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An Analysis of Child Valence Bias Trajectories as a Result of Parental Factors: A Longitudinal Perspective

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An Analysis of Child Valence Bias Trajectories as a Result of Parental Factors: A Longitudinal Perspective

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Abstract

Valence bias is an important part of how individuals perceive the world around them, and this is especially influential in terms of children's development. This study used data from longitudinal data collection surveys consisting of 197 participants, ages 6-17, to investigate correlations between valence bias, puberty, parental conflict, emotion regulation, temperament, interpersonal regulation, trait anxiety, and personality. This research provides much sought-after knowledge in terms of how parental factors impact children's development, specifically children's valence bias development. Previous research has shown that emotion regulation in parents, along with different parenting styles with equal levels of discipline and loving support largely influence children's life satisfaction and mental health outcomes. No current study has looked at how children's valence bias trajectories change over time, nor at these implications together, which was the goal of this current research. Overall, children who develop a more positive valence bias over 1-2 years report more frequent use of emotion regulation reappraisal at baseline, consistent with findings showing that better emotion regulation and a more positive valence bias both have implications for better life outcomes. lower state-trait anxiety and report more frequent use of emotion regulation reappraisal.

Key Words

Psychology

Temperament

Valence Bias

Emotion Regulation

Trait Anxiety

Dedication/Appreciation

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Introduction

Society is filled with ambiguous situations and social cues that could be interpreted as either positive or negative, and within each individual, there is a stable tendency to interpret these ambiguous cues as either more positive or more negative. These individual differences in response to ambiguity are commonly referred to as one's valence bias (Neta et al., 2009; Petro et al., 2018), and it drives responses to a variety of ambiguous signals. For example, although angry and happy faces have a relatively clear valence (negative for angry and positive for happy), other expressions are less clearly defined, such as surprise faces, which can frequently transmit both negative or positive signals. Variability in valence bias drives responses to surprised faces, leading some people to interpret them as more negative and others interpreting the same faces as more positive.

Some recent work has explored the mechanisms that drive these individual differences in valence bias. For example, previous research has shown that initial responses in all individuals are negative, which has even been shown to be the case in individuals that later tend to have a more positive valence bias (Neta & Tong, 2016). This phenomenon is known as the initial negativity hypothesis and suggests that a more positive valence bias is supported by emotion regulation, specifically cognitive reappraisal (Petro et al., 2018). As a result, studies have determined that individual differences in valence bias may be influenced by emotion regulation skills. Interestingly, kids have previously been found to be more negative compared to adults (Tottenham et al., 2013; Petro et al., 2021), which may again be explained by ability and sufficiency of emotion regulation because children do not have strong emotion regulation processes in place yet at this age (Haag et al., 2023; Gee & Cohodes, 2022). In a cross-sectional study, those more mature children that showed a more negative valence bias exhibited worse

emotion regulation connectivity patterns and increased depressive symptoms (Petro et al., 2021). These findings suggest that kids who develop a more positive bias over time will most likely be at less risk for depression and anxiety as they get older, so it is important to understand the mechanisms at play when it comes to valence bias changes over a longitudinal perspective in children and early adolescence.

In adults, prior work has shown greater variability in valence bias compared to children, and this variability is related to individual differences in negative affect and social connectedness (Neta & Brock, 2021). A more negative valence bias has also been shown to be related to increased depression, anxiety, and posttraumatic stress symptomology (Park et al., 2016; Petro et al., 2021; Clinchard et al., 2024), but also that increased emotion regulation can help to overcome this exacerbated negativity (Neta et al., 2023; Harp et al., 2023). Indeed, individuals who are more likely to use others to help them regulate their emotions are less likely to show neuroticism-related negativity (Brock et al., 2022).

Together, negative valence bias can have major detrimental and counteractive consequences for mental health and social relationships, but little is known about the trajectories of valence bias and the mechanisms by which children develop from a more negative bias toward greater positivity. It is important to study individual differences in interpreting ambiguity because negative valence has implications for detrimental mental health experiences, including depression. Thus, knowing which factors support the development of a more positive valence bias throughout the life span can assist in greater outcomes for youth mental health in the future.

This current study addresses this gap by examining longitudinal changes in valence bias in children ages 6-17, and also studying effects of valence bias and associated factors (e.g., internalizing symptoms, emotion regulation) in their primary caregivers. We also measured

factors that characterize the parent-child relationship in order to determine their effects on child valence bias trajectories.

Previous literature has described many factors which have the potential to impact one's outlook, and potentially support kids' development toward positivity. First, greater parental conflict was associated with more anxious and more depressed mood, leading to an increased negative affect, along with lower life satisfaction leading to decreased positive affect in children. Children with more cohesion within a family system have a more positive valence bias, and overall better mental health outcomes and life satisfaction (Fosco & Lydon-Staley, 2020). Second, emotion dysregulation in the child could play a crucial role, such that conflict and cohesion between the parent and adolescent were only related to life satisfaction in those who were poor at emotion regulation (Chiang et al., 2023). This article depicts that similar circumstances to parental conflict could occur for those poor at emotion regulation. Third, as noted above, adults with greater internalizing symptoms and emotion dysregulation show a more negative valence bias (Verzeletti et al., 2016). It could be that these factors driving parents toward greater negativity could ultimately influence the valence bias of their children.

Altogether, these previous studies suggest that emotion dysregulation in the parent, in the child, or between the parent and child (e.g., conflictual relationships) may shape the development of valence bias in children and adolescents. With these studies in mind, I had several hypotheses, which I divided into three categories: personality characteristics of the children; regulation in children, adolescents, and their parents; and parental factors including personality.

Category One: Personality of the children shapes valence bias development

Here, we predicted that personality factors in the children would shape valence bias as it changes longitudinally. The factors we considered were fear-related temperament, depressive-

related temperament, and intolerance of uncertainty. We looked at temperament, specifically fear and depressive mood subscales because previous literature has suggested their associations to negative valence. Intolerance of uncertainty, or the negative belief about uncertainty (Buhr & Dugas, 2009), was included because of its relatedness to feelings of ambiguous scenes and situations. Overall, we predicted that lower mean scores of fear and depressive mood temperaments along with lower levels of intolerance of uncertainty would be associated with the development of a more positive valence bias.

Category Two Hypotheses: Parent and child regulation shapes valence bias development

For the second category of hypotheses, we predicted that measures of emotion regulation would shape trajectories in valence bias. One factor we considered was tendency to reappraise, which would replicate earlier work showing that adults who tend to reappraise more often show a more positive valence bias (Harp et al., 2023). We also considered interpersonal emotion regulation (IER), or using others to be helped in managing emotions, consistent with work showing that IER helps promote a more positive bias (Brock et al., 2022).

Category Three Hypotheses: Parent factors/personality shapes valence bias development

For the third and final category of hypotheses, we predicted that there would be a positive correlation between parent and child valence bias, and that parents who tend to use reappraisal more often will have children who share that tendency. In addition, we predicted that parents who report greater interparental conflict and increased levels of anxiety would have children with a more negative/less positive valence bias. And finally, the personality characteristics of neuroticism and extraversion in parents were examined because past research has found meaningful results related to these traits (Neta & Brock, 2021; Brock, Harp, & Neta, 2022; Williams, Morelli, Ong, & Zaki, 2018), but the lack of longitudinal data for all of these variables

resulted in further data needing to be investigated. Overall, we predicted that lower levels of neuroticism and higher levels of extraversion would be associated with the development of a more positive valence bias.

Methods

Participants

Data for this research were collected as part of a larger study. One hundred and ninety-seven participants between the ages of 6 and 17 were recruited via community flyers for a two-session study (SD=3.14). All children provided verbal assent, and parents/guardians provided written consent. Participants received monetary compensation for each session and all study procedures were approved by the UNL Institutional Review Board. However, the present work is based on a longitudinal analysis of data collected on only a subset of these participants that completed yearly follow-up valence bias surveys (N=64). It is also important to note that some of the analyses conducted had sample sizes lower than 64 participants, depending on the amount of missing data for particular follow-up years. The average age of the participants was 10.19 years old, and there were 50% males (N=32) and 50% females (N=32). 48 participants or 75% were white, 2 participants or 3.125% were Black/African American, 1 participant or 1.56 % was Asian, 8 participants or 12.5% were more than one race, and 5 participants did not fill out this questionnaire about race (N=64). When looking at ethnicity, there were 7 or 10.93 % Hispanic/Latino(a) participants, 52 or 81.25% not Hispanic Latino(a) participants, and 5 participants that did not fill out this questionnaire about ethnicity (N=64).

Valence Bias

As noted above, valence bias is an instrument designed to measure how negatively or how positively one perceives the world around them to be. Responses to ambiguous faces and scenes

show wide variability in people's valence biases, and the scoring within this study show that higher scores of valence bias indicated a more negative valence, and lower scores (scores closer to zero) of valence bias indicated a more positive valence. All surveys, including valence bias, were scored, collated, and entered into a larger database that consisted of data from multiple sections. Hypotheses were then formulated, and appropriate analyses were completed in testing these hypotheses.

Valence bias ratings were determined by having each child look at events/scenes and facial expressions, some of which were overtly negative, those being angry faces or scenes of sadness or anger; others were overtly positive, such as happy smiling faces or joyful events, and others were more ambiguous and up for interpretation, those being surprised faces or scenes that elicit both positive and negative valence such as an unexpected gift or witnessing an accident. More specifically, the procedure went as follows:

In the first behavioral session, participants participated in an in-lab valence bias task in which they reviewed and examined a variety of images ranging from positive or happy, negative or angry, and ambiguous or surprised facial expressions. For each image the participants viewed, they had to make a quick and accurate forced decision on whether the image felt "good" or "bad". Participants viewed a variety of images, consisting of blocks of faces and scenes. Each participant looked at a total of 48 images in random order; 24 of which had surprise/ambiguous facial expressions, 12 of which had angry/negative facial expressions, and the last 12 had happy/positive facial expressions. All 48 faces were extracted from the NimStim Set of Facial Expressions (Tottenham et al., 2009) or the Karolinska Directed Emotional Faces database (Goeleven et al., 2008). In conjunction with the display of facial expressions, scenes taken from the International Affective Picture System (IAPS; Lang et al., 1997) were also shown. Similar to

the 48 faces depicted, 48 scenes were shown randomly dispersed alongside the faces; 24 with ambiguous scenes; 12 with negative scenes; and the last 12 with positive scenes. All images, including faces and scenes were self-paced with images presented for 1000 ms. Participants were removed if their responses of angry and happy faces or positive or negative scenes were below 60% accuracy, which indicated that they did not understand or were not focusing on the task. Participants who did pass the 60% accuracy were invited back about a week later for an MRI session, which was outside the scope of this project (Pierce et al., 2022).

Faces and scenes were used to effectively test valence bias, due to the fact that surprised facial expressions and ambiguous scenes can be consistently recognized across all age groups and their evaluations reflect developmental shifts in emotional responses; thus, interpreting ambiguity through surprised facial expressions and ambiguous scenes is effective in identifying differences in negativity bias during early pubertal stages (Petro et al., 2021). Because there were two different tasks being used to measure valence bias on both a negative and positive scale, one being faces and one being scenes, I created three subscales for the variable of valence bias to measure the ambiguous images. There was one subscale of surprise rate (SR), taken from the results of the surprise faces, and the other subscale was of ambiguous scenes (AMB), taken from the more obscure event images. I also averaged these two subscales of valence bias together, creating a third subscale of surprise rate and ambiguous scenes (SurpAMB).

Procedures

Participants came in for two in-lab sessions, separated by about one week. Participants first came into the lab, where parents and/or caregivers provided consent and children provided verbal assent. Both children and parents completed the valence bias task, along with a variety of surveys and questionnaires and a mock scan. Following these in-lab sessions, there

were online follow-up sessions that occurred annually. These follow-ups began with a valence bias task, and then participants completed a subset of self-report questionnaires that were also completed in-lab, including measures of puberty, emotion regulation, interpersonal regulation, personality, parental conflict, temperament, trait anxiety, and intolerance of uncertainty.

Data Analysis and Scoring

When looking at valence bias, data was available from the baseline valence bias time frame, which would have been the first baseline data collected for each individual participant; however, it's important to point out that some participants had their first session 5 years ago, and others had their first session only 1 year ago. Those participants that had been a part of the study for a longer period of time also had yearly follow-up data, and the quantity of yearly follow-up data could range from anywhere between one to five years after the original baseline valence bias data was collected for each participant. As a result of this longitudinal data collection, we needed to then identify a way to measure valence bias as it changes over time, so we formulated valence bias change scores, which can be identified in Figures 1 and 2. These valence bias change scores were determined by taking the first in-lab session from each individual and subtracting the most recent data of either one year after baseline or two years after baseline from it to determine how valence bias changed from baseline to the shorter-term follow-up (whichever one was most recently surveyed). These valence bias change scores, from baseline to one year after baseline or two years after baseline will be referred to as the shorter-term valence bias change scores for this report. We then did the same thing for valence bias change scores from baseline to four years after baseline and five years after baseline by subtracting the year 4 follow-up or year 5 follow-up valence bias data, again, whichever year was most recently surveyed, from the relevant baseline data to determine how valence bias changed longitudinally, and these variables will be referred to

as the longer-term change scores. Because of the wide range of individuals with no follow-up data or missing follow-up data, the number of participants with valence bias change scores decreased from N=197 to N=64. After coming up with a sufficient way to measure valence bias change scores from baseline to either one year or two years after baseline along with four years or five years after baseline I then computed change scores for valence bias's three subscales of surprise rate, ambiguous rate, and an average of both surprise and ambiguous rates, resulting in six new variables: surprise rate subscale of valence bias change score from baseline to the shorter-term (one year or two years after baseline) (SRy0minusy1y2) (N=58), surprise rate subscale of valence bias change score from baseline to the longer-term (four years or five years after baseline) (SRy0minusy4y5) (N=21), ambiguous subscale of valence bias change score from baseline to the shorter-term of one or two years after baseline (AMBy0minusy1y2) (N=58), ambiguous subscale of valence bias change score from baseline to longer-term of four or five years after baseline (AMBy0minusy4y5) (N=21), averaged surprise rate and ambiguous rate subscale from baseline to the shorter-term (SurpAMBy0minusy1y2) (N=59), and averaged surprise rate and ambiguous rate subscale from baseline to the longer-term (SurpAMBy0minusy4y5) (N=21).

Puberty was one of the surveys explored using the Petersen Pubertal Development Scale (PDS) in which children filled out this survey about themselves on more than one occasion. The first time this survey was filled out was during the first in-lab session, and it was subsequently filled out in the following years during online follow-ups. The average PDS score for 53 of the participants (N=53) that were applicable to fill out this survey, using the Petersen Pubertal Development Scale, was 2.215. Puberty scores were calculated "as the average of each of the five

items assessing physical development (out of the items numbered 1–7, where the five items included varied based on [each] participant's sex;" more specifically:

> Items 1 through 4 on the girls' version and all items on the boys' version, response options were: not yet started (1 point); barely started (2 points); definitely started (3 points); seems complete (4 points); I don't know (missing). Yes on the menstruation item = 4 points; no = 1 point. Point values are averaged for all items to give a Pubertal Development Scale (PDS) score (Petro et al., 2021).

I also looked at several other variables besides valence bias and puberty. I looked at parental conflict using the O'Leary-Porter Scale, which is "a 10-item measure designed to assess overt hostility in intact couples. This original version of the measure includes items aimed at assessing the frequency of overt hostility (such as quarrels, sarcasm, physical abuse) observed by the child" (Early Intervention Foundation, 2020), and was filled out by the parent during the first in-lab session. Its format consisted of a "6-point ordinal scale (from 1 = 'Never' to 6 = 'Very Often'" (Early Intervention Foundation, 2020).

I studied temperament using the Early Adolescent Temperament Questionnaire, which is a "65-item short form…[which] assesses 10 aspects of temperament related to self-regulation in adolescents" including activation control, affiliation, attention, frustration, high intensity pleasure/surgency, inhibitory control, pleasure sensitivity, perceptual sensitivity, shyness, and aggression, but the two we will mainly be focusing on are fear and depressive mood (Ellis & Rothbart, 2001). "Scales measuring aggression and depressive mood are included to facilitate examination of relationships between temperament and traits relevant to socialization" (Ellis & Rothbart, 2001). This survey of temperament was filled out by the children about themselves during the first in-lab session, and items were "rated on a 5-point scale ranging from 1 = almost

always untrue of you to 5 = almost always true of you" (Ellis & Rothbart, 2001). A higher score reflects more unpleasant affect and lowered mood, loss of enjoyment and interest in activities" (Ellis & Rothbart, 2001).

I surveyed intolerance of uncertainty in children, using the Intolerance of Uncertainty Scale for Children which had three subscales including factor 1 (prospective intolerance of uncertainty), factor 2 (inhibitory intolerance of uncertainty), and its total. This survey was filled out by the children about themselves, but it was also filled out by the parent about the child and by the parent about themselves. This survey was administered during the first session which took place in-lab and consisted of 27-item measures on a 5-point scale, where higher scores mean more intolerance of uncertainty (Comer et al., 2009).

I also considered interpersonal regulation using the Interpersonal Regulation Questionnaire which had a total of five subscales including negative tendency, negative efficacy, positive tendency, positive efficacy, and its total. The two subscales with significant findings included Interpersonal Regulation Questionnaire-Positive Tendency and Interpersonal Regulation Questionnaire-Total. The Interpersonal Regulation Questionnaire was filled out by the children about themselves during the first in-lab session and during subsequent online follow-up sessions. It consisted of "16 itemized questions with the following 7-point Likert scale: (1) strongly disagree – (2) disagree – (3) somewhat disagree – (4) neither agree nor disagree – (5) somewhat agree – (6) agree – (7) strongly agree" (Williams et al., 2018).

I also examined emotion regulation for children using the Emotion Regulation Questionnaire for Children and Adolescents, with its two subscales of reappraisal and suppression, which was filled out by the children about themselves during the first in-lab session and during the following online follow-up sessions. When it comes to surveys regarding parents,

I looked at emotion regulation for adults and parents using the Emotion Regulation Questionnaire, which had two similar subscales to that of the emotion regulation questionnaire for children and adolescents, including reappraisal and suppression. This questionnaire, regarding emotion regulation in parents, was filled out by the parent about themselves during the first in-lab session and during subsequent online follow-up sessions. Both questionnaires regarding emotion regulation were, "10-item scale[s] designed to measure respondents' tendency to regulate their emotions in two ways: (1) Cognitive Reappraisal and (2) Expressive Suppression. Respondents answer[ed] each item on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree)" (Gross & John, 2003).

The NEO-five factor inventory was also used to look at its two subscales of neuroticism and extraversion within parents' personalities and was filled out by the parent about themselves during the first in-lab session. This survey contained 24-item measures with 12 corresponding to the neuroticism subscale and 12 corresponding with the extraversion subscale with the following 5-point scale: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, (5) strongly agree.

Trait anxiety was also explored in parents using the State Trait Anxiety Inventory, which was a self-evaluation questionnaire filled out by the parents about themselves during the first in-lab session but also during the online follow-up sessions. This questionnaire included 20-item measures with a four-point scale made up of (1) almost never, (2) sometimes, (3) often, and (4) almost always.

Table 1.
Variables Of Interest

Title	Measurement	When Measure was Collected	Acronym	M	Sd	Range	N
Surprise Rate	Valence bias for faces	First Session In-lab and Online Follow-ups	SR	Baseline= 0.560 Shorter-term= 0.075 Longer-term= -0.066	0.319 0.343 0.266	0-0.96 -0.66-0.92 -0.70-0.50	64 58 21
Ambiguous Scenes	Valence bias for scenes	First Session In-lab and Online Follow-ups	AMB	Baseline= 0.501 Shorter-term= -0.003 Longer-term= 0.039	0.137 0.170 0.188	0.17-0.79 -0.38-0.42 -0.33-0.30	64 58 21
Surprise Rate and Ambiguous Scenes averaged together	Average valence bias across faces and scenes	First Session In-lab and Online Follow-ups	SurpAMB	Baseline= 0.530 Shorter-term= 0.036 Longer-term= 0.310	0.197 0.211 0.180	0.08-0.84 -0.38-0.54 0.12-0.84	64 59 21
Petersen Pubertal Development Scale	Puberty	First Session In-lab and Online Follow-ups	PDS	2.215	0.855	1-4	53
O'Leary-Porter Scale	Interparental conflict	First Session In-lab	OPS	31.09	3.517	24-36	21
Emotion Regulation Questionnaire for Children and Adolescents	Emotion regulation tendencies in children and adolescents	First Session In-lab and Online Follow-ups	ERQCA			1-7	52
Emotion Regulation Questionnaire for Children and Adolescents	Reappraisal tendency in children and adolescents	First Session In-lab and Online Follow-ups	ERQCA.R	4.598	1.312	1-7	52

Emotion Regulation Questionnaire for Children and Adolescents	Suppression tendency in children and adolescents	First Session In-lab and Online Follow-ups	ERQCA.S	3.515	1.318	1-7	52
Emotion Regulation Questionnaire	Emotion regulation tendencies in parents	First Session In-lab and Online Follow-ups	ERQ			1-7	18
Emotion Regulation Questionnaire	Reappraisal tendency in parents	First Session In-lab and Online Follow-ups	ERQ.R	5.591	0.972	3-7	18
Emotion Regulation Questionnaire	Suppression tendency in parents	First Session In-lab and Online Follow-ups	ERQ.S	3.1	1.426	1-6	18
Early Adolescent Temperament Questionnaire	Children's temperament	First Session In-lab	EATQ				34
Early Adolescent Temperament Questionnaire	Children's fear-related temperament	First Session In-lab	EATQ.Fear	2.749	0.687	1.33-4.33	34
Early Adolescent Temperament Questionnaire	Children's depressive-related temperament	First Session In-lab	EATQ.DM	2.565	0.693	1.17-4.0	33
Intolerance of Uncertainty Scale for Children (IUSC)	Intolerance of Uncertainty in children and adolescents	First Session In-lab	IUSC	41.0	14.3	27-105	12

Interpersonal Regulation Questionnaire	Using others to help regulate oneself, focusing on overall total, including all subscales	First Session In-lab and Online Follow-ups	IRQ.Total	80.41	16.43	51-112	52
Interpersonal Regulation Questionnaire	Using others to help regulate oneself, focusing on positive tendency	First Session In-lab and Online Follow-ups	IRQ.PT	19.81	4.88	5-28	52
State Trait Anxiety Inventory	Trait anxiety	First Session In-lab and Online Follow-ups	STAI-T	34.65	11.05	20-58	18
NEO-five factor personality inventory	Personality	First Session In-lab	NEO				18
NEO-five factor personality inventory	Personality, focusing on the neuroticism subscale	First Session In-lab	NEONE.N	1.908	2.693	0-13	18
NEO-five factor personality inventory	Personality, focusing on the extraversion subscale	First Session In-lab	NEONE.E	4.162	7.289	0.92-35	18

We first tested normality for all variables using Shapiro Wilkes tests. The variables that were normally distributed ($p > .05$) were then tested with Pearson correlations; the rest of the variables were tested with Spearman correlations. Variables which were normally distributed included shorter-term surprise rate change scores, shorter-term ambiguous change scores, longer-term surprise rate change scores, longer-term ambiguous change scores, shorter-term surprise and

ambiguous change scores averaged together, longer-term surprise and ambiguous change scores averaged together, ambiguous valence bias subscale at baseline, emotion regulation reappraisal and suppression for children and adolescents (ERQCA.R and ERQCA.S), emotion regulation reappraisal and suppression for parents (ERQ.R and ERQ.S), children's fear-related temperament (EATQ.Fear), children's depressive-mood-related temperament (EATQ.DM), interpersonal regulation focusing on positive tendency (IRQ.PT), and trait anxiety (STAI.T).

Regressions were then run for all correlations which seemed to match our original hypotheses to determine if any of the changes observed in the dependent variables were associated with changes in one or more explanatory variables. Any regressions found to be significant meant the dependent variable was related to baseline valence bias, but not change in valence bias over time (years 1/2, or 4/5).

Moderators were also run to determine if any of the relationships found between two variables were being moderated by a third variable, and the quadratic formula was utilized in finding the equation of the parabola that best fits a certain set of data.

Results

Correlations of valence bias over time were analyzed using Pearson and Spearman correlations. Reports indicated that ambiguous valence bias at baseline was highly correlated with both the shorter-term $r(1)=0.621$, $p(1)=<.001$ and longer-term $r(1)=0.448$, $p(1)=0.042$ change scores of the ambiguous subscale. Ambiguous valence bias at baseline was also highly correlated with surprise rate valence bias at baseline $r(1)=0.382$, $p(1)=0.002$. Analyses also exhibited significant correlations between surprise rate valence bias at baseline and surprise rate change scores, significant in both the shorter-term $r(1)=0.484$, $p(1)=<.001$ and longer-term $r(1)=0.742$,

p(1)=<.001 change score variables. Valence bias change scores are shown in graph format in Figures 1 and 2.

Figure 1.

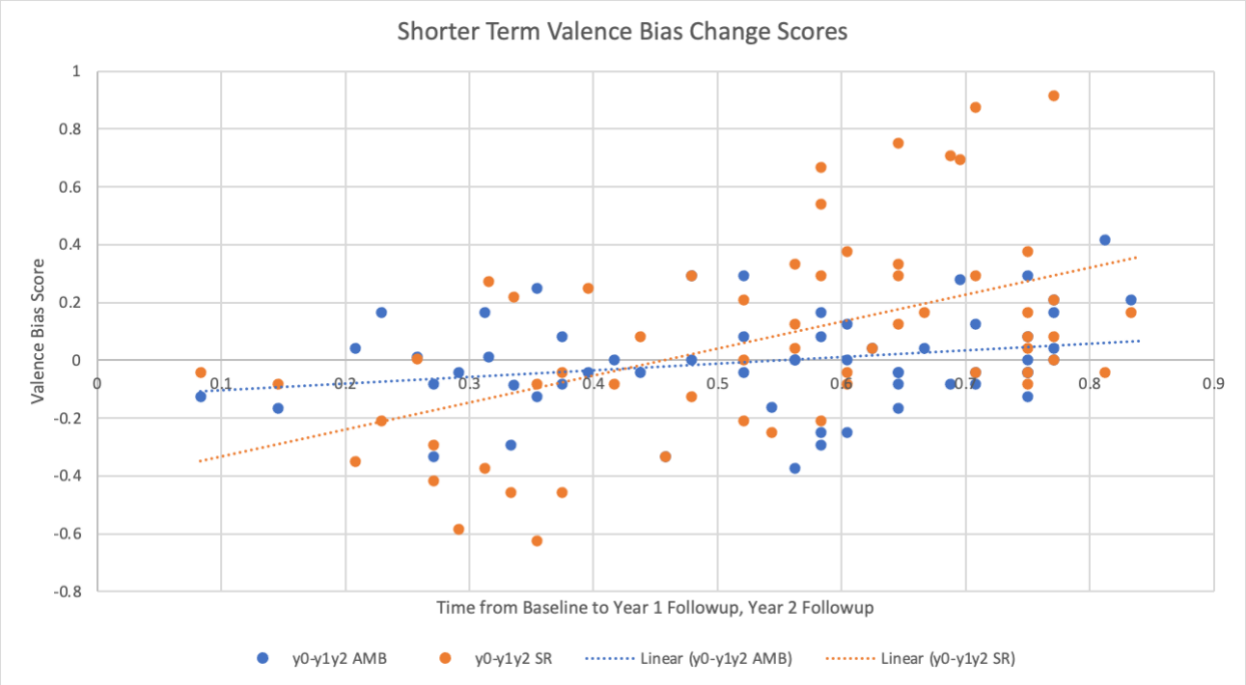
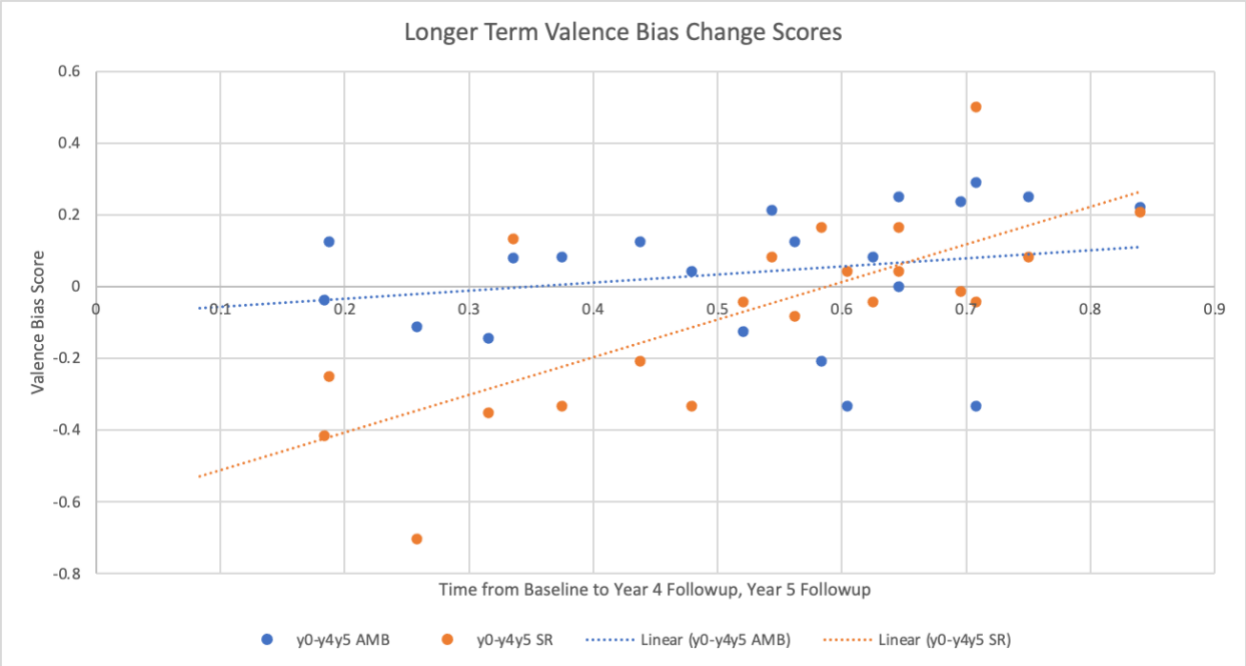


Figure 2.

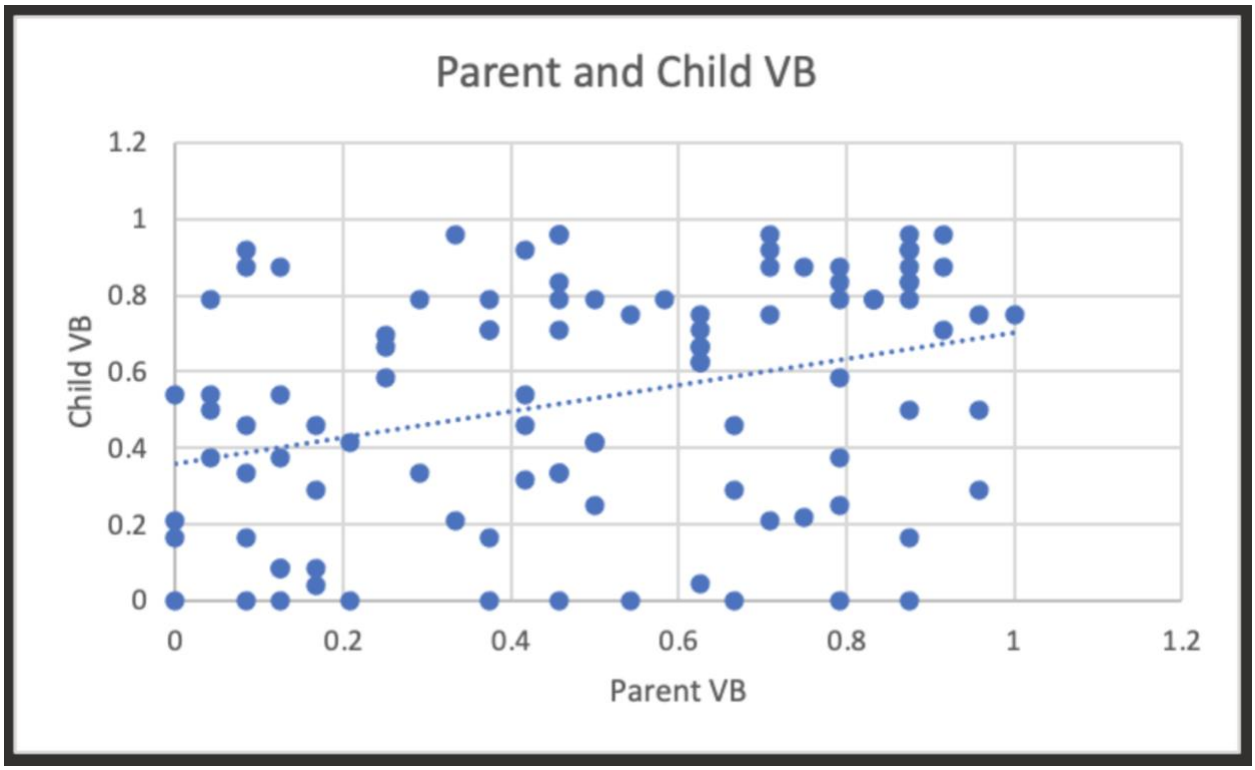


Results for Category One Hypotheses

Univariate Statistics for variables collected from the survey are shown in Table 1. The first study, categorized into personality of child participants, stated that there would be a negative correlation between puberty and valence bias, such that those who were higher on the puberty scale would have a more positive valence bias. However, this study found that there was no significant relationship between any of the valence bias change scores, neither shorter-term or longer-term and PDS.

Figure 3 depicts the relationship between parent and child valence biases at baseline, and although no significant findings came about connecting these two variables, the graph below shows corresponding trends between parents' valence biases in relation to their children's valence biases.

Figure 3.



The second hypothesis, under the first category, was that children and adolescents with lower mean scores of fear/depressive mood temperaments (EATQ) would have more positive valence bias scores. However, results from regression analyses suggest that children who become more positive in ratings of surprised faces over 1-2 years, have higher levels of early adolescent temperament in terms of depressive mood/unpleasant affect at baseline (N=33) $r(1)=0.351$, $p=0.045$, and children who become more positive of ambiguous scenes over 1-2 years alone (N=34) $r(1)=0.361$, $p=0.036$, along with ambiguous scenes and faces combined (N=34) $r(1)=0.395$, $p=0.021$, have higher levels of early adolescent temperament in terms of fear/distress.

The third hypothesis, in relation to intolerance of uncertainty, stated that those with lower levels of intolerance of uncertainty (IUSC) would have an overall more positive valence bias. This hypothesis was supported, but only for ambiguous scenes of longer-term change scores, 4-5 years after baseline. Children who become more positive in ratings of ambiguous scenes over 4-5 years have lower levels of intolerance of uncertainty at baseline (N=12) $r(1)=-0.678$, $p=0.015$.

Results for Category Two Hypotheses

The first hypothesis, under the regulation category of hypotheses, suggested that emotion regulation in children and adolescents (ERQCA) and valence bias would have a positive linear relationship. More specifically, as a child gets better at emotion regulation and uses the strategy of reappraisal more often, they will become more positive, and as a child uses the strategy of suppression less often, they will become more positive. This hypothesis was partially supported, as no significant findings were related to emotion regulation suppression, but there were significant findings related to reappraisal; such that children who become more positive in ratings of ambiguous scenes over the shorter-term change scores,1-2 years after baseline, report more

frequent use of reappraisal at baseline (N=52) $r(1)=0.286$, $p=0.04$. However, it is important to note that this effect disappeared in a regression analysis that included baseline valence bias.

The hypothesis regarding interpersonal regulation (IRQ) suggested that those who utilize others in emotion regulation more often will have more positive mean valence bias scores, and results do not support this hypothesis. Findings indicate that children who become more positive in ratings of surprised faces over 1-2 years after baseline, have lower levels of interpersonal regulation at baseline (N=52) $r(1)=-0.289$, $p=0.038$, and more specifically, that children who become more positive in ratings of surprised faces over years 1 and 2 have lower tendency to use others to upregulate positive emotions (N=52) $r(1)=-0.284$, $p=0.042$.

Results for Category Three Hypotheses

The first hypothesis under the third category, described that there would be a significant negative correlation between parental conflict (OPS) and children's valence bias, such that those whose parents scored higher on the O'Leary Porter Scale would have a more negative/less positive valence bias. Contrary to the hypothesis, OPS was related to increased positivity in children, such that children who become more positive in ratings of ambiguous scenes over 1-2 years after baseline, have parents with higher levels of interparental conflict at baseline (N=21) $r(1)=0.426$, $p=0.054$; however, this effect went away when baseline valence bias was added into the model to account for a more negative valence bias in children to begin with $r(1)=0.235$, $t=1.226$. In moderation analyses, there was a moderation between OPS and depressive mood where kids who are less depressed are the ones that show the OPS effect with increased positivity; although it is important to note the lack of correlation between OPS and depression in the regression model.

The second hypothesis under category three, stated that parents who have higher levels of emotion regulation reappraisal (ERQ.R) would have higher mean valence bias scores compared to those that have a higher levels of emotion regulation suppression (ERQ.S). Findings suggest that children who become more positive in ratings of ambiguous scenes over the shorter-term change scores,1-2 years after baseline, have parents who report more frequent use of reappraisal at baseline which highly aligns with the results from the children and adolescent emotion regulation questionnaire and previous research (N=18) $r(1)=0.472$, $p=0.048$, but this finding was only trending and had a very weak effect with regression analyses including baseline valence bias (N=18) $p=0.09$.

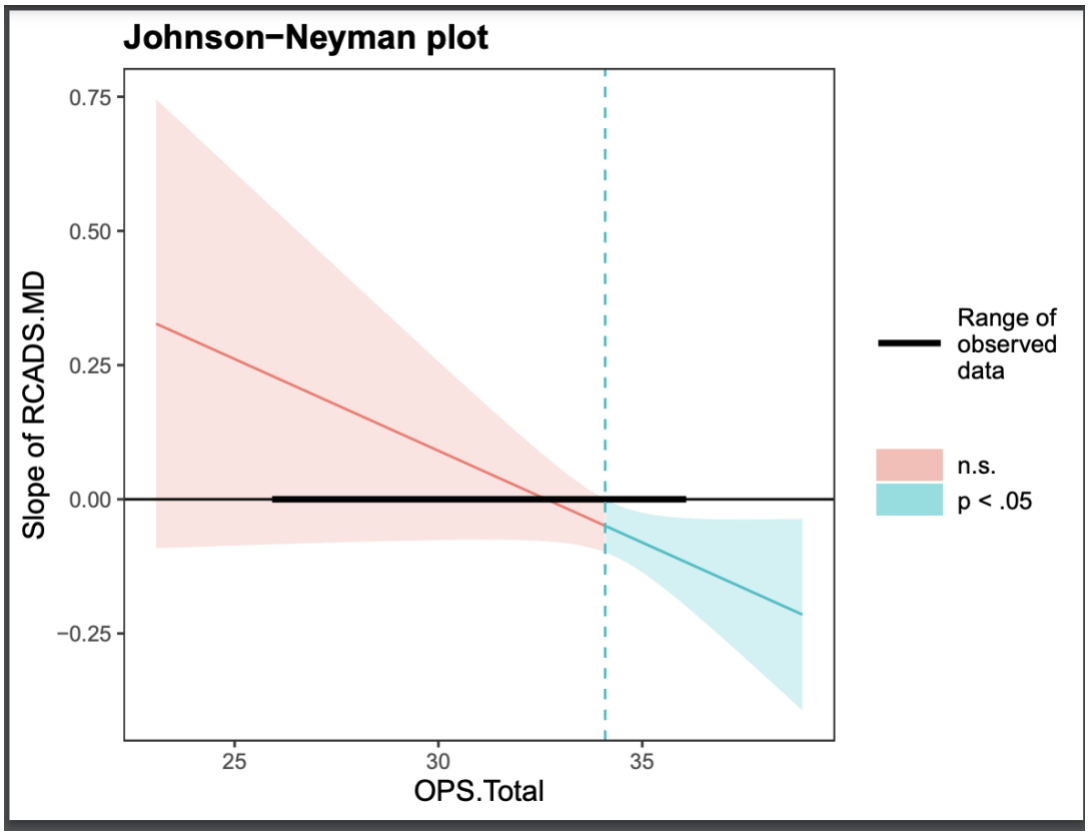
The third hypothesis was that children with parents who have higher levels of trait anxiety (STAI.T) would have less positive/more negative mean valence bias scores compared to those with lower levels of anxiety. Results from regression analysis indicate that children who become more positive in ratings of ambiguous scenes over the shorter-term change scores, 1-2 years after baseline, have parents who have lower state-trait anxiety at baseline, which supports our original hypothesis (N=18) $r(1)=-0.575$, $p=0.013$. This effect was no longer significant after including baseline valence bias in the regression; however, it was trending (N=18) $p=0.10$.

The fourth and final hypothesis for the category three variables, related to parental factors, was that the personality trait of neuroticism (NEONE.N) would be negatively correlated with valence bias, and that the personality trait of extraversion (NEONE.E) would be positively correlated with valence bias. This hypothesis was partially supported as no significant analyses could be found in terms of extraversion, but there were significant findings in terms of neuroticism; such that children who become more positive in ratings of ambiguous scenes over the shorter-term change scores from 1-2 years after baseline have parents who are lower in

neuroticism at baseline (N=18) $r(1)$=-0.494, p=0.037; although, this effect disappeared in a regression analysis that included baseline valence bias.

Moderations and quadratic analyses were run to examine the findings opposite of what was expected from our hypotheses. Analyses revealed that there was a trending moderation with OPS and the Revised Children's Anxiety and Depression Scale (RCADS.MD), specifically in terms of the major depression subscale (N=21) $r(1)$ =-2.033, p=0.066, ANOVA $r(2)$=0.002, where kids who experience high interparental conflict at home are the ones that show the OPS effect with increased positivity as shown in Figure 4 (Child Outcomes Research Consortium, n.d.). In sum, only in the context of high interparental conflict is lower depression associated with a greater increase toward a more positive valence bias. No other moderations panned out to explain the counterintuitive findings.

Figure 4.



The only quadratic effect we found for the counterintuitive effects was EATQ.DM and more positive ratings of surprise in the shorter-term change scores, 1-2 years after baseline (N=33) $t(1)=2.684$, $p=0.011$, $t(2)=-2.446$, $p=0.020$. This significant effect went away in the regression that included baseline VB $t=1.394$, $p=0.173$, but it was still trending in the same direction. Regression analyses were also run to determine whether changes observed in the dependent variable were associated with changes in one or more explanatory variables.
Statistical reports determined that IRQ.PT (N=52) and EATQ.Fear (N=34) effects held even when accounting for baseline VB, resulting in a true significant effect where kids that get more positive after shorter-term change scores have lower tendency to use others to upregulate positive emotions, and have higher temperament related to fear and distress.

Discussion

The results from these analyses depict the first longitudinal evidence of developmental changes toward increasing positivity in relation to parental factors; overall suggesting that children who develop a more positive valence bias over 1-2 years report more frequent use of emotion regulation reappraisal at baseline, consistent with previous findings showing that better emotion regulation and a more positive valence bias both have implications for better life outcomes. In addition, children who develop a more positive valence bias over 1-2 years have parents that are less neurotic, although this may be explained by variability in baseline valence bias. Other findings revealed that children who develop a more positive valence bias in ratings of ambiguous scenes over 1-2 years, have parents who have lower state-trait anxiety and report more frequent use of emotion regulation reappraisal. These findings will be explained further in organizational categories similar to that above.

Category One: Personality of the children shapes valence bias development

In category one, we predicted that personality factors in children would shape valence bias as it changes longitudinally. The factors we considered were fear-related temperament, depressive-related temperament, and intolerance of uncertainty. Overall, we predicted that lower mean scores of fear and depressive mood temperaments and lower levels of intolerance of uncertainty would be associated with the development of a more positive valence bias. When examining the relationship between fear and depressive mood temperaments and valence bias scores, the hypotheses were not supported. Results determined that children who become more positive in ratings of surprised faces over 1-2 years, have *higher* levels of early adolescent temperament in terms of depressive mood/unpleasant affect at baseline, and children who become more positive of ambiguous scenes over 1-2 years alone, along with ambiguous scenes and faces combined, have higher levels of early adolescent temperament in terms of fear and distress which is contradictory of our original research hypothesis. Future work will be needed to better understand this effect, which was counter to our predictions. Previous literature suggests that perhaps children who experience more internal fear and distress are more resilient, which allows them to maintain the trajectory of increased positivity as they grow older. As the current research suggests, with baseline valence bias included in the analyses, regardless of children starting off more negative, they still become more positive in relation to fear and distress.

The hypothesis in relation to intolerance of uncertainty was partially supported as the ambiguous scenes over years 4 and 5 was the only valence bias change score with a significant relationship to intolerance of uncertainty at baseline. None of the other five valence bias change scores appeared to be significant in terms of intolerance of uncertainty. This is worth noting because a majority of the significant effects, including this one, came from ambiguous scenes

rather than surprise faces. This may be indicative of there being more to look at in a scene, but these scenes have also not been well defined as ambiguous for kids, as they are clearly defined as ambiguous for adults, so further research is required to determine why this might be and if the faces are truly a good measure of affective flexibility in children.

Category Two Hypotheses: Parent and child regulation shapes valence bias development

In the second category of hypotheses, we predicted that measures of emotion regulation would shape trajectories in valence bias specifically showing that adults who tend to reappraise more often would show a more positive valence bias. We also considered interpersonal emotion regulation and hypothesized that those who use others to help regulate their emotions more often would have a more positive valence bias.

More specifically, the hypothesis examining emotion regulation suggested that emotion regulation in children and adolescents and valence bias would have a positive linear relationship. This hypothesis was supported, as there were significant findings related to reappraisal; such that children who become more positive in ratings of ambiguous scenes over 1-2 years report more frequent use of reappraisal at baseline, demonstrating that reappraisal influences valence bias, but other emotion regulation strategies, such as suppression do not. This finding supports previous research (Neta et. al., 2022) suggesting that reappraisal is a key component in interpreting ambiguity.

The hypothesis regarding interpersonal regulation suggested that those who utilize others in emotion regulation more often will have more positive mean valence bias scores, and results indicate that the original hypothesis is not supported. Children who become more positive in ratings of surprised faces over 1-2 years, were found to have lower levels of interpersonal regulation at baseline. This finding is inconsistent with work showing that participants with

higher levels of social connectedness, including interpersonal regulation, tend to have a more positive valence bias (Neta & Brock, 2021).

Category Three Hypotheses: Parent factors/personality shapes valence bias development

As for the hypotheses categorized under the third section, related to parental impacts, one hypothesis described a significant negative relationship between parental conflict and children's valence bias. Contrary to the hypothesis, parental conflict was related to increased positivity in children, such that children who become more positive in ratings of ambiguous scenes over 1-2 years, have parents with *higher* levels of interparental conflict at baseline; however, this effect went away when baseline valence bias was added into the model. In moderation analyses, there was a moderation between parental conflict and depressive mood where kids who started out as less depressed are the ones that showed the parental conflict effect aligned with increased positivity. This suggests that children who are more depressed are more likely to have a negative valence bias when their parents engage in conflict.

When interpreting the analyses of parental conflict and its effects on children's valence bias development, no significant findings were discovered in the prospect of this project; however, it was still important to include in the write up, as this was the main focus of the current research. With baseline valence bias included in the analyses, correlations were no longer significant between parental conflict and children's increased positivity, such that baseline valence bias altered their trajectories; they became more positive as time went on because of their negative valence bias at baseline. Moderation analyses then attempted to explain this, and findings may indicate that children who are less depressed are the ones that display the parental conflict findings with increased positivity, meaning that children who are more depressed are

more likely to have a negative valence bias when their parents participate in conflict. This finding was consistent with prediction and expected.

A similar hypothesis was that parents who have higher levels of emotion regulation reappraisal will have children who develop a more positive valence bias. Findings suggest that this hypothesis is partially supported. Children who become more positive in ratings of ambiguous scenes over 1-2 years, have parents who report more frequent use of reappraisal at baseline, although no significant findings corresponded with any of the other five valence bias change scores.

The hypothesis related to trait anxiety stated that children with parents who have higher levels of trait anxiety will be less likely to develop a positive valence bias compared to those with parents who have lower levels of anxiety. This hypothesis was, again, partially supported, as it was only significantly correlated with ratings of ambiguous scenes over 1-2 years.

The final hypothesis related to parental factors was partially supported as no significant analyses could be found in terms of extraversion, but there were significant findings in terms of neuroticism; such that children who become more positive in ratings of ambiguous scenes over 1-2 years have parents who are lower in neuroticism at baseline. This finding highly aligns with previous literature examining the relationship between neuroticism and valence bias; however, previous findings suggest that this relationship is moderated by interpersonal regulation, such that neuroticism is only related to a more negative valence bias, if that individual is less likely to utilize others in regulating themselves (Brock, Harp, & Neta, 2022).

The daily association between parent and child relationships may play a moderating role in emotion dysregulation, such that children who do not attempt emotion regulation, follow the paths of their parent's valence biases because they are more susceptible to it.

Limitations

There are important limitations to consider in this work. One limitation is the overall sample size, which could have limited our ability to detect important effects. To further the generalizability of this study, future directions should consider taking participants from different states within the United States, or perhaps even different countries outside of the United States. A related limitation of this study was the use of only European American faces in the surprise ratings of valence bias; facial expressions in other races and/or ethnicities should be examined in the future. It is also worth noting that a majority of the significant effects came from ambiguous scenes rather than surprise faces. This may be indicative of there being more to look at in a scene, but these scenes have also not been well defined as ambiguous for kids, as they are clearly defined as ambiguous for adults. Further research is required to determine why this might be and if the faces are truly a good measure of valence bias in children.

Conclusion

In this study, we explored different factors that shape the development of valence bias in children. Valence bias is critical to development, specifically because development of a more positive valence bias is associated with better mental health outcomes and overall higher life satisfaction. There was some evidence, within this research, that children who become more positive in ratings of ambiguous scenes over 1-2 years report more frequent use of reappraisal at baseline and have parents that are less neurotic. There was also evidence that children who become more positive in ratings of ambiguous scenes over 1-2 years, have parents with lower state-trait anxiety at baseline and have parents who report more frequent use of reappraisal at baseline, but future work will be needed to fully understand the factors that shape the process of valence bias development in children.

When considering combining findings from different hypotheses, according to the findings related to parental trait anxiety and parental use of reappraisal, one may speculate that the variables and impacts that affect children's change in valence bias over time may be driven by the child themselves more than the parent, given the finding that emotion regulation in children, at this specific developmental stage, is significant but parent anxiety is not. Because of the highly correlated emotion regulation between both children and their parents one might infer that in order to help children with emotion regulation over the long run, we must first help parents with their emotion regulation, specifically in terms of reappraisal, but children may still be driving valence bias change more than the parents. In conclusion, the contribution of this study was to approach the development of valence biases in children from the perspective of parental factors, by looking at data longitudinally, and results indicate that there are many factors that shape a child's development of a positive or negative valence bias over time, with varying degrees of impact.

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