

Chapter 15: Cognition and emotion

Historically, many cognitive psychologists have ignored the effects of emotion on cognition. However, there has been growing interest in cognition and emotion, particularly in research on everyday memory and decision making. How is our emotional experience influenced by our cognitive appraisal or interpretation of that situation? What processes are involved when we manage our own emotions? How does emotion affect cognition? For example, when we feel anxious, how does that affect what we learn and remember? In this chapter, the bi-directional relationship between emotion and cognition is explored in further detail.

Patients with clinical anxiety or depression often show cognitive biases in the way they attend to, interpret and remember threatening stimuli. Do these biases cause anxious and depressive disorders, or is it the disorders themselves that produce cognitive biases? Is it possible to change cognitive biases through training, and does this have consequent effects on mood? The chapter concludes by examining the possible causal relationship between cognitive biases and affect in clinical populations.

There are two main approaches to the structure of emotions: dimensional and categorical. Izard (2007) suggested there are several distinct emotions such as fear, happiness, sadness, anger and disgust. Barrett and Russell (1998) argued for two uncorrelated dimensions of misery–pleasure (valence) and arousal–sleep. In contrast, Watson and Tellegen (1985) favoured two uncorrelated dimensions of positive and negative affect. In a meta-analysis of neuroimaging studies, Lindquist et al. (2012) found areas associated with attentional processes, language and long-term memory were activated across several emotions. Emotional experience depends on bottom-up (or stimulus-driven) processes involving attention and perception. It also depends on top-down processes involving appraisal of the situation drawing on stored knowledge of similar situations (Ochsner et al., 2009).

CASE STUDY: Basic emotions as natural kinds

- **Appraisal theories**

Brosch (2013, p. 370) suggests that appraisal theories assume that “emotional responses are elicited as the organism evaluates the relevance of environmental changes for its well-being”. Fontaine et al. (2013) tested the centrality of appraisal to emotion. Emotions were correctly classified solely on the basis of appraisal features in 71% of cases. All other components (e.g., bodily sensations, motor expressions, action tendencies) improved classification accuracy only slightly. These findings suggest appraisal is vitally important in determining emotional states.

Smith and Lazarus (1993) found appraisal manipulations generally had the predicted effects on participants’ emotional states. However, Parkinson (2001) was unimpressed by their findings. He pointed out that under 30% of the variance in emotion ratings was accounted for by participants’ appraisal manipulations. Any given emotion can result from several different combinations of appraisals. No *single* appraisal (or combination of appraisals) was necessary or sufficient for the experience of any emotional state.

The appraisal approach can explain some individual differences in emotional reactions to a given situation (Ceulemans et al., 2012). Kuppens et al. (2003) argued that any given emotion can be produced by a combination of appraisals. They found that none of the four appraisal components tested were necessary or sufficient as a determinant for anger. Individual differences in the amount of anger triggered by the scenarios depended on two factors: (1) the appraisals activated by each scenario; and (2) the specific pattern of appraisal components necessary for the individual to experience anger. Most research reports associations or correlations between cognitive appraisals and emotional states and so cannot shed direct light on causality. This work suggests there are conscious appraisal mechanisms.

WEBLINK: [Appraisal article](#)

Appraisal can also involve rapid associative processes occurring subconsciously. Öhman and Soares (1994) presented pictures subliminally to participants. Their participants showed arousal responses demonstrating the appraisal process was unconscious. Tamietto et al. (2009) found facial muscles were activated by presented expressions. These facial reactions occurred 200–300 ms faster for non-consciously perceived expressions than consciously perceived ones. Emotional processing may be faster below the level of conscious awareness because it bypasses the cortex.

RESEARCH ACTIVITY: Appraisal–emotion relationships in daily life

Limitations of appraisal theory are:

- Appraisal may not always play a role in determining emotional experiences.
- The focus is on passive individuals.
- The focus is on emotions and appraisals currently experienced rather than those that happened in the past.
- The causality of appraisal and emotional experience may be bi-directional.

According to appraisal theories, cognitive appraisals start the emotional process. Lazarus (1966, 1982) proposed an influential theory distinguishing between three forms of appraisal – primary, secondary and reappraisal. He also distinguished between automatic and deliberate appraisal processes. There is substantial evidence demonstrating that cognitive appraisals can affect the emotional experience, and can also explain individual differences in emotional experience. However, strong causal evidence is still lacking, and it is likely the direction of causality may operate from appraisals to emotions as well as vice versa.

- **Emotion regulation**

Emotion regulation is the set of processes whereby people seek to redirect the spontaneous flow of their emotions. There are numerous forms of emotion regulation: cognitive appraisal, controlled breathing, muscle relaxation, stress-induced eating, attentional deployment, response modulation, etc. The distinction between emotion generation and emotion regulation is often blurred (Gross et al., 2011). Emotion-generative and emotion-regulatory processes interact and involve overlapping brain systems (Ochsner et al., 2009).

Gross and Thompson (2007) proposed a *process model* categorising emotion-regulation strategies. The crucial assumption of the model is that strategies can be used at various points in time. The strategies employed in emotion regulation are:

- situation selection;
- situation modification;
- attention deployment;
- cognitive change;
- response modulation.

Strategies involving situation selection, situation modification, attentional deployment and cognitive change are all *antecedent*-focused – they occur before appraisals produce a full-blown emotional response. In contrast, response modulation strategies are *response*-focused – they occur after emotional responses have been generated. Most emotion-regulation strategies are used at the attentional deployment stage (e.g., distraction – disengaging attention from emotional processing) or the cognitive change stage (e.g., reappraisal – elaborating emotional information and then changing its meaning).

Gyurak et al. (2011) argued that *implicit* emotion regulation is also important. Augustine and Hemenover (2009) distinguished between cognitive strategies (involving thinking) and behavioural strategies (involving physical action). Cognitive strategies (especially reappraisal and distraction) were more effective than behavioural strategies.

Aldao et al. (2010) found acceptance, problem solving and reappraisal had beneficial effects on anxiety and depression. However, rumination (obsessive thinking about issues) and avoidance both *increased* the symptoms of anxiety and depression. Troy et al. (2013) argued that reappraisal would be effective in situations in which stress was uncontrollable. However, it would be ineffective in situations in which stress was controllable and the optimal strategy would probably be problem-focused coping rather than changing one's emotional state. Cognitive reappraisal involves reinterpreting the meaning of a stimulus to change one's emotional response to it (Ochsner & Gross, 2005). It is assumed that: cognitive reappraisal involves higher-level control processes; and reappraisal strategies vary in the processes and brain areas involved.

WEBLINK: [Article by Ochsner and Gross \(2005\)](#)

Ochsner and Gross (2008) distinguished between two types of reappraisal strategy:

- *Reinterpretation*: changing the meaning of the context.
- *Distancing*: taking a detached perspective.

Functional neuroimaging studies (e.g., reviewed by Ochsner and Gross, 2008) indicate that reappraisal often involves an interaction between the areas associated with cognitive control (prefrontal cortex, anterior cingulate) and emotion (amygdala). Kohn et al. (2014) identified several brain areas associated with emotion regulation. Their findings were consistent with a three-stage neural network model:

- *Emotion evaluation*: This network centres on the ventrolateral prefrontal cortex (VLPFC) and is involved in initiating appraisal and signalling the need to regulate emotion.
- *Initiation of regulation*: This network centres on the dorsolateral prefrontal cortex (DLPFC) and is involved in processing the regulation of emotion.
- *Execution of regulation*: This network regulates affective arousal by changing the emotional state.

Reappraisal was associated with greater increases in activation within the medial prefrontal cortex and anterior temporal regions (associated with processing affective meaning). It was also more effective in reducing negative affect. This suggests reappraisal was associated with greater *control* of the individual's emotional state (McRae et al., 2010). Lee et al. (2012) found individuals with the strongest links between prefrontal areas and the amygdala would show the most effective use of reappraisal. Reappraisal works well at low levels of emotional intensity but was counterproductive at high levels (Sheppes & Gross, 2011).

Prior exposure to reappraisal-relevant words (e.g., *restrains, stable*), during a task in which words were rearranged to form sentences, caused participants to experience less anger and general negative emotions than controls because of the implicit processes they used when provoked (Mauss et al., 2007).

Functional neuroimaging studies indicate that in reappraisal higher cognitive control processes associated with the prefrontal cortex are used rapidly, followed by reduced emotional responses in the amygdala. The cognitive processes used in reappraisal vary as a function of the strategy being used. It is unclear whether cognitive processes involved in emotion regulation are the same as those used in complex cognitive tasks.

Emotion regulation is a deliberate, effortful process by which people override their spontaneous emotional response. There are several strategies for emotion regulation including cognitive appraisal, reappraisal and distraction (attentional deployment). Attentional processes can influence emotional states. For example, attentional deployment may be effective in reducing negative effect because it reduces the amount of capacity in working memory devoted to processing negative emotional information. There is also evidence for the existence of attentional counter-regulation. Cognitive reappraisal is a strategy for emotion regulation that involves reinterpreting the meaning of a stimulus to change one's emotional response. Ochsner and Gross (2008) distinguished between two main types of reappraisal strategies: reinterpretation and distancing. There is neuroimaging evidence that in reappraisal higher cognitive control processes associated with the prefrontal cortex are used rapidly, followed by reduced emotional responses in the amygdala.

- **Affect and cognition: attention and memory**

Any given mood state appears to influence cognitive processing. Pêcher et al. (2009) used a simulator to study the effects of music on car driving. Sad music had no effect on drivers' ability to keep the car in its lane but there was a slight reduction in speed. However, happy music reduced ability to keep the car in its lane and there was an 8 mph decrease in speed relative to the neutral music condition.

Mood can affect *attention*. Easterbrook (1959) hypothesised that the range of cues processed (i.e., the breadth of attention) decreases as arousal or anxiety increases. High negative affect produces "tunnel vision". There is also some evidence (e.g., Janelle et al., 1999) that anxious car drivers attend less than non-anxious ones to peripheral information. Fredrickson and Branigan (2005, p. 315) found positive emotions "widen the array of percepts, thoughts, and actions presently in mind". Harmon-Jones et al. (2011) argued that positive and negative affective states of high motivational intensity produce attentional narrowing. In contrast, there is attentional broadening with positive and negative affective states of low motivational intensity.

Gable and Harmon-Jones (2010b) considered the effects of two other negative mood states (disgust and sadness) on attentional narrowing. Disgust (a mood state involving high motivational intensity) produced attentional narrowing. In contrast, sadness (a mood state involving low motivational intensity) led to attentional broadening. Positive affect of low motivational intensity was associated with attentional broadening. However, positive affect with high motivational intensity produced attentional narrowing (Gable & Harmon-Jones, 2011).

Mood affects *memory* as well. What we think and remember matches our mood state (mood congruity). Mood-congruity effects based on mood at the time of learning were studied by Hills et al. (2011). Participants induced into a happy mood showed better subsequent recognition memory for happy than sad faces. In contrast, those induced into a sad mood had slightly (but non-significantly) better recognition memory for sad than for happy faces.

CASE STUDY: Hills, Werno and Lewis (2011)

Research on mood and autobiographical memory was reviewed by Holland and Kensinger (2010). There was clear evidence of mood congruity when people were in a positive mood, but mood congruity was less often found when people were in a negative mood. The most plausible explanation for the frequent failure to obtain mood congruity in a negative mood state is that people are motivated to change it into a positive mood state. These results can be explained within Tulving's (1979) encoding specificity principle.

Mood-state-dependent memory also exists. Memory is best when mood at retrieval matches that at learning. Findings on mood-state-dependent memory have been inconsistent. Ucros (1989) reviewed 40 studies and found only a moderate tendency for the effect. Kenealy (1997) controlled the level of learning and used both free recall and cued recall tests. Participants showed strong mood-dependent effects in free recall but not in cued recall. Eich (1995) proposed a "do-it-yourself" principle – the more participants need to rely on internal resources to generate both target events and retrieval cues, the more memory tends to be mood dependent. Eich and Metcalfe (1989) found evidence for the importance of internal processes at encoding.

WEBLINK: [Article on mood-state-dependent memory](#)

Adolphs et al. (2005) found healthy controls showed enhanced memory for gist when the encoding context was emotional rather than neutral. In contrast, patients with amygdala damage showed a *specific* impairment of gist memory only with an emotional context at encoding with background details being remembered accurately. This suggests the amygdala is important for emotional memory. Some research has involved the study of patients with Urbach–Wiethe disease. This is a disease in which the amygdala and nearby areas are destroyed. Cahill et

al. (1995) studied BP, a patient with the disease. His recall of a very emotional event in a story was poorer than his recall of an emotionally neutral event.

Mood states influence cognitive processing so that what we think and remember matches that mood state. Several theories have been proposed to account for this effect. According to Bower's network theory, emotions are nodes within a semantic network. Activation of an emotion node triggers activation of related nodes and concepts in the network. This model predicts several effects such as mood-state-dependent memory, mood congruity, thought congruity and mood-intensity effects. There is reasonable evidence for the existence of these effects, however the theory is oversimplified and assumes that mood will influence cognitive processing more generally than it actually does.

- **Affect and cognition: judgement and decision making**

Angie et al. (2011) found major mood states (sadness, anger, fear or anxiety, happiness) have significant (and somewhat different) effects *on judgement and decision making* and the average effects of mood are greater with respect to decision making than judgement. We need to distinguish between integral emotions and incidental emotions (Han & Lerner, 2009):

- *Integral* emotions are triggered by considering the consequences of a decision.
- *Incidental* emotions arise from past events totally *unrelated* to the present decision.

Damasio (1994) put forward a somatic marker hypothesis explaining how integral emotions may be of value. According to this hypothesis, automatic bodily arousal responses (somatic markers) are triggered by emotional events and mark them with an emotional signal. These somatic markers influence decision making. Of key importance is interoception, which is the ability to detect subtle bodily changes. Dunn et al. (2010) found individuals high in interoceptive ability made much more use of information from their bodily responses than those low in decision making.

Most people have what is known as an optimism bias. This bias involves individuals believing they are more likely than other people to experience positive events but less likely to experience negative events. Anxious and depressed individuals show a smaller optimism bias. Anxious individuals typically make less risky decisions than non-anxious ones (Gambetti & Giusberti, 2012; Lorian & Grisham, 2011). Sad people are more pessimistic than those of individuals in a positive mood state regarding risks of health hazards (Waters, 2008). Cryder et al. (2008) investigated the misery-is-not-miserly effect – sad individuals will pay more than others to acquire a given commodity. This may be due to a diminished sense of self.

Since angry people perceive themselves to have high control over situations, we might expect them to make riskier decisions than others (Lerner & Keltner, 2001). Kugler et al. (2012) suggest the effects of anger on decision making are more complex than stated so far. They replicated the above findings when angry participants were tested alone; however, the opposite occurred when participants were tested in pairs. Angry individuals did not want to lose control of the situation by making the risky choice. Anger can lead to shallow processing based on heuristics (rules of thumb) rather than systematic or analytic processing (Litvak et al., 2010). This was supported in a study of film directors (Coget et al., 2011). Anger causes *judgements* (Ask & Granhag, 2007) as well as decisions (Small & Lerner, 2008) to be made using heuristic processing.

Positive mood states are typically associated with a risk-averse approach to decision making (Blanchette & Richards, 2010). In one study (Cahir & Thomas, 2010), participants in a positive mood made less-risky decisions than those in a neutral mood when betting on hypothetical horse races. Positive affect is associated with increased use of heuristic or low-effort processing and decreased use of analytic processing (Griskevicius et al., 2010). An important function of positive mood states is to maintain the current mood (Oatley & Johnson-Laird, 1987). This leads happy individuals to engage in shallow or heuristic processing and to avoid taking risks that might endanger the positive mood state.

Most research discussed so far has involved *mild* mood manipulations. In the real world, however, strong emotion can be involved when we make complex judgements and decisions (e.g., with *moral dilemmas*). According to Greene et al. (2008), personal moral dilemmas trigger a strong emotional response. In their dual-process model, Greene et al. (2008) distinguished between two systems:

- a fast, automatic and affective system producing deontological decisions;
- a slower, effortful and more “cognitive” system producing utilitarian decisions.

Utilitarian judgements with personal moral dilemmas typically involve much use of the cognitive system. Therefore, under higher cognitive load, more time is taken to make utilitarian judgements (Greene et al., 2008). Perkins et al. (2013) found anti-anxiety drugs increased utilitarian judgements (and reduced deontological ones) with personal moral dilemmas but did not affect judgements with impersonal ones. Thomas et al. (2011) studied patients with damage to the ventromedial prefrontal cortex (VMPFC). Such patients have reduced emotional responsiveness and make more utilitarian judgements.

According to Broeders et al. (2011), the assumption that utilitarian judgements with personal moral dilemmas are based on pragmatic considerations, while deontological judgements are based on moral rules, is oversimplified. Kahane et al. (2012) pointed out that utilitarian judgements in most previous research were *counterintuitive* or opposed to common sense meaning they take longer to process.

- **Anxiety, depression and cognitive biases**

Much of the previous research has dealt with transient emotional states. It may be that clinical disorders produce significantly different patterns of results. A key difference between anxiety and depression is that anxiety is associated with worry about future threats while depression is associated with past losses (Hirsch & Mathews, 2012). Many theorists (e.g., Beck & Dozois, 2011) assume vulnerability to clinical anxiety and depression depends in part on various cognitive biases. The most important cognitive biases are:

- *Attentional bias*: selective attention to threat-related stimuli.
- *Interpretive bias*: the tendency to interpret ambiguous stimuli in a threatening fashion.
- *Explicit memory bias*: the tendency to retrieve mostly negative information on a memory test involving conscious recollection.
- *Implicit memory bias*: the tendency to exhibit superior performance for negative information on a memory test not involving conscious recollection.

Williams et al. (1997) proposed a new theory in which anxiety and depression fulfil different functions. These have consequences for information processing:

- Anxiety involves anticipating future danger or threat. Processing is predominantly perceptual (fast and automatic).
- Depression involves the replacement of failed goals. Processing is predominantly conceptual (slower and controlled).

Their theory predicts that:

- Anxious individuals show attentional bias when perceptual processes are involved. Depressed individuals show attentional bias when conceptual processing is involved.
- Both anxious and depressed individuals have an interpretive bias.
- Depressed individuals have an explicit memory bias.
- Anxious individuals have an implicit memory bias.

Hirsch et al. (2006) suggest these biases can interact with each other.

Joormann (e.g., Joormann et al., 2007; Gotlib & Joormann, 2010) argued that executive or control processes are important to an understanding of cognitive biases in depression. If depressed individuals have deficient inhibitory control, they might have difficulty in disengaging attention from negative stimuli. There is much evidence that depressed individuals are slower than non-depressed people to disengage attention from negative

emotional stimuli (De Raedt & Koster, 2010). Eysenck et al. (2007) reviewed numerous studies showing anxious individuals are impaired in their ability to inhibit and to shift attention.

To measure attentional biases affected by emotion, two tasks have been widely used:

- the dot-probe task

WEBLINK: [Dot-probe task details](#)

- the emotional Stroop task.

Anxious individuals show a clear attentional bias early in processing (hypervigilance), but avoid threat-related stimuli later in processing (avoidance). Bar-Haim et al. (2007) found in a meta-analysis that individuals with anxiety disorders showed attentional bias, particularly for supraliminal stimuli. Rudaizky et al. (2014) found high trait anxiety was associated with facilitated attentional *engagement* with negative stimuli and also with slowed attentional *disengagement* from such stimuli. Peckham et al. (2010) found clear evidence for attentional bias with depressed patients and healthy samples using the dot-probe task but less effect when using the emotional Stroop task.

There is general agreement that anxious individuals show *interpretive bias*. Eysenck et al. (1987) found a correlation of +0.60 between trait anxiety and the number of threatening homophone interpretations. However, it is less clear if depressed individuals show interpretive bias. Depressed individuals typically select more negative interpretations than controls in the Cognitive Bias Questionnaire. Mogg et al. (2006) found depressed individuals show an interpretation bias when writing homophones.

Depressed patients typically exhibit an explicit *memory bias* and may also show implicit memory bias. Depressed individuals showed an explicit memory bias with free recall (Rinck & Becker, 2005). There are several reports of implicit memory bias in depression (Phillips et al., 2010). Mitte (2008) found anxiety was not associated with implicit memory bias. These results do not seem consistent with Williams et al. (1997) and their predictions for cognitive biases.

White et al. (2011) used a training procedure to increase attentional bias. This increased participants' tendency to interpret ambiguous information in a threatening way. Amir et al. (2010) found training to reduce interpretive bias made it easier for participants to disengage attention from threat. These findings suggest attentional and interpretive biases interact with each other.

Lewinsohn et al. (2001) assessed interpretive bias in adolescents. One year later, they recorded the negative life events experienced by the participants over the 12-month period. Those most likely to have developed major depressive disorder over that period experienced many negative life events and had a strong interpretive bias initially. These results suggest a *cognitive vulnerability marker*.

There is convincing evidence that anxious and depressed individuals have various cognitive biases. Anxiety should be strongly associated with an *external* focus and attentional bias. Depression has an *internal* focus and memory biases.

It is often assumed that vulnerability to clinical anxiety and depression depends in part on cognitive biases such as attentional bias, interpretive bias and explicit and implicit memory biases. The approach proposed by Williams et al. (1997) distinguishes between different cognitive functions and effects in anxiety and depression. Anxiety, with a function of anticipating future threat, is thought to be associated with perceptual processing. Depression, functioning to replace failed goals, is more associated with conceptual processing. Consequently, anxiety and depression are expected to produce specific and different patterns of cognitive bias. Much of the experimental evidence supports the approach by Williams et al. (1997). Anxious individuals show attentional bias early in processing (but avoidance later), while depressed individuals do not show attentional bias with

briefly presented subliminal stimuli. Both groups of individuals may show interpretive bias. There is strong evidence that depressed individuals have an explicit memory bias and anxious individuals have an implicit memory bias.

- **Cognitive bias modification**

There is evidence that therapy designed to reduce attentional bias is helpful in anxiety disorders. However, it is unclear whether such training can reduce automatic attentional bias. Cognitive bias modification is effective in reducing anxious symptoms and (to a lesser extent) depressive symptoms (MacLeod & Clarke, 2013).

MacLeod and Matthews (2012) identified several limitations with work on cognitive bias modification. It is unclear whether the training effects generalise to situations outside the laboratory. Assessment of success of the treatment is solely from self-report measures. Finally, the mechanisms for any improvement is unclear. Increasing evidence suggests attentional and interpretive biases can have a causal effect on anxiety or depression, and that training on biases can affect subsequent mood. However, the causality issue is complex and no definitive conclusions as yet can be drawn.

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