as if they were being perceived directly from our own eyes, referred to as the ‘field’ or ‘first-person’ perspective, but sometimes are perceived as if by another person so that we are included in our own image, referred to as the “observer” or “third-person” perspective (Nigro & Neisser, 1983). Evidence suggests that the two image perspectives arise differently and have somewhat different consequences. For example, recent memories, particularly of times when feeling more self-aware, are usually described as being seen from the field perspective, but more distant memories from the observer perspective (Berntsen & Rubin, 2006). The observer perspective is also more common when we imagine ourselves as we used to be, but believe we have since changed (Libby & Eibach, 2002).

Field and observer-perspective images are differentially associated with emotion. When instructed to switch the perspective taken when recalling recent emotional events from field to observer, participants' ratings of the emotion associated with memories was reduced (but not vice versa, Berntsen & Rubin, 2006; Robinson & Swanson, 1993). Memory for events recalled when adopting a field perspective tended to include more detail about emotional reactions and sensations whereas observer-perspective images included more information about spatial relations and physical appearance (McIsaac & Eich, 2002). Similar emotional differences emerged in another study of images cued by standard descriptions of hypothetical situations, rather than the recall of actual events. Instructions to adopt a field perspective for images of standard positive events (those used in Holmes et al., 2006) enhanced mood more than did either observer-perspective images or instructions to maintain a verbal focus for the same descriptions (Holmes, Coughtrey, & Connor, 2008). Consistent with this effect of image perspective, it has been proposed that deliberate adoption of an observer perspective may sometimes be used as a method for reducing distress due to intrusive imagery.

A commonly noted clinical example is that victims of repeated child abuse appear to emotionally detach themselves from their memory by using an observer perspective, watching themselves from the outside rather than as if re-experiencing the event. Such a strategy was reported by some traumatized individuals when recalling traumatic memories (McIsaac & Eich, 2004), and use of the observer perspective was found to be correlated with self reports of emotional avoidance in another traumatized sample (Kenny & Bryant, 2007). Adoption of an observer perspective is also reported to be common in other anxiety disorders such as social phobia (Clark & Wells, 1995; Hackmann, Clark, & McManus, 2000), agoraphobia (Day, Holmes, & Hackmann, 2004), and depression, although whether this latter effect similarly arises from avoidance, a ruminative self focus, or some other factor is less clear (Kuyken & Howell, 2006; Williams & Moulds, 2007a). Despite the intent to avoid negative affect by adopting an observer perspective, this strategy has not been found to be associated with improved longer term outcomes. Consequently, Holmes,

Coughtrey, et al. (2008) suggested that promoting a switch from observer to field perspective may be beneficial for the promotion of positive affect in depression. Although the observer perspective may be adopted to reduce the immediate aversive emotional effects of imagery, it seems also to have the unintended consequence of maintaining some disorders by focusing attention on a stereotyped and distorted self-image rather than on sources of more positive information.

Overall, it seems that the perspective adopted in mental images can have both emotional and behavioral consequences, with self-perspective images generally having greater emotional effects, and observer-perspective images having more influence on behavioral goals and public self-perception (Libby, Shaeffer, Eibach, & Slemmer, 2007). The interaction between image perspective and emotion is unlikely to operate in only one direction, however. That is, as well as having later consequences for emotion or behavior, the perspective adopted is likely to depend on our current goals, such as avoiding aversive emotion, or desire to change how we perceive ourselves.

6. Further reasons why imagery is important in psychological disorders

Having reviewed mechanisms and evidence for the impact of imagery on emotion, we will now turn to other aspects of emotional imagery relevant to cognition in psychological disorders. These include ‘reality monitoring’, the potential to confuse what happened in imagery with reality, and the ability of imagery to persuade us events are more likely to occur. Imagery can also influence behavior more directly. A better understanding of such aspects is essential to a more complete explanation of how emotional imagery is involved in psychopathology.

6.1. Seeing is believing? Reality monitoring and emotion

At times imagery may be confused with reality, and this may be done more easily with imagery than verbal thought. Reality monitoring refers to the methods and processes that underlie our ability to distinguish between real and imagined events (Johnson & Raye, 1981). The repeated imagination of actions or events that never actually happened can lead to their being falsely remembered as having occurred in reality (Hyman & Pentland, 1996; Johnson & Raye, 1981; Thomas, Hannula, & Loftus, 2007). A considerable body of evidence shows that this distinction is not an inherent property of real or imagined events, but rather depends on a variety of content cues, such as subjective clarity or consistency with other knowledge (which serve to favor a ‘real’ decision), or recall of the processes involved, such as how an image was created (favoring a “not real” decision).

Because we have argued that the overlap between imagery and perceptual processing may be one reason for the emotional effect of images, it might be supposed that people react emotionally to images due to confusing them with real events in memory. This process is presumed to typically occur in the absence of a conscious comparison or awareness of such confusion. Vividness (or clarity) is one feature favoring recall of an event as being real (Gonsalves et al., 2004; Johnson, 2006) and emotional images are typically experienced as being more vivid than are neutral images (Bywaters, Andrade, & Turpin, 2004). Consequently it might be expected that more vivid emotional images should be particularly liable to be misremembered as being real events, or even assumed to be valid ‘premonitions’ of some future event occurring. Some results do indeed suggest that source monitoring for emotional information (e.g. which person in a group made an emotional versus neutral statement) might be less good than for neutral information (Johnson, 2006). This seems to suggest that attention to the type of information required for identifying the source of an emotional memory as imagined or actual might be reduced, if attention is

focused on the emotion experienced rather than on other cues distinguishing images from real events.

In studies of false memory it has been found that imagining childhood events that did *not* in fact occur can lead some individuals to assert that these events were real and that they can remember them happening. In one such study, Hyman and Pentland (1996) obtained details of several true childhood events from parents, and presented these to participants, intermixed with one false event (that as a child the participant had upset a punch bowl at a wedding reception). Ostensibly to aid recall, in one condition the events were repeatedly imagined, while in another, participants were instead asked to think quietly about them for an equivalent time. Those who had imagined the false event were significantly more likely to claim that they clearly remembered it happening than were those who only thought about it (25% versus 9%). It is not certain what those instructed to 'think about' the event actually did, but even if this involved some imagery, the results still strongly suggest that instructions to repeatedly imagine events makes them more confusable with reality than verbal thinking.

Furthermore, even if such reality monitoring errors are rare, it could still be that images are subjectively more similar to real events than when the same event is thought about verbally. As noted earlier, individuals suffering from PTSD often report that their flashback images seem real, almost as if the traumatic event was happening again in the present time, although they can later recognize that it did not do so in fact (Brewin & Holmes, 2003; Ehlers & Clark, 2000; Hackmann, Ehlers, Speckens, & Clark, 2004; Holmes, Grey, & Young, 2005). The emotional effects of this momentary confusion may outlast such accurate recognition, however, in the same way that on awakening we can quickly appreciate that an upsetting dream was not real but the resulting emotion may take longer to disappear. Relatedly, imagining a previously experienced aversive event following a cue can maintain or enhance conditioned responses to that cue, almost as if the aversive event had recurred (Dadds, Bovbjerg, Redd, & Cutmore, 1997). Thus, if intrusive images are a feature of psychopathology, one can see how such imagery may provide a mechanism perpetuating responding to a variety of internal and external cues.

We suggest that the power of imagery to appear real and thus be confused with reality can occur in a wide range of psychological disorders, not only PTSD. For example, in more extreme forms hallucinatory imagery in psychosis may appear to overtake reality in the here and now (D'Argembeau, Raffard, & Van der Linden, 2008; Morrison et al., 2002; Steel, Fowler, & Holmes, 2005). Indeed, people high in schizotypy (a trait associated with psychosis) are more prone to experiencing intrusive imagery after a stressful experience (Steel et al., 2005; Steel, Mahmood, & Holmes, 2008). In obsessive compulsive disorder, images of contamination such as germs invading the skin may promote bouts of washing (de Silva, 1986; de Silva & Marks, 1999; Rachman, 2007). In social phobia (Hackmann et al., 2000; Hirsch, Clark, Mathews, & Williams, 2003) and agoraphobia (Day et al., 2004) images associated with earlier memories can reoccur in trigger situations, and their similarity to reality can then serve to activate dysfunctional behavior such as talking very quickly, or not leaving one's home.

In sum, emotional images can sometimes be responded to as if they were real, at least in some respects. Initial evidence suggests that images are more likely to be recalled as being real events than are verbal representations (e.g. Hyman & Pentland, 1996), though further research on this issue is clearly needed. We suggest that highly emotional images *seem* more real at the time of their occurrence and are thus more "believable". Images may seem real in the sense of resembling an actual memory, or perceptually in the sense of apparently happening in the here and now, and also in the sense of making an event seem more likely to happen in the future (see below). We further suggest that the experience of extreme emotion can temporarily block attention to other information, including knowledge incompatible with the reality of image content, even though this knowledge might be readily accessible on later recall.

Thus we can feel genuinely tense and frightened while absorbed in a Sci-Fi horror film as if it is difficult to simultaneously access the knowledge that aliens are not about to invade our living room. In contrast, verbal representations may be more likely to promote access to incompatible information at the time, and thus can be more readily dismissed on logical grounds (cf. Holmes, Lang, & Shah, 2009, experiment 2). Needless to say, more research is needed to investigate these interesting possibilities in a clinical context.

6.2. *Believing in and acting on imagery*

Imagining a possible event outcome (such one candidate winning an election) increases our subjective probability (i.e. belief) that the same outcome will actually occur (Carroll, 1978), and imagining one's own future behavior (such as subscribing to a cable TV service) increases the chances of our enacting that behavior in reality (Gregory, Cialdini, & Carpenter, 1982; Koehler, 1991; Libby, Shaeffer, Eibach, & Slemmer, 2007). While most of this research has been in non-clinical populations, the finding that mental imagery of a future event can increase the perceived probability of that event has clear relevance to psychopathology. For example, ease of imagining symptoms of a disease increases subjective likelihood ratings of contracting that disease (Sherman, Cialdini, Schwartzman, & Reynolds, 1985). Similarly, it seems likely that imagery of "dirt and germs" could exacerbate a dysfunctional belief about contamination in Obsessive Compulsive Disorder (de Silva, 1986) or imagining winning at gambling may propel manic beliefs about 'being a winner' in Bipolar Disorder (Holmes, Geddes, Colom, & Goodwin, 2008).

Mental images (particularly from an observer perspective) can also influence future behavior. Imagining voting increases the probability of actually voting later (Libby et al., 2007), while appropriate imagery increases the likelihood of signing up for cable TV (Gregory et al., 1982), revising for an examination (Pham & Taylor, 1999) or donating blood (Carroll, 1978). These effects are usually explained in terms of the 'availability heuristic': that is, our intuitive judgments of probability of an event outcome are based in part on the ease of accessing instances consistent with that outcome. Thus the speed with which specific emotional episodes can be recalled (or imagined) is correlated with the subjective probability of that event occurring again. Induction of negative (or positive) mood increased speed of access to congruent memories, and correspondingly enhanced their subjective probability (MacLeod & Campbell, 1992). In emotional imagery, an additional effect (the so-called 'how do I feel about it?' heuristic) comes into play, in which anxiety in response to a threatening image is taken as evidence for the genuinely dangerous consequences of that event (Arntz, Rauner, & Van den Hout, 1995; Forgas, 1995). Thus the combination of a fearful response to a threatening mental image, together with use of the 'how do I feel about it?' heuristic, is likely to increase both subjective probability of the feared outcome, as well as associated behaviors, such as avoidance.

Imagery can also be important in guiding behavior relevant to the achievement of personal goals (Conway, 2001; Conway et al., 2004). If an imagined event outcome seems useful (e.g. navigating to a desired destination), the above consequences of mental imagery, such as increased action readiness, can have clear benefits for achieving goals. However, if the imagined event includes unrealistically negative outcomes then these same properties of imagery have dysfunctional implications. For example, the prospective mental images of killing oneself reported by some depressed patients ('flash-forwards') may serve to increase the probability of later suicidal behavior (Holmes, Crane, Fennell, & Williams, 2007). Conversely, if, as we have argued, dysphoria is associated with a deficit in generating positive imagery of the future, despite an intact ability to experience negative prospective imagery (Deeprouse & Holmes, *in press*; Holmes, Lang, Moulds, & Steele, 2008), then this may compromise the ability of people with depression to act on positive goals.

People often evaluate future (or past) actions via so-called “mental simulation”: for example, by mentally rehearsing them in order to decide what to do, using imagery or other representational methods (Taylor, Pham, Rivkin, & Armor, 1998). Although this research has not distinguished imagery from other types of simulation, it seems likely that imagined actions and their outcomes are used to determine behavioral choices, while avoiding the cost of real-life trial and error. Mental simulation of future positive outcomes (e.g. day-dreaming about personal success) is typically associated with happy mood, and of negative outcomes with unhappy mood (e.g., Sanna, 2000). In psychopathology, if the outcomes represented in imagery are negative (e.g. a PTSD flashback to crashing a car) then a mental simulation approach suggests that related actions would be avoided (e.g. car driving). In anxious patients, preliminary evidence suggests that the ease of image formation was correlated with subjective probability of an event occurring (Raune, MacLeod, & Holmes, 2005). Simulation of future negative events may also be involved in disorders such as obsessive compulsive disorder (Keen, Brown, & Wheatley, 2008).

In the same way that imagery can exacerbate maladaptive behavior, it can also be used to reduce it. For example, repeated images of calmly approaching a feared situation first reduces anxiety during imagery itself and subsequently increases approach behavior in reality (Mathews, 1971; Wolpe, 1958). Originally conceived as being based on counter-conditioning and generalization, from the present perspective it seems likely that such imaginal methods have effects via the various cognitive mechanisms discussed above.

7. A cognitive model of imagery versus verbal representations, and their impact on emotion, perceived reality and behavior

To summarise the properties of imagery reviewed above, a heuristic model is presented in Fig. 1 that contrasts the generation of language-based representations with imagery. The model offers a descriptive account of the proposed differences between imagery and verbal representation, and their effects on emotion, perceived reality and behavior.

The central section of Fig. 1 indicates that there are two ways in which images can be initiated. In one of them (bottom up), a sensory cue that partially matches a representation in episodic memory (Fig. 1, *Select from autobiographic and semantic memory*) automatically elicits an image (Fig. 1, *Bottom up sensory cue*), together with any emotions

associated with the original episode. This describes the generation of intrusive, unbidden, involuntary imagery. In the other route, top-down control processes guide the (deliberate) construction of an image (Fig. 1, *Top-down control processes*). In the figure these routes converge such that both cases are summarised in the box on the right hand side ‘(Re)constructed image of emotional instance’. Indeed, in both cases processing overlaps with that of perceived events (see Fig. 1: *Processing overlaps with perceived events*), since imagery activates many of the brain systems involved in equivalent forms of perception (perceptual processes). When the imagery is emotional in content, it can activate brain systems involved in processing emotional information, in much the same way as with perceived events (see Fig. 1; *Direct contact with emotional systems*). Thus, this overlap of imagery (whether involuntary or deliberately generated) with perception gives direct access to emotional systems.

Depending on image properties, such as whether field or observer perspective is adopted, varying degrees of emotion may be evoked. Field (self) perspective images give rise to greater emotional effects, whereas observer (third person) perspective images have more influence on behavioral goals. Imagery’s influence on goals brings us to other associated properties of imagery—that is, its effect on aspects beyond emotion. This includes increasing readiness for action, and promoting the performance of an imagined behavior. Using imagery can enhance the believability of the content, and the perceived likelihood an event is true / will happen. Imagery can also prime changes in self-perception, such as how person believes they are intrinsically or appears to others (Fig. 1, *Associates: action readiness, believability, attitude to self, etc.*).

Alternatively, in the left hand section of the figure (see box *Verbal representation of emotional meaning*), the verbal representation of (emotional) information via the autobiographic and semantic memory knowledge base yields *little overlap with processing of perceived events*. Consequently, as compared to the imagery route, verbal representations typically yield less emotion, and are less likely to be treated as being “real” or to promote associated behaviors. However, the verbal route does make contact with other knowledge in semantic memory (Fig. 1, *Contact with other semantic knowledge*), increasing the likelihood of accessing information that opposes the original verbal representation. While the model is designed to best contrast these two forms of processing, it is noted that imagery and verbal routes are not exclusionary alternatives of processing and that both may occur simultaneously.

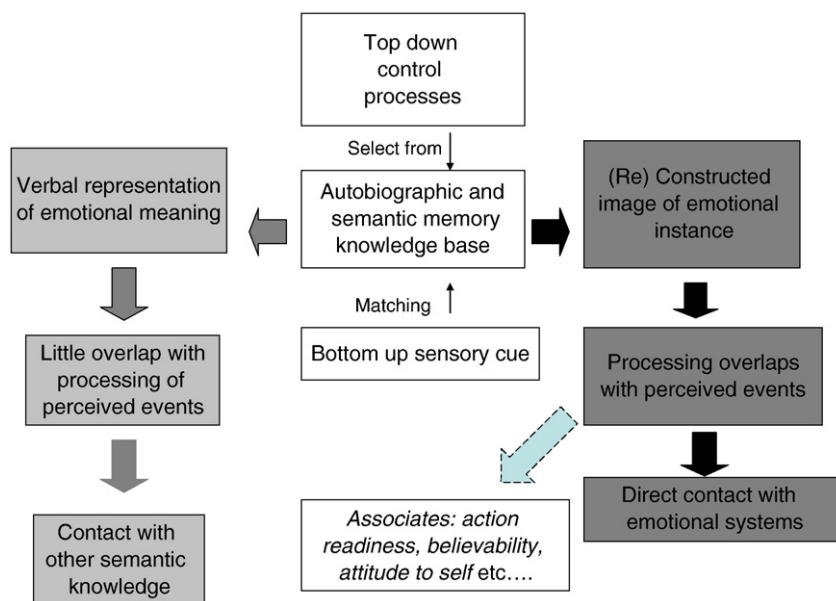


Fig. 1. The construction of imagery versus verbal representations, and their relative impact on emotion.

8. An unhealthy imagination: imagery in emotional disorders

In these final sections we return to the clinical implications of our line of argument about imagery and emotion. As noted earlier, emotional disorders are often characterized by intrusive and distressing emotional images—or attempts to avoid them—(for reviews see Hirsch & Holmes, 2007; Hackmann & Holmes, 2004; Holmes, Arntz, et al., 2007; Holmes & Hackmann, 2004).

Flashbacks in PTSD consist of vivid emotional trauma memories accompanied by a strong sense of current threat, so that a road traffic accident survivor may experience flashbacks of the sight and sound of a car crashing (Ehlers, Hackmann, & Michael, 2004; Ehlers & Steil, 1995; Grey & Holmes, 2008; Holmes et al., 2005; Karatzias, Power, Brown, & McGoldrick, 2009; Kosslyn, 2005; Krans, Naring, Becker, & Holmes, 2009a). In social phobia, observer-perspective images of oneself appearing anxious in social situations are commonly reported, such as seeing one's own face appearing as red as a tomato (Hackmann et al., 2000; Stopa & Bryant, 2004). In agoraphobia, patients often describe imagery of being unable to cope with an impending mental or physical catastrophe, such as seeing themselves frozen and surrounded by an intimidating crowd (Day et al., 2004; Hackmann, Day, & Holmes, 2009; Wells & Papageorgiou, 1999). In obsessive compulsive disorder, images can represent current contamination (e.g. by germs) or future threats (e.g. killing someone; (Speckens, Hackmann, Ehlers, & Cuthbert, 2007). Imagery also occurs in specific phobias, such as images of unfeasibly large and dangerous spiders with teeth (Pratt, Cooper, & Hackmann, 2004) or terrifying snakes (Hunt & Fenton, 2007). People with body dysmorphic disorder report imagery of distorted body features (Osman, Cooper, Hackmann, & Veale, 2004) as do some patients with eating disorders (Hinrichsen, Morrison, Waller, & Schmidt, 2007; Mountford & Waller, 2006; Somerville, Cooper, & Hackmann, 2007). Negative intrusive imagery related to autobiographical memories is also a feature of depression, and is currently attracting interest as a treatment target (Brewin et al., 2009; Moulds, Kandris, Williams, & Lang, 2008; Patel et al., 2007; Wheatley et al., 2007; Williams & Moulds, 2008). Intrusive images related to grief are also being explored (Boelen & Huntjens, 2008). Intrusive emotional images perceived as involuntary and distressing are thus widespread across emotional disorders and feature in several cognitive behavioral models of these conditions (e.g. Clark & Wells, 1995; Ehlers & Clark, 2000).

To test the hypothesis that such images are causally implicated in social anxiety, Hirsch et al. (2003) instructed subjects with social phobias either to maintain their usual self-image or to replace it with a more positive image, while they were conversing with another person. Both self-report and independent ratings by judges indicated that anxiety symptoms were reduced when holding the more positive self-image in mind. In fact, such findings are not confined to those with emotional disorders. Even individuals who described themselves as socially confident experienced greater anxiety while delivering a speech if they had earlier been asked to rehearse images of themselves performing badly rather than well when speaking (Hirsch, Mathews, Clark, Williams, & Morrison, 2005). These results show that modifying the content of images elicits congruent changes in emotional state, albeit without revealing whether imagery per se has any special properties not shared by other representational forms. However, the previously reviewed research involving explicit comparisons of imagery with language-based representations strongly suggests that changing imagery is likely to have particularly powerful effects in modifying social anxiety.

In sum, many emotional disorders are associated with reports of repeated mental images of aversive events that seem to intrude involuntarily when cued by appropriate situations. In some disorders, such as social phobia, the images typically include the person themselves as if seen from an observer perspective. As noted earlier, this may represent an attempt at emotional avoidance but one that has the unintended consequence of maintaining the disorder by focusing attention on a stereotyped and distorted self-image.

In addition to these intrusive and distressing emotional images (or attempts to avoid them), some disorders are associated with image content that is less aversive, and can even be perceived as positive, but none the less has maladaptive effects. Examples include images of substance abuse that elicit cravings (May, Andrade, Panabokke, & Kavanagh, 2004), of food (Harvey, Kemps, & Tiggemann, 2005; May, Andrade, Kavanagh, & Penfound, 2008; Tiggemann & Kemps, 2005), suicidal plans (Holmes, Crane, et al., 2007) or unrealistic goals in the manic phases of bipolar disorder (Holmes, Geddes, et al., 2008). Such imagery can contribute to the maintenance of psychopathology but via destructive approach behavior rather than avoidance.

8.1. *Springing to mind unbidden: involuntary images*

In psychopathology, many images are described as being intrusive—that is, they spring to mind unbidden, as if against the person's will. In an experimental analogue of this process, engagement in a visuo-spatial working-memory task while watching an emotionally disturbing video was found to reduce later involuntary intrusive images (Holmes, Brewin, & Hennessy, 2004). In contrast, a verbal working-memory task had the opposite effect of increasing intrusions above that in a baseline condition. On the assumption that the visuo-spatial task interfered with perceptual encoding of the video, this finding provides support for the hypothesis that later emotional intrusions depend on perceptual representation of the original events in memory (see also Holmes & Bourne, 2008; Stuart, Holmes, & Brewin, 2006). The reason for the converse effect of verbal processing is less obvious, but if it had the effect of blocking verbal elaboration of video contents, then proportionately more emotionally related perceptual information may have been encoded, providing a larger database for the production of intrusive images.

These studies indicate that it may be possible to interfere with sensory processes at encoding and ameliorate the development of later emotional, intrusive imagery. Current work suggests it may also be possible to interfere with the development of intrusions at a later stage in memory consolidation, that is half an hour after viewing traumatic material (Holmes, James, Coode-Bate, & Deeproose, 2009), see also Krans, Naring, Holmes, and Becker (2009c).

Related experiments have employed exposure to narrations and slide sequences depicting either a central traumatic or neutral event. It is already well established that emotionally arousing pictures are better recalled than are neutral (Bradley, Greenwald, Petry, & Lang, 1992; Cahill & McGaugh, 1995) but the fate of perceptual aspects in memory has been less studied. In one experiment it was found that superior recall of emotional events were associated with better perceptual memory for those events, as assessed by identification of graded parts of emotional slides, but not by better conceptual memory, assessed from conceptual word stem completions and recognition for associated semantic information (Arntz, de Groot, & Kindt, 2005). In a series of experiments using similar materials, better identification of degraded objects was also found for neutral items immediately preceding the emotional slide, suggesting that emotion may act rather generally on consolidation processes in perceptual memory rather than only on selective encoding of the emotional events themselves (Michael & Ehlers, 2007).

Recently, it has also been shown that involuntary memories can arise merely from listening to verbal descriptions of traumatic events and imagining them (Krans, Naring, Holmes, & Becker, 2009b), that is, one's own imagination can generate images that later prove to be intrusive. Further experimental work suggests that involuntary intrusions in the form of images versus verbal thoughts are independent (Hagenaars, Brewin, van Minnen, Holmes, & Hoogduin, 2010).

In sum, many emotional disorders are associated with reports of repeated images related to perceptually encoded memories (or fragments of memories) for aversive events that seem to intrude involuntarily when cued by related events (cf. 'bottom up sensory cues' in

Fig. 1). Targeting the triggering and control processes that influence image production and contents may offer one route to therapeutic intervention.

9. Imagery and emotion: some implications for therapy

In the following section, we offer some (admittedly speculative) suggestions about the therapeutic implications of evidence discussed so far. For an historical review of imagery techniques in therapy up to CBT in the present day see Edwards (2007).

9.1. Imaginal exposure and systematic desensitization

Well established techniques for fear-based imagery include imaginal exposure (Foa, Steketee, Turner, & Fischer, 1980) and systematic desensitization (Wolpe, 1958) in which patients imagine feared objects or outcomes until their fear begins to subside. The view presented by Öhman and Mineka (2001) suggests that this allows activation of the 'fear module' to diminish, and that cognitive therapy aimed at the level of verbal beliefs about the phobic objects would be less effective. While Öhman and Mineka discuss only real fear stimuli, to the extent that images resemble real percepts, their arguments should apply equally to verbal discussion of a feared image, which may therefore be less effective than direct exposure to or modification of a target negative image.

9.2. Seeing is not believing

Alternatively, if one of the reasons that imagery enhances emotion is due to responding as if it is a 'real' stimulus (Kosslyn et al., 2001), then recognizing that negative images are mental representations, and not reality *per se*, could be helpful. Therapeutically this might be achieved by manipulating the image in ways described above, or within cognitive therapy, via a meta-cognitive approach (Wells, 2000) or mindfulness based cognitive therapy (Segal, Teasdale, & Williams, 2002). More recently, maladaptive appraisals about the experience of intrusive imagery in depression (Moulds et al., 2008; Starr & Moulds, 2006; Williams & Moulds, 2007b) have been targeted using computerised training techniques (Lang, Moulds, & Holmes, 2009).

9.3. Imagery reduction via competition

Imagery competition due to a concurrent visuo-spatial task (rather than distraction *per se*) could be another useful way of reducing the impact of intrusive negative imagery. Prior research has shown that it is difficult to both hold a negative image in mind and perform a task which draws on related cognitive resources (Baddeley & Andrade, 2000; Holmes et al., 2004; Kavanagh, Freese, Andrade, & May, 2001; van den Hout, Muris, Salemink, & Kindt, 2001). Such competing tasks have only just begun to be applied to clinical problems (Holmes, James, et al., 2009; Kavanagh et al., 2005; Kemps & Tiggemann, 2007; Lilley, Andrade, Turpin, Sabin-Farrell, & Holmes, 2009) and provide an interesting avenue of further investigation.

9.4. Imagery rescripting

In imagery rescripting, the patient is instructed to change a problematic image into a more benign form (Arntz, Tiesema, & Kindt, 2007; Arntz & Weertman, 1999; Butler & Holmes, 2009; Grey, Young, & Holmes, 2002; Hackmann, 1999; A. G. Harvey, Clark, Ehlers, & Rapee, 2000; Holmes, Arntz, et al., 2007; Ohanian, 2002; Rusch, Grunert, Mendelsohn, & Smucker, 2000; Smucker & Dancu, 2000). Guided imagery is another term used for techniques in which an image is transformed (Arbuthnott, Arbuthnott, & Rossiter, 2001; Arbuthnott, Geelen, & Kealy, 2002; Fors, Sexton, & Gotestam, 2002). Another strategy for directly modifying mental images in social phobia is to

require patients to contrast their mental image of themselves with a video of their own social performance, while being encouraged to view it as if watching another person (Harvey et al., 2000). In all these methods, the critical mechanism may be to make an alternative and more positive image more accessible, and thus more effectively compete with the original maladaptive image(s). The evidence reviewed earlier suggests that promoting alternatives in the form of images, rather than verbal representations, may make them more believable and more likely to be acted on.

9.5. Positive imagery re-training

Even without starting with a negative image, positive imagery can be encouraged directly. Examples include work with patients having borderline personality disorder (Arntz & Weertman, 1999; Giesen-Bloo et al., 2006) and compassionate mind imagery techniques for depression (Gilbert & Irons, 2004) and self soothing (Kelly, Zuroff, & Shapira, 2009). An alternative to verbal instructions for promoting habitual use of positive imagery is to employ cognitive bias training (cf. Mathews & MacLeod, 2002; Yiend, 2004) in which people repeatedly generate positive imagery in response to ambiguous cues, so automating the production of benign imagery when encountering novel stimuli. Lack of positive imagery about the future is thought to maintain depression (Holmes, Lang, et al., 2008) so that computerised training (as part of what is known as 'cognitive bias modification'; CBM) to produce such imagery might also alleviate depressed mood (Blackwell & Holmes, *in press*; Holmes, Lang, & Deerprouse, 2009; Holmes, Lang, & Shah, 2009). Using very similar instructions to our imagery procedure (Holmes & Mathews, 2005) other CBM developments have also encouraged the use of imagery in depression in terms of increased 'concreteness' (Watkins, Baeyens, & Read, 2009) and increased autobiographical memory specificity (Raes, Williams, & Hermans, 2009).

10. A final word about words

Throughout this review we have consistently argued that emotional effects of imagery are greater than those of alternative language-based representations, and under some conditions verbal processing may even cause deterioration of an existing emotional state. Nonetheless, it is not our intent to claim that language never has emotional effects. Language-based negative rumination can exacerbate and prolong depression (Nolen-Hoeksema, 1991), and language-based worry may similarly prolong anxiety states, even though it has been proposed to arise as a strategy adopted to reduce the aversive effects of emotional imagery (Borkovec, Alcaine, & Behar, 2001; Borkovec & Inz, 1990).

Beyond emotional disorders, from our own common experience it seems obvious that novels or other literary works can evoke quite powerful emotions, and this presumably underlies our motivation for reading them. Of course, it could be argued that the emotion aroused when reading is due to images conjured up by the skilful use of language, as exemplified by the "imagist poetry" of Ezra Pound. While reading can undoubtedly provoke imagery (and participants in our own research were instructed to do something similar) it does not, in our view, provide a complete account of the emotions that can be created by literature and language. Such effects can perhaps be understood in terms of repeated prior experiences linking certain ideas and meanings to associated emotions within a general schematic representation (e.g. Power & Dalglish, 1999). Thus we can be moved by a speech or a poem that makes contact with these meanings without being aware of any obvious mediating imagery.

Other descriptive accounts suggest that vivid imagery can sometimes paradoxically interfere with the emotional effects of language. Luria's (1968) classic study of an individual with an apparently limitless memory capacity revealed that he constantly experienced extremely vivid imagery, to the extent that even single words or numbers evoked vivid synesthetic images. At the same time, rather than being moved by

literary prose or poetry, he claimed not to be able to understand it and simply experienced a series of images created by each phrase. A simple illustration is provided by his inability to comprehend a metaphor such as “to weigh one’s words”, in response to which he reported a vivid image of a large scale used to weigh bread, and confusion as to the intended meaning, asking “Now how can you weigh words?”.

Although necessarily speculative, it may be that the conclusions of the present review are limited to certain kinds of material: specifically, to representations of events similar in form to those stored in autobiographical memory. Just as imagery helps memory for concrete but not abstract nouns (Paivio, Smythe, & Yuille, 1968), it could be that imagery facilitates emotional responses to representations of possible events (and particularly of personally prototypic emotional events; Neumann & Philippot, 2007), but not to more complex abstract meanings that are not easily represented in the form of an image. Most core concerns in psychopathology seem readily represented as images (fear of dying, of doing harm, of failing socially, being contaminated, losing control, etc). Perhaps it is the ease of mentally simulating such catastrophic outcomes in the form of imagery that accounts for their prevalence in many dysfunctional emotional states.

11. Conclusions

This review had addressed four areas: (1) we have reviewed literature suggesting that imagery can evoke emotion in at least three ways and (2) empirical evidence confirming that imagery does indeed evoke greater emotional responses than verbal representation of the same information. Next, (3) we considered other relevant characteristics of imagery—the extent it is perceived as representing reality and influences actual behavior. We have presented a heuristic model that contrasts the generation of language-based representations with imagery and offers an account of their differing effects on emotions, beliefs and behavior. Finally, (4) because intrusive images are such a common feature in emotional disorders, we have reviewed the possible causal role of imagery in these disorders, and how it can be used in therapy.

The motivation for this review is that, although it has often been widely thought that images have a special relationship to emotion, until recently there has been remarkably little evidence to support this assumption. There is now a body of evidence that provides more convincing support for the idea that imagery does indeed have more powerful emotional consequences than does representation of the same initial event in verbal form. There are a number of (related) explanations for this difference, including links between images and information in autobiographical memory, the overlap between perceptual processes and imagery, and the possibility that sensory-perceptual signals have more direct connections with emotional systems in the brain. We have argued that these possibilities are complementary rather than being alternatives so that all may be part of a complete account (as illustrated in Fig. 1). The experiments discussed here have provided new evidence supporting the first part of this integrated account—that of links between imagery and the contents of autobiographical memory. Evidence has also been reviewed suggesting that, although emotional images can usually be distinguished from reality, they may still convey a sense of immediate perceptual experience that is lacking from other representational forms. This seems particularly true for field-perspective images, so that the adoption of an observer perspective may reduce the immediate negative emotional effects, albeit with possible longer term disadvantages. Future research needs to be directed towards investigating the generality of the conclusion that images have more emotional effects, by testing the extent to which they apply to more complex emotional states that may be less readily evoked, or modified, by imaged episodes. In any event, the more powerful effects of imagery provide strong support for current efforts to use imagery in modifying negative emotional conditions in therapy. In summary, we propose that mental

imagery acts as an “emotional amplifier” in both negative and positive emotional states and in many emotional disorders.

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