



## King's Research Portal

DOI:

[10.1016/j.biopsycho.2016.04.003](https://doi.org/10.1016/j.biopsycho.2016.04.003)

*Document Version*

Peer reviewed version

[Link to publication record in King's Research Portal](#)

*Citation for published version (APA):*

Davey, G. C. L., & Meeten, F. (2016). The Perseverative Worry Bout: A Review of Cognitive, Affective & Motivational Factors that Contribute to Worry Perseveration. *Biological Psychology*.  
<https://doi.org/10.1016/j.biopsycho.2016.04.003>

### **Citing this paper**

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

### **General rights**

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

### **Take down policy**

If you believe that this document breaches copyright please contact [librarypure@kcl.ac.uk](mailto:librarypure@kcl.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.

## Accepted Manuscript

Title: The Perseverative Worry Bout: A Review of Cognitive, Affective and Motivational Factors that Contribute to Worry Perseveration

Author: Graham C.L. Davey F. Meeten



PII: S0301-0511(16)30096-5  
DOI: <http://dx.doi.org/doi:10.1016/j.biopsycho.2016.04.003>  
Reference: BIOPSY 7191

To appear in:

Received date: 17-6-2015  
Revised date: 7-4-2016  
Accepted date: 7-4-2016

Please cite this article as: Davey, Graham C.L., Meeten, F., The Perseverative Worry Bout: A Review of Cognitive, Affective and Motivational Factors that Contribute to Worry Perseveration. *Biological Psychology* <http://dx.doi.org/10.1016/j.biopsycho.2016.04.003>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The Perseverative Worry Bout: A Review of Cognitive, Affective & Motivational Factors that Contribute to Worry Perseveration

By

Graham C L Davey<sup>1</sup> & Frances Meeten<sup>2</sup>

<sup>1</sup> University of Sussex, Brighton, UK

<sup>2</sup> Institute of Psychiatry, Psychology and Neuroscience, King's College, London, UK

Correspondence to:

Graham Davey, Ph.D.,  
Professor of Psychology,  
School of Psychology  
The University of Sussex  
Brighton,  
BN1 9QH  
UK.  
Email: grahamda@sussex.ac.uk  
Tel: +44 1273 678485

#### Abstract

This paper reviews the cognitive, affective and attentional factors that contribute to individual perseverative worry bouts. We describe how automatic biases in attentional and interpretational processes contribute to threat detection and to the inclusion of negative intrusive thoughts into the worry stream typical of the “what if ...?” thinking style of pathological worriers. The review also describes processes occurring downstream from these perceptual biases that also facilitate perseveration, including cognitive biases in beliefs about the nature of the worry process, the automatic deployment of strict goal-directed responses for dealing with the threat, the role of negative mood in

facilitating effortful forms of information processing (i.e. systematic information processing styles), and in providing negative information for evaluating the success of the worry bout. We also consider the clinical implications of this model for an integrated intervention programme for pathological worrying.

Key terms: worry; anxiety; attentional biases; interpretational biases; goal-directed rules; negative mood; systematic information processing

## **Introduction**

Worry is an activity that most people experience on a regular basis. But for some people this activity can become pathological, uncontrollable and distressing, and lead to regular bouts of seemingly uncontrollable, anxious worry that negatively affects social, occupational, and familial functioning. When excessive and uncontrollable worry of this kind occurs, it is the defining feature of Generalized Anxiety Disorder (GAD) (DSM-5, American Psychiatric Association, 2013). As well as being the cardinal diagnostic feature

of GAD, pathological worry<sup>1</sup> is also an important transdiagnostic process, which contributes to a number of other psychopathologies (Barlow, Allen, & Choate, 2004; Ehring & Watson, 2008). These include panic disorder (Casey, Oei, & Newcombe, 2004), social phobia (Clark & Wells; Mellings & Alden, 1995), obsessive-compulsive disorder (Comer, Kendall, Franklin, Hudson, & Pimentel, 2004), and depression (Diefenbach et al., 2001; Nolen-Hoeksema, 1991). Individuals who exhibit high levels of worry (either with GAD, with sub-threshold GAD, or without a GAD diagnosis) also report poorer perceived physical health, greater levels of stress, and increased sleep difficulties (Kertz & Woodruff-Borden, 2011).

Pathological worry is defined by Barlow (2002) as excessive anxious apprehension relating to future negative or threatening events, and this type of worry is considered to be negatively valenced, distressing to the worrier (Borkovec, Robinson, Pruzinsky, & DePree, 1983; Davey, Eldridge, Drost & MacDonald, 2007), and predominately verbal (Borkovec, Ray, & Stober, 1998). Pathological worriers view their worries as being uncontrollable whereas infrequent worriers do not (Davey, Tallis, Capuzzo, 1994), and one way in which uncontrollable worry manifests is in the process of catastrophising (Brietholtz, Westling & Ost, 1998; Davey & Levy, 1998; Vasey & Borkovec, 1992), where individuals appear to apply a perseverative “what if?” questioning style to perceived problems. Key differences in duration and intensity of worry are also reported in high compared to low worriers. High worriers will continue with a worry episode for significantly longer and experience greater emotional discomfort than non-worriers (Startup & Davey, 2001; Vasey & Borkovec 1992).

---

<sup>1</sup> When used throughout this paper, the term ‘pathological worry’ refers to worrying that is excessive, relatively uncontrollable and distressing for the individual, and as such is transdiagnostic in nature.

While pathological worry is closely associated with anxiety and is a prominent feature of almost all of the anxiety disorders (Brown, Antony & Barlow, 1992), it is an activity that is distinct from anxiety and not simply the cognitive component of anxiety. For example, Davey Hampton, Farrell, and Davidson (1992) found that worry and anxiety can be understood as two separate constructs, each with their own unique sources of variance. They reported that worry was associated with adaptive problem focused coping strategies and an information seeking cognitive style, whereas trait anxiety was associated with poor problem solving confidence, poor perceived personal control, responsibility for negative but not positive outcomes, the tendency to perceive events as threats, and avoidant or emotion focused coping strategies. Thus, while worry is an attempt to address problems or find solutions suitable for dealing with future threats, this problem-solving process can often be thwarted by factors associated with high levels of anxiety (Davey, 1994), and this can result in perseveration of a worry bout and increases in self-reported distress during a worry bout (Davey, Eldridge, Drost & MacDonald, 2007; Vasey & Borkovec, 1992), both of which contribute to turning adaptive worrying into pathological worrying.

Most contemporary models of pathological worrying attempt to explain this psychopathology by alluding to pathological worrying as a dispositional characteristic found across a range of anxiety disorders and postulate explanations at the global level in terms of how worrying has become an endemic characteristic of an anxious individual (e.g. Wells, 2007, 2012; Ladoucer, Talbot & Dugas, 1997; Birrell, Meares, Wilkinson & Freeston, 2011; Pratt, Tallis & Eysenck, 1997). However, proximal models of individual pathological worry bouts are much rarer (but see Hirsch & Mathews, 2012), but will be required to understand the individual psychological mechanisms which generate a worry experience that is perseverative, seemingly uncontrollable, and increasingly distressing as the bout

continues.

This purpose of this paper is to review some of the cognitive, affective and attentional factors that contribute to the perseverative worry bout. At the proximal level we need to understand what triggers an individual worry bout, and what cognitive mechanisms cause the individual to persevere that worry bout. We have focused on worry bout perseveration because it is one feature that operationalizes the inability to control the worry bout, and it is a characteristic of catastrophic worry where increasing levels of distress are caused by systematic inflation of the aversiveness of the worry as the bout progresses (Vasey & Borkovec, 1992) As such, perseveration embodies many of the critical characteristics that define worry as pathological. Processes involved in generating a perseverative bout include the role of cognitive biases in identifying threats, biases in beliefs about the nature of the worry process, biases in the deployment of goal-directed rules for worrying, and finally, biases in the way that experienced mood can influence the nature of the processing undertaken during a worry bout. The following sections in turn describe (1) the role of cognitive biases in identifying worries, (2) the determinants of perseveration during a worry bout, and finally (3) a description of how these processes may interact to generate worry perseveration. Because of the transdiagnostic nature of pathological worry and the involvement of basic psychological processes in perseverative worry, the evidence described in these sections comes from a combination of studies conducted on both clinical populations and experimental psychopathology studies conducted on healthy participants.

## **The Role of Cognitive Biases in Identifying Worries**

We are exposed to a barrage of information in daily life and we make either implicit or explicit decisions about how that information is processed. People who experience high levels of anxiety (both those with GAD and high worriers) are known to have a number of biases in the way they process information which means that they have greater exposure to, or are more aware of, threat relevant information in the environment (Mathews & McLeod, 1994). These cognitive biases are thought both to cause and maintain pathological worry (Hayes & Hirsch, 2007; Hirsch & Mathews, 2012, Mathews & MacLeod, 2002). This section will examine cognitive biases in attention, interpretation, and memory and consider evidence for their role in pathological worry.

**Attentional Biases:** Attending to potentially threatening information quickly and efficiently is an adaptive process. If the potential threat is assessed as being problematic it can then be dealt with and if the concern was a false alarm, one can step down from psychological and physiological threat readiness. However, individuals who are vulnerable to anxiety have a threat orientated ‘vigilant’ processing mode where attention is easily captured by potential, often minor, threat cues (Mathews & MacLeod, 2002).

Attentional biases contribute to excessive and pathological worry by enhancing the worrier’s ability to detect and selectively attend to threat cues (Mathews, 1990). Individuals who experience excessive and uncontrollable anxiety have been shown to attend to threat-relevant information at the expense of benign or positive information and this has been associated with the onset and maintenance of experienced anxiety and with the development of anxiety disorders (Mathews, 1990; Mathews & MacLeod, 1994; Mathews &

MacLeod, 2002). However, while biases in attention toward threat-relevant information have been associated with anxiety, what evidence is there that these information-processing biases relate to worry per se?

Research has examined attentional biases in individuals with GAD. Mathews, Mogg, Kentish, and Eysenk (1995) found that compared to a non-anxious control group, individuals with GAD were slower on a Stroop task to name colours when the word was threat-relevant and slower when searching for a target within threatening distractors. This indicates that GAD participants (who experience excessive and uncontrollable worry as a core symptom of their diagnosis) exhibit greater attentional bias for threat as compared to non-anxious controls. However, a limitation of this type of study is that worry and trait anxiety cannot be teased apart and thus it is unclear whether the attentional bias is associated with worry, or trait anxiety, or both. There is however robust evidence to support the view that biases in attention to threat are not only correlated with pathological worry, but are also a significant causal factor in generating worry (Hayes & Hirsch, 2007; Mathews & MacLeod, 2002). This is evidenced by studies that have attempted to ameliorate the threat attention biases in pathological worriers using cognitive bias modification techniques (e.g. Hayes, Hirsch, & Mathews, 2010; Krebs, Hirsch, & Mathews, 2010). In one study, Hayes et al. (2010) asked high worriers to complete two attention training tasks (a benign vs. worry words task and a dichotomous listening task) where 50% of the high worry group had their attention trained towards benign information while ignoring worrying information and the other half the group had their attention directed to equal amounts of both benign and worry related information. The dependent variable was a worry task where participants were asked to engage in a breathing task, during which numbers of intrusive thoughts were monitored. Hayes et al. found that the group who had their attention

trained towards benign material had significantly fewer worry-relevant negative thought intrusions as compared to the control group, although the groups did not differ on the type of worry topics or how negative the topics were. This finding suggests that attentional biases contribute to the frequency of negative thought intrusions that are common in worry thought content, but not the severity of the thought intrusions. Interestingly, there was no effect of attention training on anxious mood, indicating that training affected intrusive thoughts relevant to worry, but not self-reported anxiety. Hirsch et al. (2011) also demonstrated that training non-anxious participants to have increased biased attentional engagement with threat, subsequently increased worry symptoms (negative thought intrusions) as compared to those who had been trained to disengage from threat. One indirect implication of this is that increased attentional engagement with threat causally affects worry symptoms (Hirsch et al., 2011).

The research cited above suggests that individuals who experience pathological worry exhibit attentional biases to threatening information. The tendency to attend to threatening material at the expense of benign information will heighten the perception that the world is a threatening place, which is likely to trigger processes that will initiate worry. Once threat representations are activated, attentional biases are thought to contribute to maintenance of worry episodes by promoting attention towards threatening thought intrusions, thus escalating threat perception and maintaining the worry cycle (Hirsch & Mathews, 2012).

**Interpretation Biases:** Daily life is full of ambiguity and research suggests that people who experience high levels of anxiety are more likely to interpret emotionally ambiguous situations in a threatening rather than non-threatening manner (e.g. Butler & Mathews, 1983; Eysenk, MacLeod, & Mathews, 1987; Eysenk, Mogg, May, Richards, & Mathews, 1991, Mathews & Mackintosh, 2000). This

tendency to interpret ambiguity in favour of threatening interpretations is another example of an information processing bias that is thought to exert both a causal and maintaining effect on pathological worry. For example, individuals with a diagnosis of GAD are more likely to interpret emotionally ambiguous information in a threat-congruent manner compared to non-anxious controls (e.g. Mathews, Richards, & Eysenk, 1989). Experimental studies with high worriers have enabled researchers to conclude that there is a causal relationship between interpretation biases and worry. For example, Hirsch, Hayes, and Mathews (2009) examined the effect of manipulating interpretation biases in high worriers. They employed two tasks, a homograph task and an ambiguous scenarios task. Half the participants were assigned to a benign training condition, which meant that they were exposed to only benign interpretations of the ambiguous scenarios and the control group were exposed to equal numbers of benign and threat interpretations of the ambiguous information. The dependent variable was the number of negative thought intrusions in a breathing focus period that took place both before and after an instructed worry period. There was a significant difference between the two groups, suggesting that the manipulation of interpretation towards benign outcomes (as opposed to training which did not favour either benign or negative outcomes) had an ameliorative effect on thought intrusions. However, Hirsch et al. (2009) reported that there was no difference between the two groups in the type of negative thought intrusion, or how negative the topics were. These findings were also replicated in participants with a diagnosis of GAD (Hayes et al., 2010) and provide evidence that threat-relevant interpretation biases can play a direct causal role in generating negative intrusions implicated in the onset of worry (Hayes & Hirsch, 2007; Hirsch & Mathews, 2012).

Research cited above indicates that interpretation biases are likely to trigger worry by creating negative interpretations of ambiguous information and this (as was also found in studies of attentional biases) has been found to increase the frequency of negative thought intrusions, but not the type or severity of the thought intrusion. This is in keeping with a dimensional view of psychopathology where pathological worry is thought to be quantitatively rather than qualitatively different to normal functioning (Ruscio, Borkovec, & Ruscio, 2001). Research outlined above suggests that in pathological worry, habitually experiencing negative responses to emotionally ambiguous information will increase threat perception, subsequently triggering worry processes (Hirsch & Mathews, 2012; Mathews, 1990). However, this type of interpretation bias does not necessarily exist in isolation from attentional biases and a combined cognitive bias approach (Hirsch, Clark & Mathews, 2006; Hirsch & Mathews, 2012) assumes that information processing biases interact with one another. Hayes & Hirsch (2007) outline a scenario whereby attention could be captured by a cue in the environment, which may be hard to then disengage from. Once threat representations are activated through attentional biases, this may make the individual more likely to interpret emotionally ambiguous information in a threatening manner which in turn increases threat perception and so the cycle may continue resulting in a full-blown worry episode. This approach to understanding the nature of cognitive biases in worry has been supported in research by White, Suway, Pine, Bar-Haim, & Fox (2011) who found that training individuals to have biased attention toward threat was linked to subsequent negative interpretation of ambiguity.

**Memory Biases:** A third information processing bias that has been examined as a potential contributor to pathological worry is memory biases. One hypothesis is that pathological worry is facilitated by a processing bias in favour of the recall of threat-relevant information. This selective memory for threatening information could serve to heighten threat perception, which in turn feeds processing that may facilitate worry. However, there is currently little evidence to support this view. For example, Coles and Heimberg (2002) in a review of memory biases in clinically anxious populations (e.g. where worry is a cardinal diagnostic feature) point out that only one out of nine studies found any support for the role of an explicit (e.g. effortful and conscious retrieval of information) memory bias in a GAD population. The study by Mogg and Mathews (1990) reported that in an explicit memory task the GAD patients recalled more anxiety words than non-anxious controls. However, they predicted that a recall bias in GAD participants would only be evident in anxious words that were also self-referent but this prediction was not upheld. Mogg, Mathews, and Weinman (1987) compared clinically anxious patients with non-anxious controls on recall of positive, negative, threatening, and non-threatening words, and found no evidence to support the view of biased recall in an anxious population. Interestingly, their results actually indicated that high anxious individuals had poorer memory for threat words as compared to a control condition, and other studies have also consistently found no evidence to support the role of explicit memory biases in pathological worry (e.g., Foa, McNally & Murdock, 1989; Mathews & MacLeod, 1985, Mogg et al., 1989).

Implicit memory biases (enhanced recall related to prior exposure to a stimulus, without awareness of that prior exposure) have also been implicated in pathological worry. In one study Mathews, Mogg, May, and Eysenk (1989) reported that, after an implicit memory task,

individuals with a diagnosis of GAD generated more threat-relevant completions on a word completion task as compared to a non-clinical control group. Further association between this type of memory bias and GAD was found by MacLeod and McLaughlin (1995). However, as highlighted by Coles and Heimberg (2002), two other studies (Bradely et al., 1995; Mathews et al., 1995) did not replicate these results. More recently, Coles, Turk & Heimberg (2007) proposed that previous studies may have failed to find support for implicit and explicit memory biases in GAD as anxious stimuli used in experimental tasks may not have had equal relevance for all participants. Coles et al. (2007) suggested that if the stimuli do not have relevance for each individual's specific domain of worry, then it is unlikely that there will be evidence of a memory bias. This hypothesis was confirmed by assessing implicit and explicit memory bias in GAD patients where the GAD group individually selected words that were personally relevant to their domain of worry. Using idiographic stimuli, compared to non-anxious controls, the GAD group showed evidence of an implicit memory bias. Furthermore there was some evidence (a trend that did not reach statistical significance) to suggest the GAD group also showed an explicit memory bias, but Coles et al. (2007) highlight that this finding would need to be clarified by a study with greater power to detect group differences. The evidence for the role of implicit memory biases in GAD is thus currently contradictory. However, studies that employ idiographic stimuli may provide a more methodologically appropriate way of examining memory biases in worry. Presently, therefore, there is little conclusive evidence that involves memory biases in the processes that lead to pathological worrying, and so we do not include memory biases in the building blocks of the model we describe below. However, this situation may change with further research that directly explores the role of implicit memory processes in the development and maintenance of pathological worrying.

**Summary:** There is evidence to suggest that both attention and interpretation biases are associated with, and play a causal role in, pathological worry. However, there is little evidence thus far suggesting that memory biases contribute directly to pathological worry. Attention and interpretation biases appear to facilitate the frequency of negatively-valenced thought intrusions which will either trigger worrying or provide suitable subject matter for the worrier's "what if...?" questioning style.

### **Attentional control and worry**

Information processing biases are considered to be automatic 'bottom-up' processes (e.g. Hirsch & Mathews, 2012) and (as discussed above) attention and interpretation biases increase the frequency of intrusive worry thoughts. Deciding when to attend to (or distract ourselves from) these types of threat relevant information is an effortful top-down process that requires attentional control. Attentional control is a key function of the central executive component of working memory (Derakshan & Eysenk, 2009; MacLeod & Donnellan, 1993; Rapee, 1993). Attentional control theory assumes that worry impairs cognitive performance by consuming limited attentional resources in working memory, meaning that less working memory capacity is available for concurrent tasks (Eysenk & Calvos, 1992; Eysenk, Derakshan, Santos, & Calvo, 2007). Individuals with GAD are known to have depleted attentional control (Stefanopoulou, Hirsch, Hayes, Adlam & Coker, 2014) and one implication of this is that they are less able to exert attention control over

worry thoughts to stop worrying (Hayes, Hirsch, & Mathews, 2008). These research findings help to explain why high anxious individuals find it more difficult to control and dismiss worry thoughts.

### **Determinants of Perseveration During a Worry Bout**

At the proximal level we need to understand not only what triggers an individual worry bout, but also what cognitive mechanisms cause the individual to persevere that worry bout. In this section we will discuss some of the processes that contribute to the perseveration of a worry bout and which begin to define a mechanism of pathological worry at the proximal level. These processes include cognitive biases in beliefs about the nature of the worry process, biases in the deployment of goal-directed rules for worrying, and biases in the way that experienced mood can influence the nature of the processing undertaken during a worry bout as well as provide information by which goal-directed rules contribute to perseveration.

**Perseverative or Iterative Styles:** Early accounts of perseverative worrying hypothesized that worriers had biases towards perseverative or iterative styles of thought (e.g. Kendall & Ingram, 1987; Davey & Levy, 1998; Vasey & Borkovec, 1992). Various thinking styles were believed to contribute to perseveration, including the worrier persistently posing internal automatic questions of the

“what if...?” kind (e.g. Kendall & Ingram, 1987) that would inevitably lead to the catastrophizing of individual worries. Using a procedure based on the cognitive techniques of de-catastrophizing, Vasey & Borkovec (1992) found that chronic worriers generated significantly more catastrophizing steps in a catastrophizing interview<sup>2</sup> than nonworriers, and reported a significant increase in discomfort and distress as the catastrophizing process progressed. This also led to worriers rating the events in each step of the catastrophizing process as more likely to occur than did nonworriers, suggesting the possibility of an expectancy bias for threatening or negative outcomes to occur – a bias that is found in a number of other forms of psychopathology (Davey, 1992) and can be driven by prior levels of fear or anxiety (Diamond, Matchett & Davey, 1995). This catastrophic perseveration in worriers has been observed in a variety of procedures (Davey, 2006a) using both real worries and hypothetical worries that the worrier would not have considered before (Davey & Levy, 1998) – the latter suggesting that this style is one that is not simply based on the previous elaboration of already experienced worries, but can be readily applied to novel worries by the worrier.

One initial explanation of this catastrophizing style of worriers was that it may be generated by mood congruency effects (Bower, 1981). There is clear evidence that pathological worriers experience significantly increased levels of negative mood compared with nonworriers (e.g. Meyer, Miller, Metzger & Borkovec, 1990; Davey, Hampton, Farrell & Davidson, 1992), and also experience increased

---

<sup>2</sup> The catastrophising interview procedure begins with the question “What is it about \_\_\_\_\_ that worries you?” where the blank is the participant’s main current worry. The participant’s response is then followed by the question “What about \_\_\_\_\_ would you find fearful or bad if it did actually happen?” where the blank is filled by the participants response to the previous question. This process continues until the participant can think of no more answers, and the number of steps emitted is used as a measure of perseveration (Davey, 2006a)

distress and negative mood as a worry bout progresses (Vasey & Borkovec, 1992; Davey, Eldridge, Drost & MacDonald, 2007), and this negative mood may facilitate the access and retrieval of congruent negative information in memory which feeds the iterative “what if ...?” questioning style. The fact that negative mood can contribute causally to worry perseveration has been shown in experimental studies that have manipulated mood valency and found that negative mood facilitates worry perseveration relative to positive and neutral mood manipulations (Johnston & Davey, 1997; Startup & Davey, 2001, 2003).

However, what makes mood congruency difficult to sustain as a principal cognitive bias underpinning perseverative worry is that worriers will also perseverate more in a positive iterative task than nonworriers. Davey & Levy (1998, Study 4) found that chronic worriers would also perseverate for longer than nonworriers at a positive iteration task – even though they reported being in a significantly more negative mood than nonworriers. In a subsequent study, Startup & Davey (2001, Experiment 1) induced negative, positive and neutral moods in three groups of healthy, nonclinical participants. Contrary to predictions from a mood congruency explanation, participants in a negative mood emitted significantly more steps in both a positive and negative iteration task (where they were respectively asked to iterate what was either ‘good’ or ‘bad’ about a situation) than participants in either a positive or a neutral mood. These findings are not easy to incorporate within a mood congruency explanation of worry perseveration claiming that perseveration should be facilitated only when there is a congruency between the valency of the material being iterated and the mood in which this task is being conducted.

### **Biases in the Deployment of Goal-Directed Rules for Worrying:**

For most people, worrying has a purpose, whether it be to solve perceived problems of daily living (Davey, 1994), as an attempt to repair negative mood (Schwarz & Clore, 1983), or as a means to try and ensure that ‘bad’ things don’t happen or to avoid future catastrophes (Breitholtz, Westling & Ost, 1998; Davey, Tallis & Capuzzo, 1996; Wells, 2010; Borkovec, Hazlett-Stevens & Diaz, 1999). Activities that have such a purpose usually come with a set of goal-directed rules that are deployed to maximize goal attainment and to evaluate when the goal has been reached (Martin, Ward, Achee & Wyer, 1993; Chaiken, Liberman & Eagly, 1989). Goal-directed rules require attention to the goal of the worry task and a desire to continue with the task until the strict aims of the task have been achieved. When such rules are articulated by worriers, they include statements such as “I feel I must focus on every conceivable solution to this worry”, “I must sort out what is worrying me” (Davey, Startup, MacDonald, Jenkins & Patterson, 2005). These rules don’t necessarily tell the worrier how to achieve the goal, but they have a motivational influence by stressing the importance of the goal and activating processes for monitoring whether the goal has been achieved (Davey, 2006b). With repeated deployment, these goal-directed rules are likely to be activated automatically and evaluated implicitly (Aarts & Dijksterhuis, 2000; Bargh, 1989), resulting in a motivational impact that will have an influence on task perseveration that appears to be outside of the worrier’s ability to deliberately control.

First, there is good evidence that worriers have biases in beliefs about the worry process that may influence the deployment and strictness of goal-directed rules for worrying. For example, pathological worriers and individuals with a diagnosis of GAD hold strong

beliefs that worrying is a necessary process that must be undertaken fully and properly in order to avoid future catastrophes. For instance, Davey, Tallis & Capuzzo (1996) found that beliefs about worrying could be divided into both negative and positive beliefs about the consequences of worrying, with negative beliefs covering topics such as 'worry causes me stress' and 'worry exaggerates the problem', while positive beliefs include 'worry motivates me' and 'worry helps analytic thinking'. Perhaps surprisingly, individuals who scored high on positive beliefs about worrying also scored high on a number of measures of psychopathology, including trait anxiety and measures of the frequency of pathological worrying, suggesting there is a strong association with these positive beliefs about worrying and the tendency to worry and to develop other symptoms of anxious psychopathology. Similarly, Borkovec, Hazlett-Stevens & Diaz (1999) found that individuals with a diagnosis of GAD held a number of beliefs about the utility of worrying, including (1) worrying will prevent something bad happening, (2) worrying makes it less likely something bad will happen, (3) worrying helps me to distract myself from even worse things, (4) if I worry about something bad happening then I'll be prepared for it, and (5) worry is an effective way to problem-solve. In addition to these biases in global beliefs about worrying, worriers also score highly on other cognitive factors that would indicate a need to deploy and monitor strict goal-directed rules for worrying. For example, they possess elevated evidence requirements for decision-making (Tallis, Eysenck & Mathews, 1991) that would indicate that they should explore all possibilities before terminating a worry bout. Trait worry has also been related to measures of perfectionism (Pratt, Tallis & Eysenck, 1997; Frost, Lahart & Rosenblate, 1990), feelings of responsibility for negative outcomes (Wells & Papageorgiou, 1998), intolerance of uncertainty (Dugas, Freeston & Ladouceur, 1997; Meeten, Dash, Scarlet & Davey, 2012), and inflated concerns over mistakes (Stober & Joorman, 2001).

All of these are dispositional factors that are likely to lead to the deployment of strict goal-directed rules at the outset of a worry bout, and are likely to generate perseveration at the task to ensure that the rather strict outcomes required of worrying are achieved (e.g. avoiding bad things happening, reducing uncertainty, minimizing mistakes, reducing feelings of responsibility for negative outcomes).

In addition, there is now considerable experimental evidence that such dispositional traits and biased beliefs about the utility of worry do influence the deployment of goal-directed stop rules for worry and facilitate perseveration of the worry bout. First, goal-directed rules (often called ‘as many as can’ stop rules in the worry literature) can be contrasted with what are known as ‘feel like continuing’ stop rules (Martin, Ward, Achee & Wyer, 1993; Davey, 2006b), and pathological worriers have a strong bias towards deploying the former rather than the latter type of rule. Goal-directed rules require attention to the goal of the worry task and a desire to continue with the task until the strict aims of the task have been achieved. In contrast, ‘feel like continuing’ stop rules require the individual to continue the task only to the point where they ‘no longer feel like continuing it’ because, for example, they have lost motivation or the task is no longer enjoyable. As we might expect, the deployment of goal-directed stop rules is highly correlated with a variety of worry-relevant variables, including measures of trait worry (the Penn State Worry Questionnaire, PSWQ), beliefs about the positive consequences of worry (as measured by the Consequences of Worry Scale, COWS, Davey, Tallis & Capuzzo, 1996), and with measures of shame and guilt (Davey, Startup, MacDonald, Jenkins & Patterson, 2005, Study 1), and the reported use of goal-directed rules significantly predicts perseveration on behavioural measures of catastrophic worrying (Davey, Startup, MacDonald, Jenkins & Patterson, 2005, Study 2). Much of the current evidence of a link between positive beliefs about worry and the deployment of goal-

directed rules for worrying is correlational in nature, so we must be wary at this time about assuming a causal relationship between beliefs and goal-directed rules. However, studies that have experimentally manipulated some of the beliefs relevant to worriers, such as intolerance of uncertainty and responsibility for negative outcomes, have demonstrated that experimentally inducing these beliefs leads to increased perseveration on behavioural measures of worrying such as the catastrophizing interview task (Startup & Davey, 2003; Meeten, Dash, Scarlet & Davey, 2012).

Secondly, explicitly manipulating the deployed stop rule for worrying also has important and predicted effects on worry perseveration. For example, Startup & Davey (2001) compared worriers and nonworriers on a catastrophizing task when they were explicitly asked to use either a goal-directed rule or a 'feel like continuing' rule. They found that manipulating the deployed rule had differential effects on worriers and nonworriers. When participants were asked to use a goal-directed rule, worriers generated significantly more catastrophizing steps than nonworriers. However, when participants were asked to use a 'feel like continuing' rule, worriers emitted slightly fewer steps than nonworriers. These are relatively important findings because they imply that worriers do not have an iterative style on worry tasks that is independent of the task rule that they deploy, with the further implication that perseveration is significantly influenced by the nature and deployment of the rule used.

**The Role of Mood:** We have already mentioned that pathological worriers tend to be in significantly more negative moods than nonworriers (e.g. Meyer, Miller, Metzger & Borkovec, 1990; Davey, Hampton, Farrell & Davidson, 1992), and this is not simply an

emotional outcome of the worry process or an affective consequence of the need to deal with potential threats. The worrier's negative mood also exerts a significant causal effect on the worry process, creating biases not only in attentional and interpretation processes (see earlier sections), but also providing biased information by which progress during the worry bout is evaluated. Laboratory studies manipulating mood have consistently demonstrated that negative mood (in the form of both anxiety and sadness) can significantly prolong the length of a worry bout (Johnston & Davey, 1997; Startup & Davey, 2001, 2003), but that this effect cannot simply be explained in terms of a mood congruency process.

However, negative mood does appear to bias the worry bout towards perseveration in two important ways. First, negative mood promotes a more systematic, deliberate and effortful information-processing style than positive or neutral mood (Ambady & Gray, 2002; Batra & Stayman, 1990; Tiedens & Linton, 2001), and induces comparatively higher performance standards than positive or neutral moods (Scott & Cervone, 2002). For example, within the Heuristic-Systematic model of information processing, systematic processing is described as an “analytical orientation in which perceivers access and scrutinize all informational input for its relevance and importance ... and integrate all useful information in forming their judgments” (Chaiken, Liberman & Eagly, 1989, p212), and this effect of negative mood on information processing style implies a bias towards the deployment of stricter goal-directed rules for worrying that will facilitate perseveration (e.g. Dash, Meeten & Davey, 2013). There is empirical evidence that this is the case. For example, Dash & Davey (2012) found that experimentally-induced negative mood facilitated the endorsement of cognitive appraisals known to increase systematic processing, and also facilitated the endorsement of the deployment of goal-directed rules for worrying. A mediation analysis

also confirmed that the relationship between negative mood and measures of worrying were mediated by the intention to use goal-directed rules for worry and cognitive appraisals that would generate effortful systematic processing during worry.

Secondly, negative mood not only biases information processing style during worry towards systematic processing that raises performance standards, requires effortful scrutiny of all relevant evidence, and the deployment of strict goal-directed rules for closure, but also provides information when the worrier is implicitly evaluating goal attainment during the worry bout. The use of mood as information in these types of context is described by the mood-as-input hypothesis, an approach to task perseveration that explains perseveration in terms of an interaction between the nature of the deployed rules for the task and the valency of the individual's concurrent mood (Martin, Ward, Achee & Wyer, 1993; Davey, 2006b; Meeten & Davey, 2011). For example, if a worrier deploys a goal-directed rule when worrying, they may use their current mood during the worry bout to provide information about whether they've achieved those goals (e.g. solving the problem, repairing negative mood, etc.). If they are in a negative mood, this will provide information that the goals have not been achieved and so they must continue. In such circumstances, the deployment of strict goal-directed rules employing a systematic information processing style with raised performance standards together with a negative mood would be a toxic recipe for perseveration. Evidence that individuals do use their current mood as information for evaluating progress on open-ended perseverative tasks such as worrying comes from studies that have manipulated both mood and the nature of deployed stop rules. For instance, compared with a positive mood, negative mood is only associated with perseveration when a goal-directed stop rule is used. In contrast, when a 'feel like continuing' stop rule is used, individuals in a positive mood persevere at the task for longer than those

in a negative mood (Martin, Ward, Achee & Wyer, 1993; Startup & Davey, 2001, 2003; MacDonald & Davey, 2005; Hawksley & Davey, 2010; Meeten & Davey, 2012). From this it can be inferred that mood is being used to evaluate the aims of the deployed rule. When the rule is to achieve a specific goal using the task, a negative mood tells the individual that the goal has not yet been reached and they should continue with the task. When the rule is to continue until the individual 'no longer feels like continuing', a negative mood instead tells them to stop.

Finally, why should a worrier use their mood to evaluate goal-attainment during a worry bout? Why not deploy a more skill-based process based on an evaluation using relevant knowledge and experience? The literature on the use of mood as information provides some interesting insights into the conditions under which individuals will use mood as information, and these conditions have significant implications for clinical populations of the kind who suffer from perseverative disorders such as pathological worrying (see Meeten & Davey, 2011, p1266-1269). For example, individuals will default to using their mood as information (1) when they lack the relevant skills and expertise on which to make relevant judgments (Schwarz, 2001; Forgas & Tehani, 2005), (2) when they have reason to believe that their current mood state is highly relevant to the task at hand (Schwarz & Clore, 1983; Clark & Isen, 1982), and (3) when cognitive load is high or the task at hand is a complex one (Schwarz, Strack, Kommer & Wagner, 1987; Siemer & Reisenzein, 1998). Pathological worriers who have symptoms severe enough to warrant a clinical diagnosis do exhibit these types of characteristics that will facilitate the use of mood as information during a worry task. Chronic worriers (1) tend to have significantly poorer problem-solving confidence than nonworriers, suggesting a lack of confidence in their expertise and ability to successfully solve problems of the type addressed by

worrying (Davey, 1994; Laugesen & Dugas, 2000; Davey & Levy, 1998), (2) they tend to initiate worrying in an attempt to explain, understand and repair their negative mood, and so will view their mood as being highly relevant to the worry task (Davey & Meeten, 2011; Schwarz & Clore, 1983), and (3) they tend to adopt information processing strategies that inflict a high cognitive load, such as systematic information processing (Dash & Davey, 2012), or which deplete working memory capacity (Hayes, Hirsch & Mathews, 2008; Leigh & Hirsch, 2011). All of these characteristics will tend the worrier to using mood as information when implicitly evaluating goal-attainment during the worry task.

In summary, negative mood has a number of independent causal effects that will facilitate perseveration of the worry bout. These effects include the promotion of a systematic, deliberate and effortful information-processing style, and the deployment of strict goal-directed rules for worrying that will set comparatively higher performance standards. In addition, negative mood can also provide information that the goals of the worry task have not been achieved and so worry should continue.

### **Interactions between Cognitive, Affective & Attentional Factors**

Figure 1 provides a schematic representation of the processes that contribute to the perseveration of a worry bout based on the empirical evidence discussed above.

The hatched boxes indicate how attentional and interpretational biases can facilitate the identification of potential worries by directly influencing how stimuli and events are evaluated or by increasing the frequency with which intrusive negative thoughts are experienced (e.g. Hirsch & Mathews, 2012). Such preferential allocation of attention to threatening stimuli in anxious individuals is automatic and occurs pre-attentively (Mogg, Bradley, Williams & Mathews, 1993; Mogg, Bradley & Halliwell, 1994), and this preferential allocation of attention has been shown to have a 'downstream' effect leading to ambiguous information being interpreted in a threat-related manner that is likely to be automatic (White et al. 2011). As a result, interpretation of ambiguous material as threats occurs on-line rather than being reconstructed later (Calvo & Castillo, 2001; MacLeod, 1999). Once identified in this way, potential worries or threats can activate the worrier's positive beliefs about the need to worry (Wells, 2007, 2010), and be operationalized in the deployment of goal-direct rules for worrying, ensuring that the pathological worrier "continues to worry until he/she assesses that he/she will be able to effectively cope with anticipated threat" (Wells, 2007, p19). Once identified, threats act to prime well-rehearsed and habitual goal-directed worry rules in an automatic fashion (Aarts & Dijksterhuis, 2000; Bargh, 1989), and these strict rules for completion of the worry bout will themselves directly contribute to perseveration (in order to ensure all eventualities are considered). The fact that an anxious individual may be unable to control attentional biases has further implications for the worry bout. This will lead to the worrier continually

identifying new threats associated with the worry topic in the “What if...?” fashion that is typical of pathological worriers (Kendall & Ingram, 1987). Each newly identified threat will sustain activation of the cognitive processing strategies and goal-directed responses that will contribute to perseveration. An additional indirect effect of automatic attentional bias is that it will continually engage working memory with newly identified potential threats, and working memory is an important contributor to emotion regulation (Hofman, Gschwender, Friese, Wiers & Schmitt, 2008; Ochsner, Bunge, Gross & Gabrieli, 2002). This is likely to impede any attempts at top down inhibitory control, and may even exacerbate the attentional bias because loading working memory can create difficulties in disengaging attention (e.g. Judah, Grant, Lechner & Mills, 2013; Eysenck, Derakshan, Santos & Calvo, 2008). In these respects, the perceptual and interpretational biases operate to facilitate worry in a way very similar to those proposed in the cognitive model of Hirsch & Mathews (2012). Involuntary allocation of attention to potential threats generates awareness of the initial worry, and also generates a stream of subsequent automatic thoughts about related threats which give rise to the “what if ...?” style of worrisome thinking found in pathological worriers. In addition, an inability to exert top down control over these perceptual and interpretational biases may result either from the impairing effect that worry has on the central executive function of working memory (Eysenck, Derakshan, Santos & Calvo, 2007), or the beliefs that worriers develop that worry is inherently ‘uncontrollable’ (Wells, 2010).

The present review extends the information-processing approach hypothesized by Hirsch & Mathews (2012) by specifying some of the behavioural and cognitive processes downstream from attentional and interpretational bias that add to the perseverative nature of

worry in pathological worriers. These include the activation of beliefs about both the utility and uncontrollability of worry (Wells, 2010), the automatic deployment of strict goal-directed responses for dealing with the threat, the role of negative mood in facilitating effortful forms of information processing (i.e. systematic information processing styles), and in providing negative information for evaluating the success of the worry bout. In earlier sections of this paper we have already provided evidence supporting many of the interactions illustrated in Figure 1, including the effect of attentional biases on threat interpretation (e.g. White et al., 2011), the effect of a threat interpretation bias on negative mood (e.g. Wilson, MacLeod, Mathews & Rutherford, 2006), the effect of negative mood on systematic information processing (e.g. Ambady & Gray, 2002), and the effect of negative mood on the deployment of goal-directed rules for worry (e.g. Dash & Davey, 2012), the use of negative mood as evaluative information (e.g. Startup & Davey, 2001), and the effect of the deployment of goal-directed rules for worry on worry perseveration (e.g. Davey, Startup, MacDonald, Jenkins & Patterson, 2005). Interactions that still require some endorsing evidence include the influence that threat perception has in triggering goal-directed rules for worry and positive beliefs about worry. However, evidence for the automatic activation of goal-directed behaviours and beliefs by worries could be investigated using the goal-priming paradigm described by Aarts & Dijksterhuis (2000) in which we would predict that response latencies to goal-directed rules for worry and positive worry beliefs would be faster following priming by worry words than non-worry words. Finally, while there is good evidence for a causal effect of negative mood in facilitating systematic information processing, there is less direct evidence that systematic information processing directly contributes to perseverative worry. However, systematic information processing appears to be supported by a functionally distinct brain process located in the left frontal lobes

(Leynes, 2002; Leynes & Phillips, 2008), and studies have reported that increases in worrying are also associated with increased left hemisphere frontal activation (Borkovec, Ray & Stober, 1998). This suggests that both systematic processing and worrying are verbal-based forms of analytical thought supported by functionally similar brain processes. Studies directly manipulating styles of information processing and observing the effect of this on worry perseveration have still to be performed, although there is very substantial evidence to expect these effects to be found when such studies are conducted (e.g. Dash, Meeten & Davey, 2013).

The role of negative mood is critical because it has a number of separate causal effects. It facilitates the deployment of goal-directed rules for the worry bout and initiates the deliberate and effortful process of systematic information processing (Dash & Davey, 2012). In addition it also provides negative information that is used during the evaluation of goal attainment - a process that inferential experimental studies indicate will facilitate perseveration if the worrier has deployed goal-directed rules for the bout (Startup & Davey, 2001, 2003). This multiple role of negative mood in generating worry perseveration may also have some added benefits that reinforce the tendency to worry over successive bouts. For example, the contrast avoidance model of worry proposes that worry is reinforced because pathological worriers prefer to feel chronically distressed in order to prepare for the worst outcome associated with the threat, and there is a significant amount of physiological evidence to support this view (Newman & Llera, 2011). Thus, any proximal processes that prolong the worry bout will have the added advantage of avoiding a negative emotional contrast (i.e. a shift from a positive state to a negative emotion), and also maintain the worrier in a state that helps them to anticipate and prepare for the negative event (Borkovec & Roemer,

1995). As Newman & Lera (2011) suggest, this will increase the likelihood that those processes generating worry perseveration will be activated on future occasions.

One important clinical feature of the perseverative worry bout in pathological worriers is that this process causes the worrier increasing distress as the worry bout continues (Davey, Eldridge, Drost & MacDonald, 2007; Vasey & Borkovec, 1992). This distress is typical of worriers with a diagnosis of GAD, and is something that still requires explanation as a defining feature of pathological worrying. There are two sources of distress that are consequences of the perseverative nature of worry described here. One is the role that beliefs about worrying may play in generating worry-related distress. A perplexing feature of pathological worriers is that they appear to hold what seem like contradictory beliefs about worry: positive beliefs that worry is necessary (e.g. “worry will keep me safe”), as well as negative beliefs that worry is uncontrollable and dangerous (e.g. “worrying will make me lose my mind”) (Wells, 2010; Davey, Tallis & Cappuzo, 1996), and holding both types of beliefs is associated with significantly higher scores on a variety of psychopathology measures than holding just negative beliefs (Davey, Tallis & Capuzzo, 1996). One plausible hypothesis is that these negative beliefs about worry are a consequence of the processes that contribute to the perseverative mechanism that underlies pathological worry. These include the contribution of perceptual and interpretation biases that occur pre-attentively (e.g. Mogg, Bradley, Williams & Mathews, 1993; Mogg, Bradley & Halliwell, 1994), the deployment of goal-oriented task rules that are likely to be nonverbal in nature and automatically activated when used habitually (Davey, 2006b; Aarts & Dijksterhuis, 2000), and the implicit involvement of, or misattribution of, mood in evaluating outcomes (Schwarz & Clore, 1983; Oikawa, Aarts & Oikawa, 2011). This automaticity will

inevitably result in poor awareness of these interactive factors (preventing insight into the reasons why worry becomes perseverative) and to all intents and purposes makes worry seem uncontrollable. This hypothesis is supported by the fact that individuals meeting diagnostic criteria for GAD score significantly higher than non-worriers on beliefs that worry is uncontrollable and dangerous (Davis & Valentier, 2000), and although more research is required, it is feasible that these beliefs about the uncontrollability and dangerousness of worry contribute to the distress experienced during a perseverative worry bout.

A second source of potential distress for pathological worriers is the research finding that as a worry bout continues, more self-statements about personal inadequacy and inability to cope intrude into the worry stream of pathological worriers regardless of the actual worry topic itself (Davey & Levy, 1998, Study 6), and these types of statement are significantly correlated with measures of anxiety, depression and poor problem-solving confidence (Davey & Levy, 1999). These statements certainly seem to be associated with increasing levels of distress – but only in individuals scoring high on measures of pathological worry (Vasey & Borkovec, 1992; Davey, Eldridge, Drost & MacDonald, 2007), so they may represent the effects during a worry bout of dispositional factors possessed by worriers (such as poor problem-solving confidence) rather than being an effect of perseveration *per se*. The effect of these increasing levels of distress as the worry bout continues is to contribute further negative mood and to exacerbate the effects that negative mood will have on perseveration. Given that increasing negative mood will increase perseveration, how does the pathological worrier disengage from the worry process? One way in which disengagement can eventually occur is through the abandonment of ‘as many as can’ goal-

directed responses in favour of 'feel like continuing' stop rules (Davey, Eldridge, Drost & MacDonald, 2007). 'Feel like continuing' stop rules ask the implicit question 'Do I feel like continuing with this task?', and if the worrier is using their mood as information, their high levels of negative mood will indicate they do not feel like continuing. In this way, changes in stop rule during the worry bout can have quite significant effects on whether the individual either stops worrying or continues to persevere.

Finally, while perseveration appears to be dependent on the cognitive biases and individual characteristics that worriers bring with them to the worry bout, further etiological research is required to understand why pathological worriers have developed positive beliefs about the utility of worrying and how these beliefs are operationalized into goal-directed rules for worrying. In addition, the negative mood that pathological worriers bring with them to the worry bout is also endemic (Decker, Turk, Hess & Murray, 2008; Mennin, Heimberg, Turk & Fresco, 1995), and the psychological and biological factors that support this pervasive anxious experience still need to be fully catalogued, and the processes that generate this endemic state described and evaluated.

## **Clinical Implications**

Providing a detailed analysis of all the factors that may interact to generate a perseverative worry bout has a number of implications for interventions for pathological worrying.

First, the interactive processes that generate perseveration are often implicit and occur outside of awareness. One such factor is the interaction between goal-directed rules for worry and the use of a concurrent negative mood to evaluate progress towards that goal. This is known as the “mood-as-input” hypothesis because mood is used as input to evaluate progress on the worry task (Startup & Davey, 2001; Meeten & Davey, 2011; Davey, 2006b). Using a brief, low-intensity psychoeducation procedure, Dash, Meeten, Jones & Davey (2014) provided high worriers with psychoeducation about the basic principles of the mood-as-input hypothesis and received guidance on how to identify and change worry-relevant goal-directed rules for worry and also how to identify and change negative moods. Compared to controls who received no information about the mood-as-input hypothesis, psychoeducation about the model significantly reduced measures of worry at follow-up, and homework tasks raised mood and reduced worry immediately. This suggests that providing basic insight into the processes that generate perseveration, helping the individual to identify the stop rules they deploy for worrying, and to identify and change negative mood can have immediate beneficial effects. In addition, a further implication of providing insights into the role of negative mood during worrying is that a range of mood management interventions can be adopted to help the worrier manage their worry-related negative moods – moods that contribute directly to perseveration. These include behavioural activation interventions developed specifically for excessive worry (e.g. Chen, Liu, Rapee & Pillay, 2013), and mindfulness and acceptance-based approaches that will help the worrier to distance themselves from on-going negative emotions (Orsillo & Roemer, 2011).

Second, one obvious implication of the processes represented in Figure 1 is that the frequency of worrying would be reduced if the threat-relevant attentional and interpretation biases that identify potential worries could be reduced. One method for achieving this is the use of cognitive bias modification (CBM) procedures (MacLeod & Mathews, 2012; Hakamata, Lissek, Bar-Haim, Britton et al., 2010), in which pathological worriers would be provided with a structured program of computer-based trials that would establish attentional and interpretational predispositions towards benign resolutions and away from threatening ones. Prototype CBM interventions have already been found to successfully reduce threat attentional biases (Hayes, Hirsch & Mathews, 2010), and threat interpretational biases (Hirsch, Hayes & Mathews, 2009) in high worriers. However, there is still some doubt about the longer-term effectiveness of CBM procedures, and whether such procedures have any significant effect on clinical symptoms (Koster & Bernstein, 2015; Cristea, Kok & Cuijpers, 2015). But despite these concerns, CBM procedures would seem to be a useful tool in the early stages of an integrated intervention package for pathological worriers.

Thirdly, dysfunctional beliefs about the utility or benefit of worrying may be a trigger for the deployment of strict goal-directed rules for the worry episode (e.g. “I must continue to worry until I have covered all the possible problems that this worry raises”). We know very little about how these positive beliefs about worry develop, but they are characteristic of pathological worriers generally (Breitholtz, Westling & Ost, 1998; Davey, Tallis & Capuzzo, 1996; Wells, 2010; Borkovec, Hazlett-Stevens & Diaz, 1999), and are a significant factor in motivating the worrier’s desire to worry. In order to address and modify these positive beliefs, Wells and colleagues have developed a metacognitive therapy for worry (Wells, 1997, 2007, 2010). This therapy involves socializing the client to the

metacognitive model and beliefs about worrying, and challenging positive beliefs about worrying through a combination of verbal reattribution and behavioural experiments (e.g. increasing and decreasing worry whilst performing tasks to determine if worrying actually enhances performance or improves coping). Outcome studies suggest that this approach is associated with greater levels of recovery than approaches comprised of applied relaxation or CBT treatment focused on intolerance of uncertainty (Fisher, 2006; Wells, Welford, King, Papageorgiou, Wisely & Mendel, 2010; Heiden, Methorst, Muris & Molen, 2012).

Finally, as we begin to unpack the details of the proximal mechanisms that underlie an individual bout of pathological worrying, we begin to have a picture of what an integrated, comprehensive intervention for pathological worrying might look like. The early stages should begin with socialization to the model and in particular to important interactions within the model (e.g. between stop rules and concurrent mood). This psychoeducation would enable the client to identify these processes during their own worrying, and to manage their negative moods using a range of developed methods such as behavioural activation, mindfulness, and acceptance-based approaches. Dealing with deep-seated beliefs about worry (both positive and negative) would seem an obvious second stage – probably using metacognitive therapy principles to challenge these beliefs. A final stage would involve providing the client with a toolbox for dealing with real time worry bouts by helping them to identify and change negative moods and dysfunctional goal-directed stop rules. Alleviating negative mood would have a number of benefits by (1) reducing the desire to deploy goal-directed rules for worry, (2) reducing the tendency to utilize systematic information processing strategies that are likely to lead to micro-analysis of problems and to the generation of “what if ...?” questioning styles, and (3) eliminating the use of negative mood as information which would have prevented closure on

the worry episode. Finally, CBM could be offered for threat-related attention and interpretation biases if such biases are found to be a particularly strong feature of an individual's worry processes. While an integrated approach of this kind to treating pathological worry is yet to be tested, it is worth reiterating that most of the elements in this integrated approach have already been shown to have beneficial effects on levels of pathological worrying, including a psychoeducation intervention addressing the role of mood-as-input (Dash, Meeten, Jones & Davey, 2014), metacognitive therapy addressing dysfunctional beliefs about worry (Wells, 2010), and CBM procedures addressing attentional and interpretational biases (Hayes, Hirsch & Mathews, 2010; Hirsch, Hayes & Mathews, 2009).

## **Summary**

This paper has reviewed some of the cognitive, affective and attentional factors that contribute to the perseverative worry bout typical of pathological worriers. We describe how automatic biases in attentional and interpretational processes contribute to threat detection and to the inclusion of negative intrusive thoughts into the worry stream typical of the “what if ...?” thinking style of pathological worriers. We also describe processes occurring downstream from these perceptual biases that facilitate perseveration, including the activation of beliefs about the utility of worry, the automatic deployment of strict goal-directed responses for dealing with the threat, the role of negative mood in facilitating effortful forms of information processing (i.e. systematic information processing styles), and in providing

negative information for evaluating the success of the worry bout. The clinical implications of these factors for an integrated intervention programme for pathological worrying are also considered.

#### References

Aarts H & Dijksterhuis A (2000) Habits as knowledge structures: Automaticity in goal-directed behavior. *Journal of Personality & Social Psychology*, 78, 53-63.

Ambady, N., & Gray, H. M. (2002). On being sad and mistaken: Mood effects on the accuracy of thin-slice judgments. *Journal of Personality and Social Psychology*, 83(4), 947-961. doi: 10.1037/0022-3514.83.4.947

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5<sup>th</sup> ed.). Washington, DC: Author.

Bargh J A (1989) Conditional automaticity: Varieties of automatic influence in social perception and cognition. In J S Ulerman & J A Bargh (Eds) *Unintended thought* (pp3-51). New York: Guilford Press.

Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. New York: The Guilford Press.

Barlow, D. H. , Allen, L. B., Choate, M. L. (2004). Towards a unified treatment for emotional disorders. *Behavior Therapy*, 35, 205–230.

Batra, R., & Stayman, D. M. (1990). The role of mood in advertising effectiveness. *The Journal of Consumer Research*, 17(2), 203-214.

Borkovec, T. D. (1994). The nature, functions, and origins of worry. In G. C. L. Davey, & F. Tallis (Eds.), *Worrying: Perspectives on Theory, Assessment and Treatment*. Chichester, UK: John Wiley & Sons, Ltd.

Borkovec, T. D., Alcaine, O. M., & Behar, E. (2004). Avoidance Theory of Worry and Generalized Anxiety Disorder. *Generalized anxiety disorder: Advances in research and practice*, 77–108.

Borkovec T.D., Hazlett-Stevens H. & Diaz M.L. (1999) The role of positive beliefs about worry in generalized anxiety disorder and its treatment. *Clinical Psychology & Psychotherapy*, 6, 126-138.

Borkovec, T. D., Ray, W. J., & Stöber, J. (1998). Worry: A cognitive phenomenon intimately linked to affective, physiological, and interpersonal behavioral processes. *Cognitive Therapy and Research*, 22(6), 561–576.

Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy*, *21*(1), 9–16.

Bower, G. H. (1981). Mood and Memory. *American Psychologist*, *36*(2), 129-148.

Bradley, B. P., Mogg, K., & Williams, R. (1995). Implicit and explicit memory for emotion-congruent information in clinical depression and anxiety. *Behaviour Research and Therapy*, *33*, 755–770.

Breitholtz, E., Westling, B. E., & Ost, L-G. (1998). Cognitions in generalized anxiety disorder and panic disorder patients. *Journal of Anxiety Disorders*, *12*, 567-577.

Butler, G., & Mathews, A. (1983). Cognitive processes in anxiety. *Advances in Behaviour Research and Therapy*, *5*(1), 51–62.

Calvo, M. G. & Castillo, M. D. (2001) Bias in predictive inferences during reading. *Discourse Processes*, *32*, 43-71.

Casey, L. M., Oei, T. P., Newcombe, P. A. (2004). An integrated cognitive model of panic disorder: the role of positive and negative

cognitions. *Clinical Psychology Review* 24, 529-55.

Chaiken, S., Liberman, A., & Eagly, A. H. (1989). Heuristic and systematic information processing within and beyond the persuasion context. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended Thought*. New York: Guilford Press.

Chen J., Liu, X., Rapee, R. M., & Pillay, P. (2013). Behavioural activation: A pilot study of transdiagnostic treatment for excessive worry. *Behaviour Research & Therapy*, 51, 533-539.

Clark, M. S. & Isen, A. M. (1982). *Toward understanding the relationship between feeling states and social behavior*. In A. H. Hastorf, & A. M. Isen (Eds.), *Cognitive social psychology* (pp. 73-108). Elsevier: New York.

Clark, D. & Wells, A. A. cognitive model of social phobia. In Heimberg, R., Liebowitz, M., Hope, D., Schneider, R., editors. *Social Phobia: Diagnosis, Assessment, and Treatment*. New York: Guilford Press; 1995. p. 69-93.

Comer, J. S., Kendall, P. C., Franklin, M. E., Hudson, J. L., & Pimentel, S. S. (2004). Obsessing/worrying about the overlap between obsessive-compulsive disorder and generalized anxiety disorder in youth. *Clinical Psychology Review*, 24, 663-683.

Coles, M. E. & Heimberg, R. G. (2002). Memory biases in the anxiety disorders: current status. *Clinical Psychology Review*, 22, 587–627.

Coles, M. E. Turk, C. L. & Heimberg, R. G. (2007). Memory Bias for Threat in Generalized Anxiety Disorder: The Potential Importance of Stimulus Relevance, *Cognitive Behaviour Therapy*, 36, 65-73, DOI: 10.1080/16506070601070459

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *British Journal of Psychiatry*, 206, 7-16.

Dash, S. R. & Davey, G. C. L. (2012). An experimental investigation of the role of negative mood in worry: The role of appraisals that facilitate systematic information processing. *Journal of Behavior Therapy & Experimental Psychiatry*, 43, 823-831.

Dash, S. R., Meeten, F. & Davey, G. C. L. (2013). Systematic processing information style and perseverative worrying. *Clinical Psychology Review*, 33, 1041-1056.

Dash, S. R., Meeten, F., Jones, F., & Davey, G. C. L. (2014). Evaluation of a brief 4-session psychoeducation procedure for high worriers based on the mood-as-input hypothesis. *Journal of Behavior Therapy & Experimental Psychiatry*, *46*, 126-132.

Diamond D, Matchett G & Davey G C L (1995) The effect of prior fear levels on UCS-expectancy ratings to a fear-relevant stimulus. *Quarterly Journal of Experimental Psychology*, *48*, 237-247.

Davey G C L (1992) An expectancy model of laboratory preparedness effects. *Journal of Experimental Psychology: General*, *121*, 24-40.

Davey, G. C. L. (1994a). Pathological worrying as exacerbated problem solving. In G. C. L. Davey & F. Tallis (Eds.), *Worrying perspectives on theory, assessment and treatment*. Chichester: John Wiley.

Davey, G. C. L. (1994b). Worrying, social problem-solving abilities, and social problem-solving confidence. *Behaviour Research and Therapy*, *32* (3), 327-320.

Davey, G. C. L. (2006a). The catastrophising interview procedure. In G. C. L. Davey, & A. Wells (Eds.), *Worry and its psychological disorders: Theory, assessment and treatment*. Chichester: John Wiley.

Davey, G. C. L. (2006b). A mood-as-input account of perseverative worrying. In G. C. L. Davey & A. Wells (Eds.), *Worry and its psychological disorders: Theory, assessment and treatment*. Chichester: Wiley.

Davey, G. C. L., Eldridge, F., Drost, Jolijn, & MacDonald, B. (2007). What ends a worry bout? An analysis of changes in mood and stop rule use across the catastrophising interview task. *Behaviour Research and Therapy*, *44*, 1375-1384.

Davey, G. C. L., Hampton, J., Farrell, J., & Davidson, S. (1992). Some characteristics of worrying: Evidence for worrying and anxiety as separate constructs. *Journal of Personality and Individual Differences*, *13*(2), 133-147.

Davey, G. C. L. & Levy, S. (1998). Catastrophic worrying: personal inadequacy and a perseverative iterative style as features of the catastrophising process. *Journal of Abnormal Psychology*, *107*, 576-586.

Davey G. C. L. & Levy S. (1999). Internal statements associated with catastrophic worrying. *Personality & Individual Differences*, *26*, 21-32

Davey G. C. L., Tallis, F. & Capuzzo, N. (1996) Beliefs about the consequences of worrying. *Cognitive Therapy and Research*, 20, 599-520.

Davey, G. C. L., Startup, H. M., MacDonald, C. B., Jenkins, D., & Patterson, K. (2005). The use of "as many as can" versus "feel like continuing" stop rules during worrying. *Cognitive Therapy and Research*, 29(2), 155-169.

Davis, R. N., & Valentiner, D. P. (2000). Meta-cognition: Unique relationships to pathological worry and anxiety. *Personality and Individual Differences*, 29, 513-526.

Decker, M. L., Turk, C. L., Hess, B., & Murray, C. E. (2008). Emotion regulation among individuals classified with and without Generalized Anxiety Disorder. *Journal of Anxiety Disorders*, 22, 485-494.

Derakshan, N. & Eysenck, M. W. (2009). Anxiety, Processing Efficiency, and Cognitive Performance. *European Psychologist*, 14, 168-176.

Diefenbach, G. J., McCarthy-Larzelere, M. E., Williamson, D. A., Mathews, A., Manguno-Mire, G. M., & Bentz, B. G. (2001). Anxiety,

depression, and the content of worries. *Depression and anxiety*, 14(4), 247-250.

Dugas, M. J., Freeston, M. H. & Ladouceur, R. (1997). Intolerance of uncertainty and problem orientation in worry. *Cognitive Therapy & Research*, 21, 593-606.

Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy*, 1(3), 192-205.

Eysenck, M. W. & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion*, 6, 409–434.

Eysenck M. W., Derakshan N, Santos R & Calvo M. G. (2007) Anxiety and cognitive performance. Attentional control theory. *Emotion*, 7, 336-353.

Eysenck, M.W., MacLeod, C., & Mathews, A.M. (1987). Cognitive functioning in anxiety. *Psychological Research*, 49, 189–195.

Eysenck, M. W., Mogg, K., May, J., Richards, A., & Mathews, A. (1991). Bias in interpretation of ambiguous sentences related to threat in anxiety. *Journal of Abnormal Psychology, 100*, 144–150.

Fisher, P. L. (2006). The efficacy of psychological treatments for Generalized Anxiety Disorder. In G. C. L. Davey & A. Wells (Eds.) *Worry and its psychological disorders: Theory, Assessment & Treatment*. Wiley: Chichester.

Foa, E. B., McNally, R. & Murdock, T. (1989). Anxious mood and memory. *Behaviour Research and Therapy, 27*, 141-147.

Forgas, J. P., & Tehani, G. (2005). Affective influences on language use: Mood effects on performance feedback by experts and novices. *Journal of Language and Social Psychology, 24*, 269-284.

Frost R.O., Marten P., Lahart C. & Rosenblate R. (1990) The dimensions of perfectionism. *Cognitive Therapy & Research, 14*, 449-468.

Hakamata, Y., Lissek, S., Bar-Haim, Y, Britton, J. C. *et al.* (2010). Attention bias modification treatment: A meta-analysis toward the establishment of novel treatment for anxiety. *Biological Psychiatry, 68*, 982–990.

Hawksley J & Davey G.C.L. (2010) Mood-as-input and depressive rumination. *Behaviour Research & Therapy, 48*, 134-140.

Hayes S., Hirsch C. R. (2007). Information processing biases in generalized anxiety disorder. *Psychiatry Research*, 6, 176–182.

Hayes S., Hirsch C. R. & Mathews A. (2008) Restriction of working memory capacity during worry. *Journal of Abnormal Psychology*, 117, 712–717.

Hayes, S., Hirsch, C. R., & Mathews, A. (2010). Facilitating a benign attentional bias reduces negative thought intrusions. *Journal of Abnormal Psychology*, 119, 235-240. <http://dx.doi.org/10.1037/a0018264>.

Heiden, C. van der, Methorst, G., Muris, P. & Molen, H.T. van der (2012). Randomized controlled trial on the effectiveness of metacognitive therapy and intolerance-of-uncertainty therapy for generalized anxiety disorder. *Behaviour Research and Therapy*, 50, 100-109.

Hirsch, C. R., Clark, D. M., & Mathews, A. (2006). Imagery and interpretations in social phobia: support for the combined cognitive biases hypothesis. *Behavior Therapy*, 37, 223-236. <http://dx.doi.org/10.1016/j.beth.2006.02.001>

Hirsch, C. R., Hayes, S., & Mathews, A. (2009). Looking on the bright side: accessing benign meanings reduces worry. *Abnormal*

*Psychology, 118, 44-54.*

Hirsch, C. R. & Mathews, A. (2012). A model of pathological worry. *Behaviour Research and Therapy, 50* 636-646.

Hirsch, C. R., MacLeod C., Mathews, A., Sandher O., Siyani A., Hayes S. (2011). The contribution of attentional bias to worry: distinguishing the roles of selective engagement and disengagement. *Journal of Anxiety Disorders. 25, 272–277.*

Hofmann, W., Gschwendner, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008). Working memory capacity and self-regulatory behavior: Towards an individual differences perspective on behavior determination by automatic versus controlled processes. *Journal of Personality and Social Psychology, 95, 962-977.*

Johnston W.M. & Davey G.C.L. (1997). The psychological impact of negative TV news bulletins: The catastrophising of personal worries. *British Journal of Psychology, 88, 85-91.*

Judah MR, Grant DM, Lechner WV & Mills AC (2013) Working memory load moderates late attentional bias in social anxiety. *Cognition & Emotion, 27, 502-511.*

Kendall P. C. & Ingram R. E. (1987). The future for cognitive assessment of anxiety: Let's get specific. In L. Michaelson & L. M. Ascher (Eds.) *Anxiety and stress disorders: Cognitive-behavioral assessment and treatment*. New York: Guildford.

Kertz, S., & Woodruff-Borden, J. (2011). Human and Economic Burden of GAD, Subthreshold GAD, and Worry in a Primary Care Sample. *Journal of Clinical Psychology in Medical Settings, 18*(3), 281-290.

Koster, E. & Bernstein, A. (2015). Introduction to the special issue on cognitive bias modification: Taking a step back to move forward? *Journal of Behavior Therapy & Experimental Psychiatry*, in press.

Krebs, G., Hirsch, C. R., & Mathews, A. (2010). The effects of attention modification with explicit vs. minimal intrusions on worry. *Behaviour Research and Therapy, 48*, 251-256. <http://dx.doi.org/10.1016/j.brat.2009.10.009>.

Laugesen, N., & Dugas, M. (2000). Worry in adolescence: Relationship with problem orientation and problem solving skills. 'State-of-the-Art Lectures, Invited Symposia, Keynote Addresses, Poster session', *International Journal of Psychology, 35*(3), 272 – 369.

Leigh E. & Hirsch C.R. (2011) Worry in imagery and verbal form: effect on residual working memory capacity. *Behaviour Research and Therapy*, 49, 99–105.

Leynes, A. P. (2002). The effect of specific test queries on source-monitoring event-related potentials. *Brain and Cognition*, 50(2), 218–233.

Leynes, A., & Phillips, M. C. (2008). Event-Related Potential (ERP) evidence for varied recollection during source monitoring. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34(4), 741–751.

MacDonald C. B. & Davey G. C. L. (2005). Inflated responsibility and perseverative checking: The role of negative mood. *Journal of Abnormal Psychology*, 114, 176-182.

MacLeod, C. (1999). Anxiety and anxiety disorders. In T. Dalgleish & M. J. Power (Eds.) *Handbook of cognition and emotion* (pp. 447-477). New York: Wiley.

MacLeod, C., & Donnellan, A. M. (1993). Individual differences in anxiety and the restriction of working memory capacity. *Personality and Individual Differences*, 15, 163–173.

MacLeod, C. & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual Review of Clinical Psychology*, 8, 189–217.

Martin, L. L., Ward, D. W., Achee, J. W., & Wyer, R. S. (1993). Mood as input: People have to interpret the motivational implications of their moods. *Journal of Personality and Social Psychology*, 64(3), 317-326.

Mathews, A. (1990). Why worry? The cognitive function of anxiety. *Behaviour Research and Therapy*, 28, 455-468.

[http://dx.doi.org/10.1016/0005-7967\(90\)90132-3](http://dx.doi.org/10.1016/0005-7967(90)90132-3).

Mathews, A., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy*, 23, 563–569.

Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, 45, 25–50.

Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition and Emotion*, 16, 331-354.

<http://dx.doi.org/10.1080/02699930143000518>.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology, 109*, 602–615.

Mathews, A., Mogg, K., Kentish, J., & Eysenck, M. (1995). Effect of psychological treatment on cognitive bias in generalized anxiety disorder. *Behaviour Research and Therapy, 33*, 293–303.

Mathews, A., Richards, A., & Eysenck, M. (1989). Interpretation of homophones related to threat in anxiety states. *Journal of Abnormal Psychology, 98*, 31e34. <http://dx.doi.org/10.1037/0021-843X.98.1.31>.

Meeten, F. & Davey, G. C. L. (2012). Mood-as-input effects following the induction of discrete negative moods. *Behavior Therapy, 43*, 393-406.

Meeten, F., Dash, S. R., Scarlet, A., & Davey, G. C. L. (2012). Investigating the effect of intolerance of uncertainty on catastrophic worrying and mood. *Behaviour Research & Therapy, 50*, 690-698.

Meeten, F., & Davey, G. C. L. (2011). Mood-as-input hypothesis and perseverative psychopathologies. *Clinical Psychology Review*, 31(8), 1259-1275. doi: 10.1016/j.cpr.2011.08.002.

Mennin, D. S., Heimberg, R. G., Turk, C. L. & Fresco, D. M. (2005). Preliminary evidence for an emotion dysregulation model of Generalized Anxiety Disorder. *Behaviour Research & Therapy*, 43, 1281-1310.

Mellings, T. M. B., & Alden, L. E. (2000). Cognitive processes in social anxiety: The effects of self-focus, rumination and anticipatory processing. *Behaviour Research and Therapy*, 38, 243–257.

Meyer, T., Miller, M., Metzger, R., & Borkovec, T. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, 28(6), 487-495.

Mogg, K., Bradley, B. P. & Halliwell, N. (1994). Attentional bias to threat: Roles of trait anxiety, stressful events, and awareness. *Quarterly Journal of Experimental psychology*, 47A, 841-864.

Mogg, K., Bradley, B. P., Williams, R., & Mathews, A. (1993). Subliminal processing of emotional information in anxiety and depression. *Journal of Abnormal Psychology, 102*, 304-311.

Mogg, K., Mathews, A., & Weinman, J. (1987). Memory bias in clinical anxiety. *Journal of Abnormal Psychology, 96*, 94-98.

Newman M G & Llera S J (2011) A novel theory of experiential avoidance in generalized anxiety disorder: A review and synthesis of research supporting a contrast model of worry. *Clinical Psychology Review, 31*, 371-382.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*, 569e582. <http://dx.doi.org/10.1037/0021-843X.100.4.569>.

Ochsner, K. N., Bunge, S. A., Gross, J. J., & Gabrieli, J. D. E. (2002). Rethinking feelings: An fMRI study of the cognitive regulation of emotion. *Journal of Cognitive Neuroscience, 14*, 1215-1229.

Oikawa, M., Aarts, H., & Oikawa, H. (2011). There is a fire burning in my heart: The role of causal attribution in affect transfer. *Cognition & Emotion, 25*, 156-163.

Orsillo SM & Roemer L (2011) *The mindful way through anxiety: Break free from chronic worry and reclaim your life*. Guilford Press.

Pratt P., Tallis F. & Eysenck M. (1997). Information-processing, storage characteristics and worry. *Behaviour Research & Therapy*, 35, 1015-1023.

Rapee, R . M. (1993). The utilization of working memory by worry. *Behavior Research and Therapy*, 31, 617–620.

Rusico, A. M. (2002). Delimiting the boundaries of generalized anxiety disorder: differentiating high worriers with and without GAD. *Journal of Anxiety Disorders*, 16, 377–400.

Ruscio, A. M., Borkovec, T. D., & Ruscio, J. (2001). A taxometric investigation of the latent structure of worry. *Journal of Abnormal Psychology*, 110, 413-422.

Schwarz, N. (2001). Feelings as information: Implications for affective influences on information processing. In G. L. Core & L. L. Martin (Eds.), *Theories of mood and cognition: A users handbook*. New Jersey: Lawrence Erlbaum Associates.

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being. Informative and directive functions of affective states. *Journal of Personality and Social Psychology*, 45(3), 513-523.

Schwarz, N., Strack, F., Kommer, D. & Wagner, D. (1987). Soccer, rooms, and the quality of your life: Mood effects on judgments of satisfaction with life in general and with specific domains. *European Journal of Social Psychology*, 17, 69-79.

Scott, W. D., & Cervone, D. (2002). The impact of negative affect on performance standards: Evidence for an affect-as-information mechanism. *Cognitive Therapy and Research*, 26, 19-37. doi: 10.1023/A:1013837520031

Siemer, M., & Reisenzein, R. (1998). Effects of mood on evaluative judgements: Influence of reduced processing capacity and mood salience. *Cognition and Emotion*, 12, 783-805.

Startup, H. M., & Davey, G. C. L. (2001). Mood as input and catastrophic worrying. *Journal of Abnormal Psychology*, 110(1), 83-96.

Startup, H. M., & Davey, G. C. L. (2003). Inflated responsibility and the use of stop rules for catastrophic worrying. *Behaviour Research and Therapy*, 41(4), 495-503.

Stefanopoulou, E., Hirsch, C. R., Hayes, S., Adlam, A., & Coker, S. (2014). Are attentional control resources reduced by worry in generalized anxiety disorder? *Journal of Abnormal Psychology*, 123, 330-35.

Stober J. & Joormann J. (2001) Worry, procrastination, and perfectionism: Differentiating amount of worry, pathological worry, anxiety, and depression. *Cognitive Therapy & Research*, 25, 49-60.

Tallis, F., Eysenck, M. W. & Mathews A. (1991) Elevated evidence requirements and worry. *Personality & Individual Differences*, 12, 505-520.

Tiedens, L. Z., & Linton, S. (2001). Judgment under emotional certainty and uncertainty: The effects of specific moods on information processing. *Journal of Personality and Social Psychology*, 81(6), 973-988.

Vasey M. & Borkovec T.D. (1992) A catastrophising assessment of worrisome thoughts. *Cognitive Therapy & Research*, 16, 505-520.

Wells, A. (2007). Cognition about cognition: Metacognitive therapy and change in Generalized Anxiety Disorder and Social Phobia. *Cognitive & Behavioral Practice, 14*, 18-25.

Wells, A. (2010). Metacognitive Theory and Therapy for Worry and Generalised Anxiety Disorder: Review and Status. *Journal of Experimental Psychopathology, 1*, 133-145.

Wells, A. & Papageorgiou, C. (1998) relationships between worry, obsessive-compulsive symptoms and meta-cognitive beliefs. *Behaviour Research and Therapy, 36*, 899-913.

Wells, A., Welford, M., King, P., Papageorgiou, C., Wisely, J. & Mendel, E. (2010). A pilot randomized trial of metacognitive therapy vs applied relaxation in the treatment of adults with Generalized Anxiety Disorder. *Behaviour Research & Therapy, 48*, 429-434.

White, L. K., Suway, J. G., Pine, D. S., Bar-Haim, Y., & Fox, N. A. (2011). Cascading effects: The influence of attention bias to threat on the interpretation of ambiguous information. *Behaviour Research & Therapy, 49*, 244-251.

Wilson, E. J., MacLeod, C., Mathews, A. & Rutherford, E. M. (2006). The causal role of interpretive bias in anxiety reactivity. *Journal of Abnormal psychology, 115*, 103-111.

FIGURE LEGEND

A schematic representation of the processes that contribute to perseveration of an individual worry bout. This represents an integrated cascading network of cognitive and behavioural reactions in response to the threat posed by the worry (see text for further elaboration).

FIGURE 1

