ORIGINALCONTRIBUTION

Impulsivity and affect reactivity prospectively predict disordered eating attitudes in adolescents: a 6-year longitudinal study

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Abstract

Eating disorders (EDs) are associated with significant psychological and physical comorbidities, and adolescence is a particularly high-risk time for the development of EDs. Impulsivity (i.e., acting with little conscious judgment or forethought) and affect reactivity (i.e., changes in negative affect in response to a stressor) are hypothesized to contribute to the development of binge/purge ED pathology. The current study is the first to examine the prospective relationships between impulsivity and affect reactivity as predictors of the development of ED attitudes in adolescents over time. Two hundred six adolescents participated in a longitudinal study examining the development of psychopathology. ED attitudes were assessed via the College Eating Disorders Screen annually for 6 years. Baseline impulsivity and affect reactivity were also assessed. Affect reactivity, impulsivity, and their interaction were examined as baseline predictors of changes in ED attitudes over time using latent growth modeling. Results of latent growth modeling indicated that ED attitudes increased over time. The interaction between impulsivity and affect reactivity significantly predicted the slope of ED attitudes, such that the relationship between impulsivity and ED attitudes was strongest for those with elevated levels of affect reactivity. Findings suggest that greater levels of affect reactivity and impulsivity are key risk factors for the development of ED attitudes in adolescents. Subsequent research should examine the relation between affect reactivity and impulsivity in predicting objectively measured ED behaviors, in addition to ED attitudes. Further investigation may implicate affect reactivity and impulsivity as important targets for early intervention to prevent onset of ED symptoms in adolescents.

Keywords Eating disorders · Adolescents · Impulsivity · Affect reactivity · Longitudinal

Introduction

Eating disorders (EDs) are serious disorders associated with significant psychological and physical comorbidities [1] and increased risk for mortality [2]. Adolescence is a particularly high-risk time for the emergence of ED pathology, and anorexia nervosa (AN) and bulimia nervosa (BN) have the highest incidence and point prevalence during adolescence [3]. Furthermore, risk of ED pathology in early adolescence is associated with higher rates of AN and BN by the end of adolescence [4, 5], as well as higher rates of mental and physical health concerns extending past adolescence and into adulthood [6]. As such, it is important to identify risk factors of ED onset and to identify which adolescents are at particularly high risk of developing EDs, so that early prevention and treatment can occur. In particular, impulsivity (i.e., acting with little conscious forethought [7]) and affect reactivity (i.e., change in negative affect in response to a stressor [8, 9]) are two risk factors implicated in the development of binge/purge ED pathology (e.g., bulimia nervosa, binge eating disorder, anorexia nervosa binge-eating/purging type) that merit attention, as both traits can be indicators of ED risk, and both are valuable potential treatment targets in psychological intervention for EDs. However, greater understanding of how impulsivity and affect reactivity influence

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the development of binge/purge ED pathology over time, both individually and in combination, is needed.

The role of impulsivity in the development of eating disorders

Impulsivity is a risk factor implicated in the development of binge/purge ED symptoms. Impulsivity is a broadly defined, multi-dimensional concept, but generally refers to performing behaviors with little conscious forethought, or acting on the spur of the moment [7]. High levels of impulsivity are thought to increase the risk of binge/purge ED pathology, as highly impulsive individuals are more likely to engage in rash behavior (e.g., bingeing, purging [10]) in response to negative cognitions or affective states, as a means of temporarily distracting from or coping with negative emotions [11]. Indeed, in adults, impulsivity is associated with the presence of ED pathology both cross-sectionally [12–23] and longitudinally [24, 25]. Cross-sectional data from mixed samples of adult and adolescent patients with binge-eating pathology and bulimia nervosa have also shown higher levels of impulsivity in these individuals compared to peers without EDs [26, 27]. Impulsivity in adults with ED pathology is also associated with poorer treatment outcomes [28–32] and predicts treatment dropout [33]. Taken together, impulsivity is a well-documented risk factor for the development of ED pathology and treatment outcome in adults.

In adolescent-only samples, the association between high levels of impulsivity and binge/purge ED pathology has also been documented by several cross-sectional studies [34–38]. In longitudinal studies examining the role of impulsivity and the development of binge/purge ED pathology in adolescents, however, the results are mixed. In six previous trials, self-reported levels of impulsivity failed to significantly predict the subsequent development of ED pathology [10, 39–43]. Only three trials have found a significant relationship between levels of impulsivity and the subsequent development of ED pathology. In these studies, higher levels of impulsivity in elementary school-aged children were associated with greater levels of bulimic symptoms in mid-adolescence relative to normative comparison groups [44–46]. Thus, despite research indicating that impulsivity is significantly associated with development of EDs, the studies documenting the relationship of impulsivity and ED pathology over time are few in number and present mixed results.

In summary, while evidence indicates that impulsivity is a key risk factor in the development of EDs, further research is needed to better understand the role that impulsivity plays in the development of ED pathology in adolescents over time. This is particularly important given that the few longitudinal trials described above were conducted in specific samples of youth, warranting further investigation in larger, diverse samples. Furthermore, adolescents have high levels

of impulsivity in general [47], making it particularly important to assess other psychological traits that may interact with impulsivity to better understand why some adolescents develop EDs and others do not. One such moderating trait may be change in negative affect in response to a stressor (i.e., affect reactivity).

The role of affect reactivity in the development of eating disorders

Emerging research has implicated affect reactivity in the development and maintenance of ED pathology [48–50]. Individuals with high levels of affect reactivity are more prone to experience negative affective states more strongly and frequently [51], and may, thus, be more susceptible to engaging in maladaptive behavior, such as disordered eating, as a means of coping with high levels of negative affect [11]. Indeed, Goldschmidt and colleagues found that binge/purge episodes were immediately preceded by negative affect in response to a stressor [48]. Relatedly, greater levels of negative affect are concurrently associated with greater urges to engage in emotional eating [52]. As such, affect reactivity may be an important predictor and maintenance factor for ED pathology. This relationship may be particularly strong in adolescents, who generally experience greater levels of emotional reactivity, which is empirically linked with greater levels of impulsivity [47]. However, further research is needed into the role of affect reactivity alone, as well as how it may interact with other psychological traits commonly associated with ED pathology, such as impulsivity.

The interaction of affect reactivity and impulsivity in the development of eating disorders

Impulsivity and affect reactivity are both important individual risk factors for the development of ED pathology. Adolescents who are highly impulsive (and, thus, prone to engage in impulsive behaviors to cope with negative affective states [53]) and high in affect reactivity (and, thus, frequently experiencing strong, negative affective states; [51]) are more likely to engage in rash behaviors, such as disordered eating, to reduce or distract from negative affective states [54]. Thus, affect reactivity may moderate the relationship between impulsivity and ED pathology, such that the relationship between impulsivity and ED pathology may be strongest for youth with higher levels of affect reactivity, as a means of coping with aversive negative affect.

However, no study to date has examined the interaction between affect reactivity and impulsivity in relation to the development of ED pathology. Furthermore, given that the risk of ED development is greatest in adolescence, examining the relationship between key risk factors is particularly important in an adolescent sample. Most importantly,

a more nuanced understanding of combinations of psychological traits that confer elevated risk for the development of EDs, such as impulsivity and affect reactivity, will advance our understanding of risk and maintenance factors for EDs, with potential implications for more targeted treatment and prevention efforts for at-risk youth.

Current study

The current study examined affect reactivity and impulsivity as prospective predictors of ED pathology in adolescents to better understand how impulsivity in adolescents relates to the emergence of EDs. This study built on recent findings of our team using the same data set, which demonstrated that affect reactivity is a prospective risk factor in both the onset and maintenance of ED attitudes in adolescents [55]. The present study elaborates on this finding by specifically examining the interaction between affect reactivity and impulsivity traits. This novel interaction effect has not been previously investigated, in our data set or any others, and has potential to enhance our understanding of how individual differences in levels of impulsivity and affect reactivity may influence risk of developing ED pathology. Better understanding the role of individual traits in ED risk may ultimately allow for development of highly personalized and tailored intervention and treatment approaches.

In the current study, we specifically assessed the development of ED attitudes (i.e., individually held attitudes regarding eating behavior and weight). ED attitudes in early adolescence predict the continuation of ED symptoms in later adolescence and early adulthood [4, 5]. Such findings are consistent with the cognitive-behavioral model of EDs [56], which describes overvaluation of and concern about shape and weight (i.e., ED attitudes) as a core maintenance factor of ED symptoms. However, few longitudinal studies have examined the development of ED attitudes in adolescents across time. The current study was conducted using a large, longitudinal data set that included an assessment of ED attitudes over multiple assessment points, to capture pre-clinical ED symptoms and assess vulnerability to the subsequent development of EDs.

Specifically, we hypothesized that greater levels of impulsivity would predict the development of higher levels of ED attitudes in adolescents over time. Additionally, we hypothesized that affect reactivity would moderate the relationship between impulsivity and ED attitude development, such that higher levels of affect reactivity and impulsivity would predict the development of ED attitudes over time, compared to adolescents with lower levels of one or both of those traits.

Methods

Participants and procedures

The present study included adolescents taking part in a longitudinal study examining the development of psychopathology. Adolescents and their families were recruited from a metropolitan area community. Inclusion criteria included proficiency in English and the ability to commit to taking part in yearly assessments. The original sample was comprised of 277 (46% female) adolescents and their parents; however, because key measures related to the present study were not introduced until the third year of participant enrollment, the current study utilized data only from those youth who completed all measures at this assessment point (Wave 3 for the parent study, relabeled T1 for clarity in the remainder of the manuscript). As such, the current sample included 206 adolescents with ages ranging from 11 to 15 ($M_{age} = 13.03$, $SD_{age} = 0.89$) at T1. Retention of participants over the course of the study was good; of the original sample of 206 youth, 193 ($M_{age} = 14.00$, $SD_{age} = 0.89$) participated in Wave 4 (T2), 175 ($M_{age} = 15.02$, $SD_{age} = 0.95$) participated in Wave 5 (T3), 152 ($M_{age} = 16.06$, $SD_{age} = 0.89$) participated in Wave 6 (T4), 130 ($M_{age} = 17.00$, $SD_{age} = 0.95$) participated in Wave 7 (T5), and 123 ($M_{age} = 18.05$, $SD_{age} = 0.97$) participated in Wave 8 (T6). Forty-nine percent of the sample identified as White/Caucasian, 37% as Black/African–American, 4% as Latino/a, and 10% as "Other." The Institutional Review Board approved all protocols used in this study.

Measures

Eating disorder attitudes

The College Eating Disorders Screen (COEDS) [57] is a seven-item self-report measure of adolescents' attitudes regarding eating behavior and weight. Participants were asked to rate the extent to which they had certain eating disorder thoughts or feelings, e.g., "I believe I am fatter than most people say I am." The COEDS is considered a measure of vulnerability to the development of EDs and was developed as a clinical screening tool to capture pre-clinical symptoms of EDs [57, 58]. The COEDS is particularly useful for identifying individuals who carry beliefs that put them at heightened risk for development of an ED in the future [57, 59]. Indeed, COEDS scores predicted restricting and compensatory behavior 1 year later in an adolescent sample [58]. The COEDS has good convergent validity with other validated measures of ED pathology

[59]. The COEDS is valid and reliable for use in an adolescent population [58]. In the current study, Cronbach's alphas ranged from 0.85 to 0.91 across all years.

Affect reactivity

Affect reactivity was assessed using an adapted version of the Positive and Negative Affect Schedule for Children (PANAS-C) [60]. The PANAS-C measure asked participants to rate current levels of negative affect including "mad," "frustrated," "upset," "embarrassed," and "nervous" on a 10-point rating scale ranging from 0 (not at all) to 10 (extremely). Participants completed the questionnaire to capture levels of negative affect immediately prior to and following the completion of the Behavioral Indicator of Resiliency to Distress (BIRD) task [61], which is a laboratory-based behavioral measure of distress intolerance. During this computerized task, individuals click one of the ten boxes designated by a dot. Clicking on the correct box results in the participant being awarded one point. Clicking on the incorrect box produces a loud and unpleasant noise, and no point is earned. The BIRD task is divided into three levels that increase in difficulty. At the beginning of the task, participants are informed that they may quit the last (hardest) level at any point, but that they will lose the opportunity to earn more points once they quit. The time the individual persists in the final level of the task is then used as a measure of behavioral distress intolerance, with lower values denoting higher intolerance. The BIRD has demonstrated validity as an indicator of risk taking, externalizing symptoms, and internalizing symptoms among both clinical and community samples [62].

The total score on the PANAS-C measure at both time points was then computed by summing the responses on each item. The measure has been indicated to be both reliable and valid in adolescent populations [60]. In the current study, Cronbach's alpha was 0.76 for the pre-BIRD administration and 0.80 for the post-BIRD evaluation. Affect reactivity was computed by subtracting the post-task PANAS-C score from the pre-task score, with lower scores reflecting greater negative affect reactivity. The resulting change in affect reactivity scores ranged from −40 to 30.

Eysenck impulsivity inventory

We used the Eysenck Impulsivity Subscale, Version 7 (EI-7 subscale) [63] to measure impulsivity, which is a self-report inventory consisting of 19 items. The subscale assesses the tendency to act without being aware of risk or considering consequences. Questions are answered in a yes/no format. Sample items include: "I often buy things on impulse'' and "I often do things on the spur of the moment." The total score was computed by adding the score on each individual item, with higher scores indicating higher levels of impulsivity. The coefficient alpha for the subscale in our study was 0.77.

Data analytic plan

To examine trajectories of ED attitudes over time, as well as predictors of these trajectories, we utilized a latent growth curve (LGC) approach, which is a special case of structural equation modeling. LGC allows for examining latent baseline (or intercept) and growth (or slope) terms that describe trajectories of change or stability over time in the population. By adding predictors of the intercept and growth terms to our model, it is also possible to examine how specific covariates may influence these parameters. Because the trend in change over time is not known a priori, we utilized a model building approach that allowed us to determine the shape of the change in ED attitudes over time. First, we estimated an unconditional model, which does not include any exogenous predictors. We examined a series of trajectory shapes, starting with an intercept-only model (which reflects no change in ED attitudes over time) and then adding additional growth factors (including linear, quadratic, and cubic change in ED attitudes) until the most parsimonious and best-fitting model was determined. Improvements in model fit were indexed using a change in χ^2 statistic and accompanying degrees of freedom. Once the appropriate growth term was determined, we then examined a model in which the residual (or error) variances were constrained to be the same across measures. If this constraint did not result in a significant decrement of fit, it was retained for all subsequent models. The means and variances of the intercept and growth terms were then examined. Statistically significant estimates of latent means suggest that the baseline value is significantly different than zero (in the case of the intercept) and significantly grows or changes over time (in the case of the growth factor). Statistically significant estimates of the variances suggest individual differences around these estimates. Significant variance estimates would support the inclusion of predictors of these factors in the model.

Next, we estimated a conditional model, which included exogenous predictors of the latent intercept and growth term. First, we examined the main effects of our focal predictors, impulsivity and affect reactivity, as well as our covariates, sex and baseline negative affect. Finally, we included an interaction term between impulsivity and negative emotional reactivity and added it to our model.

Four fit indices were used to determine how well each of these models fit the data: the χ^2 statistic, the Comparative Fit Index (CFI) [64], the Tucker Lewis Index (TLI) [65], and the Root Mean Square Error of Approximation (RMSEA) [66]. Non-significant χ^2 values indicate good fit; however, this index is sensitive to sample size. CFI and TLI values greater

than 0.90 and RMSEA values less than 0.08 suggest acceptable fit [67]. M*plus* 6.0 [68] was used for all LGC models. M*plus* uses full information maximum likelihood (ML) estimation to handle missing data that are missing completely at random (MCAR) or missing at random (MAR). ML uses less biased parameter estimates than other missing data procedures, such as listwise or pairwise deletion. Moreover, ML allows for the full sample of 238 youth to be included in the analyses.

Results

Preliminary analyses

First, we examined our dependent variables (ED attitudes) at each time point to evaluate univariate normality. Time 1 COEDS was found to be kurtotic; thus, we transformed the variable at each time point by taking its natural log. The transformed variables were all within acceptable bounds for skew and kurtosis (± 3.0) and were retained throughout the following analyses. To better understand the patterns of missing data, we conducted a Little's MCAR test [69]. Results support the assumption that data were missing completely at random: $\chi^2(182) = 141.02$, $p = 0.989$. We then examined the descriptive statistics and bivariate correlations between our key study variables (see Table 1). Of note, we found that sex was correlated with negative affect reactivity and our measure of ED attitudes at every wave, indicating that girls report greater affect reactivity and higher levels of ED attitudes. Baseline impulsivity was correlated with ED attitudes at the first and last time points only. Both negative affect reactivity and baseline negative affect were correlated with ED attitudes at time 1, but only reactivity was associated at time 3, 4, and 5 as well.

Previously, Juarascio et al. [55] investigated the trajectory of ED attitudes over time in the current sample of adolescents, as well as the role of internalizing symptoms, affect reactivity, and distress intolerance as prospective predictors of increases in ED attitudes during adolescence. To do this, the trajectory of ED attitudes over time was first modeled by examining a series of growth models to determine the best fitting and most parsimonious model. A linear growth model with homoscedastic residuals was the best fitting model (see [55] for details). The results of this model indicated that ED attitudes at baseline were greater than zero and that they increased significantly over time in a linear fashion. Moreover, both the variances of the mean and slope were significant, suggesting that there are important individual differences around the level of initial ED attitudes and their rate of increase, supporting the inclusion of predictors of these parameters. The slope and intercept were not correlated with each other ($r = 0.01$, $p = 0.388$), indicating that the level of baseline ED attitudes was not predictive of change in attitudes over time. Of the baseline variables examined (internalizing symptoms, affect reactivity, and distress intolerance), only negative affect reactivity was a significant predictor of the latent slope (std. est. $= -0.32$, $p = 0.003$), suggesting that youth with greater levels of negative affect reactivity evidenced steeper increases in ED attitudes over time.

Conditional growth models

To examine the role of impulsivity and affect reactivity, we added our main effects (baseline impulsivity and affect reactivity) and covariates (sex and baseline negative affect) to the previously established linear growth model as predictors of the latent intercept and slope. This model continued to fit the data well: $\chi^2_{(df=37)} = 58.86$, $p = 0.013$,

Table 1 Mean, standard deviations, and intercorrelations of key study variables

|	1	2	3	4	5	6	7	8	9	10
1. Sex (male)	1.00									
2. Time 1 EIS	0.05	1.00								
3. Time 1 negative affect reactivity	0.19**	−0.10	1.00							
4. Time 1 negative affect	−0.06	0.11	0.32**	1.00						
5. Time 1 COEDS	−0.32**	0.19**	−0.16*	0.17**	1.00					
6. Time 2 COEDS	−0.36**	0.12	−0.03	0.08	0.70**	1.00				
7. Time 3 COEDS	−0.31**	0.12	−0.14	0.06	0.55**	0.65**	1.00			
8. Time 4 COEDS	−0.32**	0.07	−0.24**	0.13	0.55**	0.62**	0.71**	1.00		
9. Time 5 COEDS	−0.36**	0.16	−0.32**	0.10	0.56**	0.64**	0.73**	0.71**	1.00	
10. Time 6 COEDS	−0.28**	0.17*	−0.24**	0.09	0.48**	0.49**	0.59**	0.67**	0.69**	1.00
Mean	0.56	8.27	−3.25	4.47	3.22	3.32	3.34	3.42	3.43	3.47
(SD)	(0.50)	(4.13)	(7.93)	(6.33)	(0.64)	(0.75)	(0.69)	(0.75)	(0.83)	(0.78)

EIS Eysenck Impulsivity Scale; *COEDS* College Eating Disorders Screen. *$p < 0.05$, **$p < 0.01$

CFI = 0.97, TLI = 0.97, RMSEA = 0.05 (90% CI = 0.02–0.07). Results suggest that sex (std. est. = −0.41, $p < 0.001$), baseline negative affect (std. est. = 0.15, $p = 0.042$), and baseline impulsivity (std. est. = 0.20, $p = 0.004$) were all significant predictors of the intercept. Specifically, girls and adolescents with higher baseline levels of negative affect and impulsivity evidenced higher levels of ED attitudes at baseline.

Finally, we added an impulsivity × negative affect reactivity interaction term as a predictor, retaining all main effect and covariates in the model (see Fig. 1). This model also fit the data well: $\chi^2_{(df=41)} = 69.64$, $p = 0.004$, CFI = 0.96,

TLI = 0.96, RMSEA = 0.05 (90% CI = 0.03–0.08). The interaction term was a significant predictor of the slope only (std est. = −0.60, $p = 0.033$). To better understand the nature of this interaction, we ran a post hoc multigroup model examining the relation between impulsivity and ED attitudes (controlling for sex and baseline negative affect), in a sub-group of participants who scored ± 1 SD from the mean on negative affect reactivity. Results suggest that impulsivity was not associated with the slope of ED attitudes for the low-negative affect reactivity group (std. est. = 0.07, $p = 0.901$) but was significantly associated for the high-negative affect reactivity group (std. est. = 0.63, $p = 0.010$). These findings suggest that for youth with

Fig. 1 Final latent growth curve model with standardized (and unstandardized) estimates. *$p < 0.05$, **$p < 0.01$
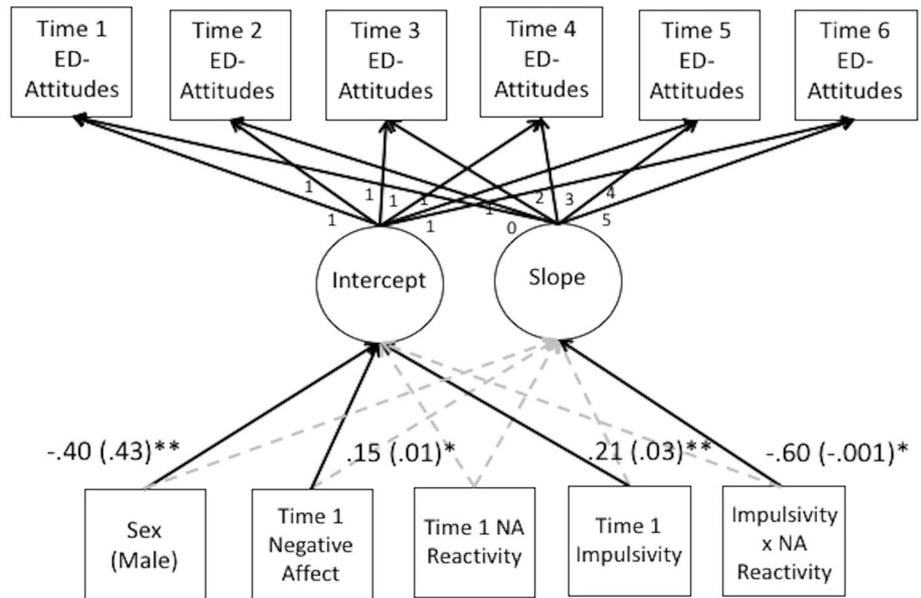
Fig. 2 Graph of the linear trajectories of ED attitudes for high- and low-negative affect reactivity and impulsivity groups. Groups were created by dividing the sample at the mean of both the Eysenck Impulsivity Scale and the Negative Affect Reactivity measure. Lines represent trajectories rather than point estimates to better capture growth over time and parallel reported analyses. *$p < 0.05$, **$p < 0.01$
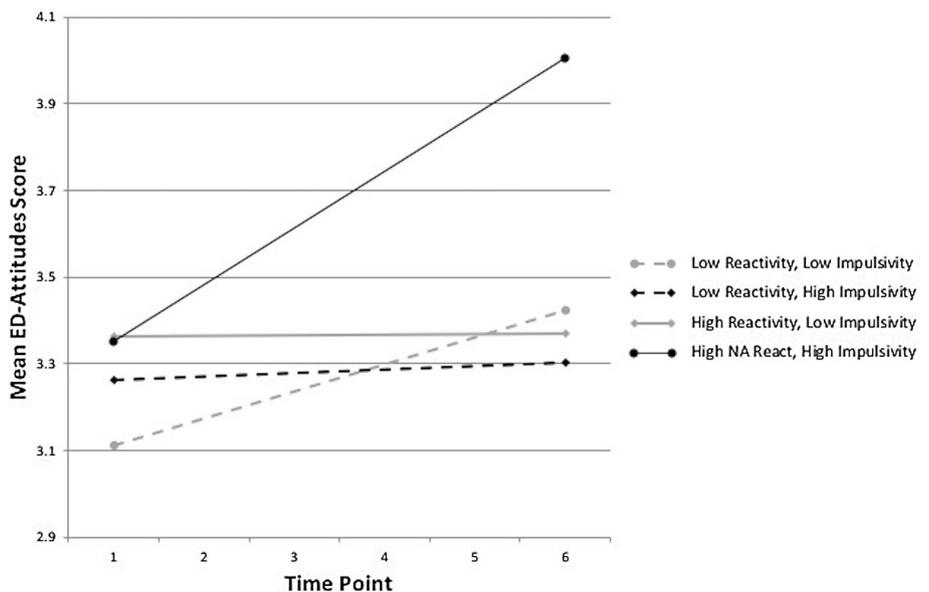
greater negative affect reactivity, higher levels of impulsivity were more strongly related to increases in ED attitudes over time, relative to less-affectively reactive youth (see Fig. 2).

Discussion

Consistent with our hypotheses, the results of the current study indicated that greater levels of impulsivity predicted the development of higher levels of ED attitudes in adolescents over time. Furthermore, affect reactivity interacted with impulsivity to increase risk of ED attitude development, such that for youth with greater affect reactivity, increases in impulsivity were more strongly related to increases in ED attitudes over time, relative to less-affectively reactive youth. Juarascio et al. previously found in the same sample that affect reactivity alone was significantly associated with both baseline levels of ED attitudes and increases in ED attitudes over time [55]. The novel results of the current study build upon the previous findings by indicating that higher levels of impulsivity at baseline were also associated with greater levels of ED attitudes, and that a stronger relationship exists between high levels of impulsivity and ED attitudes in youth who are also high in affect reactivity. Thus, high levels of both traits (i.e., impulsivity and affect reactivity) in combination confer the greatest risk of ED attitude development in adolescents over time.

While impulsivity has previously been investigated in association with ED symptoms, no study to date has examined the moderating effect of affect reactivity on impulsivity in relation to ED attitudes. The moderating effect of affect reactivity on impulsivity in relation to ED attitudes may help to explain the discrepant findings in the existing literature regarding the longitudinal impact of impulsivity on ED pathology over time [10, 39–46], and suggests that impulsivity may be most strongly linked to ED attitude development when levels of emotional reactivity are also high. Thus, the present study enhances our understanding of combinations of psychological traits that confer higher risk of the emergence of ED pathology.

Furthermore, our findings add to our knowledge of potential risk factors for developing ED attitudes in particular, which measure vulnerability to subsequent development of ED behavior [57–59]. The current findings indicate that youth with high trait levels of impulsivity and affect reactivity have greater levels of ED attitudes, which suggests that this subset of youth may be at heightened risk for development of an ED in the future [57, 59]. While preliminary, these findings suggest that early intervention or prevention efforts in youth with high trait levels of impulsivity and affect reactivity may be important to prevent heightened vulnerability to ED development. However, future research

with comprehensive measures of clinical ED pathology is needed to expand upon these findings and examine these risk factors in relation to the development of objective ED symptomology.

The current findings that high levels of affect reactivity and impulsivity in combination confer higher risk for developing ED attitudes are consistent with data that youth with high levels of impulsivity have a greater propensity to engage in rash behavior to cope with negative or unpleasant thoughts, emotions, or situations [70]. Impulsively engaging in ED behaviors (e.g., vomiting to cope with feeling fat) or ED attitudes (e.g., mentally comparing one's body to others who are larger to cope with feeling fat) reinforces reliance on ED pathology as a strategy for coping with negative emotion [48]. Highly impulsive youth who are also highly affectively reactive will experience negative affect more strongly and frequently [71]. Thus, more frequent and intense experiences of negative affect may increase the likelihood of engaging in impulsive behaviors to cope with negative affect [72], therefore strengthening the relationship between rash behaviors and engagement in ED attitudes. As ED attitudes are a measure of vulnerability of developing ED behaviors [58], an increase in ED attitudes in highly impulsive and affectively reactive youth may subsequently manifest in objective ED behaviors. While the current study provides initial support for the interaction between impulsivity and affect reactivity in relation to the development of ED attitudes, further investigation is needed to understand the relationship between these traits and the development of ED behaviors. As such, the present findings provide preliminary evidence to support further research into impulsivity and affective reactivity as ED risk factors, which may result in clear clinical implications for early identification and intervention for youth at potential risk of ED development.

Strengths and limitations

A key strength of the current study is the use of a large, longitudinal data set comprised of a diverse sample of adolescents from the community including both males and females, which provides a representative sample from which conclusions are more broadly generalizable. Furthermore, this study adds to our knowledge of the development of ED attitudes in adolescents, an area in which there is a paucity of literature. Existing longitudinal investigations of impulsivity and ED development have other limitations that this study was able to address; for instance, the trials that did find a significant effect of impulsivity on ED pathology were conducted within specific samples of youth (e.g., Black females [44], children with ADHD [46]), which limits the conclusions that can be drawn from the findings. The present study was conducted in a large, diverse, community sample, which enhances generalizability. Furthermore, existing longitudinal

research on impulsivity and EDs only assessed disordered eating at 2–3 time points. In contrast, the present longitudinal data set assessed ED attitudes at 6 time points over the span of adolescence, which provides a more nuanced and thorough look at the changes in ED attitudes over multiple time points.

One notable limitation of the current study was that we were unable to include a measure of clinical ED behaviors, which would have allowed us to more comprehensively assess the development of ED symptomatology over time. To build upon this study's preliminary findings and more fully understand the role of impulsivity and affect reactivity in the development of ED symptomatology, future longitudinal research is needed that includes a comprehensive measure of clinical ED pathology. A second limitation is that the measure used in the current study does not clearly distinguish between binge/purge- and restriction-type ED attitudes. Therefore, we are unable to answer whether the found associations hold for all eating disorder diagnoses. Given existing data on impulsivity and affect reactivity (e.g., [34–36, 38, 55]), the current findings are likely more applicable to binge/purge-type ED attitudes, rather than restrictive-type EDs, such as AN. However, future research with improved diagnostic specificity is warranted. Finally, self-report measures were relied upon to assess impulsivity and affect reactivity. Self-report measures are subjective ratings, and subject to inaccuracy and bias, as individuals may be unwilling or unable to report on certain internal experiences [73, 74]. In future research, behavioral measures of impulsivity and affect reactivity should be considered to allow for more objective assessment of these traits.

Conclusions and future directions

This study is the first to our knowledge to longitudinally assess the interaction of impulsivity and affect reactivity in predicting the development of ED attitudes in adolescents. Our results suggest that adolescents with high levels of both impulsivity and affect reactivity are at especially high risk of developing ED attitudes, which are associated with the development of ED behaviors in previous research. Further research is needed to assess whether the interaction of impulsivity and affect reactivity also predicts the development of ED behaviors in adolescents, to better understand the link between these factors and whether the increase in ED attitudes manifests in the development of behavioral ED symptoms. Further investigation may implicate affect reactivity and impulsivity as important targets for early intervention to prevent later onset of ED symptoms in adolescents. Interventions targeted towards improving inhibitory control (e.g., inhibitory control training paradigms such as go/no-go tasks or stop-signal tasks) and tolerating high levels of negative affect (e.g., emotion regulation skills taught in dialectical behavior therapy) could be beneficial in directly intervening on the traits that put adolescents at greater risk of developing EDs. However, additional research is first needed to replicate and build upon the current findings to pave the way for more targeted prevention and intervention programs.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical standards This human study was approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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