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Research Paper

Temperament and symptoms of stress and depression among adolescents: The mediating role of psychological flexibility

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ABSTRACT

Background: Early appearing temperamental differences and the psychological flexibility skills of individuals are proposed factors influencing stress and depression among adolescents. We test the theoretical assumption that temperament may form a basis for facing the outer world, while the development of psychological flexibility being another such basis and a mediator in well-being outcomes.

Methods: Using data on 740 adolescents (M_{age} = 15.7 years, 57% female) assessed at the beginning and end of the final grade of basic education, structural equation modeling (SEM) with mediation analysis was conducted to examine the associations between the key temperament dimensions, changes in *psychological flexibility,* and changes in *symptoms of stress and depression*.

Results: The results indicate that both temperament and psychological flexibility had unique, *direct* associations with changes in symptoms of stress and depression. There were also *indirect* links between temperament and changes in symptoms achieved via psychological flexibility: adolescents with *negative affectivity* (NA) showed an increase in symptoms of stress and depression mediated by lower psychological flexibility, while adolescents with *effortful control* (EC) *and extraversion* (EX) showed a decrease in symptoms, mediated by higher psychological flexibility.

Limitations: More research with longer-term follow-up study designs is needed to explore these associations thoroughly.

Conclusions: Temperamental patterns play a significant role in the development of psychological symptoms. However, these associations are modified by psychological flexibility. Together, temperamental dimensions and psychological flexibility form cumulative patterns influencing psychological symptoms. The practical implications of the findings are discussed in this study.

Psychological flexibility refers to the ability to contact the present moment fully and with adequate behavior in the service of chosen values (Hayes et al., 2012). It is a set of skills that includes the ability to feel and think with openness, to attend to experiences in the present moment, and to move life in the direction that is important to oneself (Hayes, 2019). Numerous studies on adults have shown that high psychological flexibility is closely connected to well-being and health, whereas low psychological flexibility is linked to ill-being and a variety of psychological symptoms (A-Tjak et al., 2015; Powers et al., 2009). However, studies exploring the associations between psychological flexibility and psychological well-being and ill-being among adolescents are still rare, with research by Halliburton and Cooper (2015) and Swain et al. (2015) being among the few in the literature. In addition, less attention has been paid to innate, early appearing, relatively stable individual differences such as temperament and how temperament interacts with psychological flexibility with regard to understanding

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psychological symptoms and well-being. Although it is known that temperament and well-being are closely related in adolescents (Laceulle et al., 2015; Klein and Finsaas, 2017), no previous studies have investigated potential direct and indirect associations between temperament and psychological flexibility and well-being.

To overcome the limitations of previous research, this study investigates the associations between temperament and psychological flexibility as well as their role in the development of psychological symptoms among youth. This knowledge may provide new perspectives on these attributes and skills, and may also have practical implications—for example—for the planning of individualized psychological interventions aimed at improving the well-being and health of adolescents.

1. Stress and depressive symptoms among adolescents

An alarming number of adolescents (20–40%) across the Western world report symptoms of stress and depression during their last school year of basic education (Wiklund et al., 2012). During their last compulsory school year, the levels of stress and depression experienced by adolescents can be even higher than those experienced by adults (APA, 2014; WHO, 2014) because adolescents are likely to face multiple personal and social challenges simultaneously across different life domains due to changes in their cognitive development, biological maturation, evolving sexuality, social relationships, and educational paths (Denham et al., 2009).

2. Psychological flexibility and well-being

Psychological flexibility is a key concept derived from the third-wave cognitive therapy approach of acceptance and commitment therapy (ACT). *Psychological flexibility* is defined as the ability to fully contact the present moment as a conscious human being, and changing or persisting in one's behavior while doing so serves valued goals (Hayes et al., 2006). Psychological flexibility comprises two broader sub-processes: a mindfulness and acceptance process, and a behavioral process. *Mindfulness* refers to a state of consciousness in which attention is focused on present moment phenomena, and *acceptance* to a willingness to experience all ongoing experiences without changing, avoiding, or controlling the experiences. *Behavioral processes* are used to clarify one's values and take actions that lead to goal accomplishment (Hayes and Hofmann, 2017; Hayes et al., 2006).

There are an abundance of intervention studies showing that enhanced psychological flexibility is connected to well-being and mental health among adults (Flaxman et al., 2013; Hayes et al., 2006; Powers et al., 2009). Intervention studies of adolescents have also been successful in enhancing psychological flexibility, increasing quality of life and alleviating diverse psychological conditions (Fang and Ding, 2020; Swain et al., 2015) including symptoms of stress and depression (Livheim et al., 2015; Petts et al., 2017; Puolakanaho et al., 2019).

In the theoretical views of ACT, every person is thought to have an innate capacity for psychological flexibility and related subskills (here mindfulness and acceptance skills and behavioral skills pursuing into one's own valued life). These skills are thought to develop via interactions with other individuals and across life events (Hayes et al., 2006, 2012; Hayes and Hofmann, 2017), and therefore, they also vary across the people. On the other hand, in the ACT interventions psychological flexibility is thought to act as a change mechanism—that is—a mediator of changes in well-being (Dindo et al., 2017; Hayes et al., 2012; Hayes and Hofmann, 2017) as illustrated especially in intervention studies using adult samples (Lloyd et al., 2013; Puolakanaho et al., 2020).

Thus, levels of psychological flexibility related skills and changes in them are thought to reflect core psychological skills and thereby influence how individuals experience various factors related to oneself and life events (Hayes et al., 2012; Hayes and Hofmann, 2017).

The ACT approach also suggests that diverse psychological symptoms are associated because they have common roots in the psychological processes and skills of the individual (Dindo et al., 2017; Hayes and Hofmann, 2017). These theoretical views also suggests that (developmental) changes in psychological flexibility may influence other individual constructs, such as temperament. In this study, we investigate whether symptoms of stress and depression have similar associations with psychological flexibility and how these constructs are linked to temperament using developmental data.

3. Temperament and well-being

Temperament refers to early appearing individual differences in reactivity to environmental and internal stimuli, as well as in the neural and behavioral self-regulation processes modulating this reactivity (Putnam et al., 2001; Rothbart, 2011). Temperament is thought to form the core of an individual's uniqueness, and the individual's personality develops as a result of the interaction between the individual's temperament and the environment; therefore, temperament and personality are correlated individual attributes (Rothbart, 2007). Thus, temperament can be seen as part of an individual's personality. However, personality also includes cognitions about the self and others, values, attitudes, and coping strategies (Rothbart, 2007, 2011). In the following literature review, relevant personality studies, especially those referring to " Big Five" personality dimensions, (McCrae and Costa, 1997, 2008) are also outlined.

This study applies the developmental model of temperament proposed by Rothbart and her colleagues (Rothbart, 2011), examined also among Finnish adolescents (Kiuru et al., 2019). According to the model, temperament can be categorized into four main dimensions: *effortful control (EC), negative affectivity (NA), extraversion (EX),* and *affiliativeness (AF)* (Kiuru et al., 2019; Putnam et al., 2001; Rothbarth, 2007). Temperament is thought to shape the ways in which the individual reacts and adapts to external and internal stimuli (Rothbart, 2011). Consistent with this view, the four temperament dimensions have been linked to various psychological well-being outcomes. Conversely, these same dimensions are inversely related to ill-being outcomes (DeNeve and Cooper, 1998; Klein and Finsaas, 2017). For example, Viñas eand her colleagues studied a sample of 12- to 16-year-old adolescents and found that the temperament dimensions that best predicted a high level of personal well-being were reversed subscales of EX (activity level and shyness) and subscales of EC (inhibitory control and activation control) and affiliation (Viñas et al., 2014). Emotional instability or neuroticism (close with NA) has consistently been found to be linked to internalizing symptoms (e.g., depressive symptoms and anxiety) among adolescents in clinical and community samples (Dougherty et al., 2010; Muris et al., 2007). Adolescents with emotional instability or neuroticism also experience lower levels of well-being than those who score low in these dimensions (Muris et al., 2007). In contrast, findings by Gulley et al. (2016) indicate that high levels of EC are linked to lower levels of depressive and anxious symptoms (Hollenstein and Lougheed, 2013). Finally, Hirvonen et al. (2019) demonstrated that among sixth-grade students, high NA and low EC are linked to experiencing school-related stress (Laceulle et al., 2015).

4. Associations between temperament, psychological flexibility, and well-being

Research in the literature show that both psychological flexibility and temperament are connected to a variety of well-being outcomes. However, there is a dearth of studies examining the simultaneous associations between temperament, psychological flexibility, and well-being among adolescents. A couple of studies have found connections between personality traits and psychological flexibility among adults (Giluk, 2009; Latzman and Masuda, 2013) while a few have investigated the relationship between personality traits (primarily neuroticism) and

mindfulness in relation to well-being outcomes (Luca et al., 2017; Mario et al., 2015). However, only a handful of studies have investigated mediation relationships (an indirect link) between these constructs. As an exception, Fetterman et al. (2010) studied 226 undergraduate students and found that mindfulness fully mediates the relations between neuroticism and subsequent impulsivity and behavioral regulation. In addition, O'Loughlin et al. (2019) conducted two studies on university students, with the first study revealing that mindfulness skills partially mediate the associations between neuroticism and physical symptoms. The second study demonstrates that increased neuroticism is associated with increased stress appraisals (the first mediator) and lowered mindfulness (the second mediator), which are in turn linked to higher stress levels and more severe physical symptoms (O'Loughlin et al., 2019). To the best of our knowledge, thus far, no developmental research has investigated the key temperament dimensions and their relationships to developmental changes in psychological flexibility and symptoms of stress and depression among younger adolescents, which is the chief aim of this study.

5. The current study

Temperament and psychological flexibility seem to complete each other within their theoretical framework. Temperament connotes the early appearing innate predisposition to face different live events and the outer world (Rothbart, 2011). Psychological flexibility, on the other hand, consists of developing learnable self-awareness and behavioral skills, which influence the individual's interpretation of internal stimuli and adaptation to the outer world (Hayes et al., 2012; Hayes and Hofmann, 2017). To conclude, temperament refers to mostly inherited individual differences that are biologically based. We propose that these individual differences could be influenced and modified by psychological flexibility. This hypothesis is based on the idea that temperament patterns show up in behaviors. In fact, temperament is usually concluded from behaviors, actions, emotional and thought patterns and reactions. Thus, there is an interaction between biological individual differences and behavioral patterns. We assume that this interaction could be influenced by psychological flexibility. If this is the case, then temperament patterns could be impacted by increased psychological flexibility skills. *Thus, temperament may form a basis for facing the outer world, and psychological flexibility is another such basis and a mediator to well-being outcomes.* The primary objective of this paper is to test these assumptions.

We investigate whether changes in psychological flexibility can mediate the relationship between temperament and changes in symptoms of stress and depression among the adolescent population. The sample used in this study was a large community sample ($n = 740$) of ninth-grade adolescents assessed during their final year of basic education, immediately preceding the critical transition to upper secondary education, which is likely to induce psychological ill-being and related symptoms, such as stress and depression. The associations between the selected variables were investigated using structural equation modeling (SEM), which allows for simultaneous examination of the mediation effects including direct (c') and indirect ($a * b$) relationships between multiple variables (Fig. 1) (Kline, 2015).

The research questions were as follows:

Q1: First, we wanted to verify whether changes in the hypothesized mediating variables—of psychological flexibility—were associated with changes in symptoms of stress and depression. Thus: *Are the changes in ninth-grade adolescents' psychological flexibility related to changes in their reported symptoms of stress and depression?* (Path *bS* and Path *bD*, Fig. 1). Based on the ACT theory (Dindo et al., 2017; Hayes et al., 2012; Hayes and Hofmann, 2017) and some previous intervention studies among adults (Lloyd et al., 2013: Puolakanaho et al., 2020), we assumed that both initial levels of and changes in psychological flexibility are related to changes in symptoms of stress and depression (Q1: Hypothesis 1).

Q2: Second, we wanted to investigate whether our independent variable (temperament) is associated with changes in psychological flexibility. Thus: *Are the four temperament dimensions (EC, NA, EX, AF) associated with changes in the psychological flexibility of ninth-grade adolescents?* (Path *a*, Fig. 1). We assumed that individual innate predisposition differences (temperament) are associated with psychological flexibility. Based on earlier studies, which found associations between all Big Five personality traits and psychological flexibility related measures (Giluk, 2009; Latzman and Masuda, 2013), we expected to find significant associations between the four temperament dimensions and psychological flexibility. Specifically, NA was expected to be negatively related to psychological flexibility, while all the other dimensions (i.e., EC, EX, and AF) were expected to be positively related to psychological flexibility (Q2: Hypothesis 2).

Q3: The third question is twofold. First, *do the four temperament dimensions and psychological flexibility have unique, direct associations with changes in symptoms of stress and depression?* (Paths *c'S* and Path *c'D,* Fig. 1). Second, *do the four temperament dimensions have indirect associations (mediation relationships) with changes in symptoms of stress and depression?* (Path *a * bS* and Path *a * bD,* Fig. 1). We assumed—based on earlier research—that there is a connection between temperament and changes in symptoms of stress and depression, and that these connections are mediated by changes in psychological flexibility (Fetterman et al., al.,2010; O'Loughlin et al., 2019) (Q3: Hypothesis 3). In addition, we expected that the relationship between NA and symptoms of stress and depression are mediated by changes in psychological flexibility (Q3: Hypothesis 4) (O'Loughlin et al., 2019). Because no previous studies have investigated indirect

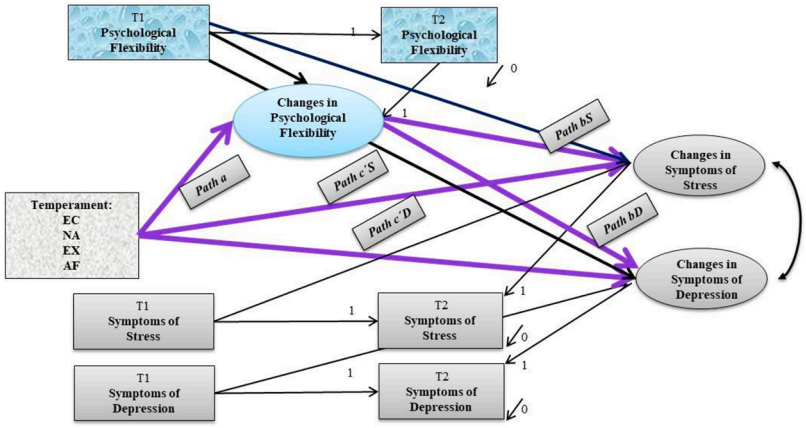

Fig. 1. A Construct Model Showing the Associations Between Temperament Dimensions and Changes in Symptoms via Changes in Psychological Flexibility.

Note. This figure shows the modeled connections of four temperament dimensions (EC, NA, EX, AF) with changes in psychological Flexibility (acceptance and mindfulness) and changes in symptoms of stress and depression. In the final models, the paths between temperament scores and changes in symptoms (of stress or depression) were tested simultaneously with expected mediation paths (***a, bS, bD, c'S*** and ***c'D*** in this picture) using SEM in Mplus. However, the initial scores of psychological flexibility and initial scores of symptoms (of stress or depression) were controlled together with the gender effects. EC = Effortful Control, NA = Negative Affectivity, EX = Extraversion, AF = Affiliativeness.

connections with respect to other temperament dimensions, no other hypotheses were set.

6. Methods

6.1. Participants and the study design

STAIRWAY is a longitudinal research project that aims to provide evidence-based information on the individual and environment-related factors that promote learning, well-being, and successful educational transitions (https://www.jyu.fi/edupsy/fi/laitokset/psykologia/en/research/research-areas/motivation-and-learning/projects/stairway). The project has followed a community sample of students at the age of 15 to 16 ($N = \sim 900$, herein referred to as the *basic sample*) through their transition from primary school to lower secondary school in two medium-sized towns in Central Finland with a combined population of 130,000. In one of the towns, all lower secondary schools were recruited to the study, whereas, in the other town, the participating schools covered approximately 75% of the targeted age group. The ninth-grade students came from 59 classes in 13 schools. Data collection was conducted from September 2017 to May 2018.

A subsample of students from the broader basic sample were selected for the present study. Of the adolescents in the basic sample, 249 participated in an ACT intervention during the Fall semester (see Puolakanaho et al., 2019) and were thus not included in the current study, leaving 740 participants in this study. This study was conducted in compliance with APA ethical standards. Informed consent was obtained from both the adolescents and their parents, and the study was approved by the Ethics Committee of the University of YYYY-masked (08–03–2017). A total of 57% of the participants were female and 43% were male, with a mean age of 15.3 years (*SD* 0.39). The native language of most participants (97%) was Finnish, and most of the adolescents (71%) lived in two-parent households. The baseline demographic and sample characteristics are shown in Table 1.

The mothers' educational level and family structure of the participants in the sample were compared to that of the general Finnish population. In comparison with same-age women in Finland (Official Statistics of Finland, 2018a), the sample included fewer mothers with a vocational or upper secondary education or lower, and more mothers with a Bachelor's degree or higher, suggesting that the mothers of the participating adolescents were somewhat more educated than same-age women on average in Finland. Compared to all Finnish families with children under the age of 18 (Official Statistics of Finland, 2018b), two-parent families were somewhat overrepresented and single-parent households underrepresented in the study sample.

Table 1
Sample Characteristics in the Study.

	All (n = 740)	Female group (n = 413)	Male group (n = 304)
Participants (%)	100%	57%	43%
Age *M* (*SD*)	15.74 (*0.38*)	15.72 (*0.33*)	15.77 (*0.44*)
Mother tongue			
Finnish	656 (96.5%)	379 (96.4%)	277 (87.9%)
Language other than Finnish	16 (2.4%)	8 (2.0%)	8 (2.8%)
Bilingual (Finnish + another language)	8 (1.2%)	6 (1.5%)	2 (0.7%)
Missing information	60	32	28
Living with			
Mother and father	484 (70.9%)	267 (67.6%)	217 (75.3%)
With mother or father	69 (10.1%)	42 (10.6%)	27 (9.4%)
Alternately with mother and father	67 (9.8%)	42 (10.6%)	25 (8.7%)
Others[1]	63 (9.2%)	44 (11.1%)	19 (6.6%)
Missing information	57	30	27
Parental education			
Mother: A/B/C (%)[2]		35/22/44 (%)	32/21/47 (%)
[3]Missing cases		107	81
Father: A/B/C (%)[2]		49/16/35 (%)	46/16/38 (%)
[3]Missing cases		176	130

Note. [1] Living with mother and stepfather, father and stepmother, in foster care, or in approved home. Parental education level: [2]A = vocational upper secondary education or lower, *B* = vocational college degree, C = Bachelor's degree or higher. Information of education level was missing[3] in some cases.

6.2. Procedure

Two trained testers collected the data in the classrooms on regular school days in the fall, at the start of the last school year (Time 1; in September–October), and again in the spring (Time 2; in February–May). Participants completed a range of demographic questions at Time 1. Symptoms of stress and depression as well as psychological flexibility were measured at Times 1 and 2 (see below). Since temperament is known to be fairly stable individual construct during adolescence (Elkins et al., 2017), especially over a single school year, the measure was assessed only at Time 2.

6.3. Psychological flexibility related measures

Acceptance skills. We used the 8-item version of Avoidance and Fusion Questionnaire for Youth (AFQ-Y; Greco et al., 2008) to measure the ACT-specific construct of psychological inflexibility. Sample items include "My life won't be good until I feel happy" and "I must get rid of my worries and fears so I can have a good life"; these are evaluated using a five-point Likert scale with responses ranging from 0 (not true at all) to 4 (very true). The total score is derived by summing the responses, yielding a total possible score of 32. Using the original scoring, higher scores on the AFQ would have indicated a higher tendency toward experiential avoidance and fusion. However, in the current study, we used a *reverse score* in which higher scores indicate *acceptance and cognitive defusion skills* [for using reversed scale for assessing psychological flexibility see Muris et al. (2017)]. The Cronbach's alpha for this sample was 0.90 for Time 1 and 0.87 for Time 2.

Mindfulness skills. To measure the degree to which adolescents observed internal experiences, acted with awareness, and accepted internal experiences without judging them; a 10-item Child Acceptance and Mindfulness Measure (CAMM; Greco et al., 2011) was used. Sample items include "I tell myself that I shouldn't feel the way I'm feeling" and "I think about things that have happened in the past instead of thinking about things that are happening right now"; these are evaluated using a five-point Likert scale with responses ranging from 0 (not true at all) to 4 (very true). The scoring was conducted according to the instructions (Greco et al., 2011): all scores were reversed, and the total score was derived by summing the responses, yielding a total possible score of 40. Higher scores correspond to higher levels of acceptance and mindfulness. The CAMM is a developmentally appropriate measure with adequate internal consistency (Greco et al., 2011). In this sample, the Cronbach's alpha was 0.89 assessed at Time 1 and 0.88 assessed at Time 2.

6.4. Symptoms of stress and depression

Overall stress. Overall stress was first defined for the participants in written form: "Stress refers to a situation where people feel tense, restless, nervous, or anxious and have difficulty sleeping due to the things wandering in their mind." Using a six-point Likert scale (1 = not at all, 2 = only a little, 3 = to some extent, 4 = quite a bit, 5 = a lot, and 6 = very much), the participants were asked to answer, "Do you feel this kind of stress at the moment?" The test–reliability was 0.79 (for the validity of the stress measure, see Elo et al., 2003; Puolakanaho et al., 2019).

Depressive symptoms. To measure depressive symptoms, adolescents completed the Depression Scale (DEPS; Salokangas et al., 1995).

This instrument consists of 10 self-reported items describing depressive symptoms during the last month (e.g., "I feel sad," "I feel that my future is hopeless"). The item response categories of the DEPS range from 0 (not at all) to 3 (very much). Sum scores were calculated across the 10 questions to measure the adolescents' depressive symptoms (range of scale 0–30). In the present study, the Cronbach's alpha reliability coefficient was 0.95 at Time 1 and 0.95 at Time 2.

6.5. Temperament dimensions

The adolescents evaluated their own temperament using the Finnish version of the Early Adolescent Temperament Questionnaire – Revised (EATQ-R; Ellis, 2002; Putnam et al., 2001). The original EATQ-R consists of 65 statements assessed on a five-point Likert scale (1 = almost never true; 5 = almost always true). After a pilot study, six statements (e.g., "I get irritated if I'm criticized"; "I finish what I start") drawn from similar subscales of the EATQ-R Parent-Report Form were added to improve the reliability of some of the scales. The resulting 71 statements were used to identify four temperament dimensions, that is, *Effortful Control* (EC), *Negative Affectivity* (NA), *Extraversion* (EX), and *Affiliativeness* (AF), validated in regard to Finnish adolescents in a study by Kiuru et al. (2019). EC consists of subscales of attention (7 items), activation control (5 items), and inhibitory control (6 items); EX consists of subscales of high-intensity pleasure (7 items) and shyness (reversed; 4 items); NA consists of subscales of fear (6 items), sadness (7 items), and frustration (8 items); and AF consists of subscales of affiliation (5 items), pleasure sensitivity (5 items), and perceptual sensitivity (4 items). Scores for EC ($\alpha = 0.79$), NA ($\alpha = 0.86$), EX ($\alpha = 0.73$), and AF ($\alpha = 0.73$) represent the means of the scales (based on the mean of the subscales).

6.6. Statistical analysis

First, descriptive statistics were explored. In subsequent analyses, the effects of gender were controlled. Next, we analyzed the data using structural equation modeling (SEM) in Mplus (Version 8.0; Muthén and Muthén, 1998–2018). Because of relatively high correlations between temperament dimensions, separate models were formed for each of the four temperament dimensions. Based on the observed scores at T1 and T2, *latent change scores* were estimated for psychological flexibility (i.e., AFQ-Y and CAMM) and symptoms of stress and depression. Latent factors of symptoms were allowed to correlate with each other. Latent change scores of psychological flexibility were used as mediators. Based on the modification indices and to provide an acceptable model fit, provided by SEM, additional paths were added to all of the models (see dashed arrows in Fig. 1).

Each model included the examination of three direct paths and one indirect path in order to assess: (1) whether changes in psychological flexibility have unique connections with changes in the symptoms (Q1, paths *bS* and *bD* in Fig. 1, in which gender, temperament, and the initial level of flexibility and symptoms were controlled), (2) whether the temperament dimensions are connected with changes in psychological flexibility (Q2, path *a* in Fig. 1, in which gender and the initial level of psychological flexibility were controlled), and (3) whether the temperament dimensions have direct connections with changes in symptoms (Q3, paths *cS* and *cD* in Fig. 1, in which gender, the initial level of and changes in psychological flexibility, and the initial level of symptoms were controlled). In the final step, exploring second part of Q3, indirect effects ($a * b$) of each temperament dimension on changes in symptoms were estimated.

The maximum likelihood estimation and bias-corrected bootstrap method with 5000 draws were used to obtain standard errors that are robust to non-normality and to achieve non-symmetric 95% confidence intervals (*CIs*) for the indirect effects (MacKinnon, 2008; Muthén and Muthén, 1998–2018). The model fit was evaluated using the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Values higher than 0.90 for CFI and TLI, and lower than 0.06 for RMSEA and 0.08 for SRMR, were considered to indicate a satisfactory fit. All analyses were conducted using full information maximum likelihood (FIML) estimation, which accounts for values missing-at-random (MAR) and includes all of the available data. The minimum covariance coverage matrix value was 0.918 for any pair of variables.

7. Results

7.1. Descriptive statistics

Descriptive statistics and correlations are shown in Table 2. Significant gender differences at Time 1 were observed in symptoms of stress and depression, as well as in psychological flexibility and in two of the temperament scales. At Time 1, males reported higher levels of psychological flexibility (AFQ-Y, CAMM) and fewer symptoms of stress and depression. Also, NA and AF were lower among males compared to females (see Table 2. For more details). A two-way ANOVA showed significant increases in symptoms of depression [$F(1, 681) = 47.74$, $p < 0.001$] and decreases in CAMM [$F(1, 685) = 11.68$, $p < 0.001$] as well as decreases in AFQ-Y [$F(1, 684) = 13.97$, $p < 0.001$] in both genders, although males showed larger changes ($p < 0.05$) than female participants. All participants showed increased symptoms of stress [$F(1, 678) = 75.58$, $p < 0.001$] from Time 1 to Time 2. Due to these differences, the gender effect is controlled in the following analysis.

7.2. Associations between temperament, psychological flexibility and psychological symptoms

Eight separate SEM analyses were conducted to explore the impact of four temperament dimensions (i.e., EC, NA, EX, AF) and changes in psychological flexibility (i.e., AFQ-Y and CAMM) on changes in symptoms of stress and depression. All the SEM models fit the data well, as shown in the fit indices in Table 3. The main results and standardized beta coefficient (β) values are reported are shown in Fig. 2.

Q1. The results regarding the associations of changes of psychological flexibility (acceptance and mindfulness) with changes in symptoms of stress and depression (when gender, initial level of temperament, and initial symptoms were controlled for) are shown in Table 4 (see also paths *b* in Figs. 1 and 2). The results confirmed Hypothesis 1 by showing that decreases in acceptance (AFQ-Y) and mindfulness (CAMM) were significantly connected with increases in symptoms of stress (*bS*= –0.19 to –0.32, $p < 0.001$) and depression (*bD* =–0.22 to –0.43, $p < 0.001$) in all models.

Q2. Similarly, the results regarding associations of the temperament dimensions with changes in psychological flexibility (when gender and the initial level of psychological flexibility were controlled for) are shown in Table 4 (see path *a* in Figs. 1 and 2). The results partially confirmed Hypothesis 2 by revealing that of the four temperament dimensions all except AF were connected to changes in psychological flexibility. EC and EX had positive connections with changes in AFQ-Y ($a = 0.15$ to 0.20, $p < 0.05$) and in CAMM ($a = 0.07$ to 0.21, $p < 0.05$), whereas NA had strong negative connection with changes in AFQ-Y ($a = –0.39$, $p < 0.001$) and in CAMM ($a = –0.43$, $p < 0.001$). Thus, high EC and EX were related to increases in psychological flexibility from Time 1 to Time 2, whereas high NA was related to decreases in psychological flexibility.

Q3. Finally, the modeling results were used to answer to whether the four temperament dimensions have direct associations with changes in symptoms of stress and depression (after gender as well as changes in psychological flexibility and the initial level of symptoms were controlled for; paths *c'* in Figs. 1 and 2, and Table 4). When acceptance skills (AFQ-Y) were controlled for, NA had direct, significant positive connections with changes in symptoms of stress ($c' = 0.19$, $p < 0.001$) and depression ($c' = 0.20$, $p < 0.001$), and EC had direct, small negative

Table 2
Means, Standard Deviations, and Correlations in the Two Measurement Phases.

	Scales	Female n / Male n	Sig	Mean Female	SD	Mean Male	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1.	Acceptance, T1	414/303	**	22.88	6.40	25.32	6.02												
2	Acceptance, T2	409/299	ns.	22.29	6.21	22.80	6.70	.57**											
3.	Mindfulness, T1	415/305	**	24.82	7.67	27.31	7.00	.66**	.44**										
4.	Mindfulness , T2	409/297	ns.	24.19	7.67	25.12	8.07	.42**	.63**	.57**									
5.	Stress, T1	414/303	**	3.38	1.42	2.65	1.24	−0.53**	−0.37**	−0.48**	−0.38**								
6.	Stress, T2	405/295	**	3.62	1.43	2.74	1.24	−0.43**	−0.45**	−0.40**	−0.45**	.64**							
7.	Depression, T1	413/304	**	8.26	7.90	4.34	5.71	−0.66**	−0.44**	−0.59**	−0.42**	.62**	.50**						
8.	Depression, T2	413/297	**	8.58	7.75	5.60	7.08	−0.49**	−0.60**	−0.46**	−0.51**	.47**	.60**	.64**					
9.	EC: Effortful Control	411/305	ns.	3.31	0.51	3.25	0.48	.27**	.34**	.30**	.35**	−0.19**	−0.22**	−0.31**	−0.33**				
10.	NA: Negative Affectivity	411/306	**	2.81	0.55	2.48	0.53	−0.47**	−0.52**	−0.46**	−0.54**	.47**	.52**	.48**	.52**	−0.32**			
11.	EX: Extraversion	411/307	ns.	0.42	0.72	0.45	0.61	.12**	.23**	.12**	.17**	−0.10**	−0.16**	−0.13**	−0.19**	.18**	−0.34**		
12.	AF: Affiliativeness	411/308	**	3.64	0.56	3.20	0.60	−0.07	.02	−0.09*	−0.03	.16**	.17**	.08*	.05	.31**	.22**	.07	
13.	Sex: 1=female, 2=male	425/315						.21**	.05	.15**	.06	−0.26**	−0.31**	−0.30**	−0.24**	−0.09*	−0.29**	.01	−0.37**

Note. Sig = Two-tailed *t*-test difference between female and male participants based on Spearman correlations. ** $p < 0.01$, *$p < 0.05$.

Table 3
Chi-Square and Goodness-of-Fit Values of the Conducted Models of Changes in Well-Being Outcomes.

	df	Chi-Square	CFI	TLI	RMSEA	SRMR
			>0.95	>0.95	<0.06	<0.08
Acceptance with						
EC: Effortful Control	4	12.48*	0.994	0.973	<0.05	.022
NA: Negative Affectivity	4	6.593$^{ns.}$	0.998	0.992	<0.05	.009
EX: Extraversion	4	16.84**	0.991	0.959	<0.05	.020
AF: Affiliativeness	4	18.84**	0.989	0.952	<0.05	.021
Mindfulness with						
EC: Effortful Control	4	25.51**	0.984	0.927	<0.05	.026
NA: Negative Affectivity	4	11.08*	0.995	0.977	<0.05	.014
EX: Extraversion	4	30.57**	0.980	0.908	<0.05	.030
AF: Affiliativeness	4	33.27**	0.977	0.898	<0.05	.031

Note. $n = 740$. Eight mediation models describing how the temperament dimension (EC, NA, EX, AF) are connected to changes in psychological flexibility (measured using mindfulness or acceptance scales), and also to changes in well-being (measured as scales of stress and depressive symptoms) using SEM in Mplus. The effects of gender are controlled for in the final models presented in this table.** $p < 0.01$, *$p < 0.05$.

effects on stress ($c' = -0.07$, $p < 0.05$) and depressive symptoms ($c' = -0.07$, $p < 0.05$). When the mindfulness skills (CAMM) were controlled for, NA had direct, significant positive connections with changes in both stress and depressive symptoms ($c' = 0.15$ –0.20, $p < 0.001$), EX had direct, small negative effects on stress ($c' = -0.09$, $p < 0.05$) and depressive symptoms ($c' = -0.08$, $p < 0.05$), and EC had a direct, negative effect on depressive symptoms ($c' = -0.10$, $p < 0.05$). Thus, the results partially confirm Hypothesis 3 by showing that high NA was related to increases in stress and depressive symptoms, whereas high EC and EX had weaker direct connections to decreases in stress and depressive symptoms (see Fig. 2).

To answer the second part of Q3, we explored whether the four temperament dimensions had indirect associations (that is, mediated connections via changes in psychological flexibility) with changes in symptoms of stress and depression (see paths $a * b$ in Fig. 2 and Table 4). The results confirm Hypothesis 4 by indicating that the temperament dimensions of NA had indirect associations with changes in symptoms of stress and depression via changes observed in both acceptance (AFQ-Y) and mindfulness (CAMM) scales. Notably, also EC and EX had indirect associations with changes in symptoms of stress and depression, while no such connections were observed for the AF scale. Thus, high NA was connected to increased symptoms of stress and depression via decreased acceptance and mindfulness scores, whereas high EC and EX were connected to decreased symptoms of stress and depression via increased acceptance and mindfulness scores.

8. Discussion

In this study, we examined the assumption that temperament forms a basis for facing the outer world while psychological flexibility serves as another such basis and a mediator of the impact of temperament on psychological well-being. The study used data on a general sample of 15-year-old adolescents ($n = 740$) in a transition phase from primary school to lower secondary school, and therefore vulnerable to psychological ill-being.

Symptoms of both stress and depression increased over the school year, confirming the harshness of this life period. Because we were particularly interested in whether psychological flexibility mediates the impact of temperamental differences on changes in symptoms of depression and stress, we first examined the associations between changes in psychological flexibility and changes in symptoms of stress and depression. We observed that an increase in symptoms is related to a

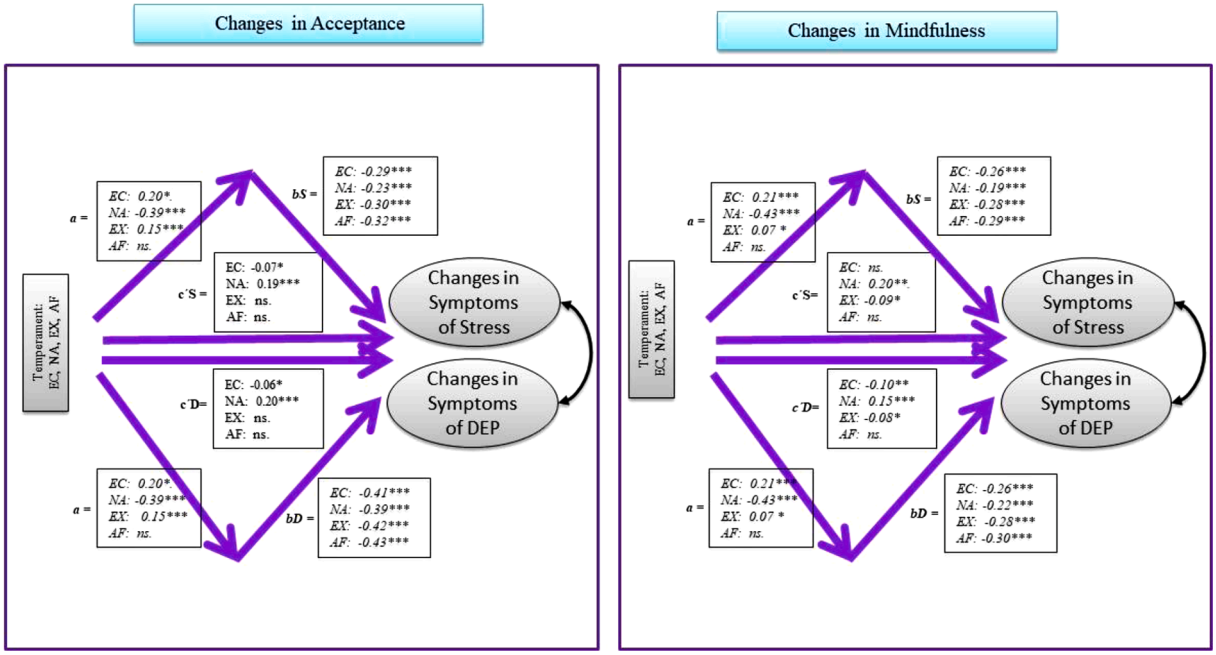

Fig. 2. The Results of Modeling Showing the Associations Between Temperament Dimensions and Changes in Symptoms via Changes in Acceptance or in Mindfulness.

Note. $n = 740$ adolescents (425 female, 315 male). Changes in symptoms of stress and depression were analyzed together using eight separate models representing four temperament dimensions in two conditions of psychological flexibility (e.g., via changes in acceptance or via changes in mindfulness). The scores in paths ***a, bS, bD, cS, cD*** represent standardized beta coefficient values. EC = Effortful Control, NA = Negative Affectivity, EX = Extraversion, AF = Affiliativeness, DEP = Depression.

decrease in psychological flexibility. Next, we investigated whether the four temperament dimensions were connected to changes in psychological flexibility during the school year. The results show that NA is strongly and negatively associated with changes in psychological flexibility, while *EC* and *EX* are positively associated—although to a lower extent—with changes in psychological flexibility. To our knowledge, this is the first study to show the associations between these three temperament dimensions and changes in psychological flexibility. *AF* was also expected to correlate with psychological flexibility based on associations between the Big Five constructs and psychological flexibility found among adults in previous studies (Giluk, 2009; Latzman and Masuda, 2013); however, there was no correlation.

Third, the results indicate that both psychological flexibility and temperament play distinct and unique roles (*direct* associations) in changes in well-being. Finally, we examined the indirect associations between the study constructs. The results indicate that temperament is also *indirectly* associated with changes in stress and depression symptoms via psychological flexibility: Adolescents with high *NA* showed an increase in symptoms of stress and depression, mediated by lower psychological flexibility, whereas adolescents with high *EC and EX* showed a decrease in symptoms, mediated by higher psychological flexibility. These results are in agreement with the few previous studies that report associations between NA and well-being (Luca et al., 2017; Mario et al., 2015; Fetterman et al., 2010), and physical symptoms being mediated by mindfulness (O'Loughlin et al., 2019). This study is the first study on adolescents to show the associations between the temperament dimensions of *EC* and *EX* on the one hand and changes in psychological flexibility and psychological symptoms on the other.

8.1. Practical implications

Based on our findings, we propose that temperament forms a basis for how adolescents face the outer world, with psychological flexibility as a contributing factor—via learnable psychological skills—that can also mediate the impact of individual differences on well-being. The results are in agreement with the findings of previous studies (Gulley et al., 2016; Hirvonen et al., 2014; Hollenstein and Lougheed, 2013; Laceulle et al., 2015; Muris et al., 2007; Rothbart, 2011; Viñas et al., 2014), indicating that temperamental reactivity and regulation patterns play significant roles in the development of symptoms of stress and depression. However, our results also indicate that the impact of these individual differences on the psychological well-being of adolescents can be modified by psychological flexibility, which is a new finding in the field of ACT (Hayes et al., 2012; Hayes and Hofmann, 2017).

The current data suggests a cumulative pattern among adolescents with diverse temperament dimensions. It appears that *temperament dimensions and psychological flexibility* are associated with psychological symptoms. However, these constructs are also entangled with each other. A person with a tendency for negative reactions (i.e., high NA) is likely to experience the world more negatively, and consequently, experience more symptoms of stress and depression. This individual is also likely to have a lower level of psychological flexibility, and thus, a lower ability to use skills such as recognition and pursuit of one's own values and noticing thoughts and emotional reactions in an accepting and open manner (Hayes et al., 2006; 2012; Hofmann and Hayes, 2019). This, in turn, tends to lead to the experience of more symptoms of stress and depression. On the other hand, it is likely that individuals with high *EC* can achieve more control over their thoughts and actions, sustain attention, and direct themselves adequately, and are thereby able to adjust to demands flexibly and willfully. These abilities may be strengthened by improving psychological flexibility skills, and thus inhibit the development of stress and depression symptoms. Individuals with *EX* are likely to enjoy new exciting things. Consequently, they are likely to find a new situation positively challenging rather than threatening, which in turn inhibits the development of stress and depression symptoms. They are also able to profit from psychological flexibility related skills, which in turn protects against stress and depression.

The promising results of recent psychological flexibility based

Table 4
The Effects of Temperament on Changes in Psychological Symptoms via Psychological Flexibility.

Acceptance with	*a*	*bS*	*bD*	*cS*	*cD*	*Indirect effects a x bS*	*S: CI lower 2.5%*	*S: CI upper 2.5%*	*Indirect effects a x bD*	*D: CI lower 2.5%*	*D: CI upper 2.5%*	*Total effects: a x bS+cS*	*Total effects a x bD+cD*
EC: Effortful control	0.20 [a]	−0.29 [a]	−0.41 [a]	−0.07 [c]	−0.06 [c]	−0.06	−0.09	−0.04	−0.09	−0.13	−0.06	−0.13 [a]	−0.16 [a]
NA: Negative Affectivity	−0.39 [a]	−0.23 [a]	−0.39 [a]	0.19 [a]	0.08	0.10	0.07	0.15	0.17	0.13	0.22	0.29 [a]	0.25 [a]
EX: Extraversion	0.15 [a]	−0.30 [a]	−0.42 [a]	−0.06	−0.03	−0.05	−0.07	−0.03	−0.07	−0.10	−0.04	−0.11 [b]	−0.09 [b]
AF: Affiliativeness	0.01	−0.32 [a]	−0.43 [a]	0.02	−0.04	−0.00	−0.02	0.02	−0.00	−0.03	0.03	0.02 [ns.]	−0.04 [ns.]
Mindfulness with	*a*	*bS*	*bD*	*cS*	*cD*	*Indirect effects a x bS*	*S: CI lower 2.5%*	*S: CI upper 2.5%*	*Indirect effects a x bD*	*D: CI lower 2.5%*	*D: CI upper 2.5%*	*Total effects: a x bS+cS*	*Total effects a x bD+cD*
EC: Effortful control	0.21 [a]	−0.26 [a]	−0.26 [a]	−0.07	−0.10 [b]	−0.06	−0.09	−0.03	−0.06	−0.09	−0.04	−0.13 [b]	−0.16 [a]
NA: Negative Affectivity	−0.43 [a]	−0.19 [a]	−0.22 [a]	0.20 [a]	0.15 [a]	0.10	0.06	0.14	0.12	0.07	0.16	0.29 [a]	0.26 [a]
EX: Extraversion	0.07 [c]	−0.28 [a]	−0.28 [a]	−0.09 [b]	−0.08 [c]	−0.02	−0.04	−0.001	−0.02	−0.05	−0.001	−0.11 [b]	−0.09 [b]
AF: Affiliativeness	−0.01	−0.29 [a]	−0.30 [a]	0.02	−0.04	0.00	−0.02	0.03	0.00	−0.02	0.03	0.01 [ns.]	−0.04 [ns.]

Note. $n = 740$. Path *a*: the effect of the temperament dimension (EC, NA, EX, AF) on changes in psychological flexibility (using *mindfulness or acceptance* scales); *b*: the effect of the changes in psychological flexibility on the outcomes of changes in symptoms of stress or depression; *c*́: the direct effect of temperament on the outcome. $a * b$: indirect effects, that is, path throughout the changes in psychological flexibility on the well-being outcome. $a * b + c'$: the total effects of the temperament dimension and changes in psychological flexibility on well-being outcomes of stress and depression. The scores in the columns represent standardized beta coefficient values. Statistical significance is marked as follows: $a = (p < 0.001)$, $b = (p < 0.01)$, $c = (p < 0.05)$, ns. = non-significant. Symptoms were assessed using stress (*S*) and depression (*D*) scales.

interventions among adults (Flaxman et al., 2013; Powers et al., 2009) and adolescents (Livheim et al., 2015; Petts et al., 2017) suggest that even brief six to eight-week programs can promote well-being and decrease stress and depression. Furthermore, interventions can be helpful even if delivered via the web or via mobile-based tools (Lappalainen et al., 2021; Puolakanaho et al., 2019), accomplished in a class and school context (Burckhardt et al., 2016). These views, together with the results of a current study, lead us to propose that interventions based on the principles of psychological flexibility (Ciarrochi et al., 2012; Hayes and Ciarrochi, 2015) are likely to be worthwhile when used to support well-being among adolescents that fall under temperament dimensions categorized as challenging (i.e., high NA, and possibly low EC and low EX). In sum, this study highlights the possibility that the effects of individual temperament patterns on psychological well-being can be altered via psychological flexibility skills. However, longer follow-up and intervention studies are needed to explore this issue in depth.

8.2. Limitations and future directions

Several limitations are apparent when evaluating the conclusions reached in this study. First, all the measures used in this longitudinal study are based on self-reports, which may have induced the shared-method effect (systematic covariation), resulting in too-close relationships between the study constructs. However, the strength of the associations between the measures varies in a comprehensive manner, supporting the reliability of the results. Measures of psychological flexibility generated using the Avoidance and Fusion Questionnaire for Youth (AFQ-Y) and the Child and Adolescent Mindfulness Measure (CAMM), as well as the measures in the Early Adolescent Temperament Questionnaire-Revised (EATQ-R) used to assess temperament dimensions, showed good internal consistency and consistent associations with each other—indicating that these measures are reliable and valid. The depression scale also showed good internal reliability. Although stress was measured using a single-scale measure with satisfactory test-retest reliability and validity (Elo et al., 2003; Puolakanaho et al., 2019). This may have lessened the sensitivity of the measures. However, the associations between the predictive scales and the outcomes (depression and stress) were expected and quite similar, supporting the reliability of the stress scale.

Notably, our research design was not optimal due to the temperament measurement time. However, as temperament is rather stable quality, we did not expect marked changes occurring in it during the six months follow-up period in ninth grade (T1 in the fall and T2 in the spring). In the future longitudinal studies with higher number of measurement points are needed to investigate bidirectional longitudinal dynamics between psychological flexibility and psychological symptoms thoroughly. Finally, it is notable that the sample used in this study comprised ninth-grade adolescents closely representative of Finnish adolescents. However, when generalizing the results to other contexts (e.g., different age groups and social settings), caution is advised. More studies are needed to confirm our findings.

9 Conclusion

The results of this study indicate that temperamental differences (i.e., individual reactivity and regulation patterns) play a crucial role in the development of symptoms of depression and stress among 15 to 16-year-old adolescents. However, temperamental differences are also associated with changes in psychological flexibility, which also impact symptoms of depression and stress. In this study, adolescents with high *NA* were likely to experience more symptoms of stress and depression over the school year. This pattern was accompanied by a decrease in psychological flexibility. Further, over the same school year, adolescents with high *EC* and *EX* showed the opposite pattern, with fewer symptoms of stress and depression accompanied by increased psychological flexibility. Thus, temperamental dimensions and psychological flexibility

together form cumulative patterns that influences psychological symptoms. In conclusion, this study highlights the possibility that the impact of individual temperament differences on psychological well-being among adolescents is affected by the development of psychological flexibility skills. In the future, it would be important to investigate whether psychological flexibility based interventions can alleviate psychological ill-being among individuals with challenging temperaments.

Compliance with ethical standards

This study was conducted in compliance with APA ethical standards. Informed consent was obtained from both the adolescents and their parents, and the study was approved by the Ethics Committee of the University of Jyväskylä (08–03–2017).

Author statement

AP conceived the study, drafted the manuscript, and analyzed the data; JM analyzed the data using MPLUS; RL, RH and PL helped with data gathering, interpretation, and collection; NK led the main study, including implementation of data collection and responsibility for participant recruitment. All authors critically revised the manuscript for important content. All authors read and approved the final manuscript.

Data sharing declaration

The datasets generated and/or analyzed during this study are not publicly available but are available from the corresponding author on reasonable request.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced or appear to have influenced the research reported in this paper.

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