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A Mindfulness-Based Group Intervention for Enhancing Self-Regulation of Emotion in Late Childhood and Adolescence: A Pilot Study

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Abstract Emotion dysregulation is strongly implicated in the development of psychological problems during adolescence. The purpose of this study was to examine the feasibility and acceptability of an intervention for enhancing self-regulation of emotion in adolescents, adapted from Mindfulness-based Cognitive Therapy. We studied the impact of the intervention on depressive symptoms, as well as on transdiagnostic psychological processes related to emotional regulation, namely impulsivity and ruminative thinking. Twenty-one participants aged between 11 and 19 years were offered a nine-session group intervention. Adolescents completed standardized questionnaires before and after the training. This intervention was found to increase self-reported mindfulness and was well-accepted by adolescents, as estimated by the low dropout rate. As expected, a decrease was observed in depressive symptoms, in specific impulsivity facets (urgency and lack of perseverance), and in internal-dysfunctional strategies of emotion regulation (especially in unconstructive repetitive thoughts). The present findings provide preliminary support for a group intervention for adolescents characterized by emotion regulation difficulties, targeting transdiagnostic psychological processes (impulsivity and ruminative thinking). Furthermore, by potentially enhancing self-regulation skills, this

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intervention might constitute an effective method for general prevention of psychological disorders in late childhood and adolescence.

Adolescents are confronted with physical, psychological, and social transformations, leading to the experience of frequent and intense emotions (Larson and Lampman-Petraitis 1989). Given this emotional stress, adolescence is a critical period for the development of psychopathology. For example, adolescence constitutes one of the peak risk periods for developing depressive disorders, with a mean onset age of 14.7 years for girls and 15.4 years for boys (Lewinsohn et al. 2001). During the transition from middle to late adolescence (i.e., 15–18 years), there is a sixfold increase in the prevalence of depression (Kessler et al. 2001). Furthermore, the impact of psychiatric disorders on important areas of functioning (family, school, and peers) shows an initial decline from ages 9 to 12, followed by a substantial increase through early to mid-adolescence, with a final decrease by age 16 (Ezpeleta et al. 2001). Emotional problems in adolescence tend to persist, and the severity of symptoms is a risk factor for psychiatric disorders in adulthood (Hofstra et al. 2001).

Difficulties in emotional regulation are involved in the development and maintenance of diverse forms of adolescent psychopathology, including both internalized disorders, such as depression (e.g., Betts et al. 2009; Silk et al. 2003) and externalized disorders, such as aggressive behaviours (Silk et al. 2003; Sullivan et al. 2010). The regulation of emotion is of great interest in adolescence, given the high prevalence of psychological problems and the changes in developmental and maturational processes that affect emotion regulation (Steinberg 2005). These data emphasize the need to develop and validate interventions designed to enhance adolescents' emotion regulation to be implemented either before the onset of problems or their recurrence (Monroe and Harkness 2005).

In recent years, several interventions programs targeting the development of mindful attention have been proposed for children (e.g., Semple and Lee 2011) and adolescents (e.g., Biegel et al. 2009). These mindfulness-based interventions (MBI) vary considerably in terms of length and number of sessions (for a reviews, see Deplus et al. 2014; Thompson and Gauntlett-Gilbert 2008). Still, most include (1) paying deliberate attention to the present moment (e.g., sounds, physical sensations), (2) exploring and accepting emotional experiences (e.g., negative affect, intrusive thoughts), (3) inhibiting automatic behaviours triggered by emotional contexts (e.g., aggressive behaviours, substance use), (4) distancing oneself from one's thoughts using body awareness, and (5) engaging in valued actions. These skills, necessary for effective emotion regulation, help individuals to prevent maladaptive impulsive behaviours and to disengage from ruminative thinking (e.g., Heeren and Philippot 2011). Accordingly, MBI target two key transdiagnostic factors involved in the etiology of emotional disorders: impulsivity and rumination.

Impulsivity has a pervasive role in psychopathology. This construct is one of the more common diagnostic criteria in nosography manuals (e.g., DSM). For example, studies in adolescent samples showed that impulsivity is associated with externalizing problems (Eisenberg et al. 2009), addictive behaviours (Colder and Chassin 1997), and bulimic symptomatology (Bodell et al. 2012). Although numerous studies have focused on the relationship between impulsivity and problematic behaviours in adolescence, they have provided limited explanations of the psychological mechanisms involved, as they have too often been

conducted without considering the multifaceted nature of impulsivity. Whiteside and Lynam (2001) clarified the multidimensionality of impulsivity by dividing it into four dimensions: (1) *urgency*, the tendency to act rashly under conditions of negative affect, (2) *lack of premeditation*, the difficulty in thinking about and reflecting on the consequences of an act before engaging in that act, (3) *lack of perseverance*, the inability to remain focused on tedious or difficult tasks, and (4) *sensation seeking*, the tendency to enjoy and pursue exciting activities and the openness to try new experiences that may be dangerous. These impulsivity components have been linked to specific cognitive mechanisms (e.g., deficits in distinct executive functions) and motivational factors (e.g., variations in reinforcement sensitivity) (Bechara and Van der Linden 2005; Gay et al. 2008). d'Acremont and Van der Linden (2007) showed that two components of impulsivity, namely urgency and lack of perseverance, were related to depressive symptoms in adolescence. Interestingly, these relations between impulsivity and depression were mediated by the more frequent use of maladaptive emotion regulation strategies (e.g., rumination, blaming others) in comparison to adaptive strategies (e.g., positive reappraisal, putting into perspective).

A recent longitudinal study conducted in young adolescents (11–13 years old) revealed that urgency predicted the development of depressive symptomatology and the presence of externalizing behaviours at a 1-year follow-up (Smith et al. 2013). Another study conducted in children and young adolescents (9–13 years old) revealed that ADHD is associated with a higher level of urgency and lower levels of premeditation and perseverance (Miller et al. 2010). Moreover, this study also found that the urgency facet is the best predictor of behavioural problems in children with ADHD.

In recent years, a growing body of literature has indicated that ruminative thinking is involved in the onset and perpetuation of psychopathological states, and thus acts as a transdiagnostic process (Nolen-Hoeksema and Watkins 2011). Two modes of repetitive thinking can be distinguished in rumination: (1) a constructive form of rumination, characterized by concrete and experiential thinking (e.g., "how am I feeling now? What are my bodily sensations and emotions, presently?") and (2) an unconstructive form of rumination, consisting in abstract and analytical thinking (e.g., "why am I feeling so depressed, what will happen to me if I cannot feel better?) (Watkins 2008). In adults, it has been shown that the beneficial effects on psychological symptoms of participating in a program of Mindfulness-Based Cognitive Therapy (MBCT; Segal et al. 2002) were partly mediated by changes in ruminative thinking (Heeren and Philippot 2011). It is suggested that the development of executive attention entailed by mindfulness training boosts the individual's capacity to disengage from abstract repetitive thinking. This decrease in unconstructive rumination would foster a better regulation of emotional problems. Studies in adolescent samples have shown that ruminative thinking predicts a future increase in bulimic and substance abuse symptoms (Nolen-Hoeksema et al. 2007) and in internalized symptoms (Hankin 2008). In particular, higher levels of rumination are associated with a greater increase in depressive symptoms over time (e.g., Nolen-Hoeksema et al. 2007), with a fourfold increase in the likelihood of experiencing a future major depressive episode, and with a longer duration of future depressive episodes (Abela and Hankin 2011). Moreover, unconstructive rumination is associated with maladaptive coping strategies in response to stressors, including avoidance, denial, and fleeing (Burwell and Shirk 2007). Few studies have considered conduct and opposition disorders in relation to rumination in adolescence; in those that have examined these constructs, no relationship was observed (Hankin 2008; Nolen-Hoeksema et al. 2007).

Studies utilizing MBI in adolescent samples showed some beneficial effects on lessening symptomatology (for a detail review, see Deplus et al. 2014). Regarding externalizing symptomatology, there is evidence for decreased self-reported ADHD symptoms (Zylowska et al. 2008), less aggressive behaviours among adolescents with autism (Singh et al. 2011a, 2011b), fewer self-reported social problems (Bögels et al. 2008), as well as parental reports of fewer social and behaviour problems (Haydicky et al. 2012).

With regards to internalizing symptomatology, studies have shown a decrease in self-reported anxiety, depression, and somatic distress (Biegel et al. 2009), in sleep disturbances (Bootzin and Stevens 2005), as well as in emotional discomfort among HIV-infected and at-risk urban youth (Sibinga et al. 2011). Raes et al. (2014) found that the decrease in self-reported depression after an intervention was maintained at a 6-month follow-up. Improvements in self-esteem, sleep quality (Biegel et al. 2009), and optimism (Schonert-Reichl and Stewart Lawlor 2010) have also been emphasized. However, no differences were observed in positive and negative affect (Schonert-Reichl and Stewart Lawlor 2010) or in executive functioning (Haydicky et al. 2012).

It should be noted that only two studies incorporated a self-report measure in their design to assess change in mindfulness. One study reported a significant increase in mindfulness following the intervention (Bögels et al. 2008), whilst the other did not (Van de Weijer-Bergsma et al. 2012). To our knowledge, no study has explored the impact of MBI on impulsivity. Nevertheless, in correlational studies conducted in young adults, low mindfulness was associated with both high urgency and low perseverance (Murphy and MacKillop 2012; Peters et al. 2011). With regards to rumination, studies in adults observed that changes in ruminative thinking mediate the benefits of mindfulness on psychological symptoms (Heeren and Philippot 2011). In a sample of adolescents, Bootzin and Stevens (2005) reported a decrease in rumination after a six-session MBI for insomnia.

The purpose of this study was to examine the effect of an MBI intended to enhance self-regulation of emotion in adolescents. Beyond symptom reduction, special attention was given to identifying the processes by which such an intervention operates. Hence, we studied not only the impact of the intervention on mindfulness skills and depressive symptoms, but also on emotional regulation strategies, impulsivity, and rumination. We hypothesized that participating in the intervention would be associated to an increase in mindfulness and a decrease in dysfunctional emotional regulation strategies, impulsivity facets that have been relied to low mindfulness (urgency and lack of perseverance), ruminative thinking, and depressive symptomatology.

Method

Participants

The adolescents were clients at an academic centre for clinical psychology in Belgium that routinely offers mindfulness training to adults, adolescents, and children. Participants were recruited through an Internet advertisement about an MBI for self-regulation of emotion. Interested participants and their parents were given information about the mindfulness intervention (e.g., participation, exercises to be implemented in the daily life) and about the study (e.g., procedure, ethical considerations). Inclusion criteria were that both the child and the parents were requesting and motivated for an intervention targeting emotional difficulties

presented by the child; being registered in a regular secondary school program; and being fluent in French. Exclusion criteria were presenting an acute disorder necessitating another primary intervention; an IQ below 80; and a physical impairment preventing oral communication. A total of 41 white Caucasian adolescents were initially contacted. Ten adolescents eventually refused to participate in the intervention due to lack of personal interest. Ten met criteria for exclusion (severe attention deficit never treated, occurrence of dissociative states, severe communication impairment) and were redirected to other professionals. Parents participated in an individual informative interview before and after the intervention but were not included in the treatment program.

A total of 21 participants were offered free MBI training. They were distributed in small groups according to their age. No dropout occurred. The sample included 15 girls and 6 boys, aged between 11 and 19 years ($M = 14.61$, $SD = 2.20$). All were native French speakers. The parents' highest level of education was used as indicator of socio-economic status: 15.8 % of mothers had high school education, 42.1 % higher education, and 42.1 % university education; 15.8 % of fathers had high school education, 15.8 % higher education, and 68.4 % university education. More than half of the participants (57.1 %) met or exceeded the cutoff score for mild depression on the Multiscore Depression Inventory for Children ($M = 57.48$, $S.D. = 8.71$).

Procedure

Both participants and their parents provided informed consent. For the baseline assessment, the adolescents completed the questionnaires at home in the course of the week before the intervention. The second assessment was done individually at the end of the last group session. Upon completion of the entire study, the participants were fully debriefed.

Intervention

The intervention was derived from Mindfulness-Based Cognitive Therapy (MBCT; Segal et al. 2002), adapted for French-speaking adolescents aged 11 to 18 year olds. This adaptation was based on the authors' clinical experience and on recommendations in the literature that aim to enhance youths' comprehension and commitment to such an intervention (Thompson and Gauntlett-Gilbert 2008). Modifications were made to the number, length, and content of the weekly sessions, and the modified intervention comprised nine 90-minute weekly sessions. Specifically, the program includes the practices and the progressive nature of MBCT, but the formal practices were shortened to a length of 10 min. The MBCT component of psychoeducation about depression was suppressed. During each session, we introduced information on emotion (distinguishing thoughts, feeling and body sensations) and emotional regulation. However, no specific emotion regulatory skills were taught beyond mindfulness training. The program structure and progression was similar for all age groups, but the specific examples and metaphors used during psychoeducation and debriefing were adapted to the age of the participants. We also stressed the utility of mindfulness practices in everyday life by teaching participants to apply mindfulness techniques to their own idiosyncratic difficulties using a large variety of entertaining and multisensory exercises, such as listening to short segments of music and identifying any feelings that arise or playing with a balloon and exploring the sensations of the breath. In order to further encourage youth to use mindfulness techniques, the length of formal practice was decreased to about 10 min per day. Table 1 shows

an overview of the main themes of each of the nine sessions. The treatment manual may be obtained from the authors on request.

Each group was conducted by a senior therapist (CBT certified therapist with at least 2 years of experience in MBI with children and adolescents) and a junior trainee (trainee in a CBT psychotherapy program with a Master's degree in psychology). There were two senior therapists and a junior trainee. The latter checked (a) the integrity of the program on the basis of a comprehensive manual and a checklist of all necessary elements for each session and (b) the similarity of the intervention between senior therapists.

Participants received an audio CD with mindfulness exercises and session handouts that described the session theme, provided instructions for practice, and included homework completion forms. For the nine training sessions, the participants were divided into three subgroups of six to eight according to their age.

Measures

Mindfulness

The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006, Baer et al. 2008; French validation by Heeren et al. 2011) is a 39-item self-report measure assessing the level of mindfulness in daily life. It includes five facets of mindfulness: *observing* (attending to or noticing internal and external stimuli, such as sensations, emotions, cognitions, sights, sounds, and smells; Cronbach's alpha in the present study: .78), *describing* (noting or mentally labeling these internal and external stimuli with words; Cronbach's alpha in the present study: .87), *acting with awareness* (attending to one's current actions, as opposed to behaving automatically or absent-mindedly; Cronbach's alpha in the present study: .87), *non-judging of inner experience* (refraining from evaluation of one's sensations, cognitions, and emotions; Cronbach's alpha in the present study: 91) and *non-reactivity to inner experience* (allowing thoughts and feelings to come and go, without attention getting caught up in them; Cronbach's alpha in the present study: 61). Items are rated on a 5-point scale from 1 (*never or very rarely true*) to 5 (*very often or always true*). Heeren et al. (2011) reported a good internal

Table 1 Overview of the adolescent mindfulness-based intervention for enhancing emotional regulation

Session	Theme	General goals
1.	The Alien's attitude	Developing community; defining the setting; introduction to mindfulness.
2.	Paying attention to the body	Becoming more mindful of the body sensations.
3.	Stopping and breathing	Breathing as an anchor in the present.
4.	Welcoming the emotion	Identifying judgment of the emotional experience; exploring emotion.
5.	Not doing what the emotion tells me to do	Inhibiting automatic response to the emotion.
6.	Keeping my distance from the thoughts	Changing the attitude toward the thoughts.
7.	Moving forward to what is important to me	Reflection about values; engagement in actions.
8.	Acting	Defining constructive actions in distressful situations.
9.	It is only the beginning…	Sharing experiences of the intervention; discussing the upholding of the practice.

consistency, with a value of Cronbach's alpha higher than .75 for all factors (between .76 and .89). Test-retest reliability was good for the global scale (r = .64) and for each subscale (between .41 and .73) over a period of 8 weeks.

Depressive Symptomatology

The Multiscore Depression Inventory for Children (MDI-C; Berndt and Kaiser 1996; French validation by Berndt and Kaiser 1999) is a self-report inventory that assesses depressive symptoms in children and adolescents from 8 to 17 years old. The MDI-C includes 79 true-false items on eight subscales: *anxiety* (physical and cognitive aspects), *low self-esteem* (child's perception of him/herself), *sad mood* (child's affective state), *instrumental helplessness* (child's perception of his/her capacity to cope with social situations), *social introversion* (child's tendency to withdraw into him/herself in social situations), *low energy* (intensity of cognitive and physical capacities), *pessimism* (child's perception of his/her future), and *defiance* (behavioural problems). Internal consistency for the total score was reported to be good, with a Cronbach's alpha value of .92 in the original validation (Berndt and Kaiser 1999), and .91 in the present study. T-scores on the MDI-C from 56 to 65 indicate mild to moderate depressive symptoms, whereas T-scores over 75 indicate severe symptoms. As this measure assesses mood states that tend to be stable and persistent, it is comparatively insensitive to transient fluctuations in affect. The MDI-C was chosen because it measures various depression-related features separately and because it can be used to assess both mildly and severely depressed youth.

Impulsivity

The UPPS Impulsivity Scale (Whiteside and Lynam 2001; French validation by Van der Linden et al. 2006) is a 45-item self-report inventory, divided in four subscales: *urgency* (Cronbach's alpha in the present study: 86), *lack of premeditation* (Cronbach's alpha in the present study: .85), *lack of perseverance* (Cronbach's alpha in the present study: .77), and *sensation seeking* (Cronbach's alpha in the present study: .87). Items are rated on a 4-point scale from 1 (*I completely agree*) to 4 (*I completely disagree*). In a community sample of adolescents aged from 12 to 19 years, the four subscales had good internal reliability, with Cronbach's alpha higher than .81 (d'Acremont and Van der Linden 2005).

Emotional Regulation

The Regulation of Emotions Questionnaire (REQ; de Phillips and Power 2007; French translation by Philippot 2009) is a 22-item self-report inventory developed for adolescents between 12 and 19 years old that classifies emotion regulation strategies according to the adaptive function of the strategy used (functional or dysfunctional) and according to the nature of the resources used (internal or external). It has four subscales: *internal-functional strategies* (Cronbach's alpha in the present study: .58), *external-functional strategies* (Cronbach's alpha in the present study: .70), *internal-dysfunctional strategies* (Cronbach's alpha in the present study: .58), and *external-dysfunctional strategies* (Cronbach's alpha in the present study: .77). Items are rated on a 5-point scale from 1 (*not at all*) to 5 (*always*). In the original validation study, all scales demonstrated acceptable internal consistency, with Cronbach's alpha between .66 and .76 (Phillips and Power 2007).

Repetitive Thoughts

The Mini Cambridge-Exeter Repetitive Thought Scale (Mini-CERTS; Barnard et al. 2007; French validation by Douilliez et al. 2014) is a 16-item self-report inventory that assesses two dimensions of ruminative thinking: constructive thinking and un-constructive thinking. Items are rated on a 4-point scale from 1 (*almost never*) to 4 (*almost always*). The internal consistency, as measured by Cronbach's alpha, is acceptable to good for the subscales constructive thinking (.61 Cronbach's alpha in the present study) and unconstructive thinking (.80 Cronbach's alpha in the present study) (Douilliez et al. 2014).

Compliance

Three ad-hoc questions were submitted to the participants after the intervention in order to evaluate their compliance with the formal and informal practice requested by the program. The first question was "during in-session formal practice, I was exactly following instruction" and had four possible answers (never, sometime, most of the time, always). The second and third questions pertained to formal and informal practice at home : "At home, I was doing the formal practice homework assigned after the session", and 'I was using during everyday life mindfulness practice learned during sessions", with multiple-choice answers (never, once or twice a week, three to five time a week, more than five time a week).

Results

Outcomes of the Mindfulness-Based Intervention on Mindfulness

A pair-wise comparison Student *t*-test evidenced a significant increase in the total score of mindfulness (FFMQ) from pre-test to post-test This increase was observed for all subfacets: *Observing*, *Describing*, *Acting with awareness*, *Non-reactivity to inner experience*, and *Non-judging of inner experience*. Means, standard deviations, *t*-test and *d* values are displayed in Table 2.

Outcomes of the Mindfulness-Based Intervention on Depressive Symptomatology

The total score on depressive symptomatology (MDI-C) decreased significantly from pre-test to post-test. Regarding the subscales, the decrease was significant in *Instrumental helplessness*, *Low self-esteem*, *Social introversion*, and *Pessimism*. The decrease was either not significant or merely showed a statistical trend in the other subscales: *Anxiety Sad mood*, *Low energy*, and *Defiance* (see Table 2).

Outcomes of Mindfulness-Based Intervention on Psychological Processes

Regarding impulsivity, we observed a significant decrease in *Urgency* and *Lack of persever-ance*. The decrease was not significant for *Lack of premeditation* or *Sensation seeking* (see Table 2).

Table 2 Means and standard deviations in FFMQ, MDI-C, UPPS, QRE and MINI-CERTS pre- and post-intervention (N=21)

	Pre-intervention M (SD)	Post-intervention M SD)	t-Test	d
Mindfulness (FFMQ)	108.48 (16.60)	126.19 (19.70)	5.46***	1.00
Observing	21.48 (6.57)	24.43 (4.94)	1.82*	.52
Describing	22.76 (6.43)	25.62 (5.07)	2.40*	.51
Acting with awareness	22.76 (7.17)	25.10 (6.03)	2.37*	.36
Non-reactivity	17.33 (3.97)	21.43 (4.35)	3.92***	1.01
Non-judging	24.14 (8.03)	29.62 (9.47)	5.46***	.64
Symptomatology (MDI-C)	22.71 (11.95)	16.28 (10.47)	2.91**	.59
Anxiety	5.04 (2.31)	4.38 (2.51)	1.62†	.28
Low self-esteem	2.90 (2.34)	2.00 (1.92)	1.75*	.43
Sad mood	2.42 (2.31)	1.52 (2.33)	1.69†	.40
Helplessness	2.04 (2.15)	1.14 (1.23	2.25*	.53
Introversion	1.19 (1.50)	.57 (.97)	1.89*	.50
Low energy	3.19 (2.31)	2.47 (2.35)	1.36†	.32
Pessimism	2.47 (2.58)	1.38 (2.13)	2.39†	.47
Defiance	3.42 (2.18)	2.80 (1.86)	1.48†	.31
Emotional regulation (QRE)				
External-functional	3.12 (.74)	3.23 (.66)	1.02	.16
External-dysfunctional	1.74 (.69)	1.58 (.46)	1.30	.28
Internal-functional	2.83 (.44)	2.96 (.48)	.96	.29
Internal-dysfunctional	2.64 (.74)	2.01 (.60)	3.96***	.96
Impulsivity (UPPS)				
Urgency	32.95 (7.48)	28.86 (6.73)	2.77**	.59
Lack of perseverance	23.48 (5.13)	21.19 (4.16)	2.67**	.50
Lack of premeditation	26.29 (5.78)	24.19 (4.00)	1.35†	.43
Sensation seeking	31.00 (8.03)	29.95 (8.09)	.87	.13
Repetitive thoughts (Mini-CERTS)				
Constructive	16.28 (3.39)	17.80 (2.40)	1.79*	.53
Unconstructive	23.9 (5.44)	19.95 (5.45)	3.97***	.74

† = .10, * $p < .05$, ** $p < .01$, *** $p < .001$

FFMQ Five Facet Mindfulness Questionnaire; *MDI-C* Multiscore Depression Inventory for Children; *UPPS* UPPS Impulsivity Behavior Scale; *REQ* Regulation of Emotions Questionnaire; *Mini-CERTS* Mini Cambridge-Exeter Repetitive Thought Scale

Analysis of the emotion regulation questionnaire (REQ) revealed that the *internal-dysfunctional strategies* decreased from pre-test to post-test. However, the decrease in the *external-dysfunctional strategies* was not significant. No significant difference was observed in the *internal-functional strategies* or *external-functional strategies* (see Table 2).

Regarding repetitive thoughts assessed by the Mini-CERTS, the score on *unconstructive repetitive thoughts* decreased significantly from pre-test to post-test, whereas the score on *constructive repetitive thoughts* increased (See Table 2).

Correlations Between Mindfulness and Improvement in the Other Evaluations

In order to assess the relationship between changes in mindfulness and in the other evaluations, we first calculated a change score (i.e., the difference between pre- and post-intervention scores for each evaluation). Pearson correlations between change scores on mindfulness, depressive symptomatology, impulsivity, emotion regulation, and repetitive thoughts revealed several significant relationships, which are presented in Table 3.

Are the Effects of Mindfulness Improvement on Mental Health Mediated by Emotion Regulation Processes?

Table 3 shows that improvement in mindfulness is correlated with a diminution of symptomatology. In order to examine whether the effect of mindfulness training (as indexed by a change on the FFMQ) is mediated by an improvement in emotion regulation skills, we conducted mediation analyses. In these analyses, the change score in mindfulness (difference score of the FFMQ) was the independent variable and the change score in symptomatology (difference score on the MDI-C) was the dependent variable. Mediation analyses used the PRODCLIN method (Tofighi and MacKinnon 2011) and computations were performed on the web-based freeware www.amp.gatech.edu/RMediation . Separate mediation analyses were conducted with, respectively, change scores in unconstructive rumination, in internal dysfunctional emotion regulation strategies, and in lack of perseverance as mediators, i.e., the processes for which a significant correlation with mindfulness change is reported in Table 3. These analyses revealed a significant mediation effect for unconstructive rumination changes (CI, $p < 05$: -.499 - -.018; $\mu = -.202$; $\sigma = .125$), and for internal dysfunctional emotion regulation changes (CI, $p < 05$: -.548 - -.004; $\mu = -.253$; $\sigma = .139$). However, for changes in lack of perseverance, the confidence interval included 0, failing to index a significant mediation (CI, $p < 05$: -.342 - .056; $\mu = -.089$; $\sigma = .125$). These mediational analyses should be interpreted cautiously given the small sample size.

Compliance

Participants were generally compliant during the sessions: eight participants reported to always follow exactly the instruction of the practice during session, nine to follow them most of the time, three to do it sometime, and only one to systematically fail to follow exactly the instructions. Homework practice was generally well attended: All but one participant reported to do the homework on a regular basis. Eight practiced once or twice a week, ten participants three to five times a week and two participants more than five times. Finally, participants reported to have transferred mindfulness practice in their everyday life. Eight reported to use some practice in everyday life once or twice a week, 11 participants three to five times a week, and two participants, more than five times a week.

Discussion

Participants reported an increase in each of the five facets of mindfulness: observing internal and external stimuli, describing inner experience, non-judging of inner experience, non-reactivity to inner experience, and acting with awareness. These results are consistent with

Table 3 Correlations (Pearson) between change scores for mindfulness, depressive symptomatology, impulsivity, emotion regulation, and repetitive thoughts (N = 21)

	MDI-C	UPPS				REQ				MINI-CERTS	
		U	Pers	Prem	SS	IF	ID	EF	ED	C	UC
Mindfulness (FFMQ)	-.455**	-.324	-.531*	-.400	.147	.038	-.279*	.039	-.083	.212	-.332**
Symptomatology (MDI-C)	—	.558**	.203	.290	.035	.154	.523**	-.257*	.335**	-.118	.293**
Impulsivity (UPPS)											
Urgency		—	-.027	.097	.331	-.153	.637**	-.084	.366	-.288	.332
Lack of perseverance			—	.475*	-.102	-.101	.141	-.339	.114	-.245	.496*
Lack of premeditation				—	-.268	.376	.362	-.432*	.092	-.481*	.327
Sensation seeking					—	-.035	.034	-.105	.324	-.233	.288
Emotional regulation (QRE)											
Internal-functional						—	.024	.130	.117	.285*	.034
Internal-dysfunctional							—	-.141	.364**	-.116	.315**
External-functional								—	.079	.120	-.057
External-dysfunctional									—	.075	.199
Repetitive thoughts (Mini-CERTS)											
Constructive										—	-.027

*$p < .05$, ** $p < .01$

FFMQ Five Facet Mindfulness Questionnaire; MDI-C Multiscore Depression Inventory for Children; UPPS UPPS Impulsive Behavior Scale, U urgency, Prem: lack of premeditation, Pers: lack of perseverance, and SS sensation seeking; REQ Regulation of Emotions Questionnaire, IF internal-functional strategies, EF external-functional strategies, ID internal-dysfunctional strategies, and ED external-dysfunctional strategies; Mini-CERTS Mini Cambridge-Exeter Repetitive Thought Scale, C constructive thinking and UC unconstructive thinking

previous findings in French-speaking adults showing that mindfulness training increases self-reported mindfulness assessed with the FFMQ (e.g., Heeren et al. 2011, 2015). The items of this questionnaire refer to daily life (e.g., *When I take a shower or bath, I stay alert to the sensations of water on my body*). Hence, the changes reported on the FFMQ suggest that the present mindfulness-based intervention has improved mindfulness skills and their practice in daily life. Furthermore, the fact that all the participants completed the nine-session program suggests that the intervention is suitable for adolescents aged between 11 and 19 years. This is further supported by the compliance data, most of the participants reported a regular formal practice in session and between sessions, as well as transferring mindfulness practices in their everyday life.

Following this mindfulness skills training, a decreased level in depressive symptoms was observed, as was the case in previous studies with adults (e.g., van Aalderen et al. 2012) and with adolescents (Biegel et al. 2009; Bögels et al. 2008; Raes et al. 2014). The current study reinforces the need to develop this body of literature in assessing not only the symptomatology, but also potential mediating psychological processes.

As expected, a decrease was observed regarding the two impulsivity facets that were related to poor mindfulness skills in previous studies, namely urgency and lack of perseverance (Murphy and MacKillop 2012; Peters et al. 2011). These results are of particular interest if we consider the cognitive mechanisms associated with these impulsivity traits. First, lack of perseverance was related to a reduced ability to resist to the occurrence of irrelevant or intrusive information into awareness, as evidenced by low performances in laboratory tasks measuring resistance to proactive interference and mind-wandering proneness (Gay et al. 2008), as well as with poorer thought control skills (Gay et al. 2011).

Second, high urgency was related to a poorer ability to inhibit automatic behaviors, as evidenced by low performance in a laboratory task assessing prepotent response inhibition (Gay et al. 2008), as well as with the proneness to be involved in externalizing behaviors aiming at relieving negative affect in the short term despite adverse consequences (e.g., substance abuse, disordered eating; Billieux et al. 2007, 2010; Mobbs et al. 2010). Thus, it is reasonable to suggest that MBI, through the development of skills regarding non-reactivity to inner experiences or acting with awareness, might be useful to reduce the occurrence of impulsive behaviors. It is worth noting that no changes were found regarding the sensation seeking and the lack of premeditation facets of impulsivity. These results are unsurprising and in accordance with previous data obtained in adult samples. On the one hand, sensation seeking reflects openness to new experiences and stimulations, which is actually a characteristic of mindfulness. Previous studies indeed found this impulsivity component to positively correlate with the observing facet of mindfulness (Murphy and MacKillop 2012; Peters et al. 2011). On the other hand, premeditation could depend on the efficacy of high-level cognitive processes involved in deliberative thinking and decision-making skills (Bechara and Van der Linden 2005; Billieux et al. 2010) which are not directly targeted by an MBI.

After the intervention, the internal-dysfunctional emotional strategies decreased, especially the unconstructive mode of rumination. Participants reported less abstract and analytical repetitive thinking. As mentioned earlier, the literature has highlighted the relation between emotional regulation skills and psychopathology in late childhood and adolescence (e.g., Betts et al. 2009), notably rumination and depression (e.g., Abela and Hankin 2011). The mediation analyses suggest that the relation between mindfulness training and depressive

symptomatology is partly mediated by a decrease in internal dysfunctional emotion regulation strategies and in unconstructive rumination. A similar result has already been reported in adults (Heeren and Philippot 2011).

However, these results should be interpreted with caution due to the small sample size and the lack of a control group. Multiple tests were conducted, raising the probability of Type I error. Future research should include a larger sample of adolescents from more diverse socio-cultural groups. As we only rely on self-reports, we cannot exclude the influence of response bias (e.g., social desirability, lack of introspection). Further, participants filled in the question-naire at home. Although parents and adolescents were instructed that the questionnaires were to be filled in by the child alone in a quiet room, we cannot exclude the influence of external factors. Finally, follow-up data should be collected to determine whether the outcomes are maintained over time.

In conclusion, the present findings support the hypothesis that MBI is associated with change in self-reported mindfulness, emotion regulation processes, impulsivity, and depressive symptomatology. It provides a nine-session group intervention for adolescents with emotion regulation difficulties, targeting transdiagnostic psychological processes such as impulsivity and ruminative thinking. Furthermore, by potentially enhancing important self-regulation skills, this intervention might constitute an attractive method of general prevention for psychological disorders.

Compliance with Ethical Standards

Conflict of Interest Sandrine Deplus, Chantal Scharff, Joël Billieux and Pierre Philippot declare that they have no conflict of interest.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

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