

Associations Between Interpretation Bias and Depression in Adolescents

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Abstract Interpretation biases have been shown to play a role in adult depression and are a target in cognitive behavioural therapy. Adolescence is a key risk period for the development of depression and a period of rapid cognitive and emotional development but little research has investigated the relationship between interpretation biases and depression in adolescents. This study adapted a measure of interpretation bias, the Ambiguous Scenarios Test for Depression, for adolescents and evaluated its reliability and validity. A community sample of 206 young people aged 12–18 years completed a validated measure of depression symptoms (Mood and Feelings Questionnaires) and the adapted Ambiguous Scenarios Test. The Ambiguous Scenarios Test for Depression in Adolescents had good internal consistency and split half reliability. Depression symptoms were associated with participants' ratings of the valence of ambiguous situations and with interpretation biases. Importantly, symptoms of depression and anxiety were independently associated with interpretation bias. This research suggests that interpretation biases can be measured in this age group, that negative interpretation biases exist in adolescents and that these are associated with depression symptoms.

Keywords Adolescent · Depression · Cognition · Interpretation

Introduction

Cognitive models of emotional disorders suggest that information processing is biased in anxiety and depression (Mathews and MacLeod 2005). A key element of information processing is the interpretation of ambiguous information. Individuals with anxiety disorders interpret ambiguous information as threatening and the interpretation is typically specific to the type of anxiety disorder, e.g. social threat, physical threat (Richards et al. 2001; Voncken et al. 2003). Research investigating interpretation bias in depression is in its early stages (Gotlib and Joormann 2010) but 'offline' self-report methods and 'online' response latency methods, suggest that, depression in adults is associated with negatively biased interpretation of ambiguous information (Butler and Mathews 1983; Lawson et al. 2002; Rude et al. 2002).

Cognitive behavioural therapy (CBT), a treatment recommended for depression in adults and adolescents (e.g. APA 2010; NICE 2005, 2009) includes targeting interpretation biases as a core technique. It is generally assumed that the cognitive model of depression applies to adolescents and thus that they will also exhibit negative cognitive biases. However, CBT appears to be less effective with depressed adolescents than with adults (e.g. Weisz et al. 2006). There are many possible reasons for this but one plausible explanation is that the cognitive model of depression may not be directly transferrable to this group. During adolescence, cognitive and emotional development is ongoing; adolescents do not have the same cognitive 'architecture' as adults (e.g. Pfeifer and Blakemore 2012) and therefore direct comparisons may not be valid. Interpretation biases have been reported in anxious adolescents (Miers et al. 2008; Waite et al. 2015). However, cognitive and neural processing of anxiety and depression during

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adolescence shows both overlaps and differences (e.g. Beesdo et al. 2009; Etkin and Schatzberg 2011; Thomas et al. 2001), with some evidence that cognitions associated with anxiety emerge before those associated with depression.

There is limited evidence that interpretation biases are associated specifically with depression and low mood in adolescents. Dearing and Gotlib (2009) assessed interpretation bias in daughters of women with recurrent depression. Participants completed two interpretation bias tasks. In the first of these tasks, participants listened to ambiguous auditory stimuli (acoustic blends of neutral words combined with positive words e.g. joy-boy, or negative words e.g. sad-sand), then selected the word they thought they heard. In the second task, participants were presented with ambiguous stories that remained ambiguous until the final word resolved the ambiguity. Participants were instructed to indicate with a key press that the final word was grammatically correct. Response latencies to the key press were recorded. Following a negative mood induction, girls with depressed mothers made more negative interpretations on both tasks than a control group of girls who had mothers with no depression. Haley et al. (1985) presented four possible outcomes to ambiguous vignettes to children and adolescents with and without a depressive disorder. Depressed participants were more likely to choose the most negatively biased outcomes. Recent work has also started investigating the use of a cognitive bias modification (CBM) paradigm in adolescent depression. Research has investigated CBM with healthy participants (Lothmann et al. 2011) and with participants with mild depression (Micco et al. 2014). Both studies found that positive CBM training reduced negative interpretation biases. However, only Lothmann et al. (2011) found that this change in interpretation translated to decreased negative affect.

The standard method of measuring interpretation biases has been established in relation to anxiety disorders using responses to ambiguous scenarios (Butler and Mathews 1983). Berna et al. (2011) adapted this to create the Ambiguous Scenarios Test for Depression (AST-D). Their measure includes 24 scenarios, for example, ‘You join a tennis club and before long you are asked to play in a doubles match. It’s a tough match and afterwards you discuss your performance with your partner.’ Berna et al. (2011) asked participants to imagine an outcome for each scenario and to rate the pleasantness of each imagined outcome. Outcomes were also coded as positive, negative or neutral interpretations. Symptoms of depression were positively correlated with the number of negative interpretations, and negatively correlated with the number of positive interpretations and pleasantness ratings. Pleasantness ratings and interpretations distinguished between high

and low dysphoric participants. The AST-D predicts future depressive symptoms in adults (Kleim et al. 2014), and a reduction in negative interpretations, as measured by the pleasantness ratings of the AST-D, was associated with reductions in symptoms of depression (Williams et al. 2013).

We adapted the Ambiguous Scenarios Test for Depression (Berna et al. 2011) so that the content was appropriate for adolescents. We therefore assessed the suitability and psychometric qualities of this adapted measure with adolescents aged 12–18 years. Importantly we also examined the strength of the association between depression and interpretation bias, independently of anxiety symptoms. Anxiety and depression frequently co-occur in both adults and depression and interpretation biases are a well-established feature of anxiety. It is therefore possible that any observed link between interpretation biases and low mood is an artefact of the high co-morbidity of anxiety and depression rather than a specific feature of depression.

Based on theory and previous research, the following hypotheses were examined:

1. Depression and anxiety symptoms will significantly predict adolescents’ ratings of ambiguous scenarios. Higher symptoms of depression and anxiety will be associated with more negative interpretations and lower pleasantness ratings.
2. Depression symptoms will be a significant and independent predictor of interpretation bias and pleasantness after controlling for anxiety.

Materials and Methods

Participants

Two hundred and six adolescents, aged 12–18 years, participated in the study. The majority of the sample completed the study in groups in their school classroom (N = 169); 37 were tested individually either in the laboratory or at home depending on their preference.

To gain access to schools, letters were sent to the head teachers requesting permission to conduct an experiment at the school. Once approval was obtained, information packs were provided for adolescents and parents describing the study and its purpose. Adolescents who participated in the laboratory and at home were recruited through flyers. Parents of adolescents under 16 years of age provided written informed consent prior to their child’s participation in the experiment. All children under 16 years gave assent and young people aged 16 years and over gave consent.

Procedure

The study was approved by the University of Reading Research Ethics Committee. Research was conducted in the presence of a researcher. Participants completed self-report measures of depression and anxiety and then completed the ambiguous scenarios questionnaire.

Measures

Symptom Questionnaires

Mood and Feelings Questionnaire (MFQ); Costello and Angold 1988). The MFQ is a 33 item self-report measure of depression symptoms with good psychometric properties (Burlison Daviss et al. 2006). Each symptom is rated on a 3 point scale from 0 (*not true*) to 2 (*true*). Internal consistency in this sample was excellent (George and Mallery 2003; MFQ $\alpha = .94$).

Revised Child Anxiety and Depression Scale (RCADS); Chorpita et al. 2000). The RCADS Total Anxiety subscale (37 items) was used to assess anxiety symptoms. The RCADS has good construct validity (Chorpita et al. 2000), and the Total Anxiety subscale had excellent internal consistency (George and Mallery 2003; RCADS-Total Anxiety $\alpha = .96$). The Major Depression subscale of the RCADS (10 items) was also administered. It was used to examine the psychometric properties of the adapted Ambiguous Scenarios Test (see below) but not in the analyses of the main hypotheses for which the MFQ was the primary measure of depression. The RCADS Major Depression subscale has excellent internal consistency (George and Mallery 2003; RCADS-Major Depression $\alpha = .90$).

Ambiguous Scenarios Test for Depression in Adolescents (AST-DA)

Adolescents completed an adapted version of the Ambiguous Scenarios Test for Depression (AST-D; Berna et al. 2011). The original questionnaire included 24 items. Eleven items were retained and unchanged, 7 items were adapted to be more appropriate for adolescents e.g. ‘an office party’ was changed to ‘a prom party’; 4 items could not easily be adapted without significantly changing the meaning so were removed; 1 adolescent relevant item was added; 2 items were combined into a single item. The adapted version of the AST therefore had 20 items. The adapted questionnaire (with new and amended items) was informally piloted with 12 adolescents of a variety of ages, to ensure that the content and the task demands were age appropriate.

Each item consisted of a scenario (e.g. ‘You have recently taken an important exam. Your results arrive with

an unexpected letter of explanation about your grade’). Participants were instructed to (a) rate the scenario for pleasantness (from 1 = *Not at all pleasant*; to 9 = *Very pleasant*) and (b) give a written description of their imagined outcome of the situation. There was no time limit for completion. A mean pleasantness rating across the scenarios was calculated for each participant. Interpretation bias was calculated by coding each open-ended response into one of four categories. Three were based on Berna et al. (2011): ‘positive’ (e.g. ‘I got the highest mark in the exam’); ‘negative’ (e.g. ‘I failed the exam’); and ‘neutral’ if the response did not include an emotive outcome (e.g. ‘The letter tells me what grade I got’). An additional ‘mixed’ category was added; if answers included both positive and negative ideas (e.g. ‘I got the mark I needed but didn’t do as well as I had hoped’). All scenarios were rated blind to MFQ and RCADS scores. Two independent raters were trained to score responses through reading the coding scheme, verbal instruction and participating in consensus discussions. Discrepancies were handled during the training process and raters always reached agreement. Once training was completed, 10 % of the sample ($N = 20$) was double-rated and inter-rater reliability was assessed on these responses. Inter-rater reliability was excellent (Landis and Koch 1977; $\kappa = .89$). The independent raters then separately coded the rest of the data. For each participant, a proportion score was created for each of the four categories (positive, negative, mixed, neutral) across the scenarios.

Results

Data Analysis

Fourteen adolescents were excluded from the final sample for having substantial missing data (more than 25 % missing) on the MFQ ($n = 8$) or on the ambiguous scenarios questionnaire ($n = 9$) resulting in a sample of $N = 192$ in the final analysis. Preliminary data analysis of the association between mood, anxiety and interpretive biases found no differences between adolescents tested at school, in the laboratory or at home so they were combined throughout.

Each adolescent gave one interpretation for each scenario. All responses were codable into the four categories. Across all participants, 43 % of scenarios were coded as positive, 38 % as negative, 11 % mixed and 9 % neutral. There was no significant correlation between mixed responses and neutral responses with symptoms of depression or anxiety, so results focus only on positive and negative interpretations. To measure interpretation bias, a difference score for each participant was computed by

taking the proportion of their negative interpretations away from the proportion of their positive responses. This method of calculation accommodates the existence of neutral and mixed responses, but is equivalent to assigning them a bias value of 0. Therefore a positive value indicated a positive interpretation bias and a negative value indicated a negative interpretation bias, with zero indicating no bias in either direction. A participant who responded to every scenario with a positive interpretation would have a bias score of 1.0 and a participant who responded to every scenario with a negative interpretation would have a bias score of -1.0 .

The distributions of depression and anxiety symptoms were positively skewed. These variables were successfully transformed using square root transformations, and analyses were conducted with the transformed variables. Confirmatory analyses were conducted by running analyses with 1,000 bootstrap samples. All results were consistent, so original analyses with transformed variables are reported.

Psychometric Properties of the AST-DA

The AST-DA had good internal consistency on pleasantness ratings (Cronbach's $\alpha = .83$, George and Mallery 2003) and excellent split half reliability ($r = .80$). There was good construct validity of the coded responses of interpretation bias; participants' pleasantness ratings of scenarios' were significantly positively correlated with interpretation bias scores ($r = .79$). Pleasantness ratings were normally distributed (Kolmogorov–Smirnov: $D = .99$, $p = .20$) and were not correlated with age. There was a significant difference between gender on pleasantness ratings [$t(191) = -3.88$, $p < .001$]; girls had significantly lower pleasantness ratings than boys. This was expected because female participants also reported higher levels of depression symptoms [$t(194) = 3.52$, $p = .001$] and anxiety symptoms [$t(200) = 6.71$, $p < .001$], similar to many other studies (e.g. Angold et al. 2002; Costello et al. 1996).

Descriptive Statistics

Sample characteristics are presented in Table 1. Mean MFQ scores were slightly higher than non-depressed norms for young people ($M = 12$; Burleson Daviss et al. 2006), but much lower than in young people with current Major Depressive Disorder ($M = 33$; Burleson Daviss et al. 2006). Mean RCADS Total Anxiety scores were similar to those seen by young people experiencing an anxiety disorders ($M = 33$; Chorpita et al. 2005) and higher than those without an anxiety disorder ($M = 22$; Chorpita et al. 2005). Standard deviations of both depression and anxiety

scores suggest that a wide range of scores were reported by participants.

The approximately equal proportions of positive (42 %) and negative (37 %) interpretations in the sample as a whole is reflected in the interpretation bias difference score ($M = .05$).

Inter-correlations between variables are presented in Table 2. As expected, depression and anxiety measures were positively correlated, and pleasantness ratings for the scenarios were negatively correlated with depression and anxiety symptoms. Also consistent with expectations, interpretation bias was negatively correlated with depression and anxiety symptoms. Age was not significantly correlated with symptoms of depression and anxiety, pleasantness ratings or interpretation bias.

Hypothesis Testing

To test the hypotheses that interpretation bias would be associated with depression independently of the relationship between anxiety and interpretation bias, and irrespective of gender, forced entry three step multiple regression models were conducted. As depression and anxiety symptoms were highly inter-correlated, collinearity statistics were consulted and results met the required assumptions (max. VIF = 2.37, min. tolerance = .42).

Association of Depression and Anxiety with Pleasantness Ratings

The individual contribution of anxiety and depression symptoms on pleasantness ratings was examined in a forced entry multiple regression model. Gender was associated with anxiety and depression symptoms; therefore gender, depression and anxiety scores were entered as predictor variables with pleasantness as the dependent variable. The overall equation for the prediction of pleasantness ratings was significant, $F(3,184) = 24.99$, $p < .001$, $R^2 = .29$. Gender did not independently predict pleasantness ratings [$B = .10$, $t(184) = 1.50$, $p = .14$]. Anxiety [$B = -.32$, $t(184) = -3.35$, $p = .001$] and depression symptom scores [$B = -.21$, $t(184) = -2.32$, $p = .021$] were independent predictors of pleasantness ratings of ambiguous scenarios.

Association of Depression and Anxiety with Interpretation Bias

To assess the individual contribution of anxiety and depression symptoms on interpretation bias, gender, anxiety and depression scores were entered in a forced entry multiple regression model. The overall equation for the prediction of interpretation bias was significant,

Table 1 Sample characteristics

(Mean, <i>SD</i> , range)	N = 192
Age	16.06 (1.21) [12.48–18.61]
Gender (percent female)	66 %
MFQ	17.98 (12.77) [0–59]
RCADS Total Anxiety	31.75 (19.87) [0–99]
RCADS Major Depression	8.58 (5.90) [0–28]
Pleasantness Ratings	5.46 (1.05) [2.65–9.00]
Interpretation Bias	.05 (.33) [–.75 to .85]

MFQ Mood and Feelings Questionnaire, RCADS Revised Child Anxiety and Depression Scale, Pleasantness Ratings Mean Pleasantness Ratings, Interpretation Bias Interpretation Bias Difference Score

$F(3,185) = 39.06$, $p < .001$, $R^2 = .39$. Gender did not independently predict interpretation bias [$B = .04$, $t(185) = .56$, $p = .57$]. Anxiety [$B = -.44$, $t(185) = -4.93$, $p < .001$] and depression symptom scores [$B = -.21$, $t(185) = -2.56$, $p = .011$] were independent predictors of interpretation bias.

Discussion

According to the cognitive model of depression, information processing errors, including a negative interpretation bias, contribute to the development and maintenance of depression and anxiety. Based on this, cognitive behaviour therapy for depression involves identifying and modifying cognitive biases, including negative interpretation biases. Despite this, the hypothesis that interpretation biases are associated with depression has rarely been tested in adult or adolescents. It is important to test the model in adolescents, separately from adults, because cognitive and emotional

processing and the neural structures that organise and integrate cognition and emotion develop rapidly during this period of life. For this reason it cannot be assumed that cognitions that are identified in adult samples will also be identified amongst adolescents.

In this study we adapted a measure of depressive interpretation bias (Berna et al. 2011) so that it was suitable for adolescents. In a sample of adolescents recruited from the community, the adapted measure of ambiguous scenarios was internally consistent, had good inter-rater reliability and appeared to have construct validity. The sample included young people with symptoms that were similar in severity to those in a clinical population (81 participants had anxiety scores similar to those with an anxiety disorder and 45 participants had depression scores similar to those with depressive disorder). However, the presence of clinical depression and/or anxiety diagnoses was not assessed so the proportion of the sample who would have met formal diagnostic criteria is unknown. It is important therefore to validate the AST-DA in a clinical sample of adolescents. Ideally this would identify a difference in interpretation biases between clinically depressed adolescents and healthy control adolescents.

We tested the hypothesis that a negative interpretation bias is associated with depression in adolescents, and that this relationship is independent of co-occurring anxiety symptoms. There was a moderate association between depression symptoms and interpretation bias, even after controlling for anxiety symptoms. Young people with elevated symptoms of depression (and/or anxiety) were significantly more likely to interpret ambiguous scenarios as negative than as positive. These data therefore suggest that a core element of the cognitive model of depression does apply to adolescents. A gender difference was found for scores on the AST-DA, however, we were unable to explore this further as the male and female groups were not

Table 2 Inter-correlations between the measures

	MFQ	RCADS-Anx	Age	Pleasantness	Interpretation	Positive	Negative	Neutral
RCADS-Anx	.73*							
Age	.08	.14						
Pleasantness	-.47*	-.50*	-.05					
Interpretation	-.54*	-.59*	.09	.79*				
Positive	-.45*	-.52*	.10	.70*	.94*			
Negative	.56*	.58*	-.06	-.78*	-.94*	-.77*		
Neutral	-.15	-.16	-.18	.15	-.03	-.26*	-.20	
Mixed	-.10	.01	.12	.07	.12	-.12	-.33*	-.11

MFQ Mood and Feelings Questionnaire, RCADS-Anx Revised Child Anxiety and Depression Scale-Total Anxiety Score, Pleasantness Mean Pleasantness Ratings, Interpretation Interpretation Bias Difference Score, Positive Positive Interpretations, Negative Negative Interpretations, Neutral Neutral Interpretations, Mixed Mixed Interpretations

* $p < .001$

matched in the current sample. The interaction between gender and depressive symptoms on bias scores would be interesting for future work to address. There was no association between interpretation bias and age. The mean age of participants in this study was 16 years and further investigation of how and when interpretation biases emerge would be valuable.

This was a cross sectional study and thus it cannot be assumed that interpretation biases lead to depression. Ideally a longitudinal study of adolescents recruited at a younger age would clarify both the causal direction of the relationship between bias and depression and identify when interpretation biases begin to emerge. This research has a number of implications for developmental psychopathology research. It shows that adolescents make interpretation biases (both negative and positive) and that these are associated with symptoms of depression. It suggests that the cognitive model of depression is relevant to adolescents, at least in the area of interpretation biases. It also provides a tool to assess interpretation biases in adolescents. This may be of value in research on cognitive bias modification in adolescents, either as a pre- and post-treatment assessment tool, or as standardised stimuli that could be used in treatment (Chan et al. 2014).

Conclusion

Interpretation biases can be measured in adolescents and are associated independently with depression and anxiety symptoms, suggesting that this core element of the cognitive model of depression does apply to adolescents. The direction of causality has not been reliably established and we do not know at what age the biases develop and emerge.

Compliance with Ethical Standards

Conflict of Interest Faith Orchard, Laura Pass and Shirley Reynolds declare that they have no conflict of interest.

Informed Consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (national and institutional). Informed consent was obtained from all individual subjects participating in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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