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RESEARCH ARTICLE

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The incremental validity of level of personality functioning over borderline personality features in associations with early adolescent social reward processing

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Abstract

More work is needed to establish the validity of the Alternative Model of Personality Disorders (AMPD) in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Acceptance of the AMPD as the primary model of personality disorder requires identifying neurocognitive validators of AMPD-defined personality functioning and demonstrating superiority of the AMPD over the traditional categorical model of personality disorder. It is also important to establish the utility of the AMPD in a developmental context given evidence that personality disorder emerges in adolescence. We assessed the incremental validity of AMPD-defined level of personality functioning (LPF) versus borderline personality features (BPF) in explaining alterations in neural processing of social acceptance feedback in early adolescent girls. One hundred nine girls ($M_{age} = 12.21$, $SD = 1.21$; $N = 79$ with a psychiatric history) completed a computerized peer interaction task to elicit neural response to social acceptance feedback via electroencephalogram (EEG). Subjects or caregivers reported adolescent psychopathology. In hierarchical regressions controlling for neural response to social rejection and internalizing and externalizing symptoms, LPF incremented BPF and all other covariates in predicting response to social acceptance, but BPF did not. Higher LPF impairment was associated with enhanced reactivity to social acceptance (St.b = 0.274, $p = 0.018$). LPF appears to provide additional information about neural response to social reward in early adolescence beyond that provided by borderline personality features. These findings add to an emerging literature demonstrating the validity and superiority of the AMPD and help build the rationale for moving toward the AMPD as the primary model of personality disorder classification.

INTRODUCTION

The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) includes two models for diagnosing personality disorders: the traditional, 10-disorder categorical model in Section II, and the newer Alternative Model of Personality Disorders (AMPD) in Section III. The AMPD was developed to address several shortcomings of the categorical model, including substantial heterogeneity of symptom expression within personality disorder (PD) categories and extensive comorbidity across PD categories (Widiger & Trull, 2007). The AMPD reformulates PD diagnosis around core impairments in self and interpersonal functioning common to all PDs (Criterion A, Level of Personality Functioning [LPF]). Instead of diagnosing 10 discrete disorders, LPF provides a dimensionally distributed single indicator of personality pathology, increasing parsimony and clinical utility. LPF is rated on a dimension of severity from healthy personality functioning (0, *no impairment*) to highly impaired personality functioning (4, *extreme impairment*). This dimensional approach has particular developmental relevance as it is conducive to assessing emerging personality impairment among youth who could benefit from early intervention (Sharp et al., 2022).

In the decade since its publication, several empirical investigations and reviews have supported the validity and utility of the AMPD as a whole and of its components, Criterion A and Criterion B (Milinkovic & Tiliopoulos, 2020; Sharp & Miller, 2022; Sharp & Wall, 2021; Zimmermann et al., 2019). However, further research is needed to continue to refine the AMPD and establish its validity and clinical utility above and beyond the traditional categorical system. The American Psychiatric Association (APA) requires the demonstration of superior validity before newly proposed diagnostic criteria can be accepted into the main section (Section II) of the DSM (American Psychiatric Association, 2021). Further, the APA denotes concurrent validity with neural substrates as a high priority in the validation process (Sharp, 2020), but neurocognitive validation of the AMPD has thus far been limited. Herein, we provide a direct comparison of the AMPD and the categorical system by examining whether alterations in neural processing of social reward are more strongly associated with LPF versus borderline personality features (BPF) in a sample of early adolescent females. Of note, we focus our attention on LPF (Criterion A of the AMPD) rather than on maladaptive traits (Criterion B) given the theoretical links between social reward processing and self and interpersonal functioning (which we expand upon below), and because neurocognitive changes undergirding the development of personality functioning are expected to take place in adolescence, while traits are viewed as more continuous, relatively stable features of personality (Sharp, 2020). Further, LPF is the entry criterion for PD diagnosis in the AMPD (and the only required criterion for diagnosis of PD in the ICD-11), so it is particularly important to demonstrate its utility.

SOCIAL REWARD PROCESSING AND PERSONALITY PATHOLOGY

Alterations in social processing, including processing of social inclusion, exclusion, acceptance, and rejection cues, have become an area of interest in research on PDs given the central role of interpersonal dysfunction in these disorders (Bhanji & Delgado, 2014; Crone & Dahl, 2012; King-Casas et al., 2008; Sharp et al., 2012). Social processing involves both controlled, reflective components and automatic, unconscious components, and deficits may be in either domain (Crick & Dodge, 1994; Strack & Deutsch, 2004). Although a sizable literature has examined interpersonal functioning in borderline personality disorder (BPD) and BPF, most studies used self-report or reports by other informants (Runions et al., 2021), providing limited insight into the unconscious, automatic components of social processing.

Emerging findings from functional magnetic resonance imaging (fMRI) studies show evidence of enhanced processing of social inclusion in adults with BPD (Malejko et al., 2018, 2019). Studies examining event-related potentials (ERPs), which have enhanced temporal specificity relative to fMRI, also show enhanced processing of social inclusion relative to exclusion in adults with BPD (Gutz et al., 2015; Weinbrecht et al., 2018). This work focused on the P3 component, an ERP associated with processing unexpected information; those with more BPF may be more responsive to experiences of social acceptance versus rejection because they are less likely to expect social acceptance from others (Babinski et al., 2023; Malejko et al., 2019; Weinbrecht et al., 2018). BPD is associated with greater rejection sensitivity, which not only enhances expectations of rejection but also enhances the tendency to readily perceive rejection; those with more BPD symptoms are also more likely to respond to perceived rejection with heightened negative affect and aggression (Scott et al., 2017), which could elicit further actual and perceived social rejection and again exacerbate expectations of rejection. There is also emerging evidence that the reward positivity (RewP) component is particularly relevant for examining social

reward processing. RewP is a frontocentral ERP component appearing approximately 300 ms after stimuli onset that is correlated with self-report and behavioral measures of reward responsiveness, in addition to activation in reward-related brain regions, such as the ventral striatum, ventromedial prefrontal cortex, midcingulate and anterior cingulate (Becker et al., 2014; Bress & Hajcak, 2013; Carlson et al., 2011). RewP may reflect individual differences in approach motivation and reward sensitivity (Bress & Hajcak, 2013). Recent work by Babinski et al. (2023) found that young adults with more BPF demonstrated enhanced neural reactivity (RewP) to social acceptance cues, along with less adaptive social behavior (i.e., greater tendency to vote to remove players who had voted to keep them). Effects persisted even when considering the effects of co-occurring depression and anxiety, pointing to the relevance of alterations in social reward (indicated by RewP) in borderline personality pathology.

Much less work has considered neural correlates of interpersonal functioning through the lens of the AMPD. Given that LPF places an even greater emphasis on interpersonal functioning than BPD criteria, LPF may be associated with similar (if not more pronounced) alterations in social reward processing. Just as rejection sensitivity likely plays a role in exacerbating expectations and experiences of rejection among those with BPD, one would expect that greater impairments in the LPF domains of empathy (i.e., difficulty understanding others' motivations and tolerating others' perspectives) and intimacy (i.e., diminished capacity for maintaining close relationships and mutual social behavior) might also enhance expectations of rejection and actual and perceived experiences of rejection. Following the study by Babinski et al. (2023) on BPF and social reward processing in young adults, Babinski and colleagues (2024) examined associations between LPF and social reward processing in early adolescent girls. In line with the BPD findings, girls with more impaired LPF demonstrated enhanced neural reactivity (RewP) to social acceptance feedback, even when considering the effects of co-occurring depression, anxiety, attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD) and conduct disorder (CD) symptoms. This finding provided a preliminary, non-specific neurocognitive validator for LPF, suggesting that the enhanced neural reactivity to social acceptance observed among those with higher BPD features may extend to those with more impaired LPF ratings. Enhanced reactivity to social acceptance could be an early biomarker of AMPD-defined impairment in personality functioning. In line with our goal of examining the validity of the AMPD versus traditional model of personality disorder, the current study extends this work (Babinski et al., 2024) by examining the incremental validity of AMPD-defined level of personality functioning (LPF) versus borderline personality features (BPF) in explaining reactivity to social acceptance within the same sample of early adolescent girls.

We focus our study specifically on early adolescence because changes in reward processing are a critical component of adolescent development and may relate to emerging personality pathology during this period (Crone & Dahl, 2012; Dahl, 2004). Indeed, despite the unwillingness of some providers to consider emerging personality pathology in youth, several reviews now document extensive evidence supporting the validity, reliability, stability, and clinical utility of borderline personality disorder (BPD) diagnosis in adolescence (Chanen et al., 2017; Leichsenring et al., 2024; Miller et al., 2008; Sharp & Fonagy, 2015). While it is of course important to take developmental considerations into account when diagnosing BPD in youth to avoid pathologizing typical experiences, prior work suggests that adolescents with normative distress can be distinguished from adolescents with clinically meaningful, elevated PD traits that are more likely to persist (Johnson et al., 2000; Sharp et al., 2018). Even before adolescence, children's maladaptive personality traits and borderline "features" (i.e., affective instability, identity problems, and negative relationships) can be identified. These traits and features have clinical meaning: prospective research has demonstrated the stability of maladaptive personality traits (De Clercq et al., 2009) and the stability and concurrent validity of borderline features (Crick et al., 2005) measured as early as ages 7 and 9, respectively. Borderline symptoms may provide useful information as early as age 12; for example, Wertz et al. (2020) found that borderline symptoms at age 12 predicted poorer mental health and worse functional outcomes (i.e., educational failure, health-risk behaviors, and lower well-being) at age 18. Using the AMPD framework, Goth et al. (2018) and Wu et al. (2024) have demonstrated the validity of measures assessing personality functioning in children as young as 10. Taken together, these findings suggest that borderline features and personality functioning can be validly measured in early adolescence and can provide meaningful information about concurrent and future outcomes. Using dimensional constructs, such as BPF and LPF in this study, can capture subthreshold levels of personality pathology that may be seen in early adolescence. It is therefore not only warranted but important that we examine neurocognitive correlates of personality functioning during the critical period of early adolescence and determine whether the AMPD or traditional model is more informative in this respect.

THE CURRENT STUDY

The current study examined the incremental validity of LPF versus BPF in explaining variance in neural processing of social reward among early adolescent girls. Internalizing and externalizing symptoms were included in models given their comorbidity with LPF and/or BPF (Sleep et al., 2019; Stepp et al., 2012) and their associations with altered reward processing (Babinski et al., 2019; Hill et al., 2023; Kujawa et al., 2017). We hypothesized that LPF would have incremental validity over BPF in explaining enhanced neural processing of social acceptance because interpersonal dysfunction is at the core of LPF, but is only emphasized in 2 of 9 BPD symptoms. We further hypothesized that relationships between LPF and social reward processing would remain significant while controlling for comorbid internalizing and externalizing symptoms, given that interpersonal impairment is suggested to play a more central role in personality pathology compared to other disorders (Beeney et al., 2019; Bender et al., 2011).

METHOD

Participants were 109 girls, ages 10 to 14 years old (M_{age} = 12.21, *SD* = 1.21), and their caregivers. Caregivers included mothers (n = 96), fathers (n = 10), or grandmothers (n = 3). Participants were oversampled for mental health problems. Participants with intellectual, developmental, or psychotic disorders were excluded. In the full sample, 33.94% of participants reported suicidal thoughts or behaviors, and lifetime diagnoses were as follows: 11.93% mood disorder, 33.94% anxiety disorder, 12.84% ADHD, 26.61% ODD, and 6.42% CD. Sixteen participants (14.68%) were using psychiatric medication and 24 (22.02%) were attending therapy. Most were White (91.74%) and not Hispanic or Latino (93.58%). See Babinski and colleagues (2024) for more details on recruitment.

Measures

LPF

Participants completed the 12-item Level of Personality Functioning Scale Brief Form 2.0 (LPFS-BF 2.0) (Weekers et al., 2018). Items were rated on a 4-point Likert scale from 1 (*Completely untrue*) to 4 (*Completely true*) and totaled. Higher scores indicate greater impairment. The LPFS-BF 2.0 has established psychometric properties in both adults (Weekers et al., 2018) and adolescents (Wu et al., 2024) with excellent internal consistency in the current sample (α = 0.907).

BPF

Participants completed the 24-item Borderline Personality Features Scale for Children (BPFS-C) (Crick et al., 2005). Items were rated on a 5-point Likert scale from 1 (*Not at all true*) to 5 (*Always true*) and totaled, with a suggested clinical cut-off score of 66 (Chang et al., 2011). The BPFS-C has established psychometric properties (Crick et al., 2005) with good internal consistency (α = 0.872) in the current sample.

ADHD, ODD, and CD symptoms

Participants' caregivers completed the 45-item Disruptive Behavior Disorders Rating Scale, evaluating DSM-5 symptoms of ADHD, ODD, and CD (Fosco et al., 2023). Items were rated on a 4-point Likert scale from 0 (*Not at all*) to 3 (*Very much*) and severity scores were calculated by averaging symptom items for each construct. The psychometric properties of the DBD are well supported (Fosco et al., 2023). Internal consistencies in the current sample were excellent for ADHD (α = 0.927) and ODD (α = 0.900) and good for CD (α = 0.811).

Depression

Participants completed the 13-item Short Mood and Feelings Questionnaire, assessing depression severity in the past 2 weeks (Messer et al., 1995). Items were rated on a 3-point Likert scale from 0 (*Not true*) to 2 (*True*) and totaled. This measure has strong psychometric properties (Messer et al., 1995) and internal consistency in the current sample (α = 0.907) was excellent.

Anxiety

Participants completed the 41-item Screen for Child Anxiety Related Emotional Disorders, assessing anxiety severity in the past 3 months (Birmaher et al., 1999). Items were rated on a 3-point Likert scale from 0 (*Not true or hardly ever true*) to 2 (*True or often true*) and totaled. Internal consistency in the current sample (α = 0.929) was excellent.

Social reward task

In the Island Getaway Task (Kujawa et al., 2014, 2017) participants were told they would be playing a computer game with 11 age-matched co-players in which they would be traveling the Hawaiian Islands, and at each island, they would have to vote whether they wanted each peer to continue in the game and would then receive feedback on how each peer voted for them. Participants reviewed simulated co-players' profiles and in subsequent rounds reviewed co-players' responses to poll questions, followed by a voting and feedback phase. Participants were prompted to vote to accept ("Keep") or reject ("Kick out") each co-player, and after each vote, they saw feedback indicating whether that co-player had voted to accept ("thumbs up") or reject ("thumbs down") them. The task included 51 feedback trials split evenly between acceptance and rejection, with the last trial type determined randomly. After each round, participants were informed that another player had been sent home, and after the sixth round, participants were told that they made it to the winning group. This task reliably elicits RewP in response to social acceptance (Kujawa et al., 2014, 2017). EEG data acquisition and processing are described in detail by Babinski and colleauges (2024).

Data analytic plan

We computed bivariate correlations between study variables. We then performed two hierarchical regressions with RewP to acceptance as the dependent variable. In the first hierarchical regression, the independent variables in step 1 were RewP to rejection and ADHD, ODD, CD, anxiety, and depression symptoms. We then added BPF as an independent variable in step 2, and LPF as an independent variable in step 3. In the second hierarchical regression, step 1 was the same, but LPF was added in step 2, and BPF was added in step 3.

RESULTS

Descriptive statistics and correlations between study variables are in Table 1. BPF ($M = 62.16$, $SD = 12.72$) and LPF ($M = 20.91$, $SD = 7.23$) were both well-represented in the sample. No psychopathology variables were significantly correlated with RewP to acceptance or RewP to rejection at the bivariate level (r's $= -0.134$ to 0.076). Nearly all psychopathology variables were correlated with one another (except for nonsignificant relationships between anxiety symptoms and ADHD or ODD symptoms). BPF, LPF, depression, and anxiety symptoms were all significantly and highly correlated with one another ($r > 0.71$).

Given the co-occurrence of LPF with other psychopathology, including depression, which is often associated with a blunted RewP (Kujawa & Burkhouse, 2017), there may be suppressor effects that mask associations with LPF. Guided by this empirical and theoretical rationale, hierarchical regressions accounting for comorbid psychopathology symptoms and RewP to rejection were conducted. Regression analyses complied with the assumptions of linearity, homoscedasticity, normality, and independence. Variable inflation factor (VIF) scores were below 4.0 for all independent variables. In step 1 of both hierarchical regression models, ADHD, ODD, CD, anxiety, and depression symptoms and RewP to rejection together explained a significant amount of variance ($R^2 = 0.645$) in RewP to acceptance, but only RewP to rejection was uniquely associated with RewP to

TABLE 1 Descriptive statistics and bivariate correlations between study variables.

	M (SD)	1.	2.	3.	4.	5.	6.	7.	8.
1. RewP to social acceptance	8.715 (8.779)	—							
2. RewP to social rejection	6.125 (8.798)	0.797**	—						
3. BPF	62.156 (12.721)	−0.025	−0.055	—					
4. LPF	20.908 (7.227)	−0.013	−0.110	0.755**	—				
5. Depression symptoms	6.220 (5.648)	−0.092	−0.134	0.745**	0.798**	—			
6. Anxiety symptoms	29.844 (14.564)	−0.105	−0.128	0.774**	0.764**	0.714**	—		
7. ADHD symptoms	0.592 (0.561)	0.010	−0.004	0.287**	0.209*	0.378**	0.173+	—	
8. ODD symptoms	0.647 (0.606)	0.037	0.043	0.235*	0.199*	0.269**	0.073	0.701**	—
9. CD symptoms	0.080 (0.171)	0.076	0.009	0.301**	0.230*	0.323**	0.249**	0.592**	0.663**

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BPF, borderline personality features; CD, conduct disorder; LPF, level of personality functioning; ODD, oppositional defiant disorder; RewP, reward positivity.

*$p < 0.05$, **$p < 0.01$, and $^{+}p < 0.10$ level (two-tailed).

TABLE 2 Incremental validity of BPF followed by LPF in predicting RewP to social acceptance.

Variables	*B*	*SE B*	*St. b*	*p*
Step 1: $F(6, 102) = 30.853$, $p < 0.001$; $R^2 = 0.645$				
ADHD symptoms	−0.166	1.379	−0.011	0.905
ODD symptoms	−1.191	1.354	−0.082	0.381
CD symptoms	6.712	4.289	0.131	0.121
Anxiety symptoms	−0.032	0.053	−0.053	0.543
Depression symptoms	0.057	0.142	0.037	0.689
RewP to rejection	**0.796**	**0.060**	**0.798**	**<0.001**
Step 2: $F(7, 101) = 26.280$, $p < 0.001$; $\Delta R^2 = 0.001$, $p = 0.631$				
ADHD symptoms	−0.157	1.384	−0.010	0.910
ODD symptoms	−1.277	1.371	−0.088	0.354
CD symptoms	6.753	4.306	0.132	0.120
Anxiety symptoms	−0.048	0.063	−0.080	0.442
Depression symptoms	0.029	0.154	0.018	0.852
RewP to rejection	**0.793**	**0.060**	**0.795**	**<0.001**
BPF	0.035	0.073	0.051	0.631
Step 3: $F(8, 100) = 24.818$ $p < 0.001$; $\Delta R^2 = 0.019$, $p = 0.018$				
ADHD symptoms	0.438	1.375	0.028	0.751
ODD symptoms	−1.883	1.363	−0.130	0.170
CD symptoms	7.808	4.230	0.152	0.068
Anxiety symptoms	−0.100	0.065	−0.166	0.125
Depression symptoms	−0.170	0.172	−0.109	0.324
RewP to rejection	**0.794**	**0.059**	**0.796**	**<0.001**
BPF	−0.001	0.073	−0.001	0.994
LPF	**0.333**	**0.138**	**0.274**	**0.018**

Note: Bold indicates significant predictor.
Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BPF, borderline personality features; CD, conduct disorder; LPF, level of personality functioning; ODD, oppositional defiant disorder; RewP, reward positivity.

TABLE 3 Incremental validity of LPF followed by BPF in predicting RewP to social acceptance.

Variables	*B*	*SE B*	*St. b*	*p*
Step 1: $F(6, 102) = 30.853$, $p < 0.001$; $R^2 = 0.645$				
ADHD symptoms	−0.166	1.379	−0.011	0.905
ODD symptoms	−1.191	1.354	−0.082	0.381
CD symptoms	6.712	4.289	0.131	0.121
Anxiety symptoms	−0.032	0.053	−0.053	0.543
Depression symptoms	0.057	0.142	0.037	0.689
RewP to rejection	**0.796**	**0.060**	**0.798**	**<0.001**
Step 2: $F(7, 101) = 28.647$, $p < 0.001$; $\Delta R^2 = 0.020$, $p = 0.015$				
ADHD symptoms	0.437	1.367	0.028	0.750
ODD symptoms	−1.883	1.351	−0.130	0.116
CD symptoms	7.808	4.209	0.152	0.066
Anxiety symptoms	−0.101	0.058	−0.167	0.088
Depression symptoms	−0.170	0.166	−0.110	0.308
RewP to rejection	**0.794**	**0.058**	**0.795**	**<0.001**
LPF	**0.332**	**0.134**	**0.274**	**0.015**
Step 3: $F(8, 100) = 24.818$ $p < 0.001$; $\Delta R^2 = 0.000$, $p = 0.994$				
ADHD symptoms	0.438	1.375	0.028	0.751
ODD symptoms	−1.883	1.363	−0.130	0.170
CD symptoms	7.808	4.230	0.152	0.068
Anxiety symptoms	−0.100	0.065	−0.166	0.125
Depression symptoms	−0.170	0.172	−0.109	0.324
RewP to rejection	**0.794**	**0.059**	**0.796**	**<0.001**
LPF	**0.333**	**0.138**	**0.274**	**0.018**
BPF	−0.001	0.073	−0.001	0.994

Note: Bold indicates significant predictor.
Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BPF, borderline personality features; CD, conduct disorder; LPF, level of personality functioning; ODD, oppositional defiant disorder; RewP, reward positivity.

acceptance (St. b = 0.798, $p < 0.001$). In step 2 of the first hierarchical regression (Table 2), the change in variance explained was not significant when BPF was added to the model ($\Delta R^2 = 0.001$, $p = 0.631$). In step 3, the change in variance explained was significant when LPF was added to the model ($\Delta R^2 = 0.019$, $p = 0.018$). Similar findings emerged in the other hierarchical regression (Table 3): the change in variance explained was significant when LPF was added in step 2 ($\Delta R^2 = 0.020$, $p = 0.015$) but not when BPF was added in step 3 ($\Delta R^2 = 0.00$, $p = 0.994$). In the final step of both models, only RewP to rejection (St. b = 0.796, $p < 0.001$) and LPF (St. b = 0.274, $p = 0.018$) were significant predictors of RewP to acceptance. Effects of other psychopathology symptoms, including BPF, were not significant. Higher LPF and higher RewP to rejection were associated with higher RewP to acceptance. This pattern of results indicates greater differentiation in neural responses to acceptance versus rejection feedback in participants with higher LPF[1] (Figure 1). A scatterplot of the association between residual LPF and residual RewP to acceptance (adjusting for RewP to rejection) is depicted in Figure 2. A scatterplot of the association between residual BPF and residual

[1]In hierarchical regressions with RewP to rejection as the outcome variable, LPF, BPF, and other psychopathology did not significantly predict RewP to rejection, and only RewP to acceptance emerged as a significant predictor. This indicates that higher LPF is specifically related to higher RewP to acceptance.

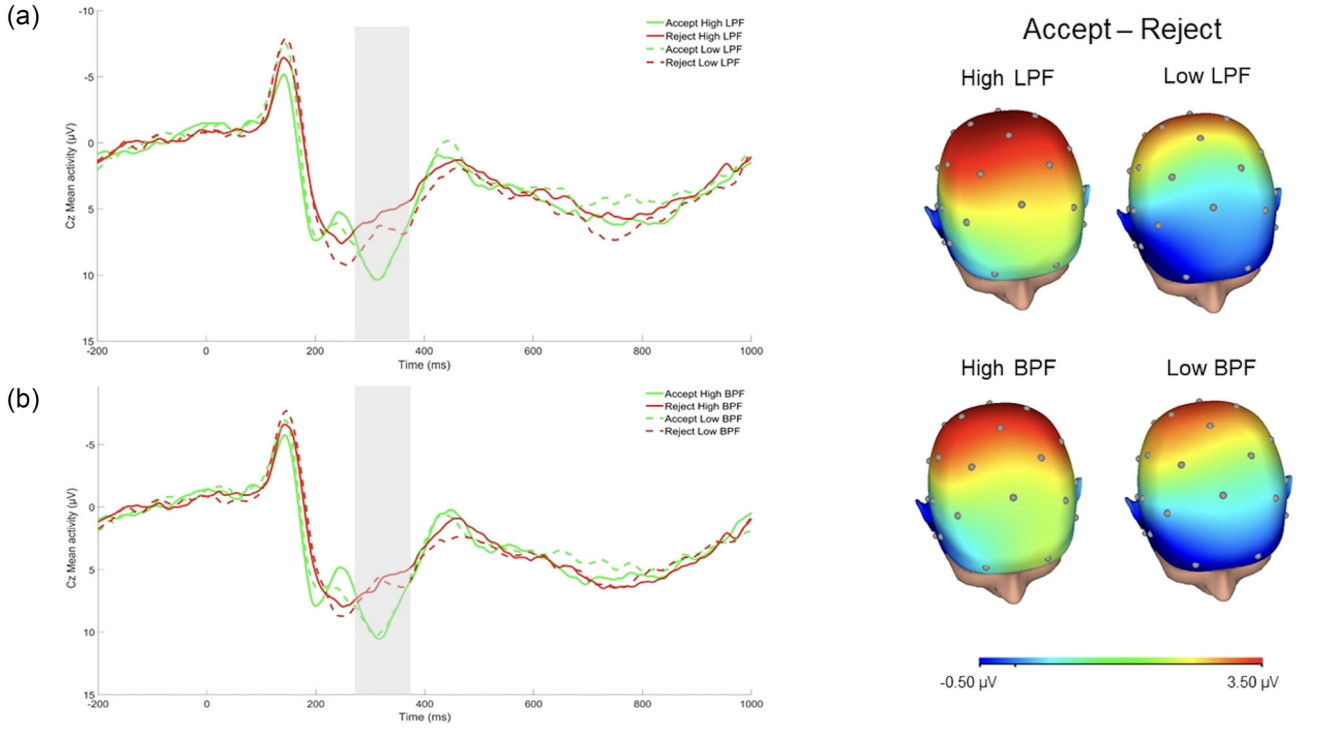

FIGURE 1 Waveform and scalp distributions depicting neural responses to social feedback for low and high LPF (a) and low and high BPF (b). *Note*: ERP waveform is at Cz. The 275–375 ms time window is highlighted representing the RewP. Negative values are plotted up. Scalp distributions reference the RewP time window. A median split was computed for illustrative purposes to present findings for youth with low and high LPF (a) and low and high BPF (b). BPF, borderline personality features; ERP, event-related potential; LPF, level of personality functioning; RewP, reward positivity.

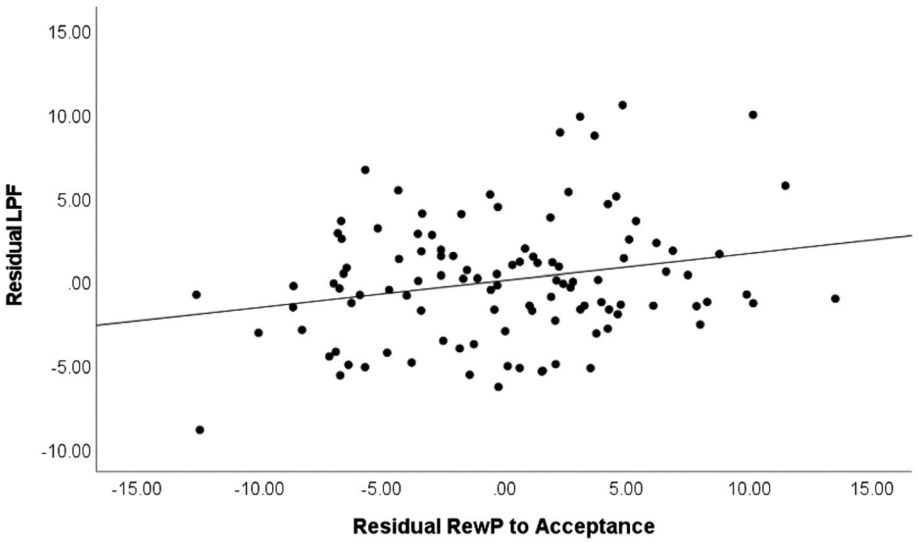

FIGURE 2 Scatterplot depicting the association between residual RewP to acceptance and residual LPF. *Note*: Unstandardized residual RewP to acceptance was adjusted for RewP to rejection. Unstandardized residual LPF was adjusted for depression symptoms, anxiety symptoms, attention-deficit/hyperactivity disorder symptoms, oppositional defiant disorder symptoms, conduct disorder symptoms, and borderline personality features. LPF, level of personality functioning; RewP, reward positivity.

RewP to acceptance (adjusting for RewP to rejection) is depicted in Figure 3.

DISCUSSION

It is now more than a decade since the publication of the AMPD in the DSM-5 and comprehensive reviews demonstrate a robust evidence base in support of the validity, reliability, and clinical utility of AMPD-defined PD; however, the superiority of AMPD-defined personality pathology over traditional concepts such as the borderline construct has yet to be established (Sharp & Miller, 2022). In the current study, LPF explained additional variance in neural responsiveness to social acceptance beyond that explained by a borderline personality

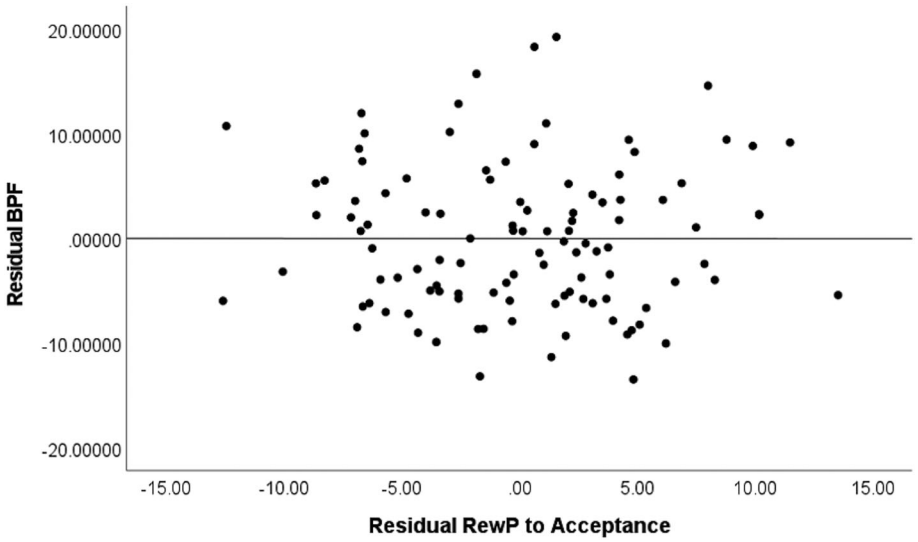

FIGURE 3 Scatterplot depicting the association between residual RewP to acceptance and residual BPF. *Note*: Unstandardized residual RewP to acceptance was adjusted for RewP to rejection. Unstandardized residual BPF was adjusted for depression symptoms, anxiety symptoms, attention-deficit/hyperactivity disorder symptoms, oppositional defiant disorder symptoms, conduct disorder symptoms, and level of personality functioning. BPF, borderline personality features; RewP, reward positivity.

measure. The opposite was not true, supporting the conclusion that LPF may be a superior indicator of social reward alterations in adolescents when compared to the BPF.

In the final step of both models, LPF was the only psychopathology variable significantly associated with RewP to acceptance. Even before adding LPF to the model, BPF was not a significant predictor of RewP to acceptance, contrasting findings by Babinski et al. (2023); it may be that accounting for both externalizing and internalizing comorbid symptoms reduces the variance in RewP to acceptance explained by BPF, or that BPF are less informative in clinically complex samples compared to community samples. LPF, however, was a significant predictor of RewP to acceptance both before and after adding BPF to the model. The effect of LPF was modest in size: although significant, adding LPF to the hierarchical model explained only an additional 2% of the variance in RewP to acceptance. Similarly, bivariate correlations between RewP and psychopathology variables in the current study were modest and not statistically significant. Small effects between self-report and physiological measures are often documented (Babinski et al., 2019, 2023; Kujawa et al., 2017; Pegg et al., 2021) and expected, given the lack of shared method variance (Patrick et al., 2013). Suppressor effects are also possible, particularly given that depression, which co-occurs with LPF is often associated with a blunted RewP (Kujawa & Burkhouse, 2017). We decided to proceed with hierarchical regression analyses given that assumptions for multivariate regression were met and that we had a strong theoretical rationale for examining the relationship between RewP and LPF and RewP and BPF while accounting for comorbid psychopathology and RewP to rejection. However, our findings should be interpreted with caution given the lack of significant associations at the bivariate level. Future work may be helpful for identifying the ideal methodology and power needed to identify associations between physiological and self-report measures.

Notwithstanding these limitations, it is noteworthy that LPF provided virtually full coverage of the variance explained by BPF and explained significantly more variance than BPF. That LPF outperforms a personality disorder measure based on traditional Section II conceptualizations of personality disorder is consistent with an emerging evidence base for the superiority of AMPD-defined personality disorder (Bach & Tracy, 2022; Milinkovic & Tiliopoulos, 2020). These reviews point to the clinical utility of the LPF in that it may be better at identifying key features of personality pathology that can then be the focus of treatment – specifically impairment in self- and interpersonal functioning. The borderline construct has served the field well and is the most researched PD with a robust treatment literature. Evidence of superiority of LPF does not imply irrelevance of this treatment literature; rather, evidence suggests that BPD symptoms provide relatively good coverage of LPF, and may represent the general features of personality pathology shared by all PDs (Clark et al., 2018; Sharp et al., 2015; Wright et al., 2016), albeit incompletely. LPF may simply represent a more complete, more homogenous representation of the key features of self and interpersonal functioning that have always represented the key distinguishing features of BPD vs. other PDs (which are defined in Section II with more behavioral criteria less focused on self and interpersonal relatedness) (Bender et al., 2011).

Limitations of the current study include the cross-sectional design, the use of single-informant measures, and the limited sample diversity. The cross-sectional

design prevents conclusions about directional effects or the relative timing of the development of LPF versus social reward processing. Future longitudinal research beginning earlier in childhood could clarify the directionality, timing, and possible mechanisms of the relationship between alterations in social reward processing and impaired LPF. Interview-based measures or reports from multiple informants could provide a more thorough and contextualized assessment. Future work should also examine relationships between LPF, BPF, and social reward processing in male and gender minority youth and youth from different racial, ethnic, and cultural backgrounds, being careful to consider sociocultural context and how aspects of personality functioning might be considered adaptive versus maladaptive in different contexts or in response to stressors and oppression (Rodriguez-Seijas, 2022). Examination of gender or sex differences may be of particular interest given mixed findings on gender or sex differences in mean levels of LPF in adolescence (Goth et al., 2018; Kerr et al., 2023; Wu et al., 2024) and mixed findings on gender or sex differences in reward processing (as reviewed by Dhingra et al. (2021)). Strengths of the study include the use of a neural measure of social reward processing (capturing the more automatic, unconscious stages of reward processing) and the inclusion of internalizing and externalizing symptoms in our models. The use of an early adolescent sample also represents a major strength given the scarcity of prior research on LPF in this developmental period, when personality impairment may be first emerging.

Findings from this study add to a growing body of research supporting the AMPD's superior utility over the traditional categorical model of PDs (Bach & Tracy, 2022; Milinkovic & Tiliopoulos, 2020) and are among the first to demonstrate this in youth. As the AMPD gains traction, it is critical that PD researchers use measures of LPF in their research and continue to compare the validity of the AMPD vs. traditional PD categories. The AMPD was designed to define the core impairments common to all PDs, increase parsimony and utility of PD diagnosis, facilitate developmental research, and improve early intervention (Bender et al., 2011; Sharp et al., 2022; Sharp & Wall, 2021). The identification of early risk markers and treatment targets for PDs is critical given the profound impairment and cost to well-being associated with these disorders (Chanen et al., 2017).

CONFLICT OF INTEREST STATEMENT

Dr. Babinski has received consulting fees from Supernus Pharmaceuticals, Inc. unrelated to this work, and the other authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Raw data are available in the NIMH Data Archive (NDA). Scored data are available upon request.

ETHICS STATEMENT

This study was reviewed and approved by the Pennsylvania State University Institutional Review Board.

PATIENT CONSENT STATEMENT

The participants' caregivers provided their written informed consent and the participants provided their written assent to participate in this study.

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