



Stability of alexithymia is low from adolescence to young adulthood, and the consistency of alexithymia is associated with symptoms of depression and dissociation

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ABSTRACT

Background: The aims of this study were to investigate the stability of alexithymia from adolescence to young adulthood, as well as the association between alexithymia, peer relationships, and symptoms of depression and dissociation.

Methods: The participants ($n = 755$, aged 13–18 years) were assessed with self-rated questionnaires and the 20-item Toronto Alexithymia Scale (TAS-20) at baseline in 2005 and on follow-up in 2011.

Results: The changes in the TAS-20 total score ($t = -12.26$) and the scores for its subscales, difficulty identifying feelings (DIF) ($t = -4.04$), difficulty describing feelings (DDF) ($t = -5.10$), and externally oriented thinking (EOT) ($t = -18.23$), were statistically significant ($p < 0.001$). Effect sizes (Cohen's d) for the change indicating absolute stability were small for DIF (-0.15) and DDF (-0.19), medium for TAS-20 total (-0.45), and large for EOT (-0.66) scores. Moderate correlations in test–retests with Spearman's ρ (TAS-20 total 0.46, DIF 0.41, DDF 0.39, EOT 0.43) indicated relative stability, whereas low intraclass correlation coefficients (ICCs) (respectively 0.41, 0.39, 0.37, 0.37) indicated poor reliability of test–retests. In regression analyses, poor relationships with peers, loneliness, and symptoms of depression and dissociation at baseline associated with alexithymia at baseline and on follow-up. Unlike EOT, increases in the TAS-20 total, DIF, and DDF scores during the 6-year follow-up associated with baseline symptoms of depression and dissociation.

Conclusions: Alexithymia in adolescence is not always a reliable predictor of alexithymia in young adulthood. Mental health symptoms appear to affect the consistency of alexithymia during adolescent development.

1. Introduction

Alexithymia is a personality construct that represents a reduced ability to identify and describe feelings, limited imagination, and a concrete, externally oriented way of thinking [1]. The prevalence of alexithymia in the general population varies from 5 to 14% [1,2]. The most common method for measuring alexithymia is the self-rated 20-item Toronto Alexithymia Scale (TAS-20), which has three subscales:

difficulty identifying feelings (DIF), difficulty describing feelings (DDF), and externally oriented thinking (EOT) [3,4]. The psychometric properties of TAS-20 have been satisfactory among young adults [5], but variable among underaged individuals [6]. The reliability of the TAS-20 scale has been observed to be lower for adolescents aged 12 to 14 years old than among those aged 15 to 17 years [7]. However, it has been suggested that TAS-20 may have shortcomings among underaged individuals, especially early adolescents, possibly due to their still

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developing affect regulation [5,6].

In adult general populations, the stability of alexithymia was found to be high during an 11-year follow-up [8,9]. Among adult patients with depression, alexithymia was a relatively stable personality trait and associated with depressive symptoms in a 5-year follow-up [10]. The stability of alexithymia was also relatively high in a one-month follow-up among young adult students (mean age 26.5 years) [11], and in a 4-year follow-up in a general population of late adolescents (age 17–21 years) [12]. There is some evidence that alexithymia levels tend to decrease from early to middle adolescence [7,13]. To our knowledge, there have been no previous longitudinal studies investigating the stability and consistency of alexithymia from adolescence to young adulthood.

Previous studies have demonstrated that alexithymia is associated with difficulties in social relationships with friends in male adolescents, and with friends, siblings, and parents in female adolescents (aged 13–18 years) [14]. Furthermore, alexithymia has been associated with a subjectively reduced amount of social support and with maternal overprotection in late adolescents (aged 17–21 years) [15], and with less social support, fewer close relationships, poorer social skills, and distrust in social relationships in young adults [15–17].

Alexithymia has been associated with anxiety in adolescents [12,18], and also with dissociation [19,20]. It has been suggested that emotional regulation problems such as low emotional awareness, which is typical in alexithymia, might associate with increased internalizing symptoms during adolescence [21]. In latent class analysis of preadolescents, in which emotional awareness was measured with the TAS-20 EOT subscale, internalizing symptoms related to lower externally oriented thinking, externalizing symptoms, and problems in peer relationships [22].

In adults, regardless of the type of current mental health disorder, TAS-20 scores have been correlated with the severity of anxiety and depressive symptoms [23]. In a factor analysis of adults, the TAS-20 subscale DIF cross-loaded with higher levels of current general psychological distress [24]. In addition, alexithymia measured with a more comprehensible, shorter, item-reduced version (TAS-8) was highly correlated with neuroticism among samples of adults with verbal autism and a control group [25].

Longitudinal studies on alexithymia and related factors among adolescents are scarce [7,11–13]. Even though alexithymia has been observed to be a stable trait among adults and older adolescents, to the best of our knowledge, there is no evidence regarding the stability of alexithymia from adolescence to adulthood. Furthermore, the reliability of TAS-20 in early adolescents has been questioned [5,6]. As far as we are aware, there have been no previous longitudinal studies on the consistency and reliability of TAS-20 scores in adolescents as a predictor of TAS-20 scores in young adulthood. In the current study, we aimed to assess: 1) the stability of TAS-20 scores from adolescence to young adulthood; 2) the reliability of TAS-20 scores in adolescence as a predictor of alexithymia in young adulthood; 3) the associations between alexithymia and its subscales and symptoms of depression and dissociation, the quality of peer relationships, and loneliness at baseline and on follow-up; and 4) the change in alexithymia and its subscale scores during a 6-year follow-up period. Based on the earlier literature, we hypothesized that 1) alexithymia from adolescence to young adulthood would not be as stable and consistent as it is in late adolescence or in adulthood, and 2) levels of alexithymia at baseline and on follow-up, and the change in TAS scores between baseline and follow-up, would be associated with the quality of adolescents' social relationships measured as the self-reported frequency of meeting friends, peer relationship quality, and loneliness, as well as symptoms of depression and dissociation.

2. Methods

2.1. Participants

The participants were cohorts of adolescents aged from 13 to 18 years from the Youth Well-being Study [26], a follow-up study on the somatic and mental well-being of from comprehensive, upper secondary, and vocational schools in Kuopio, a city in Eastern Finland with approximately 111,000 inhabitants. Two special schools were excluded from the study on the recommendation of their headmasters, as the questionnaires were considered to be too complicated for their developmentally impaired pupils. All other schools and their pupils were included. The baseline data were collected between August 2004 and March 2005 using structured self-rating questionnaires that the participants completed during class periods at school. Before participating in the study, written consent was requested from all the adolescents and from the parents of those aged less than 15 years. Some of the schools wanted to administer the study by themselves. In these cases, the researcher informed the teachers about the study and gave them instructions on how to perform it. In some of the schools, a researcher administered the test. The validity of the questionnaires was tested in a pilot study ($n = 27$), after which the setting was changed so that the researcher or teacher explained to the adolescents how to complete the questionnaires. Due to this methodological difference, the pilot participants were not included in the final study sample. Methodological aspects of the baseline study setting have previously been described in detail by Laukkanen et al. (2009) [26].

The original target population comprised 6421 adolescents aged from 11 to 21 years in 2005. The response rate was 65.5%, leading to a sample of 4214 adolescents. Girls responded significantly more often compared to boys. Altogether, 43 participants were excluded due to an age of 12 or younger or 19 or older, leading to a final sample of 4171 adolescents. From this population, 1827 (43.8%) provided their consent to be contacted for a follow-up study. A younger age, female gender, higher school performance, and a higher number of hobbies were associated with consenting to be contacted and participation in the follow-up [27]. The follow-up data were collected by mail between January 2010 and December 2011. There were 1585 participants whose addresses were retrieved for recruitment by mail (86.8% of those who consented). Finally, 795 young adults (females 70.9%) aged 18 to 25 years participated in the follow-up five years later, in 2011 (43.5% of those who consented and 50.2% of those whose postal address could be retrieved). Alexithymia self-reports were completed by 755 participants. Fig. 1 presents the sample selection of the study.

All procedures performed on the participants were in accordance with the ethical standards of the institutional and national research committee, and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The Research Ethics Committee of Kuopio University Hospital approved the study design. Before the study, written informed consent was obtained from all individual participants included in the study, and from the parents of those aged below 15 years according to Finnish legislation governing medical research. All participants had the possibility to withdraw from the study at any time without explanation. Participants were informed of possible psychological inconvenience and guided to seek specialized psychosocial support or treatment when necessary.

2.2. Measurements

Participant data collected at baseline included age, gender, lifestyle, and psychosocial background characteristics such as the frequency of meeting friends, social relationships with peers, loneliness, and symptoms of depression and dissociation. Background factors, social relationships, and loneliness were assessed with questions included in a standardized self-rated questionnaire, the Youth Self-Report for ages 11–18 years (YSR), which is designed for the assessment of problem

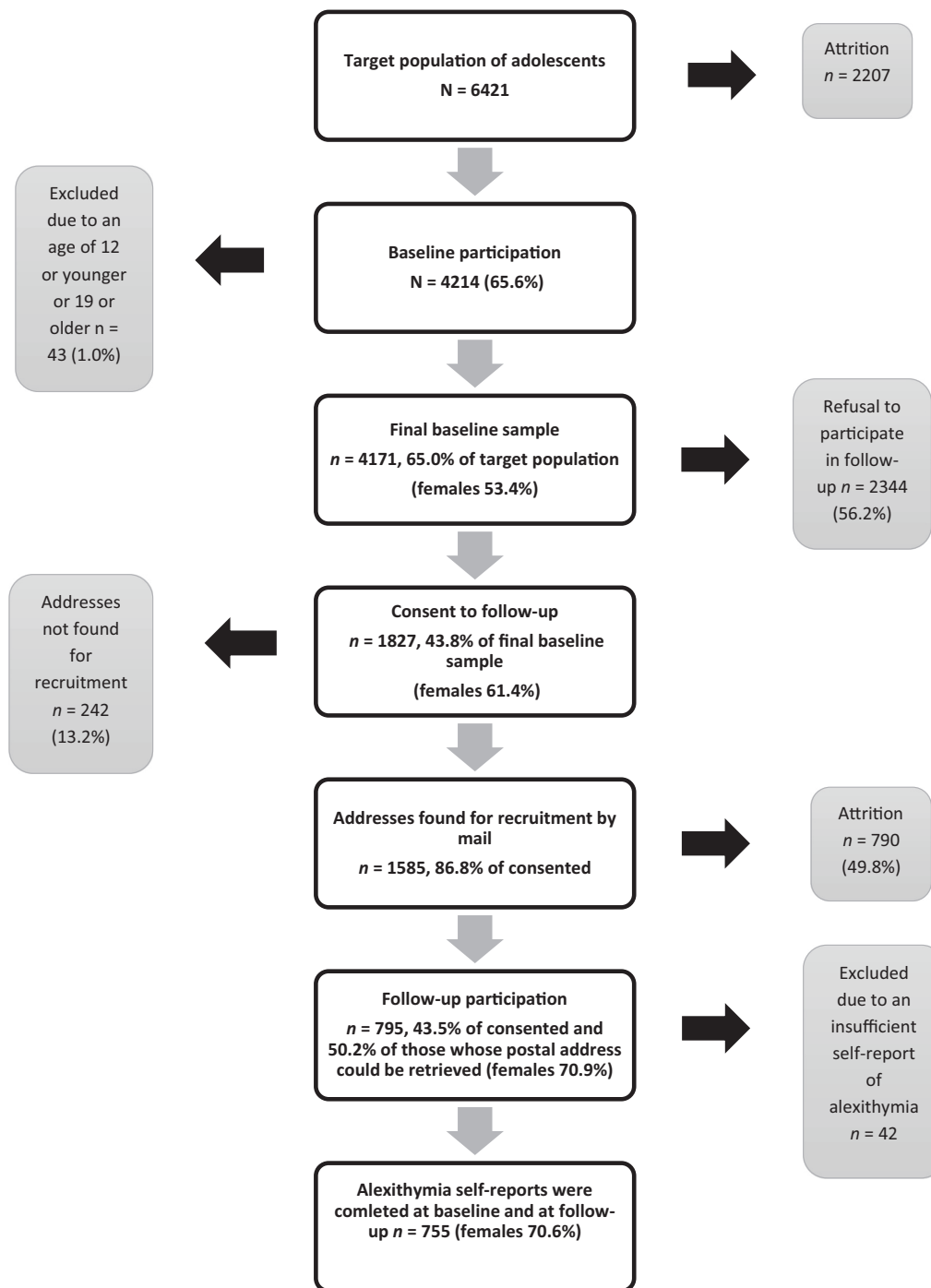


Fig. 1. The target population and sample selection of the study.

behaviors among children and adolescents [28]. In the YSR, participants were asked: “How many times a week you do things with friends outside of regular school hours?”, with the response alternatives “Less than once”, “One or two times”, or “Three or more times”, and “What kind of relationship do you have with your peers?”, with the response alternatives “Poor”, “Average”, or “Good”. In addition, they were asked “Do you feel lonely?”, with the response alternatives “No”, “Somewhat”, or “Yes”. These YSR questions, with their response scales, and the characteristics of the study sample concerning the levels of alexithymia measured by TAS-20 total scores at baseline are presented in Table 1.

The prevalence of alexithymia was assessed both at baseline among adolescents and on follow-up among young adults using the Finnish

version of the 20-item Toronto Alexithymia Scale (TAS-20) [3]. Studies on Finnish populations have demonstrated the validity of the TAS-20 in adolescents, although no cut-off scores have been established [7,14]. The items in the TAS-20 are statements for which response options are provided on a five-point Likert scale ranging from *strongly disagree* to *strongly agree* [4]. The total score ranges from 20 to 100, with a higher score indicating a higher level of alexithymia. The TAS-20 has three subscales: 1) DIF refers to subjects' difficulty in differentiating their affects from each other or the affective states from their accompanying bodily sensations, 2) DDF measures the subjects' capacity to name, describe, and verbalize their feelings, and 3) EOT measures the extent to which subjects relate more to objective events than to psychological

Table 1

Baseline characteristics of the study participants according to the level of alexithymia measured with the 20-item Toronto Alexithymia Scale (TAS-20) at baseline.

Baseline variable		Level of alexithymia at baseline (TAS-20 total score)					Odds Ratio (OR) ^d	Confidence Interval for OR
		No/Low-Moderate alexithymia (<60)		High alexithymia (>=61)		p		
		n	%	n	%			
Gender	Male	205	29.8	17	25.8	0.496 ^a	1.000	
	Female	484	70.2	49	74.2		0.819	0.461–1.456
Meeting with friends, frequency per week	<1	46	6.6	11	16.7	0.056 ^b	2.935	1.390–6.197
	1–2	236	34.4	22	33.3		1.144	0.652–2.009
	>3	405	59.0	33	50.0		1.000	
Relationship with peers	Poor	15	2.2	5	7.6	0.008 ^b	5.294	1.720–16.299
	Average	393	58.0	44	66.7		1.1778	0.995–3.178
	Good	270	39.8	17	25.8		1.000	
Loneliness	No	421	61.1	20	30.3	< 0.001 ^b	0.109	0.053–0.225
	Somewhat	229	33.2	29	43.9		0.291	0.146–0.578
	Yes	39	5.7	17	25.8		1.000	
		Mean	SD	Mean	SD	p	Cohen's d	Confidence Interval for Cohen's d
Age, years		15.43	1.50	15.70	1.41	0.160 ^c	1.493	–0.434–0.072
Beck Depression Inventory (BDI) scores in 2005		3.78	4.81	13.83	9.74	< 0.001 ^b		
Adolescent Dissociative Experiences Scale (A-DES) scores in 2005		0.68	0.94	2.33	1.87	< 0.001 ^b		

^a Chi-squared test.^b Mann-Whitney *U* test.^c Student's *t*-test.^d Odds ratio from logistic regression analysis.

processes. The scores for the three TAS-20 subscales were calculated by using the original factor structure of Bagby et al. (1994) [3]. Recent knowledge reviewed by the original developers of TAS-20 supports the dimensional rather than the categorical classification of alexithymia [5]. However, in order to allow comparison with previous literature, the TAS-20 total scores were classified into three categories using traditional cut-offs: no alexithymia (<51), low or moderate (52–60), or high levels of alexithymia (>=61) [29]. Cronbach's alpha (reliability) for the TAS-20 scale in our data was 0.77 at baseline and 0.83 on follow-up.

Depressive symptoms were assessed with the 21-item Beck Depression Inventory (BDI). The BDI questions target cognition, behavior, emotions, and somatic complaints [30,31]. The BDI has been validated for adolescents [32], in whom a sum total score of 16 has been used as a cut-off point to screen for major depressive disorder (MDD) [32]. Here, we refer to those with BDI scores of 16 or more as having an elevated level of depressive symptoms. Cronbach's alpha for the BDI scale in our data was 0.89 at baseline and 0.90 on follow-up.

Dissociative symptoms were measured with the Adolescent Dissociative Experience Scale (A-DES), which is a structured scale for the assessment of pathological dissociation among adolescents [33]. The A-DES is a self-report questionnaire with 30 items, of which each is an 11-point Likert scale ranging from “never” to “always”. Its original developer, J.G. Armstrong, approved the Finnish version of the A-DES in 2004 [33]. Cronbach's alpha for the A-DES scale in our data was 0.93 at baseline and 0.92 on follow-up.

2.3. Statistics

Effect sizes were calculated with a free web-based calculator (<https://www.uccs.edu/lbecker/>). The internal consistencies and reliabilities for the TAS-20 total and subscale scores were calculated using Cronbach's alpha. The absolute stability of the TAS-20 total and subscale scores between baseline and the 6-year follow-up was tested with the paired samples *t*-test. Cohen's *d* was calculated to determine the effect sizes for variables [34].

The relative stability, reliability over time, and agreement between TAS-20 total and subscale scores at baseline and on follow-up were assessed with two different statistical methods to catch possible substantial discrepancy between these methods: test–retest correlation using Spearman's ρ , and intraclass correlation coefficients (ICCs). ICC

estimates and their 95% confident intervals for TAS-20 total and subscale scores were calculated based on a single-rating, absolute-agreement, 2-way mixed-effects model. Calculations of 95% confidence intervals for Spearman's ρ were assessed with a free web-based calculator (<http://vassarstats.net/rho.html>) based on the Fisher transformation.

Pearson's correlation coefficients (*r*) were used to measure the associations between continuous variables. Differences between baseline and follow-up TAS-20 total and subscale scores were calculated. The chi-squared test was used to analyze the group differences (between high levels of alexithymia and moderate levels or no alexithymia) in the categorical dichotomous variables such as gender, whereas Mann-Whitney *U* tests were used to analyze the group difference in categorical variables such as frequency of meeting with friends, social relationships with peers, and loneliness. The Student's *t*-test and Mann-Whitney *U* test were similarly applied to continuous variables with a normal distribution and non-normal distribution, respectively.

Associations of all the variables were assessed with linear regression analysis (method: Enter). In linear models, TAS-20 total scores and subscale scores and the change in alexithymia from baseline to follow-up were used as dependent variables, while all the categorical variables (gender, frequency of meeting with friends, social relationships with peers, and loneliness) and other continuous variables (BDI, A-DES) were used as covariates. TAS-20 total scores and subscale scores were investigated in separate linear models. We analyzed whether certain self-reported factors at baseline or on follow-up (i.e., age, gender, peer relationships, symptoms of depression) could explain the TAS-20 scores at baseline or on follow-up, or the change in scores from baseline to follow-up. Regression analyses were performed with all the variables in the same model, and also with gender split file analysis. Results from gender split files were adjusted with gender*covariate interaction terms.

Secondly, regression analyses were performed with selected data to avoid the sources of bias in the study results caused by overlapping alexithymia and elevated levels of depression. Participants were selected for the analysis by excluding those with BDI scores of 16 or more indicating at least borderline clinical depression at baseline (*n* = 45) and on follow-up (*n* = 65). Along with the above-mentioned list of covariates, the BDI-21 score was added as a covariate. The selected data consisted of 684 participants (212 boys and 472 girls).

The coefficient of determination (R^2) was used to report the

proportion of the variance in the dependent variable explained by independent variables in regression models. R^2 values in the regression models ranged from 0.01 to 0.45.

P -values below 0.05 were considered to indicate statistical significance. All the models were tested for multicollinearity, and all variance inflation factors (VIF) were less than 5. All analyses were conducted with IBM SPSS (version 24) statistical software.

3. Results

3.1. Alexithymia and characteristics of the study sample

At baseline, 8.7% ($n = 66$) of the participants had high levels of alexithymia, 22.8% ($n = 172$) had moderate levels of alexithymia, and 68.5% ($n = 517$) had no alexithymia. On follow-up, the respective figures were 4.2% ($n = 32$), 15.9% ($n = 120$), and 79.9% ($n = 603$). Of those who had high levels of alexithymia at baseline, ten subjects (15.2%, $p < 0.001$) also had high levels of alexithymia on follow-up. The TAS-20 total scores were ≥ 61 at baseline (2005) in 17 boys (8.2%) and 49 girls (10.1%) ($p = 0.496$), and on 6-year follow-up (2011) in 6 boys (2.9%) and 26 girls (5.4%) ($p = 0.176$). Those with high levels of alexithymia had a lower frequency of meeting with friends per week, poorer relationship with peers, higher loneliness, higher BDI scores, and higher A-DES scores than those with lower levels of alexithymia (Table 1). Toronto Alexithymia Scale-20 (TAS-20) total and subscale scores for the whole sample at baseline and on 6-year follow-up ($n = 755$) are presented in Table 2.

3.2. Stability of alexithymia

The absolute stability of alexithymia was low. The results of ICC calculations for TAS-20 total and subscale scores are presented in Table 3. The results suggest a relative decrease in the TAS-20 scores, but

no gender differences were found. The correlations (Spearman's ρ) between TAS-20 total and subscale scores at baseline and on 6-year follow-up were all significant (Table 3), including when participants with signs of clinical depression either at baseline or on follow-up were excluded (Supplementary table 7).

There were variations in effect sizes: medium for TAS-20 total scores, small for the subscales DIF and DDF, and large for EOT. The results were similar when analyses were repeated by gender (Table 2). The changes in the TAS-20 total and subscale scores from baseline to follow-up and their effect sizes were similar when participants with signs of clinical depression at baseline were excluded (Supplementary table 6).

With the low to moderate internal reliabilities for baseline scores (except for the reliability of DDF and EOT), Cronbach's alpha indicated good internal consistency for the TAS-20 total score at baseline (0.77) and on follow-up (0.83), as well as for DIF at baseline (0.82) and on follow-up (0.83), and for DDF on follow-up (0.79). However, Cronbach's alpha indicated poor internal consistency for DDF at baseline (0.32) and for EOT at baseline (0.48) and on follow-up (0.65).

3.3. Correlations between alexithymia, depression, and dissociation

At baseline, Pearson's correlation coefficients (r) between BDI scores and TAS-20 scores were 0.52 ($p < 0.001$) for TAS-20 total scores, 0.59 ($p < 0.001$) for DIF scores, and 0.50 ($p < 0.001$) for DDF scores. Pearson's correlation coefficients (r) between baseline A-DES scores and baseline TAS-20 scores were, correspondingly, 0.50 ($p < 0.001$), 0.56 ($p < 0.001$), and 0.44 ($p < 0.001$). EOT scores were not correlated with BDI ($r = 0.03$, $p = 0.485$) or A-DES scores ($r = 0.05$, $p = 0.180$) at baseline.

On follow-up, Pearson's correlation coefficients (r) between BDI scores and TAS-20 scores were 0.56 ($p < 0.001$) for TAS-20 total scores, 0.58 ($p < 0.001$) for DIF scores, 0.51 ($p < 0.001$) for DDF scores, and 0.19 ($p < 0.001$) for EOT scores. Pearson's correlation coefficients (r) between follow-up A-DES scores and follow-up TAS-20 scores were,

Table 2

20-item Toronto Alexithymia Scale (TAS-20) total and subscale scores for the whole sample, males and females at baseline and on 6-year follow-up ($n = 755$), and significance of the change according to the paired-samples t -test.

TAS-20 scores	Mean (SD) at baseline	Mean (SD) on 6-year follow-up	Change in mean values, mean (SD)	95% Confidence Intervals of the difference (CI)	Test value (t)	p	Effect size for change (Cohen's d)	95% Confidence Intervals of the difference (CI)
All ($n = 755$)								
Total	46.70 (9.720)	42.03 (10.294)	-4.669 (10.461)	-5.416 to -3.921	-12.263	< 0.001	-0.446	-0.521 to -0.371
DIF	14.06 (5.101)	13.25 (5.003)	-0.815 (5.540)	-1.210 to -0.419	-4.040	< 0.001	-0.147	-0.219 to -0.075
DDF	11.34 (3.857)	10.53 (3.996)	-0.811 (4.364)	-1.122 to -0.499	-5.104	< 0.001	-0.186	-0.258 to -0.114
EOT	21.29 (4.264)	18.25 (4.372)	-3.044 (4.589)	-3.372 to -2.716	-18.226	< 0.001	-0.663	-0.742 to -0.584
Males ($n = 222$)								
Total	46.16 (9.211)	41.25 (9.519)	-4.910 (10.040)	-6.238 to -3.582	-7.287	< 0.001	-0.489	-0.628 to -0.349
DIF	12.75 (4.925)	11.80 (4.129)	-0.946 (5.266)	-1.643 to -0.49	-2.676	0.008	-0.180	-0.312 to -0.047
DDF	10.89 (3.591)	10.26 (3.696)	-0.631 (4.151)	-1.180 to -0.082	-2.264	0.025	-0.152	-0.284 to -0.019
EOT	22.52 (4.612)	19.19 (4.800)	-3.333 (4.835)	-3.973 to -2.694	-10.273	< 0.001	-0.689	-0.835 to -0.542
Females ($n = 533$)								
Total	46.92 (9.924)	42.35 (10.592)	-4.568 (10.640)	-5.474 to -3.663	-9.913	< 0.001	-0.429	-0.518 to -0.340
DIF	14.61 (5.078)	13.85 (5.212)	-0.760 (5.654)	-1.241 to -0.279	-3.103	0.002	-0.134	-0.220 to -0.049
DDF	11.53 (3.951)	10.65 (4.113)	-0.886 (4.451)	-1.264 to -0.507	-4.593	< 0.001	-0.199	-0.284 to -0.113
EOT	20.78 (4.004)	17.85 (4.112)	-2.923 (4.481)	-3.304 to -2.542	-15.059	< 0.001	-0.652	-0.746 to -0.559

DIF = difficulty identifying feelings, DDF = difficulty describing feelings, EOT = externally oriented thinking.

Table 3

The correlations (Spearman's ρ) of 20-item Toronto Alexithymia Scale (TAS-20) baseline and subscale scores with corresponding scores at the 6-year follow-up. Intraclass Correlation (ICC) estimates and their 95% confident intervals (CI) for TAS-20 total and subscale scores were calculated based on a single-rating, absolute-agreement, two-way mixed-effects model (i.e., coefficient ICC (2,1)).

	Spearman's ρ	CI of Spearman's ρ		Intraclass Correlation ^b	95% CI for ICC		F Test with True Value 0			
		Lower Limit	Upper Limit		Lower Bound	Upper Bound	Value	df1	df2	p
All (n = 755)										
Total	0.458	0.402	0.514	0.410 ^a	0.272	0.520	2.663	754	754	< 0.001
DIF	0.410	0.349	0.467	0.394 ^a	0.331	0.453	2.329	769	769	< 0.001
DDF	0.394	0.328	0.448	0.371 ^a	0.306	0.433	2.224	767	767	< 0.001
EOT	0.433	0.371	0.486	0.351 ^a	0.118	0.519	2.559	760	760	< 0.001
Males (n = 222)										
Total	0.379	0.262	0.487	0.375 ^a	0.198	0.517	2.481	221	221	< 0.001
DIF	0.347	0.229	0.460	0.322 ^a	0.201	0.435	1.978	221	221	< 0.001
DDF	0.328	0.208	0.442	0.347 ^a	0.227	0.457	2.082	221	221	< 0.001
EOT	0.476	0.372	0.575	0.379 ^a	0.109	0.567	2.792	221	221	< 0.001
Females (n = 533)										
Total	0.481	0.412	0.542	0.421 ^a	0.285	0.531	2.722	532	532	< 0.001
DIF	0.406	0.337	0.478	0.392 ^a	0.318	0.462	2.313	532	532	< 0.001
DDF	0.415	0.348	0.487	0.382 ^a	0.304	0.454	2.283	532	532	< 0.001
EOT	0.395	0.327	0.468	0.312 ^a	0.182	0.643	2.289	532	532	< 0.001

DIF = difficulty identifying feelings, DDF = difficulty describing feelings, EOT = externally oriented thinking.

Two-way mixed effects model where people effects are random and measures effects are fixed.

^a The estimator is the same, whether the interaction effect is present or not.

^b Type A intraclass correlation coefficients using an absolute agreement definition.

correspondingly, 0.51 ($p < 0.001$), 0.60 ($p < 0.001$), 0.44 ($p < 0.001$), and 0.13 ($p < 0.001$).

Pearson's correlations between the change (difference between time points) in TAS-20 total and subscale scores from baseline to follow-up, age, and the change (difference between time points) in BDI and A-DES scores from baseline to follow-up are presented in Table 4.

3.4. Linear regression analysis of the association between baseline participant characteristics and alexithymia at baseline

A younger age associated with higher TAS-20 total and EOT scores at baseline. Female gender associated with a higher DIF score, and male gender with a higher EOT score at baseline. A higher frequency of meeting friends associated with higher DIF scores at baseline. Poor relationships with peers associated with higher total, DIF, DDF, and EOT scores at baseline, while loneliness associated with higher total, DIF, and DDF scores at baseline. Higher BDI and A-DES scores associated with higher TAS-20 total, DIF, and DDF scores at baseline (Table 5).

There was a significant interaction of gender*peer relationships ($F = 16.439, p < 0.001$) for baseline EOT scores, and poor peer relationships associated with higher EOT scores at baseline in males but not in females ($B = -1.66, t = -2.85, p = 0.005$).

Table 4

Pearson's correlations (r) between age and the change (difference between time points) in 20-item Toronto Alexithymia Scale (TAS-20), Beck Depression Inventory (BDI), and Alexithymia Dissociative Experience Scale (A-DES) scores from baseline to follow-up.

		Change in TAS-20 total scores	Change in TAS-20 DIF scores	Change in TAS-20 DDF scores	Change in TAS-20 EOT scores	Change in BDI scores	Change in A-DES scores
Age	r	0.08 (0.040)	-0.04 (0.260)	0.01 (0.825)	0.23 (< 0.001)	-0.03 (0.451)	-0.03 (0.480)
	(p)						
Change in TAS-20 total scores	r	1	0.81 (< 0.001)	0.81 (< 0.001)	0.54 (< 0.001)	0.49 (< 0.001)	0.40 (< 0.001)
	(p)						
Change in TAS-20 DIF scores	r		1	0.61 (< 0.001)	0.06 (0.101)	0.51 (< 0.001)	0.49 (< 0.001)
	(p)						
Change in TAS-20 DDF scores	r			1	0.12 (< 0.001)	0.42 (< 0.001)	0.36 (< 0.001)
	(p)						
Change in TAS-20 EOT scores	r				1	0.09 (0.016)	-0.04 (0.338)
	(p)						
Change in BDI scores	r					1	0.45 (< 0.001)
	(p)						

Table 5

Linear regression analysis with unstandardized coefficients (B) and their standard errors (S.E.) using the enter method for the association of the 20-item Toronto Alexithymia Scale (TAS-20) baseline scores, follow-up scores, and change in the score between baseline and follow-up, and baseline characteristics. TAS-20 total scores and subscale scores were entered into models separately with all covariates.

Baseline variables	TAS-20 Total				DIF				DDF				EOT			
	B	S.E.	t	p	B	S.E.	t	p	B	S.E.	t	p	B	S.E.	t	p
<u>TAS-20 baseline scores</u>																
Age (Years)	-0.838	0.193	-4.340	< 0.001	0.036	0.094	0.379	0.705	-0.064	0.080	-0.797	0.426	-0.810	0.100	-8.126	< 0.001
Gender (Female)	-0.501	0.639	-0.785	0.433	1.203	0.311	3.870	< 0.001	0.093	0.265	0.349	0.727	-1.797	0.330	-5.452	< 0.001
Meeting with friends, frequency per week (>3)	0.905	0.475	1.906	0.058	0.676	0.231	2.926	0.004	-0.017	0.197	-0.085	0.932	0.246	0.245	1.003	0.316
Relationship with peers (Good)	-2.232	0.543	-4.109	< 0.001	-0.966	0.264	-3.654	< 0.001	-0.505	0.226	-2.235	0.026	-0.761	0.280	-2.716	0.007
Loneliness (Yes)	1.517	0.541	2.804	0.005	0.758	0.263	2.879	0.004	0.738	0.225	3.282	0.001	0.021	0.279	0.076	0.939
Beck Depression Inventory (BDI) scores in 2005	0.512	0.063	8.150	< 0.001	0.275	0.031	8.999	< 0.001	0.191	0.026	7.331	< 0.001	0.045	0.032	1.404	0.161
Adolescent Dissociative Experiences Scale (A-DES) scores in 2005	2.373	0.301	7.883	< 0.001	1.542	0.147	10.525	< 0.001	0.793	0.125	6.345	< 0.001	0.037	0.155	0.240	0.810
<u>TAS-20 follow-up scores</u>																
Age (Years)	-0.242	0.242	-1.002	0.317	-0.108	0.115	-0.936	0.350	-0.043	0.096	-0.447	0.655	-0.092	0.106	-0.866	0.387
Gender (Female)	0.523	0.800	0.654	0.513	1.746	0.380	4.589	< 0.001	0.137	0.317	0.434	0.665	-1.360	0.351	-3.876	< 0.001
Meeting with friends, frequency per week (>3)	0.740	0.595	1.244	0.214	0.375	0.283	1.327	0.185	-0.088	0.235	-0.374	0.709	0.453	0.261	1.736	0.083
Relationship with peers (Good)	-3.134	0.681	-4.603	< 0.001	-1.054	0.324	-3.257	0.001	-0.771	0.270	-2.860	0.004	-1.309	0.298	-4.387	< 0.001
Loneliness (Yes)	1.410	0.678	2.079	0.038	0.666	0.322	2.065	0.039	0.626	0.268	2.332	0.020	0.119	0.297	0.399	0.690
Beck Depression Inventory (BDI) scores in 2005	0.215	0.079	2.734	0.006	0.121	0.037	3.232	0.001	0.083	0.031	2.669	0.008	0.011	0.034	0.323	0.747
Adolescent Dissociative Experiences Scale (A-DES) scores in 2005	1.383	0.377	3.666	< 0.001	0.678	0.179	3.781	< 0.001	0.310	0.149	2.073	0.038	0.395	0.165	2.392	0.017
<u>Changes in the TAS-20 scores between baseline and follow-up</u>																
Age (Years)	0.596	0.253	2.353	0.019	-0.143	0.131	-1.094	0.274	0.021	0.106	0.199	0.842	0.718	0.111	6.465	< 0.001
Gender (Female)	1.025	0.837	1.224	0.221	0.543	0.433	1.253	0.211	0.045	0.350	0.128	0.898	0.437	0.367	1.190	0.234
Meeting with friends, frequency per week (>3)	-0.165	0.622	-0.265	0.791	-0.301	0.322	-0.934	0.350	-0.071	0.260	-0.274	0.784	0.207	0.273	0.758	0.448
Relationship with peers (Good)	-0.902	0.712	-1.266	0.206	-0.088	0.369	-0.238	0.812	-0.266	0.298	-0.894	0.372	-0.548	0.312	-1.754	0.080
Loneliness (Yes)	-0.107	0.709	-0.151	0.880	-0.093	0.367	-0.253	0.801	-0.112	0.297	-0.377	0.706	0.097	0.311	0.313	0.755
Beck Depression Inventory (BDI) scores in 2005	-0.297	0.082	-3.604	< 0.001	-0.154	0.043	-3.620	< 0.001	-0.108	0.034	-3.141	0.002	-0.034	0.036	-0.951	0.342
Adolescent Dissociative Experiences Scale (A-DES) scores in 2005	-0.990	0.394	-2.509	0.012	-0.864	0.204	-4.233	< 0.001	-0.484	0.165	-2.933	0.003	0.358	0.173	2.069	0.039

DIF = difficulty identifying feelings, DDF = difficulty describing feelings, EOT = externally oriented thinking.

4. Discussion

4.1. Comparison with previous literature

TAS-20 total and subscale scores generally decreased during the 6-year follow-up in both genders, with EOT subscale scores decreasing the most. The changes in the TAS-20 total scores and the subscale scores from baseline to the 6-year follow-up were statistically significant. Magnitudes of the changes between time points were small for the subscales DIF and DDF, moderate for the TAS-20 total score, and large for the subscale EOT, indicating the low absolute stability of TAS-20 and its subscales.

The correlations between TAS-20 scores and its subscales at baseline and on 6-year follow-up were significant. However, all correlation coefficients were below 0.50, and low intraclass correlation (ICC) especially indicated the poor reliability of TAS-20 scores from baseline to follow-up, suggesting a low relative stability of TAS-20 scores. The results were similar when analyses were repeated by gender. In our study, the correlation of retest values was smaller, and the magnitude of changes was greater compared to previous studies in adult populations [8,9] and late adolescents [12], suggesting a low absolute stability of alexithymia from adolescence to young adulthood. In our study, low ICCs might reflect a low degree of measurement agreement.

In this study, symptoms of depression and dissociation associated with higher baseline and follow-up TAS-20 scores and a smaller change in TAS-20 scores from baseline to follow-up. In addition, the subscales DIF and DDF, but not EOT, were associated with symptoms of depression. Overlapping of alexithymia and dissociation, as well as depression and anxiety, has been reported earlier in our previous studies [14,20] and elsewhere [35,36]. It has been suggested that alexithymia might contribute to depression and anxiety symptoms more in females than males [37]. In a previous follow-up study among late adolescents, the TAS-20 subscale DIF was not associated with symptoms of depression [18], whereas in our study, DIF associated with symptoms of depression in both genders at baseline, but only in females on follow-up. Previous results from adult studies suggest that TAS-20 measures negative affect rather than alexithymia per se among patients with MDD [23], alexithymia overlaps with neuroticism [25], and the subscale DIF overlaps with general psychological distress [24].

There were also gender differences in alexithymia. Previously, the results of a small cross-sectional study suggested that pubertal maturation and alexithymia might contribute to the symptoms of depression and anxiety more commonly in females than males [37]. Female gender associated with higher baseline and follow-up DIF scores, and male gender associated with higher baseline and follow-up EOT scores. Our findings are in line with previous results from a general population of adolescents, in which female gender associated with DIF scores and male gender with EOT scores [12,38]. In our study, the baseline prevalence of alexithymia was 10.1% for females and 8.2% for males, which is comparable with a previous study in which the prevalence of alexithymia in 15- to 16-year-olds was 10% for females and 7% for males [39].

Poor relationships with peers associated with both baseline and follow-up TAS scores. Our study results suggest that poor peer relationships were related to alexithymia, whereas in previous studies on adolescents, alexithymia has been associated with lower social support, fewer close relationships, and poorer social skills [16]. In adolescence, emotion identification skills are related to the size and quality of the social support network [40].

Loneliness was associated with higher TAS-20 scores at baseline and on follow-up, especially among males. Previously, Qualter et al. (2009) [17] demonstrated that the association between alexithymia and loneliness among young adults was mediated by distrust in social relationships. It was surprising in our study that a higher frequency of meeting friends also associated with a higher DIF score at baseline.

The development of social skills and behavior might be dependent on social support and secure relationships in adolescence [40–42].

Furthermore, a neglectful parenting style has been linked to alexithymia and internalizing symptoms in adolescence [43]. The causality between negative inter-personal experiences and alexithymia seems to be complex and difficult to confirm. A low level of emotional awareness related to alexithymia might be a vulnerability factor for difficulties in peer relationships [22], and for increased internalizing symptoms during adolescence [21], especially in females [37]. Alexithymia traits in adolescence may also reflect the incomplete development of affect regulation and personality [44].

4.2. Strengths and limitations

The main strength of this study was its longitudinal setting, with a large variety of possible confounding variables being evaluated. Another strength was our large sample of students participating at both study points. In addition, in comparison with earlier studies [8,9,12], the participants in this study were younger at baseline, which is also a strength. The high dropout rate can be considered as a limitation. The attrition rate was associated with male gender, problems in school performance, and having no hobbies [27]. Female gender overrepresentation must be considered when interpreting the study results. In addition, some degree of self-selection in this study might have increased the risk of bias in the results. The exclusion of possible overlapping psychiatric disorders could have been better designed. Furthermore, we could not monitor whether participants had been supported by a psychologist after the collection of the baseline data. Utilizing structured clinical interviews or a more extensive repertoire of standardized questionnaires to obtain psychiatric diagnoses would have added to the information gathered with self-reported questionnaires. In addition, not measuring the trait of neuroticism as a covariate is also a limitation in the study. However, due to the large sample size of the study, we were unable to utilize these types of tools with this dataset. Self-reporting of health may be vulnerable to bias, especially in the case of potentially embarrassing health complaints.

4.3. Summary and conclusions

The stability of alexithymia from adolescence to young adulthood over 6 years of follow-up was lower compared to previous studies among late adolescents and adults. Levels of alexithymia appear to decrease from adolescence to young adulthood, whereas symptoms of depression and dissociation diminished the change in TAS scores. Therefore, alexithymia in adolescence might not be reliable predictor of alexithymia in young adulthood. It is possible that alexithymia in adolescence is transitory due to the development of affect regulation and personality. Of the baseline characteristics, a younger age, poor relationships with peers, higher levels of loneliness, and symptoms of depression and dissociation associated with alexithymia at baseline and on follow-up. Mental health in adolescence might affect the development of the alexithymia traits of difficulty in identifying and describing feelings, but not an externally oriented thinking style.

Data availability statement

The data on which the findings of this study have been based are available from the corresponding author upon reasonable request.

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Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpsychores.2021.110629>.

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