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Resilience in Development: Pathways to Multisystem Integration

Social interpretation inflexibility moderates emotional reactions to social situations in children and adolescents

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Abstract

Interpretation biases and inflexibility (i.e., difficulties revising interpretations) have been linked to increased internalizing symptoms. Although adolescence is a developmental period characterized by novel social situations and increased vulnerability to internalizing disorders, no studies have examined interpretation inflexibility in adolescents. Additionally, no studies (on adolescents or adults) have examined interpretation flexibility as a protective factor against adverse outcomes of interpersonal events. Using a novel task and a 28-day diary we examined relations among interpretation bias and inflexibility, internalizing symptoms, and negative interpersonal events in a sample of children and adolescents ($N = 159$, ages 9–18). At baseline, negative interpretation bias was positively correlated with social anxiety symptoms, and positive interpretation bias negatively correlated with social anxiety and depressive symptoms. Inflexible positive interpretations were correlated with higher social anxiety and depressive symptoms, while inflexible negative interpretations were correlated with higher social anxiety. Finally, interpretation inflexibility moderated daily associations between negative interpersonal events and depressive symptoms in daily life, such that higher inflexibility was associated with stronger associations between interpersonal events and subsequent depressive symptoms, potentially increasing depressive symptom instability. These results suggest that interpretation biases and inflexibility may act as both risk and protective factors for adolescent anxiety and depression.

Keywords: interpretation flexibility; children and adolescents; daily diaries; social anxiety; depression

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Introduction

Adolescence is a critical period for social-emotional development. It is marked by the increasing salience of peer relationships, as well as greater volatility and complexity of social relationships with family members and with peers (Crone & Dahl, 2012; Hadiwijaya et al., 2017; Nelson et al., 2005; Somerville, 2013). Moreover, the transition to adolescence typically coincides with transferring schools, which results in the disruption of existing friendships, and a need to establish new relationships (Meuwese et al., 2017). These novel and dynamic social situations, together with increased sensitivity to social threats and rewards (Blakemore, 2018; Schriber & Guyer, 2016; Towner et al., 2023) and preexisting risk factors, are theorized to underlie increases in social anxiety and depression during adolescence (Rapee et al., 2019). Indeed, empirical studies

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show that more negative and fewer positive social interactions with family members and peers are associated with increases in depression and anxiety during adolescence (e.g., Gadassi Polack et al., 2021c; Spence & Rapee, 2016).

Interpretation is a semantic process that integrates aspects of a situation into a mental representation that clarifies the meaning and implications of an event (Blanchette & Richards, 2010). How adolescents interpret ambiguous social situations can profoundly influence their emotional experiences, especially given the importance of social feedback during this developmental stage (Rapee et al., 2019; Somerville, 2013). For example, biased interpretations, which involve the habitual selection of overly negative (or insufficiently positive) models of ambiguous events, may promote depression by inspiring pessimistic beliefs about the self, others, and the world (Beck & Bredemeier, 2016). Similarly, overly negative interpretations may encourage social anxiety by increasing perceived social inadequacy and creating expectations of future social failure (Leung et al., 2022).

Multiple studies of adolescent depression and social anxiety support the adverse effect of interpretation biases on emotional experiences. Adolescents with depression or anxiety select more negative interpretations and fewer positive ones, across several

different tasks (Haller et al., 2016; Lau & Waters, 2017; Leigh & Clark, 2018; Mobach et al., 2019; Oliver et al., 2019; Sfärlea et al., 2021; Stuijfzand et al., 2018). Preliminary evidence suggests that these biases are not merely consequences of depression or anxiety. Adolescents who never experienced depression themselves, but who have a parent with depression, also exhibit a more negative interpretation bias compared to low-risk peers (Dearing & Gotlib, 2009; Sfärlea et al., 2021), suggesting that these biases may play a role in the intergenerational transmission of risk for depression and anxiety (Sfärlea et al., 2019; Subar & Rozenman, 2021). Furthermore, evidence from the Cognitive Bias Modification literature shows that children's and adolescents' interpretations of their mothers' behavior became more positive after treatment (De Winter et al., 2017), and that decreases in negative interpretations and increases in positive ones are related to decreases in anxiety symptoms (e.g., Krebs et al., 2018; Platt et al., 2017). The impact of interpretation biases on adolescent emotional experiences is also broadly consistent with cognitive-behavioral theories positing that information-processing difficulties contribute to depression and anxiety across development (Cannon & Weems, 2010; Everaert et al., 2012; Gadassi Polack et al., 2023; Leung et al., 2022; Stuijfzand et al., 2018).

Although more negative and less positive interpretation biases may have adverse mental health consequences, it is important to keep in mind that interpretation is a dynamic and contextualized process. Initial interpretations should ideally shift to reflect additional information gathered as situations evolve, such that initial and final interpretations differ dramatically. For example, as adolescents learn to independently navigate new and more complex social situations (e.g., romantic relationships with peers), they learn that initial interpretations may not be fully accurate, and prior beliefs or expectations may not always provide useful guidance. Revisions that reflect accrued evidence, therefore, become crucial to final interpretation accuracy. In the present investigation, interpretation flexibility is defined as the degree to which an initial interpretation is revised (or updated) to reflect subsequent information which suggests the initial interpretation was incorrect.

While studies of interpretation (in)flexibility among adolescents are scarce, studies of adults underscore the importance of inflexibility by showing its association with higher levels of depression, social anxiety, and suicidality (above and beyond the effects of interpretation bias; Deng et al., 2022, 2023; Everaert et al., 2018, 2020, 2021; Kube & Rozenkrantz, 2021). In addition, depression and anxiety are associated with other types of cognitive and psychological inflexibility in children and adolescents, lending credence to the notion that internalizing symptoms may be encouraged by inflexible interpretations (e.g., Chahal et al., 2021; Harms et al., 2018; Morea & Calvete, 2021; Muris & Petrocchi, 2017; Patwardhan et al., 2021).

Gaps in extant literature on inflexible interpretation of social situations

Given the putative importance of inflexible interpretations to the formation and maintenance of internalizing psychopathology in adolescents, the present study sought to address several critical gaps in the extant literature on these interpretations and their impact:

Associations with biological sex and age

As risk for psychopathology increases during the transition to adolescence, it is crucial to consider how the risk and protective factors we examine – interpretation bias and flexibility – change in occurrence and function during this developmental period. Research on interpretation bias suggests that over the transition from childhood to adolescence there is a marked increase in negative interpretation bias and substantial decreases in positive interpretation bias (e.g., Habicht et al., 2022; Stuijfzand et al., 2018). Additionally, meta-analytic evidence suggests that the association between interpretation bias and anxiety strengthens from childhood to adolescence (Stuijfzand et al., 2018). These results are in line with evidence that typically developing adolescents are more sensitive and reactive to social feedback compared to adults (Blakemore, 2018; Rodman et al., 2017; Schriber & Guyer, 2016; Towner et al., 2023).

The current investigation is the first to examine the developmental aspect of interpretation flexibility. Multiple aspects of cognitive and behavioral flexibility change during the transition to adolescence. For example, the ability to adjust one's behavior according to changing environmental demands (Dajani & Uddin, 2015) increases rapidly over the preteen years and continues to improve throughout adolescence and into adulthood. Similarly, the ability to flexibly evaluate the emotional value of social stimuli increases with age (Nelson & Guyer, 2011). These forms of flexibility are supported by the prefrontal cortex, which goes through protracted development during puberty (Schriber & Guyer, 2016). However, literature on the development of belief flexibility or updating (i.e., changing prior beliefs in light of new information), suggests a more nuanced picture. It has been argued that flexibility regarding negative and positive beliefs has different developmental trajectories (Kube & Rozenkrantz, 2021). In support of this notion, cross-sectional studies on children and adolescents suggest that older age is related to increased ability to update prior beliefs in light of new undesirable (but not desirable) information (Moutsiana et al., 2013) and learn more from negative (but not positive) outcomes (Habicht et al., 2022); in contrast, the ability to learn from positive information does not seem to change with age (Habicht et al., 2022; Moutsiana et al., 2013). Importantly, theoretical accounts suggest that the developmental trajectory of belief flexibility is nonlinear, perhaps peaking in young adulthood (Kube & Rozenkrantz, 2021).

To summarize, depression and social anxiety both increase dramatically during the transition to adolescence, particularly for girls (e.g., Rapee et al., 2019; Salk et al., 2016). At the same time, negative interpretation bias increases, positive interpretation bias decreases, and the ability to integrate negative information increases. It remains unclear whether changes in interpretation flexibility, interpretation bias, or both, drive age and sex differences in internalizing psychopathology during adolescence.

Flexibility as a driver of resilience

Adolescence is a time of steep increases in psychopathology (Solmi et al., 2022). Conceptual models of adolescence suggest that the interaction between risk factors and normative developmental challenges (e.g., novel social stressors) contribute to the development of psychopathology during adolescence (Rapee et al., 2019). Conversely, we argue that the interaction between protective factors and developmental challenges of adolescence can contribute to resilience. Indeed, resilience is defined as the ability of a system or an individual to adapt successfully to challenges that threaten function, survival, or development (Masten et al., 2021). Although some studies operationalize resilience by focusing on the outcome (e.g., positive adaptation; Sattler

et al., 2023), evidence suggests that there are individual-level protective factors (e.g., perceived social support; Feng et al., 2023) that enhance resilience (Masten et al., 2021).

In the current investigation, we suggest that *flexibility* in the interpretation of social situations may be a protective factor that contributes to resilience by reducing the impact of negative experiences. Indeed, it has been argued that flexible interpretation of ambiguous social situations may increase resilience against internalizing psychopathology by producing accurate interpretations that allow individuals to match behavioral responses to situations that change dynamically (Everaert et al., 2018; Kashdan & Rottenberg, 2010; Mehu & Scherer, 2015; Stange et al., 2017). However, to our knowledge, no studies on adults or adolescents have examined this hypothesis. Identifying these effects is critical for prevention and intervention efforts.

Longitudinal relationships between interpretations, social experiences, and depressive symptoms

There is a dearth of longitudinal studies on interpretation bias and inflexibility, particularly in adolescents (Gadassi Polack et al., 2023). This complicates inferences about whether interpretations influence emotional reactions to everyday social situations or are mere correlates of them. The present study uses a structured daily measurement technique (daily diaries) as a highly ecologically valid way to examine social-emotional processes among adolescents in everyday life (aan het Rot, 2012; Russell & Gajos, 2020). Importantly, daily diaries allow for uncovering dynamic daily processes that contribute to psychopathology by tracking daily fluctuations of social interactions and depressive symptoms (Baltasar-Tello et al., 2018; Gadassi Polack et al., 2021a; Russell & Gajos, 2020). Finally, such intensive longitudinal methods reduce retrospective reporting bias and sampling noise by utilizing multiple assessment points (Trull & Ebner-Priemer, 2020).

The present study

With the forging literature in mind, the present study sought to elucidate relations between inflexible and biased interpretations, depression, and social anxiety in children and adolescents. As a first step toward this goal, we created a developmentally-sensitive version of the emotional bias against disconfirmatory evidence (BADE) task (Everaert et al., 2018). During the emotional BADE, participants read self-referential scenarios containing three statements. Each statement provides additional information about an unfolding ambiguous interpersonal situation relevant to themes of social failure and rejection. After viewing each statement, participants rate the plausibility of four different interpretations of the information acquired thus far in that scenario. The first statement guides the participant to one direction of interpretation (negative or positive), but as additional statements are added, this initial direction is discovered to be erroneous. Thus, the emotional BADE task requires participants to revise their initial beliefs about the situation, either from negative to positive or vice-versa. The task's uniqueness is that it teases apart initial interpretation biases and the ability (or lack thereof) to change the initial interpretation (i.e., interpretation inflexibility). For the present study, we created a developmentally-sensitive version of the original task (which we call "the adolescent BADE") by changing scenarios content (e.g., from work related to school related) and simplifying language, instructions, and response scale (for more details, see *Methods*). In addition to the adolescent BADE, we then used a daily diary to assess social experiences with family members and friends as well

as depressive symptoms. We tested the following hypotheses (preregistered hypotheses are indicated with a *):

H1*: The adolescent BADE task will replicate the pattern of results obtained with the adult task – particularly those regarding task scenario (variance-covariance) structure.

H2*: A less positive/more negative interpretation bias will be cross-sectionally related to greater severity of depression and social anxiety symptoms measured at baseline when controlling for interpretation inflexibility.

H3*: Greater inflexibility of negative and positive interpretations will be cross-sectionally associated with greater severity of depression and social anxiety symptoms measured at baseline when controlling for interpretation bias.

H3*: Based on the extant literature showing that girls (vs. boys) are more susceptible to depression and anxiety, we hypothesized that girls will display higher levels of negative bias, lower levels of positive bias, and lower levels of flexibility.

H4*: Considering the age range of our sample and prior findings regarding age-related differences in responses to social stimuli and interpretation bias (Stuijfzand et al., 2018), we hypothesized that older (vs. younger) youth will display higher negative interpretation bias and lower levels of positive interpretation bias. Based on prior literature on age-related differences in belief updating (Habicht et al., 2022; Moutsiana et al., 2013), predicted increases in positive flexibility (i.e., increased ability to revise positive interpretations) with age, but no age-related differences in negative flexibility. Because theoretical models suggest flexibility may develop in a nonlinear manner (Kube & Rozenkrantz, 2021), this possibility was also tested.

H5: Interpretation flexibility will moderate the association between actual social experiences and depressive symptoms in daily life during the longitudinal follow-up. Specifically, we hypothesize that individuals with greater (vs. lesser) flexibility will have weaker positive association between negative interpersonal events and depressive symptoms.

Method

This research was part of a larger study on emotions and social experiences in adolescents (Deng et al., 2021; Gadassi Polack et al., 2021a, 2021b, 2021c; Dworschak et al., 2023); only relevant measures are described.

Participants

Participants ($n = 170$ before exclusions, $n = 159$ after) were US youth from New Haven, Connecticut (ages: 9–18, $M = 12.83$, $SD = 2.61$; additional demographics, **SI Section S1**) enrolled in a longitudinal study. Youth were recruited for the first wave of the study via ads for a study examining social interactions and emotions. Those who completed the two prior data waves and indicated interest were invited for a third wave of data collection on which the present manuscript is based. Because of attrition of participants from the longitudinal study, to preserve statistical power we recruited additional participants for the current (third) wave using similar methods. The present manuscript focuses on daily diary data from participants who completed the third study wave, along with baseline data from these participants, which was collected just prior to the start of this wave. Data collection for the current investigation (baseline session and third wave of daily diary) ran from June 2021 to March 2022. For a note on potential impacts of the SARS-CoV-2 pandemic, see: **SI Section S9**.

Data quality assurance

Multiple steps were taken to ensure high data quality. Briefly, participants were excluded if they failed various attention checks, reported an age inconsistent with birth year, or used a different response process than other participants (as evidenced by person-total correlations or intra-individual variability). A total of 11 participants were excluded via these requirements. Additional information: **SI Section S3**.

Open science practices

The present study was preregistered: https://osf.io/6vxf9.

Protocol

The protocol was approved by the Yale University IRB. At baseline, participants completed the Adolescent Emotional BADE Task, then completed self-report measures of depression and social anxiety in random order. After completing the baseline sessions, participants were asked to complete a daily diary for 28 days. Participants received $15 for the baseline session, and an additional $70 if they completed at least 90% of the diary days, $50 if they completed at least 60% of the diary days, or $10 if they completed less than 60% of the diary days. Target sample size was determined based on a power analysis conducted for the first wave of the study (Gadassi Polack et al., 2021b). Adherence rates to the diary were high. Mean number of diary days completed was 87.4% (Mean = 24.46; *SD* = 4.95).

Baseline measures

Descriptive statistics and internal consistencies for all measures can be found in **SI Section S7**.

Adolescent emotional BADE task. The Adolescent Emotional BADE Task was developed for this study and based on the (adult) Emotional BADE Task (Everaert et al., 2018). Respondents are presented with ambiguous interpersonal scenarios (example: **SI Section S4**) with themes of social evaluation and failure. Scenarios contain three statements. After viewing each statement, participants rate the plausibility of four interpretations of scenario events using a 13-point scale (1 = "poor", 13 = "excellent"). Across scenarios, interpretations can be grouped into Absurd, Lure, and True categories. Absurd interpretations are consistently implausible. Lure interpretations are most plausible initially, then become less so. True interpretations are moderately plausible initially, then become most plausible. Given this structure, optimal performance on the Adolescent Emotional BADE Task requires participants to revise beliefs about the most plausible interpretation for a given scenario by integrating the disconfirmatory information provided by each of the latter two statements.

The main difference between the adolescent and adult versions of the Emotional BADE Task lies in scenario content. Scenarios in the adult version of the task focused on events – such as being called into one's boss's office at work – that children and adolescents were unlikely to have experienced. The adolescent version of the task has more developmentally-appropriate content, focusing on school-related events and interactions with parents, teachers, and peers. Several scenarios were based on content from a Cognitive Bias Modification program for adolescents, developed by Rowlands et al. (2020). The adolescent task version also features simplified instructions that can be more easily understood by younger children, and a simplified explanation for the plausibility rating scale (with 13 points, vs. the 21-point scale used by adults).

Like the adult task, the Adolescent Emotional BADE Task includes scenarios that invite revision of negative interpretations in response to disconfirmatory positive information ("*disconfirming-the-negative scenarios*") or vice-versa ("*disconfirming-the-positive scenarios*"). In keeping with our previous studies of BADE, we analyze data from these two scenario types separately. Pilot data used in task development are reported in **SI Section S5**.

Depression symptoms. Depression symptoms were measured using the Children's Depression Inventory – Short Form (Kovacs, 2003). Respondents are presented with 10 sets of three sentences. They are asked to mark the sentence in each set that best describes their current experience. Scores (0, 1, or 2) are assigned to each rating according to its suggestion of depression severity. Thus, total scores (range: 0–20) are indicative of more severe depression symptoms. This measure was also completed as part of the daily diary.

Social anxiety symptoms. Social anxiety symptoms were measured using the short-form Social Anxiety Scale for Adolescents (SAS-A; Nelemans et al., 2019). Respondents rate how well 12 anxiety-related experiences applied to them over the last two weeks (1 = "Not at all," 5 = "All the time"). Ratings are averaged to get a final score. Higher scores (range: 1–5) indicate more severe symptoms of social anxiety.

Daily diary measures

Negative interpersonal events. Daily interpersonal events were measured in the following manner: Each day, participants reported whether they had experienced different positive (e.g., being hugged, praised, or helped) and negative (e.g., being left out, criticized, in a fight) interpersonal events. We used this information to compute a negative event score by dividing the number of different negative events experienced that day by the total number of events (positive and negative) experienced that day. Note that although participants reported with whom the events occurred (mother, father, friend, sibling, or other kid/adult), for the current investigation, we collapsed across this dimension when computing event scores. So, if a participant reported having a fight with both their mother and friend, this was counted as a single event for the purpose of computing scores.

Analyses

Hypothesis 1: BADE task scenario structure. To check whether our new BADE scenarios conformed to the canonical explanation rating pattern, we inspected graphs depicting how plausibility ratings for each explanation type (Lure, Absurd, True), averaged across participants, changed over the course of each scenario. Results are described in **SI Section S5**. Scenarios generally conformed to the canonical pattern seen in BADE tasks (e.g., Lure explanations that initially are most plausible, but become less so as True explanations become more plausible). Those that did not were excluded from analysis. We also used PCA to examine the variance-covariance structure of scenario ratings, with the goal of examining the first hypothesis, that the adolescent emotional BADE would have a structure similar to the adult task.

Hypotheses 2 & 3: Associations of BADE metrics with symptoms. We tested the hypothesis that inflexible and biased interpretations would be independently associated with depression and social anxiety in baseline data. Symptoms of depression or social anxiety were the criterion. Predictors were interpretation inflexibility, positive interpretation bias, and negative

interpretation bias. Separate models were constructed for metrics from disconfirming-the-negative and disconfirming-the-positive scenarios.

Hypotheses 4 & 5: Effects of age and gender. We tested the effect of gender (Hypothesis 4) on interpretation bias and flexibility via a series of (uncorrected) t-tests. We tested the effect of age (Hypothesis 5) on interpretation bias and flexibility using multiple regression models with age and its square as predictors, and one BADE metric (positive interpretation bias, negative interpretation bias, or interpretation inflexibility) as the criterion. The examination of square age is based on prior investigations showing nonlinear patterns of social information processing across adolescence (e.g., Rodman et al., 2017). As an exploratory analysis, we examined whether age and gender interacted in predicting interpretation bias or inflexibility using a series of multiple regression models (see **SI Section S10**).

Hypothesis 6: Effects of interpretation inflexibility on relations between social experiences and daily symptoms. To examine whether interpretation flexibility moderated the same-day relation (at time t) between symptoms of depression and experienced interpersonal events (Hypothesis 6), a series of multilevel models were constructed. A multi-level approach was used to account for the nested structure of the data, which featured diary entries (t: 1–28) nested within individuals (j: 1–159). At level two (j), predictors were grand mean centered and scaled (z-scored). Unconditional (empty) models were fitted to estimate the means/variances at each level. Models were fit using R's *lmerTest* package and restricted maximum likelihood. Several participants were members of the same family. Including random intercepts for family did not change these results. Significant moderation effects were probed using R's *reghelper* package (Hughes, 2017).

Demographic covariates. The main text presents results without demographic covariates. However, there were no major qualitative differences arising when models included age and gender as covariates. Additionally, when testing hypotheses 2, 3, and 6 in which BADE metrics predict depression and anxiety, we examined whether age interacts with the BADE metrics, however, no significant interactions emerged (see Supplementary Tables S8 & S9).

Results

Descriptive statistics

At baseline, thirty-one participants had a CDI score ≥6, suggesting that approximately fifteen children in the sample are likely to meet criteria for a depression diagnosis (Allgaier et al., 2012). Participants' average CDI score was 3.19, with a standard deviation of 2.94. On average, participants experienced social anxiety symptoms slightly less than half of the time ($M = 2.46$, $SD = 0.94$). This symptom level is comparable to that observed in other large samples of adolescents (e.g., Danneel et al., 2020). Taken together, these results indicate that the sample is suitable for examining relations between within- and between- person variation in depression or social anxiety and interpretive processes. For additional descriptive statistics, see **SI Section S7**. Zero-order correlations between study variables are presented in Table 1.

Hypothesis 1: Adolescent emotional BADE task structure & scoring

As a preliminary analysis, we visualized the pattern of average explanation ratings within each candidate BADE task scenario (**SI Section S5**). Visualizations were assessed for adherence to the

Table 1. Zero-order Spearman's rho correlations in baseline data

	2	3	4	5	6	7	8	9
1	.12	−.28*	.49*	.03	.01	.15	.14	.18[+]
2	–	−.23*	−.22*	.53*	.05	.04	.11	.16
3		–	.24*	−.05	.54*	−.02	−.19[+]	−.13
4			–	.17[+]	.30*	.15	.01	.07
5				–	−.22*	.19[+]	.14	−.02
6					–	−.17[+]	−.18[+]	−.04
7						–	.54*	.16[+]
8							–	.31*

1 = negative interpretation inflexibility, 2 = negative interpretation bias (disconfirming-the-negative scenarios), 3 = positive interpretation bias (disconfirming-the-negative scenarios), 4 = positive interpretation inflexibility, 5 = negative interpretation bias (disconfirming-the-positive scenarios), 6 = positive interpretation bias (disconfirming-the-positive scenarios), 7 = social anxiety, 8 = depression (baseline), 9 = negative interpersonal interactions. df = 155. [+]=$p < .05$, *=$p < .01$.

Table 2. Robust PCA pattern matrix

Rating	Disconfirming-the-negative			Disconfirming-the-positive		
	NII	NIB	PIB	PII	PIB	NIB
Absurd1	−0.02	0.09	0.13	0.15	0.04	0.13
Absurd2	−0.02	0.04	0.18	0.18	0.02	0.10
Absurd3	0.05	0.03	0.09	0.16	0.00	0.09
Lure-A1	−0.14	**0.45**	0.07	−0.19	**0.49**	0.14
Lure-A2	−0.24	**0.40**	0.05	0.07	**0.49**	0.04
Lure-A3	**0.42**	**0.37**	0.13	**0.41**	0.13	0.00
Lure-B1	−0.20	**0.45**	0.00	−0.14	**0.46**	0.09
Lure-B2	−0.22	**0.40**	0.10	0.12	**0.46**	0.05
Lure-B3	**0.46**	**0.35**	0.12	**0.45**	0.17	0.01
True1	0.03	−0.04	**0.66**	**0.32**	0.16	**0.65**
True2	0.07	−0.06	**0.61**	−0.16	0.11	**0.68**
True3	**−0.66**	−0.05	**0.30**	**−0.58**	0.06	0.22

Note. Values ≥ .30 are bold for reader's convenience. Rating nomenclature is as follows: The word refers to the explanation type (e.g., Absurd explanations) and the number refers to the scenario statement after which the rating was made (e.g., Absurd1 would be the average Absurd explanation rating made after the first statement). The difference between Lure-A and Lure-B explanations is arbitrary. PII = positive interpretation inflexibility, NII = negative interpretation inflexibility, PIB = positive interpretation bias, NIB = negative interpretation bias. Parallel analysis supported retention of three principal components derived from each scenario type (**SI Section S6**). To compare with adult task results, see Everaert et al., 2018's Table 2.

canonical pattern of BADE task scenario ratings (consistently low Absurd explanation ratings, escalating True explanation ratings, and falling Lure explanation ratings). All disconfirming-the-positive scenarios adhered to this pattern. However, three disconfirming-the-negative scenarios did not. These three scenarios were discarded prior to computing task-related metrics.

To determine whether our preregistered strategy for deriving metrics of interpretation inflexibility and bias from the Adolescent Emotional BADE Task was appropriate, we subjected average explanation ratings for the remaining scenarios to principal component analysis (PCA; Table 2). Given that our sample size is small relative to what is considered optimal for PCA, a robust

Table 3. Multiple linear regression model: biased/inflexible interpretations' association with symptoms of depression and social anxiety in baseline data

Criterion	Type	Predictor	β	SE	t	p	95%CI
Anxiety	DiscP	**Positive interpretation inflexibility**	**0.32**	**0.08**	**3.74**	**.001**	**[0.15 0.49]**
		Negative interpretation bias	**0.20**	**0.08**	**2.49**	**.014**	**[0.04 0.37]**
		Positive interpretation bias	**−0.27**	**0.09**	**3.13**	**.002**	**[−0.43 −0.10]**
	DiscN	**Negative interpretation inflexibility**	**0.17**	**0.08**	**2.07**	**.040**	**[0.01 0.33]**
		Negative interpretation bias	0.04	0.08	<1	.618	[−0.12 0.21]
		Positive interpretation bias	−0.01	0.09	<1	.888	[−0.18 0.16]
Depression	DiscP	**Positive interpretation inflexibility**	**0.23**	**0.09**	**2.59**	**.011**	**[0.05 0.40]**
		Negative interpretation bias	0.07	0.08	<1	.398	[−0.10 0.24]
		Positive interpretation bias	**−0.26**	**0.09**	**2.93**	**.004**	**[−0.43 −0.09]**
	DiscN	Negative interpretation inflexibility	0.12	0.08	1.44	.151	[−0.04 0.28]
		Negative interpretation bias	0.05	0.08	<1	.667	[−0.11 0.22]
		Positive interpretation bias	**−0.17**	**0.08**	**2.06**	**.041**	**[−0.34 −0.01]**

Note. BOLD = statistically significant. When predicting depression from disconfirming-the-positive scenarios: $F(3,153) = 4.13$, $p = .007$, adjusted $R^2 = .06$. When predicting social anxiety from disconfirming-the-positive scenarios: $F(3,153) = 7.84$, $p < .001$, adjusted $R^2 = .12$. When predicting depression from disconfirming-the-negative scenarios: $F(3,153) = 3.43$, $p = .019$, adjusted $R^2 = .04$. When predicting social anxiety from disconfirming-the-negative scenarios: $F(3,153) = 1.77$, $p = ..156$, adjusted $R^2 = .01$.

version of the algorithm (Robust PCA; Hubert et al., 2005, as implemented in R's *Rospca* package, version 1.0.4) was used. Results were generally consistent with those obtained in previous studies using the Adult Emotional BADE Task. These past studies suggest that task performance is adequately represented with three principal components – one representing interpretation inflexibility, one representing negative interpretation bias, and a third representing positive interpretation bias (Everaert et al., 2018, 2020). As can be seen in Table 2, the components we obtained were very similar to those derived from the adult task. The first component for each scenario type featured strong positive loadings on the final Lure explanation ratings, and a strong negative loading for the final True explanation ratings, suggesting that the component captured interpretation inflexibility. The second component for each scenario type featured strong positive loadings on average Lure explanation ratings over the course of the scenarios, suggesting that it captured a bias toward endorsing the initially-plausible interpretations, which were either positive or negative depending on the scenario type. The final component for each scenario type featured strong positive loadings for True interpretations, which were also either positive or negative depending on the scenario type.

This structure was largely supportive of our preregistered plan to score the Adolescent Emotional BADE task using the same method as the adult version, which involves adding together average explanation ratings that load highly onto each principal component (e.g., Bronstein et al., 2022; Everaert et al., 2021). However, there was one adjustment to this plan based on our PCA results: Because Absurd ratings did not load strongly onto the interpretation inflexibility component, we did not use these ratings to compute interpretation inflexibility. Note that we also opted not to use the final Lure ratings when computing negative interpretation bias, despite the moderate loading of these ratings onto this component in disconfirming-the-negative scenarios. This choice was made with the results of (larger) adult studies, which yielded a similar variance-covariance structure, in mind. These studies of adults (e.g., Everaert et al., 2018) suggest that final Lure explanation ratings should not be used to compute negative interpretation bias.

In the final scoring scheme, negative interpretation inflexibility was scored as LureA3+LureB3-True3. Positive interpretation inflexibility had the same formula but with the addition of True1 ratings. The two interpretation bias components were scored as True1+True2+True3 and LureA1+LureA2+LureB1+LureB2. In these formulas, the number (i.e., the "2" in "True2") represents the statement in the scenario after which the rating was provided. The word (i.e., the "True" in "True2") describes the type of explanation rating (e.g., ratings of True explanations) that were averaged across scenarios. Critically, results were remarkably consistent regardless of whether interpretation bias and inflexibility were captured via this scoring scheme, our preregistered analysis plan, or PCA-component scores (**SI Section S8**).

Hypotheses 2 & 3: Relation of interpretation inflexibility and bias to symptoms

Using this scoring scheme, BADE task metrics were entered as simultaneous predictors into a series of multiple regression models to test whether interpretation inflexibility and positive or negative interpretation bias were independently related to symptoms of depression or social anxiety. In studies of BADE, metrics of interpretation bias and inflexibility are entered simultaneously into predictive models because each predictor could otherwise conceivably confound the others' relation with outcomes of interest. For example, consider an apparent (zero-order) relation between inflexible negative interpretations and depression. Keeping in mind the fact that people are generally less willing to revise beliefs/interpretations in which they are more confident (Kaliuzhna et al., 2012; Woodward et al., 2008), and that such confidence could result from biased interpretations, it becomes apparent that a more negative interpretation bias could drive this relation.

Social anxiety. In these models (Table 3), both positive ($\beta = 0.32$, $p = .001$) and negative ($\beta = 0.17$, $p = .040$) interpretation inflexibility were related to anxiety, above and beyond any effect of interpretation bias. Metrics of positive ($\beta = −0.27$, $p = .002$) and negative ($\beta = 0.17$, $p = .040$) interpretation bias derived from

Table 4. Multiple linear regression model: association of age and interpretation bias/inflexibility in baseline data

Type	Criterion	Predictor	β	SE	t	p	95%CI
DiscN	NII	Age	0.02	0.08	<1	.854	[−0.15 0.19]
		Age^2	0.14	0.09	1.65	.100	[−0.03 0.31]
	NIB	Age	0.10	0.08	1.26	.210	[−0.05 0.26]
		Age^2	−0.13	0.09	1.56	.121	[−0.30 0.04]
	PIB	Age	−0.06	0.08	<1	.449	[−0.22 0.10]
		Age^2	**0.23**	**0.08**	**2.72**	**.007**	**[0.06 0.40]**
DiscP	PII	Age	−0.09	0.08	1.15	.252	[−0.25 0.07]
		Age^2	**0.18**	**0.08**	**2.07**	**.040**	**[0.01 0.34]**
	NIB	**Age**	**0.33**	**0.08**	**4.20**	**.001**	**[0.17 0.48]**
		Age^2	**−0.20**	**0.08**	**2.46**	**.015**	**[−0.36 −0.04]**
	PIB	**Age**	**−0.26**	**0.08**	**3.23**	**.002**	**[−0.41 −0.10]**
		Age^2	0.16	0.08	1.95	.053	[0.00 0.33]

Note. **BOLD** = statistically significant. DiscP=disconfirming-the-positive scenarios. DiscN = disconfirming-the-negative scenarios. PII = positive interpretation inflexibility. NII = negative interpretation inflexibility. NIB = negative interpretation bias. PIB = positive interpretation bias. When predicting NII from age, $F_{(3,154)} = 1.52$, $p = .222$, adjusted $R^2 = .01$. When predicting PIB (DiscN) from age, $F_{(3,154)} = 3.70$, $p = .027$, adjusted $R^2 = .03$. When predicting NIB (DiscN) from age, $F_{(3,154)} = 1.66$, $p = .193$, adjusted $R^2 = .01$. When predicting PII from age, $F_{(3,154)} = 2.41$, $p = .094$, adjusted $R^2 = .02$. When predicting PIB (DiscP) from age, $F_{(3,154)} = 6.05$, $p = .002$, adjusted $R^2 = .06$. When predicting NIB (DiscP) from age, $F_{(3,154)} = 10.09$, $p < .001$, adjusted $R^2 = .10$.

Figure 1. Relation between age and BADE metrics derived from regression models with linear and squared effects of age. Criterion Axis Labels: (a) PIB, positive interpretation bias from disconfirming-the-negative scenarios; (b) PII, positive interpretation inflexibility, (c) NIB, negative interpretation bias from disconfirming-the-positive scenarios (bottom).

disconfirming-the-positive scenarios were also associated with anxiety, but those derived from disconfirming-the-negative scenarios were not.

Depression. Only positive ($\beta = 0.23$, $p = .011$) – and not negative ($\beta = 0.12$, $p = .151$) – interpretation inflexibility was associated with depression, above and beyond any effect of interpretation bias. Metrics of positive interpretation bias derived from disconfirming-the-positive ($\beta = −0.26$, $p = .004$) and disconfirming-the-negative ($\beta = −0.17$, $p = .041$) scenarios were also associated with depression symptoms. However, metrics of negative interpretation bias derived from both scenario types were not ($\beta = 0.07$, $p = .398$; $\beta = 0.05$, $p = .667$).

Hypotheses 4 & 5: Associations of BADE metrics with gender and age

Surprisingly, we found few significant differences between male and female participants in interpretation bias and inflexibility. Negative interpretation bias, as measured using disconfirming-the-positive scenarios, was higher in females ($M = 0.04$, $SD = 0.33$) than males ($M = −0.11$, $SD = 0.39$; $t[150.23] = 2.53$, $p = .012$, Cohen's $d = 0.41$). However, there was no corresponding difference in negative interpretation bias as measured using disconfirming-the-negative scenarios ($t[152.96] = 1.04$, $p=.301$, Cohen's $d = 0.17$). No other results were statistically significant. Note that due to their small number ($N = 3$), data from participants who identified as "other" were not included in this analysis.

Effects of age on interpretation bias and flexibility were numerous (Table 4). In disconfirming-the-negative scenarios, there was a statistically significant effect of squared age on positive interpretation bias ($\beta = 0.23$, $p = .007$), suggesting that the relation between age and positive interpretation bias followed a concave-up parabola with a nadir just above the sample-mean age, which was 12.83 (Figure 1a), suggesting that positive interpretation bias
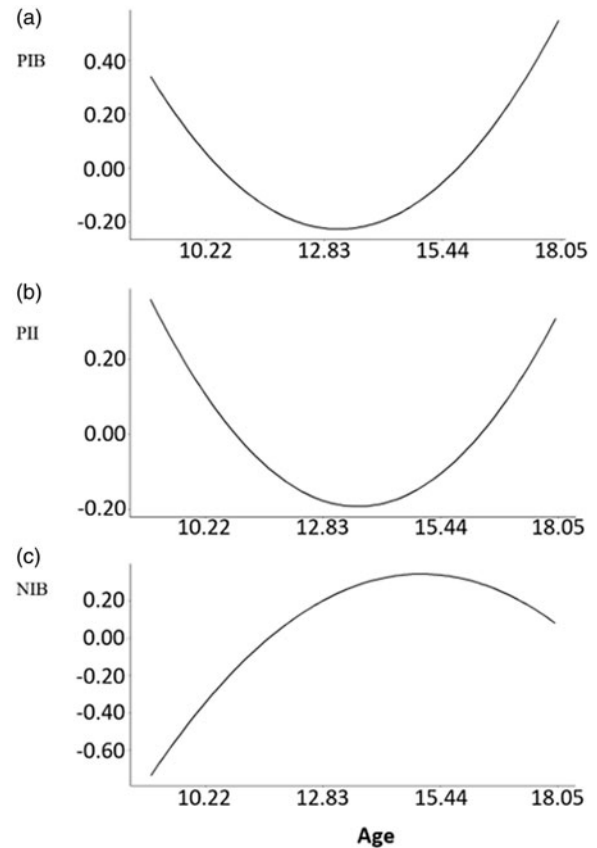
decreased with age till early adolescence and the increased again. In disconfirming-the-positive scenarios, this effect was mirrored by a nonsignificant trend ($\beta = 0.16$, $p = .053$). Squared age was also associated with positive interpretation inflexibility ($\beta = 0.18$, $p = .040$; Figure 1b), again following a concave-up parabola with a nadir slightly after the sample-mean age (12.83), suggesting that the ability to incorporate negative information increases (and therefore inflexibility scores decrease) till just before middle adolescence and then starts decreasing again, resulting in increasing inflexibility. Negative interpretation bias also had a nonlinear association with age (Squared age $\beta = −0.20$, $p = .015$; Figure 1c) in disconfirming-the-positive scenarios, suggesting an increase in negative interpretation bias that peaks around age 15 and then slightly decreases.

Finally, age was linearly associated with both positive ($\beta = −0.26$, $p = .002$) and negative ($\beta = 0.33$, $p = .001$) interpretation bias such that older children and adolescents had lower positive interpretation bias and higher negative interpretation bias. However, exploratory analyses revealed significant interactions between age and gender in determining positive interpretation bias. In both disconfirming-the-positive ($\beta = −0.17$, $t = 2.22$, $p=.028$) and disconfirming-the-negative scenarios ($\beta = −0.24$, $t = 3.02$, $p = .003$), there was a significant interaction between gender and age in determining positive interpretation bias. These interactions were such that the decline in positive interpretation bias with age was more severe in female, vs. male, participants. For additional information, see **SI Section S10**.

Table 5. Multi-level model: do biased/inflexible interpretations moderate the instantaneous association between interpersonal events and depression in daily diary data?

Model	Scenario Type	Predictor	β	SE	t	p	95%CI
(a) Two-Level Empty Model	NA	**Intercept**	**0.30**	**0.03**	**11.83**	**<.001**	**[0.25 0.35]**
Two-Level AR Model	(b)	**Intercept**	**0.21**	**0.02**	**8.71**	**<.001**	**[0.17 0.26]**
	DiscN	Measurement timepoint	0.00	0.00	1.54	.122	[0.00 0.00]
		Lagged, trait-level depression	0.00	0.03	<1	.996	[−0.05 0.05]
		Negative interpretation inflexibility	0.04	0.02	1.73	.086	[−0.01 0.09]
		Negative interpretation bias	0.03	0.02	1.36	.175	[−0.01 0.08]
		Positive interpretation bias	−0.03	0.02	1.39	.168	[−0.08 0.01]
		Interpersonal events – Negative	**0.15**	**0.01**	**13.91**	**<.001**	**[0.13 0.17]**
		Interpersonal events – Negative*NII	**0.03**	**0.01**	**2.87**	**.004**	**[0.01 0.05]**
	(c)	**Intercept**	**0.21**	**0.02**	**8.68**	**<.001**	**[0.17 0.26]**
	DiscP	Measurement timepoint	0.00	0.00	1.54	.124	[0.00 0.00]
		Lagged, trait-level depression	0.00	0.03	<1	.936	[−0.05 0.05]
		Positive interpretation inflexibility	0.05	0.03	1.93	.055	[0.00 0.10]
		Negative interpretation bias	0.03	0.03	1.33	.185	[−0.01 0.08]
		Positive interpretation bias	**−0.06**	**0.03**	**3.32**	**.022**	**[−0.11 −0.01]**
		Interpersonal events – Negative	**0.15**	**0.01**	**13.86**	**<.001**	**[0.13 0.17]**
		Interpersonal events – Negative*PII	**0.04**	**0.01**	**4.13**	**<.001**	**[0.02 0.06]**

Note. **BOLD** = significant.

Hypothesis 6: Moderation of the association between everyday social experiences and depressive symptoms by interpretation inflexibility

We first fit an empty two-level model with a random intercept by participant and daily depressive symptoms as the criterion. As can be seen in Table 5a and Figure 2, this model suggested that there were significant within- (0.04; 27% of total variance) and between-subjects (0.10; 73% of total variance) variance in daily depression. The residual from this empty model was then used as a predictor in a series of two-level autoregressive models. Each of these again included daily depressive symptoms as the criterion. Each model's predictors included positive and negative interpretation bias, daily negative interpersonal event scores (i.e., the ratio of the number of negative events experienced that day to the total number of events experienced that day), and the interaction between these scores and either positive or negative interpretation inflexibility.

The model concerning the effect of negative interpersonal events and BADE metrics from disconfirming-the-negative scenarios (Table 5b) indicated that more daily negative interpersonal events were associated with more severe daily depressive symptoms ($\beta = 0.15$, $p < .001$), with no significant main effect for negative interpretation inflexibility. These main effects were qualified by a significant interaction between daily negative interpersonal events and negative interpretation inflexibility ($\beta = 0.03$, $p = .004$). Examination of simple slopes suggested this interaction was such that the association between daily negative interpersonal events and daily depressive symptoms became stronger as negative interpretation inflexibility increased (at $1SD$ below the mean: $\beta = 0.12$, $p < .001$, at the mean: $\beta = 0.15$, $p < .001$, at $1SD$ above the mean: $\beta = 0.18$, $p < .001$; Figure 2a). These results suggest that, in line with our hypothesis, those who were less (vs.
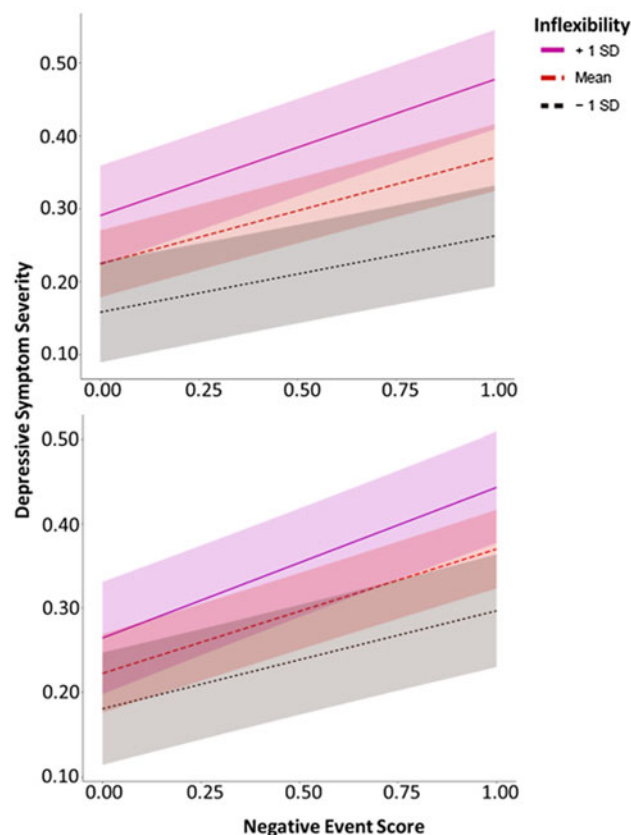

Figure 2. Visualization of the interaction between interpretation inflexibility and interpersonal events in determining daily depressive symptoms. Top row: Results when positive interpretation inflexibility is the moderator. Bottom row: Results when negative interpretation inflexibility is the moderator. Clouds are 95% CIs.

more) flexible in revising negative interpretations of social situations suffered more from the adverse effects of negative interpersonal events.

The model concerning the effect of negative interpersonal events and BADE metrics from disconfirming-the-positive scenarios (Table 5c) indicated that daily negative interpersonal events ($\beta = 0.15$, $p < .001$) and lower levels of positive interpretation bias at baseline were associated with increased depressive symptoms in the diary. This main effect was qualified by an interaction between daily negative interpersonal events and positive interpretation inflexibility, such that the association of negative interpersonal events with depressive symptoms strengthened at higher levels of inflexibility (at $1SD$ below the mean: $\beta = 0.10$, $p < .001$, at the mean: $\beta = 0.15$, $p < .001$, at $1SD$ above the mean: $\beta = 0.19$, $p < .001$; Figure 2b). These results suggest that, in line with our hypothesis, those who were less (vs. more) flexible in revising positive interpretations of social situations suffered more from the adverse effects of negative interpersonal events.

Discussion

This study used a novel, developmentally-sensitive version of the Emotional BADE Task in tandem with daily diary data to disentangle the relationships between bias and inflexibility in the interpretation of ambiguous social situations and internalizing symptoms. We specifically looked at these relations during children's transition to adolescence. This period is critical for social-emotional development and is characterized by the emergence of related psychopathologies (Rapee et al., 2019). In addition to providing researchers with this new task, the present study makes two key advances in our understanding of developmental psychopathology. First, it demonstrates that interpretation inflexibility is associated with depression and social anxiety symptoms in children and adolescents when statistically controlling for interpretation biases. Second, interpretation inflexibility moderated the relationship between negative interpersonal events and daily depressive symptoms, such that those with higher flexibility were less reactive to interpersonal events. This suggests that interpretation flexibility acts as a protective factor buffering symptom reactivity to interpersonal events and potentially contributing to resilience and emotion regulation.

Our data provide a robust foundation for future work using the Adolescent Emotional BADE Task. As predicted, in the finalized scenario set, explanation plausibility ratings unfolded in a manner suggestive of interpretation revision – True ratings became increasingly plausible while Lures became progressively less so – just as is observed in the adult task (Deng et al., 2022, 2023; Everaert et al., 2018, 2020, 2021). Moreover, the variance-covariance structure for average True and Lure explanation ratings across scenarios was highly similar to that seen with the adult task (see: Everaert et al., 2018, 2020, 2021). Intriguingly, however, in children and adolescents, the tendency to endorse Absurd (i.e., highly implausible) interpretations did not load strongly onto the "interpretation inflexibility" component derived from PCA of BADE task data. This differs from results obtained using the original task in adult participants. Our findings suggest that as individuals move from adolescence to adulthood, bias toward acceptance of the implausible (often called "liberal acceptance") may play a larger role in interpretation inflexibility. This possibility accords with the fact that psychopathologies typified by inflexible endorsement of implausible interpretations, such as schizophrenia spectrum disorders, seldom appear before

early adulthood (Solmi et al., 2022). An alternative explanation is that the covariance between inflexible interpretations and bias toward acceptance of the implausible may be most evident in people with more severe psychopathology. Consistent with this explanation, the present analyses were based on a community sample, whereas previous studies in adults (e.g., Everaert et al., 2018, 2021) used oversampling to recruit individuals with higher symptom levels. Future studies with a wider range of participant ages and symptom severities would help discriminate between these possibilities.

Our data also provide some support for the hypothesized associations between positive and negative interpretation bias with depression and social anxiety symptoms. In our cross-sectional data, positive interpretation bias was consistently and negatively associated with depressive symptoms in both types of BADE scenarios but was only associated with symptoms of anxiety in disconfirming-the-positive scenarios. In addition, positive interpretation bias predicted lower levels of depressive symptoms in our daily diary data over the subsequent four weeks. These longitudinal associations between positive interpretation bias and depressive symptoms are particularly notable given that most studies of interpretation biases in emotional disorders are cross-sectional, and focus on negative interpretation biases (Gadassi Polack et al., 2023). In contrast to our hypotheses, negative interpretation bias was not consistently associated with symptoms of social anxiety or depression in either our cross-sectional or diary data. Given that these associations have been repeatedly observed elsewhere (e.g., Oliver et al., 2019; Stuijfzand et al., 2018), these null findings may result from the fact that we used a community sample rather than an oversampling approach. Taken together, this pattern of results aligns with cognitive theories (Beck & Bredemeier, 2016; Leung et al., 2022) positing that less-positively biased interpretations play a role in the emergence and maintenance of internalizing psychopathology (Haller et al., 2016; Lau & Waters, 2017; Leigh & Clark, 2018; Mobach et al., 2019; Oliver et al., 2019; Sfärlea et al., 2019, 2021; Stuijfzand et al., 2018; Subar & Rozenman, 2021).

Even stronger support for our hypotheses was found for the predicted relationship between interpretation inflexibility and symptoms of depression and social anxiety. When statistically controlling for interpretation bias, more inflexible positive interpretations (i.e., ones that resist evidence supporting a more negative interpretation) were cross-sectionally associated with more severe social anxiety and depression. Inflexible negative interpretations (i.e., ones that resist evidence supporting more positive interpretations) were cross-sectionally associated only with more severe social anxiety, but not depression.

Our results on the significant associations between interpretation inflexibility and depression and social anxiety join with those from adults (e.g., Deng et al., 2022, 2023; Everaert et al., 2018, 2020) in suggesting that interpretation inflexibility associated with internalizing symptoms that extend beyond those of interpretation bias. Interestingly, however, our results diverge from adult findings in that positive interpretation inflexibility, rather than negative interpretation inflexibility, was the more robust correlate of symptoms in our cross-sectional data. One explanation for this difference may be that positive (vs. negative) interpretation inflexibility is more important during the transition to adolescence than it is in adulthood. Another explanation is more technical. It is possible that positive (vs. negative) interpretation inflexibility was more salient because we had a smaller number of scenarios to capture negative, vs. positive, interpretation inflexibility because more of the former scenarios did not pass our stringent quality-

control measures. The smaller number of scenarios increased error measurement for negative inflexibility thus decreasing our power.

Critically, and in line with our hypotheses, inflexibility moderated the associations between interpersonal events and depressive symptoms. Our diary data showed that negative interpersonal events were associated with higher levels of depression, as previously found (e.g., Gadassi Polack et al., 2021c). Importantly, the effect of daily negative interpersonal events on depressive symptoms was buffered in individuals with more flexible positive or negative interpretations. This valence-nonspecific effect aligns with theories asserting that flexibility is a protective factor, contributing to resilience in the face of evolving social situations (Everaert et al., 2021; Kashdan & Rottenberg, 2010; Mehu & Scherer, 2015; Stange et al., 2017). Together with findings that adolescence is a time of heightened reactivity to social feedback (e.g., Blakemore, 2018; Schriber & Guyer, 2016; Towner et al., 2023), our findings also imply that children and adolescents with more inflexible interpretations may have more unstable, or variable, negative emotions. This possibility deserves further study, given that both interpretation inflexibility (Deng et al., 2023; Everaert et al., 2021) and negative emotion variability (Dawel et al., 2023; Selby et al., 2013) are linked to internalizing symptoms and to self-injurious thoughts and behaviors.

Finally, our findings have important developmental implications, as we found that both age and gender were associated with interpretation bias and flexibility. As predicted, girls had higher levels of negative interpretation bias compared to boys. In addition, exploratory analyses showed that age and gender interacted, such that for girls (but not boys), older age was associated with lower levels of positive interpretation bias. These results are in line with findings showing that girls have more dramatic increases in internalizing symptoms during adolescence (Rapee et al., 2019; Salk et al., 2016). Additionally, across genders, we found a nonlinear association between age and positive interpretation bias and inflexibility. Specifically, we found that positive bias and inflexibility decrease from age 9 to age 13, and then begin increasing again. In other words, children become less positively biased as they enter adolescence, but also more able to revise their initially positive interpretations. As they become older, they become more positively biased, but also more resistant to revising these biased interpretations. Finally, negative interpretation biases increased nonlinearly with age and plateaued around age 15. Taken together, our results suggest that middle adolescence is a time of particularly high risk as it is characterized by lower positive and higher negative biases. This conclusion is in line with previous findings that show middle adolescence is a time of maladaptive shifts in emotion regulation (Cracco et al., 2017) and extends these findings to include interpretative processes in addition to emotion regulation. Longitudinal studies are needed to uncover whether these age-related differences in interpretation bias and flexibility underlie increases in psychopathology observable during adolescence.

Importantly, we find that the ability to integrate negative information into initially positive social interpretations increases in a nonlinear manner from preadolescence to middle adolescence, and then decreases until age 18. These results are consistent with prior findings showing that adolescents (vs. children and adults) are more willing to integrate negative social feedback into their self-view (Rodman et al., 2017). In other words, there is a nonlinear pattern of development, as was previously hypothesized (Kube & Rozenkratz, 2021). These results somewhat diverge from prior findings on belief revision suggesting that the ability to revise positive belief in light of undesirable information (or the ability to

learn from bad outcomes) linearly increases from childhood to adolescence (Habicht et al., 2022; Moutsiana et al., 2013). Whereas previous investigations focused on adolescents' ability to estimate the likelihood of adverse events (e.g., being a passenger in a car accident) or learn from negative outcomes, we examined interpretation of ambiguous social situations with self-relevant implications. Considering adolescents' sensitivity and reactivity to social self-relevant information (e.g., Rodman et al., 2017), these changes in content may explain the different trajectories. Future studies comparing social and nonsocial stimuli using a longitudinal design are needed to illuminate potential differences in belief revision trajectories during adolescence. As in prior studies (Habicht et al., 2022; Moutsiana et al., 2013), we found an asymmetry by which integration of desirable information (i.e., positive social outcomes) did not vary with age. Future studies using longitudinal designs are needed to determine whether our results are due to developmental effects rather than individual differences that are confounded with age because of the cross-sectional data used in these analyses.

Strengths and limitations. The present study was the first to examine how inflexible interpretations of ambiguous social situations relate to children's and adolescents' mental health. Importantly, by combining the novel Adolescent BADE task with a four-week-long daily diary, we were able to examine the predictive and ecological validity of the novel task. Daily diaries are an ecologically valid way to examine social-emotional processes, allowing us to uncover fine-grained daily processes that contribute to psychopathology (Baltasar-Tello et al., 2018; Gadassi Polack et al., 2021a; Russell & Gajos, 2020). Indeed, the combination of the novel task with daily diaries helped us demonstrate that interpretation flexibility serves as a protective factor that attenuates responses to interpersonal events at a developmental time when they are particularly influential (e.g., Towner et al., 2023), potentially contributing to more stable and perhaps better-regulated emotions, thus enhancing adaptive development during the transition to adolescence.

However, the study also has several limitations. The study's main limitation was that, after quality control, we were left with more disconfirming-the-positive than disconfirming-the-negative scenarios. This complicates the comparison of our results across scenario types by exposing an alternative explanation (lower internal reliability) and may also have limited our ability to detect effects of negative interpretation inflexibility. We are currently developing additional scenarios to resolve this issue. Another limitation is our use of a relatively small ($N < 200$) community sample, with relatively low levels of psychopathology. Additional studies using larger samples and clinical groups are needed to investigate bias and inflexibility at more severe symptom levels and improve the generalizability of the current findings. Finally, though we used a longitudinal design, we followed up on participants for only four weeks. Though intensive longitudinal designs are excellent at capturing micro-processes that are more easily targeted in intervention, longer-term follow-ups could tell us more about how these processes change across development (Ram & Diehl, 2014). Relatedly, this short-term longitudinal design, combined with the relatively small sample, may explain the lack of age moderation of the effects of interpretation bias and flexibility. That being said, we did find age-related changes in biases and flexibility. Studies using larger samples and a longitudinal design are needed to provide further support for our findings that interpretation bias and flexibility change over time, and also to better examine whether their function changes across development.

Future directions. The present study is an initial step toward addressing the limited attention paid to interpretation inflexibility during adolescence (cf., Habicht et al., 2022; Moutsiana et al., 2013). Future studies could use our novel task to examine whether and how interpretation inflexibility changes over time in at-risk individuals who do or do not develop depression or social anxiety. These studies would make great strides toward determining whether inflexible interpretations play a role in causal pathways leading to psychopathology, and are not, instead, their mere correlates, results of them, or trait vulnerability markers. Future studies should also examine how inflexible interpretations develop, and who (e.g., parents, peers) influences this process. Studies on interpretation bias suggest that such biases in children and their parents are closely linked, suggesting an intergenerational transmission of bias may underlie the intergenerational transmission of depression and anxiety (Dearing & Gotlib, 2009; Sfärlea et al., 2019; Subar & Rozenman, 2021). Accordingly, future studies should examine whether parent and child interpretation inflexibility are associated.

Clinical implications. Given our community sample and observational design, we urge clinicians to use caution in considering how our work informs intervention. With this in mind, our study has implications for research on existing interventions. For example, although interventions for adolescents with depression or anxiety already focus on modifying interpretation bias (e.g., De Winter et al., 2017; Krebs et al., 2018; Platt et al., 2017), the present findings suggest that stronger emphasis on increasing interpretation *flexibility* may be beneficial for children and adolescents, particularly those with both labile negative affect and interpersonal difficulties. Future research should examine this suggestion using existing interventions that target either interpretation flexibility specifically (e.g., cognitive-behavioral therapy) or cognitive flexibility more generally (e.g., "UP"; Ehrenreich et al., 2009). Such research could, simultaneously, help resolve other open questions about the clinical implications of interpretation inflexibility. For example, our past research in adults links inflexibility to (co)dampening of positive emotions (Bronstein et al., 2022; Everaert et al., 2020), suggesting that individual differences in it might alter the effectiveness of behavioral activation.

Summary. The current study is a unique investigation that examines biased and inflexible interpretations of social situations during the transition to adolescence, a critical time in which individuals encounter a plethora of social changes and challenges and are at an elevated risk for depression and anxiety (Rapee et al., 2019). Via a novel task that teases apart the effects of bias and inflexibility on interpretations of ambiguous social situations together with a daily diary design, our study provides the strongest evidence to date that interpretation inflexibility increases resilience against negative interpersonal events, potentially resulting in greater emotional stability and better emotion regulation. Accordingly, the present study provides both the tools and empirical foundation necessary for future studies focusing on adolescents. Our findings elucidate putative causal pathways to depression and anxiety involving interpersonal strife, emotion dysregulation, and interpretation bias and inflexibility.

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