The roles of trait and process resilience in relation of BIS/BAS and depressive symptoms among adolescents

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Backgrounds. Extensive literature revealed the relations of depression with behavioral inhibition system (BIS) and behavioral activation system (BAS) as vulnerability and with resilience separately. Besides, the concept of resilience is still being broad and ambiguous. Thus, this study aimed to reveal the mediation of two aspects of resilience: trait and process, in the relations of BIS and BAS to depression among adolescents.

Methods. The data set used in this study was cross-sectional survey among 965 adolescents. The obtained data of self-reported questionnaire used in this study were as below: Depression Serf-Rating Scale for Children (DSRS-C), Behavioral Inhibition and Behavioral Activation System Scale (BIS/BASS), Bidimensional Resilience Scale (BRS). Structural equation modeling (SEM) was conducted to verify the hypothesized relations among BIS/BAS, trait and behavior resilience, and depressive symptoms.

Results. The obtained indices of fit from SEM were good or sufficient (χ^2 = 562.911, *df* = 96, *p* = .000; CFI = .918; NFI = .908; RMSEA = .071, 90% CI: [.065, .077]). And the modeling showed that both BIS/BAS directly and indirectly influenced to depression. The indirect effects of BIS/BAS were mediated only trait resilience except the indirect effect of BIS via behavioral resilience.

Discussion. Our results suggested that trait resilience played significant mediation role in the relationships between BIS/BAS and depression. Trait rather than process resilience could be considered to be suitable to target of intervention in line with decreasing depression.

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Abstract

21   **Backgrounds.** Extensive literature revealed the relations of depression with behavioral inhibition
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23   Besides, the concept of resilience is still broad and ambiguous. Thus, this study aimed to reveal the
24   mediation of two aspects of resilience: trait and process, in the relations of BIS and BAS to depression
25   among adolescents.
26   **Methods.** The data set used in this study was a cross-sectional survey among 965 adolescents.
27   The obtained data from the self-reported questionnaires used in this study were as below:
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29   Activation System Scale (BIS/BASS), and Bidimensional Resilience Scale (BRS). Structural
30   equation modeling (SEM) was conducted to verify the hypothesized relations among BIS/BAS,
31   trait and behavior resilience, and depressive symptoms.
32   **Results.** The obtained indices of fit from SEM were good or sufficient (χ^2 = 562.911, df = 96, p
33   = .000; CFI = .918; NFI = .908; RMSEA = .071, 90% CI: [.065, .077], SRMR = .066). And the
34   modeling showed that both BIS/BAS directly and indirectly influenced to depression. The
35   indirect effects of BIS/BAS were mediated only trait resilience except the indirect effect of BIS
36   via behavioral resilience.

37 **Discussion.** Our results suggested that trait resilience played a significant mediation role in the
38 relationships between BIS/BAS and depression. Trait but not process resilience could be
39 considered suitable as an intervention target in line with decreasing depression.
40
41 **Introduction**
42
43   Depression is a global mental health concern. According to the World Health

44 Organization (WHO, 2021), more than 260 million people worldwide are affected by depression.

45 For depression among the young population, a meta-analysis has estimated a 2.6% prevalence

46 rate of any depressive disorder (Polanczyk et al., 2015). Depressive symptoms during

47 adolescence cause negative outcomes and serve as a risk factor for the onset of depressive

48   disorder in adulthood (Fogel, Eaton, & Ford, 2006; Johnson et al., 2018).

49   Extensive literature has revealed the significance of psychological resilience as a

50 protective factor against depression in adolescents (Anyan & Hjemdal, 2016; Edward, 2005;

51 Hjemdal et al., 2011; Ng, Ang, & Ho, 2012). Psychological resilience refers to "the process of

52 effectively negotiating, adapting to, or managing significant sources of stress or trauma"

53 (Windle, 2011), and includes various psychological and social factors. In line with the

54 relationship between depression and psychological resilience, Ding et al. (2017) found that

55 resilience related to stress coping has a buffering effect on depressive symptoms with childhood

56 trauma. Skrove, Romundstad, and Indredavik (2013) also showed an association between

57 depression and psychological resilience by suggesting a pathway in which higher psychological

58 resilience leads to good interpersonal relationships that follow lower depression.

59   In psychology, studies on resilience have noted the tendency for the concept to fall into

60 ambiguity. Southwick and colleagues (2014) called for the need to build an integrative view and

61 definition. The concept of resilience is complexly constructed by biological, psychological,

62 social, and cultural factors and their interactions. In psychology, the construct of resilience has

63   been accounted for in various ways: trait, process, and outcome (Fletcher & Sarkar, 2013). Ahern

64   (2006) pointed out the development of psychological scales for measuring resilience has resulted

65   in a broad and ambiguous definition. The roles of resilience suggested by previous studies can be

66   well explained by organizing the concept of resilience based on the distinction between trait,

67   process, and outcome (Fletcher & Sarkar, 2013). Accordingly, psychological resilience can be

68   divided into either trait or process aspects. However, research has not provided empirical

69   findings on this method of organizing itself. Investigations have yielded results on the effect of

70   resilience from the single view of either trait or process. Still, no empirical studies have

71   demonstrated the comparing among trait aspect and the process aspect of resilience. Trait

72   resilience could be assumed to affect mental health problems, including depressive symptoms,

73   via process resilience. In addition to the trait–process resilience pathway, the model remains

74   unclear. Thus, the current study used the two aspects of trait and process (behavioral) to define

75   the concept of resilience and then investigated their relation to depression.

76   Contrary to resilience as a concept of protective factor, a large body of evidence shows

77   the behavioral inhibition system (BIS) and behavioral activation system (BAS; Carver & White,

78   1994) as vulnerabilities for depression. The BIS/BAS theorized based on biology has been used

79   to explain personality construction. According to reinforcement sensitivity theory (Gray, 1987),

80   personality is primarily composed of two motivational systems (BIS and BAS). The BIS is

81   hypothesized to be sensitive to threats and punishment, thus involving avoidance and negative

82   affect. The BAS is hypothesized to be sensitive to rewards and drive, thus involving approach

83   and positive affect (Zinbarg et al., 2008; Erdle et al., 2010). Both BIS and BAS are associated

84   with depression (e.g., Kasch et al., 2002; Pinto-Meza et al., 2006; Mellick et al., 2014): a higher

85   BIS and a lower BAS are related to depressive symptoms. That is, depression is characterized by

86 high sensitivity toward threats, increased avoidant behavior and negative affect, slight sensitivity

87 toward rewards, and decreased approach behavior and positive affect. As the BIS/BAS was

88 thought to be a temperature based on the primary construction of personality, the BIS/BAS has

89 been studied in terms of its relationship with other aspects of trait. Slobodskaya (2007) found

90 correlations between the BIS/BAS and Big Five personality traits; BIS is correlated with

91 neuroticism and extraversion, whereas BAS is correlated with agreeableness and

92 conscientiousness. Włodarska et al. (2021) also showed the correlations between BIS/BAS and

93 dark triad personality traits through meta-analysis, including positive correlations between

94 Narcissism, Machiavellianism, and BAS. Although BIS/BAS and psychopathology and

95 personality have been broadly investigated, little is known about their relation to resilience.

96   Several studies revealed the relationships between BIS/BAS and some positive

97 psychological aspects in relation to resilience. Regarding optimism, which has been associated

98 with resilience (Souri & Hasanirad, 2011), De Pascalis et al. (2013) revealed that BIS and

99 optimism had a commonality in brain activity through electroencephalography and a negative

100 correlation between self-measured BIS and optimism. Taubitz et al. (2015) investigated the

101 relationships between BIS/BAS and adaptive psychological traits, such as cognitive reappraisal.

102 The results showed that reward responsiveness, a subfactor of BAS, could predict cognitive

103 reappraisal and well-being (Taubitz et al., 2015). Based on the results that BIS/BAS could

104 influence traits and that BIS/BAS was an entire brain system that affects various psychological

105 aspects, it was assumed that BIS/BAS also affects trait resilience. In addition to these pathways,

106 it would also be considered that trait resilience leads to behavioral aspects of resilience and then

107 protect against depression. However, no empirical study has investigated the relation between

108 BIS/BAS, resilience, and depression.

109   Thus, we aimed to investigate the relations among BIS/BAS, depression, trait and process

110   aspects of resilience. For distinction of trait and process resilience, we considered process

111   resilience as behavioral resilience according to the characteristics of the scale used in this study

112   (detail was described in Measure section). Based on Gray's theory and previous related studies,

113   we assumed that BIS/BAS would primarily drive trait and behavioral resilience. Therefore, we

114   hypothesized the pathways by which BIS/BAS would affect traits and resilience and then

115   influence depression, as depicted in Figure 1. We tested these pathways to examine the

116   mediation effects of trait and behavior resilience and their associations.

117   [Please insert Figure 1 here]

118
119
120   **Materials & Methods**
121
122   **Data set**

123   We used the 2021 dataset of the I'M HAPPY project in Japan, launched in 2019. This

124   project aimed to investigate psychological factors and mental health among adolescents aged 12

125   to 15 through longitudinal surveys in two junior high schools in Japan (Masuyama et al., 2021;

126   osf.io/4dfb8).

127   The survey for the dataset of 2021 was carried out during the COVID-19 pandemic; in

128   July 2021, the number of confirmed cases of infection per day was about 30 in the area where the

129   survey was conducted: Fukushima Prefecture, Japan. The dataset of 2021 contained responses on

130   depressive symptoms, trait anxiety, sleep disturbance, fear of COVID-19, internet addiction

131   symptoms, and psychological resilience from 965 adolescents (mean age = 14.03 years, SD =

132   0.67). The current study used the measures of depressive symptoms, BIS/BAS, and resilience.

133   Informed consent was obtained from the board of education, school, and teachers. Informed

134   consent from participants was obtained by providing their responses to the questionnaire. The

135   overall procedure for this longitudinal survey was approved by the ethics committee of Iryo

136   Sosei University (Receipt number: 21-09).

137

138   **Measure**

139   **Depression Serf-Rating Scale for Children (DSRS-C)**

140   To assess depressive symptoms, the Japanese version of the DSRS-C (Birleson, 1981) was used,

141   an 18-item scale that includes five reverse items. Participants responded on a three-point Likert

142   ranging from "0" (no/never) to "2" (most of the time). The Japanese DSRS-C has good

143   validation and reliability (Murata et al., 1996). The total score ranges from 0 to 36, with a higher

144   score indicating more significant depressive symptoms. The scale's internal consistency in this

145   study was $\alpha = .865$

146

147   **Behavioral Inhibition and Behavioral Activation System Scale**

148   To assess participants' BIS and BAS, the Japanese version of the BIS/BAS Scale (Carver

149   & White, 1994), which has 20 items to which participants responded using a four-point Likert

150   scale ranging from "1" (totally disagree) to "4" (totally agree), was used. The BIS/BAS scale has

151   a four-factor construction: 1) BIS, 2) BAS Reward Responsiveness, 3) BAS Drive, and 4) BAS

152   Fun Seeking. The total scores of each factor are calculated and then used in statistical analyses.

153   The Japanese BIS/BAS scale has been confirmed reliable and valid (Takahashi et al., 2007). The

154   internal consistency in this study was as follows: 1) BIS: $\alpha = .706$, 2) BAS Reward

155   Responsiveness: $\alpha = .831$, 3) BAS Drive: $\alpha = .846$, and 4) BAS Fun Seeking: $\alpha = .758$.

156

157   **Bidimensional Resilience Scale (BRS)**

158   Psychological resilience was measured using the BRS (Hirano, 2010), a 21-item scale with two

159   dimensions: innate and acquired resilience. The innate resilience dimension includes four factors

160   (optimism, control, sociability, and vitality). Example items are "I can overcome difficult events"

161   (optimism factor) and "Putting in effort is important" (vitality factor). The acquired resilience

162   dimension includes three factors (solving a problem, self-understanding, and understanding

163   others). Example items are "When a problem occurs, I collect information to solve that problem"

164   (problem-solving factor) and "I understand my personality well" (self-understanding factor).

165   Participants responded on a five-point Likert scale ranging from "1" (strongly disagree) to "5"

166   (strongly agree).

167   The BRS was developed in Japan based on the Temperament/Character model

168   (Cloninger, 1993) to classify resilience-related items into the innate and acquired dimensions

169   separately. We regarded the innate and acquired dimensions to indicate trait and process

170   resilience. The reason is that the items in the innate dimension of the scale refer to the

171   participants' ability and trait, and those in the acquired dimension, to participants' actual

172   behavior and response. The BRS has good reliability and validity (Hirano, 2010). In this study,

173   the internal consistency values were as follows: trait resilience, $\alpha = .896$; process resilience, $\alpha = $

174   .806; and total, $\alpha = .911$.

175

176   **Statistical Analyses**

177   The missing values were replaced from the dataset with the mean of the corresponding items. We

178   computed all variables separately for each subscale and factor. Our study used IBM SPSS

179 Statistics for Windows, Version 26.0, to calculate the descriptive statistics and correlations.

180 Relations among variables were evaluated using Pearson's correlation.

181 Our study conducted structural equation modeling (SEM) to verify the hypothesized

182 relations among BIS/BAS, trait and behavior resilience, and depressive symptoms, using AMOS

183 version 26. The overall hypothesized model is as follows: each factor of BIS/BAS affects the

184 trait and behavioral aspects of resilience, trait resilience also affects behavior resilience, and

185 behavior resilience affects depressive symptoms. We also estimated each factor's direct and

186 indirect effects on depressive symptoms. To evaluate the hypothesized model, we calculated the

187 goodness-of-fit indices of the SEM. Specifically, we used the comparative fit index (CFI),

188 normed fit index (NFI), root mean square error of approximation (RMSEA), and Standard Root

189 Mean Square Residual (SRMR) (Bentler, 1990; Steiger, 1998). CFI and NFI values above .90

190 suggest a good fit (Hu & Bentler, 1999). For RMSEA and SRMR, values below .05 indicate

191 good model fit, whereas values above .10 indicate unacceptable fit (Browne & Cudeck, 1993; Hu

192 & Bentler, 1999).

193 To evaluate the mediation effect of trait and behavioral resilience, in addition to model

194 testing, the mediation analyses were conducted with the model 4 setting of the PROCESS macro

195 developed by Hayes (2013). We applied the 95% bias-corrected confidence interval obtained

196 from 10,000 bootstrap resampling. The significance of mediation effects was tested by

197 determining whether the confidential interval did not pass by zero or not.

198
199
200 **Results**
201 **Descriptive Statistics and Correlational Analysis**

202 Table 1 shows the descriptive statistics separated by gender and grade. Table 2 also shows the

203 correlations among each variable. The correlation analysis showed that depression was

204 significantly correlated with each factor of BIS/BAS ($r > .162$, $p < .001$) and trait and behavioral

205 resilience ($r > .395$, $p < .001$). Significant correlations were also found among BIS/BAS factors

206 and trait and behavioral resilience ($r > .113$, $p < .001$), but not between BIS and trait resilience (r

207 $= -.078$, $p = .016$).

208

209   [Please insert Table 1 here]

210   [Please insert Table 2 here]

211

212 **Structural Equation Modeling**

213 To test the hypothesized model that the BIS and BAS would predict depressive symptoms

214 directly and indirectly via trait and behavioral resilience, we conducted SEM. The model

215 contained five latent variables: BIS, BAS, trait resilience, behavioral resilience, and depression.

216 For the latent variables of BAS, trait, and behavioral resilience, the total score of each subscale

217 was used as an indicator. As depression and BIS were measured on a unidimensional scale, we

218 applied a three-parcel-each-factor approach to preventing estimation bias (Matsunaga, 2008).

219 The indices of fit of the model were good or sufficient ($\chi^2 = 562.911$, $df = 96$, $p < .001$; CFI =

220 .925; NFI = .913; RMSEA = .073, 90% CI: [.067, .079]; SRMR = .066). All estimates of

221 observed variables toward latent variables were significant ($p < .001$). Figure 2 presents the

222 model of these variables.

223   [Please insert Figure 2 here]

224

225   According to the tested model, BIS influenced only trait resilience ($\beta = -.338$, $p < .001$),

226 whereas BAS influenced both trait and behavioral resilience ($\beta = .593$, $\beta = .609$, $p < .001$;

227   respectively). The results showed that BAS positively predicted both trait and behavioral

228   resilience, although behavioral inhibition negatively predicted only trait resilience. Next, trait

229   resilience significantly affected depression (β = -.581, p <.001). Similarly, behavioral resilience

230   also significantly affected depression (β = -.356, p <.001). These results demonstrated that both

231   trait and behavioral resilience negatively predicted depression.

232   To investigate the indirect effects of BIS/BAS on depression via resilience, mediation

233   analyses were conducted (Table 3). The mediation analyses were conducted in all pathways

234   where BIS/BAS affected depression via trait and behavioral resilience, except the path where

235   BIS involved depression mediating with behavioral resilience because of the non-significant

236   effect of BIS toward behavioral resilience in the SEM. The analysis for BIS and depression

237   mediated with trait resilience showed a significant indirect effect (estimate = .058, 95% CI:

238   [.001, .118]). Besides, the analysis for BAS and depression mediated with trait resilience also

239   showed the significant indirect effect of trait resilience (estimate = -.158, 95% CI: [-.191, -.127]).

240   At last, the mediation effect of behavioral resilience in relation to BAS and depression was

241   conducted. The result showed a significant mediation effect on behavioral resilience (estimate = -

242   .093, 95% CI: [-.119, -.069]). These results suggested that the trait resilience mediated the

243   relationships between BIS/BAS and depression, and behavioral resilience mediated the relation

244   between BAS and depression.

245

246   [Please insert Table 3 here]

247

248

Discussion

249

250   Our study aimed to test a hypothesized model on the effects of BIS/BAS on depressive

251   symptoms via trait and process resilience. The fit indices of the tested model were good, and all

252   estimates of the observed variables for each latent variable were significant. These suggested a

253   good fit of our hypothesized model with the current dataset. Further, almost all of the variables

254   yielded substantial estimates. Overall, we confirmed the relations among the following:

255   BIS/BAS affected trait and behavioral resilience, and trait and behavioral resilience affected

256   depressive symptoms. These results coincided with previous findings of the association of

257   depression with BIS/BAS (e.g., Markarian et al., 2013; Mellick et al., 2014; McFarland et al.,

258   2006) and with resilience (for a review, see Southwick et al., 2005). Our study cross-sectionally

259   investigated resilience and BIS/BAS; we found the mediation effects of resilience in the relation

260   between BIS/BAS and resilience. In addition, our findings revealed the relations between

261   BIS/BAS and depressive symptoms in terms of the trait and process aspects.

262   Consistent with previous studies (Mellick et al., 2014; Sportel et al., 2011), our results

263   demonstrated the relation of both BIS and BAS to depression. The results of our model

264   estimation showed that both BIS and BAS directly influenced depressive symptoms: BIS

265   increased depressive symptoms, whereas BAS decreased them. Based on the theoretical

266   framework of Response Sensitivity Theory (Gray & McNaughton, 2000), BIS can lead to

267   avoidance and escape-related behavior with negative affect. In contrast, BAS can lead to

268   motivation and goal-directed behavior with positive affect. Thus, our results indicate that high

269   BIS and low BAS would be related to increased depression. Indeed, Wu et al. (2021) reported

270   that high BIS predicts depressive symptoms in adolescents. McFarland et al. (2006) showed that

271   BAS deficits predict worse depression in major depressive disorder. In comparing the

272   standardized effects of BIS and BAS on depressive symptoms as absolute values, our analysis

273   showed that BIS (β = .279) more strongly predicted depressive symptoms than BAS (β = -.179).

274   However, several studies investigating BIS and BAS cross-sectionally have reported the reverse:

275   BAS more strongly indicates depressive symptoms in major depressive disorder (Kasch et al.,

276   2002) and substance abuse disorder (Xie et al., 2021). Considering the concurrence of our results

277   and those of a previous study (Wu et al., 2021) that targeted adolescents, the more significant

278   influence of BIS than BAS on depression could be an adolescent-specific characteristic of

279   depression symptomatology. Further study would be needed to elucidate how the effect of

280   BIS/BAS on depression could differ with age.

281   Apart from the direct effect of BIS/BAS on depression, we also found the mediation

282   effects of resilience. The results revealed the indirect effect of BIS via trait resilience toward

283   depression (estimate = .058). Behavioral inhibition decreased individuals' trait aspect of

284   resilience, subsequently decreasing depressive symptoms. The result suggested the buffering

285   effect of trait resilience, highlighted in depression literature (e.g., Bitsika et al., 2013; Haeffel &

286   Vargas, 2011; Waugh & Koster, 2015). Thus, trait resilience can decrease the pathway of

287   behavioral inhibition temperature, represented as avoidant or withdrawal behaviors toward

288   depression.

289   The results for the BAS pathway similarly showed the mediation effect of trait resilience.

290   The mediation analysis revealed significant indirect effect of trait resilience on the relation to the

291   BAS and depression (estimate: -.158). This indicated that high BAS is associated with a

292   reduction in depressive symptoms and that the reduction is further enhanced by trait resilience.

293   Alternatively, BAS could also increase trait resilience and consequently decrease depressive

294   symptoms. Similar to BIS, the relation between BAS and depression has been reported

295   (Markarian et al., 2013; Mellick et al., 2014). BAS has been correlated with trait resilience

296   (Genet & Siemer, 2011; Nam et al., 2018). Our results were consistent with these studies,

297   indicating that the behavioral activation temperature involved with positive emotion and reward

298   responsiveness in mediating trait resilience is associated with depressive symptoms.

299   The results also revealed a negative effect of the behavioral aspect of resilience on

300   depressive symptoms, suggesting that more resilience-related behavior could be linked to less

301   depressive symptoms. Furthermore, the mediation analysis showed that behavioral resilience had

302   significant indirect effect in relation to BAS and depression. As well as trait resilience, BAS

303   could increase behavioral aspect of resilience and then buffer depression. However, the pathway

304   of BIS to behavioral resilience obtained from model estimation was not significant ($\beta = -.099$).

305   Inconsistent with previous study that BIS was negatively correlated to adaptive behavior such as

306   self-reflection which also included in the concept of the behavioral resilience in this study

307   (Khosravani et al., 2020), our results suggested that BIS did not predict behavioral resilience.

308   Considering the high correlation between trait and behavioral resilience in this study ($r = .661$),

309   as we mentioned later, it could be possible that the division of resilience into behavioral and trait

310   aspects may have partialed out the influence of behavioral resilience.

311   Our study, which distinguished the concept of resilience into trait and behavioral aspects,

312   might provide insight into and add to the discussion on a trait–process resilience distinction

313   (Herrman et al., 2011). Our study regarded trait resilience as a trait and behavioral resilience as a

314   process. The model tested in this cross-sectional study showed that both trait and behavioral

315   resilience significantly predicted depressive symptoms (trait: $\beta = -.581$, behavioral: $\beta = -.356$).

316   The results suggested that the trait conceptualization of resilience can more buffer depressive

317   symptoms than the process resilience. This suggestion was consistent with the research that has

318 shown the buffering effect of either trait (Anyan & Hjemdal, 2016) and process (Brailovskaia et

319 al., 2018) resilience against depression. However, our study's correlation between the trait and

320 behavioral resilience was high ($r = .661$). Although there would be the limitation due to large

321 overlap between trait and process resilience, we could conclude that trait resilience rather than

322 behavioral resilience might have a buffering effect on depression, indicating the importance of

323 trait but not process resilience.

324   Our study had several limitations that must be considered when interpreting our findings.

325 First, given the cross-sectional nature of our study, the causal relations shown are mere

326 estimations. The strict consequences of BIS/BAS, resilience, and depression merit further

327 research using a longitudinal design. Second, there is no clear definition of the trait and

328 behavioral aspects of the resilience division. In recent research, as a trait of resilience, ego-

329 resiliency, which is involved with the control process of ego against stress (Block & Block,

330 1980; Block, 2002), has attracted attention in positive psychology. Empirical research has also

331 shown the buffering effect of ego-resiliency on depression (Mujeeb & Zubair, 2012). The

332 conceptualization of resilience, which remains ambiguous, needs to be further elaborated and

333 divided into traits and behaviors. Lastly, our study was carried out during the COVID-19

334 pandemic. The model estimation could have been affected by the pandemic situation, such as

335 school closures, fear of COVID-19 infection, and restrictions in the daily life of adolescents.

336 Indeed, some studies have confirmed emotional response to COVID-19 infection with

337 psychological distress (Sugawara et al., 2021). Meanwhile, several studies have revealed the

338 buffering effect of positive psychological factors on depression and anxiety (Kubo et al., 2021;

339 Masuyama et al., 2021). Including the effect of the long-lasting pandemic and its related

340 psychological effect, further investigation of adolescents' mental health is needed.

341
342

Conclusions

343
344 In this study, the BIS/BAS as a vulnerability and resilience as a protective factor toward
345 depression in adolescents, which revealed their effects separately, were investigated cross-
346 sectionally. In addition, this study divided resilience, which broadly examined and then resulted
347 in ambiguous concepts, was divided into trait and behavioral resilience. The model estimation
348 showed the strong mediation effect of trait resilience, suggesting that the trait resilience could
349 attenuate the effect of BIS on depression and that the trait resilience could enhance the
350 preventive effect of BAS. The results in this study would contribute to further intervention that
351 targeted resilience and aimed to decrease depression because of the significance of trait
352 resilience rather than process resilience.

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535

Figure 1

Hypothesized model.

Note. BIS: Behavioral Inhibition System, BAS: Behavioral Activation System.

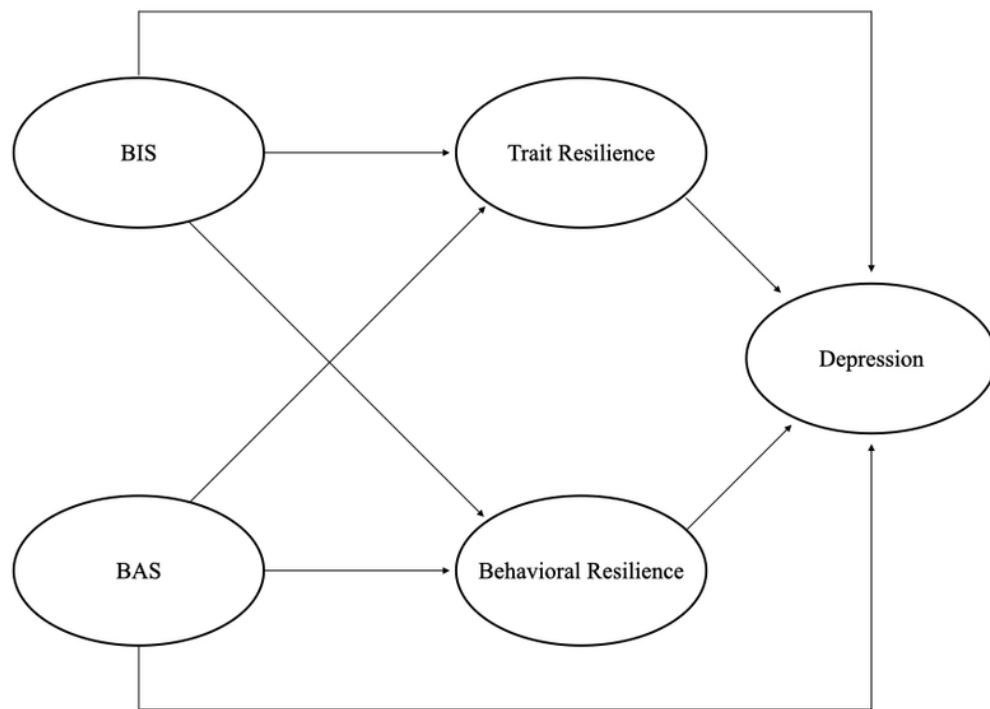
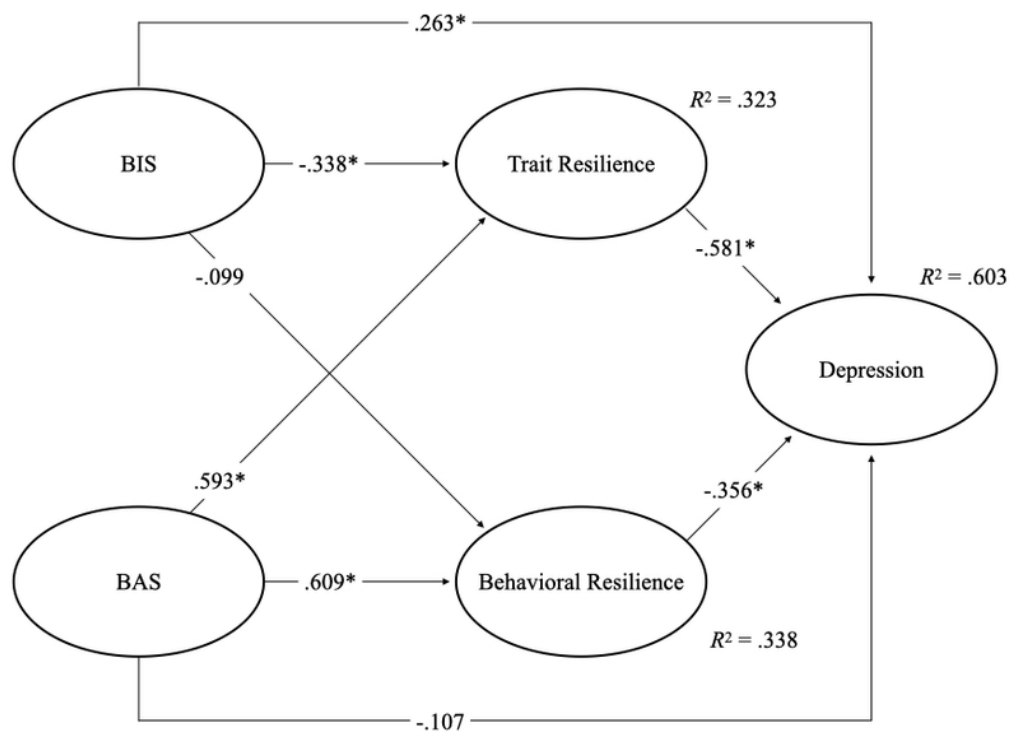



Figure 2

Model estimation and its coefficients.

Note. BIS: Behavioral Inhibition System, BAS: Behavioral Activation System.

Descriptive Statistics

5   Table 1. Descriptive Statistics (M (SD))

☐	Female ($n = 470$)			☐	Male ($n = 493$)		
☐	Grade 1	Grade 2	Grade 3		Grade 1	Grade 2	Grade 3
Depression	12.57 (6.60)	12.98 (6.87)	12.35 (6.24)		9.58 (5.74)	10.22 (5.41)	9.82 (5.80)
BIS	19.06 (3.84)	19.39 (3.90)	19.69 (3.17)		16.44 (4.64)	17.01 (4.60)	17.28 (4.09)
BAS Drive	10.78 (3.02)	10.79 (2.95)	11.19 (2.72)		10.82 (3.63)	10.56 (3.07)	11.33 (2.98)
BAS Reward Responsiveness	14.89 (3.70)	15.01 (3.58)	16.03 (3.08)		14.36 (4.08)	14.48 (3.65)	15.38 (3.47)
BAS Fun Seeking	10.07 (2.90)	10.23 (2.66)	10.86 (2.43)		10.02 (3.14)	10.3 (2.81)	10.81 (2.75)
Trait Resilience	37.9 (10.64)	38.07 (9.45)	39.15 (8.91)		40.15 (11.21)	40.34 (9.36)	40.43 (9.62)
Behavioral Resilience	30.51 (6.29)	30.52 (5.83)	32.26 (5.78)		30.13 (7.27)	31.06 (6.68)	31.52 (6.45)

6   s

7   Note. "Grade" means the grade in junior high school. BIS: Behavioral Inhibition System, BAS: Behavioral Activation System.

Correlations between each variable

5   Table 2. Correlations between each variable

	I	II	III	IV	V	VI	VII
I. Depression	—						
II. BIS	.225*	—					
III. BAS Drive	-.247*	.184*	—				
IV. BAS Reward Responsiveness	-.263*	.276*	.547*	—			
V. BAS Fun Seeking	-.162*	.244*	.433*	.607*	—		
VI. Trait Resilience	-.610*	-.078	.321*	.357*	.312*	—	
VII. Behavioral Resilience	-.395*	.113*	.354*	.420*	.293*	.661*	—

15   *p < .001

16   Note. BIS: Behavioral Inhibition System, BAS: Behavioral Activation System.

The results of mediation analyses

1   Table 3. The results of mediation analyses

Type	Effect	Estimate	*SE*	*t*	95% CI	
					Upper	Lower
Direct	BIS -> Depression	.197	.036	5.535*	.127	.266
Direct	BIS -> Trait resilience	-.181	.075	2.411	-.327	-.034
Direct	Trait resilience -> Depression	-.319	.015	20.950*	-.350	-.290
Indirect	BIS -> Trait resilience -> Depression	.010	.005	-	.000	.020
Direct	BAS -> Depression	-.350	.021	1.657	-.076	.006
Direct	BAS -> Trait resilience	.501	.037	13.493*	.428	.573
Direct	Trait resilience -> Depression	-.315	.017	18.720*	-.348	-.282
Indirect	BAS -> Trait resilience -> Depression	-.028	.003	-	-.033	-.023
Direct	BAS -> Depression	-0.01	.024	4.134*	-.147	-0.052
Direct	BAS -> Behavioral resilience	0.354	.024	14.943*	.307	.400
Direct	Behavioral resilience -> Depression	-0.263	.030	8.866*	-.321	-.205
Indirect	BAS -> Behavioral resilience -> Depression	-.016	.002	-	-.021	-.012

20   Note. BIS: Behavioral Inhibition System, BAS: Behavioral Activation System.

21   *p<.001