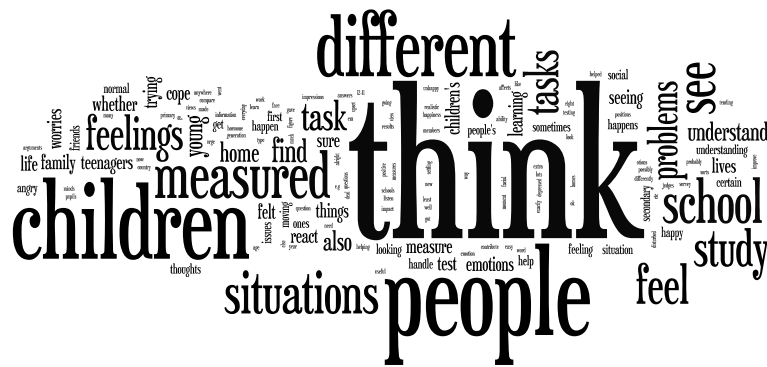


“Why Bother? It’s Gonna Hurt Me”

The role of interpersonal cognitive biases in the development of anxiety and depression



Stefano R Belli

A thesis submitted for the degree of
Doctor of Philosophy

Balliol College
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Abstract

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Child and adolescent mood and anxiety symptoms are common and debilitating, with long-term effects on well-being. Research presented in this thesis examines interpersonal cognitive factors in the emergence of anxious and depressive symptoms in late childhood through to early adulthood. The thesis considers this issue using three main approaches. For the first, data are presented showing that biases in the appraisals of social situations are the aspects of interpersonal cognition most closely associated with emotional symptoms. For the second, longitudinal twin data are used to examine genetic and environmental origins of these interpersonal cognitive biases and their temporal prediction of symptoms across a 2-year period. Data show that interpersonal cognitive factors are strongly influenced by non-shared environmental factors, and moreover, predict symptoms across time. The final section of the thesis comprises four studies using Cognitive Bias Modification of Interpretations (CBM-I) training methodology to show that both positive and negative interpretive biases for interpersonal information can be induced in adolescents. Positive biases are shown to persist for at least 24 hours after training, and induced positive and negative biases are shown to differentially predict anxious responses to an experimental stressor. Evidence is also provided to suggest that effects following training positive interpretive biases may transfer to other cognitive measures, namely appraisals of ambiguous emotional faces. Finally, data tentatively show that CBM-I training may be useful in reducing negative interpretations of interpersonal information made by 11-year-old children undergoing the transition to secondary school. In summary, studies in this thesis support the contribution of cognitive biases to mood and anxiety symptoms in childhood and adolescence. They further extend this knowledge by suggesting that these reflect individual-specific (non-shared) environmental risks to predict symptoms across time. These biases may also be amenable to change through training interventions, with some—albeit weak—effects on other cognitive outcomes.

Long Abstract

Mood and anxiety problems and disorders can emerge in childhood and adolescence (Costello, Egger, & Angold, 2005; Rapee, Schniering, & Hudson, 2009). They are marked by a wide range of impairments on social function, educational attainment, and well-being across the life course. Numerous interpersonal and cognitive risk factors have been identified for anxiety and depression across development. Prominent risk factors include negative or maladaptive patterns of interpersonal behaviour, reasoning and information processing.

Conversely, positive social interactions and positive appraisals of interpersonal situations have been identified as encouraging various aspects of physical and mental health, and resistance to emotional disorders in particular (Aneshensel & Stone, 1982; Cohen & Hoberman, 1983; Cohen, 2004). However the likelihood of experiencing these kinds of positive influences diminishes with the progression of emotional symptoms and disorders (Darley & Fazio, 1980; Schlenker & Leary, 1982; Downey, Freitas, Michaelis, & Khouri, 1998; Fombonne, Wostear, Cooper, Harrington, & Rutter, 2001b; Gurtman, Martin, & Hintzman, 1990). This then reinforces negative social expectations and exacerbates interpersonal cognitive risk factors for emotional symptoms. Research presented in this thesis has implications for strategies to improve experiences of interpersonal interaction, with a view to buffering against the debilitating effects of early anxious and depressive symptoms.

Many persistent anxiety problems emerge in the transition to adolescence. A marked increase in mood symptoms also occurs in early to mid adolescence, as well as wide-ranging changes in interpersonal function and cognition. Accordingly adolescence may represent an opportune period for the investigation of interpersonal and cognitive risk factors for emotional disorders, and interventions aimed at mitigating the effects of these risk factors (MacLeod, Koster, & Fox, 2009; Hadwin & Field, 2010a; MacLeod & Holmes, 2012). The primary focus of this thesis is therefore on the role of interpersonal cognitive factors as regards anxiety and depression, with a particular focus on adolescence. There are three main strands of enquiry. The thesis's initial studies investigate phenotypic relationships between various interpersonal factors (including cognitive biases on interpersonal situations) and emotional symptoms in late childhood and early adulthood. Next the relative influences of genes and environment on these factors and pathways are investigated. Finally the latter studies aim to combine these findings with the current body of knowledge of Cognitive Bias

Modification training. This is done with a view to developing methods that might in future inform early interventions against risk factors for emotional disorders. These developments in the latter chapters are based on key findings pertaining to the nature of interpersonal and cognitive risk factors illuminated by the earlier chapters.

The study reported in Chapter 2 investigated links between interpersonal cognitions, simple interpersonal behaviours, and self-reported emotional symptoms in a typically-developing sample of young adults. Research presented here examined three aspects of cognitive and interpersonal functioning: 1) interpretations of ambiguous situations, 2) social problem-solving and behavioural planning, and 3) behaviour in a simplified social exchange (the Trust Game; Berg, Dickhaut, & McCabe, 1995) as an experimental proxy for trust and reciprocity. A variety of correlation, regression and covariate analyses and models were used to determine the relative ability of these interpersonal factors to explain observed variance in symptoms of social anxiety and depression.

Across the various analyses, negative interpretations of interpersonal interactions were found to best predict symptoms of both depression and (social) anxiety. Results are discussed in terms of the predictive utility of various cognitive and interpersonal factors for outcome measures of anxiety and depression in future experimental work.

The second study (Chapter 3) adopted a behavioural genetics approach to demonstrate that pathways between interpersonal cognitive risk factors and emotional symptoms are longitudinally predictive, as well as subject to strong environmental influences. Two-hundred and fifty identical and non-identical twin pairs, tested at age 8 and after a two-year follow-up at age 10, were compared on symptom measures of anxiety and depression. Participants were also compared on interpersonal cognitions relating to perceptions of the self and peers in social situations, as well as expectations of mother and peer behaviour during social interactions. Analyses explored: 1) associations between childhood interpersonal cognitions and anxious and depressive symptoms; 2) dynamics of these relationships over time; and 3) genetic and environmental influences on these relationships.

Items from the Perceptions of Peers and Self and Children's Expectations of Social Behaviour Questionnaires (Rudolph, 1995) were analysed using Principal Components Analysis to identify key factors. These analyses found distinct contributions of positive and negative components of interpersonal cognition and of mother and peer-related behavioural expectations. Longitudinal regression and cross-lag models were used to examine the predictive power of interpersonal cognitive factors and emotional symptoms for one another over a two-year time period. Negative expectations of others' behaviour in ambiguous social situations were found to predict subsequent depressive symptoms. Depression at

age 8 also predicted more negative and less positive general perceptions of social interactions at age 10. Multivariate genetic models identified sources of covariance between these factors and anxiety and depression scores. Examining influences over time showed an overlapping genetic influence upon depression at age 8 and subsequent negative perceptions of social situations. There was also a latent factor explaining variance in negative expectations of mother and peer behaviour at age 8 and subsequent depressive symptoms. The influence on this latent factor was ascribable to a mixture of shared and non-shared environmental factors. Large non-shared environmental contributions to variance across variables suggested that such interpersonal cognitive biases might be amenable to environmental influence.

Across both Chapters 2 and 3, negatively biased appraisals of social situations were found to be the strongest predictors of anxious and depressive symptoms. The latter studies reported in this thesis applied these findings to methods of modifying cognitive biases in adolescents. This was done with the view that if modifications can be made to the interpersonal cognitive risk factors identified for negative emotional symptoms, then it may be possible to buffer against the development of such negative symptoms. Using a Cognitive Bias Modification of Interpretations (CBM-I) methodology, the studies demonstrated that both positive and negative biases can be induced in adolescent samples.

Cognitive Bias Modification of Interpretations (CBM-I) training has been used extensively to produce benign interpretational styles and/or to override negative interpretational styles in both psychiatrically-healthy and symptomatic adults. This paradigm has also shown promise in the limited number of studies to have adapted it to child and adolescent populations, providing evidence that positive and negative interpretive biases may be induced in developmental samples. However a number of parametric questions about cognitive bias modification training for interpretations remain unanswered. For instance the relative sizes, symmetries and longevity of positive and negative training effects have not been given due experimental consideration in extant work. Furthermore, findings showing mood changes as a result of training, generalisations to other measures of interpretation, or transfers of training effects to other cognitive measures are relatively inconsistent among the few studies to have addressed such questions.

Chapter 4 builds on prior CBM-I work in adolescents with its comparison of the effects of positive and negative CBM-I training against two forms of control paradigm (mixed valence and neutral valence). It also examined whether CBM-I training effects generalise to a novel measure of interpretation, derived from findings in Chapters 2 and 3. The 4-group analyses of different training valences suggested that outcomes from the mixed and neutral control training conditions were indistinguishable in the adolescent sample used. This suggests

that either mixed or neutral training is acceptable as a control condition. Given that positive and negative training paradigms were seen to have symmetrical effects intermediated by the two control conditions, two suggestions are proposed for future research: 1) When comparing groups in a healthy population and within a theoretical/empirical setting, comparisons of positive vs. negative training are a viable way of maximising effect sizes under consideration; 2) When comparing groups in a high-risk, anxious or depressed population (or any clinical setting), positive training may be compared against either mixed or neutral training so as to provide a viable control, whilst protecting participants against any potential ill-effects of negative CBM-I training. Chapter 4 provided no evidence that post-training modifications of interpretive biases generalised to the novel measure of interpretation.

Chapter 5 replicated the protocol of positive CBM-I training from Chapter 4, but included a comparison of interpretation bias testing immediately after training with testing 24 hours later. This was done in order to probe the longevity of CBM-I training effects. Positive CBM-I training effects on the Interpretation Bias Test were shown to persist over 24 hours. These findings can be expanded on in future to examine if other effects of CBM-I persist for 24 hours, or if such effects persist for even longer.

Chapter 6 attempted to replicate interpretation training effects from the preceding chapters, and test the viability of CBM-I in buffering against negative emotional responses to an environmental stressor. Participants anticipating a stressful social situation following training showed smaller increases in self-reported anxiety if they had undergone positive, relative to negative interpretation training. The stressful task differed from both the form and domain of the training paradigm, suggesting that these effects are not ascribable to demand characteristics. The study tentatively demonstrates the potential appropriateness of CBM-I as a buffer intervention, as it can affect mood.

Studies reported in Chapters 4 to 6 did not demonstrate strong evidence of immediate mood changes as a result of CBM-I training. Taken together with Chapter 6's demonstration that induced interpretive biases interpose experiences of negative affect upon exposure to an environmental stressor, it is posited that the most effective use of bias training might be through its application to mitigating the negative effects of environmental stressors. To this end, the final study reported in Chapter 7 replicated the efficacy of a CBM-I training task in a sample of 11-year-olds undergoing the life stressor of transitioning to secondary school. School transitions have been identified as stressful periods in young adolescents' lives, and highlighted as important candidates for interventions to improve emotional and interpersonal outcomes for young people (Evangelou et al., 2008; McGee, Ward, Gibbons, & Harlow, 2004). The study also administered measures of recent stressful life events to participants to examine if CBM-I train-

ing could influence retrospective appraisals of such stressors. Given the conclusions of Chapters 4 and 6, positive CBM-I training was compared to a neutral control condition to avoid inducing negative biases in individuals undergoing a potentially stressful life event such as school transition.

The study further examined the transfer of induced positive interpretive biases to other cognitive measures, namely appraisals of ambiguous emotional faces. The interpretation of ambiguous or morphed emotional faces has been identified as an adaptationally relevant stimulus set, and a meaningful independent risk factor for emotional symptoms. The combination of these aspects has prompted calls for more research to examine the interpretation of ambiguous emotional faces in the area of cognitive biases associated with emotional disorders (Dimberg, Thunberg, & Elmehed, 2000; Richards et al., 2002).

Participants who underwent positive training endorsed negative interpretations of novel ambiguous scenarios less strongly than did controls, showing valence-congruent effects of induced biases following CBM-I training. Therefore present findings suggest that positive interpretive styles can be trained in young adolescents undergoing school transitions. Further, findings showed for the first time that modifying verbal interpretations may be able to affect interpretations of facial stimuli. Following positive training, participants were slower to identify anger and sadness in facial stimuli, compared to participants who underwent neutral control training. These results may be explicable as negative priming effects of the positively valenced training materials in the CBM-I programme. However the study also presented the less immediately explicable findings that positive training significantly improved participants' accuracy in identifying fearful faces. This suggests that any transfer of CBM-I training effects to the identification of facial expressions likely involves processes beyond simple priming effects. This may offer some evidence of top-down influence in cognitive bias processing, as facial perception has previously been characterised as lower-level and more 'fundamental' in its processing than verbal apprehensions of social interactions. Further investigation of these and similar transfer effects should therefore help to clarify the kinds of cognitive mechanisms that could be involved in the changes observed as a result of CBM-I training procedures. The study showed no evidence of changes in self-reported mood as a result of training.

The work presented across the chapters in the latter part of the thesis draws the conclusions that training positive interpretive biases in adolescents could be a viable approach to preventing the development of negative emotional symptoms in adolescents. Encouraging positive interpersonal cognitions in place of their negative manifestation as risk factors for anxiety and depression does not appear to immediately impact upon mood, but shows evidence of providing a buffer against subsequently experienced stressors. Stress reactivity effects were

primarily demonstrated upon anxious symptoms, but the longitudinal data presented suggests that changes in depressive symptoms might theoretically be observed when employing multiple training sessions over longer time periods. More generally, results suggest that paths between negatively biased patterns of interpersonal cognition and subsequent emotional symptoms may be subject to strong environmental influences.

"It is sometimes said that science today is subservient to the imperatives of economic profitability, but that has always been true. What is new is that the economy has now come to openly make war on human beings, not only on our possibilities for life, but also those of survival. Against a great part of its own anti-slavery past, scientific thought has chosen to serve spectacular domination. Until it got to this point, science possessed a relative autonomy. It thus knew how to understand its own portion of reality and thus it made an immense contribution to increasing the means of the economy. When the all-powerful economy became mad—and these spectacular times are nothing other than that—it suppressed the last traces of scientific autonomy, both in methodology and, by the same token, in the practical conditions of activity of its 'researchers.'

No longer is science asked to understand the world, or to improve any part of it. It is asked to instantaneously justify everything that happens. As stupid in this field, which it exploits with the most ruinous thoughtlessness, as it is everywhere else, spectacular domination has cut down the gigantic tree of scientific knowledge in order to make itself a truncheon. So as to obey this ultimate social demand for a manifestly impossible justification, it is better not to be able to think too much, but rather, on the contrary, to be well trained in the comforts of spectacular discourse. And it is actually in this career that the prostituted science of these despicable times has, with much good will, deftly found its most recent specialization."

—Guy Debord, *Comments on the Society of the Spectacle* (1988)

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PEACE.

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1

Introduction

Why bother? It's gonna hurt me
It's gonna kill when you desert me
This happened to me twice before
It won't happen to me anymore

Rivers Cuomo, "Why Bother?" (1996)

1.1 Why Bother? It's Gonna Hurt Me

Anxiety and depression are debilitating problems with a wide range of negative outcomes, marked by difficulties with behaviours and cognitions within interpersonal contexts. Emotional disorders are common in childhood and adolescence (Costello et al., 2005; Rapee et al., 2009), causing impairment to those affected at significant lifetime cost (Meltzer, Gatward, Goodman, & Ford, 2000; American Psychiatric Association, 2000).

Positive social influences are especially effective buffers against emotional disorders (Aneshensel & Stone, 1982; Cohen & Hoberman, 1983; Cohen, 2004). However owing to the social withdrawal seen over the development of anxiety and depression (Darley & Fazio, 1980; Schlenker & Leary, 1982; Downey et al., 1998), those individuals who would most benefit from positive aspects of social interaction become the least likely to seek out and experience these (Fombonne et al., 2001b). Appraisals of social experiences become more negative with the progression of anxious and depressive symptoms (Downey et al., 1998; La Greca & Lopez, 1998; Leary, 1990), as well as passively eliciting more negative social interactions with others (Gurtman et al., 1990).

Research presented in this thesis seeks to clarify avenues to improving experiences of interpersonal interaction, with a view to buffering against the debilitating effects of early anxious and depressive symptoms. It does so by examining cognitive risk factors relating to interpersonal interactions across development from late childhood to early adulthood, and exploring methods of manipulating such risk factors experimentally.

1.1.1 Adolescence as a Sensitive Period for Emotional Disorders and Interpersonal Cognition

The median age of onset for any anxiety disorder is about 11 years, with most incidences of anxiety showing their first onset between the ages of 11 and 15 (Kessler et al., 2005; Otto et al., 2001). While rates of mood disorders increase during adolescence, their median age of onset is later, as such disorders show cumulative risks across the life-course following their earliest onset in late childhood and adolescence (Kessler et al., 2005). Anxious and depressive disorders' onset in childhood and adolescence also predicts emotional problems in adulthood (Kim-Cohen et al., 2003; Gregory, Caspi, et al., 2007), and earlier-emerging emotional problems are associated with more serious outcomes (Rohde, Lewinsohn, & Seeley, 1991).

Adolescence is a period of great social upheaval (Fombonne et al., 2001b; Windle, 1992; Fenzel, 2000; Puskar & Rohay, 1999), and social interactions become more salient at this age (Greenberg, Siegel, & Leitch, 1983; Brown, 2004). This coincides with increases in social cognition and susceptibility to peer influence from the age of 10 onwards (Blakemore, 2008b; Blakemore & Choudhury, 2006; Steinberg & Monahan, 2007). This however comes together with increases in the impact of interpersonal problems such as peer rejection, social isolation, and bullying (Pellegrini & Long, 2002; Zeedyk et al., 2003; D'Arcy & Siddique, 1984; Rutter, 1980).

These social changes in adolescence occur against a backdrop of systemic changes in other environments such as school (Fenzel, 2000; Puskar & Rohay, 1999; Evangelou et al., 2008), and non-linear changes in biology (Lau, 2012; Thapar & McGuffin, 1994; Boomsma, van Beijsterveldt, & Hudziak, 2005; Feigon, Waldman, Levy, & Hay, 2001). Certain genetic influences upon mood symptoms show their first effects during adolescence (Lau & Eley, 2006). Adolescence is also marked by both linear and non-linear changes in brain structure and function (Goddings, Burnett Heyes, Bird, Viner, & Blakemore, 2012; Mills, Lalonde, Clasen, Giedd, & Blakemore, 2012), many of which have been demonstrated in brain regions recruited by social tasks and interpersonal function (Blakemore & Robbins, 2012; Burnett & Blakemore, 2009), further highlighting the overlap between the influence of changing biological, social and emotional systems during adolescence.

Given these various non-linear developmental changes at adolescence, it may be that this is when individual differences in social, cognitive and emotional function first emerge, impacting typical and atypical outcomes. Accordingly it stands to reason to examine associations between emotional, interpersonal and cognitive factors at this age (Kessler et al., 2005). This consideration is especially pertinent given the apparent close association of interpersonal and cognitive factors as risk factors for emotional disorder. These associations would therefore be expected to show important developmental components.

1.1.2 Interpersonal and Cognitive Risk Factors for Emotional Disorders Across The Life-Course

Adult symptoms of emotional disorders are often preceded by social stressors (Connor-Smith & Compas, 2002). In youth, negative social experiences such as bullying and poor friendships also trigger emotional symptoms (Bond, Carlin, Thomas, Rubin, & Patton, 2001; La Greca & Harrison, 2005). Many of these negative social experiences seem in part to be brought about through maladaptive behaviours linked to anxious and depressive functioning. Anxious individuals often create inappropriate expectations about others and themselves (Schlenker & Leary, 1982), manifesting as social reticence or exaggerated approach behaviours at inopportune times (Downey et al., 1998; Darley & Fazio, 1980). Depression is similarly associated with social avoidance and withdrawal (Beck, 1970; Lewinsohn, Mischel, Chaplin, & Barton, 1980). Typically-developing controls are more likely to reject and devalue individuals displaying symptoms of anxiety and depression, more likely to experience distress themselves in proximity to such individuals, and less likely to express sympathy towards such individuals (Gurtman et al., 1990). Other work has highlighted the importance of trust and reciprocity in fostering positive social interactions that form the basis for deeper social support networks (King-Casas et al., 2008, 2005).

Though less research has been extended to younger samples, Qualter, Brown, Munn, and Rotenberg (2010) found that childhood loneliness (closely correlated with anxiety and depression) predicted social withdrawal, which in turn negatively affected both social behaviours and mood outcomes in adolescence and early adulthood. Furthermore, emotional symptoms may show meaningful associations with negative, reticent or maladaptive social behaviours (Barnett & Gotlib, 1988; Rubin & Burgess, 2001) and it has been suggested that impaired behavioural plan formulation and problem-solving may mediate these links (Ladouceur, Blais, Freeston, & Dugas, 1998; Belzer, D'Zurilla, & Maydeu-Olivares, 2002). Therefore not only are social interactions potential triggers of anxious and depressive experiences, but the quality of social interactions may be affected by pre-existing symptoms.

Another set of potential risk factors previously implicated in the development and maintenance of emotional disorders in adults (Mathews, 1990; Teasdale, 1988) are cognitive biases, characterised by privileged processing of negative information relative to positive information (Mogg & Bradley, 1998; Williams & Broadbent, 1986). One particularly robust finding is of biases towards negative evaluations of ambiguous information, seen across both anxiety and depression (Richards & French, 1992; Lawson, MacLeod, & Hammond, 2002; Butler & Mathews, 1983). Negative biases in the interpretation of specifically social cues and situations are demonstrable in anxious and depressed adult populations with both clinical and sub-clinical symptom levels (Eysenck, Mogg, May, Richards, & Mathews, 1991; Richards & French, 1992; Lawson et al., 2002; Lawson & MacLeod, 1999; Devine, Sedikides, & Fuhrman, 1989). Negative interpretive biases for specifically interpersonal information have been linked with exacerbating negative mood effects in anxiety and depression (Mathews &

MacLeod, 1994; Hirsch & Mathews, 1997; Butler & Mathews, 1983; Bargh, 1994; Mathews & Mackintosh, 2000; Devine, 1989) and propagating negative aspects of such disorders across development (Warren, Emde, & Sroufe, 2000; Hadwin & Field, 2010b). Negative cognitive biases and decision-making have also been implicated in processes of maintaining social withdrawal and maladaptive social behaviour (Gurtman et al., 1990).

Links between cognitive biases and emotional symptoms in adults are well-established, with some support for a temporally-causal relationship (Mathews & MacLeod, 2002). These biases have been speculatively linked with exacerbating negative moods and propagating negative outcomes of emotional disorders across development (Warren et al., 2000; Hadwin & Field, 2010b). Negative cognitive biases for ambiguous social cues are demonstrable in anxious and depressed child populations with both clinical and sub-clinical symptom levels (Miers, Blöte, Bögels, & Westenberg, 2008; Banerjee, 2008; Dineen & Hadwin, 2004; Hadwin, Frost, French, & Richards, 1997; Vassilopoulos & Banerjee, 2008; Warren et al., 2000; Muris, Rapee, Meesters, Schouten, & Geers, 2003), though there is generally less replication of these effects in adolescents. Yet fewer studies have looked at longitudinal relationships or possible causal predictions within this relationship. Such a focus is however crucial given the developmental sensitivity of late childhood and adolescence in the emergence of anxiety and depression (Fombonne, Wostear, Cooper, Harrington, & Rutter, 2001a; Windle, 1992; Gregory, Caspi, et al., 2007), as well as wider disturbances in socio-emotional function (Hawton et al., 2012; Pine, Cohen, Cohen, & Brook, 1999; Fombonne et al., 2001b). Given the particular developmental sensitivity of adolescence, comparisons of the relationships between interpersonal cognitive biases and emotional symptoms across different developmental groups would also be useful—e.g. before, during and after adolescence.

So then, previous work has established that maladaptive social behaviours and cognitive biases towards negative information are both risk factors involved in child and adolescent symptoms of anxiety and depression. The nexus of these risk factors—namely cognitive biases towards negative information within social scenarios or regarding ambiguous interpersonal information—may further represent a fruitful line of enquiry for future research into understanding the aetiology of emotional disorders with respect to these risk factors. Doing so might also inform potential interventions or treatment adjuncts based on the knowledge of aetiological paths to symptoms of emotional disorder.

1.1.3 Commonalities and Dissociations Between Anxiety and Depression

There are well-documented commonalities between negative interpersonal cognitions, negative social experiences and symptoms of anxiety and depression (American Psychiatric Association, 2000; Angold, Costello, & Erkanli, 1999; Gregory, Rijdsdijk, et al., 2007; Moffitt et al., 2007; Harvey, Watkins, Mansell, & Shafran, 2004). However, there are also numerous findings that dissociate risk for anxiety from risk for depression. Such findings support conceptions of tri-

partite models of anxiety and depression, such as that proposed by Clark and Watson (1991). Here certain symptoms or risk factors may be related to both disorders, while others are associated specifically with anxiety, or specifically with depression. In Clark and Watson's model, the component that collectively predicts anxiety-depression is termed general distress or negative affect. This component represents a common diathesis across the two types of disorder (Paris, 1999). Anxiety and depression are then specified by additional factors: anxiety by the *presence* of anxious arousal, and depression by the *absence* of positive affect. This tripartite structure of anxious and depressive symptomatology has also been demonstrated in child and adolescent samples (Gençöz, Voelz, Gençöz, Pettit, & Joiner, 2001).

Clark and Watson's model was based on symptom measures of anxiety and depression indexed by self-report and clinical assessments. However if the underlying concepts of anxiety and depression are separable into a tripartite structure, then behavioural or cognitive measures associated with the disorders might be expected to segregate following a similar structure. That is to say that aspects of the interpersonal cognitive risk factors identified in preceding sections may specifically predict anxiety, depression, or both, and these associations may or may not change across development. Questions of overlapping versus distinct predictors for different symptoms are therefore crucial considerations for developmental accounts of anxiety and depression.

Various studies have identified common vulnerability factors across emotional disorders (Eley & Stevenson, 1999; Kendler, Heath, Martin, & Eaves, 1987; Kendler, Neale, Kessler, Heath, & Eaves, 1992; Kendler, 1996), as well as risk factors specific to either anxiety (Chorpita, Albano, & Barlow, 1996; Vasey & Macleod, 2001) or depression (Hankin & Abela, 2005; Cole & Turner, 1993; Garber, 2006). Behavioural genetics research has also gone some way in showing moderate genetic contributions to depressive risk factors when depression is narrowly defined (Kendler et al., 1992; Kendler & Prescott, 1999; McGuffin, Katz, & Rutherford, 1991), as well as similar accounts of anxiety (Lau & Eley, 2006; Eley et al., 2008). There is also good evidence of overlapping genetic influences across anxiety and depression in childhood and early adolescence (Boomsma et al., 2005). Other work has highlighted the importance of peers and family members in the transmission of risk factors for both disorders (Gregory, Rijdsdijk, et al., 2007; Creswell, Cooper, & Murray, 2010; Field & Lester, 2010; Murray, Creswell, & Cooper, 2009; McGuffin & Katz, 1993; Dadds, Barrett, Rapee, & Ryan, 1996).

However as Hankin (2008) notes, there have been fewer efforts to identify distinct vulnerability factors for each symptom-type. Certain aspects of interpersonal behaviour or cognitive functioning may be variously conceptualised as common risk factors across anxiety and depression, or alternatively as specific to the aetiology of certain features of either disorder. For instance, cognitive biases towards negative social information have primarily been researched in relation to anxious disorders (cf. Mathews & MacLeod, 1994; Hadwin & Field, 2010a; Chorpita et al., 1996; Vasey & Macleod, 2001). This may reflect true specificity in such risk factors to anxiety, or else may simply be an artefact of previous researchers' presumptions, and such biases may be just as closely associated with

depressive disorders. Only further research detailing the shared and specific variance of such risk factors across anxious and depressive symptoms would be able to resolve such issues.

A caveat worth considering for such research is that it might be difficult to determine such specificities for all age groups given the ambiguous developmental associations between anxiety and depression themselves. A prevailing conception of developmental relationships between anxiety and depression is that anxiety shows an earlier onset, and so predicts and may even turn into later depression (Parker et al., 1999; Kovacs, Gatsonis, Paulauskas, & Richards, 1989). However more recent work has emerged to challenge this approach as subject to bias in study design, such that in a controlled model, the reverse pattern can be seen to be almost as prevalent (Moffitt et al., 2007). This illustrates the subtlety of both cross-sectional and developmental conceptions of commonality and specificity of risk factors and predictors spanning anxiety and depression, and therefore supports the imperative to study such aspects across development.

1.1.4 Research Directions for Emotional Risk Factors Across Development

Evidence and arguments provided above coalesce into three main points:

- Adolescence is a sensitive period for the development of emotional problems, as well as large and wide-ranging changes in both interpersonal and cognitive function, affording insight into the emergence of individual differences in these factors at this age.
- Interpersonal functioning, cognitive biases and specifically interpersonal cognitive biases represent potent risk factors for anxious and depressive disorders in adults and children, but less research has specifically targeted adolescents.
- There is a great deal of overlap between anxious and depressive disorders as well as between risk factors identified for these. As such, work needs to be conducted to disentangle issues in both of these areas.

These issues would be well-addressed by the following approaches:

1. Comparing different interpersonal and cognitive risk factors to determine their relative efficacy in explaining variance in anxiety and depression in cross-sectional analyses.
2. Investigating associations between pertinent interpersonal and cognitive risk factors and emotional outcomes longitudinally and in developmental samples.

1.2 Genetic And Environmental Influences On Emotional Symptoms and Interpersonal Cognitions

Previous research in the behavioural genetics literature has attempted to determine sources of genetic and environmental influence on emotional symptoms (Boomsma et al., 2005; Rice, Harold, & Thapar, 2002; Silberg, Rutter, & Eaves, 2001), as well as on interpersonal cognitive factors (Zavos, Rijdsdijk, Gregory, & Eley, 2010; Lau, Rijdsdijk, & Eley, 2006). Multivariate analyses have also sought to identify overlapping sources of genetic and environmental variance among interpersonal, cognitive and emotional measures (Gregory, Rijdsdijk, et al., 2007; Lau, Belli, Gregory, Napolitano, & Eley, 2012; Eley et al., 2008). The majority of such studies use twin samples to partition variance into three sources: genetic, shared environmental, and non-shared environmental influences (Plomin, DeFries, McClearn, & McGuffin, 2001).

Consistent literature suggests that anxious and depressive symptoms in youth are influenced by genetic influences, and moreover that these influences are common across the two measures (Eley & Stevenson, 1999; Silberg et al., 2001). For example, a large, longitudinal twin study conducted by Boomsma et al. (2005) found genetic influences explained the majority of variance in anxious and depressive symptoms between ages 7 and 12, albeit with some age-related decreases. In contrast, environmental factors, particularly those that are individual-specific (i.e. non-shared) dissociate between these symptom types (Lau & Eley, 2006).

Cognitive biases associated with symptoms of emotional disorders have largely been attributed to environmental influences. For example, intergenerational similarities in cognitive biases between parents and children have previously been attributed to interpersonal interaction (Creswell et al., 2010; Field & Lester, 2010; Murray et al., 2009). Processes of interpersonal transfer from parents or peers include explicit verbal processes (Field, Lawson, & Banerjee, 2008), as well as implicit modelling of behavioural cues (Murray, Cooper, Creswell, Schofield, & Sack, 2007). It is however less clear how to view these processes in terms of models of genetic and environmental influence. Transmission of behavioural or verbal information between individuals may be subject to gene-environment covariance (Barrett, Rapee, Dadds, & Ryan, 1996; Creswell, O'Connor, & Brewin, 2006; Dickens, Turkheimer, & Beam, 2011). For example it is unlikely that socio-emotional information transmitted by parents is wholly unambiguous in tone (especially when taking contextual cues into account), so perhaps only those children with burgeoning cognitive biases of their own—as a result of genetically-constrained perceptual or cognitive processing mechanisms—are likely to pick up this information. In support of this, work has found evidence of genetic influences on cognitive biases from childhood onwards (Eley et al., 2008), in an 8-year-old sample. These genetic influences were only moderate though, and the majority of the variance was due to the influence of non-shared environmental effects.

Another behavioural genetics study of 8-year-old twins conducted by

Gregory, Rijdsdijk, et al. (2007) again found small genetic influences on interpersonal cognitive risk factors for anxiety and depression, in comparison to relatively larger environmental influences. Moreover, Gregory et al. found overlapping sources of environmental influence across depressive symptoms, negative expectations of social partners, and the absence of positive perceptions of social situations. These data suggest that such cognitive biases reflect early environmental rather than genetic risks on anxious and depressive symptoms.

This finding that the heritability of cognitive biases may not be as strong as environmental influences upon the transmission and propagation of interpersonal cognitive risk factors for anxiety or depression during childhood and adolescence has been replicated across numerous other studies (Eley, Gregory, Clark, & Ehlers, 2007; Vasey & Macleod, 2001; Eley & Zavos, 2010). Other research has found that related aspects of cognition—such as attribution of negative events in late childhood and adolescence (Lau et al., 2012, 2006)—show evidence of heritability. Again however a relatively greater contribution is seen from the environment than genetic influences upon these cognitive risk factors for anxious and depressive symptoms. Moreover, related work has shown that genetic influences upon socio-emotional function may only show their first detectable effects during adolescence (Lau & Eley, 2006).

In an overview of such findings, Eley and Zavos (2010) present evidence that the majority of variance in cognitive biases is explicable by non-shared environmental influences, with 30–40% of the variance in anxiety-linked cognitive biases being explicable by genetic factors. However the extent to which interpersonal cognitive factors reflect genetic and/or environmental risks on anxiety and depressive symptoms in young people remains unclear.

The relative influences of heritability and environment may also change over developmental time. This could happen as a result of a number of reasons, including genes being newly or differently expressed during puberty or adolescence (Plomin, Fulker, Corley, & DeFries, 1997; Plomin et al., 2001; Kendler, 2011), changes in the same genes' effects at different ages (Fulker, DeFries, & Plomin, 1988; Loehlin, Horn, & Willerman, 1989; Fulker, Cherny, & Cardon, 1993), gene-environment covariance (Plomin, DeFries, & Loehlin, 1977; Scarr, 1992; Jaffee, 2011), and gene-environment interactions (Scarr & McCartney, 1983; Lau, Gregory, Goldwin, Pine, & Eley, 2007; Uher, 2011). As such it may not be enough for developmental accounts to estimate the relative contributions of heritability and environment to phenotypic expression at a single time-point. Rather, investigations should attempt to study the dynamic effects of genetic and environmental influence longitudinally, as well as comparing different age groups across late childhood, adolescence and post-adolescence. In the current example this would be to look at the changing patterns of heritability and environmental influence on social and interpersonal cognitive factors as they relate to symptoms of emotional disorders during the developmental approach to adolescence.

Identifying such possible sources of influence may also inform preventative interventions for emotional disorders based on addressing maladaptive cognitions. This is of especial importance when considering early interventions in

anxiety and depression, during or before adolescence, and especially given the predictive power of early anxiety and depression on later impairment (Kim-Cohen et al., 2003; Fombonne et al., 2001a, 2001b). Such questions of the relative origin and influence of interpersonal cognitive factors, and their potential overlapping sources of variance with emotional symptoms would also benefit from considerations of these interrelations over longitudinal and developmental time, as regards previous theoretical implications that interpersonal cognitive biases may have causal roles in the development of emotional disorders (Mathews & MacLeod, 1994; Williams, Watts, Macleod, & Mathews, 1997; Holmes, Lang, & Shah, 2009; Mathews & Mackintosh, 2000).

1.2.1 Research Directions For Genetic Analyses of Emotional Symptoms and Interpersonal Cognitive Factors

Longitudinal genetic studies are well placed to inform the following issues in aetiological models of anxiety and depression across childhood and adolescence:

- The relative contributions of genetic and environmental influences to anxious and depressive symptoms and to interpersonal cognitive factors
- Overlapping versus specific sources of influence across emotional symptoms and interpersonal cognitive factors
- Changes in any of these relationships over developmental time

These issues would then be well informed by the use of multivariate genetic models to identify sources of influence upon emotional symptoms and associated interpersonal cognitive factors within the same model. Furthermore, extending such models longitudinally would inform investigations of potential temporally-predictive relationships among such factors.

1.3 Cognitive Bias Modification of Interpretations

If interpersonal cognitive biases can be identified and understood, it could be possible to counteract their negative effects. Once associations are detailed by the preceding approaches, modifications to these associations may be able to improve outcomes during adolescence, when persistent mood and anxiety symptoms emerge. In particular, adolescence might represent a period of greater malleability for any such risk factors given linear and non-linear changes in brain development and associated plasticity (Goddings et al., 2012; Mills et al., 2012; Blakemore, 2008b, 2008a) and wider biology (Lau, 2012; Thapar & McGuffin, 1994; Feigon et al., 2001), as well the sea-change in regards to the onset of interpersonal problems at this age.

Various forms of Cognitive Bias Modification (CBM) have been developed to train positive cognitive biases in individuals, so as to buffer against the progression of negative emotional outcomes and disorders (Suway & Fox, 2012).

Perhaps most pertinent to interpersonal cognitive biases and routes to interpersonal behaviour is Cognitive Bias Modification of Interpretations (CBM-I), based on encouraging more positive interpersonal cognitions in the context of ambiguous social or interpersonal information (Mathews & MacLeod, 2002; Koster, Fox, & MacLeod, 2009; Hertel & Mathews, 2011; MacLeod et al., 2009; MacLeod & Holmes, 2012).

The original CBM-I paradigm developed by Mathews and Mackintosh (2000) gives participants a number of scenarios to read, which are ambiguous in tone due to a missing final word. Participants are required to complete each scenario with a provided word, which resolves the situation either positively or negatively. This positive or negative interpretation is then reinforced by completion of a Yes/No comprehension question, with feedback on the participant's given answer (see Figure 1.1 for an example of one trial). Positive training provides 'Correct!' as feedback if participants answer the comprehension question in a way that indicates a positive interpretation of the scenario and 'Wrong!' as feedback if participants answer the question negatively—and vice versa for negative training.

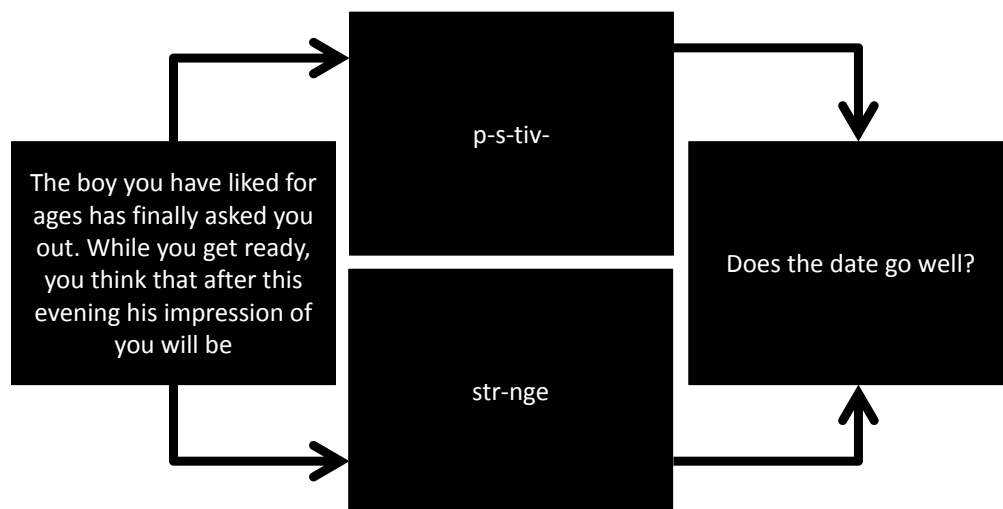


Figure 1.1: Figure illustrating a CBM-I trial, including the ambiguous unfinished scenario, positive/negative word fragment completions, and comprehension question.

Mathews and Mackintosh (2000) examined post-training biases using the Interpretation Bias Test (Eysenck et al., 1991). In the first part of this test participants are presented with novel ambiguous situations in the same format as the training paradigm—i.e. scenarios are missing the final word, which participants have to complete before answering a comprehension question. Unlike in training, the emotional valence of these scenarios is not resolved by the word fragment completion and comprehension question, maintaining the ambiguity of the novel scenarios. In the second part of the Interpretation Bias Test, participants are given a variety of positive and negative statements to rate for their perceived similarity to the ambiguous scenarios. The positive and negative state-

ments can be valid ('targets') or invalid ('foils') interpretations of the scenarios they have just read. Relative endorsement of positive versus negative interpretations provides a metric of positive/negative interpretive bias. Endorsement of targets over and above foils provides an index of biased interpretations of novel information over and above simple valence-congruence effects or response biases. This index of biased interpretations has been validated in its association with trait emotionality and neuroticism, while remaining unaffected by short-term or state variations in mood (Salemink & van den Hout, 2010).

1.3.1 CBM-I Findings in Adults

Mathews and Mackintosh (2000) demonstrated that interpretive biases indexed by the Interpretation Bias Test were amenable to change. Since then, other studies have replicated the finding that CBM-I can induce post-training interpretive biases congruent with training valence (Mackintosh, Mathews, Yiend, Ridgeway, & Cook, 2006; Holmes et al., 2009). Leading on from work to have implicated interpersonal cognitive biases in the genesis and maintenance of anxiety and depression (Warren et al., 2000; Macleod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mathews & MacLeod, 1994; Hadwin & Field, 2010b; Williams et al., 1997), research has expanded on the idea that if negatively valenced biases foster emotional symptoms and disorders, then positive biases would be expected to protect against these same problems (Holmes et al., 2009; MacLeod et al., 2009; MacLeod & Holmes, 2012; Koster et al., 2009).

More recent work has extended such findings to clinical populations (Blackwell & Holmes, 2010; Lang, Blackwell, Harmer, Davison, & Holmes, 2012), progressively enhancing the importance attributed to active generation of positive disambiguations. It has been argued that active generation of personally relevant information to resolve ambiguous scenarios during CBM-I protocols is an explicit requirement for bringing about mood change as a direct result of bias modification training (Mathews & Mackintosh, 2000; Mackintosh et al., 2006). This active generation protocol is contrasted with passive selection, where participants might be presented with an ambiguous scenario followed by two disambiguating endings (one positive, one negative) that they simply have to choose between. Participants may still receive feedback as to whether their choice was correct or incorrect, but they are not required to personally generate any information in the resolution of the scenario. In addition to active generation, training effects can be strengthened by use of imagery exercises to get participants to visualise scenarios during training from a first-person perspective (Holmes, Mathews, Dalgleish, & Mackintosh, 2006; Holmes et al., 2009), based on findings suggesting that this ability may otherwise be impaired in individuals with clinical or sub-clinical emotional disorders (Holmes, Coughtrey, & Connor, 2008; Holmes, Lang, Moulds, & Steele, 2008).

However even active generation CBM-I studies with adults have been inconsistent in either finding (Salemink, van den Hout, & Kindt, 2007; Beard & Amir, 2008) or not finding (Wilson, MacLeod, Mathews, & Rutherford, 2006; Hirsch, Hayes, & Mathews, 2009) changes in mood as a direct result of undergo-

ing CBM-I. Null findings of valence-congruent mood change as a direct result of CBM-I training appear to undermine the central tenet of CBM: that modifying patterns of cognition should reduce or prevent symptoms of emotional disorders (Koster et al., 2009; Hertel & Mathews, 2011). However, it is perhaps unreasonable to expect the effects of CBM-I to manifest as immediately observable improvements in mood. Rather, the proposed mechanism of change in subjective well-being following CBM-I is through subsequent interactions with the environment, which are posited to be experienced more positively in light of positive CBM-I training (Hoppitt, Mathews, Yiend, & Mackintosh, 2010b; Mathews, 2012). This is consistent with diathesis-stress models of emotional disorders. The goal of CBM-I can be conceived as dampening the effects of environmental risks in order to prevent the manifestation of harmful aspects of anxiety and depression in vulnerable individuals. So instead of examining participants' mood directly following positive training, a more fruitful approach may be to examine differential post-training responses to stressful environments. For example, by exposing participants to an experimental stressor after either positive or negative CBM-I training, it may be possible to estimate differential stress reactivity as a function of training.

A number of studies have incorporated experimental stressors into CBM-I paradigms. These have shown them to be a source of differential anxiety reactivity as a factor of CBM-I training valence in healthy and sub-clinical adult populations. Wilson et al. (2006) and Hoppitt et al. (2010b) used graphic videos as post-training experimental stressors, while in Murphy, Hirsch, Mathews, Smith, and Clark (2007) participants screened for high social anxiety were led to believe they were going to have a conversation with two strangers for 5 minutes. All three studies found that anxious responses following the experimental stressor were less pronounced in participants who underwent benign interpretation training, relative to controls. These findings provide evidence to support the potential utility of CBM-I as a buffer against negative reactions to stress (Hertel & Mathews, 2011; Hoppitt et al., 2010b). Negatively valenced interpretive biases may be thought of as cognitive vulnerabilities or diatheses to emotional disorders (Paris, 1999; Alloy, Hartlage, & Abramson, 1988), which are then applied to stressful or ambiguous environmental stimuli, resulting in stressful experience and constructing negative mood effects or emotional symptoms (Mathews & MacLeod, 2002; Hoppitt, Mathews, Yiend, & Mackintosh, 2010a; Mathews, 2012). Employed as a buffer intervention in such circumstances, CBM-I training might give rise to positive emotional outcomes, in contrast to null findings of mood change directly following training in experiments with no stress reactivity component.

A related issue is the extent to which CBM-I training effects generalise to other measures of interpretation bias (Salemink, van den Hout, & Kindt, 2007; Salemink, van den Hout, & Kindt, 2010). Previous work has argued that the generalisation of CBM-I training effects to responses on the Interpretation Bias Test may simply reflect demand characteristics, as training and testing are so similar in form (Harvey et al., 2004). Evidence of generalisation from CBM-I training to other related measures would theoretically demonstrate the validity

of training. Such empirical demonstrations could be further considered prerequisites for the process of applying induced interpretive biases to other, more ecologically valid ambiguous stimuli.

A further consideration for research that would propose to use CBM-I training as an intervention against the development of emotional symptoms and other negative outcomes is that of longevity of effect. Following training, any induced biases must persist if individuals are to use them in their subsequent daily life to buffer against stressor and negative experiences, or to enhance positive experiences and feelings. Adult studies have shown that induced interpretive effects from a single session of CBM-I training persist for at least 24 hours (Yiend, Mackintosh, & Mathews, 2005; Mackintosh et al., 2006). Other studies to have used longer programmes of training have suggested that induced biases may be maintained over a period of weeks if participants undergo regular CBM-I training session (Lang et al., 2012; Blackwell & Holmes, 2010), but such results do not necessarily speak to the persistence versus degradation of effects. Examinations of the persistence of effects are limited beyond this, but would benefit from considerations in populations identified as viable targets for interventive use of CBM-I, such as during adolescence.

1.3.2 CBM-I in Developmental and Adolescent Samples

Adolescence's implication as a sensitive period in social and emotional development (Fombonne et al., 2001b; Windle, 1992; Fenzel, 2000; Steinberg & Monahan, 2007) identifies it as a desirable point for CBM-I intervention to buffer against negative emotional outcomes driven by interpersonal cognitive risk factors such as interpretive biases (Hadwin & Field, 2010b; Field & Lester, 2010; MacLeod & Holmes, 2012; Kessler et al., 2005). Research should consider whether the effects seen in adults are replicable in adolescents. Various studies have demonstrated the malleability of interpretive biases across childhood and adolescence, and a brief overview of such research to date is given in Table 1.1.

1.3.2.1 Passive-Selection CBM-I Paradigms in Developmental Samples

Some of the earliest adaptations of CBM-I methods to developmental samples are reported by Muris, Huijding, Mayer, and Hameetman (2008) and Muris, Huijding, Mayer, Remmerswaal, and Vreden (2009). Muris et al. (2008) details the development of the 'Space Odyssey' task in a sample of 8–12 year-old children. The Space Odyssey task requires children to read a number of ambiguous scenarios taking place on an extraterrestrial planet, e.g. 'On the plaza you find a beautiful silver ball. You pick it up because you want to play with it...'. Children are provided with two possible endings to each scenario, one positive (e.g. 'The ball is nice and bounces very well. You take it with you to show it to a friend.') and one negative (e.g. 'Ouch! That hurts. The ball gives a painful electric shock. You are crying and run to your home.') and are required to choose one. Upon choosing their ending, participants receive 100% consistent feedback

Study	Training	Comparison	Age	Symptomatic	Immediate Mood Change	Experimental Stressor	Number Of Sessions	<i>n</i>
Muris et al. (2008)	Passive Selection Mixed Threat	Positive vs. Negative	8–12	No	n/a	No	1 (30 trials)	70
Muris et al. (2009)	Passive Selection Mixed Threat	Positive vs. Negative	9–13	No	n/a	No	1 (30 trials)	120
Vassilopoulos et al. (2009)	Passive Selection Social Threat	Benign vs. No Training	10–11	Yes	Yes	Social	3 × 15 trials	43
Lothmann et al. (2011)	Active Generation Social Threat	Positive vs. Negative	13–17	No	Yes	No	1 (60 trials)	66
Lau et al. (2011)	Active Generation Social Threat	Positive vs. Negative	13–18	No	Yes	No	1 (60 trials)	36
Salemink & Wiers (2011)	Active Generation	Positive vs. Mixed-Valence	14–16	No	No	No	1 (30 trials)	139
Social Threat								
Lester et al (2011a)	Passive Selection Animal Threat	Positive vs. Negative	6–11	No	Yes	Animal	1 (30 trials)	67
Lester et al (2011b)	Passive Selection	2 (Positive, Negative) × 2 (Animal, Social)	7–15	No	No	Animal	1 (30 trials)	103
Animal/Social Threat								
Fu et al. (2012)	Active Generation Social Threat	Positive vs. Neutral	12–17	Yes	No	No	1 (60 trials)	27
Vassilopoulos et al. (2012)	Passive Selection	Mental Imagery vs. Verbal Understanding	10–12	No	Yes	No	4 × 18 trials	94
Social Threat								
Vassilopoulos et al. (2013)	Passive Selection Social Threat	Benign vs. No Training	10–11	No	No	No	3 × 16 trials	153

Table 1.1: CBM-I studies conducted in child and adolescent samples to date

(either ‘Good!’ or ‘Wrong!’) congruent with the valence of the training they are undergoing.

Training in Muris et al. (2008)’s study was either positive or negative, in a between-groups design. Interpretations were assessed post-training using ambiguous vignettes developed for use in child research by Muris, Kindt, Bo, and Merckelbach (2000). These describe a mixture of social and non-social situations—e.g. giving an oral report in front of one’s class; losing sight of one’s mother in a large shopping centre. Participants were simply required to read these scenarios and rate how scary they would find them on 7-point Likert-like scales.

Muris et al. (2008) showed that threat perceptions indexed by the ambiguous vignettes were higher following negative than following positive training ($d = 0.88$). This study provided some of the first evidence for the viability of a CBM-I-like protocol in modifying interpretive biases within developmental samples. However, the exclusive post-training comparison of positive versus negative training makes impossible to discern whether post-training differences were driven by the effects of positive training, negative training, or both; the same criticism could be made of the original Mathews and Mackintosh (2000) paradigm in adults. Muris et al. (2008) offered the interpretation that post-training effects were driven by increased threat interpretations following negative training only in children who showed high pre-training anxiety (indexed by the Screen for Childhood Anxiety and Related Disorders, SCARED; Birmaher et al., 1997). However these conclusions were based on post-hoc comparisons of a mean-split dataset on this anxiety measure in an unselected sample, and so should be interpreted sceptically (cf. MacCallum, Zhang, Preacher, & Rucker, 2002; Irwin & McClelland, 2003; Howell, 2002).

Muris et al. (2009) replicated findings from the Space Odyssey paradigm in a larger sample of 9–13 year-olds. In place of the between-groups post-training-only test of interpretations used by Muris et al. (2008), this study tested interpretations of ambiguous vignettes both pre- and post-training. The study found no significant change in appraisals of ambiguous vignettes following positive training, but interpretations of ambiguous vignettes became more negative following negative training ($\eta_p^2 = .12$). Inclusion of anxiety symptom score (again indexed by the SCARED) as a covariate within an ANCOVA showed that higher anxiety predicted more negative interpretations both before and after training, supporting previous findings of associations of anxious symptoms with negative interpretive biases in child and adolescent samples (Miers et al., 2008; Warren et al., 2000; Muris et al., 2003). However, this more robust analysis of anxiety scores—compared to the post-hoc mean-split groupings in Muris et al. (2008)—failed to replicate the finding of the moderation of interpretation by SCARED score, or of any association between anxiety score and efficacy of training.

Across Muris et al. (2008) and Muris et al. (2009), training scenarios incorporated social interactions, physical threat and animal fears. More recent work using the Space Odyssey paradigm has attempted to dissociate distinct sources of anxiety with regards to changing salience across development. Given the relatively earlier onset of animal phobias than other anxiety disorders (Ost, 1987),

Lester, Field, and Muris (2011a) adapted the Space Odyssey training to specifically address animal fears in a sample of 6–11 year-olds. Using animal-themed pre- and post-training ratings of ambiguous vignettes (Muris et al., 2000, 2008, 2009), Lester et al. (2011a) demonstrated that negative appraisals of ambiguous information significantly increased following negative training ($d = 0.53$) but decreased following positive training ($d = 1.01$). This contrasts with findings in Muris et al. (2009), where the effects of negative training were more pronounced than (non-significant) effects of positive training. Subjective ratings of anxiety across the experiment indicated that negative training significantly increased self-reported anxiety ($d = 0.35$) and positive training decreased anxiety, albeit non-significantly ($d = 0.21$).

In a wider-ranging sample, Lester, Field, and Muris (2011b) applied the Space Odyssey paradigm to adolescents (11–15 years) as well as children (7–10 years). Participants underwent training specific to either animal or social fears, to examine whether there might be differential sensitivity to such stressors, given the differential ages of onset for such fears (Ost, 1987). Children and adolescents were randomly allocated to receive either positive animal CBM-I, negative animal CBM-I, positive social CBM-I or negative social CBM-I training in a 2×2 between-groups design. As in Lester et al. (2011a), participants' interpretations were measured using modality-specific ambiguous vignettes (ambiguous situations involving animals in those who underwent animal CBM-I training; ambiguous social situations in those who underwent social training) adapted from those in Muris et al. (2000), administered before and after training. Following negative modification, interpretation biases became more threatening, although non-significantly so ($d = 0.15$). After positive modification, biases became significantly less threatening ($d = 0.72$).

Significantly stronger changes in interpretive biases were seen in participants with more negative pre-training biases, but not as a function of pre-existing anxiety. The study also provided evidence that the efficacy of training was contingent on the content of the training material in concert with participants' age. In the 7–10 year-old children, significant changes in bias followed animal training only ($d = 1.26$). By contrast, the 11–15 year-old adolescents showed significant training effects of both animal and social training, though these were more pronounced for social stimuli ($d_{animal} = 0.70$; $d_{social} = 0.90$). This is consistent with aforementioned arguments in showing the emergence of the specific relevance of socially related cognitive biases in the 11–15 adolescent age range.

Using a different training method, Vassilopoulos, Banerjee, and Prantzalou (2009) applied CBM-I training to 10–11 year-old children screened for top-quartile scores on the Social Anxiety Scale for Children-Revised (La Greca & Stone, 1993). Children were presented with a training set comprised entirely of hypothetical social situations (e.g. 'During arts education, you ask your fellow student for one of his/her crayons, but he/she refused. What would you think if this happened to you?'). For each, participants chose either a benign (e.g. 'He/she needs the crayon to finish his/her painting') or negative (e.g. 'He/she dislikes me') interpretation. At the end of each training session (there were 3,

each consisting of 15 scenarios), participants received feedback on which responses were correct; in all cases this was the benign interpretation. Children undergoing this benign training were compared to a control test-retest group who received no training.

Participants were presented with novel ambiguous scenarios pre- and post-training—again paired with one negative and one benign interpretation. They rated each option for how likely they perceived the event as happening to themselves, from 1 (*I would not think of it at all*) to 5 (*I would think of it immediately*). Children undergoing benign interpretation training showed a significant reduction in the likelihood ratings given to negative interpretations while controls did not. No training effects were observed for ratings of the benign interpretations. This suggests that effects were driven by training children away from endorsing negative interpretations of ambiguous situations, rather than towards benign interpretations. Indeed, given the selected high-social-anxiety nature of the sample, it would be expected that individuals would have pre-existing biases towards negative interpretations (cf. Miers et al., 2008).

Vassilopoulos, Moberly, and Zisimatou (2013) used this same training paradigm in a typically-developing 10–13 year-old sample. However rather than using interpretations of ambiguous vignettes, or novel scenarios in the Interpretation Bias Test, Vassilopoulos et al. (2013) attempted to dissociate post-training biases towards positivity and away from negativity, by using distinct measures. Outcome measures of interpretation bias (administered before and after training) were the Negative Social Events Catastrophization Questionnaire and Positive Social Events Discounting Questionnaire (Vassilopoulos & Banerjee, 2008) adapted for use in younger populations. The former presented participants with mildly negative social situations (e.g. ‘You have invited one of your schoolmates to come and play at your house. The phone rings and he tells you that he will not come over’), and participants were required to rate the likelihood of two potential interpretations in manner analogous to interpretation ratings made in Vassilopoulos et al. (2009). However, in contrast to the benign versus negative interpretations offered as options in Vassilopoulos et al. (2009), options in the Negative Social Events Catastrophization Questionnaire are either neutral (e.g. ‘Something has happened that made him change his plans’), or catastrophic thoughts about outcomes (e.g. ‘He does not like me anymore and he would rather hang out with other children’). Conversely, the Positive Social Events Discounting Questionnaire provided participants with positive hypothetical social situations (e.g. ‘At school, you perform a part in a theatrical play in front of an audience comprising of students, and when the play is over you are applauded’), and two possible interpretations: one that accepted the positive judgement (e.g. ‘My performance was good and satisfied them’), and one that discounted it (e.g. ‘All children are applauded, even if they did not perform well’), each of which participants again rated for likelihood of occurrence on 5-point Likert-like scales.

This methodology allows for the dissociation of negative/non-negative and positive/non-positive interpretation effects, which remained ambiguous in the design and conclusions of Vassilopoulos et al. (2009). Benign training signifi-

cantly reduced endorsement of catastrophic interpretations of mildly negative events ($\eta_p^2 = .22$), and significantly increased endorsements of neutral interpretations of the same events ($\eta_p^2 = .12$). Endorsements of positive judgements of positive events increased following benign training ($\eta_p^2 = .12$). None of these effects were present in controls. These findings suggest that positive training might show effects in both potentiating positive interpretations, and suppressing negative interpretations in typically-developing adolescents.

Another adaptation of the Vassilopoulos et al. (2009) training paradigm by Vassilopoulos, Blackwell, Moberly, and Karahaliou (2012) explored whether adult findings of enhanced training effects when using visual imagery during CBM-I training (Holmes et al., 2006, 2009) would hold in a 10–12 year-old sample. Participants completed the training described in Vassilopoulos et al. (2009), but were additionally instructed to either vividly imagine the ambiguous situations (imagery condition) or to focus on each word in the scenario and the meaning of the vignette as a whole (verbal condition). Change in interpretation bias was measured using ratings of benign versus negative interpretations of ambiguous events as in Vassilopoulos et al. (2009). Endorsements of negative interpretations of ambiguous statements decreased from pre- to post-training in both imagery and verbal conditions ($\eta_p^2 = .30$), though comparison of change scores suggested this effect was greater in the verbal condition ($d = 0.42$).

1.3.2.2 Active-Generation CBM-I Training Studies in Developmental Samples

Child and adolescent CBM-I studies discussed thus far did not require participants to actively generate information to disambiguate training scenarios. Mathews and Mackintosh (2000) argued that such active generation is necessary for mood effects to result from CBM-I training. Other developmental studies have extended the Mathews and Mackintosh (2000) paradigm to children and adolescents (see Table 1.1, column 2), with mixed findings.

Lothmann, Holmes, Chan, and Lau (2011) adapted the Mathews and Mackintosh (2000) CBM-I paradigm to adolescents, re-writing training materials to contain age-appropriate content. Adolescents (aged 13–17 years) were trained with either predominantly positive or predominantly negative resolutions of ambiguous social situations. Participants were trained to visualise situations they were reading—in an analogous way to the imagery condition reported in Vassilopoulos et al. (2012)—following on from findings reported by Holmes et al. (2009) and Holmes et al. (2006) that using imagery potentiates training effects. Post-training interpretation biases were tested using an Interpretation Bias Test adapted from Mathews and Mackintosh (2000) and Eysenck et al. (1991) to be relevant to an adolescent population. In contrast to the preceding CBM-I studies in developmental samples, the distinction between target and foil probes in the post-training Interpretation Bias Test allows for a dissociation of specific interpretation effects upon exposure to novel ambiguous information, compared to non-specific response biases to positively and negatively valenced information (see above for a more detailed account of the test). Following training,

positively-trained individuals endorsed positive target interpretations of novel ambiguous information more strongly than negative targets ($d = 2.20$). No significant difference was found between such ratings in the negative training group. Positively-trained individuals endorsed positive targets more strongly than did negatively-trained individuals ($d = 0.72$), with the inverse effect for negative targets ($d = -1.14$). Target probes were endorsed more strongly than foils in all cases, though there was some shared character in post-training effects across the probe types, in that participants endorsed positive foils significantly more strongly following positive than following negative training. These effects indicate valence-congruent effects of CBM-I training upon subsequent interpretations of novel ambiguous information. Taken together, the within and between-group comparisons suggest positive training both increases positive interpretations and reduces negative interpretations of novel ambiguous information. However the exclusive post-training comparison of positive and negative training paradigms makes it difficult to determine the relative sizes of positive and negative training effects.

The Lothmann et al. (2011) adolescent paradigm was replicated in a 13–18 year-old sample by Lau, Molyneaux, Telman, and Belli (2011). This study contained an additional index of perceived self-efficacy (Muris, 2001). Bias-training results largely replicated those of Lothmann et al. (2011). As previously, similarity ratings for positive target interpretations of the ambiguous test scenarios were significantly higher following positive, compared to negative training ($d = 0.71$), and the reverse was true for negative targets ($d = 1.03$). Within the positively-trained group, participants rated positive targets as more similar to the ambiguous test scenarios than negative targets ($d = 0.76$). This effect was inverted and significant in the negatively trained group ($d = 0.97$)—a contrast that was non-significant in Lothmann et al. (2011). Again these results indicate valence-congruent effects of CBM-I training upon interpretations of novel ambiguous information, while remaining obscure as regards the relative strengths and sizes of positive and negative training effects.

Fu, Du, Au, and Lau (2012) extended this training protocol to a sample of 12–17 year-olds with current diagnoses of generalised or social anxiety disorder. The positive training condition was identical to that of Lothmann et al. (2011). Rather than use a negative training comparison group, the authors used a 50% positive/50% negative training set as a control, to avoid exacerbating negative interpretive biases in anxious patients. Both groups rated positive targets as more similar to the ambiguous test scenarios than negative targets, but this effect was more pronounced following positive ($d = 2.64$) than following control training ($d = 1.27$). This discrepancy was driven by lower similarity ratings assigned to negative targets in the positive training compared to control ($d = 1.26$), whereas endorsements of positive targets did not differ between groups. This suggests that, in the anxious sample used in Fu et al. (2012), the effects of positive CBM-I training were to reduce negative interpretations, rather than increasing positive interpretations of novel ambiguous material. This effect is directly analogous to the findings reported by Vassilopoulos et al. (2009) in a sample of socially anxious adolescents using a passive CBM-I training paradigm.

Salemink and Wiers (2011) replicated the use of an active-generation CBM-I training paradigm in adolescents, comparing positive to a mixed 50% positive/50% negative control training condition in a sample of 14–16 year-olds. In contrast to Lothmann et al. (2011), Lau et al. (2011) and Fu et al. (2012), changes in interpretation bias were measured using the Interpretation Bias Test (Eysenck et al., 1991) as a pre-/post-training measure, rather than solely post-training. This allows for an index of change in interpretation biases as a result of training. However administering the Interpretation Bias Test prior to training, and then again after training may telegraph the test's aims more clearly, as it is very similar in content and form to CBM-I training material. This could affect the validity of the comparison of pre-training Interpretation Bias Test scores to post-training scores, or the comparison to other studies to have used the measure as a solely post-training index. Salemink and Wiers (2011) found that relative to control, positive CBM-I training both increased positive interpretations ($d = 0.4$), and reduced negative interpretations ($d = 0.8$) in typically-developing adolescents. Comparisons of effect sizes suggest that the reduction of negative interpretations was the more pronounced effect of this form of CBM-I training.

Post-hoc median split scores were used to test for differences in training effects between individuals who were high and low on pre-training trait anxiety and negative interpretive biases, though this approach is explicitly discouraged in the statistical literature (MacCallum et al., 2002; Irwin & McClelland, 2003; Howell, 2002). Pre-existing anxiety was not found to moderate CBM-I training. Positive training effects were more pronounced in individuals with more negative interpretive biases prior to training. However these effects should be replicated using more robust analyses if they are to be given further consideration.

Salemink and Wiers (2011) and Fu et al. (2012) are unique in the child and adolescent CBM-I literature in their comparison of positive training to control training conditions. Vassilopoulos et al. (2009) also compared positive training to a no-training control. All three studies show evidence of post-training CBM-I effects following positive training, which suggests that there may be scope for the use of positive training as an intervention against the development of symptoms of emotional disorder in adolescence. Post-training effects appeared smaller following comparison to control or no-training conditions in Salemink and Wiers (2011) and Vassilopoulos et al. (2009) than following comparisons to negative training in other studies of typically-developing adolescents. However, it is inadvisable to compare effect sizes across studies using different samples and methodologies. Accordingly future research may wish to probe questions of the relative sizes of positive and negative training biases in comparison to control, within a single experiment.

1.3.2.3 Mood and Stress Reactivity

Across the nine CBM-I studies to have examined mood changes in developmental samples, changes as an immediate result of training were found in five (see Table 1.1). Of these nine studies, six studies used short-term or state mood

measures. No change in short-term mood was observed in three of these six: Salemink and Wiers (2011); Lester et al. (2011b); Fu et al. (2012). In those remaining three studies that found changes in state mood as a direct result of training, results showed inconsistencies in the direction of effects. The closest finding to consensus was that negative CBM-I training may decrease positive, relative to negative affect. Decreases in self-reported positive affect as a result of negative training were found by Lothmann et al. (2011) and Lau et al. (2011), though these decreases were qualified in both cases. In the former negative training only resulted in a decrease in positive affect for males, whereas in the latter the decrease was qualified by pre-requisite lower self-reported self-efficacy. Analogously, Lester et al. (2011a) showed that negative training increased anxiety across all participants. The only significant effect of positive training in terms of immediate mood effects across all adolescent studies conducted to date was the reduction of negative affect reported in Lothmann et al. (2011).

Responses to experimental stressors within CBM-I training designs may help to probe effects that reflect the application of biases to buffer against external stressors, and so help to resolve inconclusive mood effects across previous studies. Three adolescent CBM-I studies contained experimental stressors administered to participants after they had completed CBM-I training (see Table 1.1). Vassilopoulos et al. (2009) included a potential social interaction as an experimental stressor in selected high social-anxiety participants, showing that positive training made children less anxious about this anticipated social interaction. Lester et al. (2011a) and Lester et al. (2011b) included behavioural approach/avoidance tasks (either an anticipated social interaction, or approaching an animal in a box, depending on training content) as stressors. Both showed differential stress-reactivity as a result of training, but the specific effects were inconsistent. Lester et al. (2011b) found behavioural avoidance was reduced by positive training relative to negative training, but no differential effects in self-report anxiety. Conversely, Lester et al. (2011a) found valence-congruent training effects on self-reported anxiety following the stressor, but no differential effects on behavioural approach/avoidance.

1.3.3 Summary of Developmental CBM-I

CBM-I training conducted in children and adolescents to date shows evidence that interpretive biases may be modifiable, as in preceding adult work. These effects have been replicated across designs requiring passive selections to resolve ambiguous scenarios (e.g. Space Odyssey paradigm, Vassilopoulos et al.), as well as designs requiring active generation of disambiguating information (e.g. Lothmann et al., 2011; Salemink & Wiers, 2011).

In order to verify CBM-I training effects as ecologically valid, it is necessary for studies to show evidence of changes in interpretive bias measures beyond those with superficial similarities to the content and form of training material. Distinct measures should be incorporated into future work for two reasons: 1) to completely rule out the possibility of findings being ascribable to demand

characteristics, and 2) to determine the limits of generalisability of interpretive bias modifications following training.

There may be asymmetrical effects of positive and negative training, but this is hard to discern. Studies listed in Table 1.1 contain a mixture of approaches, examining positive CBM-I training in comparison to either negative training, mixed control training or no-training controls. Future research would do well to further delineate the relative sizes and effects of positive versus neutral training, with regards to how strong the effects of a single instance of training are.

This could be brought together with examinations of the longevity of such effects, to determine what kind of magnitude of CBM-I effect would be useful as a potential intervention in children or adolescents, and for how long these effects would be expected to persist. In particular, given the absence of examinations of the persistence of CBM-I training in adolescent populations, tests of this persistence would be apt for future research. One example could be the replication of previous adult findings of the persistence of CBM-I interpretation effects for 24 hours (Yiend et al., 2005; Mackintosh et al., 2006), within adolescent samples.

Studies showed a closer relationship between interpretive biases and anxious rather than depressive symptoms. However this could simply reflect the research's greater propensity to include measures of anxiety compared to depression. Evidence for changes in mood as a direct result of training is relatively weak, and where present is contingent on some other factor such as gender (Salemink & Wiers, 2011), elevated anxiety (Muris et al., 2008), more negative pre-existing biases (Lester et al., 2011b), or low self-efficacy (Lau et al., 2011). As such, findings pertaining to stress or mood reactivity paradigms seem more encouraging. Stress reactivity results in child and adolescent CBM-I experiments are at present rather sporadic and relatively inconsistent. While some evidence of differential stress-buffering effects have previously been shown in adults (Wilson et al., 2006; Murphy et al., 2007; Hoppitt et al., 2010b), it is of particular importance to determine whether these same effects are seen in child or adolescent samples. Therefore in light of the adolescent CBM-I training research collected to date, future work would do well to consider the following points:

- Generalisation of post-training CBM-I effects to other measures of interpretive bias, and transfer to other tasks to inform understanding of the mechanistic nature of the CBM-I process
- Longevity of post-training effects
- Control conditions and consideration of the relative effects of positive and negative training
- Standardisation of mood effects and development of experiments that examine effects of training upon stress reactivity in child and adolescent samples

1.4 Summary and General Points

The research presented makes a case for the importance of interpersonal and cognitive risk factors for emotional problems. There is also some evidence that manipulating interpretive biases may have causal influence on emotional symptoms, but this is less well established. Moreover, there is good evidence that social and cognitive risk are not exclusive, but rather intimately related and interactive. Interpersonal function, cognitive processing and ability, and emotional functioning all undergo thorough and wide-ranging developmental changes during adolescence. As such, this period is suited to the application of the potential cognitive vaccine of cognitive bias modification of interpretations to try and prevent against the negative effects of interpersonal cognitive risk factors (MacLeod et al., 2009; Hadwin & Field, 2010a).

1.4.1 Developmental Considerations

Across the various avenues for investigation discussed and outlined over the course of this chapter, there is a strong unifying theme of the importance of a developmental focus. Adolescence has been identified as a critical period in the development of various aspects of social and emotional function, as well as the onset of numerous potential adversities and emotional problems. Previous studies have highlighted the association between negatively biased interpretations of ambiguous social situations and negative emotional outcomes during adolescence (Hadwin & Field, 2010a). However, as discussed above, there is also evidence of associations between negatively biased interpersonal interpretations and social cognition in the pre-adolescent period of late childhood (Miers et al., 2008; Muris et al., 2003) and the post-adolescent period of adulthood (Mathews & MacLeod, 2002).

There are great potential negative emotional impacts of negative interpersonal cognitive biases during adolescence. As identified above, this identifies this age as potentially the most useful period for an intervention aimed at buffering against the kinds of negative cognitive biases expected to foster negative emotionality (Kessler et al., 2005; Hadwin & Field, 2010b). As such, it would be desirable for potential CBM-I interventions to be specifically targeted at adolescent populations (Field & Lester, 2010; MacLeod & Holmes, 2012). At the same time it bears keeping in mind that potentially similar interpersonal cognitive risk factors for negative emotional outcomes exist across the lifetime, from childhood to adulthood, as detailed in preceding evidence presented and discussed. While there is good evidence of large and wide-ranging changes in socio-emotional function at adolescence—due to both social (Puskar & Rohay, 1999; Brown, 2004; Blakemore & Choudhury, 2006) and biological (Thapar & McGuffin, 1994; Mills et al., 2012; Goddings et al., 2012) influences—there is also the implication of at least an element of constancy in the relationship between interpretive bias and emotionality across development. Though previous work has suggested that any such constant association between (biased) interpersonal cognition and emotionality across development may manifest differently at dif-

ferent ages, and so require methodological tailoring to the specific age at hand (Hadwin & Field, 2010b), the suggestion remains of a relatively robust pathway between interpersonal cognition and emotional symptoms.

These issues together directly bear upon the over-arching research strategy of the current thesis. Though the pathway between emotionality and interpersonal cognition may be robustly associative over time, the potential causal nature of this associative pathway may be more or less open to influence at different stages in development. In line with the arguments advanced earlier when discussing social and biological development, it may be that such a pathway is most malleable during the period of adolescence. Accordingly, the current research seeks to go beyond CBM-I and adolescence, to examine associations between interpersonal cognitive function and emotionality in both post-adolescent (i.e. young adult) and pre-adolescent (i.e. late childhood) samples. It aims to examine whether there are any common associations between aspects of emotionality and interpersonal cognition in both a sample who have already undergone adolescent development and those who have yet to undergo it. It is hypothesised that these various age-groups will be able to inform distinct questions about the nature of the association between interpersonal cognition and emotionality, as argued over the course of the preceding chapter. For example, examinations of young adults will be able to answer questions about more prolonged associations of social and interpersonal cognitions with emotional symptoms. Longitudinal and genetic analyses in children will be to identify stronger risk factors for later emotional symptoms, especially given the predictive power of earlier symptoms upon later impairment (Kim-Cohen et al., 2003; Gregory, Caspi, et al., 2007). Beyond this, there may be commonalities between socio-emotional associations at these distinct ages. If such commonalities are found, then these would also be expected to hold in adolescence. So the current thesis seeks to identify associations between interpersonal cognitive measures and emotional symptoms that are seen across childhood, adolescence, and adulthood, and then to examine to what extent these over-arching associations might be affected by CBM-I training methods.

1.4.2 Considerations for CBM-I Methodology

The aim for the current thesis's examination of CBM-I methodology is to try and discern any effects upon post-training interpretive biases and social and emotional outcome measures. The specific focus is to try and inform research and theory into the nature of the process or mechanisms by which this might occur, from an experimental psychology perspective rather than clinical or applied psychology. This level of understanding is crucial prior to any adaptation of the findings to more applied settings, for instance use as a viable buffer intervention in at-risk or clinical adolescents. In order to focus on these cognitive mechanisms, the decision was made to adopt a single-session approach to CBM-I training, as in e.g. Lothmann et al. (2011) and Salemink and Wiers (2011), rather than a multi-session protocol as used by e.g. Vassilopoulos et al. (2012, 2013)—see Table 1.1. Using a single-session allows for an examination of the discrete

effects of CBM-I training itself upon interpretation, without potential interference from intervening experiences of daily or life events. Additionally it is not entirely clear from extant research either 1) for how long the post-training effects of a single session of CBM-I training last, or 2) whether there are linear or non-linear additive effects of the effects upon interpretation of multiple sessions of CBM-I training. As a result the focus of CBM-I methodology in the current set of studies was kept to single instances of training, to look at specific and isolated effects of training itself. Providing that such results were encouraging, this paradigm could later be developed into more involved or complex training paradigms that might be of practicable use as potential interventions for at-risk adolescent populations.

1.4.3 Thesis Outline

The scope of the work presented in this thesis addresses three main strands. The first aims to identify pertinent interpersonal risk factors for symptoms of anxiety and depression across development. The second aims to investigate the genetic and environmental influences on these relationships over time. The third aims to combine these findings with the current body of knowledge of CBM-I training to develop methods that would then best enact the deployment of CBM-I to protect against negative effects of risk factors for emotional disorders. This leads to a number of inter-locking issues to be addressed by the research presented in this thesis, namely:

1. Cross-sectional relations between interpersonal behaviours, interpersonal cognitions, and emotionality within populations at both prior-to and post-adolescence stages of development.
2. Relative genetic and environmental influences on these factors and the paths between them
3. The extent to which manipulating one of these features (which, drawing on the rest of the evidence presented in the Introduction, seems like interpersonal cognitions/cognitive biases may be the most immediately accessible and powerfully influential) will change aspects of the others within an adolescent population

These issues will be addressed in turn in the following chapters.

2

Emotion, Interpersonal Cognition and Social Behaviour in Young Adults

and I will always be nicer to the cat
than I am to you you you you

Xiu Xiu (2010)

Links between social information-processing, social behaviours and emotional outcomes were investigated in a sample of unselected young adults. Specifically these interpersonal measures were: 1) interpretations of ambiguous social situations, 2) social problem-solving and behavioural planning, and 3) behaviour in a simplified social exchange (the Trust Game) as an experimental proxy for trust and reciprocity. Comparisons between these interpersonal measures were made to determine which factors held the strongest associations with emotional symptoms. Data identified negative interpretive processes as being most closely related to symptoms of social anxiety and depression. Generosity in the Trust Game provided additional explanatory power to interpersonal cognitive measures for symptoms of depression, but not for symptoms of social anxiety. Furthermore generosity in the Trust Game was in turn predicted by more passive social problem-solving styles. Results are discussed in terms of the predictive utility of various cognitive and interpersonal measures for anxiety and depression in future experimental work. Suggestions are made for the potential extension for these findings to developmental research.

2.1 Introduction

Individuals exhibiting anxious and depressive symptoms report more social rejection and exclusion than the general population (Downey et al., 1998; La Greca & Lopez, 1998; Leary, 1990). These kinds of negative social experiences may arise from reticent or maladaptive social behaviours (Barnett & Gotlib, 1988; Rubin & Burgess, 2001; Gurtman et al., 1990), impaired behavioural planning and problem-solving in social situations (Ladouceur et al., 1998; Belzer et al., 2002), and negatively biased patterns of cognition (Richards & French, 1992; Lawson et al., 2002) towards social information (Hirsch & Mathews, 1997). The purpose of this first study was to determine what metrics of interpersonal function are most closely associated with symptoms of anxiety and depression in a post-adolescent sample. It was conducted with a view to extending this work into late childhood and adolescence. Further, it sought to examine whether these various interpersonal markers reflect common or distinct correlates of anxious versus depressive symptoms.

2.1.1 Emotional Symptoms and Interpersonal Cognitions

Previous studies have identified relations between emotional symptoms and biases in interpersonal cognition. One particularly robust finding is a bias towards negative evaluations of ambiguous information among individuals with symptoms of emotional disorders (Richards & French, 1992; Lawson et al., 2002; Hirsch & Mathews, 1997). A number of demonstrations of associations between symptoms of emotional disorder and negative interpersonal cognitions have used the Ambiguous Social Situations Interpretation Questionnaire (ASSIQ; Butler & Mathews, 1983; Amir, Foa, & Coles, 1998; Stopa & Clark, 2000). Here participants are provided with a number of ambiguous situations—e.g. a group of people falling silent as you approach them. They are then required to generate explanations for the ambiguous situations, as well as selecting the explanation that they would most likely endorse from a set of positive and negative alternatives. Findings across a range of studies indicate that more negative explanations of these ambiguous situations are both endorsed and generated by individuals with higher trait and clinical levels of emotional disorders, social anxiety in particular (Stopa & Clark, 2000; Amir et al., 1998).

As well as negative styles of interpersonal interpretation, symptoms of emotional disorder have also been shown to be associated with poor problem-solving abilities (Dugas, Letarte, Rhéaume, Freeston, & Ladouceur, 1995). Difficulties with specifically *social* problem-solving have often been shown in individuals with high trait symptoms (Belzer et al., 2002; D’Zurilla & Sheedy, 1991) or clinical instances (Gotlib & Asarnow, 1979; Watkins & Baracaia, 2002) of anxiety and depression. Moreover, associations between symptoms of emotional disorder and social problem-solving do not appear to differ qualitatively between non-clinical and clinical populations (D’Zurilla, Chang, Nottingham, & Faccini, 1998).

One example of an empirical measure of social problem-solving is given

by the Means-End Problem Solving procedure (MEPS; Platt, Spivak, & Bloom, 1975). Here participants are given a social problem (e.g. someone moving to a new town and not having any friends; a romantic couple breaking up) together with its resolution (e.g. the person has lots of new friends; the couple are happily reconciled) and required to generate a set of actions by the protagonist or others by which the problem is resolved in the desired way. The ability to generate detailed and effective resolutions to these problematic scenarios (defined as the Total Relevant Means generated by participants in order to bring about the resolution) is negatively associated with symptoms of both depression (Watkins & Baracaia, 2002; Schotte & Clum, 1987) and anxiety (E. M. Marx, Williams, & Claridge, 1992). Subsequent methodological developments have suggested that this may be due more to how active and engaged participants are in generating resolutions, rather than simply the level of detail of such solutions (D’Zurilla et al., 1998)—i.e. how active the protagonist is described as being in solving the problem as opposed to passively relying on others or external circumstances. The Means-End Problem Solving task therefore represents a useful metric of ability to generate adaptive, social, behavioural plans as part of processes that have previously been shown to be impaired in individuals with emotional symptoms and disorders.

2.1.2 Social Behaviours and Emotional Symptoms

Previous work on associations between social behaviours and emotional outcomes has largely used non-experimental techniques such as self-report (e.g. Qualter & Munn, 2002), questionnaires (e.g. Reis & Wheeler, 1991; Sarason, Levine, Basham, & Sarason, 1983; Wheeler, Reis, & Nezlek, 1983) or naturalistic observation (e.g. Qualter, 2005). These approaches are typically data-rich, but such studies lack experimental rigour and leave social behaviour poorly operationalised (Bauer & Gaskell, 2000). An alternative, experimental approach to examining social behaviour is to operationalise social interactions using tasks derived from behavioural economics (Von Neumann & Morgenstern, 1953). One such example, the Trust Game, represents a simple index of social behaviour towards a single unknown peer (Berg et al., 1995); players act as Investors or Trustees, allocating investments and returns between themselves and their co-player. Previous studies using this paradigm have found that players in the Trustee role show predictable and characteristic patterns of reciprocity (Camerer, 2003; King-Casas et al., 2005). In particular, Trustees have been shown to be motivated to ensure at least equality of outcome for themselves and the Investor, and often exceeding this so as to over-compensate the Investor relative to their own pay-off—possibly in an effort to encourage future investments (Sutter & Kocher, 2007; Almqvist, Cappelen, Sørensen, & Tungodden, 2010; Belli, Rogers, & Lau, 2012). Furthermore, the Trust Game specifically affords an index of trust and reciprocity, factors that have previously been implicated as bases for more prolonged positive and healthy patterns of social interactions (King-Casas et al., 2008, 2005).

Belli et al. (2012) previously examined participants’ responses as Trustees to a

pre-programmed set of normative responses representing Investor behaviour in the Trust Game. The paradigm's use of an iterated Trust Game with an unknown end-point afforded the examination of short patterns of social exchange without recourse to non-cooperative strategies that theoretically dominate within one-shot or known-end-point games (cf. Camerer, 2003; Zagare, 1984). As in previous Trust Game research, the paradigm yielded evidence of equality-focused behaviour within an adult population. Given the prevalence of maladaptive social behaviour in anxiety and depression (Lewinsohn et al., 1980; Darley & Fazio, 1980; Gurtman et al., 1990), this measure seems suited to explorations of associations between interpersonal behaviours and symptoms of emotional disorder within a laboratory context.

2.1.3 Approach and Aims

The present study uses an individual differences design to examine relative associations between interpersonal cognitions, social behaviours, and symptoms of social anxiety and depression in a community sample of young adults. Interpersonal cognitive biases were measured using the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998) and the Means-End Problem Solving task (Platt, Spivak, & Bloom, 1975), while social behaviour was measured by responses in a previously-developed behavioural economics Trust Game (Berg et al., 1995; Belli et al., 2012). Inclusion of measures probing various levels of social function affords the potential to identify the most predictive interpersonal measures of emotional symptoms that can be investigated further in children and adolescents, as potential risk factors or targets for intervention. The aims of the current study are therefore as follows:

- To examine patterns of interrelation between interpersonal cognitive measures and emotional symptoms
- To determine the relative use and strength of these different levels of interpersonal measures (interpretation, planning, behaviour) in predicting symptoms of emotional disorders within a community sample of adults

It is expected that negative interpretations of ambiguous social situations will be associated with anxious and depressive symptoms. Similarly, simpler or less effective behavioural planning is hypothesised to be associated with higher symptom scores. Given social and behavioural withdrawal associated with social anxiety and depression, lower or non-equality-focused responses on the Trust Game are expected to be associated with higher emotional symptom scores. No specific hypotheses are made about inter-relations between the interpersonal measures.

2.2 Methods

2.2.1 Participants

Forty adults (aged 18–24, 58% female-identified) were recruited via an undergraduate student population in Oxford. Participants were recruited as part of an undergraduate psychology practical class via an opt-in volunteer sample method. Crucially, participants did not comprise participants in the class itself, so as to reduce participants' knowledge of the aims of the study and therefore mitigate potential demand characteristics. The sample over-represented psychology students, who might be expected to determine the aims of the study and so confound results. Further this issue might be expected to be exacerbated by the self-selecting nature of the sample over-representing individuals with an interest in the research at hand. However this was not found to be the case in post-experimental debriefs (See Procedure, Section 2.2.3). Though no specific data was collected pertaining to socioeconomic status, Oxford University undergraduate students are as a whole hugely over-representative of higher socioeconomic groups (Vasagar, 2010). Socioeconomic status has previously been theorised to affect performance in game theory games (Camerer, 2003). However comparisons of responses from the Trust Game in the current study to normative data from previous studies (Berg et al., 1995; King-Casas et al., 2005) gave no indication that responses in the current study were systematically skewed or biased. Further demographic data of the sample is given in Table 2.1.

2.2.2 Measures

2.2.2.1 Beck Depression Inventory

Depressive symptoms were measured using the revised Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II comprises 21 items concerning mood and its effects on cognitive and physical function. Each item consists of groups of statements—e.g. *I do not feel sad, I feel sad much of the time, I am sad all the time, I am so sad or unhappy that I can't stand it*. Participants indicate the statement that best describes the way they have been feeling over the past 2 weeks, and each item is scored 0–3 for the severity of depressive symptom indicated by the endorsed statement. Item scores are totalled, giving a total BDI-II score that ranges between 0 and 63.

The BDI-II has previously shown excellent internal reliability in a sample of 1022 undergraduate students ($\bar{x}_{age} = 21, sd = 4.47$): $\alpha = .91$ (Dozois, Dobson, & Ahnberg, 1998), and good convergent validity for depressive symptoms with the Revised Hamilton Psychiatric Rating Scale for Depression: $r = .71$ (Beck et al., 1996). The measure has also been shown to effectively predict the presence of current depressed mood diagnosis via the Structured Clinical Interview for DSM-IV Axis I Disorders (First, Spitzer, Miriam, & Williams, 1996) in undergraduate students (Sprinkle et al., 2002). Internal reliability according to Cronbach's alpha for BDI-II scores was very high in the current undergraduate sample: $\alpha = .84, n = 40$, across 21 valid items.

2.2.2.2 Liebowitz Social Anxiety Scale

Social anxiety was measured using the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987), which has been reliably tested as a self-report measure of social anxiety (Baker, Heinrichs, Kim, & Hofmann, 2002; Fresco et al., 2001). The LSAS consists of 24 actions pertaining to social anxiety, comprising sources of both performance anxiety (e.g. 'Eating in public') and social interactions (e.g. 'Meeting strangers'). Participants rate each action on a four-point scale for the fear they would feel upon performing that action (0—None, 1—Mild, 2—Moderate, 3—Severe), and the frequency with which they avoid performing the action in their daily life (0—Never, 1—Occasionally, 2—Often, 3—Usually). Scores for the LSAS are totalled fear and avoidance scores for the 24 items, giving an overall score out of 144. Fear and avoidance sub-scales can also be derived from the measure, each scored out of 72.

The self-report version of the LSAS has previously shown excellent internal reliability for the measure as a whole ($\alpha = .94$), as well as for fear ($\alpha = .91$) and avoidance ($\alpha = .85$) sub-scales in a non-clinical adult sample (Fresco et al., 2001). Total LSAS scores have also shown high convergent validity with the social sub-scale of the Social Phobia Anxiety Inventory ($r = .83$; S. M. Turner, Beidel, Dancu, & Stanley, 1989), as well as the Social Interaction Anxiety Scale and Social Phobia Scale (Mattick & Clarke, 1998) in normative adult samples ($r_{SIAS} = .72$; $r_{SPS} = .60$; Fresco et al., 2001). The LSAS is also significantly correlated with the BDI, but this relationship is less strong ($r = .48$; $r = .43$; S. M. Turner et al., 1989; Fresco et al., 2001). In the current study internal reliability for the LSAS was excellent across overall scores on the measure ($\alpha = .93$), as well as fear ($\alpha = .89$) and avoidance ($\alpha = .88$) sub-scales.

2.2.2.3 Ambiguous Social Situations Interpretation Questionnaire

Interpretations of ambiguous events were measured using the Ambiguous Social Situations Interpretation Questionnaire (ASSIQ), compiled from items used by Stopa and Clark (2000) and Amir et al. (1998). Eighteen items were used; an example is reproduced below:

1. Someone you know passes you on the street and does not stop to greet you. Why not?
 - (a) They were ignoring you
 - (b) They didn't see you
 - (c) They were in a rush and could not stop

For each item, participants chose what they thought was the most likely explanation out of 3 possibilities. One of these possibilities was always explicitly negative, while the others were neutral or positive. The total number of times that participants chose the negative explanation was summed as their 'ASSIQ Negative Responses' score. Internal reliability across the 18 items in the current study was fair: $\alpha = .59$.

2.2.2.4 Means-End Problem-Solving Questionnaire

Social problem-solving was indexed using the Means-End Problem Solving task (MEPS; Platt, Spivak, & Bloom, 1975). This requires participants to generate resolutions to negative or conflict situations. Participants were presented with 5 scenarios based on previous successful use of a shortened version of the MEPS task such as this (Platt, Siegel, & Spivack, 1975), and given 60 seconds to outline a means by which the protagonist arrives at the stated conclusion for each scenario. An example scenario is given below:

“Harry/Harriet loved his/her girl/boyfriend very much, but they had many arguments. One day she/he left Harry/Harriet. Harry/Harriet wanted things to be better. The story ends with everything fine between them. You begin the story with the girl/boyfriend leaving after an argument.”

Scenarios were administered via computer, and participants wrote their solutions into blank text-boxes. Solutions were scored for the number of ‘Total Relevant Means’ they included, as a measure of complexity. This score includes the number of active steps taken by the protagonist (Heroine/hero, ‘H’) towards resolution, as well as the number of steps taken by other characters in the scenario (Other, ‘O’), and relevant story details (Story, ‘S’). Irrelevant details (e.g. story/character details that do not contribute to the resolution of the scenario) and repetitions of information from the original scenario are not tallied as part of the Total Relevant Means score.

All solutions were additionally rated by researchers for Activity—i.e. how active the protagonist in the solution was in resolving the scenario. Activity of solution was rated by independent experimenters on a 5-point Likert-like scale from 1 (*Very Passive*) to 5 (*Very Active*)—so higher activity ratings represent more protagonist-active solutions. For instance, in the example above a more active solution would be if Harriet went and bought her partner a bunch of flowers and apologised, whereas a more passive solution would be to simply wait for the partner to come and apologise to her.

Participants’ solutions to the five MEPS scenarios were rated independently for the number of Total Relevant Means and Activity by two researchers. These researcher ratings therefore generated two scores each for Total Relevant Means (summed H+O+S scores across the 5 scenarios) and the Activity (mean Activity rating across the 5 scenarios) of solutions to scenarios. Inter-rater reliability as indexed by Pearson’s correlation coefficient was very good for Total Relevant Means scores ($r(40) = .85, p < .001$), and fair for Activity ratings ($r(40) = .53, p < .001$). Scores reported in descriptive statistics and used in analyses reported below are averaged across the two researcher ratings.

2.2.2.5 Trust Game

Social behaviour was operationalised using the Trust Game (Berg et al., 1995). All participants played as ‘Trustees’ responding to pre-programmed Investor

moves, after the design used by Belli et al. (2012). On each round of this game, the 'Investor' apportioned a £10 sum between themselves and the Trustee. The apportioned amount was tripled before reaching the Trustee, who then responds by deciding a proportion of this tripled amount to return to the Investor. This process is illustrated in Figure 2.1. Each round terminated with the total amounts gained by both the investor and trustee displayed on-screen. More generous returns from the Trustee (participant) to pre-programmed Investor moves of consistent, normative offers reflect endorsement of reciprocal social interactions (King-Casas et al., 2005, 2008).

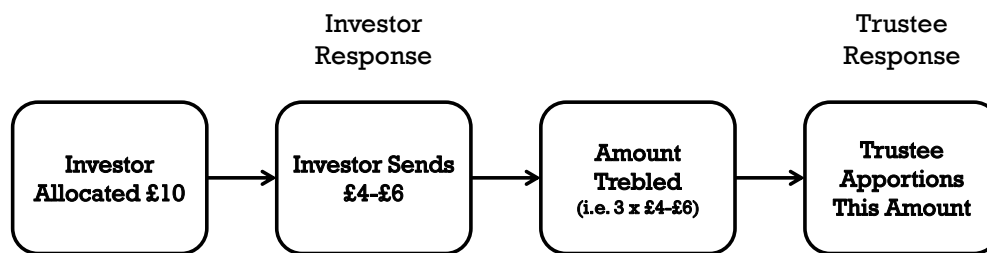


Figure 2.1: Trust Game schematic, showing the overview of a round

The Trust Game comprised 5 rounds and was administered via computer. An iterated game was used to examine responses over time, but participants were not informed for how many rounds the game would last so as to prevent backwards induction strategies (Camerer, 2003). Investors were programmed to invest between £4 and £6 of the £10 available, representing normative cooperation. Investor behaviour was informed by previous experiments indicating that normative investments are roughly half of the initial amount available (Berg et al., 1995; Croson & Buchan, 1999). The specific offers made by Investors on each round are given in Table 2.3.

To compare Trustee behaviour across rounds in which they received different investments, raw responses were re-coded as proportions of the total amount that could have been returned to the Investor on each round. For instance, if the Investor sent £1 to the Trustee, then the participant would have £3 to allocate between themselves and the Investor; if the Investor sent £6, then the Trustee would have £18 to allocate. If the Trustee/participant were to send back £3 in each of these examples, then the implications would be vastly different. Discrepant proportional return scores between the two instances therefore reflect the contextual differences in the Investor offer.

2.2.3 Procedure

Participants were recruited via the Department of Experimental Psychology, University of Oxford. Participants were tested in groups of 20 in the same room, but unable to see each other's computer screens. After giving consent and being

provided with information sheets including the rules of the Trust Game, participants completed the BDI-II, LSAS, ASSIQ and MEPS measures. Following the questionnaires, all participants began playing the Trust Game at the same time, and were informed that they would be randomly paired with another player in the group. Participants were told that within their pairing, one player would be assigned the role of Trustee and one would be assigned the role of Investor. In reality participants were given a false loading screen before being informed by the computer program that they would be playing as the Trustee. Upon completing the game, participants rated their belief in the deception of the study. All participants believed the study's deception, so no data were omitted.

2.2.4 Ethical Issues

Ethical issues arising from the current methodology largely concern the issue of deceiving participants. Ethical approval for the study was acquired from the University of Oxford Central University Research Ethics Committee (CUREC). Participants were deceived as to the full nature of the study, insofar as they were informed that they would be playing against another human player, rather than a computer program. Such a deception obviously constrains participants' ability to give fully informed consent to participation at the onset of the study. However, this deception was vital to the study, as the Trust Game index required participants to play as they would against another human (to fulfil the role of the Trust Game as a index of simple interpersonal behaviour), while at the same time responding to an operationalised set of moves in the game. The current study followed British Psychological Society and CUREC protocol for participant deception, in that participants were fully debriefed as to the nature of the study, its deceptive element, and the reason for this deception following their completion of the experiment. Participants were then offered the chance to withdraw their consent without penalty upon learning of the study deception, though none did in the current sample. Beyond these ethical issues specific to the current task, participants were also informed that they could withdraw from the study without having to give a reason at any time (either during or following its completion), and made aware prior to giving consent that their data would be anonymised, stored safely and be used for academic purposes.

2.3 Results

2.3.1 Descriptive Statistics

Outcome measures and demographics are given below in Table 2.1. Full datasets were obtained for all questionnaire measures for all 40 participants. Two participants had incomplete data on the Trust Game measure due to issues with software used to administer the experiment ($n = 38$). All measures were verified as normally distributed using Kolmogorov-Smirnoff and Shapiro-Wilks tests. Gender was initially included as a covariate in all subsequent analyses, but did not emerge as a significant factor in any (all F values < 2), nor did its inclusion alter

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the significance of any other measures. Accordingly, all analyses are reported without including gender as a covariate.

		Mean	sd
Age		20.25	1.19
Gender	Female	57.5%	
	Male	42.5%	
	Other	0.0%	
BDI-II		11.84	6.56
LSAS	Fear sub-scale	16.28	8.69
	Avoidance sub-scale	14.25	9.51
	Total	30.53	17.15
ASSIQ	Total negative responses	3.85	2.51
MEPS	Total Relevant Means	28.05	7.48
	Mean activity/passivity of responses	3.57	0.51
<i>n</i>		40	

Table 2.1: Means and standard deviations for demographic and questionnaire measures used in the study

2.3.2 Correlations for Emotional and Interpersonal Cognitive Measures

Correlations between social anxiety symptoms, depressive symptoms, interpretations (ASSIQ responses) and social problem-solving (MEPS scores) are given in Table 2.2. Social anxiety and depression symptom scores correlated significantly and positively ($r(38) = .55, p < .001$). Total negative responses given on the ASSIQ also correlated significantly and positively with depression ($r(38) = .50, p = .001$) and social anxiety ($r(38) = .46, p = .003$). Total Relevant Means scores and activity ratings of solutions from the MEPS were not significantly related to any measure.

Given the significant correlations between social anxiety and depression, partial correlations were conducted controlling for each other's effects, to examine their relative association with negative interpretations on the ASSIQ. Partial correlations are given above the diagonal in Table 2.2. ASSIQ scores retained significant correlations with depressive symptoms after partialling out social anxiety scores. Conversely, the association between ASSIQ score and social anxiety scores did not persist after partialling out depressive symptom scores.

2.3.3 Behavioural Measures: Trust Game

Trust Game responses were analysed as proportional scores of offers made by the Investor on each round, to control for the varying investments received by participants over the course of the game. Offers made by Investors on each round are given in Table 2.3, together with mean proportional returns made by participants on each round.

	BDI	LSAS	ASSIQ Responses	MEPS TRMs	MEPS Active/Passive
BDI	1		.33*	-.02	.12
LSAS	.55**	1	.26	-.07	.11
ASSIQ	.50**	.46**	1		
MEPS TRMs	-.06	-.09	.11	1	
MEPS Activity	.21	.21	.07	.02	1

Table 2.2: Correlations between symptoms of depression and social anxiety, and social cognitive measures (mean number of negative explanations selected for the ASSIQ; mean Total Relevant Means scores, and activity ratings of solutions on the MEPS). *—Significant at .05 level. **—Significant at .01 level. Partial correlations after controlling for anxiety/depression are displayed in italics above the diagonal

A repeated measures ANOVA was conducted with Round (1, 2, 3, 4, 5) as a within-subjects factor. This proved significant: $F(4, 148) = 5.98, p < .001, \eta^2 = .139$. Within-subjects contrasts revealed a significant linear effect over the course of the game: $F(1, 37) = 17.25, p < .001, \eta^2 = .318$. Means in Table 2.3 and the plot of proportional responses in Figure 2.2 further indicate that this linear effect was that returns from Trustees gradually reduced over the course of the game.

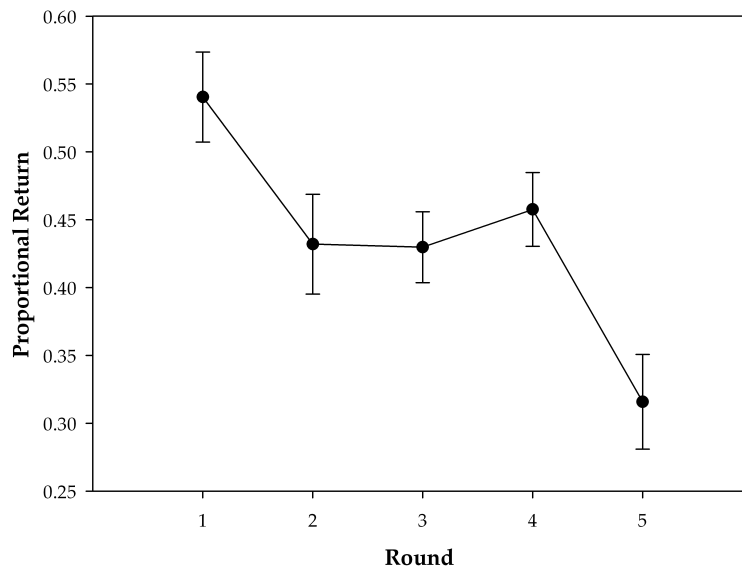


Figure 2.2: Mean proportional returns on each round of the game

The ANOVA was also re-run while including social anxiety score, depression score, ASSIQ score, and MEPS scores as separate covariates in a set of 5 ANCOVAs. The only factor that showed a significant effect was Activity ratings from the MEPS. This analysis retained the significant main effect of Round ($F(4, 144) = 2.64, p = .036, \eta^2 = .065$), with an additional main effect of MEPS Activity rating ($F(1, 36) = 4.83, p = .034, \eta^2 = .118$), but no significant inter-

action. Activity of MEPS solutions and proportional returns were significantly and negatively related to each other ($r(36) = -.34, p = .034$)—i.e. more passive solutions generated in the MEPS predicted greater returns to the Investor by participants across the Trust Game. The lack of interaction suggests that MEPS Activity scores did not modify the linear decrease in returns across the game.

Given the significant main effect of Round, mean proportional responses were compared to responses that would ensure equal pay-offs for both players for each round in the game. The proportional returns that participants would have had to make to ensure at least equal returns for their co-player are also given in Table 2.3, in the final column.

	Investment	Mean Return	Equality Return
Round 1	£5	.54 (.03)	0.33
Round 2	£4	.43 (.04)	0.25
Round 3	£5	.43 (.03)	0.33
Round 4	£6	.46 (.03)	0.39
Round 5	£4	.32 (.03)	0.25

Table 2.3: Offers made by the Investor, mean responses made by participants as Trustees, and the Trustee response that would yield equal outcomes for the Investor and Trustee on each round in the game. Standard deviations of the mean responses made by participants are given in parentheses.

One-sample *t*-tests were conducted for each round, comparing mean participant responses to the proportional response to ensure equal outcomes on that round for Investor and Trustee (see final column of Table 2.3). Participants made returns significantly higher (cf. Table 2.3) than the response to yield equal outcomes on Rounds 1–4, but not on Round 5. Similarly, effect sizes for these differences decreased over the course of the game. After performing Bonferroni corrections for multiple comparisons, responses remained significantly higher than equal-outcome responses on Rounds 1–3, but the Round 4 response dropped below significance:

Round 1	$t(37) = 6.35$	$p < .001^{**}$	$d = 2.09$
Round 2	$t(37) = 4.95$	$p < .001^{**}$	$d = 1.63$
Round 3	$t(37) = 3.83$	$p < .001^{**}$	$d = 1.26$
Round 4	$t(37) = 2.49$	$p = .018^*$	$d = 0.82$
Round 5	$t(37) = 1.89$	$p = .067$	$d = 0.62$

2.3.4 Regression Models

Two hierarchical regression analyses were conducted to determine the relative predictive power of the various interpersonal measures upon depression and social anxiety scores. The first regression used BDI-II score as the outcome measure, and the second used LSAS score. Both regressions were run as 3-stage models. Total negative responses on the ASSIQ were entered in the first model, MEPS measures (Total Relevant Means, Activity ratings) were entered in the second model. Proportional responses made over the 5 rounds of the Trust Game

were averaged and this measure (Mean proportional return) was entered in the third and final model of each of the two regressions.

Regression analyses were conducted separately for depressive symptoms and social anxiety symptoms, in order to determine differential contributions of the various cognitive and behavioural measures to each symptom type. Preceding correlation analyses demonstrated significant associations between emotional symptoms and ASSIQ scores, but not with MEPS scores or Trust Game performance. The 3-stage regression models afforded the hypothesis test of whether MEPS scores provided additional explanatory power above ASSIQ scores, and similarly whether Trust Game scores provided additional explanatory power above the interpersonal cognitive measures. This allowed for the formulation of the most predictive model of emotional symptoms using interpersonal cognitive markers.

2.3.4.1 Depression Regression Models

Adjusted R^2 and F statistics are given below for the BDI-II hierarchical regression analysis for Models 1 (ASSIQ only), 2 (ASSIQ + MEPS) and 3 (ASSIQ + MEPS + Mean Trust Game response):

Model 1	Adjusted $R^2 = .213$	R^2 change = .234	$F(1, 36) = 11.02$	$p = .002$
Model 2	Adjusted $R^2 = .226$	R^2 change = .055	$F(2, 34) = 1.31$	$p = .283$
Model 3	Adjusted $R^2 = .325$	R^2 change = .109	$F(1, 33) = 5.96$	$p = .020$

Model 1 was significant (ASSIQ only, $\beta = 0.484, p = .002$), but Model 2 (ASSIQ + MEPS) did not provide significantly better fit. Model 3 (ASSIQ + MEPS + Mean Trust Game response) provided significantly better fit than Models 1 and 2. Significant predictor variables for BDI-II score in Model 3 are given below:

Predictor Variable	β	p
Total negative responses on ASSIQ	.511	.001
Mean MEPS Activity rating	.338	.028
Mean proportional response in Trust Game	.373	.020

Therefore, across the various measures presented in the current study, depressive symptoms (BDI-II score) were best predicted by more negative responses on the ASSIQ, more active responses on the MEPS, and higher proportional returns to a co-player in the Trust Game.

2.3.4.2 Social Anxiety Regression Models

Adjusted R^2 and F statistics are given below for the LSAS hierarchical regression analysis for Models 1 (ASSIQ only), 2 (ASSIQ + MEPS) and 3 (ASSIQ + MEPS + Mean Trust Game response):

Model 1	Adjusted $R^2 = .206$	R^2 change = .227	$F(1, 36) = 10.59$	$p = .002$
Model 2	Adjusted $R^2 = .231$	R^2 change = .066	$F(2, 34) = 1.59$	$p = .220$
Model 3	Adjusted $R^2 = .285$	R^2 change = .070	$F(1, 33) = 3.60$	$p = .067$

Model 1 was significant (ASSIQ only), such that choosing more negative responses on the ASSIQ was predictive of LSAS score: $\beta = .477, p = .022$. Neither Model 2 (ASSIQ + MEPS) nor Model 3 (ASSIQ + MEPS + Mean Trust Game response) provided significantly better fit.

2.4 Discussion

Social anxiety and depression symptom scores correlated significantly and positively with one another, as previously observed (Baker et al., 2002; Fresco et al., 2001). Both correlated with the selection of more negative explanations of ambiguous situations, replicating findings from a number of previous studies using the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998; Butler & Mathews, 1983). Across various correlation and regression analyses, the strongest *single* factor for predicting symptoms of both social anxiety and depression was negative interpretation of ambiguous social information on the Ambiguous Social Situations Interpretation Questionnaire.

The relationship of negative interpretations to emotional symptoms was seemingly driven by depression, as partial correlations provided no evidence of an independent relationship with social anxiety. This implies that in the current sample of young adults at least, negative interpretations of ambiguous information might only be related to social anxiety symptoms as a result of co-occurrent depressive symptoms. This is especially interesting given that the Ambiguous Social Situations Interpretation Questionnaire was originally formulated to examine negative cognitive biases associated with social phobia (Stopa & Clark, 2000; Amir et al., 1998). That is not to say that the present findings do not find these same associations between negative biases for ambiguous interpersonal information and social anxiety symptom scores—they clearly do—but simply that the effect is seen here to be even more strongly predictive of depressive symptom scores, as long as both indices are valid.

This is intriguing in itself, but perhaps more pertinent as a developmental consideration. Numerous studies have proposed that anxiety is a developmental precedent to depression (Breslau, Schultz, & Peterson, 1995; Fava & Rankin, 2000; Hettema, Prescott, & Kendler, 2003; Rohde et al., 1991; Kovacs et al., 1989; Parker et al., 1999). While negative interpretation scores were more closely related to depressive symptoms in the present adult sample, it would be interesting to examine whether this holds in other developmental samples. For instance, following the logic of theories of the developmental precedence of anxiety to depression (Rohde et al., 1991; Breslau et al., 1995; Parker et al., 1999), it might be expected that negative interpretive styles are more closely related to anxiety than depression at earlier stages of development, but then these measures are

observed to become more closely related to depressive symptoms with age as anxious symptoms progress into depression. As such future work may wish to more closely consider the relative contributions of negative interpretations and cognitive biases to anxiety and depression in younger age groups.

Complexity of participants' social problem-solving was not correlated with symptoms of social anxiety or depression, nor interpretations of ambiguous situations. The unrelatedness of the Total Relevant Means measure of the Means-End Problem Solving task to social anxiety or depressive symptoms in simple models seems to contrast with previous findings (Watkins & Baracaia, 2002; Gotlib & Asarnow, 1979). However, this lack of relationship coheres with arguments made by D'Zurilla et al. (1998) that the Means-End Problem Solving task's Total Relevant Means index of complexity is not meaningfully related to symptoms of emotional disorder, as this measure does not reflect individuals' ability to generate effective solutions to social problems. That is to say that an individual's ability to generate *detailed* accounts of resolutions to social problems does not necessarily indicate their ability to generate *effective* solutions. Based on the evidence to hand it seems, at least in the current case, that the Total Relevant Means index was more a measure of the former than the latter.

Data show that biased interpretations of ambiguous social situations are the interpersonal factors most strongly linked to symptoms of depression, and to a lesser extent social anxiety. However these findings are limited in several ways. First, the use of a non-clinical sample limits generalisability to clinical manifestations of social anxiety and depression. Social anxiety in the current sample (means given in Table 2.1) was well below guideline clinical cut-offs for the Liebowitz Social Anxiety Scale, which are an overall score of 55 for mild social anxiety, up to 95 for severe social anxiety (Liebowitz, 1987). Scores on the Beck Depression Inventory-II were slightly higher than the normative mean of 9.11 given in Dozois et al. (1998) for an undergraduate population, but still well below clinical means (Beck et al., 1996).

Second, the index of social behaviour used in the current study (the Trust Game) exhibited a lack of any interactions with other interpersonal measures. This may call into question the viability of the Trust Game as a valid measure of simple social functioning. Participants began the Trust Game by over-compensating their co-player relative to equality of pay-off. They then progressively decreased their returns, such that by the end of the game (Round 5) their responses did not significantly differ from responses that would ensure equality of outcome for the two players. These results cohere with suggestions of equality of outcome as a stable behavioural equilibrium in behavioural exchange from previous behavioural economics work (Sutter & Kocher, 2007; Almlå s et al., 2010; Belli et al., 2012). Such findings have also previously been shown in conjunction with an initial tendency to be more generous than this equilibrium, which is then calibrated in line with the co-player's actions. This effect was again replicated by current findings.

Covariate analyses examining responses made over the course of the game suggest that this index of social behaviour was not influenced by individual differences in social anxiety or depression symptom scores. The lack of direct

association between interpretive measures, behavioural planning and low-level social behaviours shows that they index distinct aspects of interpersonal function. However the absence of meaningful associations of problem-solving and Trust Game responses with emotional symptoms may suggest that these are less valid indices of socio-emotional functioning. In any event these latter two measures have been showed to be of less direct relevance to future identifications of interpersonal markers for anxious and depressive symptoms.

2.4.1 Conclusions and Future Developments

Across the various correlation and regression analyses, the strongest *single* factor for explaining variance in scores of both social anxiety and depressive symptoms was negative interpretation of ambiguous social information. The addition of social problem-solving measures did not explain significantly more variance in depressive symptoms in adulthood, unless they were included together with the social behavioural measure of the Trust Game. However, the current study used a community sample of adults. Any individuals showcasing symptoms of anxiety or depression may therefore be those who have developed the most robust coping or compensatory strategies for dealing with their symptoms. As such these individuals may not be representative of individuals who are at risk for developing clinical emotional disorders in future.

Although current findings represent a useful description of interrelations between emotional symptoms and interpersonal measures during adulthood, there is a great deal of scope to extend this work. Interrelations between the various measures in the current study may vary across development, or be distinct in those at risk for later clinical emotional disorders. Future work should therefore extend examination of biased patterns of interpersonal interpretations in relation to emotional symptoms and disorders to other developmental groups, and to populations identified as at-risk for the development of such disorders.

3

Interpersonal Cognition and Emotional Symptoms in Twins at 8 and 10 Years

I like rolling with friends

Tyga (2010)

Consistent behavioural genetics data show child and adolescent anxiety and depression are heritable. More recent research has identified cognitive factors that may reflect risks for emotional disorders. Data from 250 twin pairs were used to examine: (i) associations between childhood interpersonal cognitions and anxious and depressive symptoms; (ii) potentially predictive directions of these associations over time; (iii) genetic and environmental influences on these relationships. Items from the Perceptions of Peers and Self and Children's Expectations of Social Behaviour Questionnaires were analysed using Principal Components Analysis to identify key factors. Longitudinal models showed negative expectations of social partners predicted subsequent depressive symptoms. Depressive symptoms predicted subsequent negative perceptions of social situations. Multivariate genetic models identified sources of co-variance between interpersonal cognitive factors and emotional symptom scores. Shared genetic and environmental variance between negative perceptions of social situations and anxious and depressive symptoms were found. However large environmental contributions across variables suggested that such interpersonal cognitive biases can be environmentally influenced.

3.1 Introduction

3.1.1 Associations Between Interpersonal Cognitions and Emotional Symptoms

Numerous studies have demonstrated strong associations between emotional symptoms and interpersonal cognitions across adolescent (Salemink & Wiers, 2011; Hankin, 2008; Taghavi, Moradi, Neshat-Doost, Yule, & Dagleish, 2000) and childhood samples (Banerjee, 2008; Barrett et al., 1996; Creswell, Schniering, & Rapee, 2005; Garnefski, 2000; Rudolph, Hammen, & Burge, 1997). At the same time, it is important to recognise that interpersonal cognitive function may not be a unitary construct in these age groups. One important distinction is between the presence of negative cognitive biases and the absence of positive cognitions (Gençöz et al., 2001). Another distinction is between cognitions about different aspects of social interaction e.g. family, peers, self (Rudolph et al., 1997; Garnefski, 2000). A third dimension is whether general perceptions about social situations and expectations of the outcomes of specific social situations are part of the same set of processing biases (Gregory, Rijsdijk, et al., 2007; Rudolph, Hammen, & Burge, 1995).

Rudolph et al. (1997) explored associations of three aspects of social interaction (family, peers, self) with symptoms of anxiety and depression in a community sample of 8–12 year-olds. Perceptions and expectations of social situations were indexed by the Perceptions Of Peers and Self, and Children's Expectations of Social Behaviour Questionnaires respectively (Rudolph et al., 1995). Negative expectations and negative or non-positive perceptions of mothers, family, peers and self were associated with both anxious and depressive symptoms. Upon controlling for concurrent anxiety and depression, the associations of negative expectations of mother and peer behaviours, and of negative expectations of peer behaviour with anxiety were largely subsumed by co-occurrent depressive symptoms. Distinct associations remained between negative and non-positive perceptions of peers and the self and both anxious and depressive symptoms. However, this analysis gave no indication of whether certain components (positive vs. negative, family vs. peer) of the various interpersonal measures might differentially predict the two symptom types.

Gregory, Rijsdijk, et al. (2007) identified the orthogonality of positive and negatively-valenced perceptions of social situations, based on the tripartite model of anxiety and depression (Clark & Watson, 1991). Gregory et al. identified four orthogonal factors within interpersonal cognition in 8-year-olds: negative expectations of peers' behaviour, negative expectations of mothers' behaviour, presence of negative perceptions of peers and self in social situations, and absence of positive perceptions of peers and self in social situations. The former 3 were correlated with both anxiety and depression, and the negative nature of these factors mirrors the 'Negative Affect' component of Clark and Watson (1991)'s tripartite model. Absence of positive perceptions of social settings was specifically associated with depressive symptoms, supporting the tripartite model's conception of depression as the manifestation of negative affect

in the absence of positive affect. These findings support other work to have previously demonstrated the validity of tripartite cognitive structures of anxiety and depression in children and adolescents (Gençöz et al., 2001). The study also showed no evidence of any distinction between cognitions relating to the self, mothers, or peers in their association with emotional symptoms.

However such studies have tended to be cross-sectional in nature. Interrelations between interpersonal, cognitive and emotional factors may be distinct at different ages (Cole & Turner, 1993; Hankin, 2008). Dynamic changes are reliably observed in late childhood and early adolescence relating to the orientation of self to others within social contexts (Brown, 2004; Hartup, 1996; Greenberg et al., 1983). Similarly, various emotional symptoms show their first onset during late childhood and early adolescence (Kessler et al., 2005; Gregory, Caspi, et al., 2007; Otto et al., 2001). Given the strong inter-relations between interpersonal cognitions and emotional symptoms, such findings strongly suggest that associations between interpersonality and emotionality will be dynamic across development. The present study therefore aims to explore associations between interpersonal cognitive factors and emotional symptoms across time.

Associations of emotional symptoms with interpersonal cognitive risk factors also bear upon potential dissociations between components of anxiety and depression. Strong correlations between anxious and depressive symptoms are well-established, and these disorders are highly co-morbid (American Psychiatric Association, 2000; Moffitt et al., 2007; Boomsma et al., 2005). As such any risk factors for anxious and depressive disorders or symptoms would therefore also likely be predictive of both disorders, even if this risk factor was specific to the aetiology of only one. This highlights the importance of constructing models that are able to control for co-occurring symptoms. Models controlling for anxious-depressive correlations would therefore be the best suited to examinations of interpersonal cognitive risk factors for emotional disorders over time, as well as questions of potential dissociations between anxiety and depression.

3.1.2 Genetic And Environmental Influences On Emotional Symptoms And Risk Factors

Research into the aetiology of emotional disorders has begun to study sources of genetic and environmental influences on associations between emotional symptoms and interpersonal cognitive risk factors across development (Eley & Zavos, 2010; Rice et al., 2002). Anxious and depressive symptoms in childhood and adolescence have previously been shown to arise from inherited characteristics (Eley & Stevenson, 1999; Silberg et al., 2001), as well as social environmental factors (Lau & Eley, 2006). Interpersonal cognitive factors have also been shown to be associated with emotional symptoms in late childhood and adolescence (Muris et al., 2003; Miers et al., 2008). So interpersonal cognitions could potentially reflect intermediate markers of genetic and environmental influences on the distal risks of emotional symptoms or disorders. These issues may be informed by research that seeks to identify sources of genetic or environmental

3. INTERPERSONAL COGNITION AND EMOTIONAL SYMPTOMS IN TWINS AT 8 AND 10 YEARS

influences shared across these interpersonal and emotional factors, and contrast these with sources of variance that distinguish between them.

Consistent behavioural genetics data have shown that anxiety and depression are largely heritable during childhood and early adolescence. In a large, emblematic study, Boomsma et al. (2005) showed emotional symptoms to be predominantly predicted by genetic factors during mid and late childhood. This decreased with age: from 67% genetic explanations of total variance at age 7, to 48% genetic variance at age 12. This study used a single measure of anxious and depressed mood derived through factor analysis, rather than separate indices for each disorder. In this sense it is unfortunately blind to any distinctions in variance between the two disorders, which is especially unfortunate given their distinct patterns of emergence and development (Kessler et al., 2005; Fava & Rankin, 2000). Nonetheless, results from Boomsma et al. (2005) reflect findings from other studies to have found significant genetic effects upon co-occurring anxiety and depression in childhood and adolescence (Eley & Stevenson, 1999; Silberg et al., 2001).

Eley and Zavos (2010) compare such predictions of a general anxiety-depressive factor primarily by genetic means with environmental influences that differentially predict anxiety and depression. Indeed, genetic influences predicting overlap between anxious and depressive symptoms, and environmental influences differentiating these two symptom types were demonstrated in late childhood in a twin study by Zavos et al. (2010). So while there may be large genetic influences upon a common anxiety-depressive component, environmental factors may determine the specific manifestation of this component as an overt outcome measure such as anxiety or depression.

In contrast to emotional symptoms, interpersonal cognitive factors have been found to be subject to lesser genetic influences, with comparatively greater influence from environmental sources. Eley et al. (2008) examined symptoms of anxiety and depression in relation to interpretive biases for ambiguous homophones (Taghavi et al., 2000) and ambiguous social situations (Barrett et al., 1996) within an 8-year-old twin sample. Univariate genetic analyses showed moderate genetic influences upon interpretations of ambiguous situations (24% of variance) and of ambiguous homophones (30% of variance). The majority of the variance however (68–69% in both cases) was explained by non-shared environmental influences, with only very small shared environment effects.

Similar results have been shown across other interpersonal cognitive risk factors for emotional symptoms in late childhood and adolescent samples. Negative attributional styles show associations with emotional disorders in a manner analogous to negatively biased interpretations (Alloy et al., 1999; Gladstone & Kaslow, 1995), and have been implicated as diathesis vulnerabilities for emotional disorder (Robinson, Garber, & Hilsman, 1995; Lau, Rijdsdijk, Gregory, McGuffin, & Eley, 2007). In a twin sample of 12–19 year-olds, Lau et al. (2006) found moderate genetic influences on attributional style, though the majority of variance was ascribable to the effects of non-shared environment. Similar analyses have examined negative attributional style between ages 8–10 (Lau et al., 2012). Negative attributional styles were primarily influenced by non-shared

environments, with small-to-moderate contributions from genes and shared environmental effects. The prevailing finding across these studies is that various interpersonal cognitive risk factors for anxiety and depression show large influences of the environment—especially non-shared environments, or environmental factors specific to individuals—and comparatively small effects of genetic influence.

Eley et al. (2008) further advocated the use of behavioural genetics to examine whether interpersonal cognitive factors reflect intermediate risk factors for distal genetic versus environmental influences on emotional outcomes. Multivariate genetic models have previously shown common sources of variance between symptoms of emotional disorder and interpersonal and cognitive factors such as attributional style or interpretive biases. Eley et al. (2008) examined correlations between sources of variance in depressive symptoms and negative interpretations of ambiguous scenarios. The association between depression and negative interpretations was primarily influenced by non-shared environment (explaining 41% of this phenotypic correlation), followed by genes (38%) and then shared environment (21%).

Lau et al. (2012)'s sample of 8–10 year-olds showed similar sources of influence. Inter-relations between negative attributional styles and emotional symptoms at each age were best fit by a model featuring a single latent factor explaining attributional style and anxious and depressive symptoms. This latent factor showed significant influences from both shared and non-shared aspects of the environment, but no significant contribution from genes. Conversely, Lau et al. (2006)'s multivariate models of 12–19 year-old adolescents investigated the influences in the phenotypic correlation between attributional style and depression—that is, the correlation between these two overt outcome measures or phenotypes. The covariance between the two phenotypes of attributional style and depression was primarily due to genetic factors (60–66% of the observed covariance). The rest of the phenotypic correlation was ascribable to influences of the non-shared environment (34–40%). So similarities between the interpersonal cognitive measure of attributional style and depressive symptoms were mainly due to shared genetic influences. By contrast, Gregory, Rijdsdijk, et al. (2007) found that overlapping sources of variance across negative interpersonal interpretations and depressive symptoms were primarily influenced by environmental factors.

Different genetic models have previously characterised overlap between interpersonal cognitive factors and emotional symptoms in different ways. Further details and example illustrations of how these various models characterise overlapping versus distinct sources of genetic and environmental influences on interpersonal and emotional phenotypes are given in Appendix A. Lau et al. (2012) found that the overlap between negative attributional style and depressive symptoms was best modelled by a single latent factor underlying both of these outcome measures. Eley et al. (2008) characterised overlap between negative interpretive biases and emotional symptoms as correlations between what were ostensibly distinct genetic and environmental influences on each phenotype.

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In contrast to both of these models, (Gregory, Rijdsdijk, et al., 2007) found that the relationship between interpersonal cognitive factors and anxious and depressive symptoms at age 8 was best fit by an independent pathways model. This model distinguishes between those sources of genetic and environmental variance that are unique to each factor within the model, and those sources that are common across various factors. In particular, the study showed common sources of shared environmental influences across depressive symptoms, negative behavioural expectations of mothers and peers, and the absence of positive perceptions of social interactions at age 8. The model also demonstrated a common source of influence from twins' non-shared environments upon depression, negative behavioural expectations of mothers and peers, and the presence of negative perceptions of social situations. These overlapping sources of variance were demonstrated in conjunction with various genetic and environmental influences specific to each factor within the model. Again, example illustrations of the kinds of models used by Lau et al. (2012), Eley et al. (2008) and Gregory, Rijdsdijk, et al. (2007) are given in Appendix A for clarity.

Across these studies, the pattern of genetic and environmental influences on the relationships *between* emotional symptoms and their interpersonal risk factors are less clearly understood than for either the symptoms or risk factors themselves. There is however a consistent finding of substantial contributions from non-shared environmental sources to the relationship between emotional symptoms and risk factors. Furthermore, patterns of associations between emotional and interpersonal cognitive factors shape the understanding of patterns of overlapping genetic and environmental influence between such factors. This highlights the need to examine multivariate genetic models of associations between interpersonal cognition and symptoms of emotional disorder in addition to univariate models of the genetic and environmental influences on each factor in isolation, in order to best understand the relationship between these factors across development, and the aetiology of emotional disorders.

3.1.2.1 Changing Genetic And Environmental Influences Over Development

Genetic and environmental influences on numerous cognitive and emotional traits show dynamic variation across development (Jaffee, 2011; Uher, 2011; Kendler, 2011). This identifies the need to examine genetic and environmental contributions to interpersonal cognitive factors and emotional symptoms across time. As previously noted, the current study aims to test temporally predictive pathways between interpersonal cognitive factors and emotional symptoms. By combining these longitudinal analyses with examinations of genetic and environmental overlap between factors, the study may also be able to speak to the issue of whether interpersonal cognitive factors represent intermediate factors for distal genetic and environmental influences on anxious and depressive symptoms.

In relation to the over-arching aims of the current work, it would be especially informative to examine commonalities and specificities in genetic and en-

environmental influences on multivariate models of interpersonal cognition and symptoms of emotional disorder at the developmental period immediately preceding adolescence (Kessler et al., 2005; Gregory, Caspi, et al., 2007; Rohde et al., 1991). In particular, determining sources of influences upon these developmental pathways to emotional symptoms stands to inform any subsequent work that would look to intervene in this process.

3.1.3 Aims

The current study aims to address three main aims in a late childhood sample:

1. To replicate different dimensions of interpersonal cognitions that children may vary upon in late childhood seen in Gregory, Rijdsdijk, et al. (2007), and the association of these factors with emotional symptoms. Further to assess the specificity of interpersonal cognitive factors to each symptom type.
2. To model temporally predictive relationships between interpersonal cognitive factors and emotional symptoms using longitudinal data.
3. To identify sources of genetic and environmental influence on predictive relationships between interpersonal cognitions and emotional symptoms across late childhood.

3.2 Methods

3.2.1 Participants

Data come from monozygotic (MZ) and dizygotic (DZ) twins taking part in the Emotions, Cognitions, Heredity and Outcome (ECHO) study (Eley et al., 2007). ECHO twins were selected from the Twins Early Development Study (TEDS; Trouton, Spinath, & Plomin, 2002), a larger ongoing longitudinal sample of all twins born in England and Wales during 1994–1996. The ECHO Wave 1 sample comprised 300 8-year-old twin pairs ($\bar{x}_{age} = 8.47$ years, $sd = 0.18$): 247 pairs were selected from TEDS on the basis of high parent-reported anxiety at age 7 (those scoring in the top 15% for anxiety); 53 control twin pairs were also chosen to ensure coverage of the full range of scores on test measures. Eleven families were considered unusable at Wave 1 because of autistic spectrum disorders, severe receptive language impairments, or persistent attention problems in at least one of the twins, so only 289 families were contacted at Wave 2 approximately 2 years later (Lau, Gregory, et al., 2007). Of these, 250 families (87%) agreed to participate.

Data collection for ECHO took place at the Institute of Psychiatry in London, with a small number of families visited in their homes. Written informed consent was obtained from parents of all twins. Cross-sectional analyses in the current study utilised Wave 2 data, but variables from the Wave 1 data set were also used in longitudinal analyses. Mean age of twins at Wave 2 was 10.09 years

3. INTERPERSONAL COGNITION AND EMOTIONAL SYMPTOMS IN TWINS AT 8 AND 10 YEARS

($sd = 0.26$). Of the 250 twin pairs at Wave 2, there were 35 male MZ pairs; 48 female MZ pairs; 25 male DZ pairs; 44 female DZ pairs; and 98 opposite-sex DZ pairs. The sample was predominantly (82%) white, and all parents of children in the sample were in employment and had remained in education until the age of 18. Full data across all questionnaires reported here were available for 246 twin pairs.

Because the ECHO sample is subject to selection biases (oversampling symptomatic children) and response biases (individuals with mothers reporting higher levels of emotional symptoms and who experienced greater negative life events were less likely to participate at Wave 2), a weighting factor was constructed for use in subsequent analyses. This multiplied the ratio of the probability of selection of high symptom families to that of non-symptom control families, and the inverse of the predicted probability of families remaining at Wave 2 using significant predictors. By incorporating weights into analysis, parameter estimates are adjusted to reflect less weight being assigned to individuals from categories over-represented by the sampling process, and greater weight to those under-represented.

3.2.2 Ethical Issues

Ethical approval was provided prior to data collection for the original ECHO (Eley et al., 2007) and TEDS (Trouton et al., 2002) studies by the Research Ethics Committee of the Institute of Psychiatry and South London and Maudsley NHS Trust. The main potential ethical issue involved with the current dataset was that of collecting information children detailing their experience of symptoms of emotional disorder, and in particular in selecting a dataset based on high-anxiety scores. As participants themselves were not old enough to legally provide fully informed consent, informed consent was provided on their behalf by their guardians/parents. All questionnaires and screening or clinical interviews conducted as part of the initial TEDS sample were administered/conducted by trained professionals with clinical experience, such that appropriate steps—or, if necessary, referrals—could be made in the event that clinical symptoms or risk behaviours were newly identified during data collection. Data were shared from the existing ECHO dataset in accordance with ethical guidelines and informed consent provided during the initial data collection, which stated that participants' data could be reviewed and analysed at other universities or institutions, for academic purposes. The dataset used for the current analyses was transferred securely, and all data were anonymised. Under formal ethical guidelines, former participants are free to withdraw their data from the dataset at any point if they so choose.

3.2.3 Measures

3.2.3.1 Screen for Childhood Anxiety Related Disorders

Anxious symptoms at both waves were measured using the Screen for Childhood Anxiety Related Disorders (SCARED; Birmaher et al., 1997). The SCARED

is a 41-item self-report questionnaire consisting of statements describing common anxiety symptoms, e.g. 'I am nervous', 'I am scared to go to school'. Participants rate how frequently these occur on a 3-point Likert-like scale between 0 (*Not True*) and 2 (*Often True*). Scores are summed across items, with higher total scores indicating higher anxiety. The SCARED has high internal reliability and test-retest reliability in 9–18 year-olds ($\alpha = .93, r = .86$; Birmaher et al., 1997), and high concurrent validity with other child and adolescent anxiety measures, including the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1978): $r = 0.86$, the revised Fear Survey Schedule for Children (Ollendick, 1983): $r = 0.62$, and the State-Trait Anxiety Inventory for Children (Spielberger, 1973): $r = 0.73$ (Muris, Merckelbach, Schmidt, & Mayer, 1998).

3.2.3.2 Children's Depression Inventory

Depressive symptoms were measured using the Children's Depression Inventory (CDI; Kovacs, 1985). The CDI is a 27-item self-report questionnaire adapted from the Beck Depression Inventory (Beck, Rush, Shaw, & Emery, 1979) for use in children and adolescents. Individual items consist of three statements about the frequency with which a depressive symptom has occurred over the past two weeks, e.g. 'I am sad once in a while' (0), 'I am often sad' (1), and 'I am sad all the time' (2). Total scores range between 0 and 54, with higher scores indicating higher levels of depression. The CDI has excellent internal reliability in both patient ($\alpha = .80, n = 105$) and community ($\alpha = .94, n = 105$) samples of 7–13 year-olds (Saylor, Finch, Spirito, & Bennett, 1984). The measure has demonstrated good discriminant and convergent validity in a 6–16 year-old sample (Hodges, 1990), and clearly discriminates between depressed and non-depressed groups (Hodges & Craighead, 1990).

3.2.3.3 Children's Expectations of Social Behaviour Questionnaire

The Children's Expectations of Social Behaviour Questionnaire (CESBQ; Rudolph et al., 1995) provided an index of children's expectations about the prospective behaviour of their mothers and peers. In this measure children are read 30 descriptions of hypothetical interpersonal situations (15 featuring their mother and 15 featuring peers), and instructed to choose the most likely outcome from 3 alternatives for each. The 3 alternative responses include a positive or accepting behaviour; an indifferent behaviour; and a negative, hostile or rejecting behaviour. For example: "You see some kids playing a game during break one day so you go over and ask if you can play with them. What do you think they might say?". The three responses are: "They might tell me to join in and make room for me" (positive), "They might just act like I wasn't even there and keep playing" (indifferent), and "They might say mean things about me and tell me to go away" (negative). Responses are rated 0 (positive), 1 (indifferent), or 2 (negative). Summing across items, higher scores indicate more negative expectations of social partners' behaviours. Rudolph et al. (1995) demonstrated high internal reliability for the measure, within both the mother ($\alpha = .72$) and

peer ($\alpha = .83$) sub-scales. The CESBQ also shows high test-retest reliability in 7–12 year-olds over a 5-month period: $r = .82$ (mother items), $r = .68$ (peer items).

3.2.3.4 Perception of Peers and Self Questionnaire

The Perception of Peers and Self questionnaire (POPS; Rudolph et al., 1995) measured children's perceptions of themselves and others in social contexts. It comprises 30 items, 15 of which concern beliefs about others (e.g. "Other kids are pretty helpful when you need them", "Other kids can sometimes be pretty mean") and 15 of which concern beliefs about the self (e.g. "I am a lot of fun to be with", "It's a waste of other kids' time to be friends with me"). Children rate how much they agree with each item on 4-point Likert-like scales ranging between 1 (*Not At All*) and 4 (*Very Much*). Some items are positive ("Other kids are pretty easy to get along with"), others are negative ("Other kids are really out to get you"). Positive items are reverse-coded such that a higher total score indicates more negative perceptions. The POPS has high internal reliability for both peer ($\alpha = .75$) and self ($\alpha = .83$) sub-scales (Rudolph et al., 1995). Additionally, Rudolph et al. (1995) found test-retest reliabilities of $r = .69$, $p < .0001$ for both sub-scales over a 1-month period, and individual test-retest reliabilities of $r = .55$, $p < .005$ (peer sub-scale); $r = .60$, $p < .002$ (self sub-scale) over a 5-month period.

3.3 Statistical Analyses

Two sets of analyses were conducted in SPSS (IBM Corp, 2011) and the structural equation modelling package Mx (Neale, Boker, Xie, & Maes, 2003). A first set of analyses examined the factor structure of interpersonal cognitive measures. These factors were used to examine phenotypic associations between interpersonal cognitive factors and emotional symptoms within Wave 2 (age 10), and across time. The second set of analyses examined genetic and environmental influences on these relationships.

3.3.1 Phenotypic Associations Between Interpersonal Cognitions and Emotional Symptoms

3.3.1.1 Factor Analyses

Factor Analyses examined the underlying phenotypic factor structure of Children's Expectations of Social Behaviour Questionnaire (CESBQ) and Perceptions of Peers and Self in Social Situations (POPS) questionnaire items at Wave 2, with a view to replicating the factor structure of components of interpersonal cognition demonstrated by Gregory, Rijdsdijk, et al. (2007). An exploratory principal components factor analysis using varimax rotation was conducted on the 2 measures' 60 constituent items at Wave 2. A second set of confirmatory factor analyses were then conducted on these same 60 items, constraining the num-

ber of factors based on Scree output from the exploratory analysis. Twin pairs were split to give two random halves of the dataset. Two confirmatory factor analyses were conducted, one in each half of the randomly-split dataset, as an internal replication. For the confirmatory analyses, each item was allocated to the factor on which it loaded most highly. These items were used to interpret and name the factors, and were compared with items loading onto factors in Wave 1 (Gregory, Rijdsdijk, et al., 2007).

Summed scores of the items loading onto each factor for each individual were calculated, as long as individuals had data for at least 70% of items. Items were allocated to the factor on which they loaded most strongly. Sum scores were then calculated for items loading onto each factor. These summed scores were used as indices for components of interpersonal cognition in all subsequent analyses. The resulting factors were examined for mean sex differences before they were used in any subsequent analyses. Male and female means were compared using a MANOVA across the emotional and interpersonal outcome measures, with sex as a fixed factor.

3.3.1.2 Within-Time Correlations

Correlation analyses examined associations between interpersonal cognitive factors and anxious and depressive symptoms scores at Wave 2, in an attempt to replicate previous findings of significant relationships between such measures. Partial correlations further examined associations at Wave 2 between interpersonal cognitive factors and anxious symptoms while controlling for depression, as well as associations between depressive symptoms and interpersonal cognitive factors while controlling for anxiety. This was done to determine potential specific associations between certain components of interpersonal cognition and either anxiety or depression, given previous establishments of the high degree of overlap between these symptom measures.

3.3.1.3 Across-Time Correlations and Cross-Lag Models

Interpersonal cognitions at Wave 1 (age 8) were correlated with symptom measures at Wave 2 (age 10), in order to model potentially predictive relationships over time. Partial correlations were used to control for pre-existing symptom scores and co-morbidity between anxious and depressive symptoms. Building on these across-time correlations, cross-lag models tested for significant predictive paths between interpersonal cognitive factors and emotional symptoms from Wave 1 to Wave 2 while controlling for the effects of Wave 1 symptoms on Wave 2 interpersonal cognitive factors. For reference, an example cross-lag model is given Appendix A.

3.3.2 Genetic Analyses of Factors

The second set of analyses investigated genetic and environmental influences on interpersonal cognitive factors and their associations with symptoms at Wave 2, and across time. Genetic and environmental influences on each measure

were estimated by comparing within-pair similarity (twin correlations) among monozygotic (MZ) twins, who share 100% of their genetic make-up, and dizygotic (DZ) twins, who share on average 50% of segregating genes. Higher MZ compared to DZ resemblance ($r_{MZ} > r_{DZ}$) is attributed to increased genetic similarity among MZ twins and used to estimate additive genetic (a^2) influences. Within-pair similarity not due to genetic factors is assigned as shared environmental variance (c^2) contributing toward resemblance among individuals in the same family. Finally, non-shared environmental influences (e^2) create differences among individuals from the same family and are estimated from within-pair differences between MZ twins, that is, the one minus MZ twin correlations ($1 - r_{MZ}$), although this term also includes measurement error.

3.3.2.1 Univariate Analyses

Univariate genetic models take these principles and identify parameter estimates of best-fit to the data. Separate univariate genetic models were run for anxious and depressive symptom scores and interpersonal cognitive factors at Wave 2 to determine the relative contributions of additive genetic effects (A), shared environments between twins (C) and non-shared environments (E) to variation in each measure. The equations that these univariate analyses are based on are replicated in Appendix A, with a basic description of how genetic and environmental influences are derived from twin-study methodology.

Models were tested for relative fit against a saturated model using Mx (Neale et al., 2003). Differences in $-2 \log$ likelihood scores between each of the presented univariate models and the saturated model result in a χ^2 distribution. This χ^2 statistic is used to compare across the models, using reductions in degrees of freedom to determine improvements in fit. Additionally the Akaike Information Criterion (AIC; Akaike, 1987, 1974) and Root Mean Square Error of Approximation (RMSEA; Steiger, 1990; Steiger & Lind, 1980) were utilised. AIC values were compared to determine the models' goodness of fit with respect to parsimony, and RMSEAs were used to ensure models showed acceptable fits to the data given large sample sizes.

3.3.2.2 Across-Time Multivariate Analyses

The premise of multivariate genetic analyses is that genetic or environmental influences may influence more than one factor in the model, as opposed to being wholly specific in effect to a single outcome measure. Covariance between factors is determined by using cross-twin, cross-trait correlations—for example, the correlation between one individual's anxiety symptom score and their twin's depression score. By calculating the covariance between emotional and interpersonal factors entered into the model separately for monozygotic and dizygotic twins, multivariate models can then estimate the relative contributions of genetic and environmental influences to shared variance across outcome measures. This is done using the same logic as in the univariate analyses described above—i.e. MZ and DZ twins both share environments, MZ twins share 100%

of their genes, and DZ twins share 50% of their genes with one another; see Appendix A for more details.

Multivariate genetic models were conducted on emotional and interpersonal cognitive measures to identify genetic and environmental sources of predictive relationships between interpersonal cognitive factors and emotional symptoms across the period of late childhood in the current sample. Significant paths between interpersonal cognitive factors and emotional symptoms from Wave 1 to Wave 2—identified in the preceding cross-lag models—were modelled using multivariate genetic analyses to determine genetic and environmental contributions to these paths. Three different multivariate models of the emotional and interpersonal cognitive factors were compared in terms of their relative fit to the data.

The 3 models tested against one another were the Cholesky Model, the Independent Pathways Model, and the Common Pathway Model (see Appendix A for full descriptions and illustrations). These models vary in how they explain common and distinct variance across measures. The Cholesky model assumes specific sets of genetic, shared and non-shared environmental factors on each phenotype within the model, but these may be correlated with one another. Overlapping variance is represented as correlations between sources of specific variance, while distinct variance is captured by differences between these correlations and unity. This approach was used to model shared variance across anxiety, depression and the interpretation of ambiguous social situations and homophones by Eley et al. (2008).

The Independent Pathways model estimates a set of common genetic, shared environmental, and non-shared environmental variance that can affect multiple measures. It then additionally represents unique variance through measure-specific genetic, shared and non-shared environmental effects. This approach was found to provide the best fit to sources of influence on interpersonal cognitive factors and emotional symptoms in Gregory, Rijdsdijk, et al. (2007).

Finally in the Common Pathway model, overlapping genetic, shared and non-shared environmental sources of variance influence a single latent psychometric factor that may then influence each phenotype in the model via factor loadings. Variance unique to each measure is again captured through measure-specific factors. This model was found to best fit data pertaining to shared variance between attributional risk factors and depression in Lau et al. (2012).

Models were tested for relative fit against a saturated model as described above. They were also tested for relative fit against one another, again using Akaike Information Criterion and Root Mean Square Error of Approximation scores. The three models compared in this set of analyses vary in parsimony: the number of statistical assumptions they make about the data. That is to say they vary in the number of statistics estimated by the model relative to observed statistics included in the model. From the Correlated Factors to the Independent Pathways to the Common Factor, each model assumes fewer paths, and so less complexity. Therefore, if two or more models do not differ significantly in the amount of variance that they explain, the most parsimonious account is desirable as it contains the fewest assumptions, as per Occam's Razor.

3.4 Results

3.4.1 Phenotypic Associations Between Interpersonal Cognitions and Emotional Symptoms

3.4.1.1 Factor Analyses

The exploratory factor analysis yielded a Scree plot suggesting a 4-factor solution, given as Figure 3.1. Confirmatory factor analyses were then conducted in each half of the Wave 2 twin sample, constraining the analysis to 4 factors. Each item was allocated to the factor on which it loaded most highly. Items loading onto each factor in both halves of the sample at Wave 2 closely replicated the factor structure of Gregory, Rijdsdijk, et al. (2007) at Wave 1. The same 4 factors emerged across waves, with similar items loading onto each (see Appendix B).

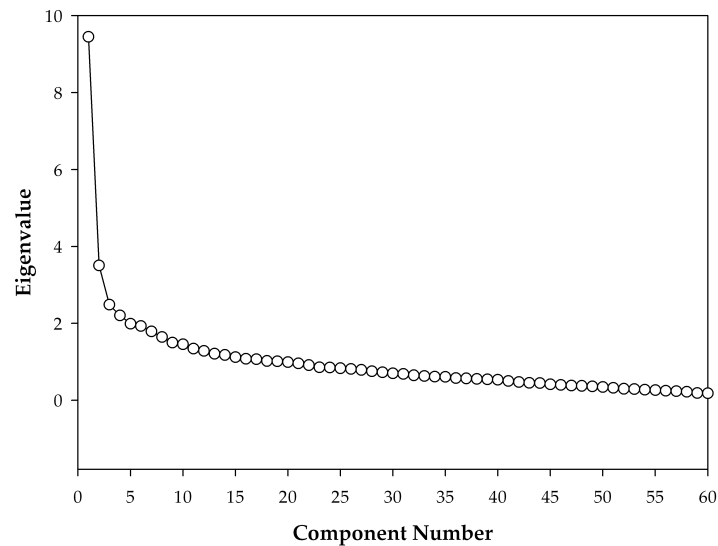


Figure 3.1: Scree Plot resulting from Exploratory Factor Analysis

Sum scores were derived from the confirmatory factor analyses, and comprised the same items used by Gregory, Rijdsdijk, et al. (2007), thus allowing for longitudinal comparisons of factors across waves (see Appendix B). The first factor ('Absence of Positive Perceptions') was comprised of the 15 positively-valenced items from the POPS; the 15 negative items were summed for the second factor ('Negative Perceptions'). Similarly, the 15 mother-related items from the CESBQ were summed for the third factor's scale ('Negative Expectations of Mother'), and the 15 peer-related CESBQ items formed the final scale ('Negative Expectations of Peers'). The 4 scales showed good reliability across the full sample: $\alpha_{AbsentPositivePerceptions} = .85$; $\alpha_{NegativePerceptions} = .76$; $\alpha_{MotherExpectations} = .78$; $\alpha_{PeerExpectations} = .67$, n of items = 15 for each scale. Full lists of items included in each of these factors generated from sum scales are given in Appendix B.

Means and standard deviations of the 4 factors' sum scores, together with symptom measures are reported in Table 3.1. Measures were tested for normality using Kolmogorov-Smirnoff and Shapiro-Wilks tests. All scores were normally distributed with the exception of depressive symptoms. Raw depression scores are given as means in Table 3.1, but all subsequent parametric analyses used transformed scores to ensure normality, so as not to violate any statistical assumptions. The specific transformation used was $\ln(x + 1)$, to allow for transformation of all zero and non-zero scores.

Male and female means were compared using a MANOVA across the six outcome measures (the 4 interpersonal factors, anxious symptoms, and depressive symptoms), with sex as a fixed factor. Significant sex differences were found only for anxiety, which was significantly higher in females than males, though effect size was small: $F(1, 491) = 5.53, p = .019, \eta^2 = .011$. Age and sex effects were regressed out in subsequently presented genetic models.

	Mean Score (<i>sd</i>)			r_{MZ}	r_{DZ}
	Overall	Female	Male		
Anxiety	25.17 (11.59)	26.23 (12.01)	23.80 (10.88)	.43	.17
Depression	8.22 (5.82)	7.89 (5.79)	8.65 (5.86)	.49	.34
Absent +ve Perceptions	1.79 (0.47)	1.80 (0.47)	1.77 (0.45)	.12	.07
Negative Perceptions	1.97 (0.47)	1.97 (0.48)	1.98 (0.47)	.46	.13
Mother Expectations	0.26 (0.22)	0.26 (0.22)	0.28 (0.21)	.41	.20
Peer Expectations	0.17 (0.23)	0.17 (0.24)	0.18 (0.22)	.36	.04

Table 3.1: Means, standard deviations and twin correlations (for monozygotic and dizygotic twin pairs) for each outcome measure. Standard deviations are given in parentheses.

3.4.1.2 Within-Time Correlations

All measures were significantly correlated with one another at Wave 2 (see Table 3.2). Negative Perceptions and Negative Expectations of Peers correlated highly with both anxious and depressive symptoms, while Absence of Positive Perceptions and Negative Expectations of Mothers yielded stronger relationships with depressive than anxious symptoms. Partial correlations (given above the diagonal in Table 3.2) showed that when controlling for depression, anxious symptoms remained significantly correlated with Negative Perceptions and Negative Expectations of Peers, but not with Absence of Positive Perceptions nor Negative Expectations of Mothers. Controlling for anxiety, depressive symptoms remained significantly correlated with all four factors.

3.4.1.3 Across-Time Correlations

All interpersonal cognitive factors at age 8 were significantly associated with symptoms of both anxiety and depression at age 10. The single exception was that Wave 1 Absence of Positive Perceptions did not predict subsequent anxious symptoms (see Table 3.3, first set of correlations). Controlling anxiety and

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	Anxiety	Depression	Absent +ve Perceptions	Negative Perceptions	Mother Expectations	Peer Expectations
Anxiety	1					
Depression	.38**	1		.33**	.05	.15*
Absent +ve Perceptions	.24**	.43**	1	.48**	.36**	.48**
Negative Perceptions	.47**	.57**	.48**	1		
Mother Expectations	.20**	.40**	.24**	.34**	1	
Peer Expectations	.32**	.55**	.44**	.51**	.47**	1

Table 3.2: Correlations between phenotypic measures at Wave 2. *—Significant at .05 level **—Significant at .01 level. Partial correlations after controlling for depression/anxiety respectively are displayed above the diagonal

depression for each other's co-occurrence allowed for an examination of differential predictions of interpersonal cognitive factors upon emotional outcomes.

All interpersonal cognitive scales at Wave 1 significantly predicted *depressive symptoms* at Wave 2 when controlling for Wave 1 anxiety and depression (see Table 3.3, second row of correlations), with the exception of Presence of Negative Perceptions. After controlling for Wave 1 anxiety and depression, Negative Expectations of Peers was the only interpersonal factor to significantly correlate with Wave 2 *anxious symptoms*.

Given the significant correlation between anxious and depressive symptoms at Wave 2 (Table 3.2), correlations were also conducted to examine the effects of Wave 1 interpersonal cognitions on anxiety at Wave 2 while partialling out concurrent (i.e. Wave 2) depression. Correlations also examined the inverse pattern, i.e. the effects of Wave 1 interpersonal cognitions on depression at Wave 2 while partialling out concurrent anxiety. Controlling for depression at Waves 1 and 2 (as well as Wave 1 anxiety), no Wave 1 interpersonal cognition scores remained significantly correlated with Wave 2 *anxious symptoms* (Table 3.3†). Conversely, when controlling for anxiety at Waves 1 and 2 (as well as Wave 1 depression), Wave 2 *depressive symptoms* remained significantly correlated with Wave 1 Negative Mother Expectations and Negative Peer Expectations (Table 3.3‡).

	W1 Absent +ve Perceptions	W1 Negative Perceptions	W1 Mother Expectations	W1 Peer Expectations
Raw Correlations				
W2 Anxiety	.09	.18**	.14*	.25**
W2 Depression	.29**	.18**	.31**	.41**
Controlling for W1 anxiety and depression				
W2 Anxiety	.05	.07	.05	.13*
W2 Depression	.15*	.06	.18**	.25**
Controlling for W1 anxiety and depression, plus W2 other symptoms				
W2 Anxiety†	.00	.05	-.01	.05
W2 Depression‡	.14	.04	.18**	.22**

Table 3.3: Correlations between interpersonal cognitions at Wave 1 and emotional symptoms at Wave 2 *—Significant at .05 level **—Significant at .01 level. Analyses control for Wave 1 anxiety and depression in the second set of correlations, and also control for Wave 2 other-symptom scores in the third set of analyses, denoted by daggers: †—Controlling for Wave 1 and Wave 2 depression, and Wave 1 anxiety ‡—Controlling for Wave 1 and Wave 2 anxiety, and Wave 1 depression.

3.4.1.4 Cross-lag Models of Interpersonal Cognitions and Depression

Accordingly, cross-lag models investigating directional relations between interpersonal cognition and emotional symptoms were conducted for the four interpersonal cognitive factors with depression scores, and not for anxiety. These models afford more precise estimates of parameters given concurrent and reciprocal associations in the current dataset. By controlling for within-time associations, they are also able to estimate the predictive direction of associations given the longitudinal nature of the sample. They estimate cross-time, cross trait paths

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(e.g. from risk factor at t1 to outcome measure at t2) as effects over and above 1) cross-trait correlations individually at each time-point and 2) within-trait correlations across time (see Appendix A for more details).

Four cross-lag models were conducted to investigate predictive paths between depressive symptoms and each of the interpersonal cognition sum scales across time, while controlling for co-occurring effects. Within each wave, each interpersonal cognitive factor was significantly correlated with depressive symptoms—i.e. significant concurrent associations—illustrated by vertical arrows in Figures 3.2–3.5. For each measure, Wave 1 data significantly predicted Wave 2 data, i.e. significant stability (horizontal arrows in Figures 3.2–3.5).

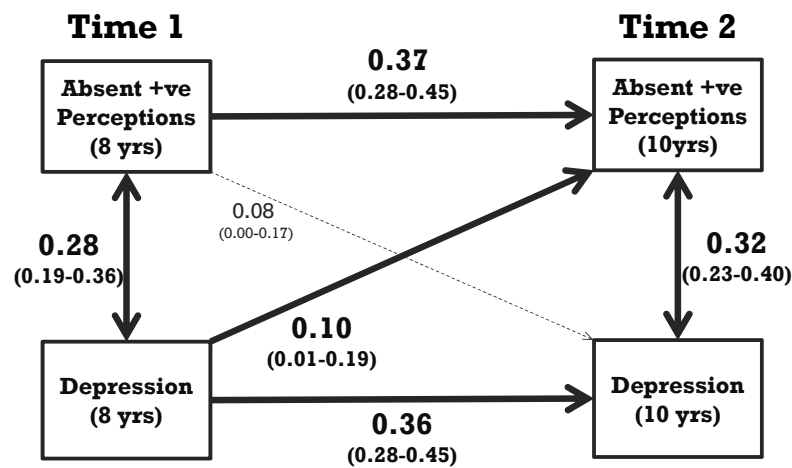


Figure 3.2: Cross-lag model for Absence of Positive Perceptions of Peers and Self, and depressive symptoms at Waves 1 and 2. Here and in the following 3 Figures, significant paths/coefficients are presented as bold lines, and non-significant paths are presented as dashed lines. Arrows indicate the direction of causation as constrained by the model. Confidence intervals are given in parentheses.

Wave 1 depressive symptoms predicted both Absence of Positive Perceptions (Figure 3.2) and Negative Perceptions (Figure 3.3) at Wave 2. However, scores on these phenotypes at Wave 1 did not predict depressive symptoms at Wave 2 suggesting that these perceptions are more likely to be residuals of symptoms than precursors. The opposite pattern was observed for the two scales reflecting expectations of negative behaviour. Depressive symptoms at Wave 1 did not significantly predict Negative Expectations of either Mother (Figure 3.4) or Peer (Figure 3.5) Behaviour at Wave 2. Scores on both of these interpersonal cognition scales at Wave 1 did however predict Wave 2 depression scores, suggesting that these expectations of mother and peer relationships were more likely to be precursors than residuals.

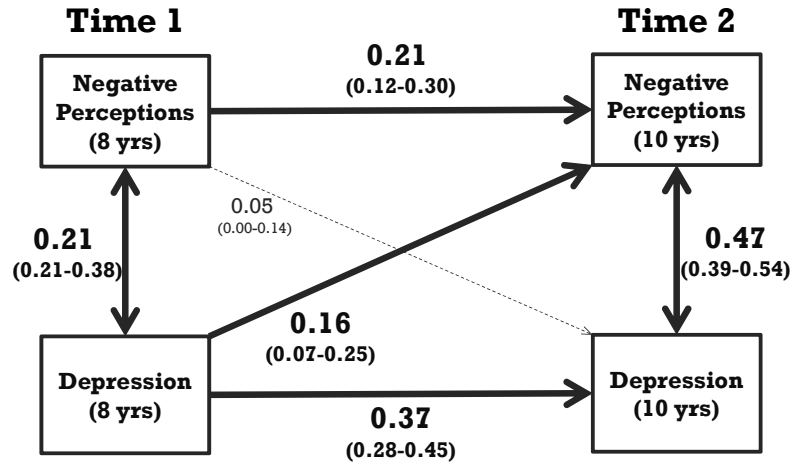


Figure 3.3: Cross-lag model for Presence of Negative Perceptions of Peers and Self, and depressive symptoms at Waves 1 and 2

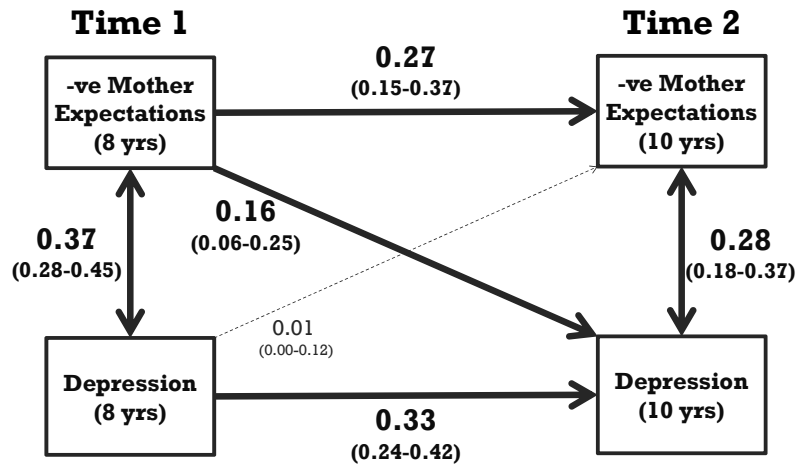


Figure 3.4: Cross-lag model for Presence of Negative Expectations of Mother Behaviour, and depressive symptoms at Waves 1 and 2

3. INTERPERSONAL COGNITION AND EMOTIONAL SYMPTOMS IN TWINS AT 8 AND 10 YEARS

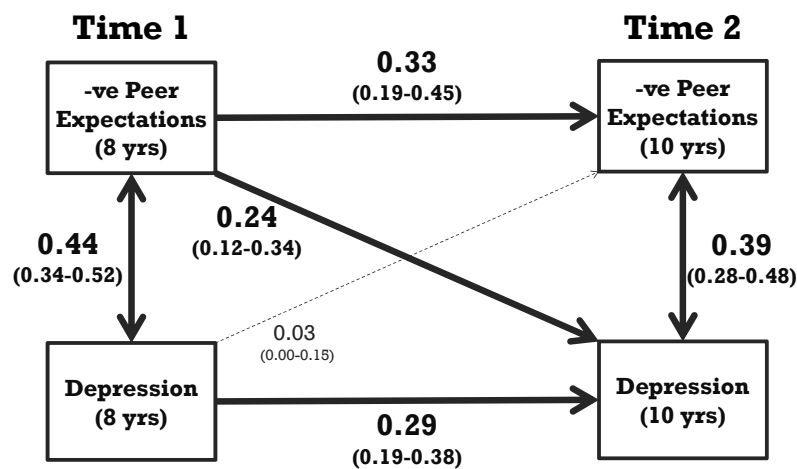


Figure 3.5: Cross-lag model for Presence of Negative Expectations of Peer Behaviour, and depressive symptoms at Waves 1 and 2

3.4.2 Genetic Analyses

3.4.2.1 Univariate Genetic Analyses

Twin correlations for MZ and DZ twin pairs are given in Table 3.1. On the basis of larger MZ than DZ twin correlations, moderate heritability was expected for anxious symptom scores. Moderate shared environmental effects were predicted for depressive symptom scores based on the size of r_{DZ} relative to r_{MZ} . Moderate effects of heritability were also estimated for Negative Expectations of Mothers and Negative Expectations of Peers. The Absence of Positive Perceptions factor showed little evidence for either genetic or shared environmental effects.

Univariate models allowed for the estimation of genetic and environmental influences on each factor, and AIC and RMSEA values showed good fit for the models to the data:

	AIC	RMSEA
Anxiety	2.56	0.05
Depression	-11.25	0.01
Absent +ve Perceptions	-11.76	0.01
Negative Perceptions	-5.23	0.04
Mother Expectations	11.04	0.07
Peer Expectations	-1.99	0.04

Genetic and environmental influences estimated from these univariate mod-

els are illustrated in Figure 3.6. Substantial and significant genetic influences were found for the presence of Negative Perceptions. Moderate genetic effects were estimated for Negative Mother Expectations, but this did not reach significance. Small, non-significant genetic effects were also estimated for anxious symptoms, depressive symptoms, Absence of Positive Perceptions, and Peer Expectations. Small shared environmental influences were estimated for anxious and depressive symptoms, but again neither were significant. Substantial and significant non-shared environmental influences were estimated for all factors.

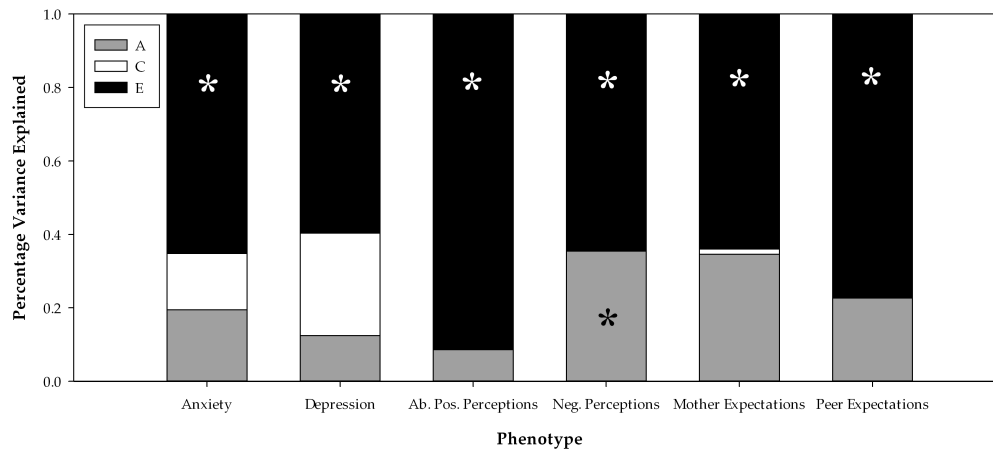


Figure 3.6: Standardised estimates of total percentages of variance explained by Genes (A), Shared (C) and Non-shared Environment (E), from univariate sex-limitation models conducted individually for each factor at Wave 2. Significant influences are shown by asterisks.

3.4.2.2 Longitudinal Multivariate Genetic Analyses

3.4.2.3 Causes of Depression at 10 years

Models represented in Figures 3.4 and 3.5 indicate that for the current set of analyses, the best interpersonal predictive factors for Wave 2 depression are Wave 1 Negative Expectations of Mother and Peer behaviour. On this basis, multivariate genetic analyses were conducted to determine the relative contribution of genetic and environmental effects to the predictive pathway from Wave 1 Negative Mother Expectations and Negative Peer Expectations to Wave 2 depressive symptoms. Three models (Cholesky, Independent Pathways, Common Pathway) were tested for their relative goodness-of-fit. Further details of each model are given in Appendix A. All three multivariate models provided good fit as indexed by AIC and RMSEA. Using the AIC, it was determined that the Common Pathway model was the best fit:

The relative best fit of the Common Pathway model suggests the presence of a latent factor mediating influences from Negative Expectations of Mothers and Peer Behaviour at Wave 1 to depressive symptoms at Wave 2. Path estimates are presented in Figure 3.7. The latent factor showed substantial and significant

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	Cholesky	Independent Pathways	Common Pathway
$-2LL$	2850.00	2850.21	2852.68
χ^2	$\chi^2(87) = 91.57$ $p = .348$	$\chi^2(87) = 91.78$ $p = .342$	$\chi^2(91) = 154.400$ $p = .387$
AIC	-82.43	-82.22	-87.75
RMSEA	0.01	0.01	0.01

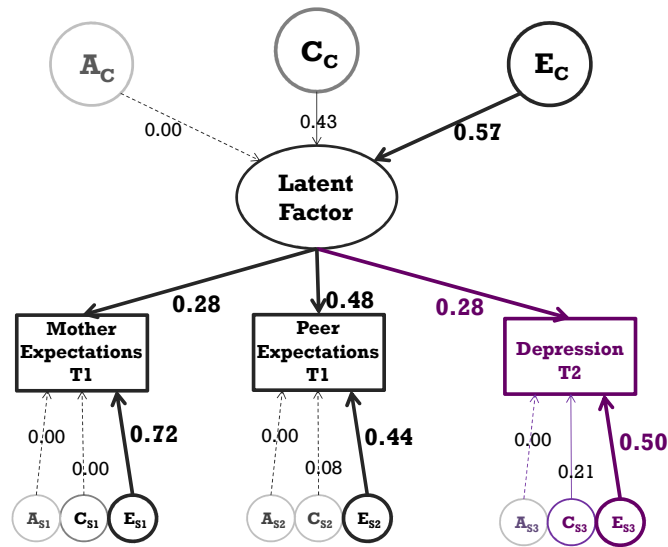


Figure 3.7: Common Pathway model of Wave 1 Negative Expectations of Peers, Wave 1 Negative Expectations of Mothers, and Wave 2 depressive symptoms. Bold lines indicate significant paths, dashed lines denote non-significant paths.

influences on all 3 factors in the model, explaining 28% of the total observed variance in Negative Expectations of Mothers at Wave 1, 48% of variance in Negative Expectations of Peers at Wave 1, and 28% of variance on depressive symptoms at Wave 2.

The sole significant influence on the latent factor was non-shared environment (E_C), common across the 3 phenotypes, which explained 57% of the total variance in the latent factor. There was also a substantial influence of common shared-environmental effects on the latent factor (E_C , explaining the remaining 43% of the total variance in this factor), but this did not reach significance in the current model.

The only other significant effects were factor-specific non-shared environmental influences. These were significant for all three measures, and explained 72% of the total observed variance in Wave 1 Negative Expectations of Mother, 44% of variance in Wave 1 Negative Expectations of Peers, and 50% of variance

in Wave 2 depressive symptoms. No specific genetic influences were found on any factor. Moderate, specific shared environmental effects were found on Negative Expectations of Peers at Wave 1 and depressive symptoms at Wave 2 (explaining 8% and 21% of the total observed variance on these factors, respectively), but neither were significant in the presented model.

3.4.2.4 Consequences of Depression at 8 years

Models presented in Figures 3.2 & 3.3 show that Wave 1 depressive symptom score significantly predicts both the Absence of Positive Perceptions, and the Presence of Negative Perceptions of Peers and Self in social situations at Wave 2. On this basis, multivariate genetic analyses were conducted to determine the relative contribution of genetic and environmental effects to the predictive pathway from Wave 1 depressive symptoms to Wave 2 Absence of Positive Perceptions and Presence of Negative Perceptions. The same three models as above were tested against one another to determine best fit to the data. All analyses were run as 3-factor models including Wave 1 Depression, Wave 2 Absence of Positive Perceptions, and Wave 2 Presence of Negative Perceptions.

All models provided good fit to the data as indexed by AIC and RMSEA. On the basis of the AIC, the data were best fit by the Cholesky model:

	Cholesky	Independent Pathways	Common Pathway
$-2LL$	3340.47	3341.26	3352.38
χ^2	$\chi^2(87) = 122.44$ $p = .007$	$\chi^2(87) = 123.23$ $p = .006$	$\chi^2(9) = 134.35$ $p = .002$
AIC	-51.56	-50.77	-47.65
RMSEA	0.02	0.02	0.02

Path estimates are presented in Figure 3.8. Genetic influence on symptoms of depression at Wave 1 (A_1) loaded significantly on Negative Perceptions at Wave 2. This genetic influence explained 33% of the observed variance in Wave 1 depressive symptoms, and 28% of the observed variance in Wave 2 Negative Perceptions. The effect also showed moderate influence on the Absence of Positive Perceptions at Wave 2 (explaining 6% of the observed variance in this factor), but this path was non-significant. Shared environmental influences were small, with no significant specific effects on any of the 3 factors.

Substantial, significant non-shared environmental effects were found on all three factors. These influences, specific to each factor in the model, explained 66% of the total observed variance in Wave 1 depressive symptoms, 90% of variance in Absence of Positive Perceptions at Wave 2, and 56% of variance in Negative Perceptions at Wave 2. There was also a significant overlapping source of non-shared environmental influence between the Absence of Positive Perceptions and Negative Perceptions at Wave 2, manifested as a significant path from non-shared environment in the former and explaining 7% of the total observed variance in the latter.

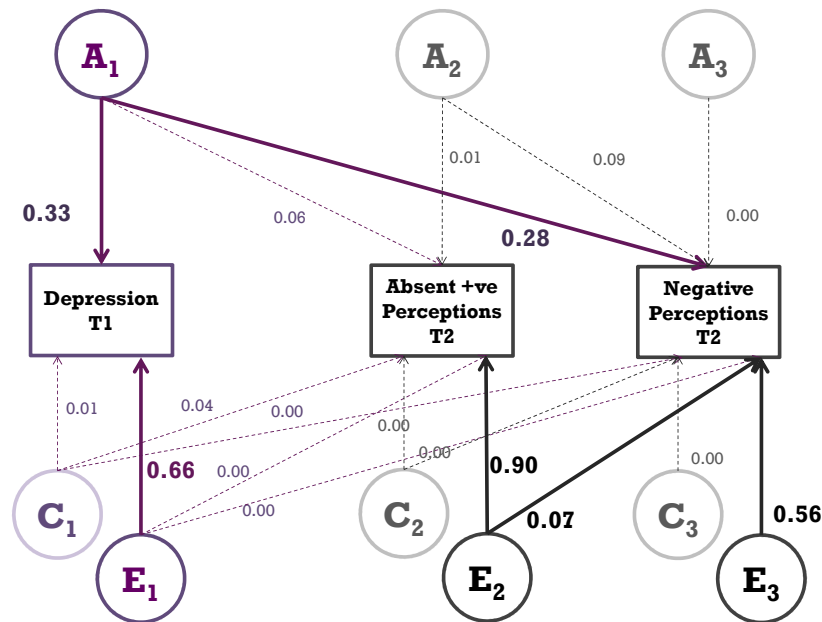


Figure 3.8: Cholesky model of Wave 1 depressive symptoms, Wave 2 Absence of Positive Perceptions and Wave 2 Negative Perceptions. Bold lines indicate significant paths, dashed lines denote non-significant paths.

3.5 Discussion

3.5.1 Summary of Findings

The current study presented two sets of analyses regarding associations between interpersonal cognitions and symptoms of emotional disorders. The first set of analyses replicated the factor structure shown by Gregory, Rijdsdijk, et al. (2007) of components of interpersonal cognitive factors across the Perceptions of Peers and Self in Social Situations and the Children's Expectations of Social Behaviour Questionnaires (Rudolph et al., 1995). Four interpersonal cognitive factors were identified: Absence of Positive Perceptions of Social Situations, Negative Perceptions of Social Situations, Negative Expectations of Mothers' Social Behaviour, and Negative Expectations of Peers' Social Behaviour. All factors correlated significantly with symptoms of anxiety and depression at age 10. When controlling for co-occurring emotional symptoms, associations between anxiety and both the absence of positive perceptions of social situations, and negative expectations of mothers' social behaviour were subsumed by associations of these factors with depressive symptoms. Across-time associations of interpersonal factors with anxious symptoms were also largely subsumed by depression. Cross-lag models showed that negative expectations of mother and peer behaviour at age 8 predicted subsequent depressive symptoms whilst con-

trolling for within and across-time associations of both factors. Symptom scores of depression at age 8 predicted more negative and less positive perceptions of social situations at age 10 whilst controlling for within and across-time associations of both factors.

The second set of analyses examined genetic and environmental contributions to symptoms of anxiety and depression, and the 4 interpersonal factors. Significant genetic influences were estimated for Negative Perceptions. Smaller, non-significant genetic effects were estimated for depressive symptoms, Absence of Positive Perceptions and Peer Expectations. Moderate shared-environmental influences were estimated for symptoms of both anxiety and depression, though again these were non-significant. Substantial and significant non-shared environmental influences were estimated for all factors. Multivariate genetic models identified sources of co-variance between interpersonal cognitive factors and emotional symptoms. Large non-shared environmental contributions across variables suggested that such interpersonal cognitive biases can be environmentally influenced. An overlapping genetic influence was found across depressive symptoms at age 8 and subsequent negative perceptions of social situations. A common latent factor was found between negative expectations of mother and peer social behaviour at age 8 and subsequent depression symptom score, and this latent factor was wholly influenced by the environment.

3.5.2 Interpersonal Cognitive Risk Factors for Emotional Symptoms

The association of negative interpersonal cognitive measures with symptoms of both anxiety and depression after controlling for one another's effects seems indicative of an over-arching composite variable. This resembles the 'Negative Affect' component of the tripartite model of anxiety and depression (Clark & Watson, 1991). By contrast, the absence of positive perceptions of social situations was specifically associated with depressive symptoms after controlling for the shared variance between anxiety and depression. This fits with that exact prediction from the tripartite model (Clark & Watson, 1991), and further supports the use of this model in child populations as well as adults (Gençöz et al., 2001; Hankin, 2008). The relatively larger influence of environment than genes on these factors are also worthy of replication in that they seemingly contradict previous findings that commonalities between anxious and depressive symptoms are primarily due to genetic influence, while their differentiation is a result of environmental influences (Eley & Zavos, 2010; Lau & Eley, 2006; Zavos et al., 2010). This reflects concerns outlined in the Introduction that influences upon socio-emotional relationships may change over time, and further supports the need to conduct more longitudinal studies of genetic and environmental influences upon different components of emotional symptoms. This is especially pertinent in light of findings suggesting dramatic decreases in genetic influences upon over-arching anxiety-depression from middle to late childhood (Boomsma et al., 2005).

The specific association of negative expectations of mother behaviour with depressive (rather than anxious) symptoms is less clear in its interpretation, given that this finding is not predicted by tripartite models (Clark & Watson, 1991; Gençöz et al., 2001). Additionally, though negative expectations of peer behaviour remained significantly correlated with anxious symptoms after controlling for depressive symptoms in cross-sectional analyses, this correlation was relatively weak compared to its correlation with depression. This suggests that negative expectations of social situations, across various social partners, were more closely linked with depressive symptoms. Stronger associations of interpersonal measures with depression than anxiety mirrors previous findings in pre-adolescent samples (Rudolph et al., 1997; Gregory, Rijdsdijk, et al., 2007). This may reflect differences in specific social stressors between the disorders.

Alternatively, Gregory, Rijdsdijk, et al. (2007) have suggested that this might be an artefact of operationalisation, as the depressive measure (Kovacs, 1985) includes more items related to interpersonal function than does the measure of anxious symptoms (Birmaher et al., 1997). This explanation could apply equally well to the current analyses given the similar findings, and use of both these same measures of anxious and depressive symptoms. Further research could disambiguate these options with the inclusion of specifically social anxiety measures together with more generalised anxiety. This would eliminate the confound between interpersonality and depressive measures. If effects were not ascribable to this confound, then future developmental work should be able to clarify what other potential aspect of depression would make it more closely related to interpersonal cognitive factors than anxiety.

Beyond associations between emotional symptoms and negatively biased interpersonal cognitions seen in Chapter 2 and more widely (Banerjee, 2008; Rudolph et al., 1997; Saleminck & Wiers, 2011; Hankin, 2008), the present study further demonstrated that negative expectations of the outcomes of specific social interactions specifically predict later symptoms of depression. This then proceeds to predict more general negative and non-positive perceptions of social situations as a result of progressive depressive symptoms. Negative expectations of mother and peer behaviour at Wave 1 significantly predicted later symptoms of depression, whereas this was not true of Negative Perceptions, nor the Absence of Positive Perceptions of social situations. The former two interpersonal cognitive factors were derived from the Children's Expectations of Social Behaviour Questionnaire, while the latter two were derived from the Perceptions of Peers and Self in Social Situations questionnaire (Rudolph et al., 1995). In the first longitudinal multivariate analysis (Figure 3.7), the specific source of this predictive relationship was that of a latent factor subject to both shared and non-shared environmental influence. The Children's Expectations of Social Behaviour Questionnaire is distinguished from the Perceptions of Peers and Self measures by its implication of children's ability to internalise previous social experiences and use these to generate expectancies of future behaviour from social partners (Rudolph et al., 1995). This feature is therefore common across both the Mother Expectations and Peer Expectations factors, and so may inform the nature of the latent factor in the first longitudinal multivariate model. Catast-

trophising about future social interactions has been implicated in the maintenance of social anxiety in adults (Beck, Emery, & Greenberg, 1985; Stopa & Clark, 2000; Vassilopoulos, 2006), and more recently has also been demonstrated in late childhood samples (Vassilopoulos & Banerjee, 2008; Vassilopoulos et al., 2013). Furthermore the impaired ability to generate positively-valenced future expectations of social situations is a hallmark of hopelessness and depressive reasoning in chronic clinical adults (MacLeod, Rose, & Williams, 1993; Williams, Van der Does, Barnhofer, Crane, & Segal, 2008), which may also be seen in children and adolescents (Spirito, Williams, Stark, & Hart, 1988). This negative future forecasting seems similar to the distinguishing factor of the Children's Expectations of Social Behaviour Questionnaire identified by Rudolph et al. (1995)—that of children's ability to generate positive expectations during social contexts.

If this comparison is indeed valid, then present findings suggest that not only is this kind of negative future forecasting present in childhood and pre-adolescence, but it is associated with depressive symptoms at this age, and most importantly predicts subsequent symptoms of depression. The fact that implicit construction of negative expectations of social partners or social situations is common to all items on the Children's Expectations of Social Behaviour Questionnaire could then be used to inform future models and experiments examining the aetiology of depression. Moreover, the latent factor underlying the predictive relationship between negative expectations of social partners and depressive symptoms was wholly influenced by the environment. This suggests that this path to depressive symptoms in late childhood may be subject to greater influence from experiences in the social environment than from genetics. One caveat worth considering in light of such potential conclusions however is that data from the ECHO sample were based on a selected high-anxiety sample, but weighted and analysed so as to be applicable to anxiety scores in the whole range of possibilities. As a result, conclusions regarding the developmental character of symptoms of anxiety and depression discussed here may not be generalisable to clinical samples.

Genetic factors specific to any one factor—i.e. that would serve to differentiate them from the other socio-emotional factors—were completely absent from both multivariate models. Factor-specific sources of influence were wholly environmental, and among these predominantly due to the effects of non-shared environments. These effects cohere with assertions from previous research that genes influence commonalities across anxiety, depression and their associated risk factors, while environmental influences specify the different manifestations within the overlapping morass of outcomes (Eley & Zavos, 2010; Lau & Eley, 2006; Kendler et al., 1987; Kendler, 1996).

As in previous research there was little evidence of genetic influence on interpersonal cognitions in childhood (Gregory, Rijdsdijk, et al., 2007; Eley et al., 2008; Lau et al., 2012). The relative strength of environmental compared to genetic influences on these interpersonal cognitive measures and their relation to depressive symptoms suggests that these patterns of cognition may be born out of negative experience rather than biological predisposition. However it may be possible that greater genetic influences emerge later in life, such as during

adolescence (Lau & Eley, 2006; Dickens et al., 2011; Scarr, 1992; Lau, Gregory, et al., 2007).

Substantial, significant non-shared environmental effects were found across the best-fitting multivariate genetic models. Due to the logic of twin analyses, non-shared environmental effects also contain Type-II error terms for the rest of the genetic model, which are then expressed as Type-I errors over-estimating the influence of the non-shared effects themselves (Neale & Maes, 1992). For example, concerns have previously been expressed that the ECHO sample might be underpowered to detect shared environmental effects (Eley et al., 2008). The problem is specific to shared environmental effects, as the assumptions of twin sample methodologies are based on correlations within twin pairs. If a study is therefore underpowered to detect significant correlations within twin pairs, then analyses will treat the twins as being more dissimilar. As non-shared environmental effects are calculated as $1 - r_{MZ}$ (see Appendix A), greater apparent dissimilarity between twins will inflate estimations of non-shared environments at the expense of shared environmental effects. This may have inflated estimates of non-shared environmental effects to some extent in the current set of results. This point notwithstanding, non-shared environmental effects appear to explain the majority of the variance in interpersonal cognitions in the presented analyses.

Specific non-shared environmental effects suggest that the expression of different facets of interpersonal cognition represented in the current study are moulded by specific life experiences. Such specific non-shared environmental effects might be expected to indicate modality-specific negative experiences. For example the especially large specific non-shared environmental effects on Negative Mother Expectations in Figures 3.7 and 3.6 could be expected to have resulted from participants' negative experiences with their mothers, which did not then generalise to negative appraisals of other situations. Conversely, overlapping non-shared environmental effects (seen in both multivariate models: Figures 3.7 & 3.8) could represent experiences more akin to life events that did generalise in their influence on appraisals of social interactions—e.g. a negative social experience that increased subsequent negative and non-positive expectations and perceptions of social situations in general.

Within a more comprehensive developmental model incorporating more longitudinal studies of interpersonal cognitive risk factors for emotional symptoms, emotional symptoms or disorders might be observed to gradually recruit other aspects of cognition, thereby losing the specificity of the original negative experiences. An example from the current results is that depressive symptom score longitudinally predicts greater negative perceptions and the absence of positive perceptions of social situations. Thus, while early and specific experiences may sculpt the expression of specific aspects of interpersonal cognition, ongoing depressive symptoms will lead to greater negativity across these unrelated aspects of interpersonality over time. A common finding in behavioural genetic research is the emergence of genetic influences at later developmental stages that were not present at earlier ages (Plomin et al., 2001; Fulker et al., 1988; Dickens et al., 2011). Additionally, the longitudinal model presented in

Figure 3.8 estimates substantial common genetic influence in the development of negative perceptions and the absence of positive perceptions of peers and self in social situations from antecedent depressive symptoms. For these reasons, we might expect to see relatively greater genetic influences on the variance and covariance of interpersonal cognitive measures and emotional symptoms during adolescence and at older ages. Future analyses of the ongoing Twin Early Development Study might be able to provide this information.

4

Positive, Negative, and Control CBM-I Training In Adolescents

And now your friends telling you stories
that you often misinterpret

Drake (2010)

This chapter compares the effectiveness of positive and negative Cognitive Bias Modification of Interpretations (CBM-I) training protocols against two control paradigms (mixed-valence, neutral valence) during adolescence. It also examines whether CBM-I training effects generalise to a questionnaire measure of interpretation. Positive interpretations of novel ambiguous social scenarios were stronger following positive training. Negative interpretations of novel information were stronger following negative training. Post-training measures of interpretations were indistinguishable between mixed and neutral control training conditions. This suggests that either mixed or neutral training is acceptable as a control condition in an unselected adolescent sample. Two suggestions are proposed for future research: 1) When comparing groups in an unselected population, comparisons of positive vs. negative training are a viable way to maximise effect sizes under consideration; 2) When comparing groups in high-risk or clinical settings, positive training may be compared against either mixed or neutral training so as to provide a viable control, whilst protecting participants against any potential ill-effects of negative CBM-I training. Results provided no evidence that post-training modifications of interpretive biases generalised to the questionnaire measure of interpretation, nor any evidence of differential changes in mood as a direct result of CBM-I training.

4.1 Introduction

Cognitive Bias Modification of Interpretations (CBM-I) has been established as a means of modifying patterns of cognitive bias. Previous research has used this to assess the potential causal relationship between negative interpretations and emotional symptoms, with a view to eventually using this methodology to improve subsequent emotional outcomes (Mathews & Mackintosh, 2000; Koster et al., 2009; Hertel & Mathews, 2011; Beard, 2011). Recent work has also been encouraging in adapting this paradigm to adolescent samples (Lau et al., 2011; Lothmann et al., 2011; Salemink & Wiers, 2011). However, given the design of most CBM-I experiments, a number of questions remain in findings obtained to date. This chapter and those following propose and test a number of extensions and modifications to CBM-I paradigms in order to address some of these questions within adolescent populations.

4.1.1 Directionality and Magnitude of Valence-Congruent Training Effects

Convention in CBM-I training paradigms is to test positive against negative training in a between-subjects design. This is the predominant approach in studies of adult (Mathews & Mackintosh, 2000; Hirsch, Mathews, & Clark, 2007; Mackintosh et al., 2006), child (Muris et al., 2008, 2009), and adolescent (Lau et al., 2011; Lothmann et al., 2011) samples. To investigate whether CBM-I training produces the intended interpretational style, participants typically complete an Interpretation Bias Test (IBT; Eysenck et al., 1991) following training. As well as completing the Interpretation Bias Test, participants also rate mood or report on symptoms before and after training to assess effects on emotional outcomes. Full details of the CBM-I paradigm and testing protocols are outlined in Chapter 1.

In comparisons of positive and negative training in child and adolescent samples, negative training has variously been argued to selectively enhance negative biases (Muris et al., 2008, 2009; Lester et al., 2011b), or to do so in conjunction with suppressing positive interpretations (Lothmann et al., 2011; Lau et al., 2011). Positive training has variously been suggested to enhance positive interpretations (Muris et al., 2009), suppress negative interpretations (Lester et al., 2011b, 2011a), or both (Lothmann et al., 2011; Lau et al., 2011). However, a limitation of comparing positive to negative training is that, as neither group is compared to a no-training or control-training condition with no net valence, the direction and magnitude of effects of positive and negative training cannot be determined. This means that the preceding alternative suggestions for the action of positive and negative training cannot be tested between.

These questions can be addressed to some extent by the use of various control conditions. A common control condition has been to use a training paradigm mixing positively-resolved and negatively-resolved scenarios, most commonly with 50% of each kind of resolution (Hirsch et al., 2007; Steinman & Teachman, 2010). Only one previous study has used mixed-valence control

training in adolescents. Salemink and Wiers (2011) compared a positive CBM-I training paradigm modelled after Mathews and Mackintosh (2000) to a control training condition comprised of positive, negative and non-valenced scenarios in a typically-developing 14–16 year-old sample. The study found that positively trained adolescents interpreted new ambiguous information significantly more positively and less negatively than adolescents in the control condition.

However this assumes that positive and negative training scenarios within training have symmetric effects. While mixed training may represent a valid intermediate form of training between positive and negative paradigms, unless positive and negative scenarios are equal in the size of their effects, it would not be an equivalent control condition to individuals who had *had no training at all*. Say for example that reading negative training scenarios has a stronger effect on subsequent interpretations than reading positive training scenarios. If an individual were then to read 10 positive and 10 scenarios in a mixed-valence training paradigm, their post-training biases would be more negative than if they had not undergone any training. Steinman and Teachman (2010) presented evidence to falsify this possibility. They found equivalent post-training effects in a mixed-valence control training condition and a no-training condition, in comparison to positive training. This effect is promising, but was conducted in a sample of adults selected for high anxiety-sensitivity. As such, it bears replicating such effects in other populations, especially the special developmental case of adolescents.

An alternative to mixed-valence training as a control condition is for scenarios within the training paradigm to share the format of positive/negative valenced CBM-I training, but to eschew giving any scenario a valenced resolution (e.g. Murphy et al., 2007). In such a condition, the word fragments and comprehension questions provide emotionally neutral factual information about the scenario rather than resolving an ambiguous emotional tone of the scenario at hand. At present the only study to have implemented this kind of control in adolescents was that of Fu et al. (2012), which compared positive training to this neutral-valenced control condition in a sample of 12–17 year-old adolescents with diagnosed anxiety disorders. Positively trained patients endorsed negative interpretations of the ambiguous testing scenarios less strongly than those who received neutral training.

Though this kind of neutral training avoids problems outlined above regarding training paradigms containing both positive and negative scenarios, it is not without its own faults. The biggest issue with this kind of neutral control training—in contrast to the positive, negative, and mixed training programmes—is that it does not actually induce any kind of emotional interpretation of scenarios. The result is that this paradigm controls for task demands and format, but not the actual process of bias modification. It may be that the process of activating interpretational styles is critical to their modification. If so, neutral training would not be able to control for this effect.

Mixed and neutral forms of control training have yet to be tested relative to each other, or to negative training as well as positive. Given the preponderance of inconsistent effects in previous child and adolescent CBM-I training research

as a result of the exclusive comparison of positive and negative training, (Muris et al., 2008, 2009; Lothmann et al., 2011; Lau et al., 2011; Lester et al., 2011a, 2011b), such a comparison stands to better inform the relative effects of positive and negative CBM-I training upon interpretations. Additionally, comparisons of the two control conditions will help determine if either is a more suitable control condition than the other for CBM-I training paradigms.

4.1.2 Generalisability of CBM-I Training Effects to Other Measures

Previous work using the CBM-I paradigm has measured the extent of trained interpretive bias by using the Interpretation Bias Test (IBT; Eysenck et al., 1991; Mathews & Mackintosh, 2000). However the format of this test is almost identical to that of the CBM-I training paradigm itself. This raises the possibility that training-congruent performance on the Interpretation Bias Test (e.g. endorsing more positive interpretations of new material following a positive training paradigm) could be due to demand characteristics or simple context-dependent learning effects, rather than due to valid changes in interpretive style beyond the specific task at hand (Harvey et al., 2004).

Accordingly, research has attempted to demonstrate that CBM-I training effects generalise or transfer to performance on other tasks. This has shown mixed results, with little replicability or theoretical consistency in which of these show evidence of generalisations or transfers of training effects beyond the Interpretation Bias Test (Salemink, van den Hout, & Kindt, 2007; Salemink, van den Hout, & Kindt, 2010; Hirsch et al., 2009; Wilson et al., 2006). For example, CBM-I training has, in adult samples, been variously found to generalise to an academic performance Interpretation Bias Test following training on social items (Salemink, van den Hout, & Kindt, 2010), not to generalise to interpretations of ambiguous homographs or items on a questionnaire (Salemink, van den Hout, & Kindt, 2007), and not to transfer to interpretations of comprehension questions following an ambiguous social/romantic vignette (Salemink, van den Hout, & Kindt, 2010).

Given these generalisability issues, it is desirable to include a measure of interpretive bias outside of the specific form of the training paradigm. Extant measures of biased interpretations include the Ambiguous Social Scenarios Interpretation Questionnaire (ASSIQ; Butler & Mathews, 1983; Stopa & Clark, 2000; Amir et al., 1998) and the Children's Expectations of Social Behaviours Questionnaire (Rudolph et al., 1995). Of particular relevance to the needs at hand, these measures were shown in Chapters 2 and 3 to be related to anxious and depressive symptoms.

4.1.2.1 Pre- and Post-Training Measures of Interpretive Bias

Use of a questionnaire like the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998) also allows for pre-/post-training measures of interpretive bias to be measured with relative ease. With a few notable exceptions (e.g. Salemink & Wiers, 2011), many CBM-I training

experiments have used exclusively post-training measures of interpretive bias—such as the Interpretation Bias Test. Despite only administering this at one time-point, these data have been used to support modification of interpretive biases.

Administering the Interpretation Bias Test to participants twice may invalidate the extent to which the latter administration validly measures the individual's interpretational style. Presentation of the Interpretation Bias Test before and after training may also enhance demand characteristics, as the test is so obviously related to the training process, and it is relatively easy to determine the overall training valence of the CBM-I training that one has undergone. As such the Interpretation Bias Test has in most instances been administered solely post-training. Though this is a viable and empirically acceptable approach to take within a between-subjects design, it does mean that as the measure was only administered post-training, there is no metric of change in any empirical test of interpretation bias.

However, use of an additional questionnaire measure of interpretation such as the Ambiguous Social Scenarios Interpretation Questionnaire may offer a complementary adjunct to the between-groups post-training Interpretation Bias Test. As this questionnaire is less superficially similar to the training paradigm, it should minimise the potential demand characteristics or salience effects that pre-/post-training administration of the Interpretation Bias Test could give rise to. This means that, in addition to a between-groups analysis of Interpretation Bias Test scores, pre-/post-training questionnaire scores could be compared to give a metric of within-subjects change in interpretive bias.

4.1.3 Mood Effects

Reasons for collecting mood scores in previous CBM-I research are twofold: 1) to determine if there were changes in mood as an immediate consequence of CBM-I training, and 2) to check for any differences in mood immediately prior to the Interpretation Bias Test. The latter is a methodological assurance that post-training tests of interpretation are not confounded with mood congruency effects (Mathews & Mackintosh, 2000). However, indices of actual mood change as a result of training (i.e. those collected immediately after training) are less clear-cut in research to date.

Previous CBM-I studies in adults have been remarkably inconsistent as to whether they have shown changes in mood as a direct effect of CBM-I training to be present (e.g. Salemink, van den Hout, & Kindt, 2007; Beard & Amir, 2008) or absent (e.g. Wilson et al., 2006; Hirsch et al., 2009). This uncertainty as to the presence (Lothmann et al., 2011; Vassilopoulos et al., 2009; Lester et al., 2011a; Vassilopoulos et al., 2012) or absence (Salemink & Wiers, 2011; Lester et al., 2011b; Fu et al., 2012; Vassilopoulos et al., 2013) of mood effects similarly characterises adolescent CBM-I literature. Among those adolescent CBM-I studies to have demonstrated mood effects, the predominant findings are that training decreases non-congruent affect rather than potentiating training-congruent affect.

Positive training has been observed to decrease self-reported anxiety or negative affect rather than potentiating positive affect (Vassilopoulos et al., 2009; Lothmann et al., 2011; Vassilopoulos et al., 2012). Negative training has similarly been observed to decrease positive affect (Lothmann et al., 2011; Lau et al., 2011), but has also been observed to increase self-reported anxiety (Lester et al., 2011a). Given the mixed conclusions from previous examinations of direct mood changes as a result of CBM-I training, there remains a requirement for research to attempt to clarify potential sources of mood change as a function of training, especially in designs containing various valenced and control training protocols.

4.1.4 Individual Differences and CBM-I Training Effects

A secondary question of many prior studies has been whether training effects vary with baseline symptoms of the target sample. These studies have typically adopted a dimensional approach to symptoms, especially within child and adolescent samples (Hadwin & Field, 2010b). This is based on conceptions of anxiety and depression as overlapping constructs (Macleod, 1991) and that clinical and non-clinical symptoms of emotional disorder exist on a continuum (Muris, 2007; Claridge & Davis, 2003). As such, it bears investigating the relative influences of such symptoms on CBM-I training, in the event that there are differential moderating influences of pre-existing individual differences.

4.1.5 Aims and Hypotheses

This study aims to address a number of outstanding issues in CBM-I studies of adolescents. Specifically, 4 aims of importance to the potential of CBM-I as an empirical tool are proposed in the adolescent sample:

- To directly compare the effects of positive and negative training paradigms against two forms of control paradigms: mixed valence, and neutral valence
- To examine whether CBM-I training effects generalise to a new measure of interpretation—one which would allow for pre-/post-training comparisons of interpretive bias
- To examine any changes in mood as a result of undergoing CBM-I training
- To examine the effects of trait symptoms of anxiety and/or depression on the effects of training

Based on previous findings in adolescent samples, it is hypothesised that positive training will suppress negative endorsements of ambiguous novel information, relative to mixed, neutral and negative CBM-I training, and may also potentiate endorsement of positive interpretations relative to these other groups. It is expected that these differences will be most pronounced between positive

and negative training conditions, and that inverse effects will be observed for negative training.

Training-congruent effects are also hypothesised to generalise to the additional questionnaire measure of interpretation. Positive training is expected to decrease negative interpretations of novel ambiguous material, and negative training is expected to increase negative interpretations from pre- to post-training. No changes are expected for control groups.

Any mood effects as a result of training are expected to be congruent with training valence—i.e. that positive training will increase positive affect and/or decrease negative affect, and that negative training will increase negative affect and/or decrease positive affect. Past CBM-I experiments recounted above offer no basis for greater specificity than this as regards potential affect effects.

No assumptions are made about potential differences in training (both interpretive and mood-related) effects upon the mixed and neutral training conditions. In line with previous findings, pre-existing anxious and depressive symptoms are expected to encourage stronger endorsements of negative interpretations and weaker endorsements of positive interpretations of ambiguous material.

4.2 Methods

4.2.1 Participants

Participants were recruited jointly to participate in the experiments detailed in this chapter and the next, and 112 participants were recruited in total. Participants were either recruited through secondary schools, or from a database of parents of teenagers who had previously given consent to being contacted about taking part in psychological experiments. In both cases this was done as part of opt-in recruitment procedures. The proportion of responding participants and proxy indices of socio-economic status were investigated across each source of recruitment. Proportional response data are taken from the most timely statistics to the time of testing given by the UK Department for Education's EduBase public portal (Department for Education, 2013). These figures were used to estimate the size of recruiting pools in the contacted schools at the time of testing, allowing for the calculation of the proportion of responses and participation from the wider potential pool of participants. Proportion of students eligible for Free School Meals (FSM) was used as a proxy measure of schools' socio-economic status (SES), as this is a common approach in social science research (Hobbs & Vignoles, 2007). This follows the general principle that the lower the proportion of students eligible for FSM, the higher the SES of the school. There are however floor effects, with virtually all fee-paying schools effectively having FSM proportions of 0% as these data are not directly provided by the Office for Standards in Education, Children's Services and Skills (Ofsted). FSM proportions for all schools were taken from 2012 data available via Ofsted inspection reports (Office for Standards in Education Children's Services and Skills, 2012), and compared with the 2012 national average of 26.7%. Use of 2012 data specifically allowed

for all schools to be compared to one another, as well as the national average, as the methodology of collecting these proportions changed between 2011 and 2012, making it impossible to compare 2012 scores to previous years.

Four state schools with comprehensive admission policies in Oxfordshire, Berkshire and London were contacted directly and asked to send out information sheets to parents of eligible participants. Due to logistical constraints in the time of year that testing took place, as well as staff resources, the recruiting pools varied slightly between schools. The first school recruited from was an all-girls Community school that converted to Academy status shortly following the completion of data collection. Using 2012 data the school was below the national average for proportion of students eligible for FSM, at 17.3%. Fifty-three participants were recruited across years 9–12 (aged 13–17) from this school, at a response rate of 8%. The second school recruited from was a mixed-sex Community school that again converted to Academy status shortly following the end of testing. The proportion of students eligible for FSM at the second school was 40.6%, well above the national average. Thirteen participants were recruited from years 12 and 13 (aged 16–17) in this school, at a response rate of 4%. One participant was omitted from this sample as they did not complete the experiment. Eleven participants were recruited from the upper sixth (aged 17–18) of the third school—an all-girls Community school with a below-average 12.2% of students eligible for FSM—at a response rate of 7%. The final school that participants in this chapter and the next were recruited through was a mixed-sex Academy. This school had a well-below national-average percentage of students eligible for FSM, at 4.3%. Three participants were recruited across years 7–11 (age 11–16) from this school for the experiment detailed in Chapters 4 and 5. Three participants were also recruited to participate in a study not reported in the current thesis, so the overall response rate of participants from this school was 1%.

Participants were also recruited by e-mailing parents of 11–18 year-olds in Oxford and surrounding areas who had agreed to be contacted about participating in future research studies. The response rate for participants recruited by this process was generally a great deal lower than participants recruited through schools, at a rate of 1%. Thirty-three participants were recruited from this pool, from ~17 different schools—4 participants had missing schools data, and 2 participants were home-schooled. As a result of the fact that this sub-sample was relatively heterogeneous in terms of school of origin—and the fact that participants were not recruited directly via schools—a weighted mean was calculated of FSM percentage. For example if two participants in the sample went to the same school, the FSM percentage of this school would be weighted twice as heavily as a school that only had a single child in the sub-sample, and so on. This gave a rough indication of the SES of this sub-sample, in analogy to the individual FSM percentages reported for the recruiting schools. Within this sub-sample of 33 participants, 9% attended independent, fee-paying schools, for whom no FSM percentage data was available via Ofsted. An educated guess was made to assign these schools a 0% FSM percentage. Further, the total number of participants the weighted mean was calculated for was adjusted from 33 to 23 to reflect

the 4 missing data entries, the 2 home-schooled participants, and 4 further 6th-form colleges for whom FSM data was not available from Ofsted. The weighted mean percentage FSM-eligible participants in this sub-sample was 16.5%, providing a rough estimate that the sample as a whole was of a moderately higher SES than the national average.

Ninety participants were recruited from schools in Oxfordshire, Berkshire and London for the study reported in the current chapter. The ages, gender identifications and ethnic make-up of the sample used in the current Chapter's 4-group analyses are given in Table 4.1. All participants were fluent in English, and all were capable of fulfilling the reading demands in the task. Participants were only recruited to the study if they had no current or previous experience of mood or anxiety disorders, so as to avoid any potential negative effects of anxious individuals undergoing negative CBM-I training. In addition to ethical concerns, individuals diagnosed with anxiety or mood problems may have more complex patterns of co-morbidity (Rohde et al., 1991; Hettema et al., 2003; Moffitt et al., 2007), and previous/current treatment, all of which might potentially confound results.

4.2.2 Measures

4.2.2.1 State-Trait Anxiety Inventory for Children

Anxious symptoms were measured using the State-Trait Anxiety Inventory for Children (STAIC; Spielberger, 1973). The STAIC is an adaptation of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) for use with children and adolescents in research contexts. The present study used the trait scale of the STAIC as an index of chronic anxious symptoms. This scale consists of 20 self-report items pertaining to anxious symptoms (e.g. 'I worry too much', 'I am secretly afraid') that participants rate for their frequency of experience. Ratings (*Hardly Ever*, *Sometimes*, *Often*, coded 1, 2, and 3 respectively) are summed across the 20 items to give trait anxiety scores between 20 and 60.

In a sample of 12–18 year-old adolescents ($\bar{x} = 15.1$ years, $sd = 2.0$), Muris, Merckelbach, Ollendick, King, and Bogie (2002) found the STAIC to show high concurrent validity with other anxiety measures: $r = .88$ with Revised Children's Manifest Anxiety Scale (Reynolds & Paget, 1983), $r = .63$ with Fear Survey Schedule for Children-Revised (Ollendick, 1983), and $r = .87$ with the Screen for Child Anxiety Related Emotional Disorders (Birmaher et al., 1997). The STAIC has shown extremely high item reliability as indexed by Cronbach's alpha ($\alpha = .91$), though it also shows significant overlap with measures of child and adolescent depression (Muris et al., 2002). Test-retest reliability for the trait STAIC measure over a 6-week period ranges between .65 and .71 (Southam-Gerow, Flannery-Schroeder, & Kendall, 2003). These findings were taken as evidence for the appropriateness of the measure in the prospective 15–17 year-old sample in the present study. In the current dataset the STAIC trait measure had excellent internal reliability: $\alpha = .85$ across 88 valid cases.

4.2.2.2 Children's Depression Inventory

The Children's Depression Inventory (CDI; Kovacs, 1985) is an adapted version of the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) for children and adolescents aged 7–17 years across community and clinical populations. The measure consists of 27 self-report items relating to various aspects of depressive symptoms. Individuals endorse one of 3 options for each item, varying in the strength of the depressive symptom indicated (e.g. Item 1: a) 'I am sad once in a while', b) 'I am often sad', c) 'I am sad all the time'). Each item is scored 0, 1, or 2 to give a total trait depression score of 0–54 over the 27 items. In the current study, a CDI item relating to suicidal ideation was omitted from the measure due to ethical concerns, so yielding a 26-item scale scored between 0 and 52.

In a 12–16 year-old normative sample ($\bar{x}$ = 15.1 years, sd = 2.0; Smucker, Craighead, Craighead, & Green, 1986), mean CDI scores have previously been found to be 9.59 (sd = 6.57). Smucker et al. (1986) found high internal reliability for the CDI (α = .83 for males, α = .85 for females). Other studies have shown the CDI to have good test-retest reliability (r = .82, .66, .67 over 2, 4 and 6 weeks respectively; Finch, Saylor, Edwards, & McIntosh, 1987), and good validity in discriminating between healthy and various symptomatic samples (Saylor et al., 1984). The measure has also been found to overlap with measures of childhood and adolescent anxiety (Saylor et al., 1984). In the current dataset the CDI had excellent internal reliability α = .86 across 94 valid cases.

4.2.2.3 Visual Analogue Scales for Mood

Mood was assessed over the course of the experiment (see Figure 4.1) using Visual Analogue Scales (VAS) based on the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). At each presentation of the VAS, participants were given a sheet of paper with 12 items; each featured a 10cm line labelled '*I feel not [emotion] at all*' at the left extreme, and '*I feel very [emotion]*' at the right extreme. Participants crossed the line to indicate to what extent they were feeling each of the 12 emotions at that point in time, and scores were coded 0.0–10.0 in cm. The 12 items were drawn from the PANAS-C and featured 4 items pertaining to positive affect (happy, calm, cheerful, energetic), 4 items relating to anxiety (nervous, upset, worried, anxious), and 4 items relating to low mood (sad, miserable, scared, gloomy). Mean scores were calculated for each set of items to generate Positive Affect, Anxiety and Low Mood scores ranging from 0.0–10.0 at each time-point (VAS1, VAS2, VAS3; see Figure 4.1).

Reliability indexed by Cronbach's α was very good for each 4-item scale at each time-point, and excellent overall in the current study:

	Overall	VAS1	VAS2	VAS3
Positive Affect	.89	.64	.82	.79
Anxiety	.91	.86	.85	.90
Low Mood	.92	.85	.85	.87

4.2.2.4 Interpretation Questionnaire

The Interpretation Questionnaire (IntQu) is a 26-item measure adapted from the Ambiguous Social Scenarios Interpretation Questionnaire (ASSIQ; Stopa & Clark, 2000; Amir et al., 1998; Butler & Mathews, 1983). Seventeen items deemed to be suitable for use in adolescents were taken from the ASSIQs used by Stopa and Clark (2000) and Amir et al. (1998). These items were supplemented with 7 additional items from the peer sub-scale of the Children's Expectations of Social Behaviour Questionnaire (CESBQ; Rudolph et al., 1995). Two further non-social items were included as filler. Each item presented an ambiguous scenario with a choice of 3 potential explanations, one of which was always a negative reflection on the participant. Participants were instructed to select what they felt was the most likely explanation. The questionnaire is replicated in full in Appendix C; examples of CESBQ and ASSIQ items from the questionnaire are given below, and negative choices are bolded:

CESBQ Item:

You have to finish a science project by the end of the week, but you still have a lot of work to do on it. You ask a friend of yours if they will help you one day after school. What do you think they might say?

- (a) They might say that they already have plans with other people and they don't have time
- (b) **They might say it was kind of a dumb project and they didn't want to work on it**
- (c) They might agree to help me out on it for a little while

ASSIQ Item:

You go into a shop and the assistant ignores you. Why do you think this is?

- (a) They are bored with their job, and behave rudely
- (b) They are concentrating on something else
- (c) **You are not important enough for them to bother with**

The 26 items were divided into two sets of 13 questions: one set was completed by participants prior to CBM-I training (t1) and the other was completed post-training (t2). Responses to each item were coded as '1' if participants endorsed the negative interpretation from the 3 choices, and '0' otherwise. Across the 12 social items in each of the t1 and t2 sets of the questionnaire, this gives pre- (IntQu t1) and post-training (IntQu t2) measures of social interpretive bias that range 0–12. This was done in order to give a metric for the change in social

interpretive biases as a result of training. Full versions of the two halves of the questionnaire are given in Appendix C.

The measure's internal reliability was very good: $\alpha = .80$ across the entire sample of participants in this chapter and the next ($n = 113$). Internal consistency for each of the pre-/post-training sub-scales was weaker, but still good: $\alpha_{t1} = .59$, $\alpha_{t2} = .73$. Correlations between Interpretation Questionnaire scores at t1 and t2 in the control training conditions were used as an index of test-retest reliability. These correlations were significant for both control groups, showing evidence of fair to good test-retest reliability: $r_{Mixed} = .60, p = .003, n = 22$; $r_{Neutral} = .61, p = .002, n = 23$; $r_{Overall} = .59, p < .001, n = 45$.

4.2.2.5 CBM-I Training Paradigm

The CBM-I training paradigm was modelled on that of Lothmann et al. (2011), itself an adaptation of Mathews and Mackintosh (2000)'s paradigm for adolescent populations. Training consisted of 5 blocks, each containing 12 training items. All items were adapted from Lothmann et al. (2011) and dealt with scenarios specifically relevant to adolescents. The full training sets are reproduced in Appendix D. Each item began with a short paragraph describing an ambiguous social scenario, missing its final word. When participants finished reading the paragraph, they pressed the spacebar to reveal a word fragment that they were required to complete (see examples below). Participants had to type the first of the word fragment's missing letters to advance to the next screen, thereby ensuring that they had read and understood the final word of the scenario. The completed word fragment resolved the scenario in either a positive, negative, or neutral manner. Examples of positive, negative, and neutral versions of a single training item are given below, with the required letter to complete the word fragment given in parentheses:

Ambiguous Scenario

"A new person has just started at your school and you go to talk to them. You think that your first impression will be"

Positive Resolution: go-d (o)

Negative Resolution: b-d (a)

Neutral Resolution: imp-rt-nt (o)

Following this, participants were presented with a Yes/No comprehension question that reinforced the valence of the training item with 'Correct!' or 'Wrong!' displayed on-screen as feedback. Example comprehension questions and answers for each training valence are given below:

Comprehension Question (Positive = Yes, Negative = No)

"Did you make a good impression on the new person?"

Neutral Comprehension Question

“Did a new person start at your school?”

Each trial provided reaction time (RT) data for word fragment completions and answers to comprehension questions, as well as accuracy data for answers to comprehension questions. No accuracy rates were collected for word fragment completions, as the paradigm *required* accurate responses to the word fragments in order to advance to the comprehension question. Examinations of accuracy and reaction times of responses during the training task itself allowed for the examination of how quickly participants apprehended the valence of the CBM-I over the course of training.

Participants were randomly allocated to one of 4 training paradigms: Negative, Positive, Mixed, or Neutral. In the positive training paradigm, 10 items in each block were positively valenced, 1 was negatively valenced, and one was neutral. This approach was taken in preference to simply having 100% positive items in the positive training paradigm in an attempt to make the nature of training less readily apparent, and thereby mitigate potential demand characteristics. Similarly, negative training consisted of 10 items per block being resolved negatively, 1 item being resolved positively and 1 item being a neutral control. The mixed training consisted of 6 positive and 6 negative items per block. Finally, the neutral training featured 10 neutral items, 1 positive item, and 1 negative item per block. All training scenarios are reproduced in Appendix D.

4.2.2.6 Interpretation Bias Test

The form of Interpretation Bias Test (IBT) was taken from Eysenck et al. (1991), via the procedure used by Mathews and Mackintosh (2000). Participants read 10 new scenarios, each of which remained ambiguous after completing the final word and comprehension question. Again the paradigm was adapted from earlier CBM-I work (Lothmann et al., 2011) to be more relevant to adolescence. These scenarios were presented as in the training paradigm, except that each scenario was additionally given a title—e.g.

“Giving a Speech”

It is the end-of-term prom, which you have helped organise. At the end of the night you are asked to give a speech. As you are speaking you see people in the audience start to

la-gh (u)

Following 10 such scenarios, the titles of each were presented again with 4 different probe statements, which participants were asked to rate for similarity

to the original scenario on a scale from 1 (*not similar at all*) to 4 (*very similar*). The 4 probe statements always contained one valid negative interpretation of the original scenario (Negative Target), one valid positive interpretation (Positive Target), one negative statement that was not directly related to the original scenario (Negative Foil), and one positive statement unrelated to the original scenario (Positive Foil).

In the example above, the probe statements were as follows: ‘The people in the audience were laughing at you’ (Negative Target); ‘The people in the audience found your jokes funny’ (Positive Target); ‘The people in the audience started booing you’ (Negative Foil); ‘The people in the audience started clapping you’ (Positive Foil). These four kinds of statements allowed for analyses of the endorsement of positive versus negative interpretations of novel ambiguous scenarios following training (Targets), compared to measures of tendency to simply endorse non-specific positive and negative statements (Foil).

4.2.3 Procedure

An overview of the study procedure is given in Figure 4.1. Testing took place in the Department of Experimental Psychology, University of Oxford. After written parental and participant consent was obtained, participants completed an initial bank of questionnaires including demographic information, the first set of VAS mood ratings (VAS1), STAIC, CDI, and the first half of the Interpretation Questionnaire (IntQu t1). Following this, participants completed the CBM-I training programme (negative, positive, mixed, neutral) that they had been randomised to. Immediately prior to training, participants engaged in a short imagery training exercise to enhance the subsequent effects of CBM-I training, based on Holmes et al. (2006) and Holmes et al. (2009). Here participants were asked to close their eyes and imagine coming home from school, taking something out of the fridge, and sitting down on a sofa with it, all from a first-person perspective. This was done to encourage participants to imagine scenarios happening ‘through their own eyes’, and this was referred back to during the training process via the prompt ‘Imagine the events as happening to yourself’, displayed after each block of training.

The recruited participants were randomly allocated to the 5 experimental conditions across this chapter and the next. Randomisation was not explicitly stratified by school, but all participants from all sources of recruitment were randomised to one of the 5 experimental conditions across this chapter and the next. Prior to testing, a spreadsheet was generated by the lead researcher (and sole experimenter for this experiment), with participants’ IDs in one column. The random number generator at the website random.org (Haahr, n.d.) was then used to randomly generate numbers between 1 and 5—corresponding to each experimental condition—for each ID number. ID numbers were then allocated to participants in order as they were recruited to the experiment.

After training, participants completed the second set of VAS measures (VAS2) and a distractor task to eliminate any potential between-group mood effects as a result of training. The distractor task lasted for 10 minutes, and

consisted of rating 60 pictures (abstract shapes, household objects and natural scenes) for pleasantness, each during a 10-second window. Following the distractor task participants completed the second half of the Interpretation Questionnaire (IntQu t2) and VAS3 ratings. Participants completed the Interpretation Bias Test immediately after VAS3 ratings. They were then debriefed in full, thanked and reimbursed for their time.

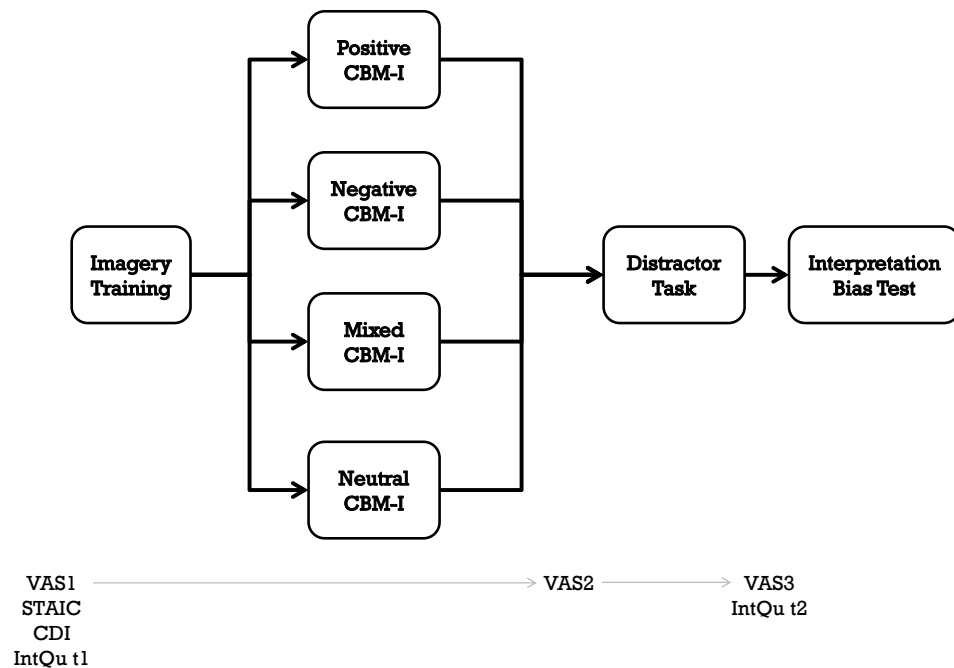


Figure 4.1: Experimental procedure for the current study

4.2.4 Ethical Issues

Ethical approval for the current study was obtained via the University of Oxford Central University Research Ethics Committee (CUREC). The main ethical issues implicated in the current study are that of recruiting and testing adolescents unable to legally give fully informed consent to participate in the current study, and the fact that as a result of CBM-I training protocols, participants were exposed to information that might be expected to impact upon their moods, and potentially to do so negatively. In order to address the latter issue, it was determined that no risks to participants' physical or mental health over and above their experience of day-to-day life would be incurred by administering either the positive or neutral forms of CBM-I training. This assumption was verified during data collection by asking about participants' feelings and experiences of the experimental protocol during debriefing. However the mixed and negatively-valenced training protocols required participants to interpret (at least some) ambiguous social situations in a negative manner. Based on the preceding literature

on which this paradigm was based (e.g. Mathews & MacLeod, 2002; Vassilopoulos et al., 2009, 2012), it is assumed that if a single session of negative training is in fact able to modify interpretive styles, then this could bring about negative emotional outcomes. As a result, participants were informed of this fact during debriefing, and then offered the opportunity to undergo a further session of positive CBM-I if they so wished. Furthermore, though it is inadvisable to attempt to induce negative interpretive styles in individuals showing high levels of anxious or depressive symptoms, there is a good amount of evidence to suggest that healthy or unselected individuals have pre-existing positive cognitive and interpretive biases (Mathews & Mackintosh, 2000; Taylor & Brown, 1988; Muris et al., 2009), which would theoretically buffer against the effects of a single session of negative training. Finally, to explicitly protect against the possibility of training negative interpretive styles in individuals with mood or anxiety disorders, participants were only recruited to the current study if they had no history of problems with anxiety or mood. This criterion was made clear to parents in the initial information sheets they received, included as Appendix H.

With regards to the issue of testing adolescent participants and recruiting through schools, ethical approval was granted provided that recruitment, testing and data collection adhered to CUREC protocols specifying the conduct of such research. Schools and headteachers were contacted, informed of the nature of the study, and given the opportunity to ask any questions of the researchers. If they agreed to let their students take part in the study, they sent information sheets (see Appendix H) out to parents/guardians of students. Similar information sheets were sent to parents/guardians who had previously indicated that they would be happy to be contacted about future research studies on behalf of their children. In all cases, the guardians/parents of participants gave fully informed consent and participants provided additional assent to taking part. Prior to providing assent/consent, participants/guardians were made aware that their data would be stored securely and anonymised in both hard and soft copy in the University of Oxford. Participants and guardians were also made aware at this point that their data could be used—in this anonymised format—as part of academic work and research either within the University of Oxford or without, and/or as the basis for journal articles and scientific presentations. Participants and guardians were made aware that they were free to withdraw their consent or data at any point during or following the study.

4.3 Results

4.3.1 Descriptive Statistics

Gender identity, ethnicity and mean scores for age, STAIC, CDI and Interpretation Questionnaire are given below in Table 4.1, for the whole sample and broken down by training group. All measures were normally distributed as determined by Kolmogorov-Smirnoff and Shapiro-Wilks tests. All 90 participants provided full data for demographic information, Interpretation Questionnaires at both time-points, and CBM-I training and testing. VAS scores were missing

for 1 participant ($n = 89$), and STAIC and CDI scores were missing for 2 participants ($n = 88$ in both cases).

Pre-training demographic information and anxious and depressive symptom scores were compared across groups to control for any between-group differences other than CBM-I training valence. Univariate ANOVAs were used to check for pre-training differences in the continuous measures of anxious symptoms, depressive symptoms, and age. ANOVAs included Training-Group (positive, negative, mixed, neutral) as a 4-level between-subjects factor. Significant group differences were found in age: $F(3, 85) = 32.32, p < .001, \eta^2 = .533$. Post-hoc t -tests with Bonferroni corrections revealed that ages in the positive and negative groups were significantly higher than in the mixed and neutral groups ($p < .001$ in all cases). Age did not differ significantly between positive and negative, or between mixed and neutral groups. ANOVAs did not find any significant differences between training groups on any other measure.

Pearson χ^2 tests were used to examine potential differences between groups on the categorical variables of gender identity and ethnicity. There was a significant difference in gender between training groups: $\chi^2(6) = 14.55, p = .024$, with higher proportions of female participants in the mixed and neutral groups, relative to the positive and negative training groups (Table 4.1). Proportions of different genders did not differ significantly between the positive and negative training groups, nor between mixed and neutral groups. Tests showed no significant differences between training groups in proportions of different ethnicities.

Based on the significant between-groups differences in age and gender, these were included as covariates in all analyses of post-training effects. These inclusions did not affect the significance of any results. Accordingly, all values reported below are for analyses that did not include these covariates. Analyses were also performed removing all males and removing individuals to equalise age, but again this did not change the significance of any results, nor did it give rise to any novel interactions.

4.3.2 Training

Repeated measures ANOVAs were used to investigate performance over the course of CBM-I training. This was done specifically to check differences in reaction times (RTs) and accuracy of responses across the different forms of training, in order to ensure relative homogeneity of experience across different training groups. Mean accuracy rates and reaction times over the 5 Blocks of training are given in Table 4.2.

Three 5×4 ANOVAs were conducted, each including a different measure of interest (1—RTs to word fragments, 2—RTs to comprehension questions, 3—accuracy of responses to comprehension questions) as an outcome measure. Block was included as a 5-level within-subjects factor (1, 2, 3, 4, 5), and Training-Group (positive, negative, mixed, neutral) was included as a 4-level between-subjects factor in all 3 analyses. Polynomial functions were used to examine within-subjects contrasts for each set of analyses.

4. POSITIVE, NEGATIVE, AND CONTROL CBM-I TRAINING IN ADOLESCENTS

		Overall	Training Valence		
			Negative	Positive	Mixed
Gender	Female	87.8%	81.0%	75.0%	95.5%
	Male	11.1%	19.0%	25.0%	0.0%
	Other	1.1%	0.0%	0.0%	4.5%
Age		16.04 (0.84)	16.62 (0.67)	16.70 (0.64)	15.41 (0.50)
Ethnicity	White	85.6%	76.2%	70.8%	100%
	Asian	8.9%	19.0%	12.5%	0.0%
	Black	1.1%	0.0%	4.2%	0.0%
	Mixed	2.2%	0.0%	8.3%	0.0%
	Other	1.1%	4.8%	0.0%	0.0%
	Did not report	1.1%	0.0%	4.2%	0.0%
STAIC		38.61 (7.18)	38.60 (7.29)	38.43 (6.39)	39.59 (8.93)
CDI		11.84 (6.56)	11.50 (7.12)	11.87 (7.64)	12.23 (6.63)
IntQu t1		2.26 (1.85)	1.67 (1.91)	2.25 (1.45)	2.32 (2.01)
IntQu t2		2.30 (2.08)	1.67 (1.80)	2.00 (1.80)	2.63 (2.77)
<i>n</i>		90	21	24	22
Positive Affect	VAS1	6.43 (1.28)	6.30 (1.23)	6.20 (1.32)	6.86 (1.37)
	VAS2	5.96 (1.74)	5.52 (1.38)	6.06 (1.73)	6.57 (2.16)
	VAS3	6.05 (1.85)	5.88 (1.31)	6.18 (1.94)	6.51 (2.35)
Anxiety	VAS1	2.35 (1.84)	2.85 (1.90)	2.45 (2.08)	2.08 (1.93)
	VAS2	1.74 (1.61)	2.32 (1.74)	1.51 (1.62)	1.14 (1.33)
	VAS3	1.36 (1.53)	1.70 (1.56)	1.31 (1.54)	0.79 (1.36)
Low Mood	VAS1	1.21 (1.22)	1.29 (1.21)	1.09 (1.31)	0.98 (1.10)
	VAS2	1.54 (1.38)	1.70 (1.24)	1.28 (1.53)	1.33 (1.51)
	VAS3	1.60 (1.68)	1.25 (1.13)	1.62 (2.13)	1.44 (1.72)

Table 4.1: Means for demographic information and questionnaire measures. Standard deviations given in parentheses. Mean VAS scores for Positive Affect, Anxiety, and Low Mood before training (VAS1), after Training (VAS2), and immediately preceding interpretation bias testing (VAS3)

Block	Word Fragment Reaction Time (ms)				Comprehension Question	
	Overall	Training Group			Reaction Time (ms)	Accuracy
		Negative	Positive	Mixed	Neutral	
1	2340.58 (1236.83)	1841.01 (690.10)	1706.08 (451.88)	2273.46 (739.99)	3522.99 (1695.84)	3249.44 (987.50) 87.1% (11.3)
2	1604.36 (490.21)	1639.33 (425.85)	1505.74 (451.33)	1475.10 (240.39)	1798.97 (686.37)	2629.27 (787.85) 91.9% (10.0)
3	1905.68 (717.80)	1641.04 (393.19)	1768.48 (695.79)	2010.88 (832.63)	2189.85 (770.11)	2587.93 (795.36) 90.5% (12.0)
4	1639.64 (574.35)	1363.19 (175.86)	1526.70 (279.23)	1638.03 (439.07)	2011.43 (899.70)	2440.02 (653.76) 90.5% (11.6)
5	1586.22 (639.26)	2010.86 (1112.59)	1359.02 (198.12)	1682.66 (353.11)	1336.67 (196.21)	2410.05 (722.98) 91.1% (11.9)
(Mean)	1789.89 (423.36)	1685.24 (396.73)	1579.39 (273.12)	1820.21 (327.74)	2176.64 (458.60)	2619.17 (644.60) 89.9% (8.1)

Table 4.2: Mean accuracy rates and RTs (ms) over the course of training. Standard deviations given in parentheses. Word fragment completion RTs are indexed by training valence, due to the main effect of Training Group on this measure. Responses to comprehension questions are collapsed across groups.

Significant main effects of block were observed for Word Fragment RTs: $F(4, 336) = 21.24, p < .001, \eta^2 = .163$, and within-subjects contrasts showed a significant linear effect: $F(1, 84) = 34.47, p < .001, \eta^2 = .211$. Taken together with comparisons of mean RTs across Blocks for these analyses (see Table 4.2) these effects represent a linear decrease in RTs over the course of training—i.e. that participants across all training conditions gradually became quicker in responding to word fragments. Furthermore, significant quadratic ($F(1, 84) = 9.02, p = .004, \eta^2 = .088$) and cubic ($F(1, 84) = 19.84, p < .001, \eta^2 = .132$) within subjects contrasts—when interpreted in terms of mean scores given in Table 4.2—indicate that the decrease in RTs across the training blocks gradually levelled off over the course of training.

A significant main effect of block was also observed for Comprehension Question RTs: $F(4, 336) = 33.15, p < .001, \eta^2 = .271$. Again, significant linear ($F(1, 84) = 60.96, p < .001, \eta^2 = .418$), quadratic ($F(1, 84) = 24.12, p < .001, \eta^2 = .211$) and cubic ($F(1, 84) = 8.38, p = .005, \eta^2 = .078$) within-subjects contrasts taken together with comparisons of mean RTs across Blocks for these analyses (see Table 4.2) show decreases in RTs over the course of training across all 4 groups, which gradually levelled off over the course of training. No significant main effect of Training Group was observed, suggesting that the above effects were consistent across all 4 training conditions.

A significant main effect of block was again observed for Comprehension Question Accuracy: $F(4, 336) = 3.40, p = .010, \eta^2 = .037$. The only significant within-subjects contrast was cubic ($F(3, 84) = 7.98, p = .006, \eta^2 = .072$). Viewed in light of Figure 4.2 this can be seen as the effect that accuracy of responses significantly improved from Block 1 to Block 2, then remained at this level for the rest of training. The absence of a main effect of Training Group meant that accuracy of responses to comprehension questions was consistent across training conditions.

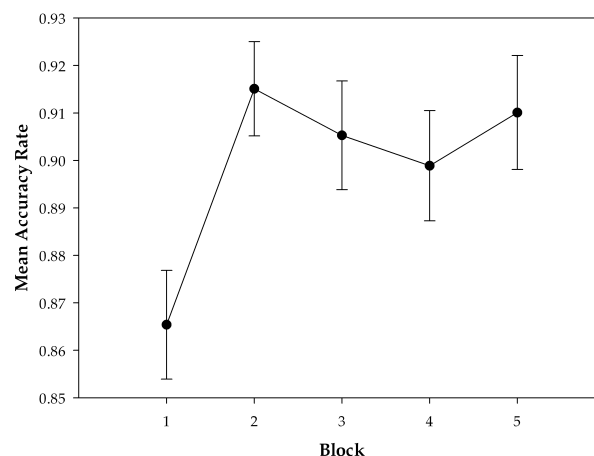


Figure 4.2: Mean accuracy rates for responses to Comprehension Questions across the 5 blocks CBM-I training. Accuracy rates are collapsed across Training Groups.

In summary, participants gradually got quicker and more accurate in their responses to comprehension questions and word fragment completions over the course of CBM-I training, across all training groups. These effects were at near-ceiling by Block 2 of training. This reinforces the idea of differences in learning rates across different training paradigms levelling out by the end of CBM-I training.

4.3.3 Mood Scores (VAS)

Three 2×4 ANOVAs were conducted on self-reported mood ratings. Each included one kind of mean affect rating (VAS Positive Affect, VAS Anxiety, VAS Low Mood) as an outcome measure. In these ANOVAs, Time (pre-training/VAS1, post-training/VAS2) was included as a 2-level within-subjects factor, and CBM-I Training-Group (positive, negative, mixed, neutral) was included as a 4-level between-subjects factor. These analyses were used to examine any potential changes in mood as a result of CBM-I training, and to test whether any such changes would differ across training valences/groups.

A main effect of time was found for VAS Positive Affect ($F(1, 85) = 13.46, p < .001, \eta^2 = .131$), which decreased from VAS1 ($\bar{x} = 6.43, sd = 1.28$) to VAS2 ($\bar{x} = 5.96, sd = 1.74$). Similar main effects were found for self-reported VAS Anxiety ($F(1, 85) = 12.04, p = .001, \eta^2 = .119$), which decreased from VAS1 ($\bar{x} = 2.35, sd = 1.84$) to VAS2 ($\bar{x} = 1.74, sd = 1.61$), and Low Mood ($F(1, 85) = 8.66, p = .004, \eta^2 = .092$), which increased from VAS1 ($\bar{x} = 1.21, sd = 1.22$) to VAS2 ($\bar{x} = 1.54, sd = 1.38$). Eta squared scores for the main effects of time on self-reported mood ratings across the three measures show that these effects were small. The absence of any significant Time*Training-Group interactions suggests that these mood changes were consistent across all training groups.

Further, 3 univariate ANOVAs with Training-Group as a 4-level between-groups factor were used to check for between-groups differences in mood following the distractor task, i.e. at VAS3. This was done to ensure that any between-groups differences observed on the Interpretation Bias Test were not ascribable to confounding mood-congruence effects rather than the result of modified interpretations following training. These 3 univariate ANOVAs were again conducted with mean VAS Positive Affect, VAS Anxiety, and VAS Low Mood as outcome measures respectively. No significant differences were found between groups. Therefore when participants completed the Interpretation Bias Test and post-training Interpretation Questionnaire, there were no confounding between-groups differences in mood. Analyses were also run including STAIC anxiety and CDI depression measures as covariates. Inclusion of these trait measures in analyses did not modify any results, nor give rise to any novel significant effects.

4.3.4 Interpretation Questionnaire

A 2×4 ANOVA was conducted to examine potential changes in responses to the Interpretation Questionnaire as a result of CBM-I training. The mean number of negative items selected was used as an outcome measure, with Time (pre-

training/IntQu t1, post-training/IntQu t2) as a 2-level within-subjects factor, and Training-Group (positive, negative, mixed, neutral) as a 4-level between-subjects factor. No significant main or interaction effects of time or training condition were found. Mean scores pre- and post-training can be seen in Table 4.1.

The number of negative responses on the Interpretation Questionnaire pre-training (IntQu t1) correlated strongly with both STAIC ($r(88) = .56, p < .001$) and CDI ($r(88) = .47, p < .001$) scores.

4.3.5 Interpretation Bias Test

A $2 \times 2 \times 4$ ANOVA was conducted to examine responses to the Interpretation Bias Test. Probe Type (target, foil) and Probe Valence (negative, positive) were included as 2-level within-subjects factors, and Training Group (negative, positive, mixed, neutral) was included as a 4-level between-subjects factor. Mean similarity ratings for probe statements across different Training Groups and Probe Types/Valences are shown in Figure 4.3 below. Analyses yielded a significant 3-way Probe-Type*Probe-Valence*Training-Group interaction: $F(3, 86) = 6.15, p = .001, \eta^2 = .162$.

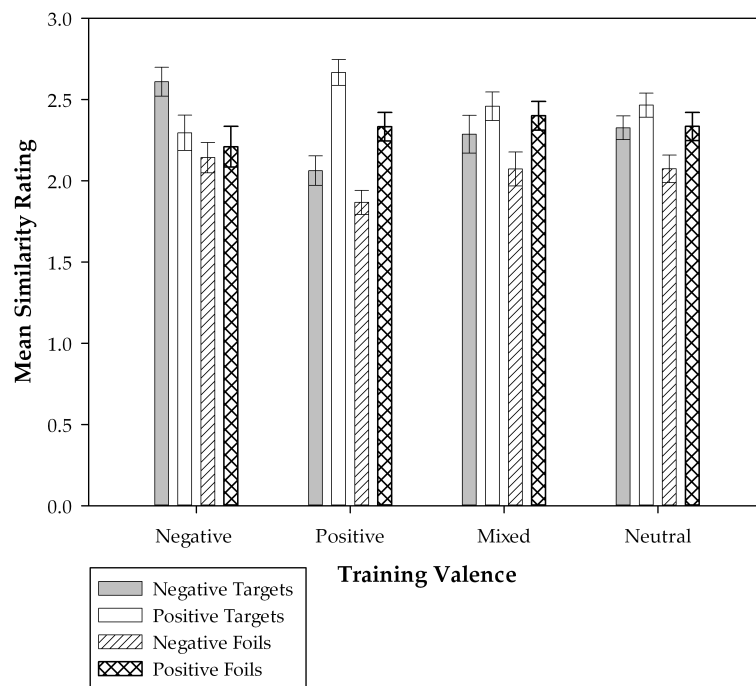


Figure 4.3: Mean similarity ratings for probes in the Interpretation Bias Test, grouped by type of probe and CBM-I training valence

Targets and Foils were analysed separately to decompose the 3-way interaction given the significant main effect of Probe-Type in the $2 \times 2 \times 4$ ANOVA: $F(1, 3) = 39.78, p < .001, \eta^2 = .310$. Targets showed a significant Probe-Valence*Training-Group interaction: $F(3, 86) = 6.03, p = .001, \eta^2 = .168$. This

interaction is illustrated in Figure 4.3 by the white (Positive Targets) and solid grey (Negative Targets) bars. Post-hoc t -tests (using Bonferroni corrections) showed that Negative Targets were rated higher by the negatively trained group compared to positively trained group ($p < .001, d = 1.31$). No other significant between-group comparisons were found for negative targets. Conversely, positive targets were rated higher by the positively trained group compared to negatively trained group ($p = .022, d = 0.86$), which again was the only significant between-groups difference.

Paired-sample t -tests were used to compare similarity ratings for positive and negative targets individually in each of the 4 Training Groups with Tukey post-hoc corrections for multiple comparisons. These t -tests showed a significant difference between positive and negative targets only in the positive training group: $t(23) = 4.27, p < .001, d = 0.871$. From Figure 4.3 it is evident that this effect is that of higher similarity ratings for positive targets than negative targets in the positive training group.

There was no significant main effect of Training Group for target statements, but there was a trending main effect of Probe-Valence: $F(1, 86) = 3.88, p = .052, \eta^2 = .036$, such that positive targets were rated as significantly more similar to the original ambiguous scenario than were negative targets ($\bar{x}_{PositiveTargets} = 2.48, sd = 0.43; \bar{x}_{NegativeTargets} = 2.31, sd = 0.48$) overall.

Foils analysed in isolation showed a significant main effect of Probe-Valence: $F(1, 86) = 17.11, p < .001, \eta^2 = .159$. Figure 4.3 shows this main effect to be of higher similarity ratings being given to positive foils than negative foils (see striped/hatched bars only in Figure 4.3), across all training groups. The main effect of Training Group and the Probe-Valence*Training Group interaction were non-significant for foils.

4.3.5.1 Power Analyses

Post-hoc power analyses were conducted based on effect sizes obtained from analyses of results from the Interpretation Bias Test. These are given together with effect sizes for all non-significant comparisons in Appendix E. In summary of the power calculations presented in the appendix, the sample sizes of $n = \sim 25$ were sufficiently powered to compare positive and negative groups in terms of endorsements of positive and negative targets (i.e. the effects reported as significant above). However analyses were not sufficiently powered for other comparisons given obtained effect sizes in the present study. This namely refers to comparisons of endorsements of positive and negative targets compared between positive and control training, or between negative and neutral training.

Relatively large effect sizes (i.e. Cohen's $d > 0.8$) were only seen for the comparison of post-training endorsements of target probes in the comparison of positive to negative training groups, and these were the only comparisons to emerge as significant in the current analyses. Though other comparisons varied between medium and small effects, it is worth mentioning that the multiple comparisons entailed by analyses of specific between-groups comparisons

in the current 4-group design and required statistical corrections also serve to effectively weaken power.

4.3.5.2 Covariate Analyses

The $2 \times 2 \times 4$ ANOVA of outcomes from the Interpretation Bias Test was replicated in a series of analyses; in each, the ANOVA was conducted as outlined above (Probe-Type and Probe-Valence as within-subjects factors; Training Group as a between-subjects factor), with the addition of one of 4 additional measures (STAIC, CDI, gender, age) as a covariate. No new main or interaction effects were observed in the analyses including gender or age. Owing to the significant differences in proportions of genders across the training groups demonstrated by the reported χ^2 tests (see Descriptive Statistics section 4.3.1), all analyses were also replicated when including only female participants in the sample. Running the analyses with only female participants did not change the significance of any findings.

However, significant new interactions were observed when including STAIC and CDI scores in the ANOVA. When including STAIC score as a covariate, a 2-way Probe-Valence*STAIC interaction emerged as significant: $F(1, 83) = 15.47, p < .001, \eta^2 = .119$. Further examination of this interaction with regression analyses showed that the higher STAIC score, the higher similarity ratings were for negative probes ($\beta = .347, p = .001$) and the lower similarity ratings were for positively valenced probes ($\beta = -.282, p = .008$). The CDI covariate analysis yielded a significant 2-way Probe-Valence*CDI interaction: $F(1, 83) = 14.38, p < .001, \eta^2 = .106$. Exploring this interaction with regression analyses showed that the higher CDI score, the higher similarity ratings were for negative probes ($\beta = .295, p = .005$), and the lower similarity ratings were for positively valenced probes ($\beta = -.303, p = .004$). These covariate analyses suggest that higher trait scores of emotional symptoms, the more likely the participant to endorse negative statements in the Interpretation Bias Test, regardless of whether the statement was a valid or invalid interpretation of the original ambiguous scenario.

4.4 Discussion

4.4.1 Summary Of Findings

Results replicated previous findings that CBM-I training is acquired effectively in adolescents (Salemink & Wiers, 2011; Lau et al., 2011; Lothmann et al., 2011). Participants became quicker and more accurate in their responses to comprehension questions and word fragment completions over the course of CBM-I training, across all training groups. Participants were able to make quick, accurate responses to valenced material in line with the content of their training paradigm by the second block of training.

Results from the Interpretation Bias Test suggest that biases congruent with the valence of training material were applied to novel ambiguous social scenar-

ios. The present study's novel comparison of positive, negative, and two forms of control training suggests that positive and negative CBM-I training have distinct, directional effects. Mixed and neutral forms of control training were found to be equivalent. Symptoms of both anxiety and depression also predicted the negativity of endorsements of novel information across both targets and foils in the Interpretation Bias Test.

The current experiment established significant correlations between trait symptom measures of anxiety and depression and an adapted questionnaire measure of interpretation bias. However, adding to a varied literature on the generalisability of CBM-I training effects to other tasks, the present study found no effect of the training on the Interpretation Questionnaire pre-/post-training index of interpretation. Finally, no differential changes in mood were observed as a direct result of training, though self-reported positive affect, anxiety and low mood did change over the course of training across all groups.

4.4.2 Interpretation Training Effects

Analyses of target statements in the Interpretation Bias Test replicated findings that negative targets were endorsed more strongly as interpretations of novel ambiguous situations following negative training than positive, and that equivalent inverted effects were seen following positive training within an adolescent sample (Lothmann et al., 2011; Lau et al., 2011; Salemink & Wiers, 2011; Lester et al., 2011b, 2011a). Post-hoc comparisons of positive with negative targets conducted separately for each of the 4 training groups suggested that relative post-training differences in similarity ratings for the 2 types of targets were only significant following positive training. Inverse effects were observed for negative training (Figure 4.3), but these were non-significant.

If the mixed and neutral training conditions are to be considered adequate controls, then they should show post-training bias effects that lie between the positive and negative training groups (assuming efficacy of the valenced training conditions). Mean comparisons showed that endorsements of both positive and negative targets in the two control groups intermediated scores for positive and negative training groups. However, across post-hoc analyses, the only significant between-groups differences were endorsements of positive and negative targets in comparisons of the positive to negative training group. Though no significant differences were found between target endorsements in the control conditions and positive/negative training, it is possible that differences do exist, and that the current study is simply underpowered to detect them via significance testing. However the fact remains that even if this difference were to be found significant in more highly-powered studies, the observed effect sizes of both positive and negative training relative to control baselines in the current study are relatively small, and so single-session CBM-I training effects on interpretation must be concluded to be rather weak.

Even taking into account the potentially underpowered analyses (see Appendix E), post-training interpretation effects did not differ between the two control training groups. This is evident from the 'Mixed' and 'Neutral' bar

clusters in Figure 4.3. The equivalence of control training effects has implications for theoretical considerations of existing adolescent CBM-I findings. The two previous adolescent studies to have compared positive to control training have used different control conditions—Salemink and Wiers (2011) used mixed-valence training, and Fu et al. (2012) used neutral control training. Both studies showed that, relative to control, positive training reduced the endorsement of negative targets as interpretations of novel ambiguous scenarios. This was also a trending, but non-significant effect in the current study (see Figure 4.3 and Appendix E). However, Salemink and Wiers (2011) additionally showed that positive training enhanced positive interpretations of novel ambiguous information relative to control.

If the current equivalence between control training conditions holds across future replications, then the discrepancy in post-training interpretations effects between Salemink and Wiers (2011) and Fu et al. (2012) must have another source. One immediately apparent difference between the samples used by the two studies is that the former used typically-developing adolescents while the latter used clinical patients. Having said this, the two studies were additionally conducted in different cultural contexts and different languages (the former in the Netherlands, the latter in the People's Republic of China), and the latter used a broader age range. Providing that these findings can be replicated while controlling for these cultural differences, this may suggest that pre-existing differences between clinical and typically-developing groups may affect the extent to or manner in which they acquire new biases during CBM-I. Covariate analyses in the current study provided no evidence that trait symptoms of anxiety or depression affected any interpretive biases acquired as a result of training. However it is possible that such differences might be observed when comparing clinical or non-clinical groups.

Furthermore these two groups would be expected to differ not only in emotional symptom scores, but also in their pre-training interpretive biases (Miers et al., 2008; Warren et al., 2000; Muris et al., 2003; Banerjee, 2008). Additionally, previous adolescent CBM-I research has provided evidence that changes in interpretation bias as a result of CBM-I training are more pronounced if individuals have more negative pre-existing interpretive biases, but no evidence of variation in the extent of bias change as a function of pre-existing anxious symptoms (Lester et al., 2011b). However Lester et al. (2011b)'s use of change indices based on positive/negative interpretations of ambiguous vignettes unfortunately means that it is not possible to determine if the stronger training effects as a result of more negative pre-existing biases specifically represent stronger potentiation of positive interpretations or stronger suppression of negative interpretations. Future research may be able to speak to such findings by using dissociable positive and negative post-training indices of bias, together with screening for pre-existing interpretive biases prior to training.

Current findings also bear upon the methodology of future research, especially in light of the relatively weak effects demonstrated following a single CBM-I training session. For experimental studies with no risk of emotional distress, it is perhaps more desirable to compare positive versus negative training,

in order to maximise the observed effects. The positive vs. negative training approach is *empirically* useful if we assume that there are small effects to be observed by training positive interpretive styles in non-disordered samples, as it allows us to potentially maximise the effects under consideration.

However, further work that aims to clarify any potential *clinical* utility of CBM-I training requires the development of suitable control conditions. Such work should avoid using negative bias training in clinical or symptomatic samples for ethical reasons. But beyond this, presenting a mixed training paradigm to anxious and/or depressed patients comes with the possibility that such individuals may selectively fixate upon negative information within the paradigm (Williams, 2004; Mogg & Bradley, 1998). In such a case, control conditions would want to avoid the risk of containing negative scenarios within a CBM-I control paradigm, for instance within a randomised control trial with a view towards treatment implications. To prevent against unduly exposing clinical or at-risk populations to material that may compound their negative interpretive biases, it seems desirable to develop a viable control for positive CBM-I that is not 50% comprised of negative training material. Based on the results from the present study, the neutral training group would be an acceptable control here.

4.4.3 Interpretation Questionnaire

The lack of generalisation of CBM-I training to the Interpretation Questionnaire coheres with previous adult research suggesting that a single session of CBM-I training will not generalise to other measures of interpretation bias (Salemink, van den Hout, & Kindt, 2010; Salemink, van den Hout, & Kindt, 2007). There are a number of potential explanations as to why CBM-I training effects were not found to generalise to Interpretation Questionnaire scores, of which the 3 most plausible seem to be: 1) the Interpretation Questionnaire is not a valid test of interpretation bias; 2) nothing generalises from CBM-I training because CBM-I training is invalid; and 3) generalisations to the Interpretation Questionnaire would not be immediately evident.

The first point regarding the validity of the Interpretation Questionnaire as a measure of interpretation bias is contentious. The measure is composed of a selection of age-appropriate items from the Ambiguous Social Situations Interpretation Questionnaire and Children's Expectations of Social Behaviours Questionnaire, both of which have previously been shown as valid indices of interpretation (Stopa & Clark, 2000; Amir et al., 1998; Rudolph et al., 1995). Test-retest reliability and alpha scores for the Interpretation Questionnaire suggested that the measure has good reliability, as well as the validity afforded by replication of significant associations with emotional symptoms. So the Interpretation Questionnaire seems to be a fair test of interpretation, but certainly one that could benefit from further examination.

As previously stated, the issue of effects generalising from CBM-I training is rather scattershot in the existing literature. Though previous studies have—like in the present findings—failed to show generalisation to other measures of interpretation (Salemink, van den Hout, & Kindt, 2010; Salemink, van den

Houdt, & Kindt, 2007), others have shown evidence that CBM-I training effects transfer to measures of mental intrusions (Hirsch et al., 2009), interpretations of academic material (Salemink, van den Hout, & Kindt, 2010), and interpretation tests presented in different modalities and in different experimental contexts (Mackintosh et al., 2006). It bears mentioning however that these generalisability effects have been demonstrated in adults, in contrast to the adolescent sample in the present study. So while the second explanation offered above for the lack of generalisation from CBM-I training to the Interpretation Questionnaire seems the most unlikely, it still requires falsification. This would entail experiments showing CBM-I effects to transfer to other measures in adolescents, which would rule out the reason for the lack of generalisability in the present study being due to the invalidity or inefficacy of the CBM-I paradigm.

The third explanation is derived from theory of the route to cognitive and behavioural change from CBM-I training, most succinctly summarised by Mathews (2012), and based in a wide selection of antecedent literature (e.g. Mathews & Mackintosh, 2000; Wilson et al., 2006; Hoppitt et al., 2010b). This suggests that CBM-I provides individuals with a tendency towards positive interpretations, which is then used to construct subsequent experiences by gradually applying this tendency to novel incoming information from the environment. As such, it is not unreasonable to expect that generalisations of CBM-I to measures outside of the training paradigm itself may not manifest immediately. Rather such effects may be expected to manifest only after real-world experience of ambiguous situations, and their resolution within that individual's post-training interpretive framework. In such a case, though generalisation of CBM-I training effects to the Interpretation Questionnaire may not be immediately apparent, this might be expected after a given period of time following training, or only after multiple instances of CBM-I exposure. Accordingly the assumptions behind the third proffered explanation for the lack of Interpretation Questionnaire effects in this study could be tested by examining Interpretation Questionnaire scores at a subsequent follow-up session rather than during the same session as training. Alternatively or additionally, Interpretation Questionnaire scores could be examined after a longer programme of CBM-I training rather than after a single session.

4.4.4 Mood Scores

Self-reported positive affect and anxiety ratings were found to decrease across the whole sample over the course of CBM-I training, while self-reported low mood increased across the whole sample. The absence of differential mood changes across training groups suggests that this may have been due to habituation or boredom effects. There were no between-group differences in any self-reported mood scores at VAS3, which suggests that effects seen in the Interpretation Bias Test were not confounded with state mood effects.

These findings replicate previous studies to have shown no evidence of mood change as a direct effect of training in adolescents (Salemink & Wiers, 2011; Lester et al., 2011b; Fu et al., 2012; Vassilopoulos et al., 2013). In doing

so they also contrast with adolescent findings of immediate mood changes seen in various studies (Lothmann et al., 2011; Vassilopoulos et al., 2009; Lester et al., 2011a; Vassilopoulos et al., 2012). Other adolescent work has suggested that such mood effects might only be observed in individuals with pre-existing high anxiety or low self-efficacy (Lau et al., 2011). Placed in a wider theoretical context, the present findings agree with suggestions that CBM-I is not likely to have immediate effects upon mood, but rather that post-training mood and anxiety would only be constructed through interactions with stressors and other features of the environment (Mathews, 2012; Hoppitt et al., 2010b). Examining post-training mood effects with regards to reactivity to environmental stressors or other processes (e.g. appraisal of intervening life events) would be an interesting development if differential post-training mood changes could be demonstrated under such circumstances.

4.4.5 Limitations

Covariate analyses including trait measures of anxiety and depression confirmed findings from previous work of the link between interpretation biases and trait emotional symptoms (Salemink & Wiers, 2011; Amir et al., 1998; Muris et al., 2008; Mathews & Mackintosh, 2000; Hadwin et al., 1997). These findings show continuity with negative and non-positive interpretive biases seen in clinical adult populations (Mathews, Richards, & Eysenck, 1989; Eysenck et al., 1991; Blackwell & Holmes, 2010), and provide preliminary evidence that strength of interpretive bias is associated with strength of symptoms in adolescence. These data suggest that to the extent that CBM-I is effective, it is no less (or more) effective in symptomatic individuals.

However the study remains limited in its generalisation beyond the non-clinical sample of the current experiment. Anxious and depressive symptom scores in the current sample (see Table 4.1) were similar to normative adolescents scores on these measures, as would be expected from a sample drawn from a typically-developing population. As such the present study is limited in its generalisability to clinical or sub-clinical high-symptomatic groups, and so findings remain limited in their applicability to meaningful implementation of CBM-I protocols as potential interventions against the development of emotional disorders in adolescence.

Chi-square tests of the make-up of the experimental groups showed that the sample as a whole was disproportionately female-heavy, and that gender make-up differed between experimental groups. Additionally, age was not constant across groups. Though neither of these aspects of the sample is desirable, they were unfortunately the result of random (rather than quota/stratified) sampling measures used for group assignment. The likely reason for this is probably because of some element of systematicity in how IDs were allocated—i.e. IDs were allocated in order, so participants recruited from the same school would cluster together. As noted above, different schools drew from different age groups and mixed or single-sex pools, which appears to be reflected in some way in allocation to certain experimental groups. As a result of the over-sampling of girls'

schools and the variation in age-pools between schools, extra care was taken in analyses to examine any potential differential effects of gender or age on CBM-I training and other measures. Statistical account was taken of these sampling issues (as described above in sections 4.3.1 and 4.3.5.2). It is encouraging that no differences to the ANOVAs reported in the section above were found upon including either gender or age as covariates in the analysis, nor when solely analysing female participants. Of course, future research may seek to negate the need for such post-hoc checks and analyses by controlling for these factors at the outset of the experiment.

The current approach to sampling also throws up a number of issues regarding participant engagement and SES data. First and foremost, the opt-in recruitment process represents a vast minority of the target population: 1–8%. This suggests that participants who took part in the current research (and/or their parents or guardian) were disproportionately more interested in psychological research than the general population. This in itself may be a motivator of demand characteristics via trying to understand the purpose of the study. In the example of the current research, the information sheets sent out to parents (see Appendix H) also made liberal reference to the fact that the experiments being recruited for concerned processes of emotional processing. This may have encouraged responses from participants or parents with sub-clinical emotional problems, or else individuals interested in these areas. Any such individual differences could perhaps be expected to potentiate effects in such a potential unrepresentative sample, and so inflate effect sizes. Various emotional measures were put in place to keep track of emotional symptoms across the various CBM-I studies and showed no such abnormalities in emotional measures. Some participants were a little higher on emotional measures, but if anything this would be desirable for the progression of any future translational research to at-risk individuals. However, any indices or individual differences that the emotional measures used across this chapter and those following were *not* sensitive to may have inflated or distorted the effect sizes for this up-stream cognitive experimental research, if such characteristics are not representative of the target population of adolescents as a whole.

The other issue is that an opt-in process may encourage participation by higher-SES individuals, an issue that has previously been seen in adult research and may be said to be widely present in psychological research as a whole (Gosling, Vazire, Srivastava, & John, 2000; Graham, 1992). Based on the (admittedly somewhat rough) FSM index of SES, it does appear that the current sample was from a higher-SES background than the general population, which could systematically bias results in one way or another (Henrich, Heine, & Norenzayan, 2010; K. Marx, 1867). The fact that individual SES data were not collected means that it is not possible to examine potential SES effects on individual differences in task performance. Furthermore based on power calculations for the current chapter (see Section 4.3.5.1 and Appendix E), it is unlikely that this chapter and those following (Chapters 5–7) would have the required statistical power to investigate the effects of SES nested at the school level upon CBM-I task performance.

4.4.6 Conclusions and Proposed Developments

The 4-group analyses of different training valences suggested that outcomes from the mixed and neutral training conditions are indistinguishable as indexed by the Interpretation Bias Test in a typically-developing 15–17 year-old adolescent sample. This suggests that either mixed or neutral training is acceptable as a control condition. However, differences between positive training and these conditions are weaker than between positive and negative training. Furthermore, post-training interpretation effects that did not involve the comparison of positive to negative training groups showed relatively small effect sizes. Two suggestions are proposed for future research:

1. When comparing groups in a healthy population and within a theoretical/empirical setting, comparisons of positive vs. negative training are a viable way to maximise effect sizes under consideration
2. When comparing groups in a high-risk, anxious or depressed population (or any clinical setting), positive training may be compared against either mixed or neutral training so as to provide a viable control, whilst protecting participants against any potential ill-effects of negative CBM-I training

Future studies should also attempt to explain the null effects of the Interpretation Questionnaire post-training in the current study by:

1. Validating the generalisability of the CBM-I to other measures within an adolescent population
2. Conducting further examinations of the validity and reliability of the Interpretation Questionnaire
3. Testing the Interpretation Questionnaire at a longer follow-up and/or as part of an iterated training programme

5

CBM-I Training Effects at 24-hour Follow-Up

Thinking 'bout tomorrow
Won't change how I feel today

Matt & Kim (2009)

5.1 Introduction

The experiment presented in this chapter attempts to expand findings from Chapter 4 to consider the longevity of CBM-I training effects, and positive training effects in particular. In order to represent a potentially useful intervention for at-risk, anxious or depressed young people, effects of positive CBM-I training should persist over time. This is because the postulated mechanism for action of the training process involves individuals taking newly-modified interpretation biases from CBM-I training, and applying them to their subsequent day-to-day lives (MacLeod & Holmes, 2012; Hoppitt et al., 2010b).

A preliminary test of the perseverance of training effects would be to investigate whether these last for 24 hours. Previous studies have shown encouraging results for the maintenance of CBM-I effects over a 24-hour period in adult samples (Yiend et al., 2005; Mackintosh et al., 2006), and there have further been suggestions that testing after 24 hours might potentiate differential mood effects following CBM-I training (Mathews, 2012).

Yiend et al. (2005) showed valence-congruent CBM-I training effects in comparisons of positive and negative training conducted using the Mathews and Mackintosh (2000) paradigm. These results were shown in two experiments testing healthy adult volunteers shortly following training. In their third experiment, Yiend et al. (2005) again trained participants using either positive or negative CBM-I, but tested interpretations after a 24-hour delay. After a 24-hour delay, positively trained participants endorsed more positive than negative interpretations of novel ambiguous material, with inverted effects following neg-

ative training—replicating effects of the paper’s first two experiments where participants were tested during the same session as training.

This pattern of results however did not characterise training effects on mood. Tests of mood in the same session as CBM-I training paradigm showed increases in self-reported state anxiety in the negative training group and decreases in the positive training group (compared to pre-training). Mood effects were only seen when participants actively generated resolutions to training scenarios, in accordance with Mathews and Mackintosh (2000)’s original findings. However mood effects quickly dissipated in the period following training. Moreover no such valence-congruent mood effects were observed at 24-hour follow-up.

These findings were replicated by Mackintosh et al. (2006). Mackintosh et al. showed greater endorsement of positive of relative to negative interpretations of novel ambiguous information following positive training than following negative training, in healthy adult volunteers tested 24 hours after training. The study further demonstrated that trained interpretation effects endured at 24-hour follow-up when changing the modality and context of testing—e.g. training participants individually using a computer or in groups using paper-and-pencil, and testing using paper-and pencil materials in a group; training participants using auditory verbal materials and testing using visual verbal materials, and vice versa. This study showed no differential changes in self-reported state anxiety following training, though negative training was found to potentiate increases in self-rated anxiety following a stressful video, relative to positive training.

These studies demonstrate that CBM-I training effects persist when tested 24 hours later in adults. However, as yet this maintenance of CBM-I training effects has not been demonstrated in adolescents.

5.1.1 Aim and Hypotheses

The aim of this chapter is to examine whether the effects of a single session of positive CBM-I training persist over a 24-hour period, within an unselected 15–17 year-old adolescent sample. As in the preceding chapter, trait symptom measures of anxiety and depression scores are examined for their effects in relation to changes in interpretational style and mood following CBM-I training.

5.2 Methods

The present study replicates the protocol of positive training from Chapter 4. An additional experimental group (tested after 24 hours) was recruited and compared with the within-session training effects from the positively trained group from the preceding chapter. Chapter 4 presented between-group training effects between positive and negative CBM-I demonstrating the effectiveness of positive training in generating positive interpretations. Therefore, an absence of differences in CBM-I training effects between the two positively-trained groups in the current study (one tested during the same session as training, one tested 24 hours later) would suggest that CBM-I effects persist for at least 24 hours.

5.2.1 Participants

Participants were recruited from schools in Oxfordshire and London. Gender identities and ethnic make-up of the sample are given in Table 5.1. All participants were fluent in English and capable of fulfilling the reading demands in the task. As in CBM-I experiments reported in the previous chapter, participants were only recruited to the study if they reported no current or previous experience of mood or anxiety disorders.

This study reports on two samples: the first was taken from the positive training group in Chapter 4 and the second was recruited specifically for 24 hour follow up. Demographic data for these two groups is presented in Table 5.1. As the ‘Same Session’ follow-up group presented in this chapter is the same as the positive training group in Chapter 4, all demographic and experimental data from these two groups (‘Same Session’ in the current chapter, and ‘Positive Training’ in Chapter 4) is identical. Processes of sampling and randomisation for the current sample are discussed at greater length in the preceding chapter. The study obtained ethical approval from the University of Oxford Central University Research Ethics Committee (CUREC). Data were collected together with data from Chapter 4, and the current study’s ethical issues and their proposed resolution are as discussed in the previous chapter (see Section 4.2.4).

5.2.2 Measures and Paradigm

Materials and procedures for positive training followed those from Chapter 4. Accordingly, measures of trait anxiety (STAIC) and trait depression (CDI) were collected prior to CBM-I training, and self-reported VAS mood ratings of Positive Affect, Anxiety and Low Mood were collected over the course of training (see Figure 5.1). The Interpretation Questionnaire was completed before (IntQu t1) and after training (IntQu t2) for both the Same Session group and the 24 Hour group. The training paradigm replicated the positive training paradigm used in the preceding chapter. The Interpretation Bias Test (IBT) was also exactly as described in Chapter 4.

In the current dataset the CDI was found to have excellent internal reliability ($\alpha = .90$ across 43 valid cases in the ‘Same Session’ and ‘24 Hour’ groups), as was the STAIC trait measure ($\alpha = .88$ across 43 valid cases). Internal reliability for the Interpretation Questionnaire was again very good measured across the entire measure ($\alpha = .82$ across 52 valid cases), and individual alpha scores for the two halves of the measure were also good: $\alpha_{t1} = .53$; $\alpha_{t2} = .76$.

Reliability indexed by Cronbach’s α was very good for each 4-item VAS scale (Positive Affect, Anxiety, Low Mood) in the current study: $\alpha_{PositiveAffect} = .94$; $\alpha_{Anx} = .86$; $\alpha_{LowMood} = .90$.

5.2.3 Procedure

All procedures were same for the Same Session and 24 Hour groups, and only diverged at the point of post-training measures. The majority of the procedure was as reported in Chapter 4, and an overview of the experiment is given in

Figure 5.1. All participants in this experiment underwent positive CBM-I training, following identical protocol to that in the previous Chapter until the post-training measures were collected. Following the 10-minute post-training distractor task, participants completed the second half of the Interpretation Questionnaire (IntQu t2) and VAS3 ratings. After this point the ‘Same Session’ and ‘24 Hour’ groups diverged.

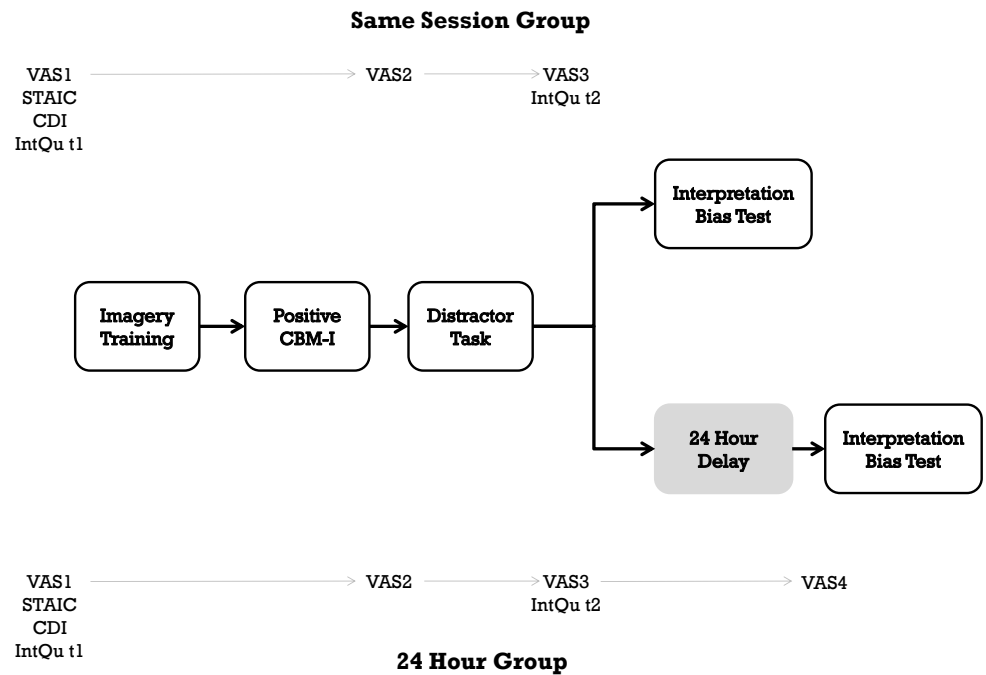


Figure 5.1: Experimental procedure for the current study

Half of the sample (‘Same Session’) completed the Interpretation Bias Test immediately after the VAS3 ratings. The other half of participants who underwent positive training (‘24 Hour’) left after completing the VAS3 ratings, and returned 24 hours later. Upon returning to the testing environment, participants completed another set of VAS ratings (VAS4), followed by the Interpretation Bias Test. As such, pre-test mood measures correspond to VAS3 ratings in the ‘Same Session’ participants, and VAS4 ratings in the ‘24 Hour’ group. After completing the bias test, participants were debriefed in full, thanked and reimbursed for their time.

5.3 Results

5.3.1 Descriptive Statistics

Mean age in years, gender, and mean scores on the STAIC, CDI and Interpretation Questionnaire are given below in Table 5.1, for the whole sample and

broken down by time of follow-up testing. Kolmogorov-Smirnoff and Shapiro-Wilks tests indicated that all continuous measures were normally distributed. All participants provided full demographic information, and CBM-I testing and training data ($n = 46$). All participants provided post-test Interpretation Questionnaire data, but pre-test Interpretation Questionnaire score was missing for one participant, meaning that pre/post comparisons on this measure were conducted on an $n = 45$ dataset. VAS scores were missing for one participant ($n = 45$), and STAIC and CDI scores were each missing from 3 participants ($n = 43$) in both cases.

		Overall	Follow-Up	
			Same Session	24 Hours
Gender	Female	69.6%	75.0%	63.6%
	Male	30.4%	25.0%	36.4%
Age		15.78 (1.85)	16.70 (0.64)	14.82 (2.20)
Ethnicity	White	80.4%	70.8%	90.9%
	Asian	8.7%	12.5%	4.5%
	Black	2.2%	4.2%	0.0%
	Mixed	6.5%	8.3%	4.5%
	Other	0.0%	0.0%	0.0%
	Did not report	2.2%	4.2%	0.0%
STAIC		38.61 (7.18)	38.43 (6.39)	39.45 (8.60)
CDI		11.84 (6.56)	11.87 (7.64)	8.95 (6.86)
IntQu t1		2.26 (1.85)	2.25 (1.45)	2.14 (2.01)
IntQu t2		2.30 (2.08)	2.00 (1.80)	2.05 (2.52)
<i>n</i>		46	24	22
Positive Affect	VAS1	6.50 (1.46)	6.20 (1.32)	6.81 (1.56)
	VAS2	6.29 (1.85)	6.06 (1.73)	6.54 (1.98)
	Pre-test	6.43 (1.86)	6.18 (1.94)	6.69 (1.78)
Anxiety	VAS1	1.95 (1.81)	2.45 (2.08)	1.42 (1.34)
	VAS2	1.33 (1.46)	1.51 (1.62)	1.13 (1.28)
	Pre-test	1.06 (1.27)	1.31 (1.54)	0.79 (0.89)
Low Mood	VAS1	0.97 (1.14)	1.09 (1.31)	0.84 (0.95)
	VAS2	1.13 (1.50)	1.28 (1.53)	0.97 (1.50)
	Pre-test	1.32 (1.96)	1.62 (2.13)	1.00 (1.77)

Table 5.1: Means for demographic information and questionnaire measures, with standard deviations given in parentheses. Mean VAS scores for self-rated Positive Affect, Anxiety and Low Mood before training (VAS1), after training (VAS2), and immediately preceding Interpretation Bias Testing. NB 'Pre-Test' VAS ratings correspond to VAS3 in the Same Session group and VAS4 in the 24 Hour group (see Procedure section 5.2.3)

Pearson χ^2 analyses showed no significant differences in the proportions of genders ($\chi^2(1) = 0.70, p = .403$) or ethnicities ($\chi^2(3) = 2.56, p = .465$) across the two experimental groups. Independent samples *t*-tests showed no significant differences between groups on STAIC or CDI scores.

Variances in ages between the two groups differed significantly according to

Levene's test for equality of variance: $F = 59.78, p < .001$. Accordingly, an independent samples t -test comparing ages across the two groups made corrections for not assuming equal variances. This test showed significant group differences in age: $t(24.34) = 3.86, p = .001, d = 1.564$. Participants in the Same Session follow-up group were significantly older than those in the 24 hour follow-up group (see Table 5.1 for means).

The number of negative responses to Interpretation Questionnaire items prior to training (IntQu t1) was strongly correlated with both STAIC ($r(41) = .69, p < .001$) and CDI ($r(41) = .61, p < .001$) scores. Given that correlations were previously calculated for the Same Session group as part of the wider sample of Chapter 4, the analyses were also conducted for the 24 hour group alone. This pattern of correlations mirrored those of the sample as a whole, and of the Chapter 4 sample.

5.3.2 Training

Three 5×2 ANOVAS were conducted to examine performance over the course of training. The first ANOVA used reaction times (RTs) to word fragment completions during training as an outcome measure; the second used RTs to comprehension questions; and the third used accuracy of responses to comprehension questions. All 3 ANOVAS included Block (1, 2, 3, 4, 5) as a 5-level within-subjects factor, and Follow-Up (Same Session, 24 Hour) as a 2-level between-subjects factor. Though the training paradigm was identical across the two experimental groups, the between-groups analysis was conducted to ensure that there were no baseline differences between the two samples in terms of learning rates during training.

Block	Word Fragment	Comprehension Question	
	Reaction Time (ms)	Reaction Time (ms)	Accuracy
1	2162.34 (1667.61)	3180.08 (1311.28)	89.7% (10.4)
2	1618.34 (1069.85)	2534.88 (1184.75)	94.8% (7.9)
3	1783.47 (723.10)	2558.13 (910.46)	92.2% (9.4)
4	1633.22 (609.72)	2459.07 (711.98)	90.9% (11.8)
5	1489.32 (559.47)	2306.03 (783.46)	95.5% (9.7)

Table 5.2: Mean accuracy rates and RTs (ms) over the course of training, collapsed across Same Session and 24 Hour groups. Standard deviations given in parentheses.

Significant main effects of Block were observed for all 3 outcome measures—Word Fragment RTs: $F(4, 176) = 6.68, p < .001, \eta^2 = .125$; Comprehension Question RTs: $F(4, 176) = 12.60, p < .001, \eta^2 = .220$; Comprehension Question Accuracy: $F(4, 176) = 4.70, p = .001, \eta^2 = .095$.

Significant linear within-subjects contrasts in the first 2 analyses $F_{WordFrag}(1, 44) = 8.99, p = .004, \eta^2 = .163$; $F_{CompQu}(1, 44) = 22.80, p < .001, \eta^2 = .341$, taken together with comparisons of mean RTs across Blocks (Table 5.2) suggest that responses became faster over training.

A trending linear within-subject contrast for Comprehension Question Accuracy $F(1, 44) = 3.44, p = .070, \eta^2 = .070$, together with examining means over the 5 blocks (see Table 5.2) suggests that while participants' answers to comprehension questions may have become slightly more accurate over the course of training, they had reached effective ceiling for accuracy during Block 1 of training.

No significant main effects of Follow-Up Group were seen for any of the 3 outcome measures, nor were there any significant Block*Follow-Up-Group interactions.

5.3.3 Mood Scores (VAS)

Three 2×2 ANOVAs were conducted to examine potential changes in self-rated mood due to training, using self-reported VAS Positive Affect, VAS Anxiety and VAS Low Mood scores as outcome measures respectively. ANOVAs included Time (VAS1, VAS2) as a 2-level within-subjects factor and Follow-Up Group (Same Session, 24 Hours) as a 2-level between-subjects factor. The only significant effect was a main effect of time for self-rated anxiety: $F(1, 43) = 7.56, p = .009, \eta^2 = .144$. This represented a decrease in anxiety ratings from VAS1 ($\bar{x} = 1.95, sd = 1.81$) to VAS2 ($\bar{x} = 1.33, sd = 1.46$), across both groups. No significant interaction effects were found of any of the analyses. Means are given in Table 5.1 above.

To compare mood scores prior to testing, VAS3 scores in the Same-Session group were compared to VAS4 scores in the 24 Hour group (these means are given in Table 5.1 as 'Pre-Test'). This is because the Same Session group went straight from post-distractor task to completing the Interpretation Bias Test, whereas in the 24 Hour group there was an intervening 24 hours between these two events (see Procedure in section 5.2.3). Independent samples *t*-tests showed no significant between-groups differences in Pre-Test self-ratings of positive affect, anxiety or low mood.

ANOVAs were also re-run including STAIC scores, CDI scores and age in separate covariate analyses. The inclusion of these factors did not affect the significance of any results, nor did it give rise to any significant novel interaction effects.

5.3.4 Interpretation Questionnaire

A 2×2 ANOVA was conducted with Time (pre-training/IntQu t1, post-training/IntQu t2) as a 2-level within-subjects factor, and Follow-Up (Same Session, 24 Hours) as a 2-level between-subjects factor. The outcome measure of the analysis was the number of endorsements of negative responses on the Interpretation Questionnaire. No significant main effects were observed for Time—i.e. there were no significant changes in Interpretation Questionnaire scores from pre- to post-training. Nor were there any main effects of Follow-Up or interactions between these factors. Mean scores on the Interpretation Questionnaire at t1 and t2 can be seen in Table 5.1.

5.3.5 Interpretation Bias Test

A $2 \times 2 \times 2$ ANOVA was conducted with Probe-Type (target, foil) and Probe-Valence (positive, negative) as within-subjects factors. Follow-up (Same Session, 24 Hours) was included as a between-subjects factor. The outcome measure was mean similarity rating for probe statements relative to the corresponding ambiguous scenario within the Interpretation Bias Test (i.e. how similarly participants rated positive/negative targets and foils to the original ambiguous scenarios, on a 4-point Likert-like scale). A significant 3-way Probe-Type*Probe-Valence*Follow-Up interaction emerged from the analysis: $F(1, 44) = 8.10, p = .007, \eta^2 = .155$, and is shown in Figure 5.2.

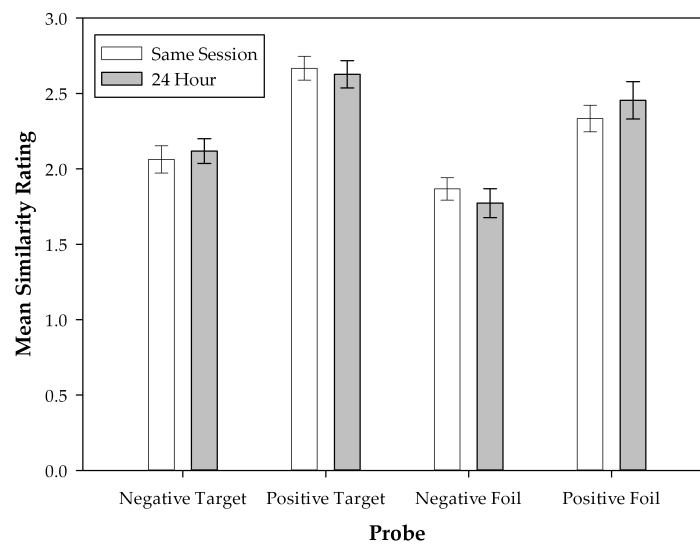


Figure 5.2: Mean similarity ratings for probes in the Interpretation Bias Test, grouped by type of probe and time of follow up bias test

Main effects were found for Probe-Valence ($F(1, 44) = 39.42, p < .001, \eta^2 = .472$) and Probe-Type ($F(1, 44) = 35.24, p < .001, \eta^2 = .445$). Figure 5.2 illustrates the directions of the main effects: similarity ratings were higher for positive than negative statements, and for targets relative to foils. Of greatest pertinence to the present analysis, there was no main effect of Follow-Up Group (i.e. Same Session vs. 24 Hours later): $F(1, 44) = 0.02, p = .886$. The $2 \times 2 \times 2$ ANOVA was decomposed into separate analyses for targets and foils, as well as for positive and negative probes. However these analyses yielded no further significant main effects nor interactions.

Given the lack of any 2-way interactions, post-hoc t -tests were conducted to examine any possible differences between Follow-Up groups in light of the 3-way interaction reported above. Same Session and 24 Hour Follow-Up Groups did not differ significantly on similarity ratings for positive targets ($t(44) = .33, p = .744$) nor negative targets ($t(44) = -0.45, p = .653$). The two groups also did not differ on difference scores between positive and negative targets

(i.e. Positive Target Ratings–Negative Target Ratings): $t(44) = 0.49, p = .630$. These post-hoc tests were subjected to Bonferroni corrections, which are known to be conservative in identifying present effects—that is they accentuate false negatives rather than false positives. However no post-hoc tests reached significance even prior to these corrections.

In summary, findings at 24 Hour follow-up show no differences to the pattern of findings following positive CBM-I training seen in Chapter 4.

5.3.5.1 Covariate Analyses

The $2 \times 2 \times 2$ ANOVA was run again including a number of covariates in separate analyses. The differences in analyses relative to the original ANOVA in the covariates whose inclusion yielded new results (STAIC, CDI, gender, age) are detailed individually below. Including age as a covariate gave rise to a main effect of age, where higher age predicted lower similarity ratings across all probe types (and groups) in the Interpretation Bias Test: $F(1, 42) = 4.35, p = .043, \eta^2 = .092$. Including gender as a covariate gave rise to a 2-way Probe-Type*Gender interaction: $F(1, 40) = 6.27, p = .016, \eta^2 = .127$. Here males showed significantly higher similarity ratings for targets ($\bar{x} = 2.49, sd = 0.20$) than did females ($\bar{x} = 2.32, sd = 0.24$): $t(44) = 2.29, p = .027, d = 0.69$, with no such effect for foils.

The only significant interaction in the STAIC covariate analysis was a 2-way Probe-Valence*STAIC interaction: $F(1, 40) = 12.94, p = .001, \eta^2 = .168$. Regression analyses to clarify this effect showed that higher STAIC scores predicted higher endorsement of negative probes ($\beta = .304, p = .047$) and lower endorsement of positive probes ($\beta = -.452, p = .002$). The pattern of results upon including CDI score as a covariate in the repeated measures ANOVA closely resembled those of the STAIC covariate analysis. The analysis yielded a significant 2-way Probe-Valence*CDI interaction: $F(1, 40) = 4.76, p = .035, \eta^2 = .065$. Regression analyses showed that higher CDI predicted lower endorsement of positive probes ($\beta = -.401, p = .008$), but the relationship between CDI and negative probes was not significant ($\beta = .090, p = .565$).

Including both STAIC and CDI scores as covariates largely reproduced the results of the above analyses. Of interactions involving specifically either STAIC, CDI or both, only the 2-way Probe-Valence*STAIC interaction was significant: $F(1, 39) = 7.59, p = .009, \eta_p^2 = .162$. Unlike the preceding covariate ANOVAs to have included only CDI as a covariate in Chapter 4, the Probe-Valence*CDI interaction was not significant: $F(1, 39) = 7.59, p = .009, \eta^2 = .116$.

5.4 Discussion

No differences were found in positive CBM-I training effects between participants tested during the same session as training, and those tested 24 hours later. No changes were seen as a result of training in the number of endorsements of negative items on the Interpretation Questionnaire following training.

Findings of no difference between an Interpretation Bias Test administered during the same session as training, and one administered 24 hours later shows that positive training effects from the CBM-I paradigm—demonstrated in Chapter 4 by comparison between this group and the negative training group—persist for at least 24 hours in adolescents. The lack of any significant differences between the Same Session and 24 Hour groups suggests that these interpretation effects are equivalent 24 hours after training to roughly 10 minutes after training. This replicates previous adult findings by showing induced positive interpersonal interpretive biases persist in their effects for at least 24 hours, but does not replicate their commensurate changes in anxiety as a result of CBM-I training (Yiend et al., 2005; Mackintosh et al., 2006). Ages were unequal between the two follow-up groups, and concerns about the limits of the randomisation techniques and its potential downstream effects mirror those discussed in Chapter 4 (see Sections 4.2.1, 4.3.1 and 4.4.5). However it is worth remarking that in the current chapter’s analyses, no differences in CBM-I training effects were observed as a result of these age differences, nor were there any significant effects of age as a covariate. This suggests that the limitations of the effectiveness of the randomisation process in allocating participants to groups *vis-a-vis* ages show no indication that they meaningfully affected experimental results.

Further it is noteworthy that periods of REM sleep act to re-encode and consolidate experiences over the course of the preceding day, re-orienting new information in relation to previous memory network organisation (Rasch & Born, 2007; Wilhelm et al., 2011). As such, the first demonstration of longevity that the effects of CBM-I training must survive is persistence after a period of REM sleep. Current findings are a positive indication that CBM-I training effects are likely to persist over this process.

Persistence over 24 hours marks the first significant milestone for a paradigm that is intended in its final form to contribute to long-lasting changes in cognition and behaviour that persist over time, and buffer risk factors for anxiety and depression over development (Hoppitt et al., 2010b; MacLeod & Holmes, 2012). However, as in Chapter 4, effect sizes were relatively small, and there was no support for previous findings or suggestions that mood changes arise as a direct result of CBM-I training (Mathews & Mackintosh, 2000; Yiend et al., 2005), nor that differential mood effects emerge later as sleeper effects (Mathews, 2012). Though self-reported anxiety ratings decreased over the course of training, the current analyses did not contain any control group. However this effect mirrors that of Chapter 4, where decreases in anxiety were consistent across all training groups. This suggests that the decrease in anxiety was most likely not a direct effect of CBM-I training material.

Interpretation Questionnaire scores were significantly correlated with trait symptom scores of both anxiety and depression. This replicates the findings of Chapter 4’s analyses across four different training groups within a homogeneous positively trained sample. Findings once again showed no evidence of generalisation from CBM-I post-training beyond the Interpretation Bias Test to this alternative interpretation measure. However as noted in Chapter 4, the generalisation or transfer of CBM-I training effects to other measures might only be

expected after intervening experiences with ambiguous or stressful experiences in real life (Mathews, 2012). As Interpretation Questionnaire scores were tested immediately following training in the current study, it is not possible to disconfirm this with the present data. Future work should next attempt to test one of two developments to this finding: 1) the presence or maintenance of other effects 24 hours after training (including transfer of training effects to other measures), or 2) the maintenance of the observed interpretation effects over longer periods.

6

CBM-I Training as a Buffer Against Stress Reactivity

Carry my joy on the left
Carry my pain on the right

Björk (2004)

The proposed utility of Cognitive Bias Modification of Interpretation (CBM-I) methodology lies in its purported ability to buffer against emotional symptoms. However, previous adolescent studies have yielded inconsistent reports of mood change as a direct consequence of CBM-I training. This chapter aimed to replicate previous findings of valence-congruent CBM-I training effects upon interpretations of novel ambiguous information and mood. It further examined whether positive and negative training would differentially affect subjective stress responses when participants were exposed to an experimental stressor. Forty adolescents aged 12–18 were randomly assigned to either positive or negative interpretation training. Following training, adolescents completed an Interpretation Bias Test, and a difficult mental arithmetic task while believing that they were being videotaped for teaching purposes. No changes in self-reported mood were observed as a direct result of training. However, participants anticipating a stressful situation following training showed smaller increases in anxious responses if they had undergone positive, relative to negative training. The stressful task differed from both the form and domain of the training paradigm, suggesting that these effects are not ascribable to demand characteristics. The study provides tentative support for the appropriateness of CBM-I as a potential buffer intervention for future research in adolescents.

6.1 Introduction

Based on the empirical association between negatively valenced cognitions and negative emotional symptoms (Mogg & Bradley, 1998; Mathews & MacLeod, 2005; Hirsch & Mathews, 2000), a central premise of CBM research is that modifying cognitive biases to be more positive should result in more positive emotional outcomes (Koster et al., 2009; Hertel & Mathews, 2011; Mathews, 2012). Previous work in adults has shown inconsistent mood effects following CBM-I training, either finding (Salemink, van den Houdt, & Kindt, 2007; Beard & Amir, 2008) or not finding (Wilson et al., 2006; Hirsch et al., 2009) changes in mood as a direct result of undergoing CBM-I. Similar discrepancies appear in the adolescent CBM-I literature, showing changes in mood (Lothmann et al., 2011), no changes in mood (Salemink & Wiers, 2011), or changes in mood predicated on other individual difference factors such as self-efficacy (Lau et al., 2011). To further contribute to inconsistencies in this literature, the preceding chapters found no evidence of valence-congruent mood change immediately following a CBM-I training procedure in a sample of healthy adolescents.

If training interpretive biases using CBM-I is not able to give rise to commensurate valence-congruent changes in mood, then this would appear to contradict the central premise of cognitive bias modification approaches noted above. However other studies have posited that improvements in mood or well-being as a result of CBM-I would not be expected to occur immediately following training, but rather through subsequent interactions with external environments, which are expected to be interpreted more positively as a result of induced positive biases (Hoppitt et al., 2010b; Mathews, 2012). In this way CBM-I training might potentially be used to buffer against the ill effects of difficult, challenging or stressful environments. This is consistent with diathesis-stress models of anxiety and depression (Paris, 1999), in that the purported use of a CBM-I intervention would be to mitigate the negative impacts of environmental features, experiences or stressors and so buffer against resultant emotional symptoms and related negative outcomes.

As suggested in Chapter 1, it may therefore be more useful for CBM-I research to examine differential post-training mood responses to environmental events, rather than measuring mood responses immediately following training. This is the logic of stress reactivity designs used in previous CBM-I training studies. Following positive or negative training, differential mood or stress responses to a experimental stressor might allow for the examination of changes in participants' stress reactivity as a function of training. Such approaches would allow for a representation of stress constructed through an interaction between an individual and their environment.

Previous CBM-I training studies to have indexed mood and other reactions to experimental stressors have yielded some evidence of differential state anxiety responses as a factor of CBM-I training valence in healthy and sub-clinical adult populations. These results have been demonstrated across various training protocols and stressors. Wilson et al. (2006) trained participants to interpret ambiguous homophones in either threatening or non-threatening ways, and

used a graphic video as an experimental stressor. Upon watching the video, participants who underwent negative and benign training both showed increases in self-reported anxiety, but these increases were smaller in the group to have undergone benign training. These findings were replicated using the same training and stressor materials by Hoppitt et al. (2010b). Murphy et al. (2007) trained participants screened for high social anxiety using benign resolutions to ambiguous social situations, and compared these to a no-training control group. Following training, participants were led to believe they were going to have to converse with strangers for five minutes. As in Wilson et al. (2006) and Hoppitt et al. (2010b), both groups showed increases in self-reported anxiety in anticipation of the stressor, but these increases were smaller in the group to have undergone benign interpretation training. It does bear mentioning that stress reactivity following an experimental stressor has not been demonstrated in all adult studies—for example in Salemink, van den Hout, and Kindt (2007) and Salemink, van den Hout, and Kindt (2010)—but otherwise remains fairly well replicated. For instance, in a meta-analysis of cognitive bias modification studies, (Hallion & Ruscio, 2011) found that differential effects of training on mood measures were stronger and more reliable when studies included an intervening experimental stressor in their paradigm, compared to simply testing mood directly following training.

Given developmental changes in the relationship between interpersonal cognition and emotional symptoms between childhood and adulthood (J. E. Turner & Cole, 1994), extensions of this methodology to developmental and adolescent populations would seem important to CBM-I research. Evidence supports the effectiveness of CBM-I training in adolescents (Salemink & Wiers, 2011; Lester et al., 2011b; Lau et al., 2011), and that adolescence may be the most opportune period to employ CBM-I as an intervention (Holmes et al., 2009; MacLeod et al., 2009). If positive CBM-I training can be shown to buffer against negative subjective responses to an environmental stressor in adolescence, this could represent the mechanism through which repeated CBM-I training may guard against the development of clinical emotional symptoms (Mathews & MacLeod, 2002; Lang et al., 2012). Accordingly, the present study sought to incorporate an experimental stressor into an adolescent CBM-I paradigm, to test validity of wider future application of CBM-I.

As outlined in Chapter 1, there is some preliminary evidence that differential stress reactivity effects as a result of CBM-I training may be observed in child and adolescent samples. Vassilopoulos et al. (2009) showed that, relative to a no-training control group, social-themed positive CBM-I training tempered the anxiety experienced in anticipation of meeting an unknown peer in a late-childhood sample who had been selected for high social anxiety. Further, in unselected samples spanning late childhood and adolescence, Lester et al. (2011a) and Lester et al. (2011b) demonstrated that participants showed differential behavioural and self-reported anxious responses to experimental stressors following positive and negative CBM-I training. These stressors required participants to approach either an animal in a box following animal-themed training, or an interaction with unknown peers following social-themed training. However the

outcomes of stress reactivity tasks in these latter two studies are not entirely clear. Lester et al. (2011a) found that positive training reduced behavioural avoidance of stressors relative to negative training, but had no effect on self-reported anxiety measures. In contrast, Lester et al. (2011b) found no effect of training on behavioural avoidance. It is worth noting that all three of these studies used passive-generation for resolutions of ambiguous scenarios during training. Previous work in adults has implicated the necessity of active-generation training procedures in producing changes in mood as a consequence of CBM-I training (Mathews & Mackintosh, 2000; Yiend et al., 2005).

So there is evidence that some form of stress reactivity effect may be seen as a result of CBM-I training in adolescents, but it is less clear whether this would be expected to impact upon subjective mood. Further, these effects have only considered the impact of CBM-I training in mitigating the effects of anxiety in response to stressors, with little consideration of other aspects of negative affect. It is also unclear whether experimental stressors that give rise to differential stress reactivity effects would have to replicate the specific content of training or not, as all adolescent CBM-I studies to have employed stress reactivity designs have used experimental stressors that relate directly to the content of training paradigms. The issue of the inconsistency of adolescent stress reactivity designs to produce differential effects on subjective measures of mood is especially pertinent in light of the wider literature regarding CBM-I training and mood change during adolescence.

Furthermore, previous adolescent literature to have investigated the potential of CBM-I training to give rise to differential effects on stress reactivity has used relatively indirect indices of stress, such as behavioural avoidance or self-reported mood. This often makes logistical sense, given that measuring cortisol or other physiological responses may be invasive. Even under such constraints, relatively closer indices of stress reactivity might be afforded by using an experimental stressor that has previously been shown to give rise to physiological stress responses. One such potential stressor is a serial subtraction mental arithmetic task, as described by the Trier Social Stress Test protocol (Kirschbaum, Pirke, & Hellhammer, 1993). Here participants are required to count backwards in their head from a large number in multiples of an odd number such as 13 or 7. This task has previously been shown to increase cortisol and heart rate, especially in situations where participants feel they are being watched or judged (Wang et al., 2005; Way & Taylor, 2010; Kirschbaum et al., 1993). These effects have also been replicated in adolescents (Gotlib, Joormann, Minor, & Hallmayer, 2008; Ellenbogen, Hodgins, Walker, Couture, & Adam, 2006). Therefore use of such a task as an experimental stressor within a CBM-I training paradigm might represent a better index of stress reactivity.

Given earlier justifications that comparison of positive to negative training is a viable approach to maximise the effects of CBM-I research in healthy samples, the present study examines CBM-I stress reactivity effects following positive and negative training protocols. This is done in order to ensure observable experimental effects, in light of the small effect sizes and inconsistencies seen in CBM-I training's ability to give rise to differential mood effects in adolescents in

the preceding chapters, and adolescent CBM-I research more widely (Hallion & Ruscio, 2011).

6.1.1 Aims and Hypotheses

The aims of the study were as follows:

- To attempt to replicate interpretation training effects in adolescents from previous research
- To examine any changes in mood as a direct result of interpretation training
- To test the effects of CBM-I training on responses to a stressor

It is hypothesised that, as in previous adolescent CBM-I studies (Salemink & Wiers, 2011; Muris et al., 2009; Lothmann et al., 2011; Lau et al., 2011), positive training will enhance positive and suppress negative interpretations of ambiguous novel information, and the inverse pattern will be seen following negative CBM-I training. Moreover this pattern of results is hypothesised to generalise to stress reactivity.

Upon exposure to an experimental stressor, it is hypothesised that positive affect will decrease, and negative affect (anxiety, low mood) will increase across all participants. The decrease in positive affect is hypothesised to be potentiated following negative training, and mitigated following positive training. Similarly, the increase in negative affect upon exposure to an experimental stressor is hypothesised to be greater following negative training than following positive training.

6.2 Methods

6.2.1 Participants

Participants were recruited from a mixed-sex Community school in West London with a comprehensive admissions policy. The school had an above-national-average proportion of students eligible for Free School Meals, 31.4%. Forty students were recruited from years 7–13 (ages 11–18); this was 3% of eligible participants in the school, recruited via an opt-in method after information sheets (see Appendix H) were sent home to parents/guardians by the school. Ages, gender identifications and ethnic make-up of the sample are given in Table 6.1. Eight participants spoke English as a second language (4 in each training group), but all participants were fluent English speakers with no reading difficulties, and as such able to comply with the task demands of the study.

6.2.2 CBM-I Training and Interpretation Testing

CBM-I training protocols and materials were identical to those described in Chapter 4, with the exception that participants were allocated to positive or

negative training programmes only. The order of training and testing is illustrated in Figure 6.1, together with other features of the experiment detailed in the Procedure section below.

6.2.3 Measures

6.2.3.1 Anxiety Symptoms (STAIC)

Trait anxiety was measured using the State-Trait Anxiety Inventory for Children (STAIC Spielberg, 1973). Accounts of the reliability and validity of the measure are given in Chapter 4. Internal reliability in the current sample was fair to good: $\alpha = .63$ across 20 items in 40 cases.

6.2.3.2 Visual Analogue Scales for Mood & Experimental Stressor

Mood ratings for Positive Affect, Anxiety, and Low Mood were obtained using the same Visual Analogue Scale (VAS) rating method as described in Chapter 4. Mood ratings were taken before (VAS1) and after (VAS2) CBM-I training as in preceding chapters. Additionally, VAS ratings were completed following training, before (VAS3) and after (VAS4) exposure to an experimental stressor. Ratings showed very good internal reliability across 4 items each, in 40 valid cases:

$\alpha_{PositiveAffect} = .70$; $\alpha_{Anxiety} = .91$; $\alpha_{LowMood} = .92$

The experimental stressor aimed to induce stress reactivity responses during a performance-related stressor in the adolescent sample. Adolescents were asked to count backwards from 555, in intervals of 7. They were required to count aloud, and had 2 minutes to complete the task. Participants performed the task in front of a digital camera, were led to believe that they would be filmed during the task, and that their performance would be shown as part of a laboratory class in the University of Oxford. In reality, no participants were filmed, and all were debriefed as to the deceptive nature of the task following the VAS4 rating and the experiment's completion.

6.2.4 Procedure

A visual depiction of the course of the experiment is given below as Figure 6.1. After providing demographic information, participants completed VAS1 ratings, followed by the STAIC. This was followed by imagery training to enhance CBM-I training effects (Holmes et al., 2009). Participants were allocated to either positive or negative CBM-I training. Allocation to the two experimental conditions was conducted the experimenter for this task (no randomisation was explicitly stated by the lead researcher) in a pseudo-random pattern of alternating female- and male-identified participants to either positive or negative training. Though this ensured an even gender split between conditions, it unfortunately gave rise to systematic age differences between the experimental conditions. These issues are discussed more in Sections 6.3.1 and 6.4.3.

After the training, participants gave another set of mood ratings (VAS2), before completing a 10-minute distractor task as described in Chapter 4. Following

the distractor task, participants completed the pre-stressor mood rating (VAS3) and then the Interpretation Bias Test. They were then informed of the nature of the mental arithmetic stressor task, and completed it. Finally they completed the post-stressor mood ratings (VAS4) and were debriefed.

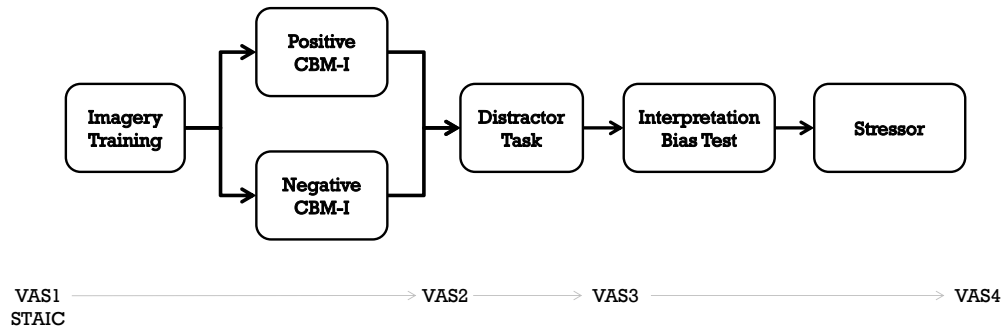


Figure 6.1: Schematic of the experimental procedure

6.2.5 Ethical Issues

Ethical approval for the study was obtained from the University of Oxford Central University Research Ethics Committee (CUREC). In addition to the ethical issues discussed in Chapter 4 (see Section 4.2.4) relating to training unselected participants with positive and negatively valenced CBM-I materials, and issues of providing informed consent for adolescent participants, the current study had the additional ethical issue of exposing participants to an experimental stressor. Though the specific form of the stressor may not have been likely to have been experienced by adolescents on a day-to-day basis, the format of performing a straightforward academic task while (theoretically) being recorded was judged to not to be beyond the realm of potential daily life stress. It was also made clear to participants at the onset of the study that participation was voluntary and that they could withdraw with no repercussions at any time, so no participant made to undergo the stressor against their will. As in Chapter 4, participants who underwent negatively valenced CBM-I training were offered the opportunity to undergo a further session of positive CBM-I training following debriefing and learning of the full nature and reasoning of the experiment. Furthermore—and again as in the other CBM-I studies presented—care was also taken to ensure that no participants with a history of anxious or mood problems were recruited to the study. This therefore prevented exposing such individuals to the experimental stressor. The fact that participants were not in fact being videotaped as they performed the arithmetic task during the stressor constitutes a deception and so prevented participants from giving fully informed assent. However participants' guardians/parents were informed as to the nature of the stressor before providing consent on their child's behalf. Following completion of the

study, participants were fully informed as to the nature of the deception and given the opportunity to withdraw their data on these grounds, though none chose to.

6.3 Results

6.3.1 Descriptive Statistics

Mean age in years, gender, and mean STAIC and VAS mood scores are given below in Table 6.1, for the whole sample and broken down by training group. All 40 participants provided complete datasets across all measures.

		Overall	Training Valence	
			Negative	Positive
Gender	Female	50%	50.0%	50.0%
	Male	50%	50.0%	50.0%
Age		14.85 (2.27)	16.10 (1.71)	13.60 (2.09)
Ethnicity	White	7.5%	0.0%	15.0%
	Asian	85.0%	90.0%	80.0%
	Black	5.0%	5.0%	5.0%
	Mixed	2.5%	5.0%	0.0%
STAIC		40.28 (7.01)	41.80 (5.86)	38.75 (7.85)
<i>n</i>		40	20	20
Positive Affect	VAS1	6.45 (1.47)	5.96 (1.27)	6.94 (1.53)
	VAS2	6.36 (1.87)	5.60 (1.77)	7.11 (1.69)
	VAS3	6.24 (2.09)	5.41 (2.03)	7.06 (1.84)
	VAS4	5.00 (2.26)	4.29 (1.75)	5.71 (2.52)
Anxiety	VAS1	2.74 (1.47)	2.98 (1.22)	2.49 (1.68)
	VAS2	1.99 (1.56)	2.40 (1.64)	1.57 (1.40)
	VAS3	1.46 (1.40)	1.69 (1.48)	1.22 (1.32)
	VAS4	3.30 (2.34)	4.10 (2.16)	2.51 (2.29)
Low Mood	VAS1	1.45 (1.31)	1.50 (1.27)	1.40 (1.38)
	VAS2	1.73 (1.95)	2.12 (1.97)	1.34 (1.89)
	VAS3	1.60 (1.65)	2.00 (1.95)	1.20 (1.19)
	VAS4	2.11 (1.99)	2.60 (2.21)	1.61 (1.67)

Table 6.1: Means for demographic information and questionnaire measures. Standard deviations given in parentheses. Mean VAS scores given for Positive Affect, Anxiety, and Low Mood pre-training (VAS1), post-training (VAS2), pre-stressor (VAS3) and post-stressor (VAS4)

Pre-training demographic information and emotional symptom scores were compared across groups to control for any extraneous inequalities across training groups—i.e. differences other than CBM-I training valence. Independent-samples *t*-tests were used to compare mean scores of continuous variables (STAIC, age) between CBM-I training groups. Pearson χ^2 tests were used to examine potential differences between groups on the categorical variables of gender identity and ethnicity. Descriptive statistics, and Kolmogorov-Smirnoff and

Shapiro-Wilks tests were used to test for normality of continuous data. Anxiety and Low Mood VAS scores were found to be non-normal, and so were transformed to ensure their normality and therefore viability in subsequent parametric tests. More details are given in the ‘Mood Scores and Stress Reactivity Task’ section (6.3.4) below.

Gender distributions did not differ between training groups. The sample was predominantly South Asian, in contrast to most CBM-I research (and experimental psychology research more generally), which tends to heavily represent white populations and under-represent ethnic minorities (Gosling et al., 2000; Henrich et al., 2010; Graham, 1992). A Pearson χ^2 analysis showed that the ethnic make-up of the sample did not differ across training groups. An independent sample *t*-test found no differences between training groups in STAIC scores. However, age was found to differ significantly between the two groups ($t(38) = 4.14, p < .001, d = 1.31$), seen in Table 6.1 to be higher in the negative than the positive training group, and moreover by quite a considerable margin.

¹ As such, age was included as a covariate and given intense scrutiny in subsequent analyses.

6.3.2 Training

Three 5×2 ANOVAs were used to examine changes in responses over the course of CBM-I training. As in Chapter 4, the first ANOVA used reaction times (RTs) for word fragment completions during training as an outcome measure, the second ANOVA used RTs to comprehension questions during training as an outcome measure, and the third used accuracy of responses to comprehension questions. All 3 ANOVAs included Training Block (1, 2, 3, 4, 5) as a 5-level within-subjects factor and Training-Group (negative, positive) as a 2-level between-subjects factor.

Word fragment RTs exhibited a small but significant main effect of Block: $F(4, 152) = 4.19, p = .003, \eta^2 = .087$. There were no significant within-subject contrasts for this effect. Comparing overall mean RTs for word fragment completions across blocks in Table 6.2, this main effect seems to be driven by longer RTs in Block 1 relative to subsequent Blocks. This small size of this effect suggests that participants reached ceiling for their speed of responses to word fragments within Block 1. There was no significant main effect of Training-Group. However, there was a significant Training-Group*Block interaction: $F(4, 152) = 5.89, p < .001, \eta^2 = .123$. Mean RTs across blocks are broken down by CBM-I training group in Table 6.2. These means suggest that the pattern of change for the positive training group follows the aforementioned pattern of the overall column. Negative training however does not show as pronounced

¹A closer examination of the make-up of each experimental group showed that participants’ ages ranged 12–17 in the negative, and 12–18 in the positive training group. However, whereas the modal age for the negatively trained group was 17 years, it was 12 and 13 years for the positively trained group. This was likely an unfortunate consequence of the non-random allocation of participants to experimental conditions, resulting in systematic extraneous between-groups differences.

Block	Word Fragment Reaction Time (ms)			Comprehension Question		
	Overall	Negative	Positive	Reaction Time (ms)	Accuracy	
1	2133.84 (1121.48)	1772.58 (449.66)	2495.17 (1450.71)	4298.64 (872.03)	84.8% (12.4)	
2	1565.16 (351.38)	1657.41 (357.80)	1472.91 (327.86)	3429.93 (693.83)	94.0% (5.5)	
3	1956.71 (737.33)	2058.35 (877.37)	1855.08 (569.55)	3460.56 (830.03)	91.3% (12.4)	
4	1758.51 (770.91)	1610.23 (435.26)	1906.79 (992.05)	3343.18 (861.58)	93.0% (12.2)	
5	1833.67 (931.23)	2124.53 (1206.79)	1542.81 (381.59)	3519.33 (1083.50)	90.0% (14.1)	

Table 6.2: Mean accuracy rates and RTs (ms) over the course of training. Standard deviations given in parentheses.

a slowing of RTs in Block 1—here instead the slowest mean RTs are in Blocks 3 and 5.

Results for RTs to comprehension questions showed a significant main effect of Block: $F(4, 72) = 11.09, p < .001, \eta^2 = .366$, but no significant main effect of Training-Group nor Training-Group*Block interaction. Significant linear ($F(1, 18) = 11.17, p = .004, \eta^2 = .374$), quadratic ($F(1, 18) = 6.98, p = .017, \eta^2 = .260$) and cubic ($F(1, 18) = 13.62, p = .002, \eta^2 = .423$) within-subjects contrasts for Block, considered together with mean RTs to comprehension questions in Table 6.2 suggest that this main effect was characterised by slower responses during Block 1, and then relatively consistent responses in Blocks 2–5—i.e. responses to comprehension questions became faster from Block 1 to 2, then levelled off for the rest of training.

Accuracy for responses to comprehension questions similarly showed a significant main effect of training block: $F(4, 72) = 3.05, p = .022, \eta^2 = .136$, with no significant main effect of Training-Group, nor a Block*Training-Group interaction. A significant quadratic within-subjects contrast for Block ($F(1, 18) = 6.21, p = .023, \eta^2 = .256$) taken together with mean accuracy scores over the course of training—as seen in Table 6.2—indicates that accuracy rates were relatively lower in Block 1 than subsequent blocks, and then reasonably stable thereafter.

In summary, responses to comprehension questions and word fragments became quicker and more accurate over the course of training, with ceiling effects being reached by Block 2, or within Block 1.

6.3.3 Interpretation Bias Test

A $2 \times 2 \times 2$ ANOVA was conducted to examine between-groups effects of CBM-I training on the Interpretation Bias Test as in Chapter 4. The outcome measure was the mean rating given by participants for probe statements' similarity to their corresponding ambiguous scenarios. Probe-Type (target, foil) and Probe-Valence (positive, negative) were included as 2-level within-subjects factors, and Training-Group (negative, positive) was included as a 2-level between-subjects factor.

A significant 3-way interaction was found between Probe-Type, Probe-Valence, and Training-Group: $F(1, 38) = 5.86, p = .020, \eta^2 = .079$. As in Chapter 4, this was broken down into analyses of targets and foils separately owing to a significant main effect of Probe-Type ($F(1, 38) = 56.74, p < .001, \eta^2 = .576$). The main effect of Probe-Type showed that Targets were rated as more similar to the novel ambiguous scenarios than were Foils ($\bar{x}_{Target} = 2.35, sd_{Target} = 0.23$; $\bar{x}_{Foil} = 2.00, sd_{Foil} = 0.33$).

A significant 2-way Probe-Valence*Training-Group interaction was found for Targets: $F(1, 38) = 61.23, p < .001, \eta^2 = .611$. This interaction is illustrated in Figure 6.2. Positively-trained adolescents gave higher similarity ratings to positive targets than did negatively-trained participants: $t(38) = 5.44, p < .001, d = 1.719$. Conversely, negatively-trained adolescents gave high similarity ratings to negative targets than did positively-trained adolescents: $t(38) = 6.51, p < .001, d = 2.18$.

.001, $d = 2.058$. Within-subjects comparisons showed that positively-trained adolescents also assigned higher similarity ratings to positive targets than to negative targets ($t(19) = -7.06, p < .001, d = 1.578$), whereas the reverse was true for negatively-trained adolescents ($t(19) = 4.36, p < .001, d = 0.976$).

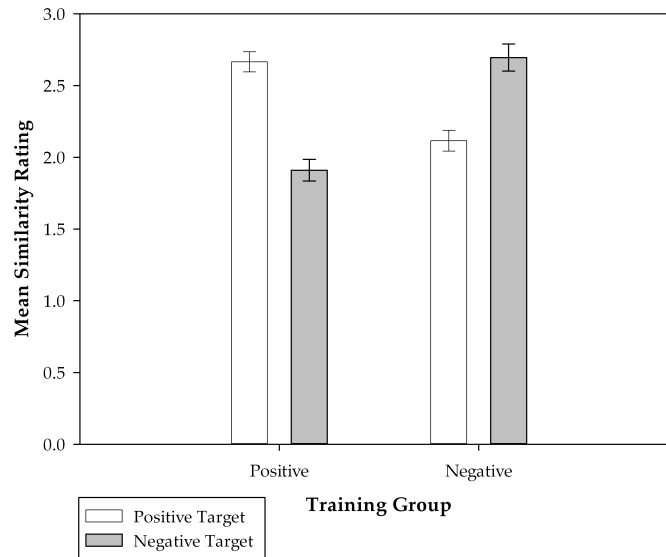


Figure 6.2: Graph showing mean similarity ratings for target probes in the interpretation bias test, grouped by CBM-I training valence

A similar significant Probe-Valence*Training-Group interaction was found for Foil statements: $F(1, 38) = 47.87, p < .001, \eta^2 = .437$. As for target statements, positively-trained adolescents gave higher similarity ratings to positive foils ($t(38) = 5.20, p < .001, d = 1.645$) and lower ratings to negative foils ($t(38) = 3.29, p = .002, d = 1.041$) than did negatively-trained adolescents. Positively-trained adolescents gave significantly higher similarity ratings to positive than to negative foils: $t(19) = -9.88, p < .001, d = 2.210$. No significant difference was found between negatively-trained adolescents' similarity ratings of positive and negative foils.

6.3.3.1 Covariate Analyses

The $2 \times 2 \times 2$ analysis was repeated including STAIC as a covariate to examine the contribution of trait emotional symptoms to interpretations of ambiguous novel information. Analyses were also re-run including age as a covariate, as this was previously found to differ between positive and negative training groups. No changes to the original ANOVA results were found for age. When including STAIC score as a covariate, there was no change to the significance of pre-existing main effects or interactions, but an additional, significant Probe-Valence*STAIC interaction emerged: $F(1, 37) = 4.81, p = .035, \eta^2 = .046$. Further examination of this interaction with regression analyses showed that the higher the STAIC score, the higher similarity ratings were for negative

probes: $\beta = .342, p = .031$. Higher STAIC was also negatively associated with similarity ratings for positive probes, but this effect was only at trend level: $\beta = -.298, p = .062$.

6.3.4 Mood Scores and Stress Reactivity Task

Raw VAS scores pre-training (VAS1), post-training (VAS2), pre-stressor (VAS3) and post-stressor (VAS4) are given in Table 6.1 for self-ratings of Positive Affect, Anxiety and Low Mood.

6.3.4.1 Mood Changes Pre- & Post-Training

Three 2×2 ANOVAs were conducted to examine potential mood changes due to training, one for each mood measure (Positive Affect, Anxiety, Low Mood). ANOVAs were conducted with Time-Point (VAS1, VAS2) as a within-subjects factor, and Training-Group (negative, positive) as a between-subjects factor.

Raw VAS scores were positively skewed and non-normally distributed for both Anxiety and Low Mood, according to Kolmogorov-Smirnoff and Shapiro-Wilk tests. These scores were therefore log-transformed prior to use in ANOVAs so as not to violate assumptions of normality in the tests. Both sets of scores were transformed using the function $\ln(x + 1)$ to ensure a successful log-transform, as some participants had scores of 0 on some ratings. VAS Positive Affect ratings were normally distributed, and so raw scores were used in all analyses for this emotion.

VAS Positive Affect showed no significant main effect of time, nor any Time-Point*Training-Group interaction. There was however a main effect of training group: $F(1, 38) = 7.41, p = .010, \eta^2 = .163$. Independent samples *t*-tests confirmed that the positive and negative training groups differed on self-reported Positive Affect at both pre-training baseline ($t_{VAS1}(38) = 2.21, p = .034, d = 0.698$) and post-training ($t_{VAS2}(38) = 2.76, p = .009, d = 0.875$). Means given in Table 6.1 show that positive affect was higher in the positive training group in both instances. Post-hoc *t*-tests are reported using the Bonferroni correction for multiple comparisons.

Self-reported VAS Anxiety showed no significant differences across training groups, nor any significant Time-Point*Training-Group interaction. There was however a significant main effect of time on VAS anxiety scores: $F(1, 38) = 11.74, p = .001, \eta^2 = .234$. Mean VAS scores given in Table 6.1 illustrate that this main effect of time corresponds to a decrease in Anxiety from VAS1 to VAS2 across both training groups. No significant effects of Time-Point, Training-Group, or their interaction were found for VAS Low Mood scores. All analyses were also re-run including STAI score as a covariate. Inclusion of this factor did not change the significance of any findings, nor give rise to any significant novel interactions.

6.3.4.2 Mood Changes Pre- & Post-Stressor

Three further 2×2 ANOVAs were used to examine between-groups differences in mood reactivity in response to the experimental stressor. These 3 ANOVAs were again conducted with mean VAS Positive Affect, VAS Anxiety, and VAS Low Mood as outcome measures respectively. Time (pre-stressor/VAS3, post-stressor/VAS4) was included as a 2-level within-subjects factor, and Training-Group (negative, positive) was included as a 2-level between-subjects factor.

Self-reported VAS Anxiety ratings at VAS3 and VAS4 showed significant main effects of both Time ($F(1, 38) = 53.69, p < .001, \eta^2 = .559$) and Training-Group ($F(1, 38) = 4.35, p = .044, \eta^2 = .103$). There was also a significant Time*Training-Group interaction: $F(1, 38) = 4.34, p = .044, \eta^2 = .045$. As seen above, positive and negative training groups did not differ significantly in VAS Anxiety ratings at VAS3. It is therefore likely that the main effect of Training-Group is driven by the Time*Training-Group interaction, and the relatively higher anxiety scores in the negative than the positive training group post-stressor, at VAS4 ($t(38) = 2.256, p = .030, d = 0.732$). Raw mean scores pre- (VAS3) and post-stressor (VAS4) for positive and negative training groups are given in Table 6.1, and the interaction is also illustrated below in Figure 6.3 below. The analysis of VAS Anxiety scores was repeated including STAIC as an additional covariate. No significant main effects of STAIC were found upon its inclusion in the analysis, nor did any significant interactions emerge between STAIC score and other factor.

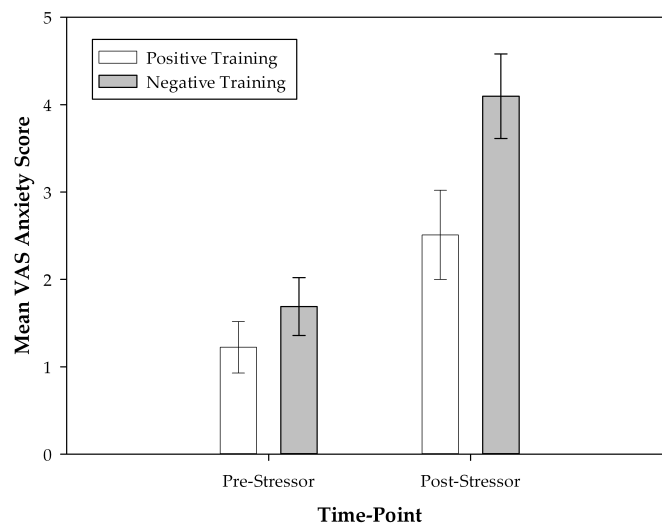


Figure 6.3: Changes in self-rated VAS Anxiety from pre- to post-stressor, across CBM-I training groups

Positive Affect showed significant main effects of both Training-Group ($F(1, 38) = 6.55, p = .015, \eta^2 = .147$) and Time ($F(1, 38) = 24.96, p < .001, \eta^2 = .395$). As in the previous examinations of Training-Group effects in this study, the main effect was that Positive Affect was higher in the positive than the neg-

ative training group across both VAS3 and VAS4. The main effect of time was that Positive Affect decreased from pre-stressor (VAS3) to post-stressor (VAS4) across both training groups. Both of these effects can be seen from comparisons of mean scores in Table 6.1. No significant interaction was found between Time and Training-Group. Given this main effect of Positive Affect, the analyses for anxiety reported above were repeated, including positive affect as a covariate. This inclusion did not affect the significance of the observed effects on anxiety ratings.

Low Mood scores showed a significant main effect of Time: $F(1, 38) = 5.01, p = .031, \eta^2 = .116$. Comparisons of mean scores in Table 6.1 show this to be indicative of increases in Low Mood from pre- to post-stressor in both training groups. No significant main effect of Training-Group was found, nor any interaction between the 2 factors.

6.4 Discussion

The present study replicated findings of the efficacy of CBM-I training in producing valence-congruent interpretive biases in adolescents (Salemink & Wiers, 2011; Lau et al., 2011; Lothmann et al., 2011). The experiment found no evidence of mood change as a direct result of CBM-I training valence. However positively-trained adolescents reported less subsequent anxiety than adolescents who underwent negative CBM-I training following the post-training experimental stressor. This replicates findings from adults (Murphy et al., 2007; Wilson et al., 2006; Hoppitt et al., 2010b) and child and adolescent samples (Vassilopoulos et al., 2009; Lester et al., 2011a, 2011b) within an adolescent sample, moreover one that is predominantly South Asian rather than Caucasian. It specifically demonstrates differential effects of CBM-I training on subjective mood after exposure to a stressor, and does so using an active-generation CBM-I training task. The pattern of valence-congruent CBM-I training effects seen in Chapters 4 and 5 as well as previous adolescent research (e.g. Lau et al., 2011; Lester et al., 2011b; Lothmann et al., 2011) was replicated in the current experiment. Moreover in contrast to Chapters 4 and 5—which used a predominantly Caucasian, above-average-SES sample—the current study replicated these post-training CBM-I effects in a lower-SES, South Asian sample. These findings could therefore provide some initial indication that CBM-I findings using the current paradigm in extant or future work are likely to be robust to differences of SES or ethnicity between samples.

6.4.1 CBM-I Training and Interpretation Bias Test

Results from the Interpretation Bias Test suggest that CBM-I training generalises to novel, ambiguous social items. Effects were valence-congruent, such that positive training enhanced the perceived similarity of positive interpretations and decreased the perceived similarity of negative interpretations, with the inverse seen following negative training (see Figure 6.2). Within-subject comparisons of

similarity ratings for positive versus negative targets indicated significant post-training effects in both positive and negative training groups, and effect sizes were comparable across the two groups. As effects were significantly stronger for targets than for foils this suggests that single session training generated specific effects on interpretational styles rather than more general mood-congruent effects (Mathews & Mackintosh, 2000), and this is reflected in the relative effect sizes of the two probe types. As in Chapter 4, trait anxiety symptom scores predicted stronger endorsement of negative probes but did not enhance differential training effects. The pattern of valence-congruent training replicates findings from previous work in adults (Mathews & Mackintosh, 2000; Mackintosh et al., 2006; Hirsch et al., 2007) and adolescents (Salemink & Wiers, 2011; Muris et al., 2009; Lau et al., 2011; Lothmann et al., 2011), as well as the pattern of post-training interpretive bias seen in Chapter 4.

Results from Chapter 4 suggested that effects of positive and negative training were similar and opposite when applied to induced interpretive biases. The results from the Interpretation Bias Test in this experiment replicate the form of those from positive and negative training groups in the preceding chapter. Accordingly, these results may be used to offer insight into conclusions regarding differential training effects on the stress reactivity measure. Furthermore, future work should attempt to replicate and expand on effects of stress reactivity and appraisal of stressful situations using more control groups such as mixed or neutral control training conditions.

6.4.2 Mood Change and Stress Reactivity Task

No significant changes in self-rated positive affect, anxiety or low mood were found directly following CBM-I training. The null effects of mood change from immediately before to after training cohere with previous findings from both Chapter 4 and the wider adolescent CBM-I literature (Salemink & Wiers, 2011; Lester et al., 2011b). The novel mood-related finding from the current experiment was the apparent buffering of self-rated anxiety induced by an external stressor following positive CBM-I training in adolescents. Main effects of mood change showed that exposure to the mental arithmetic stressor task significantly increased anxiety and low mood ratings, and decreased positive affect across both training groups. However, the post-stressor increase in subjective anxiety was significantly smaller in the group who had received positive CBM-I training, compared to the negative training group. This effect was specific to anxiety, as no such interaction was observed for low mood or positive affect scores. These anxiety-specific stress reactivity effects replicate findings from the use of experimental stressors in CBM-I paradigms in previous studies of adults, regardless of the specific form of CBM-I training (Murphy et al., 2007; Wilson et al., 2006; Hoppitt et al., 2010b).

The specificity to anxiety of the interaction between stressor exposure and training is consistent with theoretical depictions the stressor as a relatively short-term, negative, anticipatory event (Way & Taylor, 2010; Kirschbaum et al., 1993)—all characteristic of specifically anxious reactions (criterion A—Ameri-

can Psychiatric Association, 2000; World Health Organization, 2004). The finding that CBM-I training can moderate the effects of anxiety emerging in response to an environmental stressor in adolescence supports the use of CBM-I as a potential intervention tool (Holmes et al., 2009; MacLeod et al., 2009). Research should next focus on determining whether such effects would hold in high-anxious or at-risk young adolescents, and demonstrate that CBM-I effects persist over time and outside of the lab. It is worth verifying that the encouraging provisional stress-buffer effects observed in this study hold in the kind of at-risk population that would most benefit from CBM-I intervention.

The stress reactivity task also demonstrated post-training CBM-I effects from social interactions in training material, upon performance-related anxiety in a mental arithmetic task—albeit one with a strong social evaluation component. Performance and social interaction are features of distinct sub-scales of social anxiety in numerous empirical measures and clinical distinctions (e.g. Liebowitz, 1987; American Psychiatric Association, 2000; World Health Organization, 2004). This suggests that CBM-I effects may not be constrained to the single modality of ambiguous social situations as presented in the format of the training paradigm. The stressor used in the current study has been shown to give rise to physiological stress responses in previous research (Way & Taylor, 2010; Kirschbaum et al., 1993; Gotlib et al., 2008). Such previous research has also highlighted the performance related aspect of the task in its ability to induce stress. However no studies have yet tried to distinguish this aspect of performance from simpler social interaction effects, as specified by Liebowitz (1987)'s and other accounts of social components of anxiety. This may be worth pursuing in future research.

6.4.3 Limitations

One limitation in the current analyses is that there was a pre-existing difference between training groups on positive affect prior to exposure to CBM-I training (VAS1) and throughout the experiment (see Table 6.1). Thus, any potential interaction between training and stressor exposure may be obscured by the main effect of higher positive affect in the positive training group. However there was no differential change in positive affect comparable to the significant between-groups effect observed for anxiety ratings. Furthermore, the differential training group effects on self-reported anxious responses to the stressor persisted when including positive affect scores as covariates in analyses. Nevertheless it would be worth replicating the current findings in a sample with no pre-training differences in positive affect.

Additionally, since positive affect was significantly higher in the positive than the negative training group both prior to exposure to CBM-I training and throughout the experiment, any potential interaction between training and stressor exposure may be obscured by the main effect of higher positive affect in the positive training group. A comparison of the mean scores for positive affect and anxiety between training groups at VAS3 and VAS4 (see Table 6.1) suggests that there was no differential change in positive affect comparable to the sig-

nificant between-groups effect observed for anxiety ratings. However, it would again be worth replicating the current findings in a sample with no pre-training differences in positive affect.

A further limitation is that the Stress Reactivity Task was administered post-training and not at pre-training. As such there are no indices of within-subject change in the magnitude of responses to a stressor. This was because the task was predicated on deception around the stressor. Revealing the deception after administration of a pre-training stressor would have compromised the validity of the task post-training. Conversely, if participants were not debriefed following a pre-training stressor, this would have increased anxiety levels during training itself. This may then have skewed findings in the post-training stressor task, either due to ceiling effects of stress, floor effects due to habituation to a previous stressful stimulus, or an interaction of these effects. This is in addition to any effects of a pre-training stressor upon the effectiveness of CBM-I training.

Experimental stressors used in the current study and preceding adolescent research (Vassilopoulos et al., 2009; Lester et al., 2011a) cannot disconfirm the possibility that social interpretation training only gives rise to stress reactivity effects in response to stressors containing some social element. In fact, even in light of the animal-themed stressor task used by Lester et al. (2011b) and Lester et al. (2011a) it seems impossible to have any experimental stressor without such social components, given that experimenters are always present (and, perhaps more importantly, administering anxiety measures). It might therefore be worth trying to do training in the other direction—i.e. looking at the effects of non-social training upon stressful social outcome measures in future extensions to research. This would ensure that stress reactivity effects are not bounded by the fact that both training and experimental stressor share certain (social) features and content in their potentially threatening material. Put more generally, future research should attempt to determine the limits of transfer from interpretations training effects to other measures.

A final stressor-related limitation is that—like other adolescent CBM-I studies to have attempted to examine stress reactivity—the current study relied on self-reported anxiety as measure of stress rather than any physiological measures. This can only inform the nature of CBM-I training effects on stress reactivity to a limited extent. Though the stressor used has been shown to give rise to physiological stress responses in previous work (Wang et al., 2005; Ellenbogen et al., 2006) the current study would need replication of differential reactive measures beyond self-report before it could be said to speak to questions of stress responses and the potential to buffer against them.

Perhaps the greatest methodological oversight in the current study is that of the unequal distribution of ages between experimental groups. Analyses indicated that age did not have any significant main or interaction effects upon any findings when included as a covariate. This suggests that it is unlikely to have confounded the current results. However statistical checks for the absence of such confounds in datasets are less desirable than controlling for such potential confounds at the time of data collection and prior to analysis. In the current example, the issue could have been avoided by using a robust true randomisation

method to allocate participants to experimental groups.

6.4.4 Conclusions and Proposed Developments

The current study shows effects from a CBM-I training paradigm generalise beyond alterations of interpretive bias, to provisional demonstrations of buffering against negative subjective responses in a stressful situation. The stressful task differed from both the form and domain (performance, rather than direct social interaction) of the training paradigm, suggesting that these effects are not ascribable to demand characteristics.

The study demonstrates the potential appropriateness of CBM-I as a buffer intervention, insofar as it can affect mood. Other pre-requisites for such an intervention is that it should yield robust results, and that these should persist over time. As such, sensible developments for the current findings are as follows:

1. Extend findings of generalisable or transferable CBM-I effects to other outcome measures
2. Examine the persistence of buffer effects or the extension of positive CBM-I buffers to material beyond experimental stressors

7

CBM-I Effects and Transfer Effects in a Sample Undergoing School Transition

You take a deep breath
And you walk through the doors
It's the morning of your very first day

Taylor Swift (2008)

School transitions have been identified as stressful, with some young people reporting the onset of persistent socio-emotional problems at this time. Various governments have sought to improve social and emotional outcomes for such individuals, and developmental psychological work should try to buffer against negative experiences associated with stressful transitions. Following positive or neutral CBM-I training, 11-year-old participants were tested for their endorsement of positive and negative interpretations of novel ambiguous scenarios. Transfer of these effects to a different (non-verbal) measure of interpretation bias was also examined using a post-training task where participants were required to identify ambiguous facial emotions. Participants who underwent positive training endorsed negative interpretations of novel ambiguous scenarios less strongly than did controls after training. Additionally, following positive CBM-I training, participants were slower in identifying faces displaying anger or sadness than controls. Thus modifying verbal interpretations may have top-down effects on the interpretation of facial stimuli. As in previous chapters, training effects on mood were not apparent. Nor did training influence appraisals of stressful life events.

7.1 Introduction

Preceding chapters demonstrated that CBM-I training may be able to modify patterns of interpretive bias in typically-developing adolescent samples. In order for CBM-I training to be seriously considered as an early intervention against risk factors for clinical symptoms (Field & Lester, 2010; Hadwin & Field, 2010b), the investigation of induced positive interpretation biases as potential stress-buffering effects should be expanded to real-life situations and settings.

An example of cognitive bias modification offering potential stress-buffer effects to a naturalistic stressor was conducted by See, MacLeod, and Bridle (2009). Here young adult participants underwent an attentional bias modification procedure—analogous in concept to interpretation training in that participants were trained to deploy attention away from threat stimuli—compared to a no-training control group. This training took place prior to all participants in the study undergoing a large, significant life event—namely moving from Singapore to Australia to start university. Following the transition, participants who underwent positive bias modification showed significantly smaller increases in anxiety than controls, suggesting that induced positive biases may have indeed buffered against the potential negative effects of this particular life event.

A developmentally-appropriate analogue to this study could be to consider school-based transitions, which occur in early adolescence. The transition from primary to secondary school has been identified as a stressful process (Zeedyk et al., 2003; Anderson, Jacobs, Schramm, & Splittgerber, 2000) associated with changes in educational demands and decreases in peer affiliation, amongst other social conflicts (Pellegrini & Long, 2002; Zeedyk et al., 2003). School transitions are associated with proximal increases in anxiety at the population level (McGee et al., 2004; Fenzel, 2000). For most individuals these do not foster more enduring problems with stress or emotional symptoms, as negative effects are buffered against by social support and social competence (Fenzel, 2000). However problems emerging at transition are more persistent for other individuals. It may further be noteworthy that school transitions occur at a time when individual differences in interpersonal and emotional functioning are likely to first emerge (Gregory, Caspi, et al., 2007; Kessler et al., 2005; Brown, 2004; Hartup, 1996). Given the importance of social support and social competence in moderating the negative effects of school transition identified by Fenzel (2000), emergent individual differences in socio-emotional functioning may then predict adjustment. In the UK, large-scale government projects have investigated ways to improve social, emotional and educational outcomes for students making this transition (Evangelou et al., 2008). Interventions targeting social and personal skills have been called for, as these are most likely to improve subjective and academic outcomes during transitions (Evangelou et al., 2008; McGee et al., 2004). CBM-I training aimed at encouraging positive appraisals of social interaction might therefore represent a potential intervention to reduce stress reactivity at this time, with minor modification to training material for younger samples and for transitions more generally (Hadwin & Field, 2010b; Vassilopoulos et al., 2012).

7.1.1 Adapting the CBM-I Paradigm to a School Transition Sample

Previous research has yielded promising results for the viability of CBM-I training in younger populations. The ‘Space Odyssey’ task developed by Muris et al. (2008) and Muris et al. (2009) successfully induced training-valence-congruent biases in late childhood, but did not include any metrics of mood change. Using paradigms developed from the Space Odyssey task, Lester et al. (2011a, 2011b) found it was possible to induce positive and negative animal-related interpretive biases in children aged 6–11. However interpretive biases related to social situations were not found to be modifiable (Lester et al., 2011b). The studies found differential training effects upon post-training stressors, but the two experiments also found conflicting evidence as to whether mood changes were seen as a direct result of training.

In contrast to these studies, Vassilopoulos et al. (2009) successfully demonstrated modifications to interpretive biases for specifically social information as a result of multiple training sessions in a 10–11 year-old sample. Participants who underwent positive training—compared to a test-retest condition examining interpretation biases with no intervening training—showed fewer negative interpretations at test, lower trait social anxiety, and less stress reactivity to a hypothetical future social encounter.

These studies validate CBM-I training for participants of school-transition age, but all used passive-selection training protocols rather than active generation. Notably, active completion components (requiring participants themselves to generate information to disambiguate scenarios during training) have previously been identified as key in producing immediate mood effects in adults (Mathews & Mackintosh, 2000; Mackintosh et al., 2006; Hoppitt et al., 2010a). Chapter 6 also indicated that an active generation CBM-I paradigm may show evidence of buffering against negative emotional reactions to external stressors in adolescence. It would be desirable to try and extend previous findings of differential stress reactivity to more ecologically valid stressors than the specific and acute experimental stressor used in Chapter 6—for example, to interpretations or appraisals of experienced life events (Compas, Davis, Forsythe, & Wagner, 1987; Johnson & McCutcheon, 1980). Demonstrating differential CBM-I training effects on such appraisals would be encouraging for the use of CBM-I during school transition, considering the pertinence of ecologically valid and enduring stressful experiences to healthy emotional development (Cohen & Hoberman, 1983; Cohen, 2004; Fombonne et al., 2001a).

Beyond considerations of age, it may be advisable to use neutral training as a control condition in the proposed sample. To reprise one of the conclusions of Chapter 4, this would avoid exposing young people to negatively valenced social scenarios in the event that they were already experiencing social or emotional difficulties as a result of their transition to secondary school.

7.1.2 Generalisation of effects to other modalities

There is little support for the generalisation of CBM-I training effects to measures of cognitive bias beyond those that are similar in format to the training paradigm itself (Salemink, van den Hout, & Kindt, 2007; Salemink, van den Hout, & Kindt, 2010)—that is, tests featuring similar content and question structure to CBM-I training material. Other studies have found generalisations of CBM-I effects to settings with little superficial resemblance to the CBM-I training paradigm (Mackintosh et al., 2006; Hirsch et al., 2009; Wilson et al., 2006).

Interpreting ambiguous facial emotions may provide an alternative in assessing training effects on emotion-linked cognitive biases. Faces are salient stimuli that are processed swiftly and automatically (Dimberg et al., 2000; Richards et al., 2002). Richards et al. (2002) argued that, given this automatic processing, facial stimuli may be an effective way to probe pre-attentive processes involved with the interpretation of ambiguity. They found that high-trait-anxious individuals were more sensitive (i.e. correctly identifying the emotion in morphed or ambiguous faces) to fearful faces than were low-trait-anxious individuals, who in contrast were more sensitive to happy faces. Furthermore, after an anxiety-inducing mood manipulation, participants were more sensitive to angry faces, though this did not interact with trait anxiety.

Socially anxious adults also show biases for interpreting neutral faces negatively (Yoon & Zinbarg, 2008). Related impairments in the identification of emotional faces have been shown in depression (Langenecker et al., 2005). It is less clear whether biases in the interpretation of facial information would be expected to relate to the findings of CBM-I training. The present study proposes investigating the potential transfer of training effects from the verbal CBM-I paradigm used in preceding chapters to a post-training task that requires participants to identify positive and negative emotional expressions in ambiguous facial stimuli.

7.1.3 Interpretation Effects and Follow-Up

Chapters 4 and 5 showed no observable change in Interpretation Questionnaire scores measured during the same session as CBM-I training. However, results from Chapter 6 together with other studies (Hoppitt et al., 2010b; Wilson et al., 2006; Murphy et al., 2007) have suggested that positive or negatively valenced interpretive biases are applied to ambiguous or stressful environmental factors over time (Mathews, 2012; Hoppitt et al., 2010b), and this process represents the potentially useful mechanism of bias change. As such, it might be expected that verbal interpretation measures that do not bear superficial resemblance to the CBM-I training paradigm would only show post-training effects after a delay. Given that Chapter 5 also demonstrated that positive CBM-I training effects persisted for 24 hours, here the Interpretation Questionnaire was administered at a 24-hour follow-up, on the assumption that intervening opportunities for spontaneous interpretations in real-life settings would interpose the changes to answers on the Interpretation Questionnaire.

7.1.4 Aims and Hypotheses

The aims of the study were as follows:

- To extend findings from previous adolescent CBM-I paradigms to the younger sample of students undergoing school transition
- To investigate potential training effects on state mood in this sample
- To examine the effects of CBM-I training on the appraisal of recent life events
- To examine the generalisability of CBM-I training to the interpretation of ambiguous emotional faces
- To examine the effect of one session of CBM-I training on the Interpretation Questionnaire at 24-hour follow-up

It is hypothesised that interpretation training effects due to the CBM-I as indexed by the Interpretation Bias Test will be the same as for older adolescents in previous chapters, as well as other related studies (e.g. Salemink & Wiers, 2011; Lothmann et al., 2011; Fu et al., 2012). Accordingly, main effects of Probe Type and Probe Valence are predicted, such that Targets are expected to be endorsed more strongly in the Interpretation Bias Test than Foils, and Positive probes are expected to be endorsed more strongly than Negative. However, the fact that positive CBM-I training is being compared to a neutral control rather than negative training suggests that effects may be less pronounced than in previous studies, as well as the non-significant effects of social training in late childhood reported by Lester et al. (2011b). As such, the study proposes planned comparisons of similarity ratings of Positive and Negative Target probes between training groups, conducted as independent-sample *t*-tests. Based on findings from Vassilopoulos et al. (2009), it would be expected that positive social CBM-I training would reduce subsequent negative interpretations of ambiguous social situations in this younger sample.

Positive training is expected to enhance the identification of positive facial emotions, and/or impair the identification of negative emotions, relative to control. In terms of reaction times, positive (relative to neutral) training is hypothesised to speed responses to positive facial emotions, and slow responses to negative emotions.

Individuals undergoing positive training are expected to make fewer negative interpretations of ambiguous statements on the Interpretation Questionnaire measure after a delay of 24 hours. They are also expected to appraise the impact of recent life events more positively than those undergoing neutral control training.

7.2 Methods

7.2.1 Participants

Fifty-two participants were recruited from six state schools in Oxfordshire, Berkshire and Hampshire. Schools were contacted by researchers, and sent information sheets out to guardians/parents of students, and participants were recruited on an opt-in basis. Given the current research's focus on the transition to secondary school, all participants were recruited from Year 7 (age 11–12). The first school recruited from was a mixed-sex Community school with 9% of students eligible for Free School Meals (FSM). Nineteen participants were recruited from this school, at a response rate of 8% of eligible students. The second school was a mixed-sex Voluntary-Controlled state school with a comprehensive admission policy, with 6.9% of students eligible for FSM. Twelve participants were recruited from this school, at a response rate of 5%. Eight participants were recruited from the third school—a mixed-sex Academy with 16% of students eligible for FSM—at a response rate of 3%. The fourth school was a girls' Community school with 12.2% of students eligible for FSM. Five participants were recruited from this school, at a response rate of 3%. The fifth school was a girls' Academy with selective (exam-based) intake, with 3% of students eligible for FSM. Five participants were recruited from this school, a response rate of 5%. The final school was a mixed-sex community school with 20.7% of students eligible for FSM. Two participants were recruited from this school, at a response rate of 1%.

School attendance data was missing for one participant. Participant response rates for individual schools given above are estimates, calculated based on estimated of year sizes from details of school size from Ofsted reports (Department for Education, 2013), following the same procedure as detailed in Chapter 4 (see Section 4.2.1). The weighted mean of schools' percentage of students eligible for FSM (calculated as in Chapter 4, Section 4.2.1) across the entire sample was 9.6%, well below the national average of 26.7%. This suggests that the sample came from a relatively high-SES background.

Schools were recruited from and testing was carried out by four experimenters (including the lead researcher) in parallel, given the time constraints involved in testing participants in the first term of their first year at a new secondary school. Ages, gender identities and ethnic make-up of the sample are given in Table 7.2. No participants reported difficulty with reading, nor any past problems with anxiety or depression.

7.2.2 Measures

Trait symptom scores of anxiety and depression were measured using the State-Trait Anxiety Inventory for Children-Trait sub-scale (STAIC; Spielberger, 1973) and Children's Depression Inventory (CDI; Kovacs, 1981) respectively. The Interpretation Questionnaire was used to measure interpretive bias pre- (IntQu pre) and post-training (IntQu post). Full descriptions of the STAIC, CDI and In-

terpretation Questionnaire are provided in Chapter 4, together with psychometric data. In the present sample, internal reliability was excellent for the STAIC ($\alpha_{prior} = .91$; $\alpha_{post} = .91$) and CDI ($\alpha = .91$). Internal reliability was very good for Interpretation Questionnaire items overall ($\alpha = .75$), and good for items in each half of the measure ($\alpha_{pre} = .60$; $\alpha_{post} = .68$).

7.2.2.1 VAS Mood Scales

As in preceding chapters, Visual Analogue Scale (VAS) ratings based on items from the Positive and Negative Affect Schedule for Children (Laurent et al., 1999) indexed mood over the course of the experiment. As before, participants crossed a 10cm line to indicate where on a scale between ‘*Not at all* [emotion]’ and ‘*Very* [emotion]’ they felt at that moment in time. However due to time constraints participants completed only 3 items: Cheerful, Worried and Miserable. Reliability and correlation analyses conducted using VAS scores from preceding chapters found these three items to be the most predictive of Positive Affect, Anxiety and Low Mood VAS scales respectively. In these analyses VAS items averaged across time-points were correlated with the mean scale value across 169 cases taken from experiments in Chapters 4, 5 and 6. The item loading most highly on VAS Positive Affect, VAS Anxiety and VAS Low Mood (Cheerful, Worried, and Miserable respectively) were therefore used as VAS items in the current study. Correlations are presented below in Table 7.1. All items were significantly correlated with their corresponding scale: $p < .001$ in all cases.

VAS Scale	Item			
Positive Affect	Happy	Calm	Cheerful	Energetic
	.90	.77	.92	.80
Anxiety	Nervous	Worried	Anxious	Scared
	.88	.92	.91	.88
Low Mood	Sad	Upset	Miserable	Gloomy
	.89	.75	.95	.86

Table 7.1: Correlations between VAS items and their respective scales across 169 cases in Chapters 4–6. Used as the basis for the selection of Cheerful, Worried and Miserable as representative VAS items in the current study.

7.2.2.2 Recent Events Scale

To investigate appraisals of recent stressors, participants completed a 15-item Recent Events Scale adapted from the Adolescent Perceived Events Scale (Compas et al., 1987) and Child Life Events Checklist (Johnson & McCutcheon, 1980). This scale measured the incidence of life events pertaining to family life, peer relationships, school life/academic performance, and future concerns. The full questionnaire is reproduced in Appendix F. For each item, participants were required to indicate whether or not they had experienced the event described within the last 6 months. The number of events experienced was totalled for

each participant. Participants made 4 further ratings of each event they experienced: 1) 'How much impact did this event have on your life?'; 2) 'How Desirable was this event?'; 3) 'How able were you to cope with this event?'; 4) 'How much did you think you were in control of this event?'. Each of the 4 sub-ratings (Severity of impact, Desirability, Ability to cope, Felt in control) was scored 1–4, and mean scores for each of these ratings were calculated across the events experienced by each participant.

7.2.3 CBM-I Training and Interpretation Bias Test

The CBM-I training paradigm was as described in Chapters 4–6. However, two changes were made to content to make it more appropriate to an 11-year-old sample. Firstly, scenarios were tailored to the likely experiences of younger adolescents: scenarios involving part-time jobs were omitted, and language was simplified (see Appendix D for a full list of training scenarios). Secondly, the number of training blocks was reduced from 5 to 4, giving 48 scenarios in total rather than 60. Of note, results from Chapters 4–6 indicated that training performance (in terms of accuracy and reaction time to CBM-I stimuli) reached ceiling by the second training block.

Two training valences were used: positive and neutral. In each block of 12 trials in the positive training condition, 10 scenarios were resolved positively, and 2 were resolved neutrally. Conversely, in the neutral training conditions 10 out of every 12 trials were resolved neutrally, and 2 were resolved positively. The Interpretation Bias Test was as described in Chapter 4, and as used in Chapters 4–6, and so comprised ambiguous scenarios followed by ratings of positive or negatively valenced target and foils probe statements.

7.2.4 Face Emotion Task

In this task participants viewed 4 facial emotions (Anger, Happiness, Sadness, Fear), each displayed by a male and a female actor. Each emotion was presented at 6 different intensities: 13.33%, 26.67%, 36.67%, 50.00%, 63.33%, and 76.67%, giving 48 trials in total (4 emotions $\times$ 6 intensities $\times$ 2 genders). Face stimuli were taken from the set used by Lau et al. (2009), and examples of each emotion are given in Appendix G. On each trial participants were shown a face and required to indicate what emotion they thought it showed using number keys: 1 = Angry, 2 = Disgusted, 3 = Happy, 4 = Sad, 5 = Scared, 6 = No Emotion. Responses were coded as correct/incorrect in analyses. Apart from 5 practice trials at the beginning of the experiment, participants did not receive correct/incorrect feedback on their responses.

7.2.5 Procedure

A schematic of the paradigm is presented below in Figure 7.1. One key difference to the procedure from preceding chapters was that in the present study all participants completed CDI and STAIC measures 1 week prior to testing (CDI,

STAIC prior). This was due to logistical reasons regarding the potential length of testing sessions in school, rather than for theoretical reasons. Questionnaires were sent out to parents together with information sheets and consent forms, and parents were instructed to return the questionnaires to participants' schools after their children completed the measures.

On the day of testing, participants provided written assent and then completed the first half of the Interpretation Questionnaire (IntQu pre) and the first VAS mood ratings (VAS1). Following these questionnaires, participants were administered the imagery training detailed by Holmes et al. (2006), and allocated to either neutral or positive CBM-I training. Participants were allocated to the study's two experimental conditions using a similar randomisation process as for Chapters 4 and 5 (see Section 4.2.3). The lead researcher generated a spreadsheet with 20 participant ID numbers for use by each of the 4 experimenters (i.e. 80 in total). The random coin-flip function at random.org (Haahr, n.d.) was then used to flip 80 virtual coins, and so randomly allocate each of these 80 ID numbers to neutral (heads) or positive (tails) CBM-I training. The individual experimenters then allocated ID numbers to participants (from their set of 20 ID numbers) in the order in which participants were tested. Randomisation was not stratified by school (see Section 7.2.1), and all participants who opted into the study were randomised to one of the two experimental conditions. After training, participants completed VAS2 ratings and the Face Emotion Task. Following the Face Emotion Task, participants completed the final mood rating (VAS3), and finally the Interpretation Bias Test.

Twenty-four hours after CBM-I training, participants completed the final questionnaire battery in school. This battery included the trait STAIC measure (STAIC post), the Recent Events Scale, and the second half of the Interpretation Questionnaire (IntQu post). Following this, participants were debriefed in full. As part of their debriefing, participants provided written answers to the questions 'What do you think this study was actually about?' and 'What do you think the tasks measured?'. As a side note, the answers to these questions were used to generate the word cloud that appears on the front cover of this thesis.

7.2.6 Ethical Issues

Ethical approval for the current study was obtained through the University of Oxford Central University Research Ethics Committee. As detailed in the preceding chapters (see Section 4.2.4 in particular), guardians/parents of students provided informed consent on the behalf of adolescent participants, after being informed about the study via information sheets distributed through participating schools. Participants also provided written assent after being provided with a briefer account of the study and its aims (see Appendix H). In contrast to the studies detailed in Chapters 4 and 6, participants underwent positive or neutral CBM-I training only, rather than positive to negative training. In line with implications discussed in Chapter 4, this was done because previous research has identified the transition to secondary school as a potentially stressful time for young adolescents, as well as one where they will be exposed to a multi-

7. CBM-I EFFECTS AND TRANSFER EFFECTS IN A SAMPLE UNDERGOING SCHOOL TRANSITION

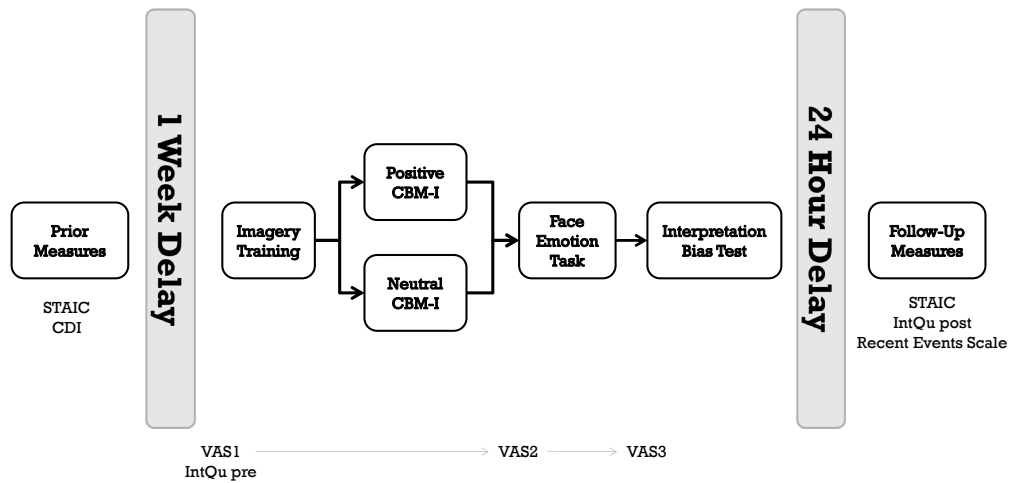


Figure 7.1: Schematic of the experimental procedure

tude of new social experiences (Fenzel, 2000; McGee et al., 2004). Taking these arguments together with findings from Chapter 6 that valenced CBM-I training may differentially affect responses to stressors, it was decided to avoid exposing the young adolescents undergoing transition in the current study to negative CBM-I training, in case this in any way enhanced their negative experience of any contemporaneous social stressors. Following the completion of the study, all participants were fully debriefed as to the nature of the study and the reasons why it was conducted.

7.3 Results

7.3.1 Descriptive Statistics

Mean age in years, gender identities, and mean scores on the STAIC, CDI and Interpretation Questionnaire are given below in Table 7.2 for the whole sample, and broken down by training group. All continuous measures were found to be normally distributed by Kolmogorov-Smirnoff and Shapiro-Wilks tests. All 52 participants provided full datasets for demographic information, CBM-I training and testing, and the Face Emotion Task. Post-training Interpretation Questionnaire data was missing for one participant ($n = 51$). Pre-test CDI and STAIC data was missing for 2 participants ($n = 50$ in both cases), and post-test STAIC scores were incomplete for 3 participants ($n = 49$).

Pearson χ^2 tests found no differences between positive and neutral training groups in either gender or ethnic make-ups: $\chi^2_{gender}(1) = 0.001, p = 1.00$; $\chi^2_{ethnicity}(3) = 1.39, p = .709$. Groups showed no baseline differences in age or CDI score: $t_{age}(49) = 0.49, p = .626$; $t_{CDI}(48) = 0.44, p = .661$. Pre- and post-

		Overall	Training Group	
			Positive	Neutral
Gender	Female	55.8%	56.0%	55.6%
	Male	44.2%	44.0%	44.4%
	Other	0.0%	0.0%	0.0%
Age		11.20 (0.40)	11.17 (0.38)	11.22 (0.42)
Ethnicity	White	84.6%	80.0%	88.9%
	Asian	5.8%	4.0%	7.4%
	Black	0.0%	0.0%	0.0%
	Mixed	3.8%	4.0%	3.7%
	Other	1.9%	4.0%	0.0%
	Did not report	3.8%	8.0%	0.0%
IntQu pre		2.37 (1.92)	2.68 (1.89)	2.07 (1.94)
IntQu post		1.20 (1.62)	1.16 (1.36)	1.23 (1.85)
CDI		10.05 (9.02)	10.64 (9.16)	9.50 (9.04)
STAIC prior		31.20 (8.11)	31.39 (6.87)	31.03 (9.16)
STAIC post		29.59 (7.93)	30.08 (7.13)	29.11 (8.76)
<i>n</i>		52	25	27
Cheerful	VAS1	7.31 (2.04)	7.05 (2.14)	7.54 (1.97)
	VAS2	7.75 (1.92)	7.80 (1.97)	7.71 (1.92)
	VAS3	8.03 (1.73)	7.77 (1.75)	8.26 (1.71)
Worried	VAS1	2.07 (2.15)	2.41 (2.39)	1.76 (1.90)
	VAS2	1.06 (1.43)	1.14 (1.59)	0.99 (1.31)
	VAS3	1.13 (1.87)	1.19 (2.01)	1.08 (1.77)
Miserable	VAS1	1.71 (1.80)	1.74 (1.78)	1.69 (1.84)
	VAS2	1.26 (1.33)	1.07 (1.24)	1.42 (1.41)
	VAS3	1.05 (1.35)	1.09 (1.14)	1.01 (1.53)
Recent Events	No.	3.08 (2.41)	3.39 (2.50)	2.81 (2.34)
	Severity of impact	1.83 (0.57)	1.87 (0.63)	1.79 (0.52)
	Desirability	1.58 (0.55)	1.43 (0.50)	1.70 (0.57)
	Ability to cope	3.00 (0.57)	2.92 (0.63)	3.07 (0.52)
	Felt in control	2.50 (0.78)	2.67 (0.87)	2.36 (0.68)

Table 7.2: Means and proportions of demographic data and questionnaire responses. Standard deviations given in parentheses. Mean VAS scores before training (VAS1), after Training (VAS2), and immediately preceding interpretation bias testing (VAS3). For other mood questionnaires, 'pre' denotes administration pre-CBM-I training on the same day as CBM-I training, 'prior' denotes administration 1 week prior to CBM-I training, and 'post' 24 hours following CBM-I training.

training tests of STAIC scores are reported in the 'Changes in State and Trait Mood Measures' section (7.3.5) below.

Interpretation Questionnaire scores were not significantly correlated with CDI scores pre-training ($r(48) = .188, p = .192$), and correlations with pre-training STAIC scores were only at trend level ($r(48) = .265, p = .063$). However post-training scores were significantly correlated with STAIC score: $r(49) = .523, p < .001$. Pre- and post-training Interpretation Questionnaire scores were significantly correlated with moderate strength: $r(51) = .456, p = .001$.

7.3.2 Training

Three 4×2 ANOVAs examined performance over the course of training. The first used reaction times (RTs) to word fragment completions as an outcome measure; the second RTs to comprehension questions, and the third used accuracy of responses to comprehension questions. All 3 ANOVAs included block (1, 2, 3, 4) as a 4-level within-subjects factor, and training group (positive, neutral) as a 2-level between-subjects factor.

There was a significant main effect of block for Word Fragment RTs: $F(3, 144) = 27.03, p < .001, \eta^2 = .343$. Within-subjects contrasts together with comparisons of mean RTs across blocks (see Table 7.3) indicated significant linear decreases in reaction time across training: $F(1, 48) = 35.38, p < .001, \eta^2 = .408$. There was also a significant Block*Training-Group interaction: $F(3, 144) = 3.76, p = .012, \eta^2 = .055$. Post hoc *t*-tests did not reveal significant differences between training groups on any block. However examining means in Table 7.3, it appears that responses to word fragments were somewhat slower in the positive ($\bar{x} = 4849.12\text{ms}, sd = 3457.72$) than neutral training group ($\bar{x} = 3504.46\text{ms}, sd = 1547.51$) during Block 1. However the post-hoc *t*-test for this comparison was only at trend level: $t(32.69) = 1.79, p = .083, d = 0.625$, even before applying Bonferroni corrections.

There was also a main effect of block on Comprehension Question RTs: $F(3, 144) = 9.65, p < .001, \eta^2 = .166$. Again, comparisons of mean RTs across blocks (see Table 7.3) and within-subjects contrasts indicated a significant linear decrease in RTs to comprehension questions over training blocks: $F(1, 48) = 19.89, p < .001, \eta^2 = .293$. These results suggest that participants became quicker in all their responses over the course of training.

Accuracy of responses to comprehension questions showed no main effect of block, but did show a significant Block*Training-Group interaction: $F(3, 144) = 3.04, p = .031, \eta^2 = .058$. The Block*Training-Group interaction for accuracy of comprehension questions seems to be primarily driven by the relatively lower accuracy of responses in the neutral group relative to positive training in Blocks 2 and 4 (see means in Table 7.3), but otherwise comprehension question responses appear to have been at relative ceiling for the entirety of training. Accuracy in the positive training group was significantly higher than in the neutral training group in Block 2 ($t(50) = 2.06, p = .045, d = 0.583$) and Block 4 ($t(48) = 2.05, p = .046, d = 0.592$), but these differences did not remain significant after applying Bonferroni post-hoc corrections.

Block	Word Fragment RT (ms)			RT (ms)	Comprehension Question Accuracy		
	Overall	Positive	Neutral		Overall	Positive	Neutral
1	4150.93 (2703.21)	4849.12 (3457.72)	3504.46 (1547.51)	3666.07 (1286.80)	91.4% (10.7)	90.3% (13.8)	92.3% (6.9)
2	2416.38 (1335.09)	2501.36 (1760.58)	2337.69 (788.54)	3102.66 (768.31)	90.4% (9.1)	93.0% (9.8)	88.0% (7.8)
3	2753.55 (1616.40)	2483.89 (1426.42)	2993.25 (1760.07)	2886.49 (1392.46)	92.0% (10.4)	93.1% (12.5)	91.1% (8.3)
4	1754.25 (423.30)	1773.06 (494.43)	1738.23 (360.92)	2700.96 (1021.67)	92.8% (8.1)	95.3% (7.0)	90.7% (8.4)

Table 7.3: Mean accuracy rates and RTs (ms) over the course of training. Standard deviations given in parentheses.

7.3.3 Interpretation Bias Test

A $2 \times 2 \times 2$ ANOVA was conducted with mean similarity ratings from the Interpretation Bias Test as the outcome measure. Probe Type (target, foil) and Probe Valence (negative, positive) were included as within-subjects factors, and Training Group (positive, neutral) was included as a between-subjects factor. Consistent with Chapters 4–6, there were significant main effects of both Probe-Type and Probe-Valence: $F_{ProbeType}(1, 50) = 54.58, p < .001, \eta^2 = .513$; $F_{ProbeValence}(1, 50) = 30.91, p < .001, \eta^2 = .718$, but no significant 2 or 3-way interactions. Target probes were rated as more similar to the original scenario ($\bar{x} = 2.32, sd = 0.29$) than were Foils ($\bar{x} = 2.08, sd = 0.32$). Positive probes received higher similarity ratings ($\bar{x} = 2.56, sd = 0.37$) than did Negative probes ($\bar{x} = 1.81, sd = 0.38$).

Given findings from Chapters 4–6 and Vassilopoulos et al. (2009), planned comparisons were performed on similarity ratings for negative and positive targets across the two Training Groups. Negative targets were rated significantly less similar to the original ambiguous scenario in the positive ($\bar{x} = 1.80, sd = 0.46$), compared to the neutral training group ($\bar{x} = 2.04, sd = 0.37$): $t(50) = 2.09, p = .042, d = 0.591$. There was no significant difference for similarity ratings for positive targets between groups: $t(50) = 0.06, p = .951, d = 0.017$; $\bar{x}_{Positive} = 2.71, sd = 0.39$; $\bar{x}_{Neutral} = 2.72, sd = 0.37$. These comparisons can be seen in Figure 7.2.

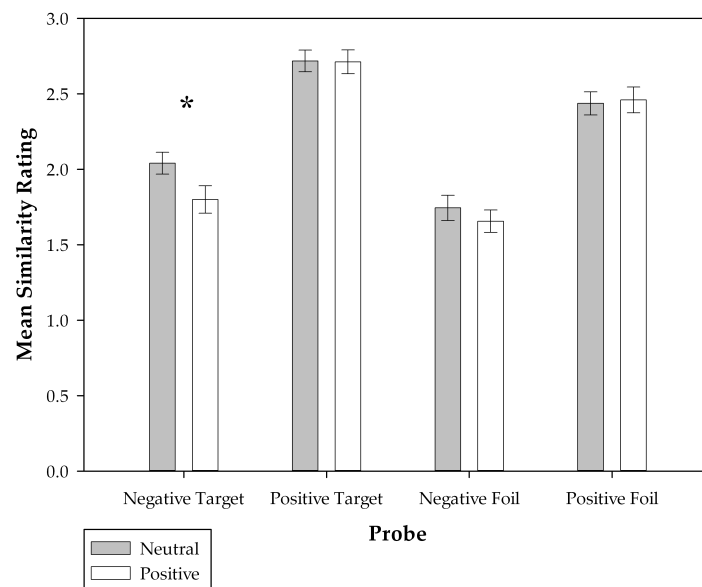


Figure 7.2: Mean similarity ratings for Negative and Positive Targets in the Interpretation Bias Test, grouped by Probe Valence and Training Group

7.3.3.1 Covariate Analyses

The $2 \times 2 \times 2$ ANOVA was also repeated including prior STAIC and CDI as covariates. There was no significant main effect of CDI, nor any significant interaction with any other factor. Including pre-training STAIC gave rise to a significant Probe-Valence*STAIC interaction: $F(1, 47) = 4.24, p = .045, \eta^2 = 0.056$. Further examination of this interaction with regression analyses showed that the higher STAIC score, the lower similarity ratings were for positively valenced probes ($\beta = -.288, p = .042$). There was no significant association between STAIC and similarity ratings for negative probes in the Interpretation Bias Test.

7.3.4 Interpretation Questionnaire

A 2×2 ANOVA was conducted with the number of endorsements of negative interpretations on the Interpretation Questionnaire as the outcome measure. Time of administration (pre-training, 24 hours following training) was included as a within-subjects factor, and CBM-I Training Group (positive, neutral) was included as a between-subjects factor. The analysis showed a significant main effect of time: $F(1, 49) = 21.90, p < .001, \eta^2 = .300$, arising from a decrease in the number of negative interpretations endorsed from pre-training to 24 hours later (see means in Table 7.2). There was no significant main effect of Training Group ($F(1, 49) = 0.50, p = .484, \eta^2 = .010$), nor any significant Time*Training-Group interaction ($F(1, 49) = 2.09, p = .155, \eta^2 = .029$).

7.3.5 Changes in State and Trait Mood Measures

State and trait measures of mood and anxious symptoms were examined using 2×2 ANOVAs, with training group (positive, neutral) as a between-subjects factor in all cases and time as a within-subject variable (before, after).

Trait STAIC score was examined using administration time (1 week prior to CBM-I training, 24 hours after training) as a within-subjects factor. This found no significant main effects of time ($F(1, 46) = 3.42, p = .071$) nor Training-Group ($F(1, 46) = 0.27, p = .607$), nor any significant Time*Training-Group effect ($F(1, 49) < 0.01, p = .997$).

All 3 VAS measures (Cheerful, Worried, Miserable) showed significant main effects of time: $F_{Cheerful}(1, 48) = 4.60, p = .037, \eta^2 = .086$; $F_{Worried}(1, 48) = 15.12, p < .001, \eta^2 = .238$; $F_{Miserable}(1, 48) = 5.42, p = .024, \eta^2 = .101$. Means in Table 7.2 show that these main effects represent an increase in Cheerful ratings from pre- to post-training, and decreases in VAS Worried and VAS Miserable ratings from VAS1 to VAS2 across the entire sample. No significant main effects of Training Group, nor Time*Training-Group interactions were found for any of the three ratings. Following CBM-I Training and the Face Emotion Task, no significant differences in any VAS rating were found between training groups at VAS3, as indexed by independent-samples t -tests: $t_{Cheerful}(49) = 1.01, p = .319$; $t_{Worried}(49) = 0.20, p = .842$; $t_{Miserable}(49) = 0.20, p = .841$. These null comparisons prior to administration of the Interpretation Bias Test suggest that

post-training measures of interpretation were not confounded with potential mood congruency effects.

Including pre-training STAIC and CDI scores as covariates did not change the significance of any analyses, nor give rise to any significant new interactions with these trait measures.

7.3.6 Face Emotion Task

7.3.6.1 Accuracy

A $4 \times 6 \times 2$ ANOVA was used to examine the percentage accuracy of participants' detection of facial emotions (collapsed across gender of face). Emotion (Angry, Happy, Sad, Scared) was included as a 4-level within-subjects factor, Intensity (1 = 13.33%, 2 = 26.67%, 3 = 36.67%, 4 = 50.00%, 5 = 63.33%, 6 = 76.67%) as a 6-level within-subjects factor, and Training Group (positive, neutral) as a 2-level between-subjects factor. Owing to a significant main effect of Emotion ($F(3, 150) = 77.82, p < .001, \eta^2 = .588$) and a significant Emotion*Training-Group interaction ($F(3, 150) = 4.44, p = .005, \eta^2 = .034$), further ANOVAs were conducted to decompose emotion-specific effects. Four 6×2 repeated measures ANOVAs were conducted: one for each emotion, again using mean percentage accuracy of emotion detection as an outcome measure, Intensity (1, 2, 3, 4, 5, 6) as a within-subjects factor, and Training Group (positive, neutral) as a between-subjects factor.

Intensity	% Accuracy			
	Angry	Happy	Sad	Scared
1	4.8% (14.9)	40.4% (34.4)	6.7% (17.2)	1.9% (9.7)
2	21.2% (28.6)	73.1% (27.0)	19.2% (28.3)	16.4% (29.2)
3	47.1% (33.5)	83.7% (25.7)	41.4% (32.4)	35.6% (40.0)
4	63.5% (31.5)	86.5% (26.4)	50.0% (31.3)	61.5% (37.9)
5	75.0% (30.5)	91.4% (19.1)	63.5% (31.5)	74.0% (33.6)
6	78.9% (28.6)	88.5% (23.5)	64.4% (31.8)	65.4% (36.4)

Table 7.4: Percentage accuracy in identifying expressions in the Face Emotion Task, broken down by Emotion and Intensity. Standard deviations are given in parentheses.

Responses to angry faces showed a significant main effect of intensity ($F(5, 250) = 78.92, p < .001, \eta^2 = .601$, and see Table 7.4), such that participants were more accurate in responding at greater intensities of anger. There was no significant main effect of Training-Group on the accurate identification of morphed angry faces. However a significant Intensity*Training-Group interaction emerged: $F(5, 250) = 2.42, p = .037, \eta^2 = .018$. This is illustrated in Figure 7.3—the interaction appears such that the positive group were less accurate in identifying angry faces than the neutral training group at lower intensities of anger (specifically intensity 3, given that accuracy was effectively at chance below this intensity), but as the intensity increased, the accuracy of the 2 groups equalised until the final intensity, where the positive group were more effective

at identifying anger in the faces. However post-hoc t -tests showed no significant between-groups differences at any intensity.

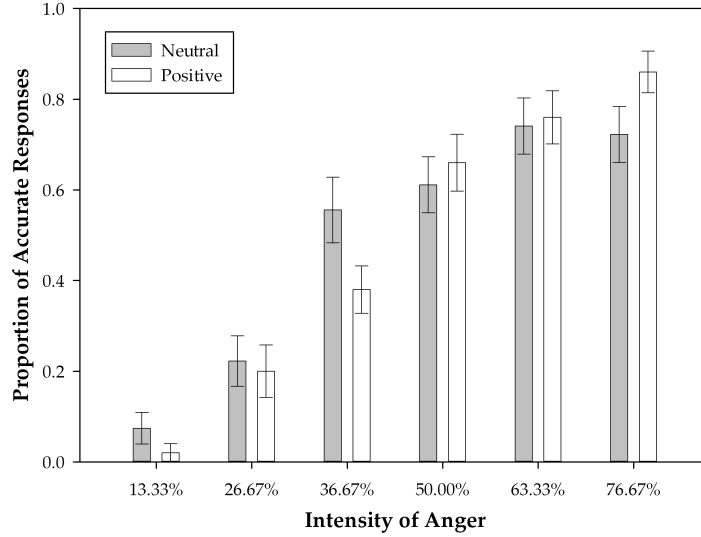


Figure 7.3: Significant Intensity*Training-Group interaction for accuracy of responses to Angry faces in the Face Emotion Task

Happy and sad faces both showed significant main effects of intensity on the accurate detection of their respective emotions: $F_{Happy}(5, 250) = 48.32, p < .001, \eta^2 = .485$; $F_{Sad}(5, 250) = 38.94, p < .001, \eta^2 = .433$. In both cases, this effect was such that greater intensity resulted in greater accuracy (see means in Table 7.4). Both increases showed significant linear ($F_{Happy}(1, 50) = 98.80, p < .001, \eta^2 = .659$; $F_{Sad}(1, 50) = 149.12, p < .001, \eta^2 = .748$), and quadratic ($F_{Happy}(1, 50) = 51.79, p < .001, \eta^2 = .506$; $F_{Sad}(1, 50) = 8.58, p = .005, \eta^2 = .146$) characters, suggesting that accuracies increased and then levelled off at ceiling. Responses to happy faces additionally showed a significant cubic contrast ($F(1, 50) = 7.14, p = .010, \eta^2 = .125$), reflecting the earlier ascension to ceiling effects for this emotion. Neither emotion showed a significant main effect of Training Group on accuracy, nor any significant Emotion*Training-Group interaction.

There was also a significant main effect of Intensity on accuracy of responses to scared faces: $F(5, 250) = 58.87, p < .001, \eta^2 = .535$ —again with accuracy increasing with greater intensity (see Table 7.4). Again, significant linear ($F(1, 50) = 187.38, p < .001, \eta^2 = .753$), quadratic ($F(1, 50) = 18.99, p < .001, \eta^2 = .267$) and cubic contrasts ($F(1, 50) = 13.57, p = .001, \eta^2 = .213$) suggested that accuracy increased with intensity, before reaching ceiling. Unlike the other emotions, scared faces also exhibited a main effect of Training-Group on accuracy: $F(1, 50) = 7.67, p = .008, \eta^2 = .133$. This main effect is illustrated in Figure 7.4, which shows that—across all intensities—participants were more accurate in correctly identifying scared faces following positive training, relative to neutral training. There was no significant Intensity*Training-Group interac-

7. CBM-I EFFECTS AND TRANSFER EFFECTS IN A SAMPLE UNDERGOING SCHOOL TRANSITION

tion for scared faces.

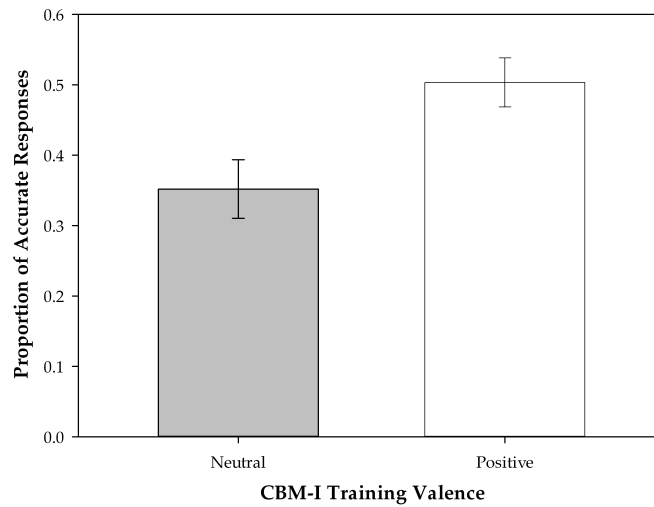


Figure 7.4: Mean accuracy in detecting morphed scared faces in the Face Emotion Task, by training group

7.3.6.2 Reaction Times

Reaction times of accurate responses in the Face Emotion Task were used as the outcome measure for a series of ANOVAs. Four 6×2 ANOVAs were conducted using intensity (1, 2, 3, 4, 5, 6) as a 6-level within-subjects factor and Training-Group (positive, neutral) as a 2-level between-subjects factor. ANOVAs were conducted separately for each emotion (Angry, Happy, Sad, Scared), based on a significant main effect of Emotion when running a single $4 \times 6 \times 2$ ANOVA: $F(3, 750) = 14.64, p < .001, \eta^2 = .225$.

Intensity	Reaction Times (ms)			
	Angry	Happy	Sad	Scared
1	4207.00 (2350.29)	4600.07 (2646.77)	6967.00 (4816.23)	4148.00 (4152.13)
2	4200.40 (1970.65)	4250.75 (2606.09)	5800.39 (3443.91)	5584.46 (2755.18)
3	3679.18 (1936.77)	3874.14 (2100.47)	4846.39 (2733.35)	6326.12 (4070.83)
4	3541.85 (1880.53)	2977.68 (1029.32)	4625.21 (2417.48)	5329.68 (3336.23)
5	3643.24 (2150.36)	2930.72 (974.15)	4356.19 (2306.24)	4992.71 (2258.53)
6	3787.39 (3375.21)	3767.79 (4322.86)	4099.60 (1665.41)	5489.76 (8057.23)

Table 7.5: Mean reaction Times to accurate responses in the Face Emotion Task, broken down by Emotion and Intensity. Standard deviations are given in parentheses.

RTs for accurate responses to happy faces showed a significant main effect of Intensity: $F(5, 150) = 2.88, p = .016, \eta^2 = .083$, where RTs were shorter for more intensely happy faces (see means in Table 7.5). Examining within-subjects contrasts, the variation of RTs with intensity showed a significant quadratic ($F(1, 30) = 4.37, p = .045, \eta^2 = .127$) character, which was likely driven by outlying long responses to intensity 6. The analysis showed no significant

Intensity*Training-Group interaction, nor any significant main effect of Training Group.

Analyses on other emotions did not show significant main effects of Intensity on reaction time, nor any significant Intensity*Training-Group interaction. Accordingly, RTs were averaged over the 6 intensities for Angry, Sad and Scared faces, to give mean reaction times for accurate responses to each of these emotions over the entire task, in the respective separate analyses conducted for the 4 different emotions.

These mean RTs for accurate responses were then compared across positive and neutral Training Groups using independent-samples *t*-tests. These comparisons showed significant differences in RTs between positive and neutral training groups in response to Angry and Sad faces: $t_{Angry}(49) = 2.27, p = .028, d = 0.648$; $t_{Sad}(49) = 2.43, p = .019, d = 0.695$. Reactions were slower following positive ($\bar{x}_{Angry} = 4165.64\text{ms}$, $sd_{Angry} = 1203.90$; $\bar{x}_{Sad} = 5314.01\text{ms}$, $sd_{Sad} = 1475.04$) than following neutral training ($\bar{x}_{Angry} = 3427.96\text{ms}$, $sd_{Angry} = 1119.25$; $\bar{x}_{Sad} = 4293.67\text{ms}$, $sd_{Sad} = 1512.79$). No significant difference in RTs of accurate responses was found between training groups for Scared faces: $t(47) = 1.27, p = .212, d = 0.369$. Between-groups differences in RTs of accurate identifications of the 4 emotions across the Face Emotion Task are illustrated in Figure 7.5.

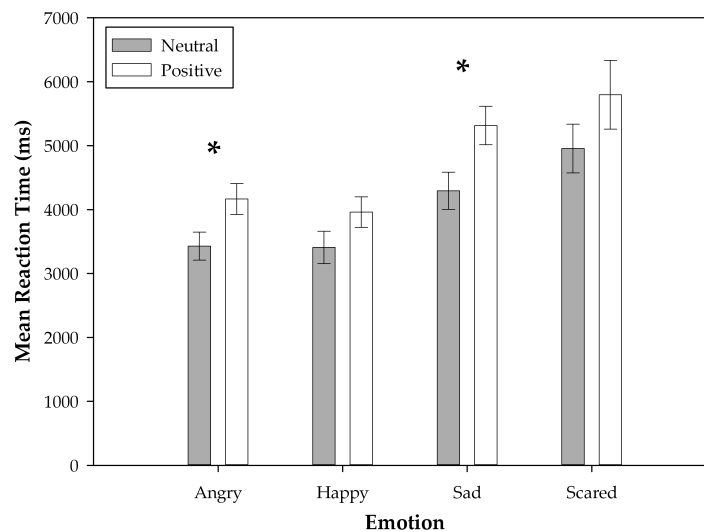


Figure 7.5: Differences between Positive and Neutral CBM-I training groups in RTs to accurate responses in the Face Emotion Task

7.3.7 Recent Events Scale

Total numbers of stressful events from the Recent Events Scale (RES) experienced by each participant were calculated. An independent-samples *t*-test was conducted to compare the mean number of stressful events experienced by the

positive and the neutral training groups (see Table 7.2 for means). There was no significant difference between the groups in the reported experience of recent stressors: $t(48) = 0.84, p = .404$.

Mean ratings were also calculated for each experienced event for its perceived severity, desirability, the individual's self-perceived ability to cope with it, and their perceived control of the event (see Table 7.2). Comparing these ratings between CBM-I training groups with independent-samples t -tests showed no significant differences for any rating. Similarly, including the 4 scores as dependent variables in a multivariate ANOVA with Training Group as a 2-level between-subjects variable yielded no significant effects.

7.4 Discussion

Results from the current study extended findings from previous CBM-I training research in adolescents to a younger sample undergoing transition from primary to secondary school. In-keeping with previous research, positive CBM-I training decreased subsequent endorsement of negative interpretations of ambiguous social situations, compared to control. Trait anxiety measures did not indicate any changes from a week prior to training to 24 hours following training. Nor were there any differential training effects on the appraisal of recent stressful life events measured 24 hours after the CBM-I intervention. Self-reported 'Worried' and 'Miserable' ratings and number of negative explanations selected on the Interpretation Questionnaire decreased from before to after training, while 'Cheerful' ratings increased. However none of these effects showed differential effects of positive versus neutral training. A novel finding was that verbal CBM-I training based on ambiguous social situations showed apparent transfer to labelling of ambiguous facial emotions. Positively trained individuals were slower in identifying angry and sad faces compared to control. Conversely, positive training enhanced participants' accuracy in identifying scared faces relative to control.

As previously discussed in Chapter 4 (see Sections 4.2.1 and 4.4.5), there are potential issues with generalisability of the current findings. Namely the current sample oversampled female-identified participants and individuals from higher-SES backgrounds (indicated at the school level by the eligibility for FSM). However, covariate analyses and other post-hoc tests showed no evidence of any gender effects on the current findings. Furthermore findings replicate the form of previous adolescent CBM-I research (e.g. Salemink & Wiers, 2011), as well as Chapter 6, which sampled individuals from lower-SES backgrounds. Again though there were no indications of confounding effects due to sampling issues in the current study, it would be ideally desirable for future research to eliminate potential confounds at the sampling stage (e.g. by sampling from exclusively mixed-sex schools or ensuring equal representation of all-boys and all-girls schools, aiming for a representative SES of the general target population) rather than in post-hoc statistical correction. This is especially pertinent for future research into potential buffer effects for stress reactivity, given that the same

stressors and risk factors for mental and emotional health have greater negative effects in lower than higher-SES individuals (Marmot, 2004, 2005).

7.4.1 Training and Interpretation

Positive training attenuated negative novel interpretations rather than potentiating positive interpretations, as in Lester et al. (2011a), Lester et al. (2011b) and Vassilopoulos et al. (2009). This extends previous findings of CBM-I training in young adolescents to show not only that CBM-I training might be used to train biases towards novel ambiguous information in late childhood and early adolescence (Muris et al., 2008, 2009; Lester et al., 2011a, 2011b; Vassilopoulos et al., 2009), but further that interpretive biases may be trained for social information using an active-generation paradigm. It does however bear mentioning that the effect sizes for post-training biases demonstrated in the current sample were relatively small compared to previous chapters, though they were comparable to comparisons between positive and neutral training seen in Chapter 4 (see also Appendix E).

Unlike Chapters 4 and 6, the present study showed a significant decrease in the number of negative explanations selected in the Interpretation Questionnaire. However the presence of this decrease in both training groups suggests that it may be due to external effects of the experimental paradigm or placebo/contact effects rather than positive effects of training.

The current study showed no evidence of mood changes as a direct result of training, despite being conducted in a sample undergoing a valid period of life stress. Current results mirror those of previous studies reported in this thesis, in showing no immediate mood change as a result of CBM-I training despite using an active -generation paradigm. Such results contrast with previous findings of mood change immediately following passive-generation studies in other young adolescent samples (Lester et al., 2011a; Vassilopoulos et al., 2009). Together these findings weaken support for Mathews and Mackintosh (2000)'s assertion that active-generation CBM-I paradigms are necessary to see mood change as a direct result of training. This issue is due further consideration in future research.

7.4.2 Generalisation to Other Measures

7.4.2.1 Face Emotion Task

Differences between the two CBM-I training groups in reaction times to angry and sad faces tentatively demonstrate that verbal interpretation training may be able to transfer to non-verbal interpretive tasks. The current post-training valence-congruence effects of positive training are in the opposite direction to previous biases in identifying facial emotions seen to be associated with anxious symptoms in adults (Richards et al., 2002; Langenecker et al., 2005; Yoon & Zinbarg, 2008). However the small effect sizes for interpretation change and absence of any commensurate mood effects following training advise against any deeper inductive interpretation of this pattern of findings beyond suggestions

that more detailed considerations of these kinds of effects and their replication might be worthwhile approaches for future research.

Slowed identifications of the negative emotions of anger and sadness following positive CBM-I training are consistent with negative priming following exposure to positive information during training (Tipper, 2001). Having said this, it is worth pointing out that the transfer of effects from CBM-I training to the Face Emotion Task would operate over a far longer time-scale than perceptual priming effects for face processing (Nummenmaa, Peets, & Salmivalli, 2008; Webb & Nelson, 2001; Tipper, 1985). The apparent transfer effects in the current study would also require a transfer across modality from verbal scenarios to facial processing. If this finding is valid across future replications, it suggests at least some aspect of integration or higher-order processing (Yeung, Nystrom, Aronson, & Cohen, 2006; Allport & Wylie, 2000). Furthermore, the absence of between-groups differences in self-rated mood immediately prior to the face task (VAS2) suggests that effects are not ascribable to mood-congruence effects (Isen, Shalker, Clark, & Karp, 1978; Gilboa-Schechtman, Revelle, & Gotlib, 2000). Again, providing that the observed effects can be replicated in further studies, future work may wish to investigate the possibility that interpretive training effects may be able to generalise between verbal and facial modalities—i.e. that priming or training in one modality can give rise to interpretive effects in another. If these kinds of effects were to be demonstrated across future studies, they could be taken to indicate that interpretive styles represent higher-order non-modality-specific processes.

The task was limited in the number of emotions it displayed, in particular only presenting a single positive emotion (happy) in contrast to three negative emotions. Previous research has outlined that certain emotions may be more readily confused than others (Richards et al., 2002). As such, the process involved in the accurate detection of fear may be informed by examining what responses were made by participants when they did not correctly identify scared faces. For instance, the improved performance in identifying scared faces in the positive group in the current study might be due to a decreased tendency to mistake it for anger or another emotion. Unfortunately, given the small number of trials in the current instance of the Face Emotion Task, such comparisons are not statistically viable using the current dataset. Such possibilities could however be probed by future research examining patterns of errors in the Face Emotion Task with more trials to afford greater reliability, especially in faces that were morphed between two emotions. Accordingly, further research would do well to consider comparisons of positive, negative and neutral CBM-I training in regards to a larger battery of face stimuli, drawing from various negative and positive emotions.

7.4.2.2 Recent Events Scale

Positive and neutral training groups did not differ on the number of life experiences they had experienced in the last 6 months. However, CBM-I training also had no effect on participants' subjective appraisals of these life events. Given

that the Recent Events Scale involves retrospective appraisals of life events, it has no real control for the number or type of events experienced, nor the distance in time of these events from the training procedure. While some recent work has suggested that interpretation training in adults can influence memory for previous interpretations (Salemink, Hertel, & Mackintosh, 2010), it appears that analogous effects were not evident in the current sample. In future work it may be worthwhile to administer questionnaires requiring retrospective re-appraisal of older memories immediately after (or before in case of simple re-activation) bias modification, such that the bias modification process is active at the same time as the reactivated memory. In the absence of this kind of approach however, present results suggest it is unlikely that an uncontrolled recollective measure of life events would show stress reactivity effects within a cognitive bias modification paradigm.

Alternatively, it may be the case that a single session of CBM-I training is insufficient to modify the interpretation of significant life events, which are characterised as chronically stressful and personally relevant (Compas et al., 1987; Johnson & McCutcheon, 1980). Previous studies in adolescent samples to have used multiple training sessions over more protracted training schedules (Vassilopoulos et al., 2009, 2012) have by contrast shown evidence suggesting that this kind of more enduring trait characteristic may be subject to the influence of training or modifying interpretive biases. Moreover, the training paradigm used in the current study was shortened from that used in previous chapters, in an attempt to make it more appropriate to a younger sample (Hadwin & Field, 2010b), as well as due to time constraints of testing during a school day.

The present null findings for effects on appraisals of stressful events as a result of CBM-I training contrast with the successful demonstration of positive CBM-I training as a buffer for stress reactivity in Chapter 6, which used an acute, experimental stressor. Given the gaps between these findings, it may be useful for future experiments to attempt to titrate between these two relatively distinct methodologies in order to determine the limits for any potential buffer effects from CBM-I training. Such comparisons would also be useful in the event that the apparent stress buffer effect seen in Chapter 6 was in fact a false positive.

In the specific context of school transitions, potentially stressful events (e.g. being picked on at school, feeling unable to cope with a class) are likely to be experienced with greater frequency than one-off large-scale life events (Zeedyk et al., 2003; Anderson et al., 2000; Compas et al., 1987; Johnson & McCutcheon, 1980), while being closer to daily life than experimental stressors. Accordingly, a development to the present line of enquiry (with direct implications for improving emotional outcomes) could be to have participants keep diaries for a given list of stressful events, and their subjective appraisals of such events for a week following a single session of CBM-I training. Such a paradigm would be able to examine reactions to stressors within a more ecologically valid setting than a controlled experimental stressor, and would also be less acute in their experience and effect. Moreover a diary study could be tailored to stressful events detailed by previous transition work (Zeedyk et al., 2003; Anderson et al., 2000;

Evangelou et al., 2008; McGee et al., 2004) by informing the list of stressors for participants to record, and so help develop CBM-I as a potential intervention for transition-specific problems as well as wider social stressors. If buffer effects of CBM-I were found, then the number of CBM-I sessions could be varied with regards to the potential longevity of effects, such that an optimal programme length of number of sessions could be determined against endurance of effects.

7.4.3 Transition Design

The current study examined a representative sample of 11-year-olds undergoing school transition. Though school transition is a potentially stressful period associated with social difficulties (Zeedyk et al., 2003; Anderson et al., 2000), these difficulties will not necessarily be experienced by all, or even the majority of individuals undergoing transition. So while the current study was able to show that it may be possible to train interpretation biases for novel ambiguous stimuli in 11-year-olds, it does not speak to the use of this approach in minimising impairment or improving outcomes for specifically those individuals who might show difficulties with transitions. As potential life stressors such as school transition are not stressful for everyone, there may be more evidence of generalisation or transfer to emotional or life-event appraisal measures in a group selected for experiencing difficulties with transition (even though trait anxiety did not moderate training effects in this study).

The way that school transitions were used as a life stressor in the current chapter was sub-optimal for showing differential stress reactivity effects as a function of in bias modification training for interpretations. As all participants were trained and tested after they had transitioned to secondary school, the study in its design examined interpretation bias modification effects against a backdrop of potential anxiety of students having already undergone aspects of transition. An alternative approach more immediately similar to the design of See et al. (2009) would be instead to have participants undergo training prior to school transition, and then test anxious symptoms and appraisals of the stressful events post-transition. In this way the transition to secondary school would represent an ecologically valid stressor within a natural experiment design, probing differential stress reactivity effects of CBM-I training. Additionally, any number of other predictable life events beyond school transitions could be used within a natural experiment design, for instance moving house, undergoing surgery, taking exams, or gender transition.

7.4.4 Conclusions and Future Developments

In conclusion, the current chapter presents evidence that the CBM-I paradigm heretofore used in adolescents remains valid when extended to a younger sample. Though relatively weak, post-training effects were shown in this sample of school transitioners. Further, the study presents preliminary evidence of the generalisation of CBM-I training effects to the accuracy and speed of processing of emotional faces, suggesting that these processes might share a cognitive un-

derpinning. A number of lines of future research are suggested to develop the current findings:

- The generalisation of CBM-I effects to the interpretation of emotional faces should be replicated with a wider range of positive and negative emotional faces
- Other potential generalisation effects should be examined, particularly the use of CBM-I as a stress buffer for short-term social stressors pertinent to a school-transition population
- Future testing should train participants prior to school transition

8

Discussion

Torniamo all'antico e sarà un progresso

Giuseppe Verdi (1883)
Weezer (2001)

8.1 Overview

Data presented over the course of this thesis have examined the roles of various aspects of interpersonal function in relation to symptoms of anxiety and depression in adolescence, late childhood, and early adulthood. This final chapter briefly summarises each preceding study. Findings are then discussed in relation to wider literature concerning interpersonal and cognitive risk factors for emotional symptoms and disorders across development. Four main themes emerging from results presented over the course of the thesis are considered:

1. Relative associations of anxious and depressive symptoms with interpretive biases
2. Aetiology of adolescent emotional symptoms and disorders and the role of interpretive biases
3. Effects of Cognitive Bias Modification of Interpretations
4. Mood and stress reactivity effects relating to interpretive biases

These points are discussed in light of findings across multiple chapters, and recommendations are made for future research to build on understanding of these themes. Methodological limitations are also identified and addressed in how they might frame current findings.

8.2 Summary of Results

Chapter 2 used a young adult sample to examine relative associations between interpersonal function and symptoms of social anxiety and depression. Three

measures were used to index different aspects of interpersonal function: 1) the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998) examined tendency to draw negative or benign interpretations from ambiguous interpersonal vignettes, 2) the Means-End Problem Solving task (Platt, Spivak, & Bloom, 1975) examined processes of forming behavioural plans for potential social problems, and 3) the Trust Game (Berg et al., 1995) indexed low-level trust and reciprocity behaviours in social exchanges. Negative interpretations of ambiguous information were associated with symptoms of both social anxiety and depression, while Trust Game indices were associated with neither. When controlling for co-occurring emotional symptoms in partial correlations, negative interpretation scores were more closely associated with depressive than anxious symptoms.

Chapter 3 investigated similar associations in a late childhood twin sample. Factor analyses established four distinct interpersonal cognitive factors: 1) Absence of Positive Perceptions of Peers and Self in Social Situations, 2) Negative Perceptions of Peers and Self in Social Situations, 3) Negative Expectations of Mothers' Behaviour, 4) Negative Expectations of Peers' Behaviour. All four factors correlated strongly with both anxious and depressive symptoms. When anxiety and depression were controlled for each other's effects, findings suggested a closer association between interpersonal cognitive factors and depressive symptoms, relative to anxiety. Longitudinal cross-lag models demonstrated that expectations of negative behaviour from social partners (both mothers and peers) at age 8 predicted later depressive symptoms, but not vice versa. Conversely, depressive symptom scores at age 8 predicted later negative perceptions and the absence of positive perceptions of peers and self in social situations, with no reciprocal path of prediction.

Comparisons of monozygotic and dizygotic twin correlations on interpersonal and emotional measures allowed for an examination of relative genetic and environmental contributions to each of these phenotypes, as well as shared variance between them and influences on the developmental pathways among them. Substantial and significant non-shared environmental influences were demonstrated for each factor. Examining influences over time showed an overlapping genetic influence upon symptoms of depression at age 8 and subsequent negative perceptions of social situations. There was also a latent factor explaining variance in negative expectations of mother and peer behaviour at age 8 and subsequent depressive symptoms. The influence on this latent factor was entirely due to environmental factors.

Chapters 4–7 investigated the potential modification of interpretations of interpersonal information by experimental means. These chapters used training protocols following Lothmann et al. (2011)'s adaptation of Mathews and Mackintosh (2000)'s Cognitive Bias Modification of Interpretations (CBM-I) paradigm to adolescent samples. Chapter 4 examined training positive and negative interpretations of ambiguous interpersonal information, relative to two control conditions in typically-developing adolescents. Negative training increased participants' endorsement of negative target interpretations of novel ambiguous social situations in the Interpretation Bias Test (Eysenck et al., 1991), while positive

training increased positive target interpretations of the novel situations. Control conditions (one a 50/50 mix of positive and negative scenarios, one a neutral task-demand control) gave rise to responses intermediating these findings, suggesting that both were viable controls. In addition to the post-training Interpretation Bias Test, Chapter 4 introduced an additional questionnaire measure—the Interpretation Questionnaire—to examine potential changes in interpretive biases from pre- to post-training. Based on findings from Chapters 2 and 3, the Interpretation Questionnaire was comprised of social items appropriate for adolescent and child samples from the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998) and the Children’s Expectations of Social Behaviour Questionnaire (Rudolph et al., 1995). Chapter 4 showed no change in Interpretation Questionnaire scores from pre- to post-training in any training condition. No differential training effects were observed upon self-reported mood.

To investigate the persistence of training effects across time, Chapter 5 tested a further group of positively trained individuals using the Interpretation Bias Test 24 hours after they had completed positive CBM-I training. This group’s responses to the Interpretation Bias Test were compared to responses made by the positively trained group in Chapter 4, who had been tested during the same session as training. No differences in post-training interpretive bias were found between the group tested during the same session as training, and the group tested 24 hours later.

Chapter 6 extended considerations of mood change following CBM-I training to use of a stress reactivity design. No differential effects upon mood were observed directly following positive or negative training. Exposure to an experimental stressor (performing a mental arithmetic task which participants believed was being filmed) led to increases in both self-reported anxiety and low mood across both training conditions. However, increases in anxiety as a result of the stressor were significantly smaller in the group who underwent positive training, compared to negative training. These stress reactivity effects appear to be anxiety-specific, as no such differentiation between training groups was seen for low-mood scores. Chapter 6 is also notable for replicating findings of demonstrable modifications to adolescent interpretive biases in a sample of predominantly South Asian ethnicity, in contrast to the high preponderance of predominantly-Caucasian samples in both this thesis and wider literature.

Finally, Chapter 7 applied CBM-I training to a sample of 11-year-olds who had recently transitioned to secondary school. The study used a shorter training procedure adapted for this younger sample. Endorsement of negative target interpretations of novel ambiguous stimuli in the Interpretation Bias Test was weaker following positive training than following neutral control training. There were no differential effects upon endorsements of positive target items. The study reported the novel finding of differential CBM-I training effects on the identification of emotions in morphed emotional faces. Positively-trained participants showed slower identification of angry and sad faces than controls. Conversely, participants who underwent positive training were more accurate in identifying scared faces than controls. No differential changes were observed

upon mood, indexed by either self-report visual analogue scales (Laurent et al., 1999) during the training paradigm, or in trait measures of anxiety (Spielberger, 1973) administered 24 hours later. Similarly, no differential training effects were observed for the Interpretation Questionnaire measure, nor were any between-group differences found for appraisals of life events as indexed by a questionnaire (Compas et al., 1987; Johnson & McCutcheon, 1980).

8.3 Relative Associations Of Anxiety And Depression With Interpretive Biases

As detailed in the brief summaries above for each preceding chapter, associations between interpersonal cognitive biases and symptoms of emotional disorders showed various commonalities and dissociations between anxious and depressive effects. Stress reactivity effects were specific to self-reported anxiety in Chapter 6. This seems to contrast with the closer associations between negatively biased expectations of outcomes in social situations and depressive symptoms seen in the longitudinal analyses detailed in Chapter 3. However, as stated in Chapter 3, as well as in previous work by Gregory, Rijdsdijk, et al. (2007), the apparent closer association between depression and interpersonal bias measures seen in this context may be an artefact of the inclusion of more social items in the Children's Depression Inventory (Kovacs, 1985) than in the Screen for Childhood Anxiety and Related Emotional Disorders (Birmaher et al., 1997), rather than actual differences between the constructs or a valid closer association between interpersonal cognitive biases and depression than anxiety.

Having said this, Chapter 2 showed closer associations of negative interpersonal expectations (indexed by the Ambiguous Social Situations Interpretation Questionnaire; Stopa & Clark, 2000; Amir et al., 1998) with symptoms of depression (Beck et al., 1996) than of social anxiety (Liebowitz, 1987), using partial correlation analyses. So associations with anxiety symptoms were subsumed by depression even when the anxiety index contained aspects of sociality. Of course it could well be the case that the subsumption of anxious associations with interpersonal cognitive factors by depressive associations are due to distinct effects in Chapters 2 and 3. Having said this, Chapter 2's results do somewhat undermine arguments that the relatively weaker association between anxious measures and interpersonal cognitive factors in Chapter 3 was solely due to an absence of social features in the anxiety measure used.

An alternative explanation is that proximal changes in interpretive biases such as those seen in Chapter 6 are associated with anxiety, whereas more enduring or chronic negatively valenced interpersonal cognitive function may show closer phenotypic association with depressive symptoms. Anxious symptoms are commonly acute, anticipatory and proactive (Mogg & Bradley, 1998; Bradley, Mogg, & Bonham-carter, 1997; Eysenck, 1992). Conversely, depressive symptoms are more enduring and chronic (Beck et al., 1979; Bradley, Mogg, & Williams, 1995; Kwiatkowski & Parkinson, 1994), emerging later in life often as reactive responses in concert with prolonged environmental features (Kessler

et al., 2005; Moffitt et al., 2007). Therefore associations with interpersonal bias measures—and concordantly any changes in depressive symptoms seen as a result of modifying these—might only be seen over longer time-frames. No association between interpretation bias training and VAS Low Mood ratings was observed in the CBM-I studies reported in Chapters 4–7, but associations between interpretive biases and depressive symptom measures were evident in Chapters 2 and 3. These discrepancies may reflect this temporal decoupling of symptoms.

This issue also bears upon wider findings and methodology in literature relating to interpretive biases. In reviewing CBM-I literature, Chapter 1 observed that CBM-I training studies to date have shown closer associations between interpretive biases with anxious symptoms than with depressive symptoms. Chapter 1 further expressed concerns that this might be an artefact of the same research's propensity to focus on anxious outcomes to the detriment of depressive or low-mood measures. For instance, Muris et al. (2009) found that trait anxiety symptoms were associated with more negative interpretations of ambiguous novel information, but this study did not include any trait depressive measure. By contrast, ANCOVAs conducted in Chapters 4–7 included symptom measures of both anxiety and depression, showing that both were associated with more negative and less positive interpretations of novel ambiguous information in the Interpretation Bias Test. These associations with both symptom types then stand in contrast to the specific effects upon anxiety in stress reactivity tasks as a function of *changes* in interpretive bias rather than enduring interpretive bias styles. The current argument would then expand on this by stating that the relative prominence of anxious effects over depressive in CBM-I training literature could be an epiphenomenal effect of the short time-frames typically employed by such studies. Extending these studies over longer periods, perhaps with longer training programmes would by this token be expected to produce commensurate shifts towards more findings pertaining to depressive outcome measures (Rohde et al., 1991; Breslau et al., 1995; Parker et al., 1999; Moffitt et al., 2007).

However this is not to say that associations between interpersonal cognitive factors and anxiety or depression are wholly the same effects on a general negative affect or anxiety-depressive factor, simply seen over different time-frames. Previous research has shown that anxiety and depression may be characterised by tripartite structures across child, adolescent and adult development (Gençöz et al., 2001; Clark & Watson, 1991). Chapter 3 taken together with the results of Gregory, Rijdsdijk, et al. (2007) also provides some evidence for the differentiation of negative affect, anxiety-specificity and depression-specificity by different features of interpersonal cognition. Namely this showed that negative perceptions of social situations and negative expectations of peer behaviour were associated with symptoms of both anxiety and depression, while the absence of positive perceptions of social situations and negative expectations of mother behaviour may have been more specifically predictive of depressive symptoms.

Based on these results it would seem unlikely that associations between interpersonal cognitive factors and emotional symptoms would not in some

way differentiate between anxious and depressive symptoms beyond the time-frames that changes were observed over. What seems more likely then is that the kinds of tripartite-like differentiation seen in Chapters 2 and 3 would also be present in CBM-I training, in addition to differentiations constrained by the time-courses of different measures. However CBM-I training paradigms would not be sensitive to these differential anxious and depressive effects, as training material collapses across various factors within interpersonal cognition for its unitary index of interpersonal interpretive bias. This highlights the importance of a dialogue between analyses characterising phenotypic features of interpersonal cognition with regards to differential emotional associations, and the construction of CBM-I training materials targeted as interventions for risks for specific features of emotional problems.

8.3.1 Conclusions and Future Directions

In summary:

- Stress buffer effects and other indices of proximal change in previous research show relatively greater evidence of anxiety-specific effects
- More enduring indices of interpretive biases additionally showed associations with depressive symptoms, particularly in the longitudinal analyses in Chapter 3
- Additional segregating components of interpersonal cognition may differentially predict anxious and depressive symptoms over time

Longitudinal research would be apt to speak to questions of proximal versus chronic changes in interpersonal cognitive factors and differentiation over time of anxious and depressive outcomes. By recording interpersonal cognitive factors and biases as well as anxious and depressive measures within a longitudinal study from late childhood through adolescence and early adulthood, cross-lag (as in Chapter 3) and structural equation modelling could be used to map paths of influence between negative or biased patterns of interpersonal cognition, anxiety and depression over time-frames longer than 2 years.

8.4 Aetiology Of Adolescent Emotional Disorders And The Role Of Interpretive Biases

Results from the current research may bear upon previous identifications of adolescence as an opportune time for interventions against negatively valenced cognitive risk factors for anxiety and depression (Kessler et al., 2005; Hadwin & Field, 2010b; Field & Lester, 2010; MacLeod & Holmes, 2012). Research presented over the course of this thesis may further be able to offer some insight into aetiological models of anxiety and depression in relation to interpersonal cognitive factors. In Chapter 3, a genetic influence upon depressive symptoms at

age 8 was also found to predict subsequent negative perceptions of social situations. This over-arching factor may represent a genetic vulnerability or diathesis to depression (Paris, 1999; Alloy et al., 1988). If valid, this suggests that the same genetic predisposition to depression is strongly predictive of later depressogenic reasoning about general aspects of social situations.

Previous genetic research into risk factors for emotional disorders and other psychopathology has advocated moving away from rigid definitions of clinical or behavioural phenotypes, and towards endophenotypes (Gottesman & Shields, 1973; Viding & Blakemore, 2007; Lau & Eley, 2010). Overt phenotypes or 'exophenotypes' (examples of which include anxiety and depression) are based on features yieldable to empirical investigation. They represent complex constructs that are difficult to attribute causal influences to, because they encompass a wide range of multifaceted features (Gottesman & Gould, 2003). Endophenotypes have been mooted as alternative ways of thinking about causation for complex phenotypic problems, as they may represent more reliably markers of genetic risk (Kendler & Neale, 2010; Flint & Munafò, 2007; DeGeus & Boomsma, 2001). Past behavioural genetic research into emotional disorders has identified endophenotypes underlying aspects of both psychological disorders and cognitive functioning (Gregory & Eley, 2007). In the present case, the common genetic influence on depressive symptoms and the presence of negative perceptions about social situations may indicate an endophenotypic substrate to aspects of both of these exophenotypic measures.

Endophenotypes for psychiatric disorders are generally agreed to satisfy four criteria: 1) they are associated with phenotypic outcome measures for their respective disorder, 2) they show genetic influence at a population level, 3) they are enduring and independent of state manifestations (e.g. depressive episodes) of their associated disorder, and 4) they are meaningfully inherited together with aspects of their respective disorder (Gottesman & Gould, 2003; Gershon, Branch, & Health, 1986). By this metric, longitudinal associations between negative interpersonal cognitive biases and depressive symptoms—as reported by Chapter 3—could be representative of endophenotypes. For specific example, Chapter 3 showed that negative perceptions of social situations were meaningfully related to depressive symptoms (1), showed shared genetic influences with depressive symptoms (2), endured across a 2-year period (3) and were specific in this relationship with depressive symptoms among other interpersonal cognitive factors in comparative models (4). The identification of such endophenotypes may be able to guide gene-finding studies for depression or wider related emotional problems in future genetic research (Flint & Munafò, 2007).

Quite separate from the genetically-influenced endophenotype explaining depressive symptoms and subsequent negative perceptions of social situations, a latent factor was demonstrated explaining negative expectations of behaviour from social partners, and subsequent depressive symptoms. The latent factor underlying these features was wholly influenced by the environment, predominantly by aspects of the environment that were not shared among twins. This suggests that the factor may have been influenced by discrete environmental experiences, in contrast to typical shared-environment features such as parenting

style, socio-economic status, school and home environment, and so on (Plomin et al., 2001). Features of these discrete environmental experiences are also common to stressor triggers in diathesis-stress models of psychopathology (Paris, 1999; Alloy et al., 1988). So findings may indicate dissociable components of a genetically-influenced (endophenotypic) diathesis vulnerability to depression and negative perceptions of social situations, together with stressor-triggers for depressive symptoms that—in late childhood—may include negative experiences with social partners. Given that other aspects of the thesis provided evidence for diathesis-stress models of emotional outcomes (though admittedly under very different circumstances, and perhaps wholly unrelated), it seems prudent for future research to continue lines of enquiry into diathesis-stress vulnerability and how it may change from late childhood and through adolescence.

Furthermore, it bears mentioning that these kinds of overlapping sources of variance may change over development. Adolescence is a period of numerous non-linear changes in neurophysiology and biology more widely (Goddings et al., 2012; Mills et al., 2012; Lau, 2012). Numerous genes and hormones first manifest or change their effects from puberty and adolescence onwards (Plomin et al., 1997, 2001; Kendler, 2011; Fulker et al., 1988; Dickens et al., 2011; Lau & Eley, 2006). Such changes have previously been argued to foster observed changes in sensitivity to interpersonal cognition and social functioning during adolescence (Blakemore, 2008b; Burnett, Bird, Moll, Frith, & Blakemore, 2009; Blakemore & Robbins, 2012), though it is of course extremely difficult to dissociate such effects from paradigmatic changes in social environments at individual (Brown, 2004; Blakemore & Choudhury, 2006; Burnett & Blakemore, 2009) and systemic levels (Evangelou et al., 2008; Fenzel, 2000; McGee et al., 2004) happening at this same time. Accordingly future research may wish to replicate and if possible track potential changes in endophenotypes such as the genetically-influenced commonality between depressive symptoms and subsequent negative perceptions of social situations shown in late childhood by Chapter 3. This would afford the examination of whether such risk factors persist in form, or else change in their nature or significance over the course of adolescent development.

8.4.1 Conclusions and Future Directions

In summary:

- Current results may be indicative of an endophenotypic factor sharing variance across depressive symptoms and negative interpretations of social situations
- This endophenotype may represent a genetically-influenced diathesis vulnerability to maladaptive interpersonal cognitive processing and emotional symptoms
- This endophenotypic diathesis may be complemented by stressors or triggers in the social environment, as a result of individual-specific social experiences

This identifies an opportunity for continuations of multivariate genetic models such as those in Chapter 3 over longer time periods and into adolescence. This may be possible using later follow-ups in the ECHO or TEDS samples (Eley et al., 2007; Trouton et al., 2002). Across all such features and questions the aim would be to identify potentially changing sources of vulnerability and shared variance between emotional outcomes and interpersonal cognitive factors across late childhood and adolescence. Doing so in dialogue with the development of potential interventive approaches may then be able to best target risk factors for distinct emotional outcomes across the erratic developmental period of adolescence.

8.5 Effects of Cognitive Bias Modification of Interpretations

Studies reported across Chapters 4–7 provided evidence that a Cognitive Bias Modification of Interpretations (CBM-I) approach is capable of inducing positive and negative interpretive biases for interpersonal information in adolescents. Training group differences characterised responses to targets, rather than foils in the Interpretation Bias Test outcome measure (Eysenck et al., 1991) across all studies. Chapter 6 showed that positive training potentiated endorsements of positive targets and weakened endorsements of negative targets relative to negative training, and vice versa. However the exclusive comparison of positive to negative training means that effects specific to each cannot be determined. Comparing positive and negative training to control conditions in Chapter 4 showed that negative training potentiated endorsement of negative targets and positive training potentiated endorsement of positive targets. However Chapter 4 showed no evidence that positive training decreased similarity ratings of negative targets to novel ambiguous scenarios, nor that negative training decreased similarity ratings for positive targets. Almost the inverse pattern was seen in Chapter 7. Post-training measures showed no relatively greater endorsement of positive targets following positive than following neutral control training, but did show that post-training similarity ratings for negative targets were lower in the positive training group relative to control.

There is similarly mixed evidence from previous CBM-I research in adolescents that *positive* CBM-I either exclusively increases positive interpretations (Muris et al., 2008, 2009) or specifically decreases negative interpretations (Vassilopoulos et al., 2009; Lester et al., 2011b, 2011a; Fu et al., 2012; Vassilopoulos et al., 2012) of novel ambiguous information. Other studies have also shown within a single experiment that positive training can both increase positive interpretations *and* decrease negative interpretations of novel interpersonal information (Salemink & Wiers, 2011; Vassilopoulos et al., 2013). As discussed in Chapter 4, one potential resolution to these disparate findings is that positive CBM-I training may in essence be able to bring about all such outcomes, but that the specific expression of its effects may be contingent on individual difference factors in those undergoing training—perhaps the likeliest candidate being

pre-existing interpretive bias. Therefore differing post-training effects observed across Chapters 4–7 could be explained by differing distributions of pre-existing biases in the various samples used. Screening for pre-training interpretive biases would allow for testing hypotheses that the specific manifestation of a number of possible outcomes of positive CBM-I training is constrained by individuals' interpretive biases prior to training. By examining changes in interpretations as a function of pre-existing biases, more predictable models of CBM-I training effects can be developed.

Provided these effects could be demonstrated more robustly, either the potentiation of positive interpretations or the suppression of negative interpretations would be desirable for the action of a theoretical CBM-I intervention against emotional problems (Holmes et al., 2009; Mathews & MacLeod, 2002; Mathews, 2012; Koster et al., 2009; Hertel & Mathews, 2011), especially within developmental populations (Field & Lester, 2010; Hadwin & Field, 2010b; MacLeod & Holmes, 2012). Increased positive interpretations of interpersonal information would be expected to foster positive affect (Williams et al., 1997), and positive interpersonal functioning is well documented as buffering against negative emotional and mental health outcomes (Aneshensel & Stone, 1982; Cohen & Hoberman, 1983; Cohen, 2004). Inhibiting negative interpretations of interpersonal situations would also be expected to distinctly contribute to efficacy of CBM-I-like intervention, as it would disrupt theoretical processes of the maintenance and exacerbation of maladaptive emotional functioning (Vasey & Macleod, 2001; Mathews & MacLeod, 2002; Warren et al., 2000). However it would also be imperative to understand the mechanism of any potential approach were it to be implemented as a clinical adjunct, especially within developing populations. So if individual differences are indeed able to explain why positive training might variously be observed to potentiate positive interpretations, suppress negative interpretations (or both) then research should identify what factors might predict the specific manifestation of positive CBM-I training effects in a given situation.

Chapter 5 replicated findings previously demonstrated in adult samples by showing induced positive interpersonal interpretive biases persist in their effects for at least 24 hours in adolescents (Yiend et al., 2005; Mackintosh et al., 2006). Beyond this, it remains unknown for how long the post-training interpretation effects of a single session of training would persist. Straightforward extensions of Chapter 5's methods could test for post-training interpretation biases after longer intervals than 24 hours—e.g. for 3 days or a week. If the process by which modifications of interpretive biases bring about mood changes is indeed through the application of an induced positive bias to ambiguous experiences (Mathews, 2012; Hoppitt et al., 2010b), then the longer that an individual goes about their daily life with positive interpretive biases framing their experiences, the more likely it should be to see differences between their mood and the mood of an individual with no such positive biases. However in relation to these effects, it strongly bears mention that no studies to date to have shown the persistence of induced positive biases over a 24-hour period have shown any evidence of differential post-testing mood effects at follow up. Indeed no changes

to any trait measure as a result of CBM-I have been observed without the use of multiple sessions of CBM-I training, in either adults (Lang et al., 2012; Blackwell & Holmes, 2010) or adolescents (Vassilopoulos et al., 2012, 2009).

This was the reason previously offered for findings of null change in the Interpretation Questionnaire both immediately following (Chapters 4 & 5) and 24 hours after (Chapter 7) exposure to a single CBM-I training session. Chapters 4, 5 and 7 used the Interpretation Questionnaire as an index of generalisation of training effects from the Lothmann et al. (2011) paradigm beyond the Interpretation Bias Test, and found no evidence of generalisation of training effects to this measure. Chapter 7 additionally included a Face Emotion Task as an index of the potential transfer of CBM-I training effects to another modality. Results from this task however remain unclear in terms of the apparent dissociation between CBM-I training's effects on the identification of fearful faces, and the identification of other negative emotions (i.e. anger and sadness). Specifically, positive CBM-I training resulted in improved accuracy in identifying scared faces. Since this finding was relatively unexpected, the discussion of Chapter 7 posited that using a wider range of facial emotions, and using faces morphed between emotions might be able to provide data on errors made by participants when attempting to identify scared faces. Examinations of these error rates, and more generally what specific aspects of performance were relatively enhanced or interfered with by positive training would help to clarify potential shared cognitive components between verbal processes of bias modification employed by the Mathews and Mackintosh (2000)/Lothmann et al. (2011) paradigm, and the identification of ambiguous emotional faces.

Transfer between verbal interpretation training and identifications of emotional faces provides some tentative evidence that aspects of cognitive biases may not be bounded by processing modality. This is supported by the fact that previous adult work using CBM-I training has shown the process to be maintained across verbal and non-verbal stimuli, presented both visually and aurally (Holmes et al., 2006; Lang et al., 2012; Holmes et al., 2009; Mackintosh et al., 2006; Yiend et al., 2005; Mathews & Mackintosh, 2000). However beyond this it may be interesting to examine to what extent cognitive biases are bounded by their proposed cognitive mechanisms, versus to what extent they represent more general or pervasive biases towards negativity in information processing. Since symptoms of emotional disorders are commonly associated with a host of other cognitive biases—for example negative future forecasting (Barlow, 2000; Holmes, Lang, et al., 2008), negative memory biases (Williams & Scott, 1988; Eysenck & Mogg, 1992; Bishop, Dalgleish, & Yule, 2004; Neshat-Doost, Taghavi, Moradi, Yule, & Dalgleish, 1998), attentional biases towards threat (Dalgleish & Watts, 1990; MacLeod, Mathews, & Tata, 1986; Broadbent & Broadbent, 1988; MacLeod & Mathews, 1988; Mogg, Mathews, & Eysenck, 1992) and attentional disability in disengaging from threat (Fox, Russo, & Dutton, 2002; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006; Yiend & Mathews, 2001), it might be the case that some process of negatively valenced information processing are common across these various multi-modal aspects of cognition. This is testable as the potential transfer from training one kind of bias

to post-training effects on another—e.g. whether interpersonal interpretation training affects attentional or memory biases, or vice versa. Given the breadth of cognitive bias training and testing paradigms currently available, this approach would be apt to control for potential confounds in task or stimulus modality. Investigation into the potential transfer of such trained biases should prove fruitful both for determining the nature of cognitive processes underpinning various biases in different modalities, and in predicting what kinds of stressors may have their negative effects buffered by training.

8.5.1 Conclusions and Future Directions

In summary:

- Inconsistencies in post-training effects of interpretation training may be resolved by considerations of pre-training individual difference measures
- CBM-I training effects have been shown to persist for 24 hours, but with no commensurate changes in mood or related trait measures
- There is some (albeit fairly weak or inconsistent) evidence for generalisations of interpretation bias training to other modalities, but this would benefit from further scrutiny

An ideal next experiment to examine the cognitive mechanisms involved in interpersonal interpretive biases and their modification would compare positive to neutral verbal CBM-I training and use either non-verbal or non-interpretive cognitive outcome measures. Specific processes of interpretation could be clarified by having participants identify faces morphed between various positive and negative emotions. This would help to ascertain whether positively-trained individuals show inhibition towards subsequent negative information, and if so, what processes might then facilitate their identification of fearful expressions. Such a task could also be used as a pre-/post-training measure, given that it is not directly decodable in terms of its relation to training content, as regards demand characteristics. Alternative examinations of generalisability and transfer effects from bias training could train either interpretive or attentional biases, and examine effects of one of these forms of training upon the other. Investigating the potential generalisability of such trained biases should prove fruitful in determining overlap across different biases for material in different modalities.

Relating back to earlier arguments, endophenotype-focused approaches may also help to clarify the boundaries of various emotion-linked cognitive biases in relation to one another. So for example, if a genetically-influenced endophenotype explains variance in both interpretive biases for social situations and depression because of common causal underpinnings, might it also explain variance in memory biases for social information, or even wider biases? Alternatively it may be the case that one endophenotype may explain common variance between interpretive biases and some aspects of depression, while another may explain dissociable aspects of variance in depressive functioning, as well

as wholly distinct attention or memory biases. In either case, twin studies could use wider endophenotype-driven models of emotional and cognitive functioning to further explore potential overlapping or dissociable variation in multiple cognitive biases and emotional functioning in future research, and so more readily identify patterns of influence upon such factors.

8.6 Mood, Stress Reactivity and Interpersonal Interpretive Biases

In comparison to effects reported by Mathews and Mackintosh (2000) and discussed in Chapter 1, no immediate changes in mood ratings were seen as a direct result of any reported CBM-I training paradigms, despite the fact that all training procedures required participants to actively generate disambiguating information. This replicates similar absences of immediate mood effects following active-generation training in previous adolescent CBM-I literature (Salemink & Wiers, 2011; Fu et al., 2012). Holmes et al. (2009) previously argued that it may not be this active-generation component *per se* that fosters immediate mood changes. Rather, Holmes et al. (2009) claim that it is mental imagery of the ambiguous scenario engendered by active-generation paradigms which acts as the criterion for mood change. Again however, studies reported in Chapters 4–7 all trained and required participants to vividly imagine the scenarios at hand, but none showed any direct evidence of mood change due to training. Further, findings from Vassilopoulos et al. (2012) directly contradict Holmes et al.'s assertions, by showing that enhanced verbal processing of CBM-I training scenarios gave rise to immediate changes in state anxiety ratings, whereas imagery-enhanced training did not. Therefore the imagery-related potentiation of CBM-I training and mood effects advocated by Holmes et al. (2006) and Holmes et al. (2009) may be absent in adolescents, or perhaps even inverted.

Similar disconfirmations are present in other adolescent studies of CBM-I training, for example the absence of immediate mood effects in active-training studies reported by Salemink and Wiers (2011) and Fu et al. (2012). Conversely, valence-congruent mood changes were observed by Lester et al. (2011a) in the absence of participants having to actively generate disambiguating information. Together these findings suggest that rather than active imagery or generation of resolutions being *necessary* for the production of immediate mood changes as a result of CBM-I training, it may merely potentiate these effects. So it seems that a more reliable metric of differential mood change as a result of training is afforded by the use of stress reactivity designs.

Chapter 6 demonstrated differential anxious responses to an experimental stressor following positive or negative interpretation training. This provides some support to the idea that the mechanism of CBM-I action is through a process of moderating potentially stressful environmental experiences as part of a process resembling diathesis-stress models of emotional symptoms and disorders (Hoppitt et al., 2010b; Mathews, 2012; Paris, 1999; Alloy et al., 1988). The findings of valence-congruent mood reactivity effects—even after a single expo-

sure to CBM-I training—within a community sample are especially encouraging. However, no differential training effects were observed upon appraisals of stressful life events in Chapter 7. Given the rather distinct metrics offered by the stress reactivity designs employed by Chapters 6 and 7, there are a number of discrepancies that could offer some explanation for the disparate findings. Namely, Chapter 6 examined effects arising in response to a proximal, anticipatory stressor, whereas Chapter 7 examined responses to a reflective, retrospective account of real-life stressor experiences.

More enduring effects on mood might be observable in experiments using longer training paradigms and evaluating emotional symptoms over longer time-frames. A potential problem with this kind of approach is that examining delayed mood outcomes assumes that these will have arisen due to the application of interpretive biases to interpersonal interactions or other environmental stressors (cf. Vassilopoulos et al., 2009, 2012, 2013). However, the methodology would in no way account for variation between individuals in the number or type of such experiences. This concern is especially pertinent in light of the robust covariance between intrapersonal emotional and cognitive factors, and extrapersonal environments (Jaffee, 2011; Lau, Gregory, et al., 2007; Uher, 2011), with particular reference to social environments (Darley & Fazio, 1980; Schlenker & Leary, 1982; Downey et al., 1998; Gurtman et al., 1990). It therefore becomes especially important to be able to control for the frequency of experience of such life events, as otherwise their frequency or severity may be confounded with individual-level variation in interpersonal or cognitive functioning. So a delayed follow-up to bias training would have high ecological validity for examining the outcome of CBM-I training, but would have little ability to specify influential factors in the process by which these outcomes occurred. As outlined in Chapter 7, this might be best instantiated in future research as diary studies, where participants are required to record and rate interpersonal experiences and life events between CBM-I training and follow-up testing. It may be advisable to use such a methodology in the later stages of examining the utility of bias modification training as a potential intervention, perhaps in a setting more akin to a clinical trial. However prior to research in such applied settings, it would be advisable to generate a robust evidence base using more directly controlled stress reactivity designs.

A further set of issues in using experimental stressors within stress-reactivity designs to examine interactions between modified interpretive biases and environmental factors on emotional outcomes are the ethical implications of intentionally exposing participants to stressful situations. This is especially relevant for any stressors strong enough to induce observable changes in trait anxiety symptoms. Furthermore—in contrast to Cuomo (1996)’s appraisal of life experiences—not all interpersonal interactions or life experiences are explicitly negative, and so designs examining the interaction of induced or modified interpretive biases with negatively valenced stressors or factors cannot describe the entirety of potential synthetic CBM-I training effects. Examining positive affect reactivity in response to positive experiences (e.g. receiving a gift, being exempted from a stressful or boring task that participants expected to have to

complete) therefore stands to more fully inform the synthesis of interpretive biases with environmental experiences in terms of emotional outcomes, but effects may be more subtle.

An alternative to using experimental stressors in stress reactivity CBM-I training designs, and particularly extensions of these protocols over longer time periods, is to use predictable life events within the context of a natural experiment design. There is clear precedent for this approach in the cognitive bias modification literature in the study conducted by See et al. (2009) using students' transition from High School in Singapore to University in Australia as a stressor in a natural experiment design. As suggested in Chapter 7, predictable life experiences such as school or university transition could be used in future work to minimise the ethical impact and maximise the ecological validity of stress reactivity designs for examinations of CBM-I interventions. Beyond academic transitions, a number of other predictable life experiences could be used in further research to improve outcomes for adolescents experiencing them. Some examples associated with especially potential stressful impacts include changes in family arrangements following parental separation or divorce (Compas et al., 1987), undergoing surgery (Gidron, McGrath, & Goodday, 1995; LaMontagne, Hepworth, Salisbury, & Cohen, 2003), and school or extracurricular examinations (Mohapatra, Panigrahi, & Rath, 2012).

8.6.1 Conclusions and Future Directions

In summary:

- Neither active generation CBM-I paradigms nor imagery seem to be reliable predictors of mood change following CBM-I training in adolescents
- Stress reactivity CBM-I paradigms are lightly encouraging for future considerations of associations between interpretive biases, environmental stressors and mood outcomes, but more robust research is now required

A further experiment to examine theoretical and mechanistic effects of CBM-I training could compare positive to neutral control training, with a valid pre-/post-training measure of interpretive bias, and including an emotional reactivity aspect either as an experimental stressor or a stressful life experience within a natural experiment. Complementary studies could use either positive or negative experimental events to identify whether immediate emotional reactivity effects manifest more strongly as potentiators of positive experience, or as buffers against negative experience. Given that the magnitude of either positive or negative reactivity may be a function of baseline trait emotional measures, or else of baseline interpretational biases, it makes sense to screen for these beforehand. As potential life stressors such as school transition are not stressful for everyone, there may be more evidence of generalisation or transfer to emotional or life-event appraisal measures in a group selected for experiencing difficulties with transition.

A useful complement to this more theoretically oriented work would be an experiment to examine the longevity and strength of training effects as a proof-of-concept for any potential future use of CBM-I as an intervention against negative social or emotional outcomes. This should take screened clinical (or at-risk sub-clinical) anxious and depressive adolescents and implement a multi-session training protocol of positive versus neutral control CBM-I training with them. Their emotional symptoms should be evaluated over the course of a longer training period (e.g. 4 weekly training sessions over the course of a month), as well as a follow-up mood evaluation after completion of the training programme (say 1, 3 or 6 months following the end of training). Participants should ideally also keep diaries detailing any life events they experience over the course of the training, as well as in the period between finishing training and follow-up.

8.7 Limitations

Various conclusions drawn across this thesis in regards to the viability of experimentally manipulating biases in the interpretation of ambiguous information are based on the assumption that the Interpretation Bias Test is a valid post-training measure. However previous research has expressed concerns that post-CBM-I-training examination of interpretive biases using the Interpretation Bias Test or similar measures may be more indicative of demand characteristics (Harvey et al., 2004; Salemink & van den Hout, 2010). Covariate analyses across Chapters 4–7 showed that higher symptom scores of both anxiety and depression were associated with higher similarity ratings for negative targets and lower similarity ratings for positive targets. This suggests that the Interpretation Bias Test might indeed be meaningfully associated with symptom-related cognitive function. Recent validations of the Interpretation Bias Test as a neuroticism-linked index of negative interpretations further support this position (Salemink & van den Hout, 2010).

These issues also relate back to the importance of developing before/after measures of interpretive bias for bias modification paradigms, discussed in Chapters 1 and 4. Studies outlined over the course of this thesis attempted to use the Interpretation Questionnaire as a pre- and post-training measure of interpretation bias. However no generalisation of effects was seen from CBM-I training to this outcome measure. One issue is that although the Interpretation Questionnaire was comprised of items from validated existing measures (Stopa & Clark, 2000; Amir et al., 1998; Butler & Mathews, 1983; Rudolph et al., 1995; Gregory, Rijdsdijk, et al., 2007), there was not a systematic evaluation of the questionnaire in its new form. A solution for future work aiming to use this measure would be to subject it to more stringent validation with other measures of interpretation, as well as properly evaluating its internal reliability, and the consistency across the two halves (before/after) of the measure. Evaluative efforts were made over the presented experiments, and the measure showed close associations with symptom measures of anxiety and depression in Chapter 4. However no study administered all the items of the questionnaire to a single

large sample, and then separated items into halves based on a factor analysis of responses to such items. Such approaches would be advisable for future instantiations of the questionnaire.

Even if it were perfectly validated, there are still theoretical constraints on whether the CBM-I training protocol would be expected to generalise to the Interpretation Questionnaire measure. A potential limitation here is that the Interpretation Questionnaire may be too trait-like. Changes in trait measures have only previously been shown in adult and adolescent samples following multiple training sessions (Lang et al., 2012; Beard & Amir, 2008; Vassilopoulos et al., 2009, 2012). This could mean that changes in trait measures of interpretive bias might not be seen following a single session of CBM-I training. Alternatively it may be the case that material that is further removed from the specific form of training simply takes longer to change as a result of training. Indeed in Chapter 7 there was some evidence that negativity indexed by the Interpretation Questionnaire decreased after a 24-hour delay, but this effect was not specific to positive training. Future work is needed to establish whether delays interposed by individuals' applying induced interpretive biases to their daily lives are required before material is observed to generalise to wider trait indices of interpretation bias.

A further caveat regarding numerous studies presented across the course of the thesis is that there may not have been sufficient power to detect certain effects. This may have been the case in the context of post-training effects on interpretation in Chapters 4 and 7 (see also Appendix E), and in the context of detecting shared environmental influences in Chapter 3. While it is undesirable to have underpowered studies, it is also worth noting that at least some of these limitations in power reflect the relatively weak training effects when comparing valenced CBM-I training to control conditions following a single session of training in typically-developing adolescents. Other studies in the existing CBM-I literature have shown that training effects upon interpretation bias or even mood may appear relatively stronger when testing in clinical populations or using multiple training sessions (Lang et al., 2012; Beard & Amir, 2008; Fu et al., 2012; Vassilopoulos et al., 2009, 2012). In any case, this identifies that the single-session CBM-I paradigm used across the present studies is likely inappropriate for implementation as an intervention against emotional disorder without a good amount of future research and revision.

Across the various studies presented in the current thesis, all participants were drawn from typically-developing samples rather than selected high-symptom clinical or sub-clinical samples. The ECHO dataset used in Chapter 3 contained selected high-anxiety children, though these were weighted against controls in line with the distribution in the population as a whole. Considerations of associations between interpersonal cognitive biases and emotional symptoms in the typically-developing population are not necessarily problematic in and of themselves. Past research has argued that continuity of symptoms between clinical and non-clinical populations means that examinations of non-clinical samples are valid and worthwhile, particularly in adolescent samples (Muris, 2007; Claridge & Davis, 2003). Having said this, the specific implica-

tion of CBM-I training as an intervention against the development of emotional disorders should require its replication and validation in clinical or sub-clinical samples, or at least samples screened for risk of later emotional disorders.

As well as increasing clinical utility, extensions of future examinations to clinical groups might also be able to improve some of the concerns regarding power in the current analyses. Negatively-valenced cognitive biases are generally held to be stronger in clinical groups (Holmes et al., 2009; Eysenck, Macleod, & Mathews, 1987; Mathews et al., 1989; Hadwin et al., 1997; Banerjee, 2008), as well as such groups' greater symptom severity. As such clinical or selected high-symptom at-risk individuals may show more pronounced changes as a result of CBM-I training, in comparison to the relatively small effects observed upon comparing positive and neutral CBM-I training in typically-developing samples in Chapters 4 and 7. Furthermore, individuals with high levels of emotional symptoms or clinical emotional disorders are more likely to show a range of various cognitive biases (Mathews & MacLeod, 1994; Miers et al., 2008; Neshat-Doost et al., 1998; Dalgleish & Watts, 1990; Banerjee, 2008). Cross-sectional and longitudinal studies of the potential overlapping sources of variance across different interpersonal cognitive factors and emotional symptoms might therefore be expected to show more pronounced associations in clinical samples.

A final minor limitation that bears repeating is that of training samples reported in Chapters 4–7. These were predominantly female and apparently higher than national average socio-economic status (SES) in Chapters 4, 5 and 7. Though findings did not vary when including or excluding male participants in/from the samples, it is still desirable to replicate observed effects in more representative samples in future work. There is evidence that the same patterns of results as seen in both these samples and previous adolescent CBM-I literature (e.g. Lau et al., 2011; Lester et al., 2011b; Lothmann et al., 2011; Salemink & Wiers, 2011) were replicated in the gender-matched and lower-SES sample of Chapter 6, which suggests that the observed CBM-I findings may be robust to such variations in sampling. However—as expressed in previous Chapters (see in particular Section 4.4.5)—it would be best for future work to avoid such potential confounds in samples when recruiting participants, rather than having to control for such issues at the stage of analysis.

8.7.1 CBM-I Methodology

One issue of note in the analyses of CBM-I training in Chapters 4–7 was that post-training biases were examined by comparing endorsements of positive and negative targets to one another. Specifically, this followed the protocol of previous adolescent CBM-I literature (e.g. Lothmann et al., 2011; Fu et al., 2012) in separately analysing Training-Valence*Probe-Valence interactions for target and foil probes, provided analyses first found a 3-way Training-Valence*Probe-Valence*Probe-Type interaction together with a main effect of Probe-Type (such that targets were endorsed significantly more strongly than foils in the Interpretation Bias Test). A more theoretically consistent approach to analysis given the design of the Interpretation Bias Test would be to test the interpretation bias ef-

fects for targets over and above that of foils—for example by comparing the relative effect size of the difference between positive and negative targets to the difference between positive and negative foils. Using this approach to the reported effect sizes in Chapters 4–7 estimates the post-training effects on interpretation to be yet smaller still than the relatively small effects concluded in the preceding chapters. However, the reason that effect sizes were not explicitly interpreted in this way was that such an approach would assume firstly that target and foil probes in the Interpretation Bias Test were independent, and secondly that no foil probes were valid interpretation of the ambiguous scenarios presented in the test. While this is a theoretical basis of the test in Eysenck et al. (1991) and its implementation in CBM-I methodology (Mathews & Mackintosh, 2000), this distinction between the validity of interpretation of target and foil probes is less clear in the Interpretation Bias Test's actual implementation and items.

For example, for the ambiguous scenario *'The school newspaper is looking for a new student reporter. You want to know what would be involved and ask for details. The teacher heading the newspaper says that they are looking for someone who is qu-l-fied'*, there is not a particularly clear distinction between what makes the negative target probe *'The teacher organizing the newspaper says that you do not suit the role.'* a valid interpretation and the negative foil probe *'The teacher organizing the newspaper says that your writing is not good enough.'* an invalid interpretation. Given the overlap in perceived relevance of two probes like this to the ambiguous scenario at hand (and especially when taking into account variation due to individual differences), taking valid negative interpretation as the endorsement of the negative target over and above the negative foil seems more like a quantitative than qualitative distinction. Moreover it seems that the assumption made by the Interpretation Bias Test methodology that there is no overlap in the mechanism used in arriving at these two interpretations—supposedly interpretive bias proper in the case of targets, and affective response bias in the case of foils—might not hold up in such instances. This issue was the main reason for the kind of analysis adopted in Chapters 4–7, which focused primarily on responses to target probes in terms of effect sizes, after establishing that targets were endorsed significantly more strongly than foils. That is to say that the magnitude of foil endorsements were not subtracted from those of targets, as there was no guarantee that responses to foils were entirely driven by affective response bias with no element of valid interpretation of the ambiguous scenario.

Other studies using CBM-I in adults have used signal detection analysis to try and analyse data from the Interpretation Bias Test (Mathews & Mackintosh, 2000). This approach seems like a viable way to try and overcome issues of separating out response bias—i.e. in the current instance a bias to positive or negative items regardless of their viability/validity as interpretations. However even when using signal detection analysis there remains the issue that the strength and validity of the approach is undermined by the materials used. Ideally greater care should be taken in ensuring that targets are unilaterally valid interpretations of ambiguous scenarios in the Interpretation Bias Test, while foils are not. As such, for reasons effectively the same as those stated in the paragraph above, there seems to be relatively little to be gained from performing signal de-

tection analyses on the data reported in Chapters 4–7. The current thesis aimed to eschew some of these problems with the use of the Interpretation Bias Test by introducing a novel measure of interpretation comprised entirely of valid positive, neutral and negative interpretations of ambiguous novel interpersonal scenarios: the Interpretation Questionnaire. Unfortunately, for the reasons discussed earlier in this chapter, the Interpretation Questionnaire in the form used in Chapters 4–7 was appropriate for such use.

As stated in Chapter 1, the focus of the CBM-I studies reported in Chapters 4–7 was on identifying specific cognitive features of the training paradigm, and how this impacted—in isolation—upon the various outcome measures used across the reported studies, from an experimental psychology perspective. That is to say that the current findings have little direct clinical relevance, as discussed in terms of the constraints of the present research in Chapter 1. Beyond this, it is also of course noteworthy that no clinical samples were recruited for the CBM-I studies in the current thesis. As discussed above, this is not to say that there would be expected to be absolutely *no* contiguity between the typically-developing samples used across Chapters 4–7 and clinical samples. Previous research in adults has shown analogous and comparable effects in interpretive bias change as a result of CBM-I across normative (Mathews & MacLeod, 2002; Beard & Amir, 2008) samples and populations with clinical manifestations of emotional disorders (Blackwell & Holmes, 2010; Lang et al., 2012). Indeed, the theory underlying the development of CBM-I paradigms (Mathews & MacLeod, 1994; Mathews & Mackintosh, 2000), as well as its current most recent revisions (MacLeod & Holmes, 2012; Mathews, 2012) suggests that analogous processes of interpretive bias would act in individuals with and without clinical anxious or mood symptoms or disorders.

However, the key distinctions to be made here are not between the immediate post-training effects of CBM-I. Firstly, CBM-I training effects upon interpretive biases would be expected to manifest as a function of pre-training biases, as previously argued in this chapter. Secondly (and most critically for generalisations of CBM-I theory beyond the current normative samples to clinical applications), the downstream effects of interpretive biases for interpersonal information would be expected to differ qualitatively between clinical and non-clinical groups, relatively independently of bias-training effects. This is because biases do not act in isolation; they act upon social and life risk factors, of which negative instances are higher in disordered populations, and may also interact with other negative cognitive effects associated with emotional disorders (Compas et al., 1987; Hoppitt et al., 2010b; Gurtman et al., 1990). For this reason, as stated above and throughout this chapter, any useful results to be taken from this thesis regarding the potential utility of positive CBM-I training as a buffer against stress reactivity or a treatment adjunct in particular would need to be first demonstrated in at-risk and clinical samples. This would be necessary before anything beyond extremely hypothetical and qualified extrapolations from the current research could be drawn to clinical instances or applications. After this, some of the more involved suggestions for future methodologies above (e.g. multiple sessions of training, incorporation of CBM-I training into diary studies)

may then start to yield information of use and relevance to clinical populations. At present though this is beyond the scope of the current findings.

8.7.2 Developmental Issues

A related issue specific to developmental psychopathology research is that it is difficult to make consistent comparisons of different clinical, sub-clinical and at-risk groups across development. Owing to the fact that symptoms emerge across development, it stands to reason that individuals exhibiting clinical symptoms and features of emotional disorders at one age may not have shown them at another (particularly younger) age. This complicates any methodology attempting to directly compare two or more developmental groups outside of a longitudinal design. For example, is it more appropriate to compare clinically anxious adults to clinically anxious children, or to sub-clinical children? Clinically anxious adolescents and children will represent a subset of anxious adults with earlier-onset anxiety, which has previously been associated with greater symptom severity, and the same holds for depression (Gregory, Caspi, et al., 2007; Otto et al., 2001).

It is also noteworthy that measures were not directly equivalent across the various studies presented over the course of the thesis. These included adult social anxiety measures (Liebowitz, 1987) and various child/adolescent and adult measures of depression and trait anxiety (Spielberger, 1973; Kovacs, 1985; Birmaher et al., 1997; Spielberger et al., 1970; Beck et al., 1996). Similarly there was a lack of consistency between the measures of interpersonal interpretive bias afforded by the Ambiguous Social Situations Interpretation Questionnaire (Stopa & Clark, 2000; Amir et al., 1998) in Chapter 2, the Perceptions of Peers and Self and Children's Expectations of Social Behaviour Questionnaires in Chapter 3 (Rudolph et al., 1995) and the composite Interpretation Questionnaire used in Chapters 4–7 (Appendix C). While there is overlap across these various measures of emotional symptoms and interpretive biases, there is certainly room for greater standardisation and therefore greater comparability across samples in future work. This consideration is especially pertinent for longitudinal work that might for instance span ages where childhood anxiety measures are appropriate (Muris et al., 2002; Smucker et al., 1986; Spielberger, 1973) and older ages where adult measures of emotional symptoms are appropriate (Beck, Steer, & Carbin, 1988; Spielberger et al., 1970). Despite the lack of consistency across the various samples presented here, future research should be able to incorporate wider batteries of emotional measures to account for transitions between different measures at different ages with relative ease. Furthermore, the validation and testing of the Interpretation Questionnaire outlined above should be apt to generate a more standardised questionnaire of interpretive bias for future research.

A wider developmental issue relating to the current research is whether it is at all possible to say anything meaningful about associative links between negatively biased interpretations of interpersonal information and emotionality across a developmental age range as wide as that drawn upon across this thesis: namely late childhood to early adulthood. Moreover, it may not even be the

case that the kind of socio-emotional functioning examined over the course of the thesis is subject to anything recognisable as linear development (cf. Blake-more, 2008b; Goddings et al., 2012; Mills et al., 2012). Admittedly the breadth of ages within and either side of adolescence presented in the studies across Chapters 2–7 precludes the desirable level of depth of focus to be able to draw valid and worthwhile conclusions across an age range this wide. Therefore extensions of conclusions drawn from any one chapter to be applied to findings beyond the age range dealt with by that study's specific sample is inadvisable. However there is one encouraging preliminary finding here. As discussed in Chapter 1, at the outset of the research conducted for this thesis, it was hoped that there would be some evidence of commonality or consistency in associations between interpersonal cognitions or interpretations and emotional outcomes. Though, as identified in the preceding sections of limitations identified in the current work, the various studies used various indices of both interpersonal cognition and emotional outcomes, all studies showed some evidence of association between emotional symptom scores (both anxious and mood scores) with negativity of interpretations of ambiguous social situations as indexed by the Children's Expectations of Social Behaviour Questionnaire (late childhood), the Ambiguous Social Situations Questionnaire (young adulthood) or the composite of these two measures in the Interpretation Questionnaire (adolescence). Though extremely preliminary and limited, this may tentatively speak to the hypothesised commonality in association between interpersonality and emotionality discussed at the beginning of this thesis.

8.8 Conclusions

Adolescence and the wider transition from childhood to early adulthood is a confusing and tumultuous period of development—perhaps even more so for teenagers than developmental psychologists. The co-occurrence of various emotional and interpersonal problems at this age singles it out as a crucial area for research into both emotionality and interpersonality, and their potential interrelation in particular. Research presented here has contributed to the broad and robust basis of knowledge of the association between interpersonal and emotional functioning, and highlighted that this relationship is strong and predictive during the sensitive developmental period of adolescence.

Longitudinal associations between interpersonal cognitions and emotional symptoms have been identified, together with predictive pathways from negative patterns of interpersonal cognition to symptoms of emotional disorder. These pathways were expanded on by experimental interventions using cognitive bias modification training to manipulate adolescents' interpretations in order to examine resultant changes in emotional and cognitive measures. The research presented has provided stimulating new findings that stand to inform the overlapping cognitive and developmental processes involved in cognitive biases for interpersonal information, as well as the paths by which these biases may influence emotional functioning.

In light of the aims set out in Chapter 1 for the research comprising this thesis, biases towards expecting negative outcomes from ambiguous interpersonal interactions and social situations have been identified as the most pertinent interpersonal risk factors for emotional disorders. These biases were shown to be manipulable by processes of Cognitive Bias Modification of Interpretations in adolescents, with induced positive interpretive biases showing preliminary evidence of selectively generalising to various cognitive and emotional outcome measures in adolescent samples.

These answers have contributed to existing knowledge relating to developmental risk factors for anxiety and depression during the emotionally and interpersonally sensitive developmental period of adolescence. They also stand to inform future interventions that will hopefully buffer against the numerous adverse influences on psychosocial development in adolescence, and in doing so maximise the potential for positive outcomes for individuals during this period of transition.

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Appendices

A

Statistical and Genetic Models for Chapter 3

I said, excuse me you're a hell of a guy
I mean my, my, my, my you're like pelican fly
I mean, you're so shy and I'm loving your tie
You're like slicker than the guy with the thing on his eye

Nicki Minaj (2010)

A.1 Univariate Genetic Models

Genetic and environmental influences on anxious and depressive symptoms and interpersonal cognitive factors were estimated by comparing within-pair similarity (within-pair twin correlations) among monozygotic (MZ) and dizygotic (DZ) twins. The equations used in these models are given below:

$$A = 2(r_{MZ} - r_{DZ})$$

$$C = r_{MZ} - A$$

$$E = 1 - r_{MZ}$$

These equations show how different sources of influence are defined by the univariate and multivariate models presented in Chapter 3. The two factors that make twins within a pair more similar to each other (i.e. make twin correlations closer to 1) are their genes (A) or their shared environment (C). Given that MZ twin-pairs have twice as many genes in common as DZ twin pairs (100% vs. 50%), the variation in an outcome measure due to genetic influence is defined as twice the difference between monozygotic twin similarity (r_{MZ}) and dizygotic twin similarity (r_{DZ}) within pairs.

Anything that makes identical twins more similar to one another beyond genetic effects is then taken to be due to effects of their shared environment. Effects of shared environments are assumed to be equivalent across MZ and DZ

twins. Therefore shared environment (C) is given as the correlation between monozygotic twins, minus the effects of genes (A).

Finally non-shared environmental effects (E)—experiences unique to each twin—are defined as any influence that does not serve to make twins more similar to one another. Hence they are given as the difference between correlations on a given outcome measure between identical twins (who share environments and all their genes with one another) and 1.

A.2 Cross-lag Models

Cross-lag models estimated within-time and across-time correlations between factors, while controlling for the effects of other factors in the model. An example cross-lag model is illustrated in Figure A.1. Cross-lag models can be used to represent predictive paths between two or more factors over time. The models used in Chapter 3 estimate correlations between two factors at time 1 (bi-directional vertical arrow on the left of Figure A.1) and at time 2 (bi-directional vertical arrow on the right of Figure A.1). They also calculate t1–t2 correlations for the factors in the model. In the example given in Figure A.1, this corresponds to t1–t2 correlations for the Risk Factor (horizontal arrow at the top of the figure) and t1–t2 correlations for the Outcome Measure (horizontal arrow at the bottom of the figure). The model then estimates cross-time, cross-trait predictive paths (diagonal arrows in Figure A.1) as uni-directional correlations between these factors (e.g. between Risk Factor at t1 and Outcome Measure at t2), controlling for the other correlations in the model.

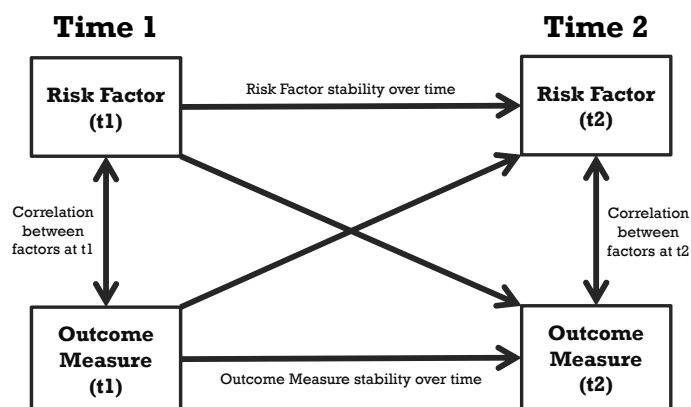


Figure A.1: Example cross-lag model showing associations between a risk factor and an outcome measure at two time-points

A.3 Multivariate Genetic Models

Various multivariate genetic models were tested against one another in Chapter 3 in order to determine which provided best fit to the data. Fit statistics and the procedures by which the models were tested against one another were given in the chapter itself. More detailed accounts of the models are given below, with discussions and examples of how each would represent the kinds of data used in Chapter 3. Within the exception of Figure A.4, models in this appendix are presented cross-sectionally, rather than with longitudinal components. This is to simplify accounts of how each model separates sources of variance for the factors it contains. All models may also be fitted to longitudinal data, and indeed this is the case with the multivariate models tested in Chapter 3.

From the Correlated Factors and Cholesky models to the Independent Pathways model and on to the Common Pathway, each model estimates fewer parameters. This is easily recognisable from the number of arrows in the illustrations of each of these models in Figures A.2–A.6. This reduction in the number of estimated parameters represents a commensurate increase in parsimony of the explanations offered by each model. Accordingly if statistics show no difference in relative fit between any two models, then the more parsimonious is always preferable.

A.3.1 Correlated Factors/Cholesky Model

Both the Correlated Factors model and the Cholesky model assume specific genetic and environmental factors on each phenotype (observable outcome measure) within the model. In the Correlated Factors model, any common variance is represented as a correlation between sources of specific variance. The Cholesky model is statistically and functionally identical in terms of model fit, but allows for specifying the order (and thus direction) of certain correlations. For example, if depression scores at two time points are included in the model, then there can only be a meaningful predictive path from earlier to later depression and not vice versa. The Cholesky model allows for such representation through hierarchical ordering of the entry order of factors into the model.

An example Correlated Factors model of the emotional and interpersonal cognitive factors used as outcome measures in Chapter 3 is given below in Figure A.2. In this model, genetic ($A_1, A_2, A_3 \dots$), shared environmental ($C_1, C_2, C_3 \dots$) and non-shared environmental ($E_1, E_2, E_3 \dots$) influences specific to each factor (Anxiety, Depression, Absence of Positive Perceptions...) are estimated—equivalent to running 6 univariate genetic models as described above, one for each factor. Correlations are then estimated between these distinct sources of variance. These correlations are represented by the bi-directional curved arrows in Figure A.2. For instance, the specific sets of genes that influence anxiety and depression may overlap to some extent. This would be represented by the value of the correlation (bi-directional curved arrow) between A_1 and A_2 in Figure A.2. For reference, the Correlated Factors model was found to be the best fit

for patterns of interpretive bias and mood and anxiety symptoms in Eley et al. (2008).

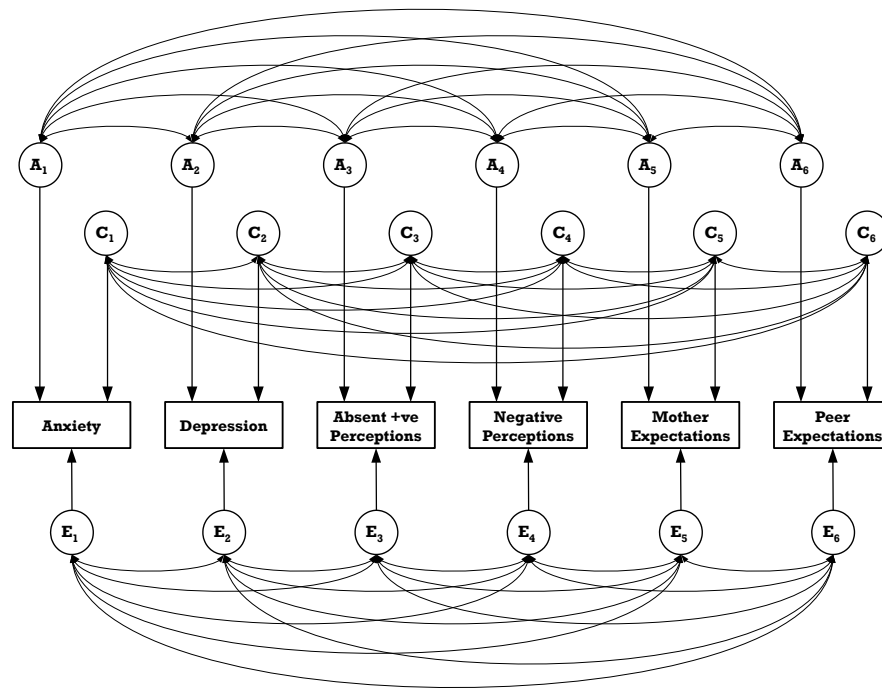


Figure A.2: Hypothetical Correlated Factors model of emotional and interpersonal cognitive outcome measures

An example Cholesky model for the emotional and interpersonal cognitive outcome measures in Chapter 3 is given in Figure A.3. Here again, specific genetic, shared environmental and non-shared environmental influences are calculated for each factor in the model. Correlations between sources of influence are also estimated. However these correlations are partitioned differently, based on the order that factors are entered into the model. So in contrast to the Correlated Factors model, overlapping genetic influences between anxiety and depression would be represented by the arrow from A_1 to Depression in Figure A.3. The remaining genetic influence specific to depression that is *not* explained by the overlapping genetic influences between anxiety and depression would then be represented by the value of the path from A_2 to depression in Figure A.3, and so on through the model in the order that factors were entered (so left to right in the figure below).

This model makes less theoretical sense than the Correlated Factors model for within-time models of genetic and environmental influence. However this model would be preferable to the Correlated Factors model when modelling relationships across time, if these are hypothesised to be predictive. So say for instance the first factor entered into the model could be an early risk factor, and the second could be an outcome measure of interest measured at follow-up—as in Figure A.4. In this case it makes theoretical sense for sources of influence on

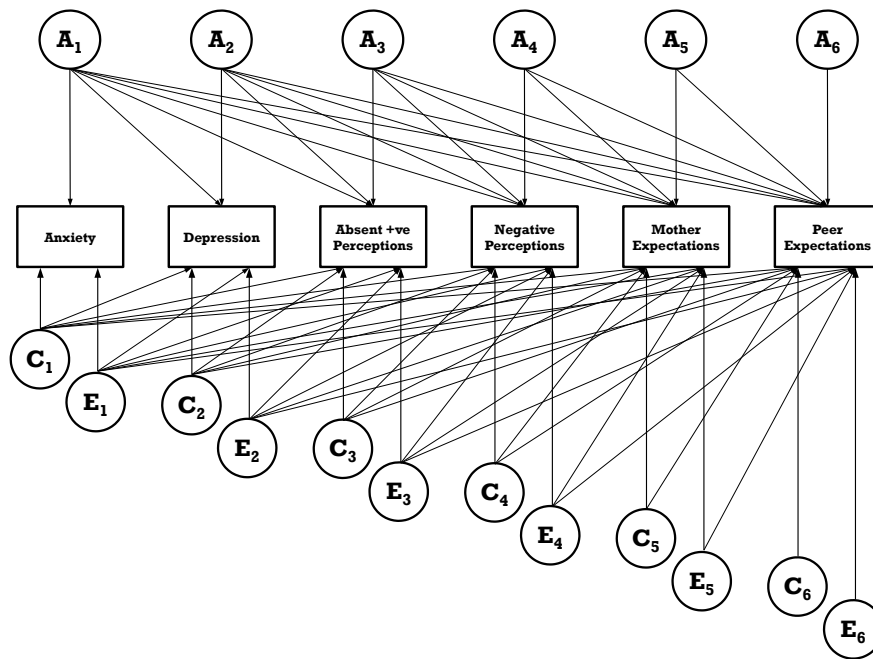


Figure A.3: Hypothetical Cholesky model of the emotional and interpersonal cognitive outcome measures in Chapter 3

the latter factor(s) to be subsumed by influences on the former. So in the example of Figure A.4, genetic influences on the early risk factor would be represented by the arrow from A_1 to t1 Risk Factor. Overlapping genetic influences between the early risk factor and the subsequent outcome measure would be represented by the arrow from A_1 to t2 Outcome Measure. The arrow from A_2 to t2 Outcome Measure would then represent the genetic influences on t2 Outcome Measure minus the value of overlapping genetic influence from the preceding factor—i.e. genetic influences specific to this outcome measure.

A.3.2 Independent Pathways Model

The Independent Pathways model estimates overlapping genetic, shared environmental, and non-shared environmental variance that can affect multiple measures. It then additionally represents unique variance through measure-specific genetic, shared and non-shared environmental effects. The Independent Pathways model was found to be the best fit for patterns of interpersonal cognitive bias and depressive symptoms in Gregory, Rijdsdijk, et al. (2007).

In Figure A.5 below, sources of genetic, shared environmental, and non-shared environmental influence common across factors in the Independent Pathways model are represented as A_C , C_C , and E_C respectively. The sources of influence of these overlapping influences may differentially affect each outcome measure in the model—seen as the arrows from these common or overlapping sources of influence to each phenotypic outcome. So say for example in Figure

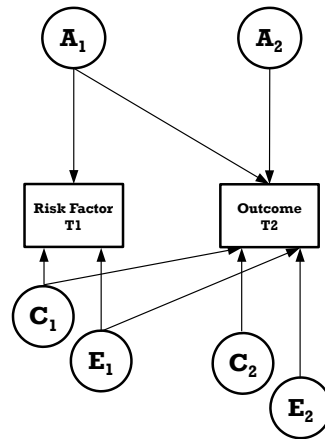


Figure A.4: Hypothetical Cholesky model of the influence of a risk factor at t1 on subsequent scores on an outcome measure at t2

A.5 there were arrows going from A_C to Anxiety, Depression and Absence of Positive Perceptions with values of 0.30, 0.50 and 0.40 respectively. This would suggest that an overlapping source of genetic influence explained 30% of the observed variance in anxiety, 50% of the variance in Depression, and 40% of the variance in Absence of Positive Perceptions. Sources of variance specific to each factor in the model—over and above any overlapping influences—are estimated for the effects of genes ($A_{S1}, A_{S2}, A_{S3} \dots$), shared environments ($C_{S1}, C_{S2}, C_{S3} \dots$) and non-shared environments ($E_{S1}, E_{S2}, E_{S3} \dots$).

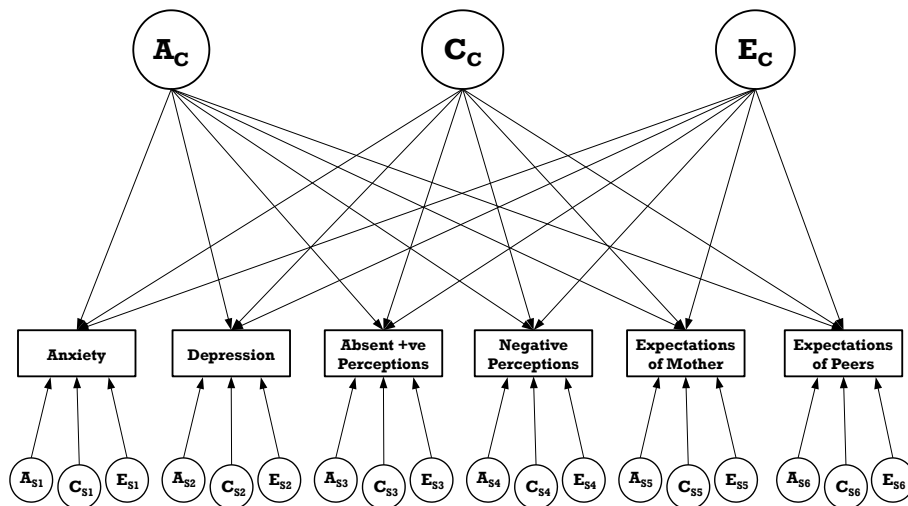


Figure A.5: Hypothetical Independent Pathways model of emotional and interpersonal cognitive outcome measures

A.3.3 Common Pathway Model

Finally an example Common Pathway model is illustrated below in Figure A.6. This model differs from the Independent Pathways model in that it represents any overlapping influences upon factors in the model as acting through a single, additional factor. So rather than acting differentially upon the phenotypic factors themselves, overlapping sources of genetic (A_C), shared environmental (C_C) or non-shared environmental (E_C) influence explain variance in the latent factor. In the current example, the latent factor might represent a concept or endophenotype such as Negative Affectivity or Neuroticism. The latent factor may then show associations of variable strength with each of the emotional or interpersonal cognitive measures in the model—represented as the arrows from the latent factor to each outcome measure in Figure A.6. As in previous models, genetic, shared environmental and non-shared environmental influences specific to each factor are also estimated (A_{Sn} , C_{Sn} , and E_{Sn} respectively). The Common Pathway model was found by Lau et al. (2012) to best fit a multivariate analysis of negative attributional styles and depressive symptoms.

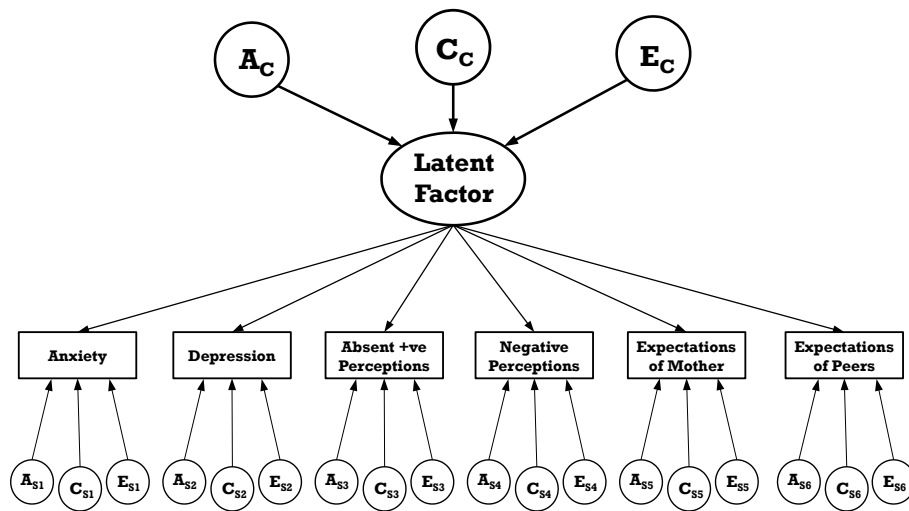


Figure A.6: Hypothetical Common Pathway model of emotional and interpersonal cognitive outcome measures

B

Factor Analyses of Interpersonal Cognitions

B.1 Exploratory Factor Analyses

Exploratory and Confirmatory Factor Analyses examined the underlying phenotypic factor structure of Children's Expectations of Social Behaviour Questionnaire (CESBQ) and Perceptions of Peers and Self in Social Situations (POPS) questionnaire items at Wave 2, with a view to replicating the factor structure of components of interpersonal cognition demonstrated by Gregory, Rijdsdijk, et al. (2007). An exploratory principal components factor analysis using varimax rotation was conducted on the measures' 60 constituent items at Wave 2. Twin pairs were split to give two random halves of the dataset, and separate analyses were conducted on each to give an internal replication. Scree plots for exploratory factor analyses in the two random halves of the data are given below as Figures B.1 and B.2. Across the two exploratory analyses, it was determined that a 4-factor solution best fit the data, based on Scree plots as well as Eigenvalues and cumulative variance explained (given in Table B.1).

Component Number	Eigenvalue		% Variance Explained		Cumulative Variance	
	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half
1	9.45	7.60	15.75	12.67	15.75	12.67
2	3.51	3.58	5.85	5.97	21.60	18.64
3	2.48	2.78	4.14	4.64	25.74	23.27
4	2.20	2.00	3.67	3.34	29.41	26.61
5	2.00	1.88	3.32	3.14	32.73	29.75

Table B.1: Factor Analysis output for the 2 split halves of the sample, and overall

B.2 Confirmatory Factor Analyses

A second set of confirmatory factor analyses were then conducted on these same 60 items, constraining the number of factors, based on Scree output from the exploratory analysis. Two confirmatory factor analyses were conducted, one in

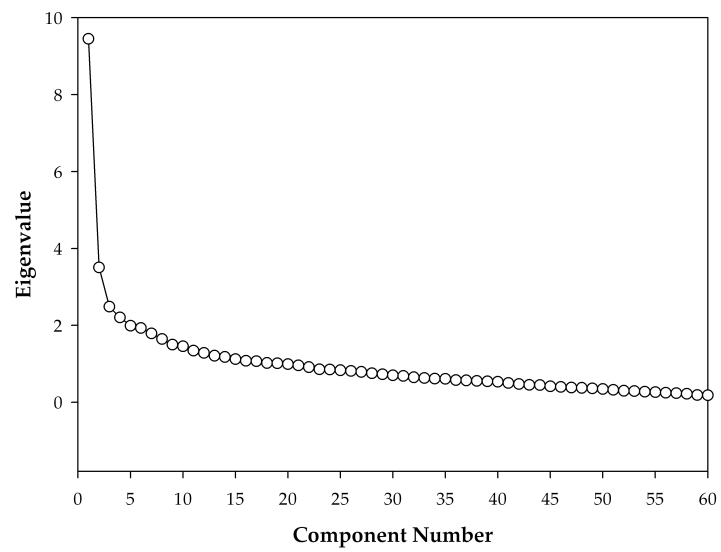


Figure B.1: Scree plot of Exploratory Factor Analysis conducted in first random half of sample

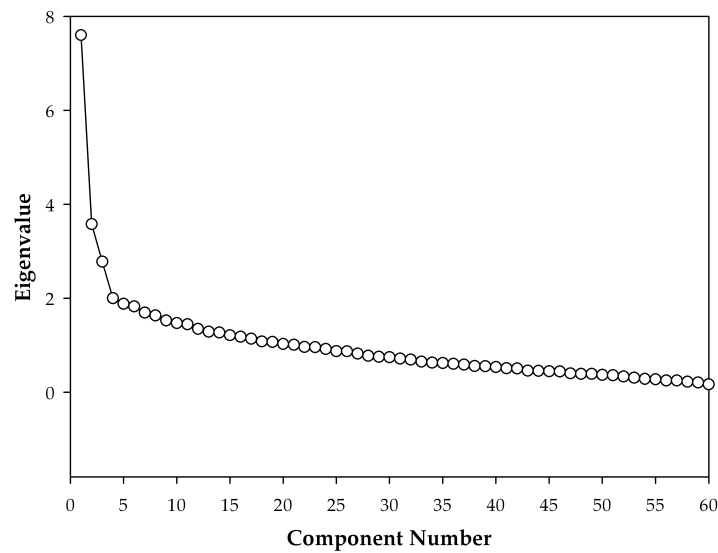


Figure B.2: Scree plot of Exploratory Factor Analysis conducted in first random half of sample

each half of the randomly-split dataset, to verify the content of each of the emergent factors. For the confirmatory analyses, loadings below an absolute value of .3 were suppressed, and each factor was allocated to the factor on which it loaded most highly. These items were used to interpret and name the factors, and were compared with items loading onto factors in Wave 1 (Gregory, Rijdsdijk, et al., 2007). Given the close replication of item loadings onto the 4 factors presented by Gregory, Rijdsdijk, et al. (2007), these same item loadings were retained for these Wave 2 data. Items are grouped into their respective factors in Table B.2 below.

Summed scores of the items loading onto each factor for each individual across both halves of the sample were then calculated, as long as individuals had data for at least 70% of items. These summed scores were used as indices for components of interpersonal cognition in all subsequent analyses. Means and standard deviations for these sum scores and their correlations with each other are given in Chapter 3, in Tables 3.1 and 3.2 respectively.

Item	Positive		Negative		Mother		Peer	
Absence of Positive Perceptions of Peers and Self								
There are a lot of things about me that other kids really like	.55	.46	.13	.04	-.09	.01	.02	-.18
I am a lot of fun to be with	.50	.56	.19	.12	-.20	-.19	.31	-.05
Once I am friends with someone, I know how to keep them as a friend	.41	.59	.06	-.05	.04	-.04	-.10	-.08
I have always been the kind of kid who makes friends really easily	.56	.58	.12	.08	-.07	-.04	-.05	-.19
Kids like to be around me because I can be a really good friend	.64	.60	.15	.05	-.05	-.06	-.08	-.11
I am good at making other kids feel better when they are upset	.58	.56	-.07	-.03	-.10	-.09	-.10	.14
I am good at making other kids laugh	.48	.55	-.06	.03	-.04	-.16	.16	.06
I can usually get other kids to play the games that I suggest	.47	.51	.15	-.05	-.17	.04	.13	-.04
Other kids are pretty helpful when you need them	.55	.51	-.04	-.05	.00	.13	-.24	-.25
Other kids are pretty easy to get along with	.64	.56	.23	.15	-.05	-.02	-.18	-.33
Other kids will try to cheer you up when you're upset	.64	.56	.04	.04	.22	.05	-.21	-.23
Other kids usually like you, even if you have some faults	.54	.58	.22	.11	-.19	-.20	-.06	-.17
Friends will take your side when other kids make fun of you	.51	.52	.22	.16	-.21	-.08	-.13	-.02
Once you're friends with someone, they usually stay friends with you	.60	.55	.23	.27	-.03	-.11	-.07	.05
Friends usually stick up for you when you are in trouble	.56	.51	.21	.06	-.04	-.15	-.09	-.02
Negative Perceptions of Peers and Self								
When other kids do not want to be around me, it's probably because there is something wrong with me	.10	.06	.48	.33	-.07	.00	.09	-.08
Sometimes I feel like I am too different from other kids	.19	.01	.50	.54	.02	-.12	-.25	-.09
It's a waste of other kids' time to be friends with me	.25	.04	.44	.53	-.09	-.34	-.05	-.01
If another kid has something I want, I am NOT very good at getting a turn with it	.25	.22	.37	.35	.03	.07	-.13	-.09
I am NOT very good at getting other kids to let me join in their games	.32	.19	.47	.40	-.06	.00	-.12	-.12

B. FACTOR ANALYSES OF INTERPERSONAL COGNITIONS

Item	Positive		Negative		Mother		Peer	
If another kid makes me angry or sad, I am NOT good at standing up for myself	.14	.14	.24	.45	-.19	-.06	.11	.06
If I get into a fight with another kid, I am NOT really good at ending it	.22	.23	.15	.25	-.28	-.06	.03	-.08
Other kids can sometimes be pretty mean	.06	-.17	.55	.51	.04	.10	-.07	-.20
Other kids will try to put you down or tease you if they have a chance	.07	-.06	.69	.62	-.10	-.09	-.11	-.27
You never really know how other kids are going to act	-.12	.00	.33	.29	-.06	.05	.06	-.02
Other kids can not be trusted	.24	-.09	.28	.60	-.07	.05	-.27	-.01
Other kids are really out to get you	.11	-.02	.50	.63	-.04	-.07	-.23	-.05
Once you get into a fight with a friend, it probably means that they will not be friends with you anymore	.16	.04	.26	.31	-.09	.00	-.06	-.17
Friends often leave you out when there are other kids around to play with	.22	.02	.49	.53	-.06	-.07	-.04	-.12
Friends may gossip about you when you're not around	.09	.16	.53	.43	-.14	-.11	-.12	-.04
Negative Expectations of Mother Behaviour								
You tell your mother that you have won a prize at school	-.02	-.13	.07	-.01	.48	.61	.24	-.06
You give your mother a lopsided vase that you have made for her	-.02	-.12	-.09	-.05	.41	.16	.03	.07
Your mother is teaching you a game, but you have difficulty understanding	-.27	.11	.00	-.05	.46	.38	.02	-.08
You return home to your mother after falling off your bike	-.16	-.13	-.12	.07	.46	.28	-.01	.30
You tell your mother that some of the kids at school were making fun of you	.04	-.02	-.17	.03	.52	.30	.04	.06
You make your mother breakfast, but the toast is overdone	.04	-.04	-.23	-.12	.50	.54	.18	.14
You ask your mother if she will take you to see a new movie	-.10	-.07	-.14	.15	.52	.27	.11	.10
You tell your mother that you can't finish a puzzle that you've started	.17	.12	-.24	-.11	.18	.10	.08	.08
You have the lead role in a play but mother gets a call from a friend	.07	-.11	-.24	-.15	.28	.31	-.05	.06
You are scared in the night and wake your mother	.01	.00	.01	.15	.54	.53	.04	.10
You ask your mother for help with some difficult homework	.14	-.05	.04	.03	.38	.21	.11	.44
You're feeling yucky in the morning, and you see your mother	-.12	-.11	-.01	.12	.49	.34	.07	.09
You ask your mother to make something for a bake sale at school	-.15	.00	-.12	.00	.37	.35	.37	.37
You show your mother a test on which you didn't do very well	-.08	.06	-.13	-.18	.36	.56	-.17	.04
Your mother is going out, and you feel really ill	-.15	-.14	.16	.05	.34	-.02	.09	.08
Negative Expectations of Peer Behaviour								
An older child picks on you in front of the kids in your class	-.11	-.21	-.48	-.22	.07	.20	.32	.39
You are running for captain of your class and ask a friend to help you	-.16	.19	-.10	.08	.33	.37	.37	.26
You make a suggestion for a school project	-.29	-.16	-.32	-.25	.13	-.05	.21	.44
You go to school, and it's your birthday	-.18	-.13	-.14	-.14	-.09	.04	.50	.43

B.2. Confirmatory Factor Analyses

Item	Positive		Negative		Mother		Peer	
You're upset by something that happened at home and try to talk to a friend	-.08	.01	-.01	-.06	-.05	.34	.65	.16
You go to your friend's party and give them a present	.09	.06	-.03	-.13	.11	.09	.53	.30
You ask another child to come to your house	-.30	.02	-.19	-.08	-.01	.31	.47	.33
You are playing a game in the playground and drop the ball	-.12	-.19	-.33	-.09	.32	.17	.20	.59
You ask some other children if you can play with them	.03	-.10	-.31	-.09	.18	.08	.46	.48
You get in trouble for passing a note that you didn't pass	-.32	-.12	-.25	-.06	.34	.22	.18	.52
Your friend is supposed to be staying at your house but gets invited to a party	-.05	-.09	-.08	-.18	.32	.21	.50	.19
You fall over in the playground and start crying	-.02	-.16	-.20	-.11	.25	.17	.62	.50
Friends of a new friend start to tease you	-.19	-.03	-.08	-.21	.29	.07	.40	.65
You are playing a game with some friends, but you keep getting the rules wrong	-.23	-.10	-.22	-.10	.19	.01	.05	.61
You ask a friend to help you finish your science project	-.30	-.13	-.01	-.01	.19	.18	.22	.40

Table B.2: Loadings of each of the 60 CESBQ and POPS items onto the 4 factors in the confirmatory factor analyses. Loadings are given for the two split-halves of the data in sub-columns. Loadings > .3 are bolded.

C

Interpretation Questionnaire

The Interpretation Questionnaire administered to participants in Chapters 4, 5 and 7 is reproduced below. The questionnaire is separated into items administered prior to training (t1) and post-training (t2). Items were drawn from the Children's Expectations of Social Situations Questionnaire (CESBQ; Rudolph et al., 1995) and the Ambiguous Social Situations Interpretations Questionnaire (ASSIQ) as implemented by Stopa and Clark (2000) and Amir et al. (1998). A key to which items were taken from each questionnaire is given below:

	CESBQ Items	ASSIQ Items
T1 Items	2, 4, 8, 12	1, 3, 5, 6, 7, 9, 10, 11, 13
T2 Items	3, 6, 8, 13	1, 2, 4, 5, 7, 9, 10, 11, 12

Each item on the questionnaire describes an ambiguous social situation and requires participants to give the interpretation that they would most likely draw. The responses to each item contain one negative interpretation (as in, the interpretation reflects negatively on the participant personally) and two benign interpretations. Each half of the questionnaire also contains one non-social filler item: Item 6 in the t1 set, and Item 10 in the t2 set. Answers to these items were omitted from analyses.

C.1 T1 Items

For each question, circle the letter next to the explanation that **you personally** would be most likely to think in each situation.

1. You go into a shop and the assistant ignores you. Why do you think this is?
 - a) They are bored with their job, and behave rudely
 - b) They are concentrating on something else
 - c) You are not important enough for them to bother with
2. You're really excited to go to school one day as it's your birthday and you can't wait to see the other kids. What do you think would happen that day in school?
 - a) The other kids might not even remember it was my birthday and wouldn't say anything
 - b) The other kids might play a mean joke on me for my birthday
 - c) The other kids might say happy birthday to me and maybe even give me cards or presents
3. A friend over hears your telephone conversation and starts to smile. Why do you think they're doing this?
 - a) You've said something amusing
 - b) You're making a fool of yourself
 - c) They're remembering a joke
4. You're feeling kind of upset about something which happened one morning at home and you decide to try and talk about it with a friend during break. As soon as the bell rings, you walk over to them and start to tell them about your problem. What do you think they might do?
 - a) They might listen to my problem and try to make me feel better
 - b) They might tell me that I always seem to have problems and I should stop bothering them
 - c) They might just walk away and say they want to hang around with some other kids
5. You are having a conversation with some friends. You say something and there is a long pause. Why do you think your friends aren't saying anything?
 - a) You said something foolish
 - b) They are thinking about what you said

- c) There was nothing more to say
6. You get in the car in the morning, but it doesn't start straight away after turning the ignition. Why not?
- a) It is a cold morning
 - b) Something is wrong with the engine
 - c) Sometimes the car takes a while to start
7. You are talking to a small group of people. As you are speaking, someone leaves the group. Why do you think they left?
- a) They had an appointment they needed to be at
 - b) They thought what you were saying was boring
 - c) They are going to bring a friend to listen to you
8. You have to finish a science project by the end of the week, but you still have a lot of work to do on it. You ask a friend of yours if they will help you one day after school. What do you think they might say?
- a) They might say that they already have plans with other people and they don't have time
 - b) They might say it was kind of a dumb project and they didn't want to work on it
 - c) They might agree to help me out on it for a little while
9. You ask a friend to go out for a meal with you in a couple of days' time and they refuse. What do you think their reason is?
- a) They are trying not to spend too much money
 - b) They don't want to spend the evening with you
 - c) They've already arranged to do something else
10. A stranger approaches you in the street. What do you think he wants?
- a) He's lost and wants directions
 - b) You have done something wrong and are about to be told off
 - c) He wants to ask some questions for a survey
11. You are talking to someone at a party. They excuse themselves to go and get a drink and then start talking to someone else. Why do you think they did this?
- a) They are just being sociable
 - b) You are boring them
 - c) They saw someone whom they haven't seen for a long time

C. INTERPRETATION QUESTIONNAIRE

12. You're waiting at a bus stop outside school when an older student comes up and starts to pick on you. What do you think the other students around you will do?
 - a) They might just ignore it so they don't also get picked on
 - b) They might stick up for you and tell the person to leave you alone
 - c) They might join in and start teasing you too.
13. You are in class and are asked to read a passage out loud. When you finish, you see that two people are staring at you. Why do you think they are staring?
 - a) They think you messed up the passage
 - b) They are looking at the notes written on the board behind you
 - c) They liked the way you read the passage

C.2 T2 Items

For each question, circle the letter next to the explanation that **you personally** would be most likely to think in each situation.

1. Not long after starting a new term your form teacher asks to see you. What do you think they want to talk about?
 - a) They want to make sure you have settled in alright.
 - b) You haven't been working hard enough.
 - c) They are going to tell you how well you have been doing.
2. You are talking to an acquaintance who briefly looks out of the window. Why do you think they did this?
 - a) Something outside has caught their attention.
 - b) They are bored with you.
 - c) They are tired and can't concentrate.
3. You're thinking about running for president of your class and you ask a friend to help you make some posters to hang around the school. What do you think they might say?
 - a) They might tell me that they knew I would win and would help me make some posters.
 - b) They might say that I'd never win anyway so it's not worth it to help me.
 - c) They might say that they are really busy and has a lot of their own things that they have to do.
4. Some people who you know are looking in your direction and talking. What do you think they are doing?
 - a) They are criticizing you.
 - b) They are being friendly and want you to join them.
 - c) They just happen to be looking your way.
5. You've made a tentative arrangement to go to the cinema with a friend and then they tell you that they can't go. What do you think their reason is?
 - a) They don't feel well.
 - b) You've done something to offend them.
 - c) They've arranged something else by mistake and are too embarrassed to tell you.

C. INTERPRETATION QUESTIONNAIRE

6. You go to a birthday party and bring your friend a present that you picked out really carefully because you were sure they would like it. All the kids give their presents then you give yours. What do you think your friend might do when you give them your present?
 - a) They might just leave it on the floor while they keep looking at one of the other presents.
 - b) They might say that they really like my present and thank me for it.
 - c) They might tell me that they liked the other kids presents better.
7. You walk past a group of tourists and they start laughing. Why do you think is this?
 - a) Their guide said something amusing.
 - b) You look odd.
 - c) They're enjoying their holiday.
8. The teacher yells at you in class because she thinks that she saw you passing a note to another kid. You know that you really didn't pass the note. What do you think the kids sitting next to you might do?
 - a) They might just not say anything at all to the teacher.
 - b) They might stick up for me and tell the teacher that I didn't pass it.
 - c) They might pretend that I really did pass it and get me in trouble.
9. Someone you are interested in dating says "Hello" to you. What do you think this means?
 - a) They want to get to know you
 - b) They say "Hello" to everyone
 - c) They feel sorry for you
10. You reach for your wallet/purse and cannot find it. What has happened to it?
 - a) It is in another pocket
 - b) You left it at home
 - c) You have lost it
11. Someone you know passes you on the street and does not stop to greet you. Why do you think this is?
 - a) They were ignoring you
 - b) They didn't see you
 - c) They were in a rush and could not stop

12. You see a group of friends having lunch, they stop talking when you approach. Why do you think this is?
- a) They are saying negative things about you
 - b) They are about to ask you to join them
 - c) They just ended their conversation
13. You're working on a group project with some other people at school and you make a suggestion for something which you could all do. What do you think they might say?
- a) They might laugh and say it was a pretty stupid idea.
 - b) They might just pretend that I didn't say anything and ignore my idea.
 - c) They might try it out to see if it would work.

D

CBM-I Training Scenarios

Scenarios were presented using feminine pronouns, masculine pronouns, and subsequently gender-neutral pronouns (to avoid ignoring the experience of non-heterosexual sexual orientations or non-binary gender orientations). Scenarios presented below in Table D.2 are taken from the female version of the task, given the preponderance of female-identified participants in the analyses presented in Chapters 4–7. Owing to the fact that positive and negative training contained 1 negative and 1 neutral item per training block, certain scenarios do not necessarily exist in all training-valence versions. In positive training, 1 scenario per block was negative. Similarly in negative training, 1 scenario per block was positive. These inverted items are identified for each block in Table D.1 below. As positive and negative training valences also contained 1 neutral/ambiguous scenario per block, certain scenarios only exist in neutral versions, which were used across all training valences. Similarly, the inclusion of one positive and one negative item per training block in neutral control training means that certain scenarios will only have neutral versions. Items that were positive and negative in the neutral training are also identified per training block in Table D.1 below.

Feature	Block				
	1	2	3	4	5
Inverted positive/negative items in respective training	10	11	5	11	8
Neutral in positive, negative and neutral training	2	12	11	12	6
Positive in neutral training	6	3	5	1	1
Negative in neutral training	12	9	7	9	10

Table D.1: Switched and inverted-valence items across training groups

Mixed-valence training in Chapter 4 was comprised exclusively of positive and negatively valenced scenarios. For each scenario in Table D.2 below, the valence that appeared in the mixed-valence control condition is indicated in the second column from the right. Additional scenarios were used to make up the shortfall due to the omission of neutral training items. These are included at the end of the table. These novel items were included in the training used in Chapter 7. In Chapter 7 numerous training scenarios were omitted due to dealing with subject matter that would be inappropriate or less relatable for this younger age

D. CBM-I TRAINING SCENARIOS

group. Scenarios from Chapter 4 that were used in Chapter 7 are indicated in Table D.2's rightmost column. Novel scenarios included exclusively in Chapter 7's training (to make up for the shortfall after omitted items) are presented at the bottom of the table.

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
Block 1							
1.1	Positive	A new girl has started at your school. She is sometimes nice but at other times does not talk to you. You decide to ask what she really feels about you. You think that her answer will be	g-od (o)	Does your new classmate like you?	Y	×	×
	Negative	A new girl has started at your school. She is sometimes nice but at other times does not talk to you. You decide to ask what she really feels about you. You think that her answer will be	b-d (a)	Does your new classmate like you?	N		
	Neutral	A new girl has started at your school. She is sometimes nice but at other times does not talk to you. You decide to ask what she really feels about you. You think that her answer will be	h-ne-t (o)	Did you talk to the new girl?	Y		
1.2	Neutral	As you are walking down a crowded street, you see your friend on the other side. You call out but she does not answer you. You think that this is because she was	b-sy (u)	Does your friend answer you?	N		×
1.3	Positive	You are invited to a fancy dress party and decide to wear a rather colourful costume. The next day your picture has been put on a website. The thought of everyone seeing it makes you feel	pl-sed (e)	Are you happy that the picture from the party was on a website?	Y	×	×
	Negative	You are invited to a fancy dress party and decide to wear a rather colourful costume. The next day your picture has been put on a website. The thought of everyone seeing it makes you feel	w-rr-ed (o)	Are you happy that the picture from the party was on a website?	N		
	Neutral	You are invited to a fancy dress party and decide to wear a rather colourful costume. The next day your picture has been put on facebook. The thought of everyone seeing it makes you feel	c-rious (u)	Was the costume you wore colourful?	Y		
1.4	Positive	It is the first day of term. Your new teacher asks everyone to stand up and introduce themselves. After you have finished, you guess the others thought you sounded	cl-v-r (e)	Do you feel unhappy with your introduction?	N	×	
	Negative	It is the first day of term. Your new teacher asks everyone to stand up and introduce themselves. After you have finished, you guess the others thought you sounded	st-p-d (u)	Do you feel unhappy with your introduction?	Y		
	Neutral	It is the first day of term. Your new teacher asks everyone to stand up and introduce themselves. After you have finished, another person gets up to	s-eak (p)	Was it the first day of term?	Y		×
1.5	Positive	The boy you have liked for ages has finally asked you out. While you get ready, you think that after this evening his impression of you will be	p-s-tiv- (o)	Does the date go well?	Y	×	×
	Negative	The boy you have liked for ages has finally asked you out. While you get ready, you think that after this evening his impression of you will be	n-g-tiv- (e)	Does the date go well?	N		
	Neutral	The boy you have liked for ages has finally asked you out. While you get ready, you think that after this evening his impression of you will be	dif-er-nt (f)	Did you ask the boy out?	N		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
1.6	Positive	After the summer, you are asked to write an essay about your holiday. In the next lesson you have to read your essay in front of the whole class. Telling everyone about your family holiday makes you feel	e-cit-d (x)	Do the others think that you had a boring summer?	N	×	×
	Negative	After the summer, you are asked to write an essay about your holiday. In the next lesson you have to read your essay in front of the whole class. Telling everyone about your family holiday makes you feel	unc-mf-rt-ble (o)	Do the others think that you had a boring summer?	Y		
1.7	Positive	Your school is looking for a new person to join their debating team. You ask for more details. After hearing these, you decide you would be	w-lc-m-d (e)	Do you have a good chance of getting the position?	Y		×
	Negative	Your school is looking for a new person to join their debating team. You ask for more details. After hearing these, you decide you would be	r-ject-d (e)	Do you have a good chance of getting the position?	N	×	
	Neutral	Your school is looking for a new person to join their debating team. You ask for more details. After hearing these, you decide you would be	int-rest-d (e)	Did the debating team give you more details?	Y		
1.8	Positive	You have a new hair-cut. When you meet with some friends later, everybody is looking at you and you think this is because your new look is	g-rg-us (o)	Do your friends like your new hair-cut?	Y		×
	Negative	You have a new hair-cut. When you meet with some friends later, everybody is looking at you and you think this is because your new look is	h-rr-ble (o)	Do your friends like your new hair-cut?	N	×	
	Neutral	You have a new hair-cut. When you meet with some friends later, everybody is looking at you and you think this is because your new look is	d-ffe-ent (i)	Did people notice your new hair-cut?	Y		
1.9	Positive	You are looking after your cousin for a few hours. After a while, she becomes tired. You pick her up and take her home. You are sure that your aunt thinks that your babysitting skills are	e-c-ll-nt (x)	Is your aunt upset with how you cared for your cousin?	N		
	Negative	You are looking after your cousin for a few hours. After a while, she becomes tired. You pick her up and take her home. You are sure that your aunt thinks that your babysitting skills are	t-rri-le (e)	Is your aunt upset with how you cared for your cousin?	Y	×	
	Neutral	You are looking after your cousin for a few hours. After a while, she becomes tired. You pick her up and take her home. She falls straight	a-l-ep (s)	Was your cousin tired?	Y		×
1.10	Positive	You have taken a maths test and feel you did well. At the next class the grades are on the notice board and everyone is looking at them. The thought of others comparing your grade with theirs makes you feel	h-ppy (a)	Do you like that others could compare their grades with yours?	Y		
	Negative	You have taken a maths test and feel you did well. At the next class the grades are on the notice board and everyone is looking at them. The thought of others comparing your grade with theirs makes you feel	n-rv-us (e)	Do you like that others could compare their grades with yours?	N	×	
	Neutral	You have taken a maths test and feel you did well. At the next class the grades are on the notice board and everyone is looking at them. The thought of others comparing your grade with theirs makes you feel	c-mpet-tive (o)	Were people comparing their scores?	Y		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
1.11	Positive	You write a poem to enter a school competition and need someone to read over it. The thought of a friend reading your work makes you feel	pro-d (u)	Are you nervous about having a friend read your poem?	N	×	×
	Negative	You write a poem to enter a school competition and need someone to read over it. The thought of a friend reading your work makes you feel	anx-us (i)	Are you nervous about having a friend read your poem?	Y		×
	Neutral	You write a poem to enter a school competition and need someone to read over it. Your friend reads it and in return you read over	th-irs (e)	Was the poetry competition at school?	Y		×
1.12	Positive	You are persuaded to join the school quiz team. During the first round you must answer all the questions. The questions are hard and you feel that your team-mates found your performance	str-g (o)	Do your team-mates feel negative about your efforts?	N	×	
	Negative	You are persuaded to join the school quiz team. During the first round you must answer all the questions. The questions are hard and you feel that your team-mates found your performance	we-k (a)	Do your team-mates feel negative about your efforts?	Y		
Block 2							
2.1	Positive	You are looking for some work experience over the summer. You see a poster at your sports club looking for young and energetic people as group leaders for a children’s camp. When you apply, they reply saying that you are	p-rf-ct (e)	Do you get the job?	Y	×	
	Negative	You are looking for some work experience over the summer. You see a poster at your sports club looking for young and energetic people as group leaders for a children’s camp. When you apply, they reply saying that you are	unqual-fi-d (i)	Do you get the job?	N		
	Neutral	You are looking for some work experience over the summer. You see a poster at your sports club looking for young and energetic people as group leaders for a children’s camp. When you apply, they reply saying that you are	y-ung (o)	Do you send your application to the camp?	Y		
2.2	Positive	While on holiday you buy some new sunglasses. They are quite large. When you meet your friends the next day they tell you that your new glasses look	t-rrif-c (e)	Do your friends find your sunglasses weird?	N	×	×
	Negative	While on holiday you buy some new sunglasses. They are quite large. When you meet your friends the next day they tell you that your new glasses look	st-p-d (u)	Do your friends find your sunglasses weird?	Y		
	Neutral	You are on holiday with your family. Since it is sunny, you decide to buy some new sunglasses. The size of the frames is quite	la-ge (r)	Did you buy your sunglasses at home?	N		×
2.3	Positive	You buy yourself a new top at a new store in town. When you wear it to a party that evening, one of the kids you like says the top looks really	c-ol (o)	Does the other kid like your top?	Y	×	
	Negative	You buy yourself a new top at a new store in town. When you wear it to a party that evening, one of the kids you like says the top looks really	od- (d)	Does the other kid like your top?	N		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Neutral	You buy yourself a new top at a new store in town. When you wear it to a party that evening, one of the kids you like says the top looks really	c-ol (o)	Does the other kid like your top?	Y		
2.4	Positive	You have just formed a new band and you have your first gig this evening. You are quite nervous but after the first half some students from your school come over to tell you that the band performed	am-z-ngly (a)	Does your first gig go badly?	N	×	×
	Negative	You have just formed a new band and you have your first gig this evening. You are quite nervous but after the first half some students from your school come over to tell you that the band performed	p-orly (o)	Does your first gig go badly?	Y		
	Neutral	You have just formed a new band and you have your first gig this evening. You are quite nervous. After the first half some students from your school come over to tell you that they saw your band's	pe-f-rm-nc- (r)	Were students from your school at the gig?	Y		×
2.5	Positive	You have finally decided to wear contact-lenses rather than glasses. Your new look is very different. You think that your friends will think that you look	w-nd-rful (o)	Do your friends find your new look terrible?	N	×	
	Negative	You have finally decided to wear contact-lenses rather than glasses. Your new look is very different. You think that your friends will think that you look	awf-l (u)	Do your friends find your new look terrible?	Y		
	Neutral	You have finally decided to wear contact-lenses rather than glasses. Your new look is very different. You think that your friends will think that you look	unf-miliar (a)	Do you look the same with your contact lenses?	N		
2.6	Positive	You really like the new kid at school. At a birthday party the two of you talk for a long time. When you meet the next day at school, he smiles at you and then leaves the room quickly when you come in. You are sure that this is because he finds you quite	attr-ct-ve (a)	Does the new kid like you?	Y	×	×
	Negative	You really like the new kid at school. At a birthday party the two of you talk for a long time. When you meet the next day at school, he smiles at you and then leaves the room quickly when you come in. You are sure that this is because he finds you quite	irr-ta-ing (i)	Does the new kid like you?	N		
	Neutral	You really like the new kid at school. At a birthday party you get the chance to chat more. Just then, the doorbell rings. It is another one of your	f-iends (r)	Did the two of you speak at the birthday party?	Y		×
2.7	Positive	Your father helps you to study for your mathematics test. When your teacher hands back the exams and you see the grade you know that your father will be very	pro-d (u)	Is your father unhappy with the grade on your mid-term?	N		×
	Negative	Your father helps you to study for your mathematics test. When your teacher hands back the exams and you see the grade you know that your father will be very	dis-pp-inted (a)	Is your father unhappy with the grade on your mid-term?	Y	×	

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Neutral	Your father helps you to study for your maths test. When your teacher hands back the exams and you see the grade you know that your father will be very	in-erest-d (t)	Did your father help you study?	Y		
2.8	Positive	You and some of your friends are working at a music store. Recently there are rumours that the owner wants to fire one of you for doing a bad job. On one of your shifts, the boss wants to talk to you. He tells you that he thinks you are	h-rdworking (a)	Will you be fired?	N		×
	Negative	You and some of your friends are working at a music store. Recently there are rumours that the owner wants to fire one of you for doing a bad job. On one of your shifts, the boss wants to talk to you. He tells you that he thinks you are	l-zy (a)	Will you be fired?	Y	×	
	Neutral	You and some of your friends are working at a music store. Recently the shop has changed over its opening hours. After one of your shifts, you go to talk to the boss about your	h-urs (o)	Are you working in a music shop?	Y		×
2.9	Positive	Your volleyball team had made it through to the final round of the national league. The trainer has to choose between you and three other kids for the last member of the team. After training he calls you all into the room. You are sure that of the four kids, you are the	b-st (e)	Will you play in the game for the national championship?	Y		
	Negative	Your volleyball team has made it through to the final round of the national league. The trainer has to choose between you and three other kids for the last member of the team. After training he calls you all into the room. You are sure that of the four kids, you are the	w-rst (o)	Will you play in the game for the national championship?	N	×	
2.10	Positive	Your best friend invites you to go out with her new friends from the drama club. You hesitate at first but then agree to come along. At the end of the evening you think that the other people thought that you were	lov-ly (e)	Did the people from the drama club enjoy your company?	Y		×
	Negative	Your best friend invites you to go out with her new friends from the drama club. You hesitate at first but then agree to come along. At the end of the evening you think that the other people thought that you were	d-ll (u)	Did the people from the drama club enjoy your company?	N	×	
	Neutral	Your best friend invites you to go out with her new friends from the drama club. You hesitate at first but then agree to come along. At the end of the evening you and your friend go home by	b-s (u)	Are the new people from the chess club?	N		×
2.11	Positive	Your mathematics teacher likes to give short quizzes at the beginning of each lesson. One day you and one of the cool kids are picked to do the quiz. The other kid does not take the quiz seriously and gets all his answers wrong whereas you do quite well. You are sure that your classmates think you are	sm-rt (a)	Do your classmates have a negative impression of you?	N		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Negative	Your maths teacher likes to give short quizzes at the beginning of each lesson. One day you and one of the cool kids are picked to do the quiz. The other kid does not take the quiz seriously and gets all his answers wrong whereas you do quite well. You are sure that your classmates think you are	ge-ky (e)	Do your classmates have a negative impression of you?	Y	×	
	Neutral	Your maths teacher likes to give short quizzes at the beginning of each lesson. One day you and one of the cool kids are picked to do the quiz. The other kid does not take the quiz seriously and gets all his answers wrong whereas you do quite well. You are sure that your classmates think you are	tryin- (g)	Does the other kid get any questions right?	N		
2.12	Neutral	On the first day back at school after the summer, you bump into your form tutor from last year. He smiles at you but keeps on walking. You think this is because he is in a	r-sh (u)	Does your form tutor from last year see you?	Y		×
Block 3							
3.1	Positive	You have been swapping emails with a penpal from France. She decides to come and visit. As you wait at the airport with your parents, you think that her first impression of you will be	p-s-tive (o)	Does your penpal like you?	Y		
	Negative	You have been swapping emails with a penpal from France. She decides to come and visit. As you wait at the airport with your parents, you think that her first impression of you will be	n-g-tive (e)	Does your penpal like you?	N	×	
	Neutral	You have been swapping emails with a penpal from France. She decides to come and visit. As you wait at the airport with your parents, you think that her first impression of you will be	imp-rt-nt (o)	Is your penpal from England?	N		
3.2	Positive	You finally write a message to the boy you like. The next morning he has written something back. You think this is because he finds you	int-r-st-ng (e)	Was he annoyed by your message?	N		×
	Negative	You finally write a message to the boy you like. The next morning he has written something back. You think this is because he finds you	b-r-ng (o)	Was he annoyed by your message?	Y	×	
	Neutral	You finally write a message to the boy you like. The next morning he has sent something back. You are interested in seeing what he has	wri-t-n (t)	Did the boy write something back?	Y		×
3.3	Positive	You and your friends went to a party last night. You were the centre of attention and told many jokes. You are sure your friends thought you were	f-nny (u)	Did your friends enjoy listening to your jokes?	Y		×
	Negative	You and your friends went to a party last night. You were the centre of attention and told many jokes. You are sure your friends thought you were	we-rd (i)	Did your friends enjoy listening to your jokes?	N	×	
	Neutral	You and your friends went to a party last night. You were the centre of attention and told many jokes. You saw a lot of people there that you	rec-gn-sed (o)	Did you talk a lot at the party?	Y		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
3.4	Positive	You have been a member of the school choir for several years and enjoy performing at concerts. One evening, you are asked to sing with some other students. Afterwards, you feel that the others thought your performance was	gre-t (a)	Are the other members of the choir unhappy with your singing?	N	×	×
	Negative	You have been a member of the school choir for several years and enjoy performing at concerts. One evening, you are asked to sing with some other students. Afterwards, you feel that the others thought your performance was	dis-pp-nting (a)	Are the other members of the choir unhappy with your singing?	Y		
	Neutral	Some new neighbours have just moved in next door, and they have a daughter a few years older than you. They ask you to show her round the area. You say that you would be able to at the	w-k-nd (e)	Is your new neighbour the same age as you?	N		
3.5	Positive	For the next school prom a prom-queen will be elected. One of your friends suggests that you run for it. You think that your becoming prom-queen is very	l-k-ly (i)	Are your chances to become prom-queen low?	N		×
	Negative	For the next school prom a prom-queen will be elected. One of your friends suggests that you run for it. You think that your becoming prom-queen is very	unl-k-ly (i)	Are your chances to become prom-queen low?	Y	×	
	Neutral	The next school prom is in June. You and your friends are all going. There will be lots of	d-nc-ng (a)	Will there be a dance floor?	Y		×
3.6	Positive	Your teacher asks you to make a schedule for cleaning the board. As you pin it up, several classmates complain about the way you have written it. You are sure your teacher thinks that it is	goo- (d)	Is your teacher dissatisfied with the schedule?	N		×
	Negative	Your teacher asks you to make a schedule for cleaning the board. As you pin it up, several classmates complain about the way you have written it. You are sure your teacher thinks that it is	slo-p- (p)	Is your teacher dissatisfied with the schedule?	Y	×	
	Neutral	Your teacher asks you to make a schedule for cleaning the board. Everyone in the class has their name on it once. You work out that the schedule should last for about six	w-ks (e)	Is the schedule to do with homework?	N		×
3.7	Positive	You have just started at a new school and some of the other kids invite you to the cinema this afternoon. When you arrive, you can't find them. They probably think you are	likab-e (l)	Did you make a good impression on your new school friends?	Y	×	×
	Negative	You have just started at a new school and some of the other kids invite you to the cinema this afternoon. When you arrive, you can't find them. They probably think you are	du-l (l)	Did you make a good impression on your new school friends?	N		
	Neutral	You have just started at a new school and some of the other kids invite you to the cinema this afternoon. You arrive a little early, so you decide to go and buy some	po-c-rn (p)	Did you see your friends straight away?	N		×

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
3.8	Positive	At a birthday party, you meet someone new and you get along very well. When you phone them the next week to suggest meeting again, they reply that it would be	gr-at (e)	Are they excited to meet with you again?	Y	×	×
	Negative	At a birthday party, you meet someone new and you get along very well. When you phone them the next week to suggest meeting again, they reply that it would be	p-intl-ss (o)	Are they excited to meet with you again?	N		
	Neutral	At a birthday party, you meet someone new and talk to them for a while. You phone them the next week to suggest meeting again. You leave a	me-s-ge (s)	Had you met the person before the birthday party?	N		×
3.9	Positive	During a break at school you hear some of your classmates talking about other people. As you walk closer to them, you overhear your name. When they see you, they stop talking. What they were saying makes you feel	ha-py (p)	Were your classmates speaking negatively about you?	N		×
	Negative	During a break at school you hear some of your classmates talking about other people. As you walk closer to them, you overhear your name. When they see you, they stop talking. What they were saying makes you feel	h-rt (u)	Were your classmates speaking negatively about you?	Y	×	
	Neutral	During break at school you hear some of your classmates talking about other people. As you walk closer to them, you overhear the name of your teacher. Soon afterwards, the bell	rin-s (g)	Were your classmates talking about your teacher?	Y		×
3.10	Positive	You have a new history teacher who is very strict. When you hand in your first homework, you think he will find it	e-c-ll-nt (x)	Does your new teacher have a good opinion of your work?	Y	×	×
	Negative	You have a new history teacher who is very strict. When you hand in your first homework, you think he will find it	m-ssy (e)	Does your new teacher have a good opinion of your work?	N		
	Neutral	You have a new history teacher. When you get your first history assignment it seems like a lot of	w-rk (o)	Did you get a lot of homework from your science teacher?	Y		×
3.11	Neutral	Your school orchestra asks you to play a solo at the next concert. You practice a few times at home. At the first rehearsal, you make a mistake. You are performing on	S-tu-d-y (a)	Have you been practising at home?	Y		×
3.12	Positive	You are asked to choose some music to play for your best friend's birthday party. Some of your friends are dancing. You think that your choice of songs is met with	pl-s-re (e)	Do the guests dislike the music?	N	×	×
	Negative	You are asked to choose some music to play for your best friend's birthday party. Some of your friends are dancing. You think that your choice of songs is met with	h-rr-r (o)	Do the guests dislike the music?	Y		
	Neutral	You are asked to choose some music to play for your best friend's birthday party. Some of your friends are dancing. You try to play a mix of different kinds of	-ongs (s)	Is the party for a friend of yours?	Y		×

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
Block 4							
4.1	Positive	You are working an evening slot in your local shop. At the end of the shift you accidentally drop a bottle of wine. When you get into work the next day, your boss wants to talk to you. He tells you that your work performance is	satisf-ct-ry (a)	Is your boss happy with your work performance?	Y	×	
	Negative	You are working an evening slot in your local shop. At the end of the shift you accidentally drop a bottle of wine. When you get into work the next day, your boss wants to talk to you. He tells you that your work performance is	c-rel-ss (a)	Is your boss happy with your work performance?	N		
4.2	Positive	Your mother asks you to iron a blouse for a family get-together next weekend. At the family reunion your aunt looks at your blouse with	-pprov-l (a)	Does your aunt dislike your blouse?	N	×	
	Negative	Your mother asks you to iron a blouse for a family get-together next weekend. At the family reunion your aunt looks at your blouse with	dis-pprov-l (a)	Does your aunt dislike your blouse?	Y		
	Neutral	Your mother asks you to iron a blouse for a family get-together next weekend. At the family reunion your aunt looks at your blouse with	-urios-ty (c)	Did you iron the blouse yourself?	Y		
4.3	Positive	You are meeting your friends at the cinema and decide to wear your new cap. As soon as you walk over to them, they stop talking and look at you. You are sure this is because they find your cap	f-nt-stic (a)	Do your friends like your cap?	Y	×	×
	Negative	You are meeting your friends at the cinema and decide to wear your new cap. As soon as you walk over to them, they stop talking and look at you. You are sure this is because they find your cap	r-dic-lous (i)	Do your friends like your cap?	N		
	Neutral	You are meeting your friends at the cinema and decide to wear your new cap. As soon as you walk over to them, they stop talking. You say hello to one	an-th-r (o)	Did you meet your friends at the park?	N		×
4.4	Positive	You have been playing basketball at school for a few years. One of the best teams in the sports club is looking for a new player. You ask your trainer advice on whether to go to the try-outs. You are sure that he thinks your chances are	str-ng (o)	Does your trainer think you should go to the try-outs?	Y	×	×
	Negative	You have been playing basketball at school for a few years. One of the best teams in the sports club is looking for a new player. You ask your trainer advice on whether to go to the try-outs. You are sure that he thinks your chances are	sl-m (i)	Does your trainer think you should go to the try-outs?	N		
	Neutral	You have been playing basketball at school for a few years. One of the best teams in the sports club is looking for a new player. Your best friend decides to try out for the	te-m (a)	Did your friend try out for the football team?	N		×
4.5	Positive	One weekend you decide to dye your hair red. You are excited at first but then not so sure. You think the other kids at school think your new hair colour is	pr-tty (e)	Do your classmates think your hair looks weird	N	×	×

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Negative	One weekend you decide to dye your hair red. You are excited at first but then not so sure. You think the other kids at school think your new hair colour is	str-nge (a)	Do your classmates think your hair looks weird?	Y		
	Neutral	One weekend your sister decides to dye her hair red. You are excited at first but then not so sure. You think that the new hair colour is	bol- (d)	Is your sisters new hair colour eye-catching?	Y		×
4.6	Positive	During a year club assembly your drama teacher asks you to make a quick announcement about the upcoming play. You try to make it interesting and some people begin to giggle. This must be because your jokes are	f-nny (u)	Do the other students find your jokes stupid?	N	×	×
	Negative	During a year club assembly your drama teacher asks you to make a quick announcement about the upcoming play. You try to make it interesting and some people begin to giggle. This must be because your jokes are	s-lly (i)	Do the other students find your jokes stupid?	Y		
	Neutral	During a year club assembly your drama teacher asks you to make a quick announcement about the upcoming play. You say when the auditions will be. After you finish your announcement you sit back	d-wn (o)	Was the announcement about a play?	Y		×
4.7	Positive	One of your new classmates who is quite handsome is talking to your friends. You go over to join them but when they see you they stop talking. Your friend later tells you that the new classmates thinks that you are	c-te (u)	Does your new classmate find you attractive?	Y		
	Negative	One of your new classmates who is quite handsome is talking to your friends. You go over to join them but when they see you they stop talking. Your friend later tells you that the new classmates thinks that you are	un-ttract-ve (a)	Does your new classmate find you attractive?	N	×	
	Neutral	One of your new classmates who is quite handsome is talking to your friends. You go over to join them but when they see you they stop talking. Your friend later tells you that the new classmate was talking about his old	s-ho-l (c)	Is the boy new to your school?	Y		
4.8	Positive	You have just taken an important test in biology. On the last exam you did not do so well. After the next biology lesson, your teacher wants to talk to you. He tells you that your mid-term results are	reas-n-ble (o)	Did you do badly on this exam?	N		
	Negative	You have just taken an important test in biology. On the last exam you did not do so well. After the next biology lesson, your teacher wants to talk to you. He tells you that your mid-term results are	po-r (o)	Did you do badly on this exam?	Y	×	
	Neutral	You have just taken an important test in biology. On the last exam you did not do very well. After the next biology lesson, your teacher wants to talk to you. He tells you that your test results are	o-t (u)	Had your biology test been marked?	Y		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
4.9	Positive	For your English class you had to write an essay about Romeo and Juliet and how this story relates to modern life. Your essay is quite long. The next day you are asked to read it in front of your class. When you finish your classmates say that they find it rather	t-uch-ng (o)	Do your classmates dislike your essay?	N	×	
	Negative	For your English class you had to write an essay about Romeo and Juliet and how this story relates to modern life. Your essay is quite long. The next day you are asked to read it in front of your class. When you finish your classmates say that they find it rather	ch-ld-sh (i)	Do your classmates dislike your essay?	Y		
4.10	Positive	You are discussing the latest song by a band you and your friends like a lot. Most of your friends think the new song is rubbish. When you say that you actually like the song, they look at you with	r-sp-ct (e)	Did your friends respect your different views?	Y	×	×
	Negative	You are discussing the latest song by a band you and your friends like a lot. Most of your friends think the new song is rubbish. When you say that you actually like the song, they look at you with	di-g-st (s)	Did your friends respect your different views?	N		
	Neutral	You are talking about the latest song by a band you and your friends like a lot. You have not heard it yet, but they have. Your friends tell you that the bands new song sounds completely	dif-er-nt (f)	Had you heard the new song?	N		
4.11	Positive	You arrive at your school's disco night feeling a little overdressed. You see some of the older kids looking at you. You are sure that they find your outfit	styl-sh (i)	Do the older kids find your outfit ridiculous?	N	×	
	Negative	You arrive at your school's disco night feeling a little overdressed. You see some of the older kids looking at you. You are sure that they find your outfit	st-p-d (u)	Do the older kids find your outfit ridiculous?	Y		
	Neutral	You arrive at your school disco feeling a little overdressed. You see some of the older kids looking at you. You are sure that they think what youre wearing is	sm-rt (a)	Did you wear casual clothes to the disco?	N		
4.12	Neutral	Your teacher asks you to read a poem out loud in class. When you finished reading, you see some of your classmates	wr-t-ng (i)	Do you read a poem in front of the class?	Y		×
Block 5							
5.1	Positive	You have just hung up some new posters in your room when your friends come over to see you. As they walk into the room, you see that they are surprised. They appear to be	i-pr-ss-d (m)	Do your friends like what you had done?	Y	×	
	Negative	You have just hung up some new posters in your room when your friends come over to see you. As they walk into the room, you see that they are surprised. They appear to be	h-rr-fi-d (o)	Do your friends like what you had done?	N		
5.2	Positive	One of your teachers asks everyone to come up with ideas for the school play. When you are asked to give your ideas, you think that your classmates will find them	exc-t-ng (i)	Do your classmates find your ideas dull?	N	×	×

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Negative	One of your teachers asks everyone to come up with ideas for the school play. When you are asked to give your ideas, you think that your classmates will find them	unor-gin-l (i)	Do your classmates find your ideas dull?	Y		
	Neutral	One of your teachers asks everyone to come up with ideas for the school play. When you are asked to give your ideas, you say them to the rest of your	cl-ssm-tes (a)	Is the teacher open to suggestions for the play?	Y		×
5.3	Positive	You are on tour with your badminton club and are sharing a room with three people you do not know really well. As you unpack, none of you talk. You feel that sharing a room with them will be	f-ne (i)	Will it be easy to get along with your new roommates?	Y	×	
	Negative	You are on tour with your badminton club and are sharing a room with three people you do not know really well. As you unpack, none of you talk. You feel that sharing a room with them will be	har- (d)	Will it be easy to get along with your new roommates?	N		
	Neutral	You are on tour with your badminton club and are sharing a room with three people you do not know really well. As you unpack, none of you talk. You feel that sharing a room with them will be	q-iet (u)	Are you good friends with your roommates?	N		
5.4	Positive	You raise your hand to give your views during a debate in the English lesson. When your teacher picks you, you suddenly think that the others will find your opinions	int-ll-g-nt (e)	Do the others approve of your opinion?	Y	×	×
	Negative	You raise your hand to give your views during a debate in the English lesson. When your teacher picks you, you suddenly think that the others will find your opinions	inc-rr-ct (o)	Do the others approve of your opinion?	N		
	Neutral	Your teacher organises a debate in the English lesson. The person before you is speaking. You put up your hand to speak	nex- (t)	Is someone else speaking at the moment?	Y		×
5.5	Positive	You receive an email saying that one of your classmates has commented on your picture on facebook. While opening the webpage you think that it must be something	n-ce (i)	Is the comment negative?	N	×	×
	Negative	You receive an email saying that one of your classmates has commented on your picture on facebook. While opening the webpage you think that it must be something	n-sty (a)	Is the comment negative?	Y		
	Neutral	You receive an email saying that one of your classmates has put a comment on your picture on facebook. While opening the webpage you think that it must be something	w-tty (i)	Do you look at the comment the person made?	Y		
5.6	Neutral	At your English class, you are given some homework to finish for next week. You finish it early and ask your teacher for his opinion. He says the work is good, apart from missing out a section. He probably thinks you are	le-rn-ng (a)	Is your teacher dissatisfied with your work?	N		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
5.7	Positive	It is your first day playing football for a new team. You report to your coach after training. Their first impression of you is probably that you are very	ke-n (e)	Does your coach think that you are anxious about your first day?	N	×	
	Negative	It is your first day playing football for a new team. You report to your coach after training. Their first impression of you is probably that you are very	w-rr-ed (o)	Does your coach think that you are anxious about your first day?	Y		
	Neutral	It is your first day playing football for a new team. You report to your coach after training. Their first impression of you is probably very	-mport-nt (i)	Do you want to make a good impression on your new team?	Y		
5.8	Positive	You are asked to be the DJ at the school's disco night. While playing music you see a few of your classmates. You can see that they think your choice of music is	awes-me (o)	Does the class like your music?	Y	×	×
	Negative	You are asked to be the DJ at the school's disco night. While playing music you see a few of your classmates. You can see that they think your choice of music is	b-r-ng (o)	Does the class like your music?	N		
	Neutral	You are asked to be the DJ at the school disco. While playing music you see a few of your classmates. They are standing near to the	spe-k-rs (a)	Were you playing music at the disco?	Y		
5.9	Positive	You are listening to your favourite band on your iPod. One of your classmates suddenly takes out your earphones and holds them to her ears. Having your classmate listen to your music makes you feel	g-od (o)	Does your classmate find your taste of music weird?	N	×	×
	Negative	You are listening to your favourite band on your iPod. One of your classmates suddenly takes out your earphones and holds them to his ears. Having your classmate listen to your music makes you feel	h-m-liat-d (u)	Does your classmate find your taste of music weird?	Y		
	Neutral	You are listening to your favourite band on your iPod. One of your classmates suddenly takes out your earphones and holds them to their ears. When the song ends he hands you back the	-eadph-nes (h)	Did your classmate want to hear what you were listening to?	Y		
5.10	Positive	At a school Christmas party you are dancing with your friends. You suddenly notice that the boy you quite like is looking at you. You think this is because he finds you	c-te (u)	Does the boy like you?	Y	×	
	Negative	At a school Christmas party you are dancing with your friends. You suddenly notice that the boy you quite like is looking at you. You think this is because he finds you	f-lish (o)	Does the boy like you?	N		
5.11	Positive	At your maths class you are asked to write the homework on the black-board. When you have finished your teacher looks at it with an expression of	agr-m-nt (e)	Does your teacher approve of your work?	Y	×	×
	Negative	At your maths class you are asked to write the homework on the black-board. When you have finished your teacher looks at it with an expression of	disagr-m-nt (e)	Does your teacher approve of your work?	N		

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Neutral	In your maths class you are asked to write the homework on the black-board. When you have finished, your teacher collects the	tex-bo-ks (t)	Does your classroom have a whiteboard?	N		×
5.12	Positive	You spend an evening with a friend and end up talking about her problems she is experiencing with her stepfather. You expect that she will find your advice	h-lpf-l (e)	Does your friend think you gave her poor advice?	N		
	Negative	You spend an evening with a friend and end up talking about her problems she is experiencing with her stepfather. You expect that she will find your advice	unh-lpful (e)	Does your friend think you gave her poor advice?	Y	×	
	Neutral	You spend an evening with a friend and end up talking about the problems she is having with her stepfather. You try your best to give her good	adv-ce (i)	Was your friend having problems with their stepmother?	N		
Additional Material for Mixed Valence Training and Chapter 7							
1	Positive	One of your friends is organising a party and asks you to help prepare some food. You decide to bake some cupcakes. At the party when you watch people eating them you can tell they think they are	t-sty (a)	Did the party guests like your cakes?	Y	×	×
	Neutral	One of your friends is organising a party and asks you to help prepare some food. You decide to bake some	c-kes (a)	Did you throw the party yourself?	N		×
2	Negative	In a PE lesson at school you are playing tennis. The teacher tells everyone to stop and look at what you are doing. You feel sure this is because your playing is	b-d (a)	Were you used as a good example in the tennis game?	N	×	
3	Positive	You are playing videogames with some friends. You have been playing the same game for a while and suggest changing to something different. You think that your friends will	agr- (e)	Were your friends cross with your suggestion?	N	×	×
	Neutral	You are playing videogames with some friends. You have been playing the same game for a while and suggest changing to something different. You and your friends decide to finish the	l-v-l (e)	Are you playing computer games alone?	N		×
4	Negative	You are alone at a bus stop listening to music on headphones. You start singing along to one of your favourite songs, but then notice that some other people are now also standing at the stop. They look like they found your singing	a-ful (w)	Did the other people at the bus stop think your singing was nice?	N	×	
5	Positive	You need to get some books out of the library for a school project. When you take them to the front desk, the librarian smiles as he scans them. You are sure this is because he thinks you are	int-ll-g-nt (e)	Was the librarian impressed with the books you got out?	Y	×	×
	Neutral	You need to get some books out of the library for a school project. When you take them to the front desk, the librarian scans them. He then turns back to another librarian to finish telling a	j-ke (o)	Were the books for a school project?	Y		×
Additional Material for Chapter 7 Only							

No.	Valence	Scenario	Word Fragment (Letter)	Comprehension Question	Answer	Mixed Valence	Chapter 7
	Positive	You are reading a book and come across a hard word so you ask your mum what it means. You think your mum will think you are	m-tiv-ted (o)	Is your mum impressed with your reading?	Y		×
	Neutral	You are reading a book and come across a hard word so you ask your mum what it means. You think your mum will know its	me-ni-g (a)	Were you confused by a word in the book?	Y		×
	Positive	You are cycling in the park. You see some people from your school. As you wave at them your bike begins to wobble. By the look on their faces you can see that they are	c-ncern-d (o)	Did your classmates laugh at you?	N		×
	Neutral	You are cycling in the park. You see some people from your school. You wave at them from your bike. After you pass them, you carry on	cy-li-g (c)	Did you see people you knew while cycling?	Y		×
	Positive	It is the end of the year and you are doing exams. During one exam, your teacher is walking around the room and stops behind you. The thought of them watching you write makes you feel	sp-cial (e)	Does your teacher being there make you feel less confident?	N		×
	Neutral	It is the end of the year and you are doing exams. During one exam, you are concentrating really hard, so you dont hear the sound of other people	wr-tin- (i)	Are you taking a test at the start of the year?	N		×
	Neutral	In art class you are put into pairs and told to draw portraits of each other. You show your partner the picture you have drawn of her, and she takes it to have a better	l-k (o)	Will your partner have to draw a picture of you?	Y		×
	Positive	You are trying to help clean up in the kitchen and you accidentally drop a bottle of milk, which smashes. When your dad finds out, he tells you he thinks you are	h-rdw-rking (a)	Is your dad happy with you?	Y		×
	Neutral	You are trying to help clean up in the kitchen and you accidentally drop a bottle of milk, which smashes. Your dad helps cleans up the broken	gl-ss (a)	Was the milk bottle made of plastic?	N		×
	Neutral	You and your friends went to a party last night. It was quite far away and so it took a while to get there. When you arrived, you saw a lot of people that you	kn-w (e)	Was the party very near?	N		×

E

Power Analyses

Post-hoc power analyses were conducted on statistical examinations of the Interpretation Bias Test in Chapter 4 to determine if analyses were sufficiently powered to detect differences between groups in post-training interpretation biases. Effect sizes are presented below for each comparison made in analyses of responses in the Interpretation Bias Test in Chapter 4. Given these effect sizes, prospective sample sizes were calculated that would allow for sufficiently-powered tests of the observed effects, using the program G*Power3.0 (Faul, Erdfelder, Lang, & Buchner, 2009). All sample sizes are calculated for error rates of $\alpha = 0.05$, $\beta = 0.85$. For reference the sample sizes used in Chapter 4 were as follows:

	<i>n</i>
Positive Training	24
Negative Training	21
Mixed-Valence Training	22
Neutral Training	23

Targets showed a significant Probe-Valence*Training-Group interaction: $F(3, 86) = 6.03, p = .001, \eta^2 = .168$. This interaction is illustrated in Figure 4.3 by the white (Positive Targets) and solid grey (Negative Targets) bars. The required sample size (per group) to have shown this effect was $n = 19$, suggesting that Chapter 4 was sufficiently powered to demonstrate this effect. However, effects were not as strong for post-hoc comparisons between target types and training groups.

E.1 Paired-Sample *t*-tests For Each Training Group

Tests in the table below are for similarity ratings given by participants to positive and negative targets in relation to ambiguous novel scenarios in the Interpretation Bias Test. All comparisons are of the form: Positive Targets–Negative Targets. Group sizes are presented for both 1-tailed and 2-tailed tests. One-tailed

tests are appropriate for comparisons of positive and negative targets in the positive and negative training groups, whereas 2-tailed tests are more theoretically appropriate for comparisons in the control training groups.

Training Group	df	<i>t</i>	<i>p</i>	Cohen's <i>d</i>	Required <i>n</i>	
					1-tailed	2-tailed
Positive	23	4.27	< .001**	0.871	5	6
Negative	20	−1.71	.103	0.373	14	18
Mixed	21	0.97	.343	0.207	42	53
Neutral	22	1.39	.179	0.290	22	28

Given the *ns* of each group above, it appears that the sample in Chapter 4 was sufficiently powered to determine within-group comparisons of ratings of positive and negative target statements in the Interpretation Bias Test. However, there may have also been a difference between post-training ratings of positive and negative targets that Chapter 4 was not able to detect. It would be plausible for future replications to use sample sizes of $n = 50$ – 60 per training-group to ascertain whether this difference was in fact present.

E.2 Post-Hoc Between-Groups Comparisons

This set of tests describes comparisons of ratings between specific pairs of training groups. The first table presents effect sizes for between-group comparisons of similarity ratings for positive targets, and the second table for ratings of negative targets. Again tables present sample sizes (per group) that would be required to demonstrate significant effects given effect sizes of findings from Chapter 4 for both 1-tailed and 2-tailed tests. One-tailed tests would be sufficient for comparisons involving either positive or negative training groups, but it would be more appropriate to use 2-tailed tests for comparisons of mixed-valence to neutral training.

Comparison	df	<i>t</i>	<i>p</i>	<i>d</i>	Required <i>n</i>	
					1-tailed	2-tailed
Positive-Negative	43	−2.81	.008**	0.856	21	26
Positive-Mixed	41	−1.18	.247	0.367	108	135
Positive-Neutral	42	−1.31	.198	0.403	90	112
Negative-Mixed	44	1.76	.085	0.531	52	65
Negative-Neutral	45	1.85	.071	0.552	48	60
Mixed-Neutral	43	−0.05	.958	0.016	56168	70145

Table E.1: Specific group-wise comparisons for similarity ratings of Positive Targets

The most obvious feature of these power analyses is that there is emphatically no difference in post-training ratings of positive or negative targets between the mixed-valence and neutral control training groups. Moreover, any possible difference between these control groups would be so minuscule as to

Comparison	df	<i>t</i>	<i>p</i>	<i>d</i>	Required <i>n</i>	
					1-tailed	2-tailed
Positive-Negative	43	4.29	< .001**	1.308	10	12
Positive-Mixed	41	2.19	.034*	0.685	32	40
Positive-Neutral	42	2.48	.017*	0.767	26	32
Negative-Mixed	44	−1.53	.132	0.463	68	85
Negative-Neutral	45	−2.26	.029*	0.673	33	41
Mixed-Neutral	43	−0.29	.771	0.089	1816	2268

Table E.2: Specific group-wise comparisons for similarity ratings of Negative Targets

be statistically irrelevant outside of the use of huge samples. Analyses in Chapter 4 were sufficiently powered to determine between-groups comparisons of ratings of positive and negative targets between positive and negative training groups. Indeed these comparisons were found to be significant in Chapter 4. However findings are less clear for comparisons of ratings of positive and negative targets between control and valenced training groups. It may be the case that significant differences would be seen upon the relatively modest increment of group sizes to $n = 50\text{--}60$, similar to as advised above. It is worth noting that the directions of all comparisons—significant or non-significant—between control and valenced training groups in the tables above are in the hypothesised valence-congruent directions. It is imperative to point out that *t*-tests and critical values in the tables above are not adjusted for multiple comparisons, so various apparently significant differences between control and valenced training groups for endorsements of negative targets did not reach the 5% significance level after post-hoc corrections, as reported in the results section of Chapter 4.

F

Recent Events Scale

Recent Events Scale

Below is a list of events that you may have experienced recently. Please answer YES or NO to each event to indicate whether **you have ACTUALLY experienced** this event over the last 6 months. If YES, please indicate how much you think the event had an impact on your life, how desirable it was, whether you were able to cope, and how controllable the event was by placing a circle around the appropriate statement. Remember, for each event that you have actually experienced during the past year, (1) circle YES to indicate that you have experienced the event, (2) indicate your opinion on the event by placing a circle around the appropriate statement for each question.

Please only respond to those events you have ACTUALLY EXPERIENCED during the last 6 months

EVENT	DID THIS HAPPEN?
1. Arguments or fights between parents or other family members	YES/NO

If answered 'NO' please continue with question 2.

If answered 'YES'...

- 1.1 How much impact did this event have on your life?**
- | | | | |
|--------|--------|----------|--------|
| No | Some | Moderate | Severe |
| Effect | Effect | Effect | Effect |
- 1.2 How desirable was this event?**
- | | | | |
|-------------|-------------|-----------|-----------|
| Undesirable | Somewhat | Desirable | Very |
| | Undesirable | | Desirable |
- 1.3 How able were you to cope with this event?**
- | | | | |
|--------|----------|------|------|
| Unable | Somewhat | Able | Very |
| | Unable | | Able |
- 1.4 How much did you think you could control this event?**
- | | | | |
|-------------------|----------|------------|-----------|
| Not in my control | Somewhat | Moderately | Very much |
|-------------------|----------|------------|-----------|

F. RECENT EVENTS SCALE

in my control in my control in my control

2. **Problems or arguments between you and close family members** YES/NO

If answered 'NO' please continue with question 3.

If answered 'YES'...

2.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

2.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

2.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

2.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

3. **Arguments or problems with your boyfriend/girlfriend** YES/NO

If answered 'NO' please continue with question 4.

If answered 'YES'...

3.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

3.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

3.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

3.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

4. **Being rejected/ignored by someone you are romantically interested in** YES/NO

If answered 'NO' please continue with question 5.

If answered 'YES'...

4.1 How much impact did this event have on your life?

No	Some	Moderate	Severe

Effect	Effect	Effect	Effect
4.2 How desirable was this event?			
Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable
4.3 How able were you to cope with this event?			
Unable	Somewhat	Able	Very
	Unable		Able
4.4 How much did you think you could control this event?			
Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

5. Feeling pressure from your friends YES/NO
(e.g friends expect you to do things or be a certain way)

If answered 'NO' please continue with question 6.
 If answered 'YES'...

5.1 How much impact did this event have on your life?			
No	Some	Moderate	Severe
Effect	Effect	Effect	Effect
5.2 How desirable was this event?			
Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable
5.3 How able were you to cope with this event?			
Unable	Somewhat	Able	Very
	Unable		Able
5.4 How much did you think you could control this event?			
Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

6. Arguments or problems with a friend YES/NO

If answered 'NO' please continue with question 7.
 If answered 'YES'...

6.1 How much impact did this event have on your life?			
No	Some	Moderate	Severe
Effect	Effect	Effect	Effect
6.2 How desirable was this event?			
Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable
6.3 How able were you to cope with this event?			
Unable	Somewhat	Able	Very
	Unable		Able
6.4 How much did you think you could control this event?			
Not in my control	Somewhat	Moderately	Very much

F. RECENT EVENTS SCALE

in my control in my control in my control

7. Concern or worries about your future

YES/NO

If answered 'NO' please continue with question 8.

If answered 'YES'...

7.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

7.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

7.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

7.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

8. Financial troubles or worry over money

YES/NO

If answered 'NO' please continue with question 9.

If answered 'YES'...

8.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

8.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

8.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

8.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

9. Doing poorly on an exam or paper

YES/NO

If answered 'NO' please continue with question 10.

If answered 'YES'...

9.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

9.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

9.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

9.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

10. Getting into trouble from school

YES/NO

If answered 'NO' please continue with question 11.

If answered 'YES'...

10.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

10.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

10.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

10.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

11. Getting bad grades or progress reports at school

YES/NO

If answered 'NO' please continue with question 12.

If answered 'YES'...

11.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

11.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

11.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

11.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

12. Having to study things you do not understand

YES/NO

F. RECENT EVENTS SCALE

If answered 'NO' please continue with question 13.

If answered 'YES'...

12.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

12.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

12.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

12.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

13. Negative feelings or worrying about appearance

YES/NO

If answered 'NO' please continue with question 14.

If answered 'YES'...

13.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

13.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

13.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

13.4 How much did you think you could control this event?

Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

14. New family responsibilities at home

YES/NO

If answered 'NO' please continue with question 15.

If answered 'YES'...

14.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

14.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

14.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very

	Unable		Able
14.4 How much did you think you could control this event?			
Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

15. Restrictions at home YES/NO
(e.g. having to be in at a certain time, not being allowed to do something you would have done)

If answered 'NO' please skip this question

If answered 'YES'...

15.1 How much impact did this event have on your life?

No	Some	Moderate	Severe
Effect	Effect	Effect	Effect

15.2 How desirable was this event?

Undesirable	Somewhat	Desirable	Very
	Undesirable		Desirable

15.3 How able were you to cope with this event?

Unable	Somewhat	Able	Very
	Unable		Able

15.4 How much did you think you could control this event?

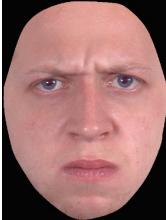
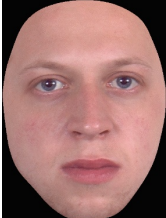
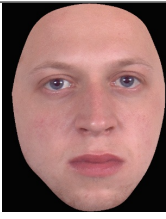
Not in my control	Somewhat	Moderately	Very much
	in my control	in my control	in my control

G

Example Face Stimuli From Chapter 7

In Chapter 7's Face Emotion Task participants were required to identify ambiguous facial stimuli. On each trial participants were shown a face and required to identify its emotion as quickly as possible. Participants did not receive feedback on their responses.

Participants viewed 4 facial emotions (Angry, Happy, Scared, Sad), each displayed by a male and a female actor. Each emotion was presented at 6 different intensities: 13.33%, 26.67%, 36.67%, 50.00%, 63.33%, and 76.67%. This gave 48 trials in total (4 emotions $\times$ 6 intensities $\times$ 2 genders). Face stimuli were taken from the set used by Lau et al. (2009). The different intensities were achieved by digitally morphing intense emotional expressions with neutral expressions portrayed by the same model. Examples of each emotion at minimum (13.33%) and maximum intensity (76.67%) are given below:

Emotion	Female Intensity		Male Intensity	
	Minimum	Maximum	Minimum	Maximum
Angry				
Happy				
Scared				
Sad				

H

Information Sheets And Consent Forms

Information sheets and consent forms are given on the following pages for novel data collection conducted as part of this thesis. In order these are:

- Information sheet and consent for the study reported in Chapter 2
- Parental information sheet and consent form for Chapters 4 and 5
- Participant information sheet and assent form for Chapters 4 and 5
- Parental information sheet and consent form for Chapter 6
- Participant information sheet and assent form for Chapter 6
- Parental information sheet and consent form for Chapter 7
- Participant information sheet and assent form for Chapter 7



Researching Emotional Disorders in Development



Social Relationships and Decision-Making Information Sheet for Participants

Stefano Belli & Dr. Jennifer Lau

We are conducting a study about how people respond to social exchanges. We would like to invite you to be part of this study and hope that you would like to take part. However, before you decide, it is important that you understand why we are doing this study and what it involves. Please remember that you do not have to take part in the study.

WHAT ARE WE TRYING TO FIND OUT?

There are lots of differences in the way that people respond to everyday situations and their social relationships. Differences in these response patterns might explain why some people are more anxious, worried or sad than others. Our research aims to investigate how differences in the ways that people reason about social situations and make decisions relate to mood and anxiety problems. We hope that this study can tell us a little about how we can treat these problems.

WHAT WILL HAPPEN IF I TAKE PART?

A member of our research team will contact you to make an appointment for you to come to the Department of Experimental Psychology. We will reimburse standard travel and parking costs. The session will take between 30 and 45 minutes. During this time, you will be asked to play a game with another participant that involves making investments and sharing profits. Depending on your performance in the game, you will be reimbursed up to £5 for your participation. You will also be asked to complete some questionnaires about your mood and feelings. As the experiment may involve situations that are similar to everyday situations in your life, a small proportion of participants might find these a little upsetting. For this reason, we do not want to include people who have had a history of anxiety or mood problems to take part in the study.

WHAT HAPPENS TO THE RESULTS OF THE STUDY?

In accordance with normal legal requirements, your identity will be kept confidential at all times. Results for each participant are also kept strictly confidential. Participants are identified by a code number only and all information is kept in a locked filing cabinet in the University. We will also keep an electronic database of the results from the computer tasks and questionnaire, but these will

not contain any identifying information. A summary of our findings will be given to the school and will be available to interested families. We also aim to publish our findings in scientific journals.

WHO IS CONDUCTING THIS RESEARCH?

The research project is organised by Dr Jennifer Lau (Lecturer in Psychology) of Oxford University and Stefano Belli. This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

WHAT SHOULD I DO IF I HAVE A COMPLAINT?

If you have a concern or complaint about this study, you may contact the project's director, Dr Jennifer Lau in the first instance. In addition, the University procedure for reporting misconduct will also be open to you. Allegations of misconduct should be reported to: The Registrar, University Offices, Wellington Square, Oxford, OX1 2JD.

WHAT SHOULD I DO NEXT?

If you have any questions about the study (now or later), please contact one of the researchers who will be happy to discuss the study with you. If you have any questions or concerns, or if you would like to discuss the research in more depth beforehand, please contact one of the research team:

Dr Jennifer Lau

[REDACTED]

[REDACTED]

Stefano Belli

stefano.belli@psy.ox.ac.uk

[REDACTED]

You can write to us at the following address:

Department of Experimental Psychology, University of Oxford, South Parks Rd, Oxford OX1 3UD.



Researching Emotional Disorders in Development



Social Exchanges and Decision-Making

Consent form for participants

Stefano Belli & Jennifer Lau

Please tick the boxes that apply and fill in your details at the bottom:

I have read and understood the details of the above study, and have had the opportunity to consider the information, ask questions and discuss the study with others.

☐

I understand that participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my education, medical care or legal rights being affected in any way.

☐

I agree to personal data being collected through the study. I know that this will be securely stored on computer and used only for the purpose of contacting me about the study or for monitoring or audit of the study by designated individuals from the University of Oxford.

☐

I agree to results of this research study being reported in medical journals or at scientific meetings, but know that the people who take part will not be named or identified.

☐

I understand how to raise a concern or make a complaint about this study.

☐

I agree to take part in this study.

Name:

Signature:

Date:

We will need the following details in order to contact you to make an appointment:

Your address:

Your phone number:

Your email address:

If you would like to receive an annual newsletter about our research, please tick this box:

☐

If you would like to be contacted about similar studies in the future, please tick this box:

☐



Researching Emotional Disorders in Development



A Study of Thoughts and Feelings in Young People

Information sheet for parents

Dr. Jennifer Lau, Stefano Belli

We are conducting a study about how young people understand emotional events and social relationships. Your son or daughter has been invited to take part, and we have given him/her more information about the study. Your child does not have to participate and if your child does decide to take part, he/she is free to stop at any time without giving a reason and with no negative consequences. This Information Sheet tells you more about the study, but this is for your information only. If you have any questions or concerns, please speak to your child or contact us for further information. Our contact details are at the end of this Information Sheet.

What are we trying to find out?

There are lots of differences in the way that people think about information in everyday situations and in their social relationships. Differences in these thought patterns might explain why some young people become anxious, worried and even sad. Our research aims to investigate how differences in the way that young people reason about social situations and make decisions. We are especially interested in how young people make judgments based on different types of information that they are given. This research may help us understand why some young people worry excessively or feel low. More importantly, these findings may tell us a little about how we can treat these problems.

What will happen if my child decides to take part?

A member of our research team will contact you to make an appointment for you and your child to come to the Department of Experimental Psychology (outside of school hours). We will reimburse standard travel and parking costs. During this time, he/she will complete some questionnaires about his/her mood and feelings. He/she will also be asked to complete some computer tasks. These tasks will ask your child to read some short stories about everyday social situations and completing missing words in the stories and answering questions. By completing the missing words, the stories always take on either a positive or negative meaning that may temporarily affect their mood. We will ask them questions about their moods and feelings in general and to events that might have happened to them in the past year. As these experiments may involve situations that are similar to

everyday situations in your child's life, a small proportion of children might find these a little upsetting. For this reason, we do not want young people who have had a history of anxiety or mood problems to take part in the study. Similarly, the experiments may involve a lot of reading. People who find reading difficult may find the experiment frustrating. In these cases we will leave it up to young people to decide whether to take part. Your son/daughter is welcome to take part if he/she wants to.

What happens to the results of the study?

In accordance with normal legal requirements, participants' identities will be kept confidential at all times. Results for each participant are also kept strictly confidential. Participants are identified by a code number only and all information is kept in a locked filing cabinet in the University. We will also keep an electronic database of the results from the computer tasks and questionnaires, but these will not contain any identifying information. We will give schools and interested families a summary of our findings. We also aim to publish our findings in scientific journals. Reports and publications will not identify any individual participants. They will only report overall group data.

Who is conducting this research?

The research project is organised by Dr Jennifer Lau (Lecturer in Psychology) and Stefano Belli (a research psychologist) of Oxford University. This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

What should I do if I have a complaint?

If you have a concern or complaint about this study, you may contact the project's director, Dr Jennifer Lau in the first instance. In addition, the University procedure for reporting misconduct will also be open to you. Allegations of misconduct should be reported to: The Registrar, University Offices, Wellington Square, Oxford, OX1 2JD.

What should I do next?

Your son or daughter is old enough to decide whether or not he/she wants to take part, so you do not need to do anything. However, if you have any questions about the study (now or later), please contact one of the researchers who will be happy to discuss the study with you.

Dr Jennifer Lau

Stefano Belli

stefano.belli@psy.ox.ac.uk

You can also write to either of us at the following address:

Department of Experimental Psychology, University of Oxford, South Parks Rd, Oxford OX1 3UD.



Researching Emotional Disorders in Development



A Study of Thoughts and Feelings in Young People

Consent Form for Parents

Dr. Jennifer Lau, Stefano Belli

Please tick the boxes that apply and fill in your details at the bottom:

I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I agree to the participation of my child being voluntary and know that we are free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

☐

I agree to personal data being collected during the visit and know that this will be securely stored on computer and used solely for the purpose of contacting me with respect to the study or for monitoring or audit of the study by designated individuals from the University of Oxford.

☐

I agree for data collected in this study to be given to researchers, including those working outside of the EU, to be used in other research studies.

☐

I agree to results of this research study being reported in medical journals or at scientific meetings, but know that the people who take part will not be named and identified.

☐

I understand how to raise a concern or make a complaint about this study.

☐

I hereby give permission for my child to take part in the above study:

Your child's name:

Date of birth:

Your name:

Signature:

Date:

We will need the following details in order to contact you to make an appointment:

Your address:

Your phone number:

Your email address:

If you would like to receive an annual newsletter about our research, please tick this box:

☐

If you would like to be contacted about similar studies in the future, please tick this box:

☐



Researching Emotional Disorders in Development



A Study of Thoughts and Feelings in Young People

Dr. Jennifer Lau, Stefano Belli

We would like to invite you to be part of a study about how young people understand emotional events and social relationships. The different ways that people think about information might explain why some people are sometimes sad, anxious or lonely. Your contribution to our research could help us find ways to reduce these problems. We very much hope you will take part but before you decide, it is important that you understand what the study involves. Please remember that you do not have to take part in this study if you do not want to.

In this study, we are especially interested in how you understand emotional situations. We are NOT interested in evaluating your performance on any of the tests and none of these tests are related to how well you do at school.

If you take part, you will be asked to:

- ◆ Answer questions about your mood and feelings;
- ◆ Complete some computer tasks or games, which involve reading short stories about situations that may be similar to situations you have experienced, and completing any missing words that you come across

You will be able to ask us more questions after the experiment but if you have any questions or concerns now, please contact a member of the research team:

Dr Jennifer Lau

Stefano Belli

stefano.belli@psy.ox.ac.uk

You can also write to any of us at the following address:

Department of Experimental Psychology, University of Oxford, South Parks Rd, Oxford OX1 3UD.



Researching Emotional Disorders in Development



A Study of Thoughts and Feelings in Young People

Assent form for participants

Dr. Jennifer Lau, Stefano Belli

Please tick the boxes that apply and fill in your details at the bottom:

I have read and understood the information about the study

☐

I have had the chance to ask questions about the study

☐

I understand that taking part in the study is voluntary

☐

I understand that all my information will be kept private.

☐

I understand that I am free to stop at any time, without giving a reason.

☐

I agree to take part in this study.

Name:

Signature:

Date:

If you would like to receive an annual newsletter about our research, please tick this box:

☐

If you would like to be contacted about similar studies in the future, please tick this box:

☐



Researching Emotional Disorders in Development



A Study of Thoughts and Feelings in Young People Information Sheet for Parents

**Dr Jennifer Lau
Stefano Belli
Rajesh Chopra**

In partnership with your child's school, we are conducting a study about how young people understand emotional events and social relationships. We would like to invite your child to be part of this study and hope that you and your child would like to take part. Your child will need to have your permission before he or she can take part. However, before you decide, it is important that you understand why we are doing this study and what it involves. Please remember that your child does not have to take part in the study and that your child's school has not given us your contact details.

WHAT ARE WE TRYING TO FIND OUT?

There are lots of differences in the way that people think about information in everyday situations and in their social relationships. Differences in these thought patterns might explain why some young people become anxious, worried and even sad. We are interested in whether we can change the way young people think about social situations by providing them with alternative explanations through training. Research in adults has shown these training techniques to be effective in changing how people think and feel and respond to emotional situations but these effects are only temporary. This research may help us understand why some young people worry excessively or feel low. More importantly, these findings may tell us a little about how we can treat these problems.

WHAT WILL HAPPEN IF MY CHILD TAKES PART?

Your child will be seen individually in a quiet area at school for approximately 45-50 minutes. During this time, he/she will complete some questionnaires about his/her mood and feelings. He/she will also be asked to complete some computer tasks. These tasks will ask your child to read some short stories about everyday social situations and completing missing words in the stories and answering questions. By completing the missing words, the stories always take on either a positive or negative meaning that may temporarily affect their mood. After this we will ask your child to perform a short mental arithmetic task in front of a camera. We will ask them questions about their moods and feelings at that point. To make sure that your child responds as naturally as possible to

the training, we ask that you not discuss the purpose of the experiment with your child until after they have completed it. It is unlikely that the effects of training will have lasting effects on mood, any more than watching a happy or sad film. However, we will also give your child a training task where positive explanations for events are emphasized. As these experiments may involve situations that are similar to everyday situations in your child's life, a small proportion of children might find these a little upsetting. For this reason, we do not want to include adolescents who have had a history of anxiety or mood problems to take part in the study. Similarly, the experiments may involve a lot of reading. If your child finds reading difficult, the experiment may be frustrating for him or her. In these cases we will leave it up to you and your child to decide on whether it is appropriate to take part. Your child is welcome to take part if he or she wants to.

WHAT HAPPENS TO THE RESULTS OF THE STUDY?

In accordance with normal legal requirements, your child's identity will be kept confidential at all times. Results for each participant are also kept strictly confidential. Participants are identified by a code number only and all information is kept in a locked filing cabinet in the University. We will also keep an electronic database of the results from the computer tasks and questionnaire, but these will not contain any identifying information. A summary of our findings will be given to the school and will be available to interested families. We also aim to publish our findings in scientific journals.

WHO IS CONDUCTING THIS RESEARCH?

The research project is organised by Dr Jennifer Lau (Lecturer in Psychology) of Oxford University, Stefano Belli and Rajesh Chopra, student researchers. This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

WHAT SHOULD I DO IF I HAVE A COMPLAINT?

If you have a concern or complaint about this study, you may contact the project's director, Dr Jennifer Lau in the first instance. In addition, the University procedure for reporting misconduct will also be open to you. Allegations of misconduct should be reported to: The Registrar, University Offices, Wellington Square, Oxford, OX1 2JD.

WHAT SHOULD I DO NEXT?

If you have any questions about the study (now or later), please contact one of the researchers who will be happy to discuss the study with you. If you are willing for your child to participate, please complete and sign the attached consent form and give it to your child to take back to school. His/her school will forward it to us and we will then be in touch with you to arrange an appointment.

Your child will then have the opportunity to decide if he or she wants to take part and to sign a separate form of assent.

If you have any questions or concerns, or if you would like to discuss the research in more depth beforehand, please contact one of the research team:

Dr Jennifer Lau

[REDACTED]

[REDACTED]

Stefano Belli

stefano.belli@psy.ox.ac.uk

[REDACTED]

You can write to any of us at the following address:

Department of Experimental Psychology, University of Oxford, South Parks Rd, Oxford OX1 3UD.



Researching Emotional Disorders in Development



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Consent Form for Parents

Dr Jennifer Lau

Stefano Belli

Rajesh Chopra

Please tick the boxes that apply and fill in your details at the bottom:

I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I agree to the participation of my child being voluntary and know that we are free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

☐

I agree to personal data being collected during the visit and know that this will be securely stored on computer and used solely for the purpose of contacting me with respect to the study or for monitoring or audit of the study by designated individuals from the University of Oxford.

☐

I agree for data collected in this study to be given to researchers, including those working outside of the EU, to be used in other research studies.

☐

I agree to results of this research study being reported in medical journals or at scientific meetings, but know that the people who take part will not be named and identified.

☐

I understand how to raise a concern or make a complaint about this study.

☐

I hereby give permission for my child to take part in the above study:

Your child's name:

Date of birth:

Your name:

Signature:

Date:

We will need the following details in order to contact you to make an appointment:

Your address:

Your phone number:

Your email address:

If you would like to receive an annual newsletter about our research, please tick this box:

☐

If you would like to be contacted about similar studies in the future, please tick this box:

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Researching Emotional Disorders in Development



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We would like to invite you to be part of a study about how young people understand emotional events and social relationships. The different ways that people think about information might explain why some people are sometimes sad, anxious or lonely. Your contribution to our research could help us find ways to reduce these problems. We very much hope you will take part but before you decide, it is important that you understand what the study involves. Please remember that you do not have to take part in this study if you do not want to.

In this study, we are especially interested in how you think about social situations. We are NOT interested in evaluating your performance on any of the tests and none of these tests are related to how well you do at school.

If you take part, you will be asked to:

- ◆ Answer questions about your mood and feelings and specific events;
 - Complete some computer tasks or games, which involve:
 - Reading short stories about situations that may be similar to situations you have experienced, and completing any missing words that you come across;

You will be able to ask us more questions after the experiment but if you have any questions or concerns now, please contact a member of the research team:

Dr Jennifer Lau



You can also write to any of us at the following address:

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Assent form for participants

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Stefano Belli

Rajesh Chopra

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Researching Emotional Disorders and Development



A Study of Thoughts and Feelings in Young People

Information Sheet for Parents

Dr Jennifer Lau
Stefano Belli

In partnership with your child's school, we are conducting a study about how young people think about social situations. We would like to invite your child to be part of this study. Your child will need to have your permission before he or she can take part. However, before you decide, it is important that you understand why we are doing this study and what it involves. Please remember that your child does not have to take part in the study.

WHAT ARE WE TRYING TO FIND OUT?

Young people think about new social situations in different ways. These differences might explain why some young people are more often anxious, worried and sad. Starting a new school may bring out some of these worries. We are interested in finding out how young people feel when they first begin secondary school. We also want to find out whether we can change how young people think about these new social situations, by providing them with alternative explanations of different situations. These findings may tell us a little about how we can help children with fears and worries.

WHAT WILL HAPPEN IF MY CHILD TAKES PART?

Your child will be seen individually in a quiet area at school across two days, 24 hours apart. During the first session, he/she will read some short stories about everyday social situations and answer questions about them. By answering these questions, your child will learn to explain situations in particular ways. He/she will also complete some other tasks on the computer such as viewing faces with different expressions. At the second appointment, we will ask your child to complete some more questionnaires on how they are feeling. We will ask them questions about their moods and feelings in general and to events that might have happened to them in the past year. The first session will take about 45-50 minutes while the second session will take about 10 minutes.

WHAT HAPPENS TO THE RESULTS OF THE STUDY?

In accordance with normal legal requirements, your child's identity will be kept confidential at all times. Results for each participant are also kept strictly confidential. Participants are identified by a code number only and all information is kept in a locked filing cabinet in the University. We will

also keep an electronic database of the results from the computer tasks and questionnaire, but these will not contain any identifying information. We aim to publish our findings in scientific journals.

WHO IS CONDUCTING THIS RESEARCH?

The research project is organised by Dr Jennifer Lau and Stefano Belli at the University of Oxford. This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

WHAT SHOULD I DO IF I HAVE A COMPLAINT?

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WHAT SHOULD I DO NEXT?

If you have any questions about the study (now or later), please contact us. If you are willing for your child to participate, please

- o Complete and sign the attached consent form
- o Ask your child to complete the attached questionnaires.
- o Ask your child to bring back both the consent form and the completed questionnaires to his/her classteacher who will forward it to us.
- o We will then arrange an appointment with your child during school hours.

Please note your child will then have the opportunity to decide if he or she wants to take part and to sign a separate form of assent.

Contact details:

Mailing address: Department of Experimental Psychology, University of Oxford, South Parks Rd, Oxford OX1 3UD.

Phone: [REDACTED]

e-mail: stefano.belli@psy.ox.ac.uk



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Stefano Belli

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I agree to the participation of my child being voluntary and know that we are free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

I agree to personal data being collected during the visit and know that this will be securely stored on computer and used solely for the purpose of contacting me with respect to the study or for monitoring or audit of the study by designated individuals from the University of Oxford.

I agree for data collected in this study to be given to researchers, including those working outside of the EU, to be used in other research studies.

I agree to results of this research study being reported in medical journals or at scientific meetings, but know that the people who take part will not be named and identified.

I understand how to raise a concern or make a complaint about this study.

I hereby give permission for my child to take part in the above study:

Your child's name:

Date of birth:

Your name:

Signature:

Date:

We will need the following details in order to contact you to make an appointment:

Your address:

Your phone number:

Your email address:

You would like to be contacted about similar studies in the future:

Yes

No



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If you take part, you will be asked to answer questions about your mood and feelings; read some short stories about social situations; and come back 24 hours later to answer more questions. You will be able to ask us more questions after the experiment but if you have any questions or concerns now, please email us: Stefano.belli@psy.ox.ac.uk

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I understand that I am free to stop at any time, without giving a reason.

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Name:

Signature:

Date:

I would like to be contacted about similar studies in the future

Yes

No

Recommended and Indicative Listening

Albums

Action Bronson	Blue Chips
Joey Bada\$\$	1999
Big Boi	Sir Lucious Left Foot: The Son of Chico Dusty
Björk	Medulla
Mykki Blanco	Cosmic Angel: The Illuminati Princess
Bon Iver	For Emma, Forever Ago
Cakes Da Killa	The Eulogy
Cloud Nothings	Attack on Memory
Drake	Take Care
Fennesz	Black Sea
Fennesz	Endless Summer
Fleetwood Mac	Tango In The Night
The Gaslight Anthem	The '59 Sound
The Get Up Kids	On A Wire
Girl Talk	All Day
Guns N' Roses	Use Your Illusion II
Handsome Furs	Face Control
Cory Johnson	The Legend of Zelda (Demos)
Kendrick Lamar	Section.80
Man Factory	Street Fight! Round One
Man Factory	Street Fight!! Round Two
Matt & Kim	Grand
Matt & Kim	Sidewalks
The Middle Ones	It Is The Rehearsal That Will Make This
The Middle Ones	Slow And Steady
Miguel	Kaleidoscope Dream
The Mountain Parade	Recordings
Terius Nash	1977
Tig Notaro	Live
Passion Pit	Gossamer
Pedro The Lion	It's Hard To Find A Friend
Perfume Genius	Put Your Back N 2 It
Red House Painters	Red House Painters (Rollercoaster)
Sleep	Dopesmoker
The Smashing Pumpkins	Machina II/The Friends & Enemies of Modern Music
Britney Spears	Femme Fatale
Sunset Rubdown	Dragonslayer
Swearin'	Swearin'
Taylor Swift	Fearless
Taylor Swift	Red
Taylor Swift	Speak Now
Tegan and Sara	The Con

RECOMMENDED AND INDICATIVE LISTENING

The-Dream	Love King
Titus Andronicus	The Monitor
Trust Fund	T.F. ∞ ENDLESS 2012
Weezer	Hurley
Weezer	Pinkerton
Weezer	Raditude
Weezer	Songs From The Black Hole
Kanye West	My Beautiful Dark Twisted Fantasy
Wilco	Kicking Television: Live In Chicago
Matt Winkworth & The Winkworthers Originals	And Now For Something Completely Brillig
Wolf Parade	Expo 86
Xenoblade Chronicles	Original Soundtrack
Youth Lagoon	The Year of Hibernation

Singles

40 Watt Sun	Restless
Ace Bushy Striptease	More Parts Per Middle Ones
The Afghan Whigs	Faded
American Football	Never Meant
Apparat	Black Water
Archers of Loaf	Web In Front
Atomic Soda	Breezeblock
Baroness	March To The Sea
Bat For Lashes	Laura
Beyoncé	Countdown
Justin Bieber	Baby
Big Boi ft. Bosko	Tremendous Damage
Black Lips	Bad Kids
Blitzen Trapper	Furr
Bone Thugs-n-Harmony	Tha Crossroads (DJ U-Neek's Mo Thug Remix)
Billy Bragg	Waiting For the Great Leap Forwards
Danny Brown	Grown Up
Danny Brown	Monopoly
Mariah Carey ft. Miguel	#Beautiful
ceo	Come With Me
Chipocrite	Bizarre Love Triangle
Jodie Connor	Now or Never
Constant Teen	Skeleton
The Cranberries	Dreams
Crystal Castles ft. Robert Smith	Not In Love
Miley Cyrus	Party In The USA
Death Cab For Cutie	Cath..
Death Cab For Cutie	The Sound of Settling
Drake	Best I Ever Had (Clean Version)
Drake	Over My Dead Body (Starslinger Remix)
Dungeon Family	Crooked Booty
Dungeon Family	On & On & On
Edward Sharpe and the Magnetic Zeros	Home
Tommy Evans	Ophelia
Sky Ferreira	Everything is Embarrassing
Free Energy	Bang Pop
Fucked Up	Queen Of Hearts
Kyle Gabler	Ode to the Bridge Builder
Kyle Gabler	Red Carpet Extend-o-matic
Gotye vs. The Police	Losing Somebody I Used to Know
Grimes	Genesis
Handsome Furs	Serve The People
Keri Hilson	Pretty Girl Rock
Japandroids	Younger Us
Jay Electronica	Eternal Sunshine (The Pledge)
JEFF The Brotherhood	Hey Friend
Carly Rae Jepsen	Call Me Maybe
Jeremih	My Sunshine
Kendal Johansson	Blue Moon
JoJo	Marvin's Room (Can't Do Better)
Ke\$ha	Your Love Is My Drug
Wiz Khalifa	Black & Yellow
Carole King	(You Make Me Feel Like) A Natural Woman

RECOMMENDED AND INDICATIVE LISTENING

Kendrick Lamar	Bitch Don't Kill My Vibe
Le1f	Wut
Light Asylum	Dark Allies
Lil Wayne	6'7'
Lil Wayne	How To Love
Local Natives	Airplanes
Matt & Kim ft. Soulja Boy & Andrew WK	I'm A Goner
Nicki Minaj	Super Bass
Nicki Minaj & Cassie	The Boys
Anais Mitchell	1984
MNDR	Cut Me Out
Mr. Muthafuckin' eXquire	Huzzah! (Remix) ft. Despot, Das Racist, Danny Brown, El-P
My Chemical Romance	Na Na Na
Charlie Nowell	Messing
OutKast ft. Lil Wayne & Snoop Dogg	Hollywood Divorce
The Perfect Pop Band	Bucket My Dear Friend
Katy Perry	Last Friday Night (T.G.I.F.)
Pictureplane	Post Physical
R Kelly	Echo
R Kelly	I Wish
Lana Del Rey	Video Games (Balam ACAB remix)
Rihanna	We Found Love (Starslinger Remix)
Robyn	Dancing On My Own
Amber Rose	Fame
Jimmy Ruffin	What Becomes of The Broken Hearted
Salem	Better Off Alone
Say Anything	Alive With the Glory of Love
The Smiths	Asleep
Solange	Losing You
Marnie Stern	For Ash
Patrick Stump	Spotlight (New Regrets)
Ten In The Swear Jar	San Jose Fight Song
Titus Andronicus	Anxiety Block
Trust Fund	Scared
Tsar	Wrong
UGK ft. OutKast	International Player's Anthem (I Choose You)
Diana Vickers	Once
Waxahatchee	Swan Dive
The Weeknd	House of Balloons/Glass Table Girls
Weezer	How Long?
Weezer	Trampoline
Kanye West	Family Business
Kanye West	Hey Mama
Kanye West ft. Beyoncé & Charlie Wilson	See Me Now
Matt Winkworth	Emma's Song
Matt Winkworth	Song For Lolo
Xiu Xiu	Honeysuckle
Xiu Xiu	Dear God I Hate Myself
Young Money	BedRock
Yuck	Suicide Policeman

List of abbreviations

Symbol	Description
$-2LL$	$-2 \log$ likelihood
A	Additive genetic factor
a^2	Additive genetic variance component
AIC	Akaike Information Criterion
ASSIQ	Ambiguous Social Situations Interpretation Questionnaire
BDI	Beck Depression Inventory
C	Common (shared) environmental factor
c^2	Common (shared) environmental variance component
CBM	Cognitive Bias Modification
CBM-I	Cognitive Bias Modification of Interpretations
CDI	Children's Depression Inventory
CESBQ	Children's Expectations of Social Behaviour Questionnaire
DZ	Dizygotic
E	Non-shared environmental factor
e^2	Non-shared environmental variance component
ECHO	Emotions, Cognitions, Heredity and Outcome study
FSM	Free school meals
IBT	Interpretation Bias Test
IntQu	Interpretation Questionnaire
LSAS	Liebowitz Social Anxiety Scale
MZ	Monozygotic
POPS	Perceptions Of Peers and Self questionnaire
r_{DZ}	Correlation between dizygotic twins
RES	Recent Events Scale
RMSEA	Root Means Square of Error Approximation
r_{MZ}	Correlation between monozygotic twins
RT	Reaction Time
sd	Standard deviation
SES	Socio-economic status
STAI	State-Trait Anxiety Inventory
STAIC	State-Trait Anxiety Inventory for Children
TEDS	Twins Early Development Study
VAS	Visual Analogue Scale
YOLO	You Only Live Once