

Recall bias of students' affective experiences in adolescence: The role of personality and internalizing behavior

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Abstract

Introduction: Adolescence is characterized by multiple biopsychosocial changes, associated with a high intraindividual variability of emotional experiences. Previous findings suggest that this intraindividual variability is reflected in a recall bias of adolescents' emotion reports. However, corresponding findings are scarce and inconclusive. Studies on predictors of recall bias in adulthood indicate that personality traits, especially neuroticism and extraversion, as well as specific internalizing disorders might affect recall bias of emotion reports.

Methods: The sample consists of 118 Swiss adolescent students in grade 8 and 9 ($M_{\text{age}} = 15.15$, $SD_{\text{age}} = 0.89$). The students' momentary affective experience was recorded using smartphones over seven consecutive days in situ at 42 randomly generated occasions (six per day), with a total of 1059 protocols on current events. At the end of the experience-sampling phase, students filled out an online questionnaire, providing information about their personality and typical behavior as well as their retrospective affective experience. In addition, the students' behavior was evaluated by their teachers. We applied two-level structural equation modeling with latent difference variables.

Results: Adolescents high in extraversion showed retrospective overestimation of positive affective experiences and underestimation of negative affective experiences. Adolescents with high neuroticism tended to overestimate negative affect retrospectively, showing no significant effects for positive affect. However, internalizing behavior did not predict a negative recall bias in adolescents' affective experience.

Conclusions: Retrospective self-reports about adolescents' affective experience are biased by relatively stable individual factors, whereas less stable individual factors did not seem to have any influence.

KEYWORDS

adolescence, affect, emotion, individual beliefs, latent difference model, recall bias

1 | INTRODUCTION

Adolescence is characterized by multiple biopsychosocial changes and constitutes a critical developmental phase involving important personality development processes (Branje et al., 2021) as well as a considerable increase in psychological problems such as anxiety and depression (e.g., Bertha & Balázs, 2013; Valois et al., 2004). According to the cognitive model, cognitions and their development are a major driver of personality development as well as of the development and maintenance of psychological problems (Beck & Haigh, 2014), because they constitute an essential part of personality in the first place but also filter relevant information according to the automatic thoughts, patterns of thoughts, and deeper level

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cognitions (i.e., basic assumptions and core beliefs) forming the emotional valence of the information. These cognitive filters may sometimes lead to perceptual distortion, inaccurate judgment, illogical interpretation, and/or retrospection effects (Ariely, 2008; Baron, 2007; Kahneman & Tversky, 1972). Thus, it is crucial to identify predictors of such biases for a better understanding of psychological development in adolescence.

Supporting the theoretical rationale, previous studies suggest a potential link between the two most prevalent internalizing disorders in adolescence—*anxiety and depression*—and a retrospective over- or underestimation of the affective experience recorded in situ (i.e., recall bias). Accordingly, results showed that adult participants with (even mild) depressive symptoms assessed their mood or affective experience more negatively in retrospection than in situ (i.e., negative recall bias; Colombo et al., 2019; Wenze et al., 2012). Studies on predictors of recall bias indicate that personality traits, especially neuroticism and extraversion, predict recall bias of emotion reports in adulthood (Levine et al., 2001; Robinson & Clore, 2002a; Safer & Keuler, 2002; Safer et al., 2002). Individuals high in neuroticism tended toward a negative recall bias of affective experience, while individuals high in extraversion tended toward a positive recall bias. Considering the development of personality as well as the increase of mental (and especially internalizing) disorders in adolescence (Ihle & Esser, 2002; Wagner et al., 2017), the question arises as to whether, to what extent, and starting at which age extraversion, neuroticism, and internalizing behavior predict adolescents' affective experiences.

One central external factor influencing adolescents' emotional conditions is the school context (Eccles & Roeser, 2011; Moksnes et al., 2016). Previous findings from educational research suggest that the intraindividual variability in adolescents' emotional self-reports is also reflected in an age-specific recall bias. However, corresponding findings are inconclusive. According to Bieg et al. (2014), adolescent students (aged 14–17) generally overestimated their positive and negative emotions in retrospective assessments, pointing to an intensity bias as a type of recall bias. Another study showed that students about 12 years old evaluated their affective experience more positively when reported retrospectively than in situ, constituting a positive recall bias or rosy view (Venetz & Zurbriggen, 2016). Zurbriggen et al. (2021) found a negative shift in recall bias from the beginning of early adolescence to middle adolescence, indicating a change from a positive recall bias toward a negative recall bias or blue view.

Against this backdrop, the present study aims to extend our knowledge of recall biases by investigating if personality factors and internalizing behavior predict recall biases in adolescent students' affective experiences. Identifying predictors of recall bias might provide a constitutive basis for the use of cognitive approaches in clinical, but also in subclinical and nonclinical settings, to prevent or reduce psychological problems in adolescence. In this critical developmental phase, dysfunctional behaviors but also dysfunctional patterns of processing affective experiences are not yet stabilized and may, hence, be changed with cognitive approaches (e.g., reality checks on subjective cognitions) which should show positive long-term effects on mental health. Furthermore, it is important to better understand possible recall bias in emotional reports as retrospective assessments are still a very common way of assessing emotional states.

1.1 | Recall bias in emotional experience and the relevance of situational and individual beliefs

In research but also in the field (e.g., in clinical settings), most methods for assessing emotional experience are used retrospectively. However, one major limitation of retrospective assessments is the high probability of recall bias. Using additional techniques to measure emotional experiences in situ, such as the experience sampling method (ESM; Hektner et al., 2007), studies repeatedly demonstrated discrepancies between current and retrospectively reported emotions or affective experience (e.g., Lay et al., 2017; Mill et al., 2016; Parkinson et al., 1995).

Although there are competing models trying to explain these discrepancies they all share that cognitive processes must be considered. One prominent model is the principle of focalism (e.g., Mitchell et al., 1997; Stone et al., 1985; Wilson et al., 1989, 2000). Focalism describes an individual's tendency to focus on a specific past event as a memorial reference for the retrospective report of emotional experience. However, the principle of focalism has been criticized as an insufficient explanatory model for recall bias, because it does not consider individual differences in beliefs (e.g., Robinson & Clore, 2002a). In contrast, the accessibility model of Robinson and Clore (2002b) takes into account normative beliefs about specific situations and individual factors in explaining differences in emotion reports. According to this model, the retrospective reconstruction of emotional experience is resorted to semantic memory, not to the episodic memory as in the current experience. Consequently, recall biases in emotion reports should be explained by subjective attitudes and generalized self-images. It is assumed that with the decrease in the accessibility of episodic information over time, the reliance on semantic knowledge should increase (i.e., generalized beliefs). Such generalized beliefs can be either identity-related (e.g., personality traits) or situation-related although “an individual is more likely to rely on identity-related beliefs when considering his or her emotions in retrospection” (Robinson & Clore, 2002a, p. 938).

1.2 | Personality traits and related recall bias in adolescents' emotional experience

Personality traits are essential factors influencing retrospective reports of emotional experiences (Levine et al., 2001; Robinson & Clore, 2002b; Safer et al., 2002). Rusting, (1998, 1999) concluded that people tend to perceive, process, and remember primarily those emotional informations that are congruent in emotional tone with their personality.

Personality is constituted by relatively stable styles of thinking, feeling, and acting that characterize an individual's persistent as well as situational attitudes (Costa et al., 1995). Prominently represented in the literature and empirically established is the "Big Five" factor model (Costa & McCrae, 1989). Neuroticism and extraversion (largely characterized by a tendency for negative and positive emotionality, respectively), in particular, have been shown to be predictive of a retrospective effect (i.e., recall bias) in research with adults. Barrett (1997) and also Lay et al. (2017) reported a negative recall bias for individuals with a high level of neuroticism and a positive recall bias for those with a high level of extraversion. That is, those scoring high in neuroticism provided more negative ratings retrospectively than in situ and those with high scores in extraversion provided more positive ratings in retrospection than in situ. In addition, Mill et al. (2016) found similar patterns of results for discrete emotions complementing the findings for dimensional assessments.

A possible explanation for these effects on recall bias "is that personality, like other sources of belief about emotion, constitutes a source of knowledge that can be drawn upon in reporting on emotions that are not currently felt" (Robinson & Clore, 2002a, p. 947). The presented findings and the theoretical background in turn raise the question of whether there might be other (maybe less) stable influences on the recall of emotions, such as externally observable preferences in behavior, besides personality.

1.3 | Internalizing behavior and related recall bias in adolescents' emotional experience

In contrast to personality traits, internalizing behavior represents less rigid but preferred accentuations. "Internalizing behavior patterns are directed inward and represent covert overcontrolled behaviors, such as depressive, anxious, somatization, and withdrawn behaviors" (Cook et al., 2011, p. 72). Essential characteristics of internalizing disorders are the dysfunctional perception, differentiation, expression, and regulation of emotions, and they relate to dynamics of reactions on a physiological, experiential, and behavioral level (Farmer et al., 2020; Kovacs & Devlin, 1998).

Adolescence as an important developmental phase is associated with a considerable increase in psychological problems, in particular anxiety and depression as (pathological) forms of internalizing experience and behavior (e.g., Bertha & Balázs, 2013; Ihle & Esser, 2002; Valois et al., 2004; Wagner et al., 2017). Previous studies focusing adulthood suggest an association between depressive symptoms and a recall bias of affective experience. There are no such studies on adolescence. Wenze et al. (2012), for instance, investigated the effects of anxiety and depression on mood recall biases in undergraduates. Overall, the results showed that participants with depressive symptoms assessed their mood more negatively in retrospection than in situ (i.e., a negative recall bias). This can be explained by the recourse to depressive thought patterns from semantic memory, which are generally associated with pessimism and a focus on negative information (Beck, 1967, 1979). Yet, anxiety was not associated with recall biases, which is in line with the conceptualization of anxiety as a "forward-looking" emotion (Mineka & Sutton, 1992). For anxious individuals, the primary focus is on potential future threats and *not* on past experiences, rendering the occurrence of retrospective bias unlikely. Results of an ESM study by Colombo et al. (2019) indicated, in line with the previously reported findings, that already mild depressive symptoms were associated with an overestimation of negative affects and an underestimation of positive affects in retrospective assessment. Previous studies on associations of depressive symptoms in adolescence and biases at the level of attention, interpretation, and memory (i.e., regardless of emotional experience) yielded inconsistent findings (cf. Platt et al., 2017). Nevertheless, to our knowledge, studies are yet to examine recall bias in affective experience related to internalizing behavior.

2 | THE PRESENT STUDY

The aim of the present study was to examine neuroticism, extraversion, and internalizing behavior as possible predictors of differences between retrospective and in situ (momentary) ratings (i.e., recall bias) of adolescents' affective experience in school. First, we investigated whether retrospectively reported affective experiences differed from aggregated in situ reports of affective experiences. Based on prior results (Zurbriggen et al., 2021) with a slightly different sample, we expected differences (biases) between retrospective and in situ reports of positive activation (PA) and negative activation (NA) by adolescent students in school (Hypothesis 1). Second, we examined whether the personality dimensions neuroticism and extraversion can predict these biases. According to the accessibility model of Robinson and Clore (2002b) as well as the abovementioned results, we expected that neuroticism is linked to a more pronounced retrospective underestimation of PA and retrospective overestimation of NA in school (Hypothesis 2a). In line with this, we assumed that extraversion is associated with a less

pronounced retrospective underestimation of PA and retrospective overestimation of NA in school (Hypothesis 2b). Third, we expected a retrospective overestimation of NA and a retrospective underestimation of PA in school in adolescent students with (externally observable) internalizing behavioral tendencies (Hypothesis 3). In an additional exploratory analysis, we explored the prediction of recall biases by neuroticism, extraversion, and internalizing behavior simultaneously.

3 | METHOD

3.1 | Sample and procedure

Data were collected from 118 adolescent students in grade 8 and 9 ($n_{\text{female}} = 49$, $n_{\text{male}} = 69$, $M_{\text{age}} = 15.15$, $SD_{\text{age}} = 0.89$) from Switzerland (cf. Zurbriggen et al., 2018). The study was approved by the education departments of the corresponding Swiss cantons and by the school principals. Adolescents and their primary caregivers provided written informed consent for participating in the study.

Students received study smartphones to report their affective experience for seven consecutive days in situ at 42 randomly generated occasions (six per day, including the weekend). As the present study focused on affective experiences of students in school contexts, only occasions during school time were considered. After the experience-sampling phase, students filled in an online self-report questionnaire, providing information about retrospective affective experience and demographical data as well as personality and typical behavior. In addition, the students' characteristics and behavior were evaluated by their teachers using a questionnaire.

Within the scope of the experience-sampling survey, a total of 1083 protocols (response rate: 74.8%) on current events as well as on adolescents' current affective states were recorded during lessons. Out of the 1083 protocols, 79.8% of the questionnaires were completed within 10 min after receiving the link, and 89.7% within 30 min. Questionnaires that were sent in more than two hours after receiving the link (2.2%) were not considered, yielding 1059 protocols for the analysis.

3.2 | Measures

For all measures, we present the German original items and their English translations in the Supporting Information material.

3.2.1 | Momentary affective experience

Momentary affective experience was assessed with two of the three scales of the *Positive Activation, Negative Activation, and Valence short scales* (PANAVA-KS) by Schallberger (2005). The valence scale for measuring pleasure (with the two items *satisfied vs. dissatisfied* and *unhappy vs. happy*) was not included in our study. We focused on PA and NA as the two dimensions of the general activation systems of affect (Watson et al., 1999). Both scales (PA and NA) consist of four items each with pairs of opposing adjectives (e.g., *listless vs. highly motivated*, *calm vs. nervous*). All eight items were scored on a 7-point bipolar Likert scale ranging from -3 to 3 , with 0 labeled as *neither nor*. The introductory self-assessment question about adolescent students' current affective experience was the following: *How did you feel just before the signal?*

Reliability coefficients (McDonald's Omega) for the PA scale ranged from $\omega = 0.61$ (95% confidence interval [CI] = [0.35, 0.87]) to $\omega = 0.95$ (95% CI = 0.91, 1) across the randomly generated signals. For the NA scale, this range was $\omega = 0.57$ (95% CI = [0.38, 0.722]) to $\omega = 0.92$ (95% CI = [0.85, 1]). We report the range of McDonald's Omega (McDonald, 1999) for the in-situ measurements to reflect the fluctuation of between-person reliabilities across the signals. The "average" in situ measurements for every student are modeled as error-free variables with perfect reliability at level-2 in multilevel models (see also Eid et al., 2008; Koch et al., 2014).

3.2.2 | Retrospective affective experience

At the end of the experience-sampling week, the retrospective affective experience of the adolescent students was assessed by using a conventional online questionnaire. For this purpose, the same PA and NA items (including the 7-point Likert scale) were used for capturing the momentary affective experience. In contrast to the introductory self-assessment question to assess the momentary affective experience, the retrospective assessment of the affective experience *during school* referred to the entire period of the study week: *How did you feel in general across the last week during lessons?* The reliability of the

retrospective PA scale was $\omega = 0.80$ (95% CI = [0.74, 0.86]), and for the retrospective NA scale, $\omega = 0.51$ (95% CI = [0.37, 0.66]).

3.2.3 | Personality dimensions neuroticism and extraversion

Neuroticism and extraversion were also measured at the end of the experience-sample week. For this purpose, the adolescent students filled in the “Brief version of Ostendorf’s (1990) *Inventory of Minimally Redundant Scales* (MRS-20)” by Schallberger and Venetz (1999). The two dimensions were each assessed with four items using pairs of opposite adjectives (e.g., *talkative vs. silent, disordered vs. ordered*). All eight items were scored on a 6-point bipolar Likert scale ranging from -3 to 3 excluding 0 ($-3 = \text{very}$, $-2 = \text{quite}$, $-1 = \text{rather}$, $1 = \text{rather}$, $2 = \text{quite}$, $3 = \text{very}$). The reliability was $\omega = 0.80$ (95% CI = [0.73, 0.87]) for the extraversion scale and $\omega = 0.61$ (95% CI = [0.43, 0.79]) for the neuroticism scale.

3.2.4 | Internalizing behavior

At the end of the experience-sampling phase, the internalizing behavior of adolescent students was also measured with the five-item scales “emotional problems” (e.g., *Many worries or often seems worried*) and “peer problems” (e.g., *Would rather be alone than with other youth*) from the German teacher version of the *Strengths and Difficulties Questionnaire* (SDQ-T; Goodman, 1997). Teachers assessed each student’s behavior on a 3-point scale (not true – somewhat true – certainly true). The reliability for the internalizing behavior scale was $\omega = 0.85$ (95% CI = [0.81, 0.88]).

3.3 | Analyses

All analyses involving the personality scales were based on the corresponding items. Due to the limited number of response categories for the items of the internalizing behavior scale, we created two test-parcels containing half of the items each (see Supporting Information: material). This renders the respective manifest variables more appropriate for the linear models (Finney & DiStefano, 2006). The reliability for the two test parcels was $\omega = 0.79$ (95% CI = [0.67, 0.91]).

Due to the nested data structure, we utilized two-level structural equation modeling (SEM) with latent variables (Eid et al., 2008). As depicted in Figure 1, the in-situ assessments of PA and NA as repeated measures (ESM-signals) are nested within students, whereas the retrospective assessments take place at the end of the study, covering the whole period of the in situ assessments. At level-2, we specified latent variables reflecting the retrospectively assessed PA and NA (RPA and RNA) as well as the “(weighted) average” of the in situ assessments of PA and NA (L2PA and L2NA). At level-1, we specified a latent variable reflecting the deviation from a specific in situ assessment from the (level-2) “average” of in situ assessments (L1PA and L1NA). With this model, we tested and corroborated forms of measurement invariance (Meredith, 1993; see the Supporting Information: material). To test H1, we reformulated this model as a latent difference model (e.g., McArdle & Nesselrode, 1994). A latent difference variable was introduced to indicate the difference between the retrospective and average in situ assessments for positive and negative affect, respectively ($\Delta\text{PA} = \text{RPA} - \text{L2PA}$; $\Delta\text{NA} = \text{RNA} - \text{L2NA}$). To test H2a–H3, we ran regression analyses predicting the latent difference variables with extraversion, neuroticism, and internalizing behavior (upper part of Figure 1). Testing H2a, b, and H3, we added extraversion, neuroticism, and internalizing behavior, respectively, as a single predictor for ΔPA and ΔNA (Models 1–3). For the exploratory analysis, we included all three exploratory variables simultaneously into the SEM (Model 4). All models (see Supporting Information: material for Mplus-scripts) were estimated using the robust maximum likelihood estimator in Mplus version 8.2 (Muthén & Muthén, 2017).

4 | RESULTS

We present descriptive statistics of manifest variables and the measurement invariance analysis in the Supporting Information: material. Overall, there were only mild to moderate violations of the normality assumption except for the two test halves (and original items) measuring internalizing behavior. These were characterized by a very low variance and severe right-skew distributions. The measurement invariance analysis revealed that the assumption of strong measurement invariance could be maintained. We can, therefore, assume that item scaling and difficulty of the PANA scales remain stable across the different “modes” of assessment (in situ and retrospective). Moreover, due to cross-level measurement invariance, we can validly assume measurement invariance across the participants (clusters) and interpret the level-2 in situ assessment of PA and NA as an aggregated mean of the ESM-signals (cf. Jak et al., 2013; Stapleton et al., 2016).

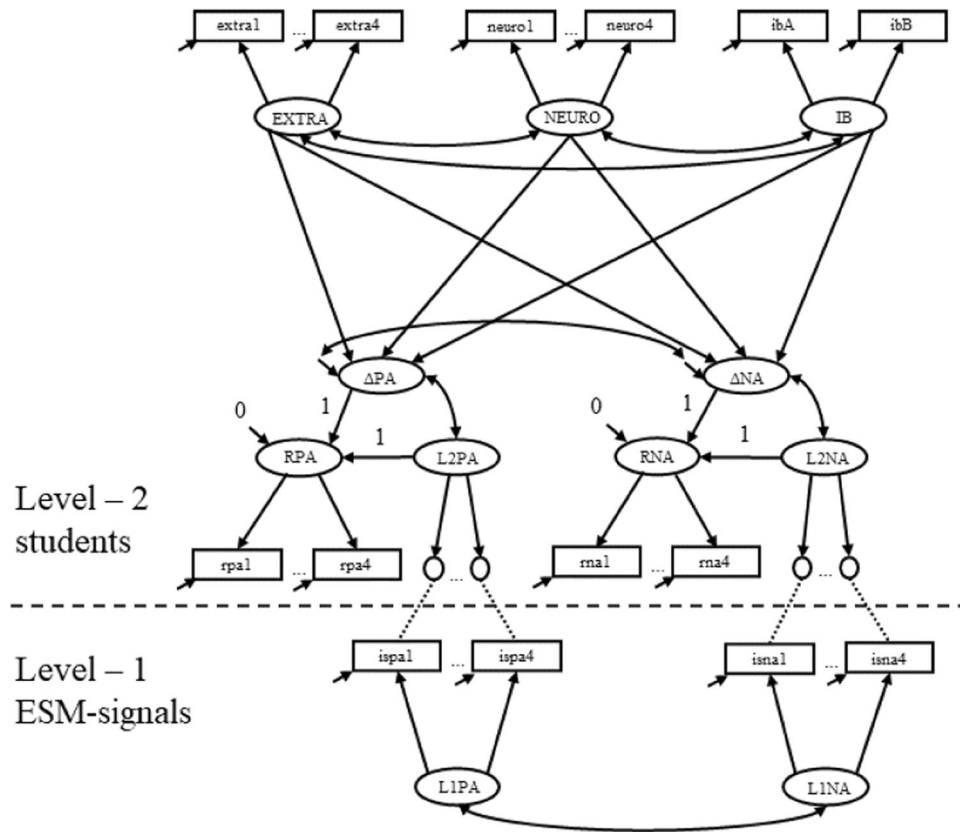


FIGURE 1 Two level structural equation model for the prediction of retrospection effects by neuroticism, extraversion and internalizing behavior (Model 4; see our exploratory research question in the section “Hypotheses”). rpa1 = the first indicator for retrospective positive activation; rpa4 = the fourth indicator for retrospective positive activation; ispa1 = the first indicator for the in situ assessment of positive activation; ispa4 = the fourth indicator for the in situ assessment of positive activation; rna1 = the first indicator for retrospective negative activation; rna4 = the fourth indicator for retrospective negative activation; isna1 = first indicator of the in situ assessment of negative activation; isna4 = the fourth indicator for the in situ assessment of negative activation; RPA = retrospective positive activation; L1PA = level 1 positive activation; L2PA = level 2 positive activation; RNA = retrospective negative activation; L1NA = level 1 negative activation; L2NA = level 2 negative activation; ΔPA = retrospection effect for positive activation; ΔNA = retrospection effect for negative activation; extra1 = the first indicator for extraversion; extra4 = the fourth indicator for extraversion; neuro1 = the first indicator for neuroticism; neuro4 = the fourth indicator for neuroticism; ibA = the first test half for internalizing behavior; ibB = the second test half for internalizing behavior; EXTRA = extraversion; NEURO = neuroticism; IB = internalizing behavior; The circles under the Level 2 latent variables L2PA and L2NA refer to their measurement with their respective Level 1 manifest variables on Level 2. They are presented as circles (latent variables) because they are defined as residual free measurements “aggregated” across the Level 1 units (see Eid et al., 2008). The three dots (...) represent the remaining indicators of a respective latent variable, which are not depicted for simplicity. ΔPA and ΔNA are estimated as latent difference variables (see McArdle & Nesselroade, 1994). The depiction of the following latent variable correlations was omitted from the figure for simplicity: EXTRA with L2PA; EXTRA with L2NA; NEURO with L2PA; NEURO with L2NA; IB with L2PA; IB with L2NA; ΔPA with ΔNA; ΔPA with L2NA; L2PA with ΔNA; L2PA with L2NA. For Hypothesis 1, the exogenous latent variables from the top are excluded from the model. For each of the remaining three hypotheses, the model is reduced to include only the measurement of one of the latent variables at the top, respectively (Model 1 only holds extraversion, Model 2 only holds neuroticism, Model 3 only holds internalizing behavior).

4.1 | Latent variable measurement models and correlations

In Table 1, we present the unstandardized intercepts, factor loadings, and residual variances of the complete model. The only items showing a nonsignificant association with their latent factor are the second and fourth items of neuroticism. As shown in Table 2, the correlation between extraversion and neuroticism is unexpectedly strong ($r = -.709$). The only other significant correlation between predictors exists between neuroticism and internalizing behavior ($r = .403$; Table 2). Students more susceptible to negative emotions are also more dispositioned to internalizing behavior.

Table 1 furthermore provides intraclass correlation coefficients (ICCs) for the in situ administered positive and negative affect items. They range from 0.158 to 0.298; i.e., the proportion of variance explained by the level-2 entities (students) in these items ranges from 15.8% to 29.8%. Hence, less than 30% of the variation in situ is due to stable differences between students, but responses to these items are mostly driven by situational factors.

TABLE 1 Intercepts, loadings, residual variances, and reliabilities for all manifest variables of the complete model and intraclass correlation coefficients (ICCs) for the in situ measurements of current affect.

Latent variable	Manifest variable	Intercept	Loading	Residual variance	Reliability	ICC
L1PA/L2PA	pa1	4.527***	1	1.273***	0.457	0.243
	pa2	4.045***	1.008***	1.651***	0.397	0.217
	pa3	4.251***	1.134***	0.934***	0.596	0.244
	pa4	3.982***	0.994***	1.508***	0.412	0.188
L1NA/L2NA	na1	3.104***	1	1.278***	0.439	0.158
	na2	2.737***	1.062***	0.924***	0.550	0.198
	na3	2.795***	0.709***	1.662***	0.232	0.194
	na4	2.980***	0.843***	1.595***	0.308	0.298
RPA	rpa1			0.857***	0.512	
	rpa2			1.886***	0.326	
	rpa3			0.811***	0.587	
	rpa4			0.958***	0.481	
RNA	rna1			1.348***	0.255	
	rna2			1.024***	0.337	
	rna3			1.896***	0.109	
	rna4			1.783***	0.155	
E	e1	4.762***	1	0.791***	0.443	
	e2	4.783***	1.165***	0.430***	0.665	
	e3	4.677***	0.812***	0.889***	0.318	
	e4	4.740***	1.194***	0.584***	0.606	
N	n1	2.631***	1	0.329	0.764	
	n2	3.403***	0.326	1.689***	0.063	
	n3	2.583***	0.541**	0.734***	0.298	
	n4	2.260***	0.243	0.770***	0.076	
IB	ibA	1.286***	1	0.044***	0.661	
	ibB	1.326***	1	0.047***	0.646	

Note: $N = 118$. Due to strong measurement invariance across the in situ and retrospective assessments of affect, the intercepts and loadings for the items assessing retrospective affect are the same for the items assessing current affect, respectively. For all analyses, the discrete item scales were transformed to scales containing whole numbers and ranging from 1 to 7 (for positive and negative affect), 1 to 6 (for extraversion and neuroticism), and 1 to 3 (for internalizing behavior), respectively.

Abbreviations: E, extraversion; IB, Internalizing behavior; N, Neuroticism; L1NA, current negative affect at level 1; L2NA, aggregated current negative affect at level 2; L1PA, current positive affect at level 1; L2PA, aggregated current positive affect at level 2; RNA, retrospective negative affect; RPA, retrospective positive affect.

* $p < .05$; ** $p < .01$; *** $p < .001$.

4.2 | Predictions of latent retrospection effects

The mean latent retrospection effect was $M(\Delta PA) = 0.112$ ($d = 0.111$, $p = .331$) for positive affect and $M(\Delta NA) = 0.063$ ($d = 0.076$, $p = .566$) for negative affect. These results suggest that, on average, students did not show a substantial bias in assessing former affective states retrospectively. However, students still differed to a considerable degree in their retrospection effects ($VAR(\Delta PA) = 1.007$, $p < .001$; $VAR(\Delta NA) = 0.682$, $p < .001$; see Table 2). Table 3 summarizes the results of the regression analyses aimed at explaining these differences. All latent regression models reached satisfactory fit with regard to the root mean square error of approximation (RMSEA; all RMSEA < 0.055 ; see West et al., 2012) and $\hat{\gamma}$ (the Gamma Hat index; all $\hat{\gamma} > 0.95$; see Fan & Sivo, 2007).

Neuroticism alone (Model 2) significantly predicted retrospection effects for negative affect only (11.0% of the variance explained). Extraversion alone (Model 1) predicts 10.2% of the variance in positive affect retrospection effects ($\beta = .399$,

TABLE 2 Variances (in the diagonal) and correlations of latent variables from a model containing latent retrospection effects and extraversion, neuroticism, and internalizing behavior.

	L1PA	L1NA	L2PA	L2NA	ΔPA	ΔNA	E	N	IB
L1PA	1.071***	0.595***							
L1NA		0.999***							
L2PA			0.559***	0.764***	0.445***	0.493***	0.052	0.191	0.127
L2NA				0.455***	0.280*	0.607***	0.007	0.052	0.033
ΔPA					1.007***	0.669***	0.321*	0.096	0.002
ΔNA						0.682***	0.518***	0.292*	0.162
E							0.630***	0.709***	0.243
N								1.064***	0.403***
IB									0.085**

Note: $N = 118$. Latent variables from different levels do not correlate with each other. The first two latent variables are on the within level, the remaining variables are on the between level.

Abbreviations: E, extraversion; IB, internalizing behavior; L1NA, current negative affect at level 1; L2NA, aggregated current negative affect at level 2; N, neuroticism; L1PA, current positive affect at level 1; L2PA, aggregated current positive affect at level 2; ΔNA, latent retrospection effect for negative affect; ΔPA, latent retrospection effect for positive affect.

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 3 Unstandardized Regression coefficients, determination coefficients, and fit statistics for the four models for the prediction of retrospection effects.

Model	Criterion	Predictor			R^2	$\chi^2(df)$	p Value	RMSEA	\hat{y}
		E	N	IB					
1	ΔPA	0.399 (0.013)			0.102	708.508 (205)	<0.001	0.048	0.955
	ΔNA	0.535 (0.002)			0.270				
2	ΔPA		0.129 (0.463)		0.011	709.110 (205)	<0.001	0.048	0.955
	ΔNA		0.337 (0.033)		0.110				
3	ΔPA			0.086 (0.383)	0.007	672.096 (170)	<0.001	0.053	0.950
	ΔNA			0.131 (0.500)	0.017				
4	ΔPA	0.640 (0.055)	0.249 (0.374)	0.061 (0.912)	0.138	930.429 (324)	<0.001	0.042	0.958
	ΔNA	0.659 (0.011)	0.153 (0.439)	0.240 (0.611)	0.286				

Note: $N = 118$. Number in brackets next to the regression coefficients reflect their p values.

Abbreviations: E, extraversion; IB, internalizing behavior; N, neuroticism; ΔNA, latent retrospection effect for negative affect; ΔPA, latent retrospection effect for positive affect.

$p = .013$) and 27.0% of the variance in negative affect retrospection effects ($\beta = -.535$, $p = .002$). Internalizing behavior alone (Model 3) did not predict retrospection effects for positive or negative affect. Considering all three predictors (Model 4) only leads to an increase of 3.6% of explained variance for positive affect and 1.6% for negative affect above the explained variance using extraversion alone. Albeit the predictive value of neuroticism for retrospection effects in negative affect, the strong correlation between extraversion and neuroticism ($r = -.709$; Table 2) prohibits a substantial increase of the determination coefficient when neuroticism is added as a predictor to the regression of negative affect retrospection effects on extraversion. The partial correlation between ΔPA and ΔNA in Model 4 was $r = -.617$ ($p < .001$).

5 | DISCUSSION

On average adolescents showed no substantial bias in retrospectively assessed affective experience in school: The means of the retrospective assessments of PA and of NA did not differ substantially from the means of the aggregated in situ assessments of students' affective experiences at the level of the sample. However, the variances of the latent difference variables indicate that students varied considerably regarding the retrospection effects. That is, adolescents show positive and negative

retrospection effects at an individual level but not at the level of the sample. Furthermore, students show considerable variations of their in situ assessments (variance of the level-1 latent variables, see Table 2) indicating that the in situ assessments are time-sensitive.

5.1 | Neuroticism and extraversion as predictors of recall bias

The isolated analyses, considering each of the single personality dimensions extraversion and neuroticism, revealed predictive effects on recall bias in adolescents' affective experience. As expected, the higher the adolescents' level of extraversion, the higher they rated PA and the lower they rated NA in retrospect than in situ. These findings are in line with the outlined research focusing on adulthood, suggesting that extraverted persons are more prone to a positive recall bias (Barrett, 1997; Lay et al., 2017; Mill et al., 2016). With respect to the accessibility model (Robinson & Clore, 2002b), the present findings suggest that semantic memory is being accessed already in adolescence during the retrospective reconstruction of affective experiences. This recourse to semantic memory is characterized by corresponding subjective attitudes and generalized self-images that appear to be more positively expressed in adolescent students the higher the level of extraversion.

Furthermore, as hypothesized, adolescent students with a high degree of neuroticism showed more pronounced ratings of NA in retrospect than in the aggregated momentary assessment. Contrary to our expectations, the analyses revealed no evidence for a predictive value of neuroticism on retrospection effects for PA in adolescents. Comparable results were also presented in the study by Lay et al. (2017). Again, these effects can be explained by the accessibility model by Robinson and Clore (2002b). In this line of thought, individuals high in neuroticism are more likely to recall negative memories primarily because the focus on NA has already manifested in subjective attitudes and generalized self-image. These basic beliefs could further contribute to a tendency to avoid PA, making it difficult to retrieve them in semantic memory as well.

Considering all predictors together, our findings support extraversion as an explanatory factor for the described positive recall bias in adolescents' affective experience. However, neuroticism did not predict retrospective effects for neither PA nor NA. The differing results may be explained by the unexpectedly high correlation between extraversion and neuroticism. In the field of personality research; however, high intercorrelations between individual personality traits have already been demonstrated in several studies—especially the negative correlation between extraversion and neuroticism (e.g., Chang et al., 2012; Körner et al., 2002).

One might argue that the high negative correlation between neuroticism and extraversion might be due to a not yet fully developed personality in adolescents. Yet, the big five as basic personality dimensions as well as the higher order factor structure were confirmed in previous studies with adolescents (e.g., DeYoung et al., 2002; Digman, 1994, 1997; Goldberg, 2001), with further studies pointing to age differences in the coherence and differentiation of the personality dimensions at this age (Allik et al., 2004; Soto et al., 2008, 2011). Taken together, the results indicated that the trait structure of extraversion and neuroticism at the age of about 15 years diverged markedly from that of those aged 10 and resembled that of those aged 20. Results on the construct validity of the big five factors in adolescence (Lamb et al., 2002) also showed substantial similarities to those in adulthood (Körner et al., 2002). However, the negative correlations between extraversion and neuroticism reported in these studies were far smaller than in the present study. In addition, we found nonsignificant factor loadings for two items of neuroticism (n2: *insensitive vs. fragile* and n4: *calm vs. anxious*). This finding also points to the possibly of not yet fully developed personality structure in the current sample. The two items correlated weakly to moderately ($0.182 < r < .275$) with the two other items measuring neuroticism and also weakly to moderately ($-.006 < r < -.253$) with the items of extraversion.

Having said that, the instrument that we employed in our study for assessing the big five personality factors (the MRS-20) does not provide a sufficient explanation for the high correlations. Moderate to high negative correlations between the two personality traits extraversion and neuroticism were indeed found by Schallberger and Venetz (1999) as well within the scope of their development and empirical evaluation of the brief version of Ostendorf's (1990) MRS-Inventory.

5.2 | Internalizing behavior as predictors of recall bias

Studies on specific internalizing disorders such as depression indicate a retrospective overestimation of NA and a retrospective underestimation of PA in adolescent students with internalizing behavior. According to the accessibility model by Robinson and Clore (2002a, 2002b), retrospective reconstruction of affective experiences relies on semantic memory, which includes general beliefs. In addition to situation-specific experiences in school and the negative connotation of the school context as a normative belief in adolescence (Hascher & Hadjar, 2018), adolescent students with internalizing behaviors can be assumed to have negative beliefs related to their identity, which might evoke a negative recall bias. Results of our study, however, do not support this hypothesis. The expected recall bias was neither found in the analysis with internalizing behavior alone as a predictor (Model 3) nor in the combined analysis. This finding might be due to the fact that

participants showed very low levels of internalizing behaviors with a low variance; hence, there might not be enough variation in the predictor to reveal an effect. It might also be that internalizing behaviors in adolescence have no predictive effects on a negative recall bias of affective experience, or that teachers cannot rate their students' internalizing behaviors with sufficient accuracy. Although our results did not confirm our hypothesis, they can be regarded as partially consistent with the findings of Wenze et al. (2012) focusing on adulthood, who found associations between depression and a negative recall bias of affective experiences but no association between anxiety and a recall bias of affective experiences. Considering these results, symptoms of anxiety may have masked the possible effects of depressive symptomatology, as both symptomatology are included in dimensional conceptualizations of internalizing behavior (Achenbach & McConaughy, 1992; Slade, 2007).

The model that includes all three predictors still supported the predictive value of extraversion, yet it yielded no significant effects for neuroticism (and internalizing behavior). This finding is likely determined by a multicollinearity issue since (as already mentioned above) the correlation between neuroticism and extraversion was very strong ($r = -.709$) and the correlation between neuroticism and internalizing behavior was also substantial ($r = .403$). This issue is also likely the reason why the direction and size of some of the partial-regression coefficients from the multiple regression are counter-intuitive (e.g., the negative sign for the partial-regression coefficient of neuroticism predicting Δ NA; cf. last row of Table 3).

6 | LIMITATIONS AND FUTURE DIRECTIONS

The current study has several limitations. First, recall bias was statistically defined as a latent difference between the retrospective assessment of affective experience and a weighted mean of all in situ reports of affective experience. This modeling strategy generally fits the wording of the retrospective assessment, as it was asked for a general affective state across the past 7 days during lessons, which, to our mind, is best assessed by an average of the specific in situ states. Nevertheless, future ESM-research should also investigate intraindividual variability in affective experience (Voelkle et al., 2012, 2014) as a possible explanation for the occurrence of recall biases. In the same vein, other parameters of the intraindividual distribution might carry significant relationships with retrospective assessments. That is, the minimum and maximum of the intraindividual in situ PA and NA scores might also be related to the retrospective ratings reflecting peak effects (e.g., Stone & Litcher-Kelly, 2006) or the median might better reflect the aggregate rating. We explored these potential relations (see Supporting Information: material for more details) and found that intraindividual means had the highest correlations with retrospective assessments. However, the intraindividual maximum of PA had a substantial relationship with retrospective NA ($r = -.202$) and the intraindividual minimum of NA had a similarly strong relationship with retrospective PA ($r = -.232$). This might indicate that highs in situational affects reflect a salient semantic resource that reduces the accuracy of retrospectively assessing negative affect; whereas lows in situational affects reflect a salient semantic resource that reduce the accuracy of retrospectively assessing positive affect. For a more thorough discussion regarding the assumptions relating to recall biases see Leertouwer et al. (2021).

Second, in examining the retrospection effect of affective experience in adolescence, we only focused on the two personality traits neuroticism and extraversion as well as internalizing behavior as predictors. Future studies would benefit from including additional or other predictors such as life satisfaction or emotion regulation strategies, for example, to obtain further insight into recall bias of affective experience in adolescence.

Third, we found certain inconsistencies in terms of unusually high intercorrelations between neuroticism and extraversion. In addition to possible sample-specific reasons, our results could also have been influenced by aspects of language comprehension (e.g., item wording) in the assessment of the personality traits investigated in adolescence (Borkenau & Ostendorf, 1993). Although the use of the MRS-20 (Schallberger & Venetz, 1999) in adolescence is supported by results from Soto et al., (2008, 2011), future studies could evaluate the MRS-20 in adolescence or use alternative instruments such as the *Short Version of the Big Five Inventory for Children and Adolescents* (BFI-K-KJ; Kupper et al., 2019).

Fourth, in capturing internalizing behavior it would be useful to assess both teacher reports and self-reports to investigate possible (different) effects of externally observable behavior and subjectively perceived experience on adolescents' recall bias of affective experience. Previous research indicated that agreement between student and teacher ratings of students internalizing behavior is typically only low to moderate. These discrepancies even increased during adolescence (Van der Ende et al., 2020). This might be due to the increase of intrapsychic emotion regulation strategies during adolescence and the relatively high number of students to be assessed for teachers.

Fifth, we examined the effect of internalizing behavior on recall bias supposing that internalizing behavior can be conceived as the subclinical spectrum of internalizing disorders such as depression or anxiety. Albeit, we did not find pronounced levels of internalizing behaviors in our sample. Future research might rely on extreme groups to evaluate how the two internalizing disorders predict (potential) recall biases of affective experiences in adolescence (Wenze et al., 2012). In this regard, a more diverse sample with more pronounced internalizing behaviors could be helpful to explore the possible impact of internalizing behaviors on recall biases.

Finally, focusing on the school context reduces generalizability to other, equally relevant contexts in adolescents' lives. Correspondingly, our results do not permit conclusions about the role of neuroticism, extraversion, and internalizing behavior on adolescents' recall bias of affective experience in leisure time or other life contexts.

7 | CONCLUSION AND IMPLICATIONS

The present study adds to previous research on recall bias in adolescence by examining the personality traits neuroticism and extraversion, as well as internalizing behavior as predictors of retrospection effects in affective experience among adolescent students. By considering associations between adolescents' emotional experience and specific cognition content or styles, our findings contribute to a better understanding of retrospective reports of adolescents on their affective experience and why certain adolescents rate their affective experience more positively or negatively in retrospect. In this vein, the findings could be useful in clinical and school practice in various ways. In a clinical context, for example, the additional assessment of personality traits could be useful for a targeted treatment of emotional problems in adolescence. In contrast to the predominantly applied disorder-specific assessments, this more resource-oriented approach could be employed to support a healthy personality development integrating more positive cognitions into subjective basic assumptions (i.e., cognitive restructuring), which in turn has an impact on adolescents' affective experience. In inclusive or special schools, special needs teacher could support adolescents with emotional or behavioral difficulties by conducting reality checks on subjective cognitions, for example, through mood logs and feedback interviews. But also other (general) teachers can promote adolescent students in their emotional development by addressing knowledge of cognitive processes and associated biases.

Overall, our results could help increase the quality of self-reports or statements of adolescents' affective experience. Exploring recall bias in affective experience as well as related predictors provide a pragmatic interface between diagnosis and prevention or intervention of emotional problems not least in adolescence while emotional development is dynamically progressing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT


Research data are not shared.

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