

SUPPLEMENTARY MATERIALS

**Depression, Anxiety, and Anhedonia as Correlates of Distinct Family Functioning Domains
among Adolescents**

Nguyen *et al.*, 2023

Supplementary Methods

All linear regression models conducted in this study were shown in **Supplementary Table 1** below. As detailed in **Methods**, only significant symptom-family domain relationships as indicated by bivariate Pearson's or Spearman's correlations were further examined with linear regression. Therefore, in the whole sample ($N = 76$), Affective Involvement and Behavior Control domains were not further examined with linear regression analysis. Similarly, in the clinical sample ($n = 59$), the Affective Involvement domain was not included in linear regression analysis.

Dependent Variable (Family Domain)	Independent Variable of Interest (Symptom Severity)		Covariates		
Whole Sample (N = 76)					
Problem Solving	TEPS-A	–	Age	Sex	Race/Ethnicity
Problem Solving	BDI	–	Age	Sex	Race/Ethnicity
Problem Solving	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Problem Solving	MASC	–	Age	Sex	Race/Ethnicity
Communication	TEPS-A	–	Age	Sex	Race/Ethnicity
Communication	TEPS-C	–	Age	Sex	Race/Ethnicity
Communication	BDI	–	Age	Sex	Race/Ethnicity
Communication	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Communication	TEPS-C	BDI	Age	Sex	Race/Ethnicity
Roles	TEPS-A	–	Age	Sex	Race/Ethnicity
Roles	BDI	–	Age	Sex	Race/Ethnicity
Roles	MASC	–	Age	Sex	Race/Ethnicity
Roles	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Affective Responsiveness	BDI	–	Age	Sex	Race/Ethnicity
General Functioning	TEPS-A	–	Age	Sex	Race/Ethnicity
General Functioning	TEPS-C	–	Age	Sex	Race/Ethnicity
General Functioning	BDI	–	Age	Sex	Race/Ethnicity
General Functioning	TEPS-A	BDI	Age	Sex	Race/Ethnicity
General Functioning	TEPS-C	BDI	Age	Sex	Race/Ethnicity
Clinical Sample (n = 59)					
Problem Solving	TEPS-A	–	Age	Sex	Race/Ethnicity
Problem Solving	BDI	–	Age	Sex	Race/Ethnicity
Problem Solving	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Communication	TEPS-A	–	Age	Sex	Race/Ethnicity
Communication	TEPS-C	–	Age	Sex	Race/Ethnicity
Communication	BDI	–	Age	Sex	Race/Ethnicity
Communication	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Communication	TEPS-C	BDI	Age	Sex	Race/Ethnicity
Roles	TEPS-A	–	Age	Sex	Race/Ethnicity
Roles	BDI	–	Age	Sex	Race/Ethnicity
Roles	MASC	–	Age	Sex	Race/Ethnicity
Roles	TEPS-A	BDI	Age	Sex	Race/Ethnicity
Affective Responsiveness	BDI	–	Age	Sex	Race/Ethnicity
Behavior Control	MASC	–	Age	Sex	Race/Ethnicity
General Functioning	TEPS-A	–	Age	Sex	Race/Ethnicity
General Functioning	BDI	–	Age	Sex	Race/Ethnicity
General Functioning	TEPS-A	BDI	Age	Sex	Race/Ethnicity

Supplementary Table 1. List of all linear regression analyses conducted in this study.

Supplementary Results

SR1. Relationships between clinical symptoms

We identified significant correlations between depression, anxiety, and anhedonia components as detailed in **Supplementary Table 2** below. Since anhedonia is considered a cardinal symptom of depression, the negative correlations between BDI and TEPS-A or TEPS-C are as expected. Additionally, since depression and anxiety are highly comorbid, the positive correlation between BDI and MASC is as expected.

Following visual inspection of these symptom variables, we determined that their adequate variability could mitigate collinearity concerns in regression models.

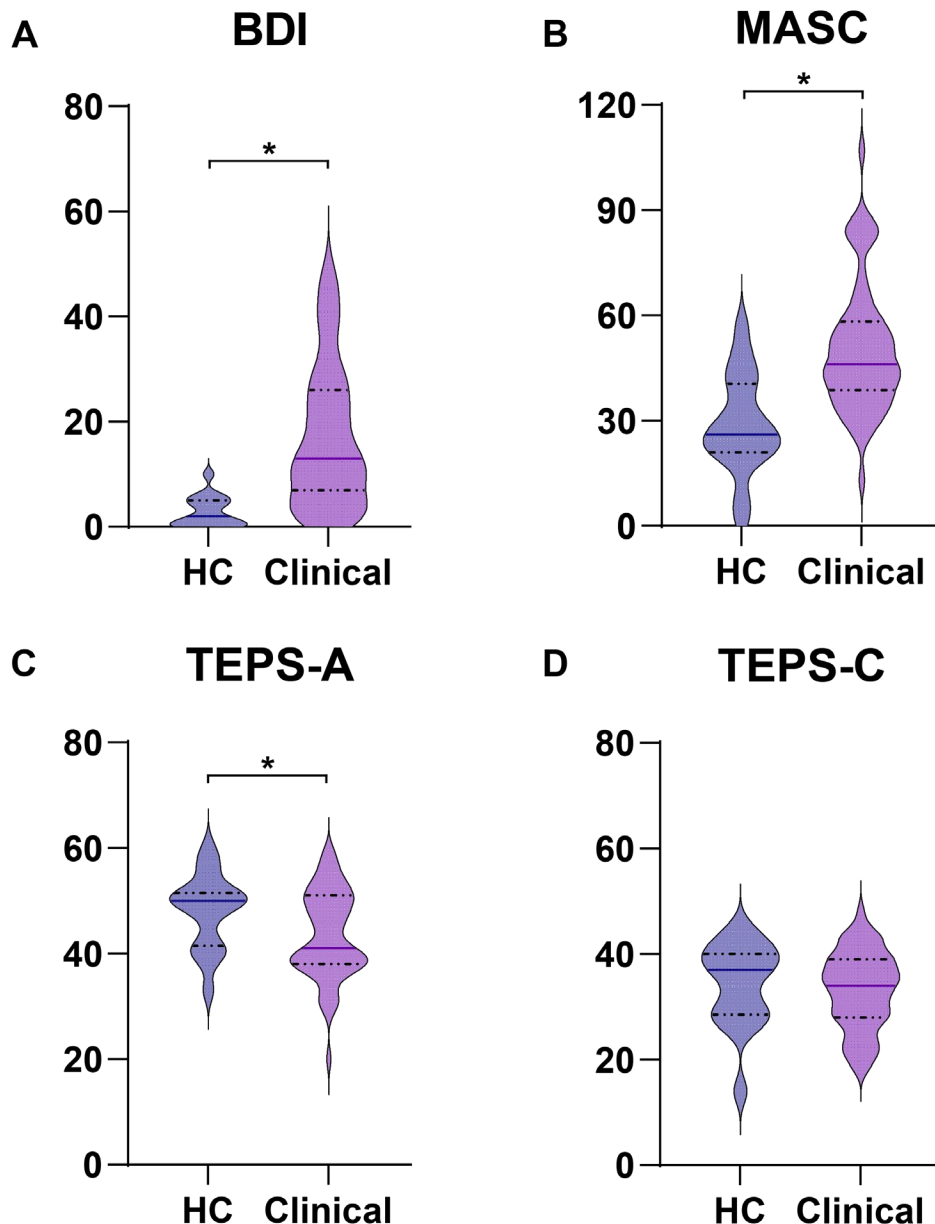
SR 2. Relationships between domains of family dysfunction

Correlations between family subscales are detailed in **Supplementary Table 3**. Overall, the subscales are partially dependent on each other, consistent with previously reported (1). By design, the shared variances across the subscales are most likely due to contributions from the General Functioning scale (1).

SR 3. Bivariate assessments and regression models in the clinical group

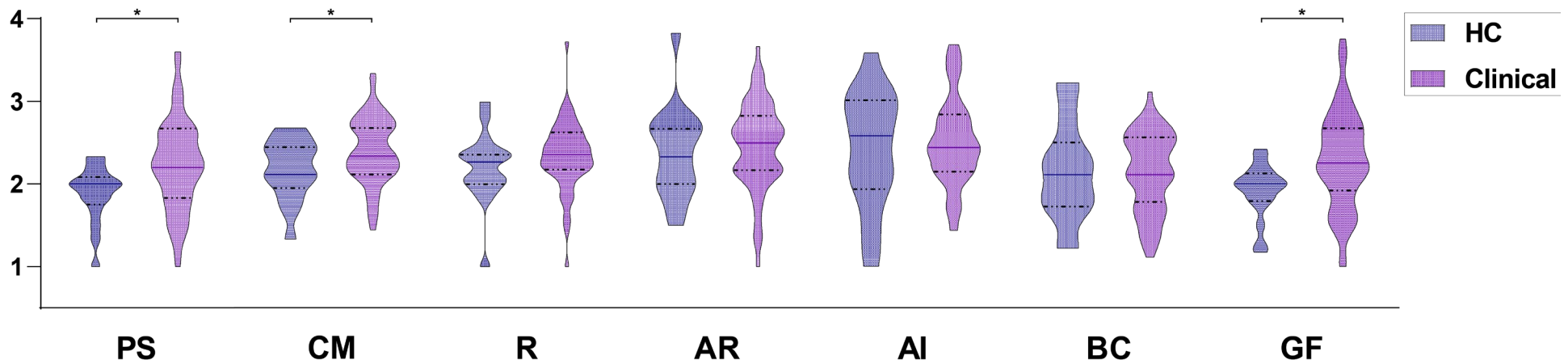
Compared to the whole sample, there were fewer significant associations, as determined by both bivariate assessments and regression models, between family subscales and symptoms within the clinical group. Full results for the clinical group are displayed in **Supplementary Tables 4–5**. Such observations further showcase the advantages of employing a dimensional approach to capture a wider range of symptom severity and family processes.

Supplementary Figures and Tables



Supplementary Figure 1. Distributions of **(A)** depression, **(B)** anxiety, **(C)** anticipatory anhedonia, and **(D)** consummatory anhedonia in our adolescent sample ($N = 76$), stratified into healthy controls (blue; $n = 17$) and clinical (purple; $n = 59$) groups. In each plot, the solid line indicates the median, while the dashed lines indicate the 25th and 75th percentile values. Relative to healthy controls, the clinical group endorsed significantly more severe depression, anxiety, and anticipatory anhedonia at the $p < 0.05$ threshold, as marked with an asterisk (*). Plots were made with *GraphPad Prism 9*.

Abbreviations: BDI: Beck Depression Inventory; Clinical: participants with psychiatric symptoms and/or diagnoses; HC: healthy control participants; MASC: Multidimensional Anxiety Scale for Children; TEPS-A: Temporal Experience of Pleasure Scale – Anticipatory; TEPS-C: Temporal Experience of Pleasure Scale – Consummatory.



Supplementary Figure 2. Distributions of family functioning scores in the domains of **(A)** Problem Solving, **(B)** Communication, **(C)** Roles, **(D)** Affective Responsiveness, **(E)** Affective Involvement, **(F)** Behavior Control, and **(G)** General Functioning in our adolescent sample ($N = 76$), stratified into healthy controls (blue; $n = 17$) and clinical (purple; $n = 59$) groups. The solid line of each plot shows the median value, while the dashed lines indicate the 25th and 75th percentile values. Relative to healthy controls, the clinical group exhibited significantly greater dysfunction in Problem Solving, Communications, and General Functioning domains at the $p < 0.05$ threshold, as marked with an asterisk (*). Plots were made with *GraphPad Prism 9*.

Abbreviations: AI: Affective Involvement; AR: Affective Responsiveness; BC: Behavior Control; Clinical: participants with psychiatric symptoms and/or diagnoses; CM: Communication; HC: healthy control participants; GF: General Functioning; PS: Problem Solving; R: Roles.

	BDI	MASC	TEPS-A	TEPS-C
BDI	1			
MASC	0.62**	1		
TEPS-A	-0.56**	-0.35*	1	
TEPS-C	-0.26*	-0.19	0.51**	1

Supplementary Table 2. Correlation matrix of dimensional measures of depression (BDI), anxiety (MASC), anticipatory anhedonia (TEPS-A), and consummatory anhedonia (TEPS-C) in the study sample (N = 76). All correlations were Spearman's except for the correlation between MASC and TEPS-C, which is Pearson's.

*: $p < 0.05$

** : $p < 0.001$

	Problem Solving	Communication	Roles	Affective Responsiveness	Affective Involvement	Behavior Control	General Functioning
Problem Solving	1						
Communication	0.57**	1					
Roles	0.34**	0.51**	1				
Affective Responsiveness	0.30*	0.57**	0.42**	1			
Affective Involvement	0.11	0.43**	0.62**	0.49**	1		
Behavior Control	0.16	0.23*	0.52**	0.45**	0.45**	1	
General Functioning	0.74**	0.75**	0.52**	0.62**	0.44**	0.38**	1

Supplementary Table 3. Correlation matrix of seven domains of family functioning, as measured by the McMaster Family Assessment Device, in the study sample (N = 76). All correlations are Pearson's except for the ones involving the Roles subscale, which are Spearman's.

*: $p < 0.05$

** : $p < 0.001$

	BDI	MASC	TEPS-A	TEPS-C
Problem Solving	0.44**	0.31*	-0.32*	-0.18
Communication	0.35*	0.12	-0.26	-0.32*
Roles	0.39*	0.31*	-0.25	-0.16
Affective Responsiveness	0.32*	0.12	-0.15	-0.19
Affective Involvement	0.14	0.08	0.07	-0.04
Behavior Control	0.19	0.30*	-0.12	-0.15
General Functioning	0.36*	0.25	-0.29*	-0.24

Supplementary Table 4. Correlation coefficients (Pearson's *r* or Spearman's *rho* depending on normality) between each family functioning domain and dimensional measures of depression (BDI), anxiety (MASC), anticipatory anhedonia (TEPS-A), and consummatory anhedonia (TEPS-C) in the clinical group (n = 59).

*: $p < 0.05$

** : $p < 0.001$

Abbreviations: BDI: Beck Depression Inventory; MASC: Multidimensional Anxiety Scale for Children; TEPS-A: Temporal Experience of Pleasure Scale – Anticipatory; TEPS-C: Temporal Experience of Pleasure Scale – Consummatory.

	$\beta \pm SE$	$p_{\text{uncorrected}}$	p_{FDR}
FAD – Problem Solving			
TEPS-A	-0.021 $\pm$ 0.009	0.032*	0.150
TEPS-A, controlling for BDI	-0.010 $\pm$ 0.010	0.364	0.473
BDI	0.015 $\pm$ 0.005	4.15 $\times 10^{-3}$*	0.021*
BDI, controlling for TEPS-A	0.012 $\pm$ 0.006	0.037*	0.046*
FAD – Communication			
TEPS-A	-0.014 $\pm$ 0.007	0.052	0.150
TEPS-A, controlling for BDI	-0.007 $\pm$ 0.008	0.414	0.473
TEPS-C	-0.018 $\pm$ 0.007	0.016*	0.031*
TEPS-C, controlling for BDI	-0.014 $\pm$ 0.007	0.059	0.059
BDI	0.010 $\pm$ 0.004	9.99 $\times 10^{-3}$*	0.025*
BDI, controlling for TEPS-A	0.008 $\pm$ 0.004	0.062	0.069
BDI, controlling for TEPS-C	0.008 $\pm$ 0.004	0.037*	0.046*
FAD – Roles			
TEPS-A	-0.014 $\pm$ 0.007	0.074	0.150
TEPS-A, controlling for BDI	-0.003 $\pm$ 0.008	0.733	0.733
BDI	0.013 $\pm$ 0.004	1.69 $\times 10^{-3}$*	0.017*
BDI, controlling for TEPS-A	0.012 $\pm$ 0.004	9.84 $\times 10^{-3}$*	0.025*
MASC	0.010 $\pm$ 0.003	1.59 $\times 10^{-3}$*	3.19 $\times 10^{-3}$*
FAD – Affective Responsiveness			
BDI	0.011 $\pm$ 0.005	0.021*	0.043*
FAD – Behavior Control			
MASC	0.011 $\pm$ 0.004	3.90 $\times 10^{-3}$*	3.90 $\times 10^{-3}$*
FAD – General Functioning			
TEPS-A	-0.018 $\pm$ 0.010	0.075	0.150
TEPS-A, controlling for BDI	-0.010 $\pm$ 0.012	0.385	0.473
BDI	0.012 $\pm$ 0.005	0.034*	0.046*
BDI, controlling for TEPS-A	0.009 $\pm$ 0.006	0.153	0.153

Supplementary Table 5. Relationships between four symptom measures and family domain scores controlling for age, biological sex, race, and ethnicity as assessed with linear regression models in the clinical group ($n = 59$). Multiple comparison correction for false discovery rate was applied to the p values of each symptom of interest across the models in which it was included. Note that the negative values of anhedonia estimates are expected due to the TEPS' scoring system (lower scores indicating more severe anhedonia).

*: $p < 0.05$ or $p_{\text{FDR}} < 0.05$

Abbreviations: BDI: Beck Depression Inventory; FAD: Family Assessment Device; MASC: Multidimensional Anxiety Scale for Children; TEPS-A: Temporal Experience of Pleasure Scale – Anticipatory; TEPS-C: Temporal Experience of Pleasure Scale – Consummatory.

Supplementary References

1. Epstein NB, Baldwin LM, Bishop DS. The McMaster family assessment device. *Journal of marital and family therapy*. 1983;9(2):171-80.