

# Increases in depressive anhedonia predict psychopathology symptoms in adolescents

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## Research article

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# Abstract

**Background:** Recent works have suggested changes in anhedonia may be a stronger predictor of psychological disorders than trait and state anhedonia. However, whether the distinction between different types of anhedonia occurs in adolescents remains unclear.

**Methods:** A total of 543 adolescents aged 14-16 years completed measures of anhedonia at two time points one year apart. State anhedonia was assessed using the Snaith Hamilton Pleasure Scale while trait social anhedonia was assessed using the Adolescent Anticipatory and Consummatory Interpersonal Pleasure Scale and depressive anhedonia was assessed using the anhedonia subscale from the Child Mood and Feelings Questionnaire.

**Results:** State, trait social and depressive anhedonia significantly increased over time. Increases in depressive anhedonia predicted all psychopathology symptoms, and increases in state anhedonia predicted suicidal ideation and anxiety, but increases in trait social anhedonia did not predict any psychopathology symptoms. Negative schizotypy predicted increases in state or trait social anhedonia whereas disorganized schizotypy, depression, generalized anxiety, suicidal ideation, academic and bereavement stressful events predicted increases in depressive anhedonia after controlling for baseline anhedonia.

**Conclusions:** This finding suggests changes in depressive anhedonia, in contrast to state and trait anhedonia, is a major contributing factor to psychopathology in adolescence.

## 1. Introduction

Anhedonia, the reduced ability to experience pleasure, has been considered as an important symptom for major depressive disorder, smoking, suicidality, post traumatic stress disorder, and autism spectrum disorder in adolescence [1]. Despite the importance of anhedonia for psychopathology, anhedonia is not well understood due to a variety of conceptual and methodological challenges.

Anhedonia is primarily studied as a trait construct in relation to schizophrenia and depression research, as well as other disorders [2, 3]. In these studies, anhedonia has generally been considered to be a stable characteristic leading to the onset of psychotic symptoms and biological vulnerability for the development of psychiatric disorders. However, a longitudinal study has demonstrated that state and trait anhedonia differentially predict the course of depression over a 10-year period [4]. On the other hand, several studies have argued that trait-level constructs are not as specific as assessments that include self-report of recent changes when examining the relationship between personality and psychopathology [5]. This seems particularly true of anhedonia. According to the clinical diagnostic assessment, anhedonia is indicated by a *decrease* in the ability to derive pleasure[6]. This is an important clinical distinction, as trait and state anhedonia measures do not examine changes from baseline, but instead evaluate cross-sectional experiences within a particular time frame. As such, changes in anhedonia may be key components in the understanding of anhedonia and mental illness. Previous studies have

suggested that recent changes in anhedonia were an important predictor of negative symptoms, depression and suicidal ideation [7-13]. It suggested recent changes in anhedonia may be uniquely predictive of key elements of psychopathology [14, 15]. These findings have suggested that the distinction between trait, state and recent changes in anhedonia is of crucial importance when studying anhedonia, and recent changes in anhedonia, may be a stronger predictor of psychological disorders than trait and state anhedonia. However, whether the distinction between different types of anhedonia occurs in adolescents remains unclear.

Nearly all self-report measures of anhedonia have been developed for adults. Recently, two validated anhedonia scales were developed for adolescents. One such measure is the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS), which includes trait experience of absence of social pleasure [16]. Trait social anhedonia has been observed among Spanish, American and Chinese adolescents [16] [17] and higher levels of social anhedonia were associated with fewer depressive symptoms, greater negative dimension of schizotypy [18]. Social anhedonia could be more associated with mental disorders than general anhedonia [17]. Another measure is the Snaith-Hamilton Pleasure Scale (SHAPS), measuring the state of general anhedonia including interest, sensory experience, and food in the last few days [19]. Studies using the SHAPS showed that state anhedonia was associated with greater depression severity, suicidal thought, addictive behaviors [8, 20]. In previous studies, the assessment of anhedonia in adolescents has mainly been based on depressive anhedonia items or subscales. This depressive anhedonia could be a more precise distinction between trait and state anhedonia when focusing on measures of symptoms-based recent changes [15, 21]. To date, few studies compared these types of anhedonia as distinct constructs in adolescents. It remains unclear how stable these elements of anhedonia are over time and how different these anhedonia constructs are for predicting psychopathology symptoms.

There is very little literature examining the course and stability of adolescent anhedonia, with the presence of different temporal features [22-24]. Bennik et al (2014) showed a significant decreasing in depressive anhedonia between the ages of 11 and 19 in a general population sample and a mutual prediction between anhedonia and depressed mood. Similarly, Pelizza et al (2019) found that trait anhedonia, as assessed by the anhedonia subscale from schizotypal personality questionnaire, remained stable while state anhedonia, as assessed by one item from the psychopathology symptoms checklist, had a significant decrease in ultra-high-risk adolescents. Trait anhedonia predicted the negative dimension of schizotypy while state anhedonia predicted impaired role functioning, apathy and obsessive-compulsive symptoms. By contrast, Leventhal et al (2017) found state anhedonia, assessed by the SHAPS, increased at 6, 12, and 18-month follow-up assessments in adolescents from age 14 onwards, and increases in state anhedonia were positively associated with the rate of increase in marijuana use frequency. However, these studies did not address the role of social anhedonia.

The aim of the present study was to investigate the stability of trait social, state and depressive anhedonia and their relationships with psychopathology symptoms across a 1-year study period. This study also investigated whether changes in depressive anhedonia would be more associated with

psychopathology symptoms than trait or state anhedonia. Building upon previous findings [13, 22-24], the hypotheses were as follows: (1) the experience of state and depressive anhedonia would decline from baseline to follow-up while trait anhedonia would remain stable; (2) the associations between anhedonia and psychopathology symptoms would vary according to the types of anhedonia; (3) changes in depressive anhedonia would be more closely associated with psychopathology symptoms than trait and state anhedonia.

## 2. Method

### 2.1 Participants

Nine hundred and eight-nine students with 10<sup>th</sup> grade were recruited from the Chenzhou High School in China. At baseline (T1), 132 students refused to join the survey. Thus, the initial sample at T1 was  $N = 857$ . The mean age was 15.14 ( $\pm 0.55$ ) years, with females comprising 51.6% ( $N=442$ ) of the sample. Eligible participants at one year after (T2) were students who had participated at T1. Two hundred and eighty-two students declined the second survey and 32 students transferred to other high school. Thus, 543 participants (63.36%) completed the survey at both T1 and at T2, with female students comprising 74.6% ( $N=405$ ) of the sample. The age distribution of the sample was as follows: 14 years ( $N=49$ , 9%), 15 years ( $N=371$ , 68.3%) and 16 years ( $N=123$ , 22.7%).

### 2.2 Measures

#### Trait social anhedonia

The Chinese adolescent version of the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS-A) is a trait anhedonia measure that assesses individual differences in one's capacity to enjoy interpersonal interactions [17]. The measure is rated on a 4-point Likert scale 0 (totally false for me) to 4 (totally true for me), with lower scores indicating a greater likelihood of social anhedonia. The Cronbach's alpha coefficients in the current sample were 0.89 and 0.92, respectively, at baseline and at follow-up.

#### State anhedonia

The Chinese version of the Snaith-Hamilton Pleasure Scale is a state anhedonia questionnaire in response to pleasant experiences that span sensory stimuli, social activities, and hobbies in the last few days [25]. Responses to each item is rated on a 4-point Likert scale 1 (strongly Agree) to 4 (strongly Disagree), with a higher total score indicates higher levels of anhedonia. The SHAPS has been validated in adolescents [19]. The SHAPS had an  $\alpha$  of 0.90 and 0.93, respectively, at baseline and at follow-up in the present study.

#### Depressive syndromes

The Chinese version of the Child Mood and Feelings Questionnaire (MFQ-C) is used to measure self-reported experiences of depression [26]. The MFQ-C contains 33 items with five factors: low self-

evaluation, suicide ideation, and slow thinking/activity, anhedonia and appetite/sleeping. Anhedonia and suicidal ideation items were removed (see below). The measure is rated on a 3-point Likert scale 0 (not true) to 2 (true), with lower scores indicating a greater depressive symptom. The MFQ-25 had excellent internal consistency in the present study, Cronbach's alpha = 0.95 and 0.96, respectively, at baseline and at follow-up.

### Depressive anhedonia

Depressive anhedonia was rated using the MFQ anhedonia subscale (MFQ-Anhedonia) [26]. Four items of the MFQ-Anhedonia were assessed in the present study: Loss of happiness (felt miserable or unhappy); Loss of enjoyment (I didn't enjoy anything at all); Loss of interest in friends (I didn't want to see my friends); Loss of school interest (I didn't have any fun in school). Other authors have suggested that recent changes in anhedonia are more accurately captured by the Beck Depression Inventory (BDI) anhedonia subscale in adult samples [13, 21]. The Cronbach's alpha for this four-item scale was 0.72 at baseline and 0.77 at baseline in the present study.

### Suicidal ideation (SI)

Suicidal ideation was rated using the MFQ suicide subscale (MFQ-SI) by computing a total score from the following items: I thought that life wasn't worth living; I thought about death or dying; I thought my family would be better off without me; I thought about killing myself, with each item rated 0 'not true', 1 'sometimes' or 2 'true' (total range 0–8). A previous study has found the MFQ-SI to have high internal consistency and reasonable stability over time [27]. The Cronbach's alpha of the scale was 0.84 at baseline and 0.86 at follow-up in the present study.

### Anxiety syndromes

The Chinese version of the Screen for Child Anxiety Related Emotional Disorders (SCARED) is used to screen for signs of anxiety disorders in children [28]. The SCARED is a 41-item inventory with five factors: generalized anxiety, separation anxiety, social phobia, school phobia and somatic anxiety. The measure is rated on a 3-point Likert scale 0 (not true) to 2 (very true), with lower scores indicating a greater a higher risk of anxiety disorders. In the current study, the Cronbach's alpha was 0.88 at baseline and 0.89 at follow-up.

### Schizotypal personality

The Chinese version of the Schizotypal Personality Questionnaire-Brief (SPQ-B) is used to measure schizotypal personality disorder [29]. The SPQ-B is a 22-item self report inventory with three subscales: positive symptoms (SPQ-P: Cognitive-Perceptual), negative symptoms (SPQ-N: Interpersonal deficits) and disorganization (SPQ-D: disorganized), rated either "yes" or "no." The SPQ-B had good validity and reliability in adolescents [30]. In the current study, the three symptom subscales had excellent internal consistency (baseline:  $\alpha = 0.88, 0.87, 0.81$ ; follow-up:  $\alpha = 0.87; 0.89, 0.82$ ).

## Stressful life events

The Chinese Version of the Adolescent Self-Rating Life Events Check List (ASLEC) was used to evaluate stressful life events experienced during the past 12 months [31]. Twenty-seven stressful life events addressing the following six domains: interpersonal stressful events, academic stressful events, punishment stressful events, bereavement, adaptation stressful events and unscaled items. The ASLEC was rated using a 6-point Likert scale 1 (not at all) to 6 (very severe), with higher total scores indicating a greater number of stressful life events experienced. The Cronbach's  $\alpha$  of the ASLEC was 0.91 at baseline and 0.89 at follow-up in the present study.

## 2.3 Procedure

The research was approved by the ethics committee of the author's university. Participants took 45 minutes to complete the paper-and-pencil survey during a regularly scheduled class period. For all participants under the age of 18, parents and guardians were asked to provide written informed consent. Researchers informed students that their responses would be kept confidential and would not be shared with their parents and school staff. Students were not individually compensated for participation but were given small incentives (e.g., sweets).

## 2.4 Analyses

First, to examine the potential influence of missing data, those with complete data at both time points ( $N=543$ ; 66.5%) and those with missing data ( $N=314$ ; 33.5%) were compared. These comparisons revealed no significant differences among important variables (all  $p>.05$ ). After data cleaning, absolute stability of symptoms was tested using paired student's t-tests. Relative stabilities (test-retest) of the anhedonia measures were tested using intraclass correlation coefficients. Cohen's  $d$  provided an estimate of the effect size of the difference. Next, Pearson's correlations were used to examine associations between the three types of anhedonia and other self-report symptoms at baseline. In order to control the family-wise error rate when making multiple comparisons, Bonferroni-correction  $p$ -values were used (*adj*  $p$ -value of .001). Gender differences in anhedonia at both time points were included in the repeated measures analysis of variance. General linear regression models were used to assess anhedonia and psychopathology symptoms predicting each other while adjusting for baseline scores. Two reciprocal associations were examined: (a) between anhedonia at baseline and psychopathology symptoms at termination, (b) between the changes in anhedonia from baseline to termination and psychopathology symptoms at termination.

# 3. Results

At baseline, SHAPS, ACIPS, and MFQ-Anhedonia were not correlated with age ( $r=-0.05$ ,  $r=-0.02$  and  $r=-0.03$ , respectively, all  $p>.05$ ). ACIPS was significantly correlated with gender ( $r=-0.20$ ,  $p<.001$ ) but SHAPS and MFQ-Anhedonia were not. A 2 (gender: male, female)  $\times$  2 (baseline, follow-up) repeated measures analysis of variance revealed males to report greater SHAPS and lower ACIPS scores than females,  $F(1, 542)$

=8.20,  $p = .004$ , partial  $\eta^2 = 0.02$ ;  $F(1, 542) = 35.58$ ,  $p < .001$ , partial  $\eta^2 = 0.06$ . Gender differences were not found in MFQ-Anhedonia,  $F(1, 542) = 0.27$ ,  $p = .61$ .

As shown in Table 1, paired t-tests indicated that ACIPS and SPQ-P significantly decreased (Cohen's  $d$ : 0.14, 0.10), but SHAPS, MFQ-Anhedonia, MFQ-SI and ALSEC significantly increased over time (Cohen's  $d$ : -0.16, 0.26, 0.10, 0.55). No difference was found in SPQ-N, SPQ-D, MFQ-23, SCARED. Four individual symptoms of the MFQ-Anhedonia were examined using paired t-tests and loss of happiness, loss of enjoyment, and loss of interest in friend significantly increased (all  $p < .001$ ) whereas loss of school interest was not significant. Test-retests indicated small correlations over time, with intraclass correlation coefficients for the SHAPS, ACIPS and MFQ-Anhedonia of 0.30, 0.25 and 0.31, respectively.

As revealed in Table 2, the SHAPS and ACIPS were not correlated with other symptoms except for the SPQ-N. However, the MFQ-Anhedonia was positively correlated with all other symptoms but was not correlated with the SHAPS and ACIPS. The SHAPS was negatively correlated with the ACIPS.

When psychopathology symptoms at T2 were assessed as dependent variables, the SHAPS, ACIPS and MFQ-Anhedonia did not predict the development of psychopathology symptoms after controlling for baseline scores. However, changes in the MFQ-Anhedonia significantly predicted all psychopathology symptoms and change in the SHAPS predicted scores on the SCARED and MFQ-SI, while changes in the ACIPS did not predict any psychopathology symptoms (see Table 3). When individual symptoms of the MFQ-Anhedonia were examined as independent variables, changes in loss of happiness, loss of enjoyment, loss of interest in friend, and loss of school interest predicted all psychopathology symptoms except change in loss of enjoyment which did not predict the SPQ-N and the SPQ-D.

When *changes* in anhedonia were assessed as the dependent variables, the SPQ-N predicted change in the ACIPS and SHAPS whereas the MFQ-SI, MFQ-25, SPQ-D, generalized anxiety, ACIPS, academic and bereavement stressful events significantly predicted change in the MFQ-Anhedonia (see Table 4). These results were the same when anhedonia was assessed as the dependent variable.

## 4. Discussion

Contrary to the study hypothesis, it was unexpected that all three types of anhedonia significantly increased after 1-year follow-up period. This finding suggests that trait social, state and depressive anhedonia increase but psychopathology symptoms remain stable in adolescents aged 14-16 years. Other studies have found mixed results. A recent study found that state anhedonia increased across 6-month, 12-month, and 18-month follow-up assessments in adolescents from age 14 upwards [24]. Anhedonia is relatively common in adolescents compared with children [32] and trait social anhedonia is higher in adolescence and lower in adulthood [33]. In the authors' recent study, state anhedonia was highest in the first year of university (mean age of 18.44), then slowly declined over the academic year [34]. It could be that most adolescents experience all kinds of anhedonia, and then state anhedonia might decline, while trait anhedonia remains stable after late adolescence which was supported by prior

studies that anhedonia was a trait characteristic in college students [35]. Late adolescence may be higher risk for the onset of depression as the relationship between anhedonia and depressive symptoms was stronger at age 19 [22]. This could mean that the low stability of trait and state anhedonia during adolescence is to some extent a consequence of temporary normative brain development processes. However, other studies have reported trait anhedonia to be stable but state or depressive anhedonia to decrease over time in adolescents [22, 23]. In the present study, the stability of all four depressive anhedonia symptoms was tested and the results showed three of the anhedonia symptoms to increase whereas loss of school pressure remained stable. Different methodology and samples could be a reason for the inconsistent results across studies. As with all unexpected findings these should be taken as tentative for guiding future research.

Changes in depressive anhedonia, but not trait and state anhedonia, was specifically predictive of psychopathology symptoms. In the present study, trait and state anhedonia was limited in its ability to predict symptoms, as none of the three types of anhedonia predicted any psychopathology symptoms over time. In reverse, increases in depressive anhedonia predicted all psychopathology symptoms and increases in state anhedonia predicted suicidal ideation and anxiety symptoms, while increases in trait social anhedonia did not predict any other symptoms. Moreover, changes in four individual symptoms of depressive anhedonia remained a robust predictor of psychopathology symptoms even after accounting for the baseline scores of each of these symptoms. This indicated that change in state anhedonia, but not change in trait anhedonia, was a robust predictor of psychopathology. Evidence suggests that recent changes in anhedonia may be specifically predictive of key elements of psychopathology in adults [7-13]. Past studies have suggested that depressive anhedonia (measured by the BDI anhedonia subscale) was a reliable measure of recent changes in anhedonia in depressed adults [13]. The current study also found the MFQ anhedonia subscale to show the most robust association with all psychopathology symptoms especially focusing on changes in anhedonia, indicating that depressive anhedonia is a predictive measure with regard to psychopathology both in adults and adolescents.

The associations between anhedonia and other psychopathological features were different according to the types of anhedonia. Negative schizotypy was specifically associated with increases in trait social and state anhedonia whereas disorganized schizotypy and affective symptoms were uniquely associated with increases in depressive anhedonia. This finding is supported by research showing that anhedonia is heterogeneous across psychiatric disorders, depending on which parts of the pleasure networks are most affected [14, 36]. Indeed, more trait-like expression of social anhedonia and physical-related hedonic deficits emerge more robustly in relation to schizophrenia-spectrum symptoms whereas recent increases in anhedonia are predictive of symptoms that are more indicative of depression and suicidal ideation [9, 10, 13, 21]. According to Loas' suggestion, trait anhedonia reflects chronic anhedonic states whereas state anhedonia reflects acute anhedonic states [11]. It is possible that trait anhedonia is more closely associated with schizophrenia-spectrum disorders whereas state anhedonia is more closely associated with affective disorders in adolescents. Furthermore, state anhedonia using the SHAPS was associated with negative schizotypy as trait anhedonia was. This may be that the SHAPS did not completely separate state and trait anhedonia whereas depressive anhedonia had a more precise distinction [15].

A limitation of the present study is that all of the measures were self-report. Behavioral measures are required to clarify whether there is a causal relation between anhedonia and psychopathology. In addition, the follow-up sample primarily consisted of females because more males had dropped out by the time of follow-up. Replication is thus needed in gender balanced samples as well as among high-risk or clinical samples to reduce the likelihood of bias. In addition to this, it is important to note that using the SPQ-B to assess schizotypal personality may limit reliability. However, the SPQ-Child contains all SPQ-B items with minor modification [37]. It would be beneficial in future studies to use self-report measures of schizotypy for children, such as the Chinese version of SPQ-C [38]. However, the use of the MFQ anhedonia items in the current study should probably not be regarded as a major limitation of the study, since the BDI anhedonia subscale has accurately captured state anhedonia in earlier findings. Furthermore, the MFQ anhedonia was not correlated with the SCIPS and SHAPS, which meant that this component differed from trait and state anhedonia.

## Conclusions

This first study demonstrated that the relationship between anhedonia and psychopathology was specific to changes in depressive anhedonia in adolescent. Recognizing the risk of increases in anhedonia could potentially improve identification of high-risk individuals in the health care system.

## Declarations

### Ethics approval and consent to participate

The study was a part of school mental health program according to the policy (China issues guideline to improve mental health in the primary and secondary school 2012-2015) and approved by the Hunan Agricultural University ethics committee. Informed consent was obtained from all individual participants and their parents or guardian included in the study.

### Consent for publication

Not applicable.

### Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare that they have no competing interests.

### Authors' contributions

XHY designed, analyzed the data and wrote up the first draft. SXL and DFW contributed to the data collection. GYL help to design the study. Phillippa were involved in critically revising the work. All authors contributed to and have approved the final manuscript.

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## Tables

Table 1 Mean and standard deviations for anhedonia and psychopathology symptoms

Variables	Baseline	Follow-up	Paired T test	<i>p</i>	Correlation
SHAPS	22.4±5.67	23.35±6.22	<b>-3.28</b>	<b>.001</b>	.35**
ACIPS	55.44±8.16	54.17±9.45	<b>2.84</b>	<b>.005</b>	.31**
MFQ-Anh	1.98±1.62	2.43±1.78	<b>-5.60</b>	<b>&lt;.001</b>	.40**
MFQ-SI	1.41±1.80	1.59±1.90	<b>-2.06</b>	<b>.040</b>	.45**
ALSEC	18.79±15.4	28.64±20.08	<b>-11.12</b>	<b>&lt;.001</b>	.35**
SPQ-P	2.84±1.97	2.64±2.13	<b>2.05</b>	<b>.041</b>	.43**
SPQ-N	2.29±1.85	2.42±2.17	-1.38	.169	.40**
SPQ-D	1.47±1.51	1.34±1.54	1.77	.077	.36**
MFQ-25	14.74±10.75	14.08±10.2	1.42	.157	.47**
SCARED	17.79±13.17	18.11±14.08	-0.55	.580	.50**

Note: Bold values are significant. MFQ: Child Mood and Feelings Questionnaire; SI: Suicide Ideation subscale in MFQ; ACIPS: Anticipatory and Consummatory Interpersonal Pleasure Scale-Adolescent Version; SHAPS: Snaith-Hamilton pleasure scale; MFQ-Anh: MFQ anhedonia subscale; SCARED: Screen for Child Anxiety Related Emotional Disorders; ALSEC: Adolescent Self-Rating Life Events Check List; SPQ: Schizotypal Personality Questionnaire-Brief; SPQ-P: Cognitive-Perceptual; SPQ-N: Interpersonal deficits; SPQ-D: Disorganization. \*\*  $p < 0.001$

Table 2. Correlations of anhedonia and psychopathology symptoms at baseline

	1	2	3	4	5	6	7	8	9
	-								
1.SPQ-P									
	.58**	-							
2.SPQ-N									
	.68**	.66**	-						
3.SPQ-D									
4.SHAPS	.01	.21**	.06	-					
5.ACIPS	.05	-.17**	-.01	-.38**	-				
6.ALSCE	.47**	.40**	.42**	.07	.05	-			
7.SCARED	.63**	.64**	.57**	.11	.00	.60**	-		
8.MFQ-Anh	.51**	.54**	.48**	.10	-.14	.49**	.65**	-	
9.MFQ-SI	.42**	.34**	.38**	.10	-.11	.41**	.53**	.63**	-
10.MFQ-25	.60**	.58**	.60**	.10	-.10	.58**	.77**	.82**	.75**

Note: Bold values are significant. MFQ: Child Mood and Feelings Questionnaire; SI: Suicide Ideation subscale in MFQ; ACIPS: Anticipatory and Consummatory Interpersonal Pleasure Scale-Adolescent Version; SHAPS: Snaith-Hamilton pleasure scale; MFQ-Anh: MFQ anhedonia subscale; SCARED: Screen for Child Anxiety Related Emotional Disorders; ALSEC: Adolescent Self-Rating Life Events Check List; SPQ: Schizotypal Personality Questionnaire-Brief; SPQ-P: Cognitive-Perceptual; SPQ-N: Interpersonal deficits; SPQ-D: Disorganization. \*\*  $p < 0.001$ , Bonferroni correction.

Table 3 Multivariate linear regression models predicting psychopathology symptoms at follow up

	SPQ-P		SPQ-N		SPQ-D		MFQ-25		MFQ-SI		SCARED	
	<i>B</i>	<i>p</i>	<i>B</i>	<i>p</i>	<i>B</i>	<i>p</i>	<i>B</i>	<i>p</i>	<i>B</i>	<i>p</i>	<i>B</i>	<i>p</i>
Female	-.30	.092	<b>-.53</b>	<b>.004</b>	<b>-.44</b>	<b>.001</b>	-.76	.221	-.12	.407	-.17	.875
Age	.24	.077	.20	.165	.18	.081	.26	.595	.03	.764	1.22	.140
C-SHAPS	.01	.229	.01	.574	.01	.319	.04	.282	<b>.02</b>	<b>.046</b>	<b>.28</b>	<b>&lt;.001</b>
C-ACIPS	.00	.672	-.01	.243	.00	.666	-.04	.110	.00	.663	.00	.924
C-MFQ-Anh	<b>.43</b>	<b>&lt;.001</b>	<b>.44</b>	<b>&lt;.001</b>	<b>.29</b>	<b>&lt;.001</b>	<b>3.55</b>	<b>&lt;.001</b>	<b>.52</b>	<b>&lt;.001</b>	<b>3.43</b>	<b>&lt;.001</b>
SPQ-P	<b>.30</b>	<b>&lt;.001</b>	-.03	.528	.01	.809	.09	.602	.03	.517	-.10	.735
SPQ-N	.04	.484	<b>.36</b>	<b>&lt;.001</b>	.05	.254	.31	.123	.02	.703	.46	.178
SPQ-D	.05	.504	-.07	.319	<b>.23</b>	<b>&lt;.001</b>	.23	.342	.09	.102	-.19	.642
MFQ-25	<b>.05</b>	<b>.001</b>	<b>.06</b>	<b>&lt;.001</b>	<b>.03</b>	<b>.006</b>	<b>.55</b>	<b>&lt;.001</b>	<b>.05</b>	<b>&lt;.001</b>	<b>.39</b>	<b>&lt;.001</b>
MFQ-SI	-.01	.907	-.09	.203	-.05	.299	-.05	.815	<b>.34</b>	<b>&lt;.001</b>	.28	.477
SCARED	.01	.519	.02	.134	.00	.664	.06	.118	-.01	.483	<b>.32</b>	<b>&lt;.001</b>
ALSCE	.00	.997	-.01	.209	.00	.776	.01	.647	.00	.342	.00	.961

Note: Bold values are significant. MFQ: Child Mood and Feelings Questionnaire; SI: Suicide Ideation subscale in MFQ; ACIPS: Anticipatory and Consummatory Interpersonal Pleasure Scale-Adolescent Version; SHAPS: Snaith-Hamilton pleasure scale; MFQ-Anh: MFQ anhedonia subscale; SCARED: Screen for Child Anxiety Related Emotional Disorders; ALSEC: Adolescent Self-Rating Life Events Check List; SPQ: Schizotypal Personality Questionnaire-Brief; SPQ-P: Cognitive-Perceptual; SPQ-N: Interpersonal deficits; SPQ-D: Disorganization; C-SHAPS: Change in the SHAPS; C-ACIPS: Change in the ACIPS; C-MFQ-Anh: Change in the MFQ-anhedonia.

Table 4 Multivariate linear regression models predicting change in anhedonia from T1 to T2

	Change in SHAPS			Change in ACIPS			Change in MFQ-Anh		
	<i>B</i>	<i>SE</i>	<i>t</i>	<i>B</i>	<i>SE</i>	<i>t</i>	<i>B</i>	<i>SE</i>	<i>t</i>
Female	-0.83	.61	-1.36	<b>2.85</b>	<b>.92</b>	<b>3.08**</b>	.29	.16	1.74
Age	.04	.46	.10	-.33	.70	-.47	.04	.12	.32
ACIPS	.00	.03	-.13	<b>-.77</b>	<b>.05</b>	<b>-14.68**</b>	<b>.02</b>	<b>.01</b>	<b>2.05*</b>
SHAPS	<b>-.67</b>	<b>.05</b>	<b>-13.79**</b>	-.14	.07	-1.90	.01	.01	.41
MFQ-Anhedonia	.24	.28	.84	-.42	.43	-.98	<b>-.70</b>	<b>.08</b>	<b>-9.22**</b>
MFQ-SI	.34	.22	1.55	-.46	.33	-1.39	<b>.12</b>	<b>.06</b>	<b>2.02*</b>
MFQ-25	-.05	.06	-.85	-.01	.09	-.15	<b>-.03</b>	<b>.02</b>	<b>-2.15*</b>
SPQ-P	-.24	.17	-1.43	.44	.26	1.74	-.04	.05	-.96
SPQ-N	<b>.42</b>	<b>.20</b>	<b>2.06*</b>	<b>-.64</b>	<b>.30</b>	<b>-2.10*</b>	.08	.05	1.41
SPQ-D	-.01	.23	-.03	-.52	.34	-1.50	<b>.16</b>	<b>.06</b>	<b>2.55*</b>
Anxiety									
Generalized-A	.17	.09	1.90	-.16	.13	-1.21	<b>.07</b>	<b>.02</b>	<b>3.04**</b>
Social-A	-.10	.09	-1.17	.23	.13	1.75	.02	.02	1.00
Separated-A	-.11	.18	-.62	.50	.27	1.85	-.08	.05	-1.71
School-A	.07	.20	.38	-.09	.30	-.31	.01	.05	.12
Somatic-A	.21	.27	.76	-.09	.41	-.22	.01	.07	.18
ALSEC									
Interpersonal	-.09	.11	-.79	.01	.17	.08	-.05	.03	-1.63
Academic	-.04	.11	-.33	.18	.16	1.08	<b>.08</b>	<b>.03</b>	<b>2.60**</b>
Punishment	.20	.11	1.80	-.04	.17	-.23	.01	.03	.23
Bereavement	.20	.12	1.68	-.22	.18	-1.22	<b>.07</b>	<b>.03</b>	<b>2.25*</b>
Adaptation	-.37	.19	-1.93	-.06	.29	-.21	-.09	.05	-1.86
Unscaled	-.22	.17	-1.33	-.06	.25	-.22	-.01	.05	-1.14

Note: Bold values are significant. MFQ: Child Mood and Feelings Questionnaire; SI: Suicide Ideation subscale in MFQ; ACIPS: Anticipatory and Consummatory Interpersonal Pleasure Scale-Adolescent Version; SHAPS: Snaith-Hamilton pleasure scale; MFQ-Anh: MFQ anhedonia subscale; ALSEC: Adolescent Self-Rating Life Events Check List; SPQ: Schizotypal Personality Questionnaire-Brief; SPQ-P: Cognitive-Perceptual; SPQ-N: Interpersonal deficits; SPQ-D: Disorganization. \* $p < 0.05$ , \*\* $p < 0.01$ .