



# When Do Good Things Lift You Up? Dampening, Enhancing, and Uplifts in Relation To Depressive and Anhedonic Symptoms in Early Adolescence

Sabine Nelis<sup>1</sup> · Margot Bastin<sup>1</sup> · Filip Raes<sup>1</sup> · Patricia Bijttebier<sup>1</sup>

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## Abstract

Longitudinal studies examining the role of response styles to positive affect (i.e., dampening and enhancing) for depressive symptoms have yielded inconsistent results. We examined concurrent and prospective relations of dampening and enhancing with depressive and anhedonic symptoms, and whether these relations depend on the frequency of uplifts. Early adolescents ( $N = 674$ , 51.6% girls,  $M_{age} = 12.7$  years, range 11.3–14.9) completed questionnaires three times (one-year intervals). Dampening interacted with daily uplifts predicting concurrent depressive symptoms. Dampening was unrelated to depressive and anhedonic symptoms one year later. High dampening and low enhancing predicted relative increases in anhedonia over two years. Relationships did not differ for girls and boys. Therapeutic interventions designed to promote adaptive responding to positive affect may, thus, reduce anhedonia in adolescence.

**Keywords** Dampening · Enhancing · Positive affect · Uplifts · Depressive symptoms · Anhedonia

## Introduction

People encounter a range of positive experiences throughout their lives, from receiving a compliment to graduating at school. The same positive experience can elicit different thoughts and behaviors. Individual differences in these response tendencies have been examined as candidate risk mechanisms for psychological problems. In cognitive models of depression, it is assumed that not just the mere occurrence of events and their associated feelings are of relevance, but that especially how individuals cognitively respond to those life events and the accompanied affect is key. For example, ruminative thinking is a maladaptive response style to *negative* affect that has been repeatedly shown to render individuals more at risk for increases in depressive symptoms (Aldao et al. 2010). Research on responses to *positive* affect, however, is less extensive (Gilbert 2012). Nevertheless, it has seen a considerable rise in the past decade as seminal studies suggest that response

styles to positive affect may have an impact on psychological health, even above and beyond responses to negative affect.

Response styles to positive affect, also often referred to as regulation of positive affect, are typically categorized into two broad types of responses that involve either dampening or enhancing/savoring of the positive experience. Dampening responses can include reducing or downgrading the significance of the positive feelings, directing attention to less fortunate aspects of life, focusing on negative aspects of the positive situation, or making external attributions (e.g., Feldman et al. 2008; Wood et al. 2003). These responses are mostly labeled as dampening (Feldman et al. 2008), minimizing (Gentzler et al. 2010), or down-regulation (Nelis et al. 2011). Types of responses that are assumed to maintain or amplify positive affect have previously been labeled as enhancing (Nelis et al. 2016), positive rumination (Feldman et al. 2008), savoring (Bryant 2003), maximizing (Gentzler et al. 2010), or up-regulation (Nelis et al. 2011).

So far, we know that increased dampening in response to positive affect is robustly related to higher levels of concurrent depressive symptoms. This has been found using a dampening questionnaire in combination with different measures of depressive symptoms in diverse

✉ Sabine Nelis  
sabine.nelis@kuleuven.be

<sup>1</sup> KU Leuven, Leuven, Belgium

samples of early adolescents (Nelis et al. 2016), young adults (Feldman et al. 2008), and adults (Nelis et al. 2015). Similar findings have been obtained using daily diary assessments of dampening (Gentzler et al. 2013; Li et al. 2017). Moreover, dysphoric and depressed adults report more dampening compared to non-dysphoric controls (Nelis et al. 2013) and non-depressed controls (Nelis et al. 2015; Werner-Seidler et al. 2013), respectively. Enhancing has been related to less concurrent depressive symptoms (e.g., Bijttebier et al. 2012; Yang and Guo 2014), although this association has not consistently been replicated. Specifically, the association was either not found (Burke et al. 2018; Verstraeten et al. 2012), or sometimes only held for a subtype of enhancing (e.g., Dempsey et al. 2011; Raes et al. 2009). In another study, increased enhancing has been found to be related to higher concurrent depressive symptoms in children at risk for depression (Gilbert et al. 2017).

Labelling response styles to positive affect as a risk for depressive symptoms, dampening and enhancing should be identified as antecedents of future levels of depressive symptoms in *longitudinal* research. As such, response styles to positive affect should be assessed several weeks, months, or preferably even years *prior to* the examination of depressive symptoms. In such longitudinal investigations so far, dampening was found to predict relative increases of depressive symptoms in undergraduate students over an interval of several weeks (Hudson et al. 2015), three months, and five months (Raes et al. 2012). Similarly, dampening during pregnancy was found to predict depressive symptoms after giving birth (Raes et al. 2014). The contribution of dampening remained significant when taking into account the way in which people respond to negative affect; i.e., ruminate (Hudson et al. 2015; Raes et al. 2012), which is also a risk factor for depressive symptoms (Aldao et al. 2010). However and importantly, the longitudinal relation between dampening and depressive symptoms has not been consistently replicated (Bijttebier et al. 2012; Gentzler et al. 2013; Gilbert et al. 2013; Nelis et al. 2015). When it comes to enhancing, again, the negative association between enhancing and depressive symptoms that has emerged cross-sectionally has not been consistently found longitudinally. No association emerged in diverse sample of adults and late adolescents (Gilbert et al. 2013; Raes et al. 2012, 2014). However, enhancing predicted less prospective depressive symptoms in early adolescents, albeit only under conditions of stress (Bijttebier et al. 2012). Also, in a recent investigation, increases in dampening and decreases in enhancing were related to increases in depressive symptoms over an interval of two years in 13 and 14 years old adolescents (Gomez-Baya et al. 2017). The conflicting results set the need for research into factors that make dampening potentially detrimental (and

enhancing protective) in the development of depression and depressive symptoms.

## Anhedonia

Depressive symptoms comprise a broad spectrum of symptoms including depressed mood, sleep disturbances, concentration problems, fatigue, and feelings of worthlessness, among other symptoms. A candidate explanation for the inconsistent findings is that dampening and/or enhancing are only or especially predictive of specific aspects of depressive symptoms. Anhedonia is a core symptom of depression. It refers to diminished interest or pleasure in (previously enjoyed) activities, reduced pleasure from anticipation and a reduced drive to do pleasurable activities. Given that anhedonia includes reduced pleasure in positive experiences, it might be especially relevant for individuals who either tend to minimize (i.e., dampen) or savor (i.e., enhance) those positive experiences (see also Nelis et al. 2015; Werner-Seidler et al. 2013). Moreover, the examination of precursors of anhedonia is important given that anhedonia predicts non-response to treatment and non-remission (Vrieze et al. 2014). Also, interventions for depression do insufficiently focus on and are insufficiently effective in changing low positive affective states (e.g., Carl et al. 2013; Dunn 2012). Low enhancing has indeed been found to predict relative increases in anhedonia-related symptoms, whereas it was not found to predict general depressive symptoms in the same sample (Nelis et al. 2015). In children and early adolescents, again, more dampening related to more concurrent anhedonia, even when controlling for non-anhedonia depressive symptoms (Gilbert et al. 2017).

## Daily Uplifts and Positive Events

The diathesis-stress hypothesis implies that being exposed to many negative life events (i.e., stress) forms a risk for depressive symptoms, particularly in combination with a maladaptive processing of these negative experiences (i.e., diathesis). It has indeed been shown that the interaction between life stress and a cognitive vulnerability (either depressive rumination or dysfunctional attitudes) predicts depressive symptoms (Driscoll et al. 2009; Hankin et al. 2004; Scher et al. 2005). The idea that the impact of life events depends on a cognitive vulnerability (e.g., the response style to those events) can also be applied to positive experiences or daily uplifts. That is, the impact of a response style may depend on the occurrence of uplifts. Or, depending on the response style to positive events, some individuals might benefit more from positive events than others. Positive events can include major events such as a graduation or a pregnancy of a family member. Spending

time with a friend or receiving a compliment can be seen as daily positive events or uplifts, which can be frequently experienced (and are often smaller events than major positive life events). Researchers have been interested in the impact of positive events, besides negative events, for a long time (e.g., Kanner et al. 1981), although its association with symptomatology has not been extensively examined, especially when compared to negative events. Positive events are related to adolescents' general well-being (McCullough et al. 2000). Concerning depressive symptoms, major positive life events during a one-year follow period predicted relative decreases of depressive symptoms in a large adult sample (Spinhoven et al. 2011) and positive events were followed by relative decreases in depressive symptoms one and two months later in a depressed sample (Blonski et al. 2016). In young samples, positive events have been negatively related to depressive symptoms on the same day in undergraduate students (Li et al. 2017) and negatively related to depressive symptoms six months later (Vines and Nixon 2009).

The existence of an interaction between positive events and response styles to positive affect (i.e., dampening/enhancing) might be another possible explanation for the mixed results on the (longitudinal) association between response styles to positive affect and symptoms (e.g., Gilbert et al. 2017; Nelis et al. 2015). The association between positive events and depressive symptoms could be attenuated when a dampening cognitive style is used and could be strengthened when an enhancing style is applied. The interaction can also work in another direction. For instance, one can reason that the combination of many uplifts with high dampening is detrimental as positive events act as a trigger or prompt dampening thoughts. Alternatively, another reasoning behind the interaction could be that experiencing only few positive events might fuel dampening thoughts right at those scarce moments that could otherwise have had an antidepressant effect. It is important to note that main effects of positive events on depressive symptoms have not always been found (e.g., Gilbert et al. 2017), which also points to the necessity of examining its interaction with processing styles. First indications for an interaction between response styles to positive experiences in the prediction of depressive symptoms come from research on attributional styles. People differ in their tendency to attribute positive life events to external, unstable, or specific causes. These attributional styles are not identical to the affect-regulation strategies of dampening and enhancing, though it is clear that external attributions such as “it was just luck” can be part of dampening thoughts. Attributional styles have been examined in relation to depressive symptoms (e.g., Johnson et al. 1998), and importantly, attribution styles were found to interact with positive events in the prediction of hopelessness and

depressive symptoms (Needles and Abramson 1990; Vines and Nixon 2009). For instance, an adaptive attribution style for positive events formed a protection against depressive symptoms when experiencing few positive events in a group of early adolescents (Vines and Nixon 2009).

Two recent studies focused specifically on dampening and enhancing in their interaction with positive experiences. Li et al. (2017) assessed dampening, enhancing, uplifts, and depressive symptoms at the end of the day for 14 days in an undergraduate sample. More daily uplifts were associated with less depressive symptoms, but only on days when dampening was low. Moreover, increased enhancing turned out to be especially related to less symptoms when few uplifts were experienced. The negative relation between enhancing and depressive symptoms was stronger on days with few, compared to many, uplifts. Again, put otherwise, enhancing might help one to get much out of just a few positive experiences. Gilbert et al. (2017) found that dampening of positive affect and positive life events interact in their prediction of depressive symptoms in children at low-risk for depression, and unexpectedly, not in high-risk children. More precisely, dampening was only associated with more depressive symptoms in the context of many positive life events. No evidence was found for an interaction between positive events and enhancing. In sum, although the results of these two studies are not entirely consistent, they both show that response styles interact with positive events in their relation with depressive symptoms. Prospective research is lacking.

### The Relevance of Examining Response Styles to Affect in Adolescence

Examining the association between affect-regulation strategies (e.g., dampening and enhancing) and depressive symptoms is relevant in adolescence for several reasons. Crucially, around ages 13 to 18, increasing trajectories in depression and depressive symptoms are present (Ge et al. 2001; Hankin et al. 2015) and a substantial amount of depressed patients experienced their first depressive episode in adolescence (Zisook et al. 2007). The increase in symptoms is understandable within the developmental background of adolescence being a developmental stage of changes at several levels (e.g., cognitive, social, emotional, hormonal). Adolescents are particularly sensitive to social influences (Blakemore and Mills 2014) and go through an emotional turbulent period. Whereas the way in which adolescents respond to emotions is challenged, adolescents' ability to regulate their emotions increases. Affect-regulation strategies change profoundly during the life span from affect being externally regulated by parents through the development of more abstract cognitive and behavioral affect-regulation strategies. Adolescents become

more independent from their parents and have an increased ability to generalize and think abstractly (cf. Piaget's formal-operational phase that starts roughly from age 12; Inhelder and Piaget 1958). In sum, adolescence is an interesting period to examine both depressive symptoms and the way in which adolescents respond to emotions.

### Gender Differences in Depressive Symptoms in Adolescence

Depression is more prevalent in adult women compared to men, with women found to be twice as likely to have depression than men (Kessler 2003). The age at which the gender difference in depression and depressive symptoms emerges varies across studies, but has generally been found in the stage of early or mid-adolescence around ages 13 to 15 (Hankin et al. 1998; Twenge and Nolen-Hoeksema 2002), or around puberty (Angold et al. 1998). As such, the increase in depressive symptoms in adolescence particularly holds for girls. Research on gender differences in risk factors and the contributing role of risk factors in depressive symptoms is necessary to help understand gender differences in depressive symptoms. Influences at the affective, cognitive, biological, and environmental level have been suggested as potential explanations, including response styles to affect (Hyde et al. 2008). For instance, girls are at greater risk for depression because they are more likely than boys to ruminate about their problems. Little is known so far whether gender differences in response styles to positive events or affect also contribute to the emergence of gender differences in adolescents' depressive symptoms. Girls may show increased levels of dampening and decreased levels of enhancing and/or these risk factors may have a greater impact in girls compared to boys. It has been found that dampening was significantly higher in girls than boys in 10 to 14 years old participants (Gentzler et al. 2014). A recent study showed that dampening increased in girls, not boys, over 2 years in a 13 and 14 years old adolescent sample, though the prospective association from dampening to depressive symptoms was not moderated by gender (Gomez-Baya et al. 2017).

### The Current Study

The first aim of the present study was to examine whether dampening and enhancing predict depressive symptoms over a long interval in a large adolescent sample as longitudinal examinations of this association remain scarce. Specifically, we examined whether depressive symptoms at grade 9 (i.e., around ages 14/15) can be predicted by dampening and enhancing measured one and two years earlier—above and beyond the contribution of rumination to negative affect. We

examined depressive symptoms at Grade 9 where the prevalence of depressive symptoms is expected to be the highest compared to Grade 7 and 8. We focused on both a one-year and two-year interval because there is not much information on suitable time lags. Part of the scope of this type of research on risk, vulnerability and protective factors for symptoms is to provide information for future research on prevention and optimal timing for preventive interventions. We expected that increased dampening and decreased enhancing would predict relative increases in depressive symptoms over both time lags. We expected to find a stronger association over one year compared to two years as more changes may have taken place in the development of dampening and enhancing strategies in the latter situation. As a second aim, we examined whether dampening and enhancing predict symptoms of anhedonia, a core depressive symptom related to positive affect. We expected that the mentioned associations would be stronger for anhedonic symptoms. Our third aim was to examine whether dampening and enhancing interact with the frequency of experienced positive events in their relation with depressive symptoms, cross-sectionally and longitudinally. We decided to focus on daily uplifts (e.g., doing enjoyable activities with friends, eating your favorite food, comprehending something difficult). Daily experiences can be frequently experienced, may have cumulative effects, and can consequently impact mental health even more strongly than the occurrence of major life events (e.g., Kanner et al. 1981; Kraaij et al. 2002). As a fourth aim, we focused on gender differences by examining whether the mean levels for dampening and enhancing are different for girls and boys and by examining whether the relation between dampening/enhancing and symptoms is different for boys and girls (i.e., moderation by gender).

## Methods

### Participants

Participants were 674 early adolescents from Grade 7. They completed questionnaires once a year for three consecutive years (2015, 2016, and 2017); see also Bastin et al. (2018) and Nelis et al. (2018) for other studies on the first two waves. Grade 7 is the first year of secondary education in the Dutch-speaking part of Belgium. Seven schools participated of which one school did not participate in the final wave (due to change in principals; this school had 11% of the participants at Time 1). At Time 2, 123 of the 674 participants dropped out (18.2%). At Time 3, 237 of the initial 674 participants dropped out (35.2%). Little's (1988) Missing Completely At Random test, using expectation maximisation, was calculated to examine the pattern of missingness (using the six variables of interest at each

**Table 1** Descriptive information

	Time 1   Grade 7					Time 2   Grade 8 (T1 + one year)					Time 3   Grade 9 (T1 + two years)				
	M	SD	Min	Max	Cronbach's α	M	SD	Min	Max	Cronbach's α	M	SD	Min	Max	Cronbach's α
Gender (% girls)	51.63%	–	–	–	–	51.18%	–	–	–	–	51.26%	–	–	–	–
Age	12.73	0.41	11.25	14.92	–	13.74	0.37	12.25	16.00	–	14.75	0.36	13.25	16.17	–
Dampening	13.10	3.87	7	28	.78	12.20	3.54	7	26	.76	11.70	3.27	7	22	.75
Enhancing	22.65	4.93	9	36	.84	22.25	4.91	9	36	.84	21.80	4.97	11	36	.85
Rumination	10.70	3.57	5	20	.80	10.65	3.51	5	20	.78	10.77	3.37	5	20	.77
Daily uplifts	56.16	8.92	16	88	–	54.72	8.57	24	82	–	53.55	8.04	31	84	–
Depressive symptoms	9.56	6.66	0	48	.86	9.59	6.69	0	48	.87	9.68	6.08	0	31	.85
Anhedonic symptoms	21.82	6.08	12	57	.81	22.20	5.94	12	47	.83	22.53	6.12	12	45	.85

Note:  $N_{T1} = 674$ ;  $N_{T2} = 551$ ;  $N_{T3} = 437$ . *Dampening and Enhancing*: Responses to Positive Affect questionnaire – Child version (RPA-C); *Rumination*: Children's Response Styles Questionnaire – extended version; *Daily uplifts*: Daily Uplifts and Hassles questionnaire for Adolescents (DUHQA); *Depressive symptoms*: the Children's Depression Inventory (CDI); *Anhedonic symptoms*: Leuven Anhedonia Self-Report Scale (LASS)

wave). This test was significant,  $\chi^2(331) = 482.38$ ,  $p < .001$ , indicating that data may not be missing completely at random. However, a normed chi square (i.e., the ratio of  $\chi^2/df$ ) is less sensitive to large sample sizes and was small ( $< 2$ ;  $\chi^2/df = 1.46$ ; Ullman 2001), indicating an acceptable fit of the data with a model that assumes randomly missing data. The vast majority of participants was born in the country where the study was conducted (95.4%) and 76.4% of the adolescents lived together with both parents. These percentages are in line with 95% born in the study country and 75.3% intact families in a large-scale adolescent sample from the same country (i.e., Belgium). Other descriptive information for all waves is presented in Table 1.

### Questionnaires

The following questionnaires were administered alongside other questionnaires that are not of interest for the present research aims. Cronbach's alpha coefficients for dampening, enhancing, rumination, depressive symptoms, and anhedonic symptoms were all acceptable to good (see Table 1).

### Depressive symptoms

To assess a broad spectrum of depressive symptoms at the cognitive, affective, and behavioral level, the *Children's Depression Inventory* (CDI; Kovacs 2003) was assessed. The CDI includes a variety of symptoms: sadness, worrying, crying, hopelessness, feelings of guilt, indecisiveness, sleeping problems, fatigue, appetite, negative self-esteem, and interpersonal problems. The CDI also includes items that can be categorized as anhedonia (e.g., pleasurable feelings at school and in general), though the broad spectrum of symptoms of anhedonia is not covered in the CDI. In the CDI, participants are asked to report on symptoms of depression during the past two weeks. Participants have to choose the best fitting description in each of the 27 three-choice statements. Each item is coded as 0, 1, or 2. Thirteen items were positively formulated and were reversed coded to represent depressive symptoms. The final total scores range from 0 to 54, with a higher score indicating more severe symptoms. A Dutch version by Timbremont et al. (2008) was used.

### Anhedonic symptoms

The *Leuven Anhedonia Self-report Scale* (LASS; see also Bastin et al. 2018) was constructed to assess the consummatory (i.e., reduced pleasure in ongoing experiences), anticipatory (i.e., the diminished pleasure from anticipation to a future positive event), and motivational (i.e., the decreased drive or motivation to pursue positive outcomes

or reward) aspects of anhedonia. Twelve items, of which six were reverse-coded, were rated on a 5-point scale ranging from *completely untrue* (1) to *completely true* (5), resulting in a total anhedonia score that can range from 12 to 60. Sample items are: “I found little pleasure in things that I used to enjoy“, “I could get really excited in advance about fun things“, and “I was motivated to do all kinds of things”.

### Regulation of positive affect: dampening and enhancing

Dampening and enhancing responses following positive affect were assessed using the *Responses to Positive Affect questionnaire for Children* (RPA-C; Bijttebier et al. 2012). The RPA-C is the child version of the adult RPA (Feldman et al. 2008; Raes et al. 2009). Participants have to indicate how often they react in the described way when feeling glad and happy using a 4-point scale ranging from 1 to 4 (*almost never, sometimes, often, almost always*). The original English questionnaire consists of 17 items (Feldman et al. 2008). In the Dutch version, one dampening item is omitted (Raes et al. 2009), resulting in seven dampening items and nine enhancing items<sup>1</sup>. Sample items of dampening are “these happy feelings won’t last” and “you think about things that could go wrong”. Sample items of enhancing are: “Think about how strong you feel” and “Think about how proud you are of yourself”. Because repeated assessments of the RPA-C over a period of two years are scarce so far, we examined stability. Stability of enhancing in terms of the intraclass coefficients between the repeated measures was .48 (Time 1 to Time 2); .43 (Time 1 to Time 3); and .53 (Time 2 to Time 3). For dampening, intraclass coefficients were .45 (Time 1 to Time 2); .36 (Time 1 to Time 3); and .55 (Time 2 to Time 3).

### Regulation of negative affect: rumination

The *Children’s Response Styles Questionnaire—extended version* (CRSQ; Abela et al. 2002; CRSQ-ext; Verstraeten et al. 2010) is a self-report questionnaire that assesses ruminative responses to sadness. Respondents had to indicate how often they respond as described when they feel sad. The rating scale ranges from 1 (*almost never*) to 4 (*almost always*). The CRSQ-ext consists of two subscales, brooding and reflection. In line with what has increasingly become standard practice, only brooding was included in the present study given that it is the most maladaptive form of rumination for depressive symptoms and a more robust

subscale than reflection (Griffith and Raes 2015). Brooding refers to an abstract way of processing negative affect. The brooding subscale includes 5 items (e.g., thinking “What have I done to deserve this?”). Scores range from 5 to 20 and higher scores indicate a greater tendency to brood in response to sadness.

### Daily uplifts

The *Daily Uplifts and Hassles Questionnaire for Adolescents* (DUHQA, see Appendix) is a new scale developed by the authors of the present paper and consists of a list of 23 uplifts and 23 hassles. The daily uplifts subscale was used for the purpose of the present study. The items include both interpersonal and non-interpersonal events and cover the domains of family, peers, school, hobby, and social activities. For each of a list of 23 uplifts, adolescents were asked to indicate how often it had occurred in the past year on a 5-point scale scored from 0 to 4 (*never, rarely, sometimes, often, very often*). Sixteen of the 23 uplift items were newly created by the authors of the present paper, six items were (adjusted from) the Children’s Uplifts Scale (Kanner et al. 1987; Michels et al. 2012) and one item came from the life events scale of Shahar and Priel (2002). A summation of the items resulted in a total score, with higher scores reflecting more uplifts. Cross-sectional correlations of the uplifts measure with anhedonic and depressive symptoms reveal a negative association (Table 2) which can be seen as evidence for its validity. The medium effect size of the correlation further indicates that the uplifts scale is sufficiently different from the symptom measures. Cronbach’s alpha was not calculated for the scale of daily uplifts because we do not assume that all different events need to be interrelated.

### Procedure

Potential participants received an invitation letter that included information about the study and allowed parents to decline for participation. Adolescents received a consent form at the day of the testing. They completed the questionnaire booklet in a paper-and-pencil format in a collective session during school hours. At least one research assistant was present to handle questions. As incentive, participants could win cinema tickets. The assessments took place during late winter or fall in Grade 7 (Time 1), Grade 8 (Time 2), and Grade 9 (Time 3). The procedure was comparable at the three waves. The interval between Time 2 and Time 3 ranged between 10 and 13 months (and was 14 months for four participants; mean of 11.7 months;  $SD = 1.2$ ). The mean interval between Time 1 and Time 3 ranged between 24 and 26 months (mean of 24.3 months;  $SD = 0.7$ ).

<sup>1</sup> The enhancing subscale was originally called positive rumination. Positive rumination, which could be seen as a form of enhancing, is further named enhancing to avoid confusion with rumination in response to negative affect.

## Data Analysis

Descriptives, correlations, and gender differences in mean levels of dampening and enhancing were calculated in IBM SPSS Statistics 24. Regression analyses were conducted in Mplus version 7 using maximum-likelihood estimation (Muthén and Muthén 2012). The full-information maximum likelihood method was used to handle missing data. This is an adequate method to deal with missing data patterns (Jeličić et al. 2009). Multivariate outliers in each regression analysis were examined using Mahalanobis distance and cases were excluded from a respective analysis when the probability associated with the distance value was .001 or less. The amount of outliers was, depending on the analysis, limited to 4 to 11 cases<sup>2</sup>.

Pearson correlations of variables at Time 3 with all other variables were calculated. Pearson correlations between dampening/enhancing and symptoms at the first two waves have been reported elsewhere within the context of other research questions (Bastin et al. 2018; Nelis et al. 2018)<sup>3</sup>. Next, hierarchical multiple regression analyses were conducted to examine the association of dampening and enhancing with concurrent depressive symptoms as well as the interaction of dampening and enhancing with daily uplifts; above and beyond gender and response style to negative affect (i.e., rumination) (third aim; cross-sectionally). These cross-sectional regression analyses were conducted for Time 1 (Grade 7), Time 2 (Grade 8), and Time 3 (Grade 9).

Longitudinal examinations of the relation between dampening and enhancing with depressive symptoms (first aim) and anhedonic symptoms (second aim) were examined from Time 1 to Time 3 (two years) and from Time 2 to Time 3 (one year). Moreover, the interactions between daily uplifts and response styles to positive affect (i.e., dampening and enhancing) were examined over the one-year interval from Time 2 to Time 3 (as the daily uplifts measure at Time 3 covered this one-year follow-up interval) (third aim, longitudinally). In all regression analyses, we controlled for gender and response style to negative affect (i.e., rumination), as these have been previously found to be associated with depressive symptoms (e.g., Aldao et al.

2010; Ge et al. 2001); and we controlled for baseline symptoms which allowed to make conclusions about predicted change over time adjusted for baseline. All variables in the regression analyses, except for gender, were standardized. Significant interaction terms were disentangled in SPSS with the PROCESS macro version 2.16.3 of Hayes (2013). Finally, we examined gender differences (fourth aim). Using multigroup analyses we examined whether the prospective associations between dampening/enhancing and symptoms were different for girls versus boys. In these analyses, the associations of dampening and enhancing with symptoms were allowed to vary across groups; using the model constraint command it was tested whether these coefficients were different across these two groups. In a next step, we tested whether the interaction of dampening/enhancing with uplifts was different for boys and girls. Moreover, using independent-samples t-tests, mean levels of dampening and enhancing were compared for boys and girls.

## Results

### Cross-sectional Analyses

Zero-order correlations between study variables are presented in Table 2. Hierarchical regression analyses conducted at each wave are presented for general depressive symptoms and symptoms of anhedonia in the left and right sight of Table 3 respectively. In a first step, the control variables of gender and rumination were included. In a second step, dampening and enhancing were added and thus their association with symptoms was examined above and beyond gender and rumination. In the third step, the uplifts variable was included and in the fourth step, the two interaction terms of dampening and enhancing with uplifts were entered.

### Dampening, enhancing, and their interaction with daily uplifts in relation to concurrent depressive symptoms

The results were comparable across Time 1, Time 2, and Time 3. Gender and rumination were first entered as control variables. Next, dampening and enhancing added significantly to the explained variance in depressive symptoms such that increased dampening and decreased enhancing significantly related to higher levels of concurrent depressive symptoms. The inclusion of uplifts in the next step added significantly to the model such that more uplifts were associated with less depressive symptoms. Finally, dampening showed a significant interaction with uplifts in the association with depressive symptoms at all three waves, see Fig. 1. Inspection of the uplifts by dampening

<sup>2</sup> For the cross-sectional regression analyses, there were ten outliers for both the anhedonic and depressive symptoms analyses at Time 1; there were four and five outliers for respectively the anhedonic and depressive symptoms analyses at Time 2; and there were six and four outliers for respectively the anhedonic and depressive symptoms analyses at Time 3. For the Time 2 to Time 3 regression analyses there were six outliers when anhedonia was the outcome and eight outliers when depressive symptoms was the outcome. For the Time 1 to Time 3 regression analyses there were nine outliers when anhedonia was the outcome and 11 outliers when depressive symptoms was the outcome.

<sup>3</sup> Higher dampening and lower enhancing were associated with higher concurrent depressive and anhedonic symptoms.

**Table 2** Associations of variables at Time 3 with all other study variables

	Enhancing T3	Dampening T3	Rumination T3	Daily uplifts T3	Depressive symptoms T3	Anhedonic symptoms T3
Enhancing T1	.44***	-.08	.03	.30***	-.14**	-.22***
Dampening T1	.05	.37***	.23***	.003	.22***	.17***
Rumination T1	.02	.22***	.47***	-.06	.33***	.16***
Daily uplifts T1	.18***	-.04	-.05	.50***	-.18***	-.16***
Depressive symptoms T1	-.14**	.32***	.33***	-.23***	.53***	.31***
Anhedonic symptoms T1	-.13**	.17***	.06	-.17***	.13**	.36***
Enhancing T2	.54***	-.01	-.001	.35***	-.23***	-.25***
Dampening T2	.01	.56***	.26***	-.03	.25***	.23***
Rumination T2	-.02	.36***	.52***	-.05	.35***	.19***
Daily uplifts T2	.22***	-.05	-.04	.62***	-.14**	-.22***
Depressive symptoms T2	-.23***	.36***	.31***	-.28***	.67***	.34***
Anhedonic symptoms T2	-.26**	.16***	.03	-.26***	.24***	.52***
Enhancing T3		-.07	.09	.44***	-.30***	-.40***
Dampening T3			.40***	-.10*	.49***	.31***
Rumination T3				-.09	.43***	.13**
Daily uplifts T3					-.33***	-.37***
Depressive symptoms T3						.47***

Note:  $413 < N < 435$ . N varies due to missing data. Pearson correlations are reported. T1 = Time 1 (Grade 7); T2 = Time 2 (Grade 8); T3 = Time 3 (Grade 9). *Dampening and Enhancing*: Responses to Positive Affect questionnaire – Child version (RPA-C); *Rumination*: Children’s Response Styles Questionnaire – extended version; *Daily uplifts*: Daily Uplifts and Hassles questionnaire for Adolescents (DUHQA); *Depressive symptoms*: the Children’s Depression Inventory (CDI); *Anhedonic symptoms*: Leuven Anhedonia Self-Report Scale (LASS)

\*\* $p < .01$ , \*\*\* $p < .001$

interaction in relation with depressive symptoms revealed that when dampening was low (i.e.,  $-1$  SD below mean) the simple slope for uplifts in relation to depressive symptoms was small (Time 1, Time 3) or not significant (Time 2); TIME 1: slope =  $-0.08$ ,  $t = 1.97$ ,  $p = .049$ ; TIME 2: slope =  $-0.05$ ,  $t = 1.02$ ,  $p = .31$ ; TIME 3: slope =  $-0.11$ ,  $t = 1.97$ ,  $p = .049$ ). However, uplifts were more strongly and significantly associated with less depressive symptoms for mean levels of dampening (TIME 1: slope =  $-0.22$ ,  $t = 7.35$ ,  $p < .001$ ; TIME 2:  $-0.19$ ,  $t = 5.75$ ,  $p < .001$ ; TIME 3: slope =  $-0.21$ ,  $t = 4.95$ ,  $p < .001$ ) and high levels of dampening (i.e.,  $+1$  SD above mean; TIME 1: slope =  $-0.37$ ,  $t = 8.59$ ,  $p < .001$ ; TIME 2:  $-0.33$ ,  $t = 7.65$ ,  $p < .001$ ; TIME 3: slope =  $-0.31$ ,  $t = 5.20$ ,  $p < .001$ ) at all three waves. A finding that was not consistent across waves was the interaction of uplifts with enhancing that was only significant at Time 2 (Fig. 2a). Inspection of this interaction revealed that less uplifts were significantly related to more depressive symptoms at all levels of enhancing, but the strongest when enhancing was low;  $-1$  SD slope =  $-0.29$ ,  $t = 7.08$ ,  $p < .001$ ; 0 SD slope =  $-0.19$ ,  $t = 5.75$ ,  $p < .001$ ;  $+1$  SD slope =  $-0.10$ ,  $t = 2.16$ ,  $p = .03$ ).

### Dampening, enhancing, and their interaction with daily uplifts in relation to concurrent anhedonic symptoms

Dampening and enhancing added significantly to the explained variance in anhedonic symptoms such that increased dampening and decreased enhancing related to higher levels of concurrent anhedonic symptoms. These associations remained when uplifts were added to the model. More uplifts related to less symptoms of anhedonia. However, the interaction of dampening with daily uplifts was not significant in relation to concurrent anhedonia. Whereas these results were consistent across the three waves, the interaction of uplifts with enhancing was not significant at Time 2 and 3, but did reach significant at Time 1 (Fig. 2b). This interaction showed that less uplifts were significantly related to more anhedonic symptoms at all levels of enhancing, but the strongest when enhancing is low;  $-1$  SD slope =  $-0.22$ ,  $t = 4.36$ ,  $p < .001$ ; 0 SD slope =  $-0.16$ ,  $t = 4.02$ ,  $p < .001$ ;  $+1$  SD slope =  $-0.10$ ,  $t = 2.01$ ,  $p = .04$ ). We should note that this interaction was small as the change in the proportion explained variance ( $R^2$ ) after adding the interaction term was negligible, i.e.,  $.005$ .

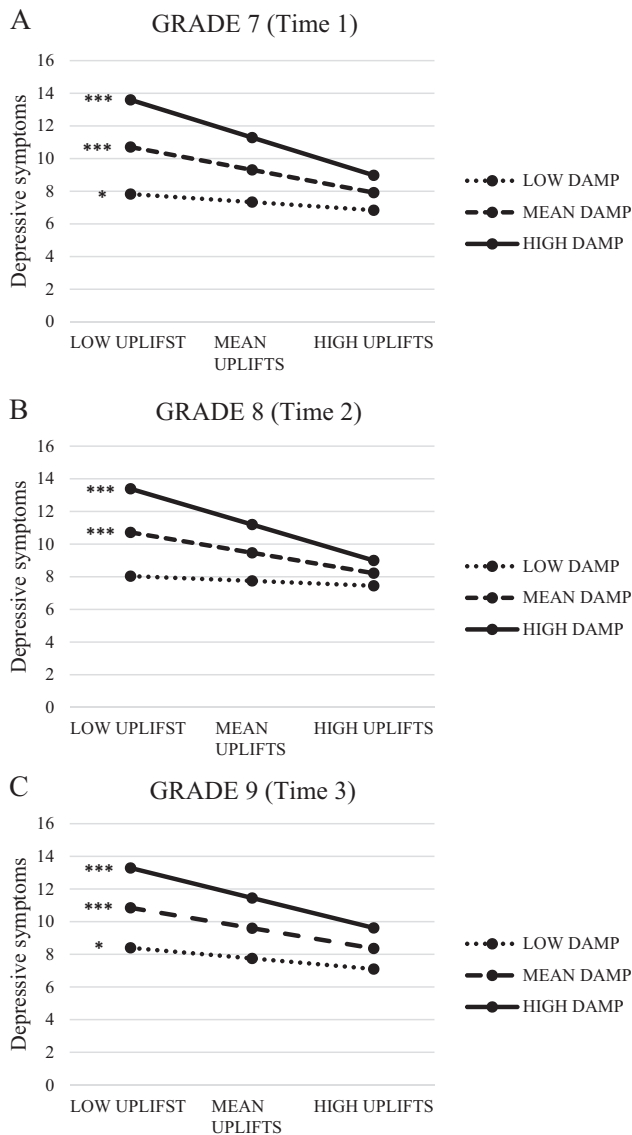


**Table 3** Hierarchical regression analysis of concurrent associations with depressive and anhedonic symptoms at Grade 7, Grade 8, and Grade 9

	DV: Depressive symptoms									DV: Anhedonic symptoms													
	T1			T2			T3			T1			T2			T3							
	$\beta$	SE	$p$	$R^2$	$\beta$	SE	$p$	$R^2$	$\beta$	SE	$p$	$R^2$	$\beta$	SE	$p$	$R^2$	$\beta$	SE	$p$	$R^2$			
<b>Step 1</b>																							
Gender	-.03	.07	.68	.42	-.06	.08	.55	.42	-.05	.09	.40	.42	-.07	.08	.40	.40	-.05	.09	.40	.40	-.05	.09	.40
Rumination	.52	.03	<.001	.27	.47	.03	<.001	.22	.45	.04	<.001	.20	.45	.04	<.001	.20	.45	.04	<.001	.20	.45	.04	<.001
<b>Step 2</b>																							
Gender	-.02	.06	.70	.66	-.03	.07	.66	.66	-.07	.08	.40	.66	-.07	.08	.40	.40	-.07	.08	.40	.40	-.07	.08	.40
Rumination	.38	.03	<.001	.33	.04	<.001	.33	.33	.33	.04	<.001	.33	.33	.04	<.001	.33	.33	.04	<.001	.33	.33	.04	<.001
Enhancing	-.35	.03	<.001	-.40	.03	<.001	-.29	.04	<.001	.39	.04	<.001	-.29	.04	<.001	.39	-.29	.04	<.001	.39	-.29	.04	<.001
Dampening	.35	.03	<.001	.47	.29	.04	<.001	.44	.33	.04	<.001	.44	.33	.04	<.001	.44	.33	.04	<.001	.44	.33	.04	<.001
<b>Step 3</b>																							
Gender	-.04	.06	.50	.67	-.03	.06	.67	.67	-.06	.08	.43	.67	-.06	.08	.43	.43	-.06	.08	.43	.43	-.06	.08	.43
Rumination	.39	.03	<.001	.33	.04	<.001	.31	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001
Enhancing	-.26	.03	<.001	-.32	.03	<.001	-.20	.04	<.001	.39	.04	<.001	-.20	.04	<.001	.39	-.20	.04	<.001	.39	-.20	.04	<.001
Dampening	.34	.03	<.001	.29	.04	<.001	.32	.32	.32	.04	<.001	.32	.32	.04	<.001	.32	.32	.04	<.001	.32	.32	.04	<.001
Uplifts	-.21	.03	<.001	.51	-.20	.03	<.001	.47	-.20	.04	<.001	.47	-.20	.04	<.001	.47	-.20	.04	<.001	.47	-.20	.04	<.001
<b>Step 4</b>																							
Gender	-.04	.06	.47	.73	-.02	.06	.73	.73	-.07	.08	.35	.73	-.07	.08	.35	.35	-.07	.08	.35	.35	-.07	.08	.35
Rumination	.39	.03	<.001	.33	.04	<.001	.31	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001
Enhancing	-.25	.03	<.001	-.32	.03	<.001	-.21	.04	<.001	.39	.04	<.001	-.21	.04	<.001	.39	-.21	.04	<.001	.39	-.21	.04	<.001
Dampening	.32	.03	<.001	.27	.04	<.001	.31	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001	.31	.31	.04	<.001
Uplifts	-.22	.03	<.001	-.19	.03	<.001	-.21	.04	<.001	.39	.04	<.001	-.21	.04	<.001	.39	-.21	.04	<.001	.39	-.21	.04	<.001
UpliftsXEnh	.02	.02	.45	.10	.03	<.001	.04	.03	.03	.03	.23	.03	.04	.03	.30	.03	.04	.03	.30	.03	.04	.03	.30
UpliftsXDamp	-.14	.02	<.001	.53	-.15	.03	<.001	.51	-.10	.04	.01	.44	-.10	.04	.39	.23	-.03	.04	.39	.23	-.03	.04	.39

DV dependent variable, SE standard error

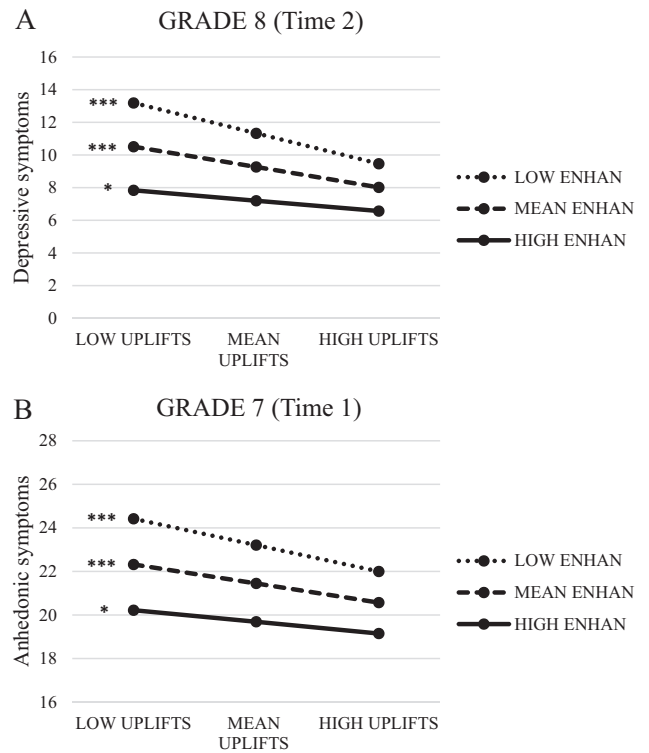
All variables are standardized (except for gender). T1 = Time 1 (Grade 7); T2 = Time 2 (Grade 8); T3 = Time 3 (Grade 9)



**Fig. 1** Interaction of daily uplifts with dampening in relation to concurrent depressive symptoms; at Grade 7 **a**, Grade 8 **b**, and Grade 9 **c**. Low, mean, and high refer respectively to one standard deviation below the mean, mean level, and one standard deviation above the mean. Depressive symptoms = sum score Child Depression Inventory (CDI); DAMP = dampening; UPLIFT = daily uplifts. \*\*\* $p < .001$ ; \* $p < .05$

**Longitudinal Analyses: One-year Interval**

The one-year longitudinal regression analyses from Time 2 to Time 3 (Table 4) differed from the cross-sectional analyses in the following ways: (1) the response styles were the Time 2 measures (instead of the concurrent Time 3 measures); and (2) baseline symptoms were included as control variable. The measures of daily uplifts remained the Time 3 measures as these follow-up measures ask for uplifts during the past year which encloses the follow-up period. Again,



**Fig. 2** Interaction of daily uplifts with enhancing in relation to concurrent depressive symptoms (Grade 8, **a**) and in relation to anhedonic symptoms (Grade 7, **b**). Low, mean, and high refer respectively to one standard deviation below the mean, mean level, and one standard deviation above the mean. Depressive symptoms = sum score Child Depression Inventory (CDI); Anhedonic symptoms = sum score Leuven Anhedonia Self-report Scale (LASS). ENHAN = enhancing; UPLIFT = daily uplifts. \*\*\* $p < .001$ ; \* $p < .05$

two separate regression analyses were conducted: one for depressive symptoms and one for anhedonic symptoms as outcomes.

**Dampening, enhancing, and their interaction with daily uplifts as predictors of depressive symptoms over a one-year interval**

In the zero-order correlations, dampening and enhancing at Time 2 were significantly correlated with depressive symptoms at Time 3 (Table 2). However, enhancing and dampening were not predictive of future depressive symptoms when controlling for gender, baseline symptoms and rumination in the regression analysis. Surprisingly, rumination was not predictive of future depressive symptoms either. More daily uplifts related to less depressive symptoms. However, against predictions, this association was not significantly moderated by dampening or enhancing. Finally, in a multigroup analysis no significant gender differences were found such that the associations of dampening and enhancing with depressive symptoms did not

**Table 4** Hierarchical regression analysis of one-year prospective associations with depressive and anhedonic symptoms (Time 2 to Time 3)

DV: Depressive symptoms T3	$\beta$	SE	$\beta$	$p$	$R^2$	DV: Anhedonic symptoms T3	$\beta$	SE	$\beta$	$p$	$R^2$
Step 1											
Gender	.03	.07	.62			Gender	-.15	.09	.08		
Depr. symptoms T2	.70	.03	<.001			Anhedonia T2	.51	.04	<.001		
Rumination T2	.05	.04	.22	.53		Rumination T2	.14	.04	.001	.31	
Step 2											
Gender	.04	.07	.62			Gender	-.16	.08	.054		
Depr. symptoms T2	.70	.04	<.001			Anhedonia T2	.46	.04	<.001		
Rumination T2	.06	.04	.20			Rumination T2	.12	.05	.01		
Enhancing T2	-.02	.04	.67			Enhancing T2	-.10	.04	.02		
Dampening T2	-.01	.04	.81	.53		Dampening T2	.06	.05	.26	.32	
Step 3											
Gender	.04	.07	.60			Gender	-.19	.08	.02		
Depr. symptoms T2	.66	.04	<.001			Anhedonia T2	.41	.04	<.001		
Rumination T2	.06	.04	.14			Rumination T2	.11	.05	.02		
Enhancing T2	.02	.04	.68			Enhancing T2	-.03	.04	.45		
Dampening T2	-.003	.04	.94			Dampening T2	.06	.05	.18		
Uplifts T3	-.14	.04	<.001	.54		Uplifts T3	-.27	.04	<.001	.38	
Step 4											
Gender	.04	.07	.60			Gender	-.18	.08	.03		
Depr. symptoms T2	.69	.05	<.001			Anhedonia T2	.42	.05	<.001		
Rumination T2	.07	.05	.14			Rumination T2	.11	.05	.02		
Enhancing T2	.02	.04	.66			Enhancing T2	-.04	.04	.39		
Dampening T2	-.003	.04	.95			Dampening T2	.07	.05	.14		
Uplifts T3	-.15	.04	<.001			Uplifts T3	-.26	.04	<.001		
Uplifts T3 X Enhancing T2	-.01	.03	.73			Uplifts T3 X Enhancing T2	.01	.04	.86		
Uplifts T3 X Dampening T2	.00	.04	.99	.54		Uplifts T3 X Dampening T2	.05	.05	.27	.39	

DV dependent variable, SE standard error

All variables are standardized (except for gender). T2 = Time 2 (Grade 8); T3 = Time 3 (Grade 9)

significantly differ across gender:  $B_{boys}-B_{girls} = .11, p = .21$  for enhancing, and  $B_{boys}-B_{girls} = .14, p = .25$  for dampening. Moreover, the interaction effects (i.e., uplifts by dampening and uplifts by enhancing) remained not significant in separate models of girls and boys,  $ps > .26$ .

**Dampening, enhancing, and their interaction with daily uplifts as predictors of anhedonic symptoms over a one-year interval**

Less enhancing was associated with relative increases in future anhedonic symptoms above and beyond gender and rumination. However, this small association became non-significant when also controlling for daily uplifts that happened during the time lag. Dampening was unrelated to future anhedonic symptoms. Uplifts were associated with less anhedonic symptoms, but, against predictions, there were no significant interactions between daily uplifts and

dampening/enhancing in the prediction of anhedonia. Finally, in a multigroup analysis no significant gender differences were found such that the associations of dampening and enhancing with anhedonic symptoms did not significantly differ across gender:  $B_{boys}-B_{girls} = -0.06, p = .53$  for enhancing, and  $B_{boys}-B_{girls} = .02, p = .90$  for dampening. Moreover, the interaction effects (i.e., uplifts by dampening and uplifts by enhancing) remained not significant in separate models of girls and boys,  $ps > .35$ .

**Longitudinal Analyses: Two-Year Interval**

**Prediction of depressive symptoms over a two-year interval**

The predictive value of enhancing and dampening in relation to symptoms two years later was examined after controlling for gender, baseline symptoms, and rumination, and for completeness we examined associations after

**Table 5** Regression analysis of two-year prospective associations (Time 1 to Time 3)

DV:	$\beta$	<i>SE</i> $\beta$	<i>p</i>	<i>R</i> <sup>2</sup>	DV:	$\beta$	<i>SE</i> $\beta$	<i>p</i>	<i>R</i> <sup>2</sup>
Depressive symptoms T3					Anhedonic symptoms T3				
Step 1									
Gender	.09	.08	.27		Gender	-.23	.09	.01	
Depr. symptoms T1	.57	.05	<.001		Anhedonia T1	.36	.05	<.001	
Rumination T1	.02	.05	.63	.34	Rumination T1	.16	.05	<.001	.18
Step 2									
Gender	.09	.08	.28		Gender	-.25	.09	.004	
Depr. symptoms T1	.55	.05	<.001		Anhedonia T1	.29	.05	<.001	
Rumination T1	.04	.05	.44		Rumination T1	.14	.05	.01	
Enhancing T1	-.05	.05	.33		Enhancing T1	-.15	.05	.001	
Dampening T1	-.01	.05	.83	.34	Dampening T1	.11	.05	.04	.22
Step 3									
Gender	.08	.08	.31		Gender	-.26	.09	.003	
Depr. symptoms T1	.54	.06	<.001		Anhedonia T1	.29	.05	<.001	
Rumination T1	.05	.05	.40		Rumination T1	.14	.05	.01	
Enhancing T1	-.03	.05	.50		Enhancing T1	-.14	.05	.01	
Dampening T1	-.01	.05	.87		Dampening T1	.11	.05	.03	
Uplifts T1	-.04	.05	.43	.34	Uplifts T1	-.05	.05	.31	.22

*DV* dependent variable, *SE* standard error

All variables are standardized (except for gender). T1 = Time 1 (Grade 7); T3 = Time 3 (Grade 9)

control for baseline uplifts in the last step (Table 5). Baseline depressive symptoms were the strongest predictor of depressive symptoms two years later. The variables of interest, dampening and enhancing, did not significantly predict relative changes in depressive symptoms when taking into account the control variables. Finally, in a multigroup analysis no significant gender differences were found such that the associations of dampening and enhancing with depressive symptoms did not significantly differ across gender:  $B_{\text{boys}} - B_{\text{girls}} = 0.07$ ,  $p = .52$  for enhancing, and  $B_{\text{boys}} - B_{\text{girls}} = 0.12$ ,  $p = .43$  for dampening.

#### Prediction of anhedonic symptoms over a two-year interval

The results are presented in Table 5. Baseline anhedonic symptoms predicted anhedonic symptoms two years later. Interestingly, more enhancing predicted relative decreases in anhedonic symptoms two years later; and more dampening related to relative increases in anhedonic symptoms. These associations hold after controlling for baseline symptoms, rumination, and baseline uplifts. Finally, in a multigroup analysis no significant gender differences were found such that the associations of dampening and enhancing with anhedonic symptoms did not significantly differ across gender:  $B_{\text{boys}} - B_{\text{girls}} = 0.08$ ,  $p = .49$  for enhancing, and  $B_{\text{boys}} - B_{\text{girls}} = -0.25$ ,  $p = .11$  for dampening.

#### Gender Differences in Mean Levels of Dampening and Enhancing

At Grade 7, the mean level of dampening did not significantly differ for boys and girls,  $Mean_{\text{boys}} = 12.94$ ;  $SD_{\text{boys}} = 3.94$ ;  $Mean_{\text{girls}} = 13.24$ ;  $SD_{\text{girls}} = 3.80$ ;  $t(658) = 1.00$ ,  $p = .32$ ,  $d = 0.08$ , nor the mean level of enhancing,  $Mean_{\text{boys}} = 22.73$ ;  $SD_{\text{boys}} = 5.10$ ;  $Mean_{\text{girls}} = 22.58$ ;  $SD_{\text{girls}} = 4.77$ ;  $t(656) = 0.39$ ,  $p = .70$ ,  $d = 0.03$  (see also Bastin et al. 2018). At Grade 8, again, the mean level of dampening did not significantly differ for boys and girls,  $Mean_{\text{boys}} = 11.93$ ;  $SD_{\text{boys}} = 3.52$ ;  $Mean_{\text{girls}} = 12.45$ ;  $SD_{\text{girls}} = 3.54$ ;  $t(541) = 1.74$ ,  $p = .08$ ,  $d = 0.15$ , nor the mean level of enhancing,  $Mean_{\text{boys}} = 22.12$ ;  $SD_{\text{boys}} = 5.23$ ;  $Mean_{\text{girls}} = 22.37$ ;  $SD_{\text{girls}} = 4.61$ ;  $t(543) = 0.58$ ,  $p = .56$ ,  $d = 0.05$ . At Grade 9, the mean level of dampening was significantly higher in girls compared to boys,  $Mean_{\text{boys}} = 11.31$ ;  $SD_{\text{boys}} = 3.12$ ;  $Mean_{\text{girls}} = 12.07$ ;  $SD_{\text{girls}} = 3.37$ ;  $t(431) = 2.43$ ,  $p = .02$ ,  $d = 0.23$ . For enhancing, again, boys and girls did not significantly differ,  $Mean_{\text{boys}} = 21.80$ ;  $SD_{\text{boys}} = 5.12$ ;  $Mean_{\text{girls}} = 21.81$ ;  $SD_{\text{girls}} = 4.83$ ;  $t(431) = 0.01$ ,  $p = .99$ ,  $d = 0.00$ .

#### Discussion

Research on risk, vulnerability and protective factors for depressive symptoms is of particular interest in early to

mid-adolescence where symptoms increase and gender differences in depressive symptoms emerge (e.g., Kessler 2003). Adolescence is a period of emotional turbulence that challenges affect-regulation strategies. Given that depression is characterized by not only increased negative affect but also reduced positive affect, the way in which adolescents respond to positive affect, i.e., either dampening or enhancing, has started to receive considerable research attention. Although dampening has robustly been related to concurrent depressive symptoms, the association with enhancing is less clear. Moreover, prospective research has revealed mixed results and is scarce in adolescents. We examined the association of response styles to positive affect, i.e., dampening and enhancing, with depressive symptoms in a sample of early adolescents. This was done cross-sectionally as well as longitudinally over a one- and two-year interval. Besides general depressive symptoms, we examined symptoms of anhedonia. Anhedonia refers to reduced pleasure in previously enjoyed activities and is a core characteristic of depression. Anhedonia might be the symptom of relevance for the way in which adolescents respond to positive affect and answers the call to focus on specific symptoms instead of general syndromes (Fried and Nesse 2015). Next, we examined interactions of dampening and enhancing with daily uplifts; as this is a candidate explanation for the mixed results in the past. Finally, we examined whether results differed for girls and boys.

### **Dampening and Enhancing in Relation to Depressive Symptoms**

More enhancing and less dampening were related to less concurrent depressive symptoms, even when taking into account gender and rumination. However, the associations were not confirmed at the prospective level. These findings are in line with the response style research so far. That is, a robust cross-sectional relationship between dampening and general depressive symptoms has been found across studies, but the longitudinal findings are mixed (e.g., Bijttebier et al. 2012; Nelis et al. 2015; Raes et al. 2012).

### **Dampening and Enhancing in Relation to Anhedonic Symptoms**

Low enhancing and high dampening were related to concurrent symptoms of anhedonia. This is the first study to examine response styles to positive affect in relation to anhedonia over long intervals of one and two years, and as expected, the concurrent relationships were replicated at the prospective level. That is, more enhancing and less dampening predicted relative decreases in anhedonic symptoms two years later. These results prove the relevance of response styles to positive affect as vulnerability factor for anhedonia

even above and beyond how adolescents respond to negative emotions, above and beyond baseline symptoms, and above and beyond the amount of daily uplifts at baseline. Our results are in line with a previous longitudinal examination where enhancing related to prospective anhedonic but not to general depressive symptoms (Nelis et al. 2015). It is difficult to say whether a focus on anhedonia would be an explanation for all mixed previous longitudinal results as anhedonia measures were not always included. However, the results at least show that research would benefit from examinations of specific aspects of depressive symptoms besides solely examining unweighted aggregations of a variety of depressive symptoms. Depressive symptoms include multiple symptom dimensions that can be expected to have different antecedents (Fried and Nesse 2015). Also in line with this focus, dampening has previously been found to be predictive of the affective and cognitive symptoms of depression, not the somatic (Raes et al. 2012).

However, importantly, the results were different for the one-year interval as dampening was not predictive of anhedonic symptoms one year later. This can be driven by a lower stability of anhedonic symptoms over two years compared to one year, leaving more room for other predictors to explain variance in follow-up depressive symptoms above and beyond baseline symptoms. Nevertheless, the lack of the one-year association for dampening can point to differences across adolescence which is a period in which affect-regulation strategies are expected to be challenged; or may be spurious. Replication is required. Enhancing did significantly predict relative decreases in anhedonic symptoms one year later, though this association became non-significant when taking into account the amount of uplifts that happened during this interval.

Finally, none of the associations between dampening/enhancing and prospective symptoms were significantly different for boys and girls and mean levels of dampening and enhancing did not significantly differ for boys and girls at Grade 7 and 8. However, at Grade 9, dampening was significantly higher for girls compared to boys with a small effect size. The direction of this result is in line with girls being more vulnerable for depressive symptoms compared to boys and higher dampening in girls compared to boys in a sample of 10 to 14 years old (Gentzler et al. 2014). More specifically, in a recent study, adolescents in Grades 7 and 8 were followed over three years and the mean levels of dampening were also only higher in girls than boys in the third year of the study (Gomez-Baya et al. 2017).

### **Interaction of Daily Uplifts with Dampening and Enhancing**

Our hypothesis that response styles to positive affect would interact with the amount of positive daily events in their

relation with symptoms was only partially confirmed. More precisely, it only held at the cross-sectional level. Thus, uplifts do not seem to provide an explanation for the mixed longitudinal results of response styles to positive affect with depressive symptoms. At the cross-sectional level, the inclusion of uplifts revealed that uplifts were more strongly associated with less depressive symptoms in the case of high levels of dampening thoughts. Thus, the amount of daily uplifts particularly matters for individuals who dampen a lot. This finding was replicated across the three waves at Grade 7, 8, and 9. Our results differ from a daily diary study where uplifts were more strongly associated with decreased depressive symptoms on days when dampening was low (Li et al. 2017). Important to note, the low dampeners in our study, relative to high dampeners, already had low levels of depressive symptoms at low levels of uplifts. Moreover, whereas our results revealed that dampening to positive affect is the most strongly related to depressive symptoms for individuals who do not experience many uplifts, Gilbert et al. (2017) found that dampening is especially detrimental when triggered by many positive events. A potential explanation for the different result is that Gilbert et al. (2017) focused on *major* positive life events, rather than daily uplifts in the present study. It is plausible that such major positive life events, compared to smaller uplifts, are more frequently accompanied by stressful changes in someone's life and more easily go along with disappointments, which may trigger dampening thoughts. Shahar and Priel (2002) already highlighted that positive life events can have stressful aspects. Comparably, dampening in pregnant women predicted depressive symptoms after childbirth (Raes et al. 2014), which is generally experienced as a major positive as well as stressful life event. Remarkably, we did not find that uplifts interact with dampening in relation to *anhedonia*. Recently, Gilbert et al. (2017) found evidence for such an interaction but only in a group of children at low risk for depression, based on maternal history of depression. Although this was unexpected, it may be an explanation for the lack of an interaction in our sample. It is also plausible that depressed individuals have a memory bias in that they underestimate the occurrence of past positive events, and speculatively, this bias may particularly occur in anhedonic participants as their enjoyment of pleasurable activities is disturbed when they report retrospectively on their uplifts.

For enhancing, we found that uplifts interacted with enhancing in relation to depressive symptoms at Time 2 and in relation to anhedonic symptoms at Time 1. However, these associations were not replicated across the three grades and the result for anhedonia was very small. Nevertheless, these findings pointed in the same direction and were in line with previous results in a student sample (Li et al. 2017). Although the interaction could be

interpreted as enhancing being a vulnerability factor in the relation between uplifts and depressive symptoms, it should rather be seen as enhancing being particularly important in the case of low uplifts or as the detrimental impact of low enhancing being weakened when people experience enough uplifts.

## Implications

The results suggest that treating anhedonia does not (solely) imply reducing dampening thoughts. Importantly, enhancing of positivity also needs to be encouraged. Anhedonia is difficult to treat and, so far, regulation of positive affect has received insufficient attention in therapy (Dunn 2012). Cognitive-behavioral techniques (e.g., cognitive bias modification) have been suggested to impact disturbances in the regulation of positive affect and anhedonia (Carl et al. 2013; Dunn 2012). A training in a sensory-experiential processing style is also a key candidate to impact thoughts in response to positive affect. So far, there is experimental evidence that such a non-analytical way of processing positive information increases positive affect (e.g., Gadeikis et al. 2017; Werner-Seidler and Moulds 2012). Moreover, family-based intervention can also be crucial as there is evidence that maternal and paternal responses to adolescents' positive affect are not only associated with symptoms but also predict adolescents' own level of enhancing of positive affect (Nelis et al. 2018).

The present results further implicate that trainings that aim to stimulate adaptive responding to positive affect might be relevant in *adolescence*, which is a critical period for the development of psychological problems and mental disorders (Lee et al. 2014), including disorders characterized by emotional disturbances such as depressive disorder (Hankin et al. 2015). Developmental plasticity of the adolescent's brain renders adolescence to be a time of vulnerability for psychological problems as well as opportunity to intervene and promote development in a positive way (Dahl 2004; Lee et al. 2014). However, we should remain careful in deriving conclusions for interventions as over the one-year interval, enhancing significantly predicted decreased levels of anhedonia, but this was no longer the case when recent uplifts were taken into account. Moreover, effect sizes of associations indicate we should bear in mind that also other factors do explain variance in symptoms (cf equifinality principle of development). Further, the results also suggest that vulnerable adolescents in terms of high dampening and low enhancing of positive affect profit the most from experiencing more daily uplifts. Moreover, the results suggest that reducing dampening thoughts can potentially make individuals less vulnerable for periods in which few uplifts are experienced. However, given that we found only cross-sectional support for response styles by

events interactions, we should be careful to derive temporal and causal conclusions.

We want to emphasize that the present results do not implicate that enhancing should be stimulated at each moment and in all circumstances. It is not desirable to promote positive affect at each moment of the day as low positive mood is part of our daily affective experiences. Moreover, strongly stimulating enhancing thoughts will probably be maladaptive in certain situations such as delusions of grandeur or mania, and a rigid focus on the pursuit of happiness should be avoided because it can have paradoxical effects (Ford et al. 2014; Gruber et al. 2011). Accordingly, positive affect should be carefully treated in therapy because “it is important to not over-emphasize positive affect repair in therapy, as this could be experienced as invalidating by clients and lead to the adoption of inflexible emotion regulation strategies” (Dunn 2012, p. 326). There is a trend in psychology research that emphasizes the *flexibility* with which certain strategies are used according to the contextual demands and personal needs (Aldao 2013; Kashdan and Rottenberg 2010) rather than merely focusing on the frequency of using these strategies.

### Strengths, Limitations, and Future Directions

The present study has several merits. It concerns a big sample with equal distribution of boys and girls. Response styles and symptoms were examined over long intervals of one and two years, and both general depressive symptoms as well as anhedonia were examined. The study has limitations too. Concerning the questionnaires, a first limitation is the self-report nature of all measures. We controlled for depressive symptoms in our models, but reports from other raters are recommended to exclude memory biases in depressed individuals. Daily uplifts were assessed using a new scale of which no data in other samples are available to show its validity. Also, participants were asked to report on the frequency of a list of uplifts for the past year. It is plausible that a one-year frame is too long to judge on these events. Third, to better isolate unique effects of anhedonia compared to other symptoms of depression, future research should include a measure of symptoms that clearly distinguishes anhedonia from other symptoms (of depression). Relatedly, previous cross-sectional research suggests that response tendencies to positive affect can also contribute to the other main internalizing problem of anxiety, even above and beyond depressive symptoms (Eisner et al. 2009; McEvoy et al. 2018); which could also be addressed in future longitudinal research. Furthermore, a study should always be interpreted within its limits of generalizability. Although the present study had an equal representation of girls and boys and was conducted in several schools, we had no information on socio-economic status that can show

generalizability on this side. Finally, the present study does not have an experimental design and as such carefulness is required in deriving causal conclusions. Experimental research that shows the impact of enhancing (and dampening) on state anhedonia is necessary as well as randomized controlled trials that prove the value of techniques that aim to increase enhancing thoughts and, as a consequence, anhedonia.

### Conclusion

Research on risk, vulnerability and protective factors for depressive symptoms is of particular interest in early to mid-adolescence where symptoms increase and gender differences in depressive symptoms emerge. The present study is one of the few longitudinal investigations in adolescence so far on response styles to positive affect (i.e., dampening and enhancing) in relation to depressive symptoms and more specifically, symptoms of anhedonia. The results stress the importance of examining specific symptoms of depression in adolescence as lower enhancing and higher dampening responses to positive affect predicted relative increases in symptoms of anhedonia two years later, but not general depressive symptoms. Strikingly, these results were not exactly replicated over a one-year interval and none of the longitudinal associations were moderated by gender. However, girls at Grade 9 reported significantly higher levels of dampening than boys which is in line with girls being more vulnerable for depressive symptoms than boys. Extending the stress-diathesis model to positive experiences, the present study revealed that the contextual factor of daily uplifts interacts with response styles to positive affect in its association with concurrent depressive symptoms, a finding that was replicated at the three grades, although no longitudinal support was found.

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**Authors' Contributions** S.N. participated in the conception and design, coordination, and data collection of the study, performed the statistical analyses, interpreted the data, and took the lead in writing up the manuscript. M.B. participated in the conception and design, coordination, and data collection of the study, and critically revised the manuscript. F.R. participated in the conception and design of the study and critically revised the manuscript. P.B. participated in the conception and design of the study, and critically revised the manuscript. All authors read and approved the final manuscript.

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**Data Sharing Declaration** The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

### Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

## Appendix

DUHQA – Uplifts

**Instruction:** We would like to know how often certain events have happened in your life during the past year. Indicate for each event below HOW OFTEN it has happened during the past year. Circle the best fit answer.

**Scale:** Never, rarely, sometimes, often, very often

**Items (English translation):**

- 
- You were good in a class in school.
  - Someone made your favorite dish.
  - You won a medal.
  - You won a board game.
  - You received a nice text message, call, email or letter.
  - You improved a personal record in a sport.
  - You organized a nice activity.
  - You made a new friend.
  - You were good in your hobby.
  - You improved a personal record in a computer game.
  - You understood something difficult.
  - You did something fun with your parents.
  - You had fun with your pupils at school.
  - You won a quiz.
  - You found something you had lost.
  - Your parents had a lot of time for you.
  - You had good grades on a task, a test, or an exam.
  - You won a game at the youth club.
- 

**Table** (continued)

You got a compliment about how well you played a music instrument.

Friends wanted to spend time with you.

You got a present you wanted.

You participated in a nice activity with friends (e.g., a movie, a party).

Your parents supported you.

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**Sabine Nelis** is a postdoctoral researcher at the research centre for School Psychology and Development in Context at the KU Leuven, Belgium. She examines response styles to positive affect and the relation with depressive symptoms.

**Margot Bastin** is a PhD student at the research centre for School Psychology and Development in Context at the KU Leuven, Belgium,

and the Research Foundation Flanders (FWO), Belgium. Her research interests include interpersonal and intrapersonal responses to both positive and negative affect as vulnerability factors of depressive symptoms in adolescence.

**Filip Raes** is a professor at the Centre for Psychology of Learning and Experimental Psychopathology at the KU Leuven, Belgium. He is a clinical psychologist and a trained behavior therapist. His research interests include depression, autobiographical memory (specificity), rumination, positive affect regulation, and (cognitive) behavior therapy.

**Patricia Bijttebier** is a professor at the research centre for School Psychology and Development in Context at the KU Leuven, Belgium. She is vice dean for education of the Faculty of Psychology and Educational Sciences. Her research focuses on temperamental and cognitive vulnerabilities to behavioral and emotional problems.