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with actor-partner interdependence model*

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Parental Motivational Perseverance Predicts Adolescents' Depressive Symptoms: An

Intergenerational Analysis with Actor-Partner Interdependence Model.

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Compliance with Ethical Standards

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Abstract

Adolescents' depressive symptoms are affected by a number of factors including life stress, gender, socio-economic status, and parental depression symptoms. However, little is known about whether adolescent depressive symptoms are also affected by parental motivational characteristics. The current study explores the relationship between parental motivational perseverance (i.e., parents' persistency in the face of setbacks and difficulties) and children's depressive symptoms during the adolescence, given the critical role of perseverance in psychological well-being. The predictive utility of two motivational characteristics relevant to perseverance: parents' growth mindset (i.e., one's belief about the malleability of human competence) and grit (i.e., perseverance for long term goals) were examined. Four hundred pairs of Japanese parents (82% mothers) and their adolescent children (50% females; average age at the time of the first assessment = 14.05 years; SD = 0.84) independently completed surveys measuring their growth mindset, grit, and depressive symptoms at two time points (approximately one year apart; attrition rate = 25%). The Actor-Partner Interdependence Model, a statistical model that accounts for inter-dependence between dyads (e.g., parents and children), was used to examine how parental motivational perseverance predicts the long-term change in their offspring's depressive symptoms. The results

showed that parental grit led to the decrease in adolescents' depressive symptoms through the changes in adolescents' grit. On the other hand, parental growth mindset directly predicted the adolescents' depressive symptoms, and this was not mediated by the adolescents' growth mindset. These findings underscore the importance of parental motivational characteristics in regards to adolescents' depressive symptoms.

Keywords: Adolescents, APIM, depression, grit, growth mindset, parents

Introduction

Depression is one of the most common mental health problems reported among adolescents (Thapar et al. 2012). There is a large body of literature examining the correlates of adolescents' depressive symptoms (for a review see Zhou et al. 2015). These studies suggest that the risk of adolescent depression is higher for girls (Salk et al. 2016), when their socio-economic status (SES) is low (Reiss 2013), and when they have certain personality characteristics, including low self-esteem (Orth et al. 2008), high narcissism (Watson et al. 2002), and high perfectionism (Kawamura et al. 2001). Accumulative evidence also points out that adolescents' motivational perseverance plays a key role in their mental health problems, including depression (Schroder et al. 2016; Wootton et al. 2017). For example, individuals who are perseverant and passionate about their long-term goals tend to be more resilient in the face of setbacks and are less likely to develop depressive symptoms (Wootton et al. 2017). Previous research has also documented that individuals who believe that their competence can be flexibly changed by effort and learning are less likely to develop depressive symptoms than those who have a belief that one's competence cannot be changed (Schroder et al., 2016). However, previous studies on perseverance and depression overlooked the effects of parents, despite a substantial body of research on parents' impact on adolescents' depressive symptoms (Goodman et al. 2011; McLeod et al. 2007). The

current study proposes that parental motivational perseverance is a critical factor that affects adolescents' perseverance as well as their depressive symptoms. This hypothesis was tested by a longitudinal intergenerational design.

Motivational Perseverance and Psychological Well-Being in Adolescence

Motivational perseverance refers to motivational characteristics that influence persistence when encountering setbacks and difficulties. While there are several questionnaires concerning motivational perseverance in the existing literature (e.g., Fredricks et al. 2004), mindset and grit have become increasingly popular among researchers, given their wide applicability to practical situations (e.g., psychopathology, education) as well as their predictive powers (West et al. 2016; for meta-analyses, see Burnette et al 2013; Schleider et al. 2015). Mindset, also called "implicit theory," concerns a belief that one's competence is "incremental-" or "entity-" based; these two types of mindset are also referred to as "growth mindset" and "fixed mindset," respectively (Dweck 2000, 2006).¹ Growth mindset is defined as an individual's belief that one can develop one's own competence through effort, strategies, and learning, whereas a fixed mindset is an individual's belief that one's competence is fixed and

¹ Mindset may be a domain-specific construct, and can be defined in a variety of domains. In accordance with existing literature, the current study focuses on the intelligence mindset (i.e., implicit theory of intelligence) -- a belief regarding one's intelligence.

cannot be changed. Although these two types of mindsets are distinctively conceptualized, most empirical studies have treated them as opposite ends of a continuum.

Previous research has indicated that individuals with growth mindset are more resilient when faced with failure and more persistent when encountering setbacks than those with fixed mindset (Dweck 2000). Growth mindset is also associated with adaptive outcomes in a variety of domains, including academic, interpersonal, and business (Dweck 2006). For adolescents, growth mindset has been found to be positively related to mastery goals (i.e., goals that develop one's competence; Blackwell et al. 2007), academic achievement (Claro et al. 2016) and adaptive self-regulations (for a meta-analytic review, see Burnette et al. 2013). Moreover, interventional studies aiming to foster growth mindset among high school students reported that mindset is amenable to such intervention, and that students in the intervention group showed higher grade point averages (GPAs), especially in individuals who were at risk of dropping out (Paunesku et al. 2015; Yeager et al. 2016).

Another concept related to motivational perseverance is grit, which is defined as dispositional perseverance and a passion to achieve long-term goals (Duckworth et al. 2007). Duckworth et al. (2007) defined achievement as a function of talent (such as intelligence) and effort, and conceptualized grit as an attribute that fosters efforts to

secure achievements. Previous research in adolescents has shown that students with grit tend to enjoy higher school achievements (e.g., course grades and GPA; Weisskirch 2018; Wolters and Hussan 2015). Importantly, grit has been shown to be relatively unrelated to intelligence (Duckworth et al. 2007), suggesting that it is a critical motivational disposition that accounts for achievement that exceeds an individual's basic cognitive abilities. As shown in mindset, it is assumed that grit is an acquired characteristic, and thus can be altered by environmental factors (Duckworth, 2016; Hill et al. 2016).

These motivational characteristics are not only important for academic achievement, but they are also a critical factor of psychological well-being. Low perseverance adolescents tend to focus on ability (e.g., intelligence) and overlook the importance of effort (Duckworth 2016; Dweck 2006). This is problematic, especially when one confronts a setback or failure; adolescents with low perseverance may think that the failure is due to their low ability, which is unchangeable (see Dweck 2006); this can result in decreased psychological well-being. For example, Schroder et al. (2016) found that growth mindset is negatively associated with high levels of anxiety and depression. A meta-analytic review also reported negative associations between growth mindset and mental health problems, such as internalizing (e.g., depressive symptoms) and externalizing problems (for more, see Schleider, et al. 2015). Moreover, in an

experimental study, Niiya et al. (2004) found that, among university students whose self-worth was contingent on academic success, growth mindset protected their self-esteem when they encountered academic failure. Similar associations were also observed for grit (e.g., Tucker-Drob et al. 2016; Wootton et al. 2017). For example, Wootton et al. (2017) demonstrated that individuals with high levels of grit tend to seek environments that foster positive life events, which consequently promotes psychological well-being. Grit is also negatively associated with juvenile delinquency and substance use (Guerrero et al. 2016) and depressive symptoms (Allenden et al. 2018; Jin and Kim 2017), and positively associated with self-esteem (Weisskirch 2018).

Growth mindset and grit have similarities in that both concern psychological dispositions that influence individual differences regarding effort and persistence, and constitute significant psychological energy that can encourage individuals to pursue their own long-term goals despite difficulties and setbacks (Duckworth et al. 2007; Paunesku et al. 2015). Existing literature also indicates that both mindset and grit are essential components of non-cognitive skills (Tucker-Drob et al. 2016; West et al. 2016). Nevertheless, few studies have examined their interrelations within the same dataset; the few that examined both have indicated that growth mindset and grit are positively correlated (Tucker-Drob et al. 2016; Wang et al. 2018), but that they uniquely predict eighth grader's academic outcomes (West et al. 2016). Neuroimaging research

also suggests that they are correlated, but this research also suggests that they have unique neural correlates. For example, one study (Wang et al. 2018) showed that, while both constructs are associated with the gray-matter volume of the same brain region (the left dorsolateral prefrontal cortex), grit, but not growth mindset, is associated with the gray-matter volume of the putamen. Moreover, Myers et al. (2016) found that grit and growth mindset are associated with different networks of the striatum. These results suggest that grit and growth mindset are not identical, and that they may complement each other in determining adolescents' behavior and wellbeing. As such, it is important to examine both growth mindset and grit together in order to understand the role of motivational perseverance in adolescents' depressive symptoms.

Parental Influence on Adolescents' Psychological Well-being

Parental factors are proximal environmental factors that directly influence their offspring's development in various ways (Bronfenbrenner and Morris 2006). For adolescent or child well-being or mental health problems, including depression, parental demographics such as low SES (e.g., Uddin et al. 2017) and parental marital status (e.g., unwed parents; e.g., Waldfogel et al. 2010) are well-known risk factors. In addition, studies have shown that offspring of parents who have depressive symptoms are more likely to demonstrate depressive symptoms, low self-esteem, and atypical development, suggesting that parental depression can have serious negative implications for children

and adolescents (e.g., for a meta-analytic review, see Goodman et al. 2011).

Maladaptive parent-child relationships also lead to higher depressive symptoms in adolescent (e.g., Petterson and Albers 2001). Another parental factor which has been extensively examined in the literature is parenting style (Baumrind, 1967; Maccoby and Martin, 1983; for a meta-analytic review see McLeod et al. 2007). Many studies have indicated that authoritative parenting style (i.e., high control to children's behavior and high responsiveness to children's need) is related to decreased psychological distress and increased well-being, whereas a more controlling parenting style (e.g., authoritarian style, which is characterized as high control but low responsiveness) is related to increased depressive symptoms and decreased well-being of offspring (e.g., Milevsky et al. 2007; Schiffrin et al. 2014; Williams et al. 2012). Schiffrin et al. (2014) also found that helicopter parenting style, which is characterized by excessive parental involvement, is associated with decreased psychological well-being of adolescents (see also Murayama et al. 2016).

However, these previous studies predominantly focused on parental depressive symptoms or parenting styles, and overlooked the potential role of parents' motivational characteristics (e.g., perseverance) in predicting adolescents' mental health problems and well-being. It has been proposed that parental motivational perseverance affects adolescents' depression through the change in adolescents' motivational perseverance.

In fact, Dweck (2006) argues that parents with fixed mindset (i.e., low motivational perseverance) tend to send implicit messages (e.g., “we will love and respect you only if you succeed”) to reinforce their children’s fixed mindset. Children, in turn, may feel that their parents’ love is contingent on the fulfillment of their parents’ aspiration, and the adolescents may try to follow the implicit messages sent by their parents (Dweck, 2006). On the other hand, high perseverant parents (e.g., parents with growth mindset or grit) encourage effort and engagement, creating motivational perseverance against failure. Previous empirical studies also provided evidence consistent with the notion that parents’ motivational perseverance can be transmitted to their offspring. For example, mindset is known to be affected by parental praise for their child’s effort and achievement; praise for ability forms fixed mindset, and praise for effort forms growth mindset (Mueller and Dweck 1998; Kamins and Dweck 1999). Gunderson et al. (2013) also reported that parents’ process praise (praising children for their problem-solving process, which is a characteristic of growth mindset) predicts the growth mindset formed by their children in later years (see also, Gunderson et al. 2018). Jose and Bellamy (2012) also reported that parental growth mindset positively predicts children’s persistence via encouragement of the children. Finally, Haimovitz and Dweck (2016) found that parents’ mindset toward failure is positively related to their children’s mindset in this regard. Thus, although evidence regarding the intergenerational

transmission of grit and growth mindset is sparse, these results suggest the possibility that parental motivational perseverance (i.e., mindset and grit) influences adolescents' mental health through the formation of motivational perseverance.

When examining the effects of parental motivational perseverance on adolescents' mental health problems, it is important to consider the effects of SES. Previous research has demonstrated that low SES is a risk factor for depression due to poor access to health care, stress exposure, violence, and so on (e.g., Lorant et al. 2003). Low SES is also known to be a risk factor for both adolescents' and parents' mental health problems (for reviews, see Muntaner et al. 2004; Reiss 2013). In addition, recent research reveals that adults' levels of grit are associated with their employment styles (Wolfe and Patel 2016) and job performance (Dugan et al., 2019). Likewise, growth mindset affects engagement at work (Caniëls et al. 2018; Keating and Heslin 2015). These findings suggest that parents' grit and growth mindset may be correlated with SES levels, and parental motivational perseverance affects adolescents' mental health indirectly through SES.

Another important risk factor to consider is gender. Previous literature has suggested that girls tend to have higher depressive symptoms than boys, perhaps because girls are more susceptible to interpersonal stress and hormonal fluctuations (e.g., menstrual cycles; e.g., Albert 2015; Girgus and Yang 2015); this gender difference

tends to be greater during adolescence (Salk et al. 2016). Previous research also suggests that parents treat and use differential parenting treatment for boys and girls (Bumpus et al. 2001; Endendijk et al. 2016). Thus, the effects of parents' motivational perseverance may be different across boys and girls.

The Current Research

The present study aims to extend the existing literature by examining whether and how parental motivational perseverance (i.e., parental growth mindset and grit) predicts adolescents' mental health (i.e., depressive symptoms). Two-wave longitudinal intergenerational data collected in Japan were analyzed to examine whether and how *parental* motivational perseverance (i.e., parental growth mindset and grit) predicts adolescents' mental health (i.e., depression). The data were analyzed by applying the Actor-Partner Interdependence Model (APIM: Kenny and Ledermann 2010). This model (Figure 1) is considered to be an application of a cross-lagged panel model for dyadic data, allowing us to examine, in a methodologically robust manner, the hypothesis that parental growth mindset and grit directly predict reductions in adolescents' depressive symptoms across time (paths (a) and (b)).

The model also included adolescents' growth mindset and grit, with the aim of examining a second hypothesis: that adolescents' motivational perseverance serves as a mediator for the influence of parental growth mindset and grit. Our data were collected

at two-time points, but with the assumption that the obtained relationship remains stable over time (i.e., stability assumption), which enabled us to infer any potential mediational process using the two-wave cross-lagged model (Little et al. 2007; for an application, see Weinstein et al. 2017). This is because stability assumption allows us to infer that the same cross-lagged relationship holds between Time 2 and (hypothetical) Time 3. More specifically, if parental motivational perseverance positively predicts adolescents' motivational perseverance (paths c–f), and if adolescents' motivational perseverance negatively predicts depression (paths g and h), this indicates that adolescents' motivational perseverance serves as a mediator between parental motivational perseverance and adolescents' depression (Little et al. 2007). Note that stability assumption has been posited or empirically supported in many applications of longitudinal data analysis (e.g., Marsh et al. 2018).

Method

Participants

Four hundred pairs of Japanese parents (mothers = 327, fathers = 73) and their adolescents (junior high school students 13 to 15 years old; females = 200, males = 200) were recruited from a large nationwide database managed by a Japanese private research firm. The firm owns the participant database which includes members recruited

via advertising in nationwide newspapers or news magazines.

Participants in this study were randomly selected from the database and were informed of the objective of this project. When they agreed to take part in the study, questionnaires were sent via postal mail. There were no regional restrictions, and participants were drawn from many different parts of the nation. Participants were compensated for their participation (i.e., monetary payment).

In the face sheet of questionnaire, both parents and adolescent children were told that they must complete the questionnaire independently, and parents were cautioned not to check their children's answers. The parents and adolescents independently completed our survey on two occasions (T1 and T2), separated by approximately one year. All of the 400 pairs completed the survey at T1; meanwhile, 299 pairs answered the survey at T2 (mothers = 247, fathers = 52; female adolescent = 146, male adolescent = 153). There were no partial pairs (i.e., observations that contain data only from a parent or a child). Participants' annual household income was obtained as a measure of SES; the incomes were varied across participants (less than 2,000,000 yen = 1.8%; 2,000,000–2,999,999 yen = 5% ; 3,000,000–3,999,999 yen = 9%; 4,000,000–4,999,999 yen = 10.3%; 5,000,000–5,999,999 yen = 19.5%; 6,000,000–6,999,999 yen = 11.3%; 7,000,000 yen– 7,999,999 yen = 15.0%; 8,000,000–8,999,999 yen = 5.8%; 9,000,000–9,999,999 yen = 7.3%; 10,000,000–11,999,999 yen = 9.0% ;

12,000,000–14,999,999 yen = 3.3%; and 15,000,000 yen or more = 2%)². The average age of the adolescent was 14.05 years ($SD = 0.84$) at the time of the first data collection. For the age range of parents, most of mothers were in their 40s (40 years to 49 years, 75.8%) and fathers were in their 40s and 50s (40 years to 49 years = 52.1%, 50 years to 59 years = 45.2%) at the time of the first data collection. Multi-group analysis was conducted to assess whether the intergenerational model can be generalized across these variables.

Measures

This study was a part of a larger research project and the full dataset includes other survey questionnaire items targeted at other research questions. The paper focuses on variables relevant to our research question, and the results from all analyses relevant to our specific research question are reported. Table 1 reports the summary descriptive statistics and reliability of the scales. These are reported separately for parents and adolescents.

Growth mindset. To assess the prevalence of growth mindset among the parents and adolescents, the Theory of Intelligence Scale (Dweck 2000) was used. This

² Whether the distribution of SES was similar to the past public survey was tested with a large, representative sample (via two-stage stratified random sampling) of child-rearing families in Japan (the Japan Institute for Labour Policy and Training, 2017). The result was non-significant $\chi^2(11) = 10.64, p = .47$, suggesting that the sample was similar to the past survey in terms of SES condition.

scale comprises three items regarding fixed mindset (e.g., “you have a certain amount of intelligence, and you can't really do much to change it”) and three items concerning growth mindset (e.g., “no matter who you are, you can significantly change your intelligence level”); these are scored using a six-point Likert scale (1 = *strongly disagree* to 6 = *strongly agree*). The items were back translated in order to ensure that the original meaning was maintained. Following previous research (e.g., Tucker-Drob et al. 2016), the fixed mindset subscale scores were reverse-coded and then averaged the scores across items to compute a single growth-mindset index for each participant. The resulting scale demonstrated high internal consistency in parents and adolescents across both time points (Cronbach's α = .83–.91).

Grit. To assess the grit of the parents and adolescents, a Japanese version of the Short Grit Scale (Grit-S; Nishikawa et al. 2015) was used. This scale is a translated and validated version of the original Grit-S (Duckworth and Quinn 2009). The scale comprises two subscales: four items concerning persistence of interest (e.g., “new ideas and new projects sometimes distract me from previous ones”) and four items concerning perseverance of effort (e.g., “I finish whatever I begin”), assessed using a five-point Likert scale (1 = *disagree* to 5 = *agree*). In accordance with previous research (e.g., Tucker-Drob et al. 2016; Wang et al. 2018), these two subscales were combined. Specifically, for each participant for each time point, average scores across items were

obtained as a single grit index. The scale demonstrated adequate internal consistency across parents and adolescents at both time points ($\alpha = .74-.81$).

Depressive symptoms. To assess depressive symptoms among parents, the Kessler Psychological Distress Scale (K10; Kessler et al. 2002) was used; this examines how often individuals have experienced depressive symptoms within the preceding 30 days. The scale has a single factor comprising 10 items (e.g., “Did you feel so depressed that nothing could cheer you up?”), assessed using a five-point Likert scale (1 = *not at all* to 5 = *always*). The validity of this scale for Japanese participants was demonstrated by Furukawa et al. (2008). In the present study, the scale showed high reliability for both time points ($\alpha = .93$ and $.93$, for T1 and T2 respectively), and the average scores across the items were computed to obtain the index of depressive symptoms for each participant. The clinical cut-off score for this study is 3.5, yielded based on Stratum-Specific Likelihood Ratios in the previous study (see Furukawa et al. 2003).

To determine the level of the adolescents’ depressive symptoms, the short version of the Depression Self-Rating Scale for Children (DSRS-C; Namikawa et al. 2011) was used; the original (long) version of DSRS-C was developed by Birleson (1981) and examines how often children have experienced depressive symptoms within the preceding week. The short version of the scale comprises two subscales: five items concerning decreased enjoyment and activities (e.g., “I look forward things as much as I

used to”; reversed item) and four items of depressive mood (e.g., I think life is not worth living), assessed using a three-point Likert scale (1 = *not at all* to 3 = *always*). The validity of this scale for Japanese adolescents was demonstrated by Namikawa et al. (2011). For this research, the scale showed acceptable reliability across time points ($\alpha = .78$ and $.79$, for T1 and T2 respectively). In accordance with the previous research (e.g., Namikawa et al., 2011), the two subscales were combined. Specifically, average scores across items were computed to create a single depressive symptom score. The clinical cut-off of the scale is 1.78 corresponding to the proportion of the original cut-off score (Namikawa et al., 2011).

Control variables. Gender was coded as “0” for females (or mothers) and “1” for males (or fathers). To measure SES, parents were asked to report their annual household income (1 = < 2,000,000 yen; 2 = 2,000,000–2,999,999 yen; 3 = 3,000,000–3,999,999 yen; 4 = 4,000,000–4,999,999 yen; 5 = 5,000,000–5,999,999 yen; 6 = 6,000,000–6,999,999 yen; 7 = 7,000,000 yen– 7,999,999 yen; 8 = 8,000,000–8,999,999 yen; 9 = 9,000,000–9,999,999 yen; 10 = 10,000,000–11,999,999 yen; 11 = 12,000,000–14,999,999 yen; and 12 = 15,000,000 yen or more; Ministry of Education, Culture, Sports, Science and Technology 2014). Multi-group analyses were conducted to assess whether the intergenerational model was moderated by these controlling variables.

Results

Descriptive Statistics and Correlation

Correlations are presented in Table 2. For the main variables, no significant mean difference was observed between T1 and T2; for parents' mindset $t(297) = .54, p = .59$; for parents' grit $t(296) = .61, p = .54$; for parents' depressive symptoms, $t(298) = .48, p = .63$; for adolescents' growth mindset, $t(297) = .11, p = .92$; for adolescents' grit $t(297) = .04, p = .97$; for adolescents' depressive symptoms, $t(297) = 1.29, p = .20$.

Critically, despite these small mean difference, growth mindset, grit, and depressive symptoms showed only moderate correlations between T1 and T2 scores ($r_s = .48-.65$).

This means that our key variables (growth mindset, grit, and depressive symptoms) have some stable components, but there is also substantial rank-order change between time points (variance not explained by the change = 58–77 %). The source of these changes was examined in the following APIM analysis.

Consistent with previous studies (Tucker-Drob et al. 2016; Wang et al. 2018), the adolescents' growth mindset and grit were found to be positively correlated with each other at both time points ($r = .34, 95\%CI [.25, .43]$ and $.24, 95\%CI [.13, .35]$ respectively; $ps < .001$). Likewise, parental grit and growth mindset were positively correlated at both T1 and T2 ($r = .22, 95\%CI [.13, .31]$ and $.30, 95\%CI [.20, .40]$, respectively; $ps < .001$). Parents' gender was only significantly correlated with parents' depressive symptoms at T2 among our key variables, $r = -.17, 95\%CI [-.06, -.28], p$

$< .01$. This correlation suggests that mothers reported stronger depressive symptoms than fathers did, but the effect was relatively small. Although not statistically significant, both for grit and growth mindset, the correlation between T1 and T2 was slightly higher in parents than in adolescents (for parents' and adolescents' grit, $r = .65$ and $r = .61$, respectively, the difference was $p = .40$; for parents' and adolescents' growth mindset, $r = .58$ and $r = .48$, respectively, the difference was $p = .12$).

Parental Motivational Perseverance and Child Motivational Perseverance and Depressive symptoms

The results of the APIM (Figure 1) are reported in Table 4. The analysis was performed using Mplus version 7.0 with full information maximum likelihood estimation (FIML; Muthén and Muthén 1998–2012). The numbers of available data are indicated in Table 3. In total, data from $N = 6$ pairs of participants were missed in at least one of the T1 variables and data from $N = 101$ pairs of participants were completely missed at T2 (i.e. attrition rate = 25%). In our model with T1 variables as independent variables and T2 variables as the dependent variables, these participants cannot be included in analysis because the likelihood function cannot be computed or evaluated for these participants.³ Therefore, our model was tested by $N = 293$ (i.e., 400 –

³ Attrition analyses were conducted in which mean differences in T1 variables relevant for this research (i.e., growth mindset, grit, depressive symptoms) were compared between participants who completely missed at T2 and those who participated T2. Any significant mean differences between the groups were not obtained. For parent, mindset $t(397) = 1.20$, $p = .23$; grit $t(398) = 0.60$, $p = .55$;

6 –101) in total⁴. Other patterns of missing data were accounted by FIML. SES and the gender of the parents and adolescents were included as control variables. The tested model was saturated. Unstandardized coefficient “*B*” as well as standardized coefficient “ β ” are reported.

Consistent with our expectation, parental growth mindset was found to be a significant negative predictor of adolescents’ depressive symptoms ($B = -0.05$, 95%*CI* [-0.09, -0.01], $\beta = -.12$, $p < .05$), indicating that parental growth mindset may serve as a preventive factor of adolescents’ depressive symptoms. On the other hand, the direct effect of parental grit on adolescents’ depressive symptoms were not statistically significant ($B = -0.04$, 95%*CI* [-.10, 0.02], $\beta = -.07$, $p = .20$). Contrary to previous findings (Elgar et al., 2004), parental depressive symptoms were not a significant predictor of adolescents’ depressive symptoms ($B = 0.00$, 95%*CI* [-0.05, 0.05], $\beta = .00$, $p = .88$).

In addition, parental growth mindset was found to significantly predict an increase in adolescents’ growth mindset over time ($B = 0.11$, 95%*CI* [0.001, 0.21], β

depressive symptoms $t(398) = 0.32$, $p = .75$. For adolescent, mindset $t(397) = 0.41$, $p = .68$; grit $t(398) = 0.17$, $p = .86$, depressive symptoms $t(398) = 0.43$, $p = .67$.

⁴ The data was also analyzed by FIML in which all correlations among predictor variables were explicitly modeled; all sets of predictor correlations were declared WITH statement in Mplus, which allows us to make use of the full sample ($N = 400$) to estimate parameters. As expected, identical path coefficients reported in Table 4 were obtained. However, the model caused an improper solution (i.e., negative variance in error variance) and we could not fix the problem. Therefore, the result obtained by the analysis discussed in the manuscript were reported.

= .10, $p < .05$). Similarly, parental grit significantly predicted an increase in adolescents' grit over time ($B = 0.17$, 95%CI [0.07, 0.27], $\beta = .16$, $p < .001$). One unexpected finding was that parental grit was a significant *negative* predictor of adolescents' growth mindset ($B = -0.20$, 95%CI [-0.36, -0.04], $\beta = -.13$, $p < .05$).

Critically, adolescents' grit was also a significant negative predictor of adolescents' depressive symptoms ($B = -0.07$, 95%CI [-0.13, -0.01], $\beta = -.13$, $p < .05$). In addition, it suggests that, consistent with our prediction, adolescents' grit may serve as a mediator between parental grit and adolescents' depressive symptoms levels. To test this indirect effect (parental grit \rightarrow adolescents' grit \rightarrow adolescents' depressive symptoms), a mediational analysis using a boot strapping method was conducted; stability assumption in cross-lagged relations was posited as in previous studies (e.g., Weinstein et al. 2017). The indirect effect was determined to be statistically significant (estimate = -0.012, 95%CI [-0.028, -0.002]). Other possible indirect effects (e.g., parent growth mindset \rightarrow adolescent mindset \rightarrow adolescent depressive symptoms) were not tested because only T1 adolescent grit significantly predicted T2 adolescent depressive symptoms. The major findings were summarized in Figure 2.

The APIM allowed us to examine the reciprocal effects between parents and adolescents: parents' effects on their adolescent children as well as adolescents' effects on their parents. Exploratory investigation of these adolescent \rightarrow parents paths did not

show any significant relationship.

Sensitivity Analysis

Multigroup analyses were conducted to check the robustness of our model across parents' and adolescents' gender (i.e., gender differences in path coefficients) and SES. Specifically, we compared two multi-group models by log-likelihood ratio test: a) a multi-group model in which path coefficients were constrained to be equal across child gender groups, and b) a multi-group model in which only paths relevant to the objective of the present research (i.e., cross-lagged relationships depicted in bold line in Fig. 1) are relaxed while the other path coefficients remained constrained. The results showed that child gender did not significantly moderate the cross-lagged relations (n female = 144; n male = 149): $\Delta\chi^2$ in log-likelihood ratio test comparing these two models was not significant, $\Delta\chi^2(8) = 5.23, p = .73$. Parental gender was also tested as a moderator with the same model comparison strategy (n mother = 241, n fathers = 52). The result again showed that $\Delta\chi^2$ was not significant, $\Delta\chi^2(8) = 4.07, p = .85$, indicating that parent gender is not a moderator in the cross-lagged relationships of our focal variables. The combination of parental gender and adolescent gender (i.e., multigroup analysis with four groups) was also tested. However, the model produced an improper solution possibly due to the small number of pairs with fathers.

Finally, a model was tested in which SES was a moderator. For SES, the sample

was divided based on the mid-point in the annual household income scale (n low SES = 139, n high SES = 154). The result showed that $\Delta\chi^2$ was not significant, $\Delta\chi^2(8) = 15.44$, $p = .051$, indicating that our intergenerational model is not significantly different across the SES groups.

Discussion

Previous research has suggested that adolescent depressive symptoms are affected by numerous factors including their personality characteristics (e.g., perfectionism; Kawamura et al. 2001). Past literature has also suggested that motivational perseverance such as grit and growth mindset are negative predictors of adolescent mental health (Schroder et al. 2016; Wootton et al. 2017). However, the literature on motivational perseverance has pretermitted the effects of parents; despite the theoretical implications of parental motivational characteristics in predicting their adolescents' mental health (Dweck 2006), there has been little empirical research that tests this possibility. To address this issue, the present study examined how parental grit and growth mindset predict their adolescent children's depressive symptoms. The results largely supported the present research's hypothesis; specifically, parental growth mindset was determined to be a significant predictor of adolescents' depressive symptoms. In addition, parental grit was found to be a positive predictor of adolescents' grit, which in turn predicted adolescents' levels of depressive symptoms. These results

indicate that parental motivational perseverance has both direct and indirect effects on adolescents' depressive symptoms.

The Mechanism of Parental Effects on Adolescents

The current study provides evidence that, over time, higher parental motivational perseverance leads to higher motivational perseverance in adolescents.

Although existing literature suggests that parents' motivational perseverance is a positive predictor of adolescents' motivational perseverance (especially for mindset; see Gunderson et al. 2018; Haimovitz and Dweck 2017), few studies have directly reported this relationship, and even fewer have focused on grit. Thus, the current study is important, as it empirically confirms this relationship. An important next step is to examine in more detail the mechanism underlying this intergenerational transmission process. For example, as indicated in the introduction, perseverant parents may exhibit more messages and parenting behaviors that encourage adolescents' persistence and perseverance, facilitating, through such implicit messages, the formation of growth mindset or a gritty disposition in their adolescent children. In fact, studies on motivation have previously suggested that motivations in adolescents are influenced by seniors' messages and behaviors (see Wigfield et al. 2015).

Existing studies have also suggested that the reinforcement of child behaviors that parents provide can be a mediator of the parent–child transmission process. For

instance, child anxiety symptoms can be reinforced by parental involvement (e.g., Essau et al. 2011), such that anxious parents may pay excessive attention to their children's anxiety symptoms and provide reinforcement (e.g., snacks), which can eventually reinforce children's anxiety symptoms. Similarly, it is possible that highly perseverant parents reinforce perseverant habits in adolescents by providing praise or rewards to their adolescents when they exhibit perseverance behaviors. Thus, adolescents' grit- or growth mindset-related behaviors can be facilitated via reinforcement provided by parents.

Another possible explanation for this intergenerational transmission process is social learning (Bandura 1986; Usher and Schunk 2018). According to the social learning theory (or the social-cognitive theory of learning), individuals form their attitudes and beliefs by observing others. For emotion regulation during adolescence, adolescents learn how to address negative emotions via modeling, as well as through direct instructions from their parents (provided the parents are responsive to the child's distress; Davidov and Grusec 2006). Thus, even if parents do not explicitly teach the importance of motivational perseverance, it is possible that adolescents still learn the attitudes of their parents.

While this study observed the significant effects of parents' motivational perseverance on adolescents' motivational perseverance, the opposite direction of the

effect (the effect of adolescents' motivational perseverance on parents' motivational perseverance) was not observed. This lack of the effect of adolescents' motivational disposition on that of parents' might be because motivational dispositions become more rigid and fixed once they are developed in an individual (i.e., as they become an adult). Thus, it may be more difficult to change motivational preservation in parents than in adolescents. Future research must test this possibility and whether the effects of adolescents on parents are always weaker than those of parents on adolescents. In one unexpected finding, parental grit was a significant negative predictor of adolescents' growth mindset. A potential explanation for this unexpected relationship is that parental grit serves as a suppressor variable, given the overlap of growth mindset and grit.

Adolescent Motivational Perseverance and Depressive symptoms

A unique feature of the current study is that both growth mindset and grit were included as predictors of adolescents' depressive symptoms. Although growth mindset and grit conceptually overlap, the results showed interesting differences between the two. For example, adolescents' growth mindset was not a significant predictor of adolescents' depressive symptoms, whereas adolescents' grit negatively predicted adolescents' depressive symptoms consistent with previous studies (e.g., Allenden et al. 2018). There may be several reasons for this non-direct link between adolescents' growth mindset and outcomes. Grit can be a more direct behavioral- or effort-based endorsement measure

compared to growth mindset; such a behavioral measure is a proximal predictor of performance and well-being. Indeed, studies have discussed the similarity between grit and behavioral concepts such as effort regulation and behavioral engagement and found that grit is positively related to such factors (Muenks et al. 2017). Adolescents with high levels of grit may actively engage in addressing stressful life events, which consequently inhibits depressive symptoms. Growth mindset may be also relate to such positive attributes (i.e., adaptive self-regulation) that negatively predict depressive symptoms. However, mindset is typically characterized as an implicit belief regarding one's competence (i.e., intelligence), which does not directly reflect a person's behavioral tendencies. This may explain why the significant relationship with depressive symptoms was attenuated after controlling for grit.

Another possible explanation is that, in comparison to grit, mindset reflects personality characteristics that are more directly related to negative emotions associated with stress. Specifically, while growth mindset may be considered *resilience*, grit may be better termed *hardiness*. Resilience reflects a recovery process from a stressful life event, while hardiness can be defined as the toughness to withstand stressors (Kobasa 1979). Dweck (2006) noted that individuals with growth mindset are resilient, but that they still feel negative emotions and can even become depressed when experiencing harshness. Mindset-related literature has already discussed the positive link between

growth mindset and resilience (Yeager and Dweck 2012). In this sense, adolescents with growth mindset can express depressive moods when they are in the process of recovery; in contrast, hardiness is related to mental toughness (Crust 2008), and can buffer the detrimental effect of stressors and allow adolescents to be relatively unaffected by stressful life events (e.g., Lambert et al. 2003; Zerach et al. 2017). As such, high-grit individuals are less susceptible to stressful life events.

One important question for future studies concerns whether the results will be replicated in other samples. While our sample consisted of Japanese dyads, our hypothesis was based on the theory and empirical studies in western countries, suggesting that it is possible that similar patterns are observed in other western countries. Nevertheless, perseverance is considered as a cultural virtue in Japan (see Suprawati et al. 2014), and Japanese parents and teachers routinely emphasize the importance of being perseverant to adolescents (Holloway 1988; Kitayama et al. 1997). Thus, it is possible that adolescents with high perseverance are more likely to be accepted by parents and teachers in Japan, which may prevent perseverant adolescents from suffering severe depressive symptoms. Although not the scope of the current investigation, future research should benefit from examining potential cultural differences using cross-cultural data.

Limitations and Future Avenues of Research

The findings of this study are also subject to several limitations. Although our model applied two-wave data and tested mediation regarding whether parental grit influences child depression, the data must be tested with more wave data. With data from more than three-time points, whether stability assumption in cross-lagged relationships between time points is supported was directly tested, and more stable estimation can be possible and more sophisticated statistical models (e.g., the Random Intercept Cross-Lagged Panel Model; Hamaker et al. 2015; Usami et al., in press) can be applied. Future research should also seek to confirm the mechanism underlying the intergenerational process identified in this study. Although possible mechanisms were discussed, these mechanisms were not necessarily confirmed empirically. Finally, this study only used self-reported questions to assess motivational perseverance and depressive symptoms. Although our cross-lagged approach makes it possible to statistically control for a stable response bias to some extent, future research should use other assessment methods to further validate our inter-generational model. One possibility is the use of clinical diagnosis in the assessment of depression like many other clinical studies.

Conclusion

Although past literature has focused on mainly parenting predicting adolescents' depressive symptoms, parental motivational characteristics were

understudied despite their potential predictive power on adolescents' depressive symptoms. The current study examined whether parental motivational perseverance influenced on adolescents' depressive symptoms using a longitudinal intergenerational design. With two-time-point longitudinal data separately obtained from parents and their children, our data allowed us to draw causal assumptions and reduce response bias. The results revealed that parental grit decreased adolescents' depressive symptoms via affecting child grit, while parental mindset decreased adolescents' depressive symptoms directly. Although this study focused on parental motivational perseverance as a predictor of adolescents' motivational perseverance and depressive symptoms, the parental effects may extend to *other* motivational constructs. Future studies should include other motivational constructs to facilitate research which integrates notions from the literatures on motivation, parenting, and depressive symptoms. This research may offer suggestions on how to improve adolescents' academic performance and well-being by altering parents' attitudes, beliefs, or parenting styles.

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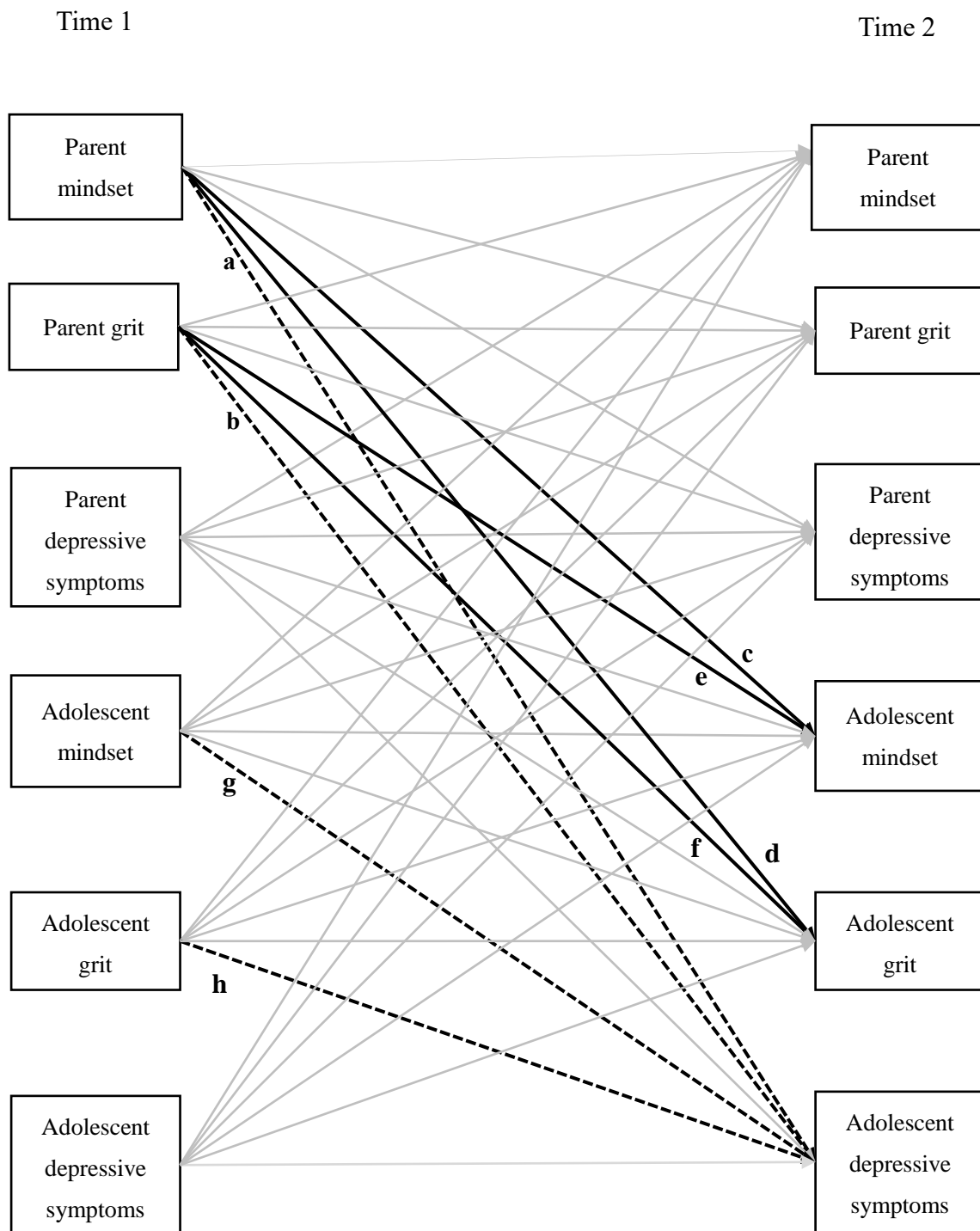


Fig. 1 the model Time 1 variable predicting Time 2 variables. Mindset; growth mindset. Bold paths represent the paths relevant to the purpose for this research. Among bold paths, the paths with dotted line represent hypothesized negative cross-lagged relationships. Those with solid line represent hypothesized positive cross-lagged relationships. Control variables were not presented for presentational clarity.

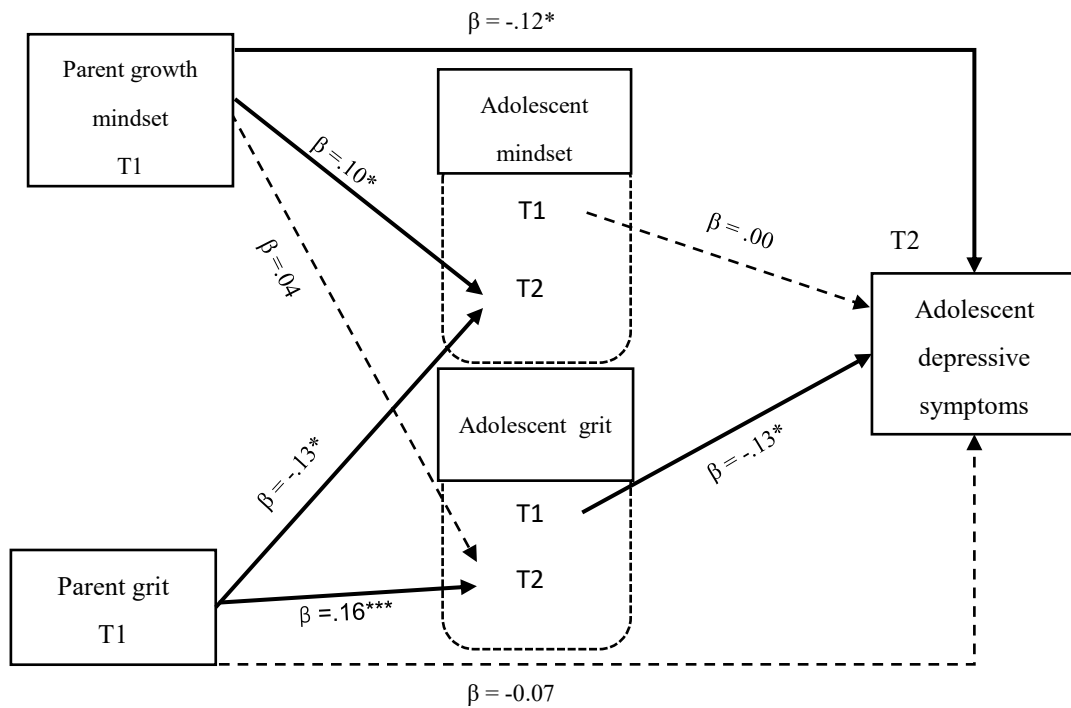


Fig 2 Summary of the primary findings of this analysis. T1; Time 1, T2; Time 2. Mindset; growth mindset. The paths with a solid line represent significant effects. Those with a dotted line represent non-significant effects. Only primary findings were presented here for clarity.

* $p < .05$, *** $p < .001$

Table 1. Descriptive statistics for Time 1 and Time 2 variables

	Time 1		Time 2		<i>t</i> (<i>df</i>)	<i>p</i>
	M(SD)	α	M(SD)	α		
Parent mindset	3.68(.87)	.89	3.63(.90)	.91	.54(297)	.59
Parent grit	3.21(.59)	.76	3.22(.64)	.81	.61(296)	.54
Parent depressive symptoms	1.83(.77)	.93	1.85(.78)	.93	.48(298)	.63
Adolescent mindset	3.91(.93)	.83	3.92(.93)	.86	.11(297)	.92
Adolescent grit	3.05(.66)	.74	3.05(.66)	.76	.04(297)	.97
Adolescent depressive symptoms	1.60(.37)	.78	1.62(.37)	.79	1.29(297)	.20

Note. Mindset; growth mindset.

Table 2. Zero-order correlations among variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Parent gender (Female = 0, Male = 1)	—														
2. SES	.13** (396)	—													
3. Parent mindset (T1)	.04 (399)	.07 (395)	—												
4. Parent grit (T1)	.01 (400)	.19*** (396)	.22*** (399)	—											
5. Parent depressive symptoms(T1)	-.05 (400)	-.14** (396)	-.16*** (399)	-.14** (400)	—										
6. Parent mindset (T2)	.05 (299)	.05 (295)	.58*** (298)	.25*** (299)	-.19*** (299)	—									
7. Parent grit (T2)	.04 (297)	.12* (294)	.14* (296)	.65*** (297)	-.16** (297)	.30*** (297)	—								
8. Parent depressive symptoms (T2)	-.17** (299)	-.07 (295)	-.16** (298)	-.15** (299)	.65*** (299)	-.22*** (299)	-.16** (297)	—							
9. Adol gender (Female = 0, Male = 1)	.06 (400)	-.05 (396)	-.01 (398)	-.05 (400)	.04 (400)	.02 (299)	-.01 (297)	-.07 (299)	—						
10. Adol mindset (T1)	.01 (399)	.05 (395)	.20*** (394)	.07 (399)	-.10* (399)	.19*** (298)	-.13* (297)	-.04 (298)	.02 (399)	—					

11. Adol grit (T1)	-.04 (400)	.02 (396)	.02 (399)	.16** (400)	-.13* (400)	.01 (299)	.21*** (297)	-.10 (299)	-.06 (400)	.34*** (399)	—				
12. Adol depressive symptoms (T1)	-.00 (400)	-.05 (396)	-.14** (399)	-.10* (400)	.17*** (400)	-.13* (299)	-.16** (297)	.16** (299)	.02 (400)	-.29*** (399)	-.30*** (400)	—			
13. Adol mindset (T2)	.08 (299)	.05 (295)	.16** (298)	-.07 (299)	-.10 (298)	.19*** (299)	.01 (297)	-.08 (299)	.10 (299)	.48*** (298)	.23*** (294)	-.09 (299)	—		
14. Adol grit (T2)	.04 (298)	-.01 (294)	.10 (297)	.26*** (298)	-.17** (298)	.08 (298)	.23*** (296)	-.13* (298)	-.10 (298)	.23*** (297)	.61*** (298)	-.20*** (298)	.24*** (298)	—	
15. Adol depressive symptoms (T2)	-.03 (298)	-.13* (294)	-.20*** (297)	-.17** (298)	.12* (298)	-.11 (298)	-.21*** (296)	.13* (298)	.01 (298)	-.20*** (297)	-.27*** (298)	.54*** (298)	-.16** (298)	-.27*** (298)	—

Note. Adol; adolescent. Mindset; growth mindset. Numbers in parentheses represent the sample sizes.

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

Table 3. Sample size, distribution and missing rate for Time 1 and Time 2 variables

	Time 1				Time 2			
	<i>N</i>	<i>Skewness</i>	<i>Kurtosis</i>	Missingness (%)	<i>N</i>	<i>Skewness</i>	<i>Kurtosis</i>	Missingness (%)
Parent mindset	399	0.01	0.09	0.003%	299	-0.14	0.24	25.25%
Parent grit	400	0.02	0.10	0%	297	-0.01	0.23	26.75%
Parent depressive symptoms	400	1.42	2.14	0%	299	1.22	1.29	25.25%
Adolescent mindset	399	-0.01	0.28	0.003%	297	0.09	-0.06	25.75%
Adolescent grit	400	0.05	-0.19	0%	298	-0.03	0.31	25.50%
Adolescent depressive symptoms	400	0.72	0.56	0 %	298	0.64	0.18	25.50%

Note. Mindset; growth mindset.

Table 4. APIM predicting Time 2 mindset, grit and depression

	Adol mindset (T2)				Adol grit (T2)				Adol depression (T2)			
	B	95%CI	β		B	95%CI	β		B	95%CI	β	
Parental predictors												
Parent gender	0.16	[-0.08, 0.40]	.07		0.08	[-0.07, 0.24]	.05		-0.02	[-0.11, 0.07]	-.02	
Parent mindset (T1)	0.11	[0.001, 0.21]	.10	*	0.03	[-0.04, 0.10]	.04		-0.05	[-0.09, -0.01]	-.12	*
Parent grit (T1)	-0.20	[-0.36, -0.04]	-.13	*	0.17	[0.07, 0.27]	.16	***	-0.04	[-0.10, 0.02]	-.07	
Parent depressive symptoms (T1)	-0.05	[-0.17, 0.07]	-.04		-0.05	[-0.13, 0.03]	-.06		0.00	[-0.05, 0.05]	.00	
SES	-0.00	[-0.04, 0.04]	-.00		-0.02	[-0.04,0.01]	-.07		-0.01	[-0.02, 0.01]	-.06	
Adolescent predictors												
Adol gender	0.16	[-0.03, 0.30]	.09		-0.08	[-0.20, 0.04]	-.06		-0.02	[-0.09, 0.05]	-.03	
Adol mindset (T1)	0.47	[0.35, 0.58]	.45	***	0.02	[-0.05, 0.09]	.03		0.00	[-0.04, 0.05]	.00	
Adol grit (T1)	0.15	[-0.01, 0.30]	.11	†	0.57	[0.47, 0.67]	.56	***	-0.07	[-0.13, -0.01]	-.13	*
Adol depressive symptoms (T1)	0.17	[-0.10, 0.44]	.07		-0.02	[-0.20, 0.15]	-.01		0.48	[0.37, 0.58]	.48	***
	R ² = .28				R ² = .42				R ² = .34			
	Parent mindset (T2)				Parent grit (T2)				Parent depression (T2)			
	B	SE	β		B	SE	β		B	SE	β	
Parental predictors												
Parent gender	0.06	[-0.16, 0.28]	.03		0.05	[-0.10, 0.19]	.03		-0.26	[-0.43, -0.08]	-.13	**
Parent mindset (T1)	0.52	[0.42, 0.62]	.52	***	-0.02	[-0.09, 0.04]	-.03		-0.04	[-0.12, 0.04]	-.05	
Parent grit (T1)	0.21	[0.07, 0.35]	.14	**	0.67	[0.57, 0.76]	.64	***	-0.06	[-0.18, 0.05]	-.05	
Parent depressive symptoms (T1)	-0.09	[-0.20, 0.02]	-.08	†	-0.03	[-0.10, 0.04]	-.04		0.62	[0.54, 0.71]	.64	***
SES	-0.01	[-0.05, 0.02]	-.04		0.00	[-0.02, 0.02]	-.00		0.02	[-0.01, 0.05]	.07	
Adolescent predictors												
Adol gender	0.03	[-0.14, 0.20]	.02		0.00	[-0.11, 0.11]	-.00		-0.15	[-0.28, -0.02]	-.10	*
Adol mindset (T1)	0.09	[0.42, 0.62]	.09	†	0.05	[-0.02, 0.12]	.07		0.06	[-0.02, 0.14]	.07	
Adol grit (T1)	-0.11	[-0.25, 0.03]	-.08		0.06	[-0.04, 0.15]	.06		0.01	[-0.10, 0.12]	.01	
Adol depressive symptoms (T1)	-0.07	[-0.32, 0.17]	-.03		-0.08	[-0.24, 0.08]	-.05		0.16	[-0.03, 0.35]	.08	
	R ² = .37				R ² = .45				R ² = .47			

Note. T1, Time 1; T2, Time 2, Adol; adolescent. Mindset; growth mindset.

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