



Mediational Effects of Life Events on the Relationship Between Personality and Behavioral Problems among Depressed and Non-Depressed Adolescents

Sheng-Shiung Huang¹, Tony Szu-Hsien Lee², Hao-Jan Yang^{1,3,†}

Abstract

Objective:

To clarify the moderating and mediating effects of different types of life events on the relationships between personality traits and adolescent's behavioral problems among 354 high school students in Taiwan.

Methods:

A school-based two-wave panel study was administered to 354 high school students. Sobel test was used to examine the complicated roles of life events in the relationships between personality and behavioral problems during adolescence.

Results:

The results showed that detrimental effects of high neuroticism traits on internalizing problems can be buffered by positive independent life events and moderated by positive dependent events. Additionally, behavioral problems occurred only through negative dependent life events generated by high levels of neuroticism among depressed adolescents.

Conclusion:

Adolescents with high neuroticism traits appear to be less able to conquer the stresses derived from the positive life events and therefore develop subsequent internalizing problems.

Keywords:

Moderating effect, Mediating effect, Life events, Personality, Behavioral problems, Depressive disorders, Adolescents

Introduction

Personality traits and negative life events are related to behavioral problems, yet little attention has been paid for the complicated mechanisms. The relationship between personality and stress has long been conceptualized and explained under the context of “diathesis-stress model” in the development of psychopathology such as

depression, anxiety, schizophrenia, or behavioral problems [1]. According to the diathesis-stress model, some adolescents are more vulnerable to the stressful life events due to their personality/temperamental characteristics. Nevertheless, recent works showed that the interaction of personality with life events may be not only limited in the adverse or stressful events. Some

¹Department of Public Health, Chung Shan Medical University, No.110, Sec.1, Jianguo N. Rd., Taichung 40201, Taiwan

²Department of Health Promotion and Health Education, National Taiwan Normal University, No. 162 Sec.1 He-Ping East Road, Taipei 10610, Taiwan

³Department of Family and Community Medicine, Chung Shan Medical University Hospital, Taichung 40201, Taiwan.

[†]Author for correspondence: Hao-Jan Yang, PhD, Associate Professor, Department of Public Health, Chung Shan Medical University Taichung 40201, Taiwan. Phone: +886-4-24730022, Ext: 12109, Fax: +886-4-23248179, email: hjyang@csmu.edu.tw

malleable individuals are also more susceptible than others to supportive environments [2,3]. In such “differential susceptibility hypothesis”, personality/temperament can serve as a susceptibility factor to moderate life events in a for-better-and-for-worse manner [4]. Interestingly, stresses may not be always triggered by negative life events. Positive events can also act as a significant moderator to affect mood disorders when accompanied by a very high amount of negative events during the same time period [5]. However, still very few studies have tried to clarify the possible mechanism between personality and type of life events among adolescents to date, especially for the development of behavioral problems.

In addition to moderating effects, literature concerning to depression also showed that personalities, especially high levels of neuroticism, are capable of developing depression through the mediation of negative life events [6]. However, this mediational pathway only explained a part of the relationship between neuroticism and depressive symptoms. The onset of depression cannot be fully explained by stressful life events as well [7]. These findings implied that personality traits and negative life events may not act in restricted mechanisms in the occurrence of depression. Many dimensions of personality and types of life events, or other biological or psychosocial factors, may play a role in such relationship. Moreover, whether the mediational pathway stands in the development of behavioral problems warrants further investigation.

When investigating the relationships among personality, stress, and behavioral problems, the influences of depression should be taken into account since depressive disorders or symptoms were found to highly comorbid with other emotional/behavioral problems [8]. In addition, research has indicated that the occurrence of depression might increase the risks of recurrence of depression through enhancing the vulnerability of individuals’ personality toward depression, which is known as the scar hypothesis [9]. Under this hypothesis, major depression may have a direct causal effect on neuroticism [10], which further affects the occurrence of behavioral problems. People with depressive disorders also are more likely to expose to more stress, which in turn trigger subsequent episodes [11]. Moreover, the number of stressful life events required for re-kindling subsequent episodes significantly decreased, and the effect of stressful life events on major depression declined substantially

with the increasing episode number [12]. These theories implied that there may be a “feedback mechanism” for the existence of depression to affect some psychosocial risk factors such as personalities and negative life events.

Adolescence is a critical time period for personality shaping and cognitive developing. During adolescence, many individuals start to encounter a number of stresses. In addition, emotional/behavioral problems [13] and depression [14] are often highly prevalent during this period. Data from adolescents are especially important for clarifying the relationship between these scenarios. In particular, the scar mechanism did not show noticeable effects in certain adult groups [15] while it has been consistently reported in many children and adolescent samples [9,16]. As such, this study recruited late adolescence as a sample and categorized personality traits and life events in detail to understand the interplay between personality traits and types of life events in the development of behavioral problems. We hypothesized that high neuroticism traits on internalizing problems can be buffered by positive independent life events, and participants with different depressive status would have different personality-stress-behavior relationships.

Methods

■ Participants

This study was a school-based two-wave panel study. Participants were randomly selected from two from public general high schools and two from public vocational high schools, in Changhua County, Taiwan. After a complete description of the study was given by research assistants, 460 students were invited to participate in the study and completed a self-reported questionnaire and underwent a face-to-face psychiatric diagnostic interview by well-trained interviewers. Six months later, a second wave assessment was only performed on 359 of the 460 participants because graduating seniors at three schools were not able to cooperate with the process of this study. Moreover, individuals with more than 10% of the items unanswered in the self-reported questionnaire (n=5) were also excluded from the analyses. Therefore, a total number of 354 adolescents were used in the analysis of this study. Approval for the study was granted by the Institutional Review Board of Chung Shan Medical University Hospital (CS07052).

■ Measures

Youth Self-Report (YSR)

Behavioral problems of the participants were evaluated by the YSR [17], which included 118 behavioral items. These behavioral items enable the categorization of children and adolescents into three broad-band syndromes (Internalizing, Externalizing, and Total Problems). The YSR exhibited satisfactory internal consistency in this study, with Cronbach's α for the Total Problems range from .93 at baseline to .94 at follow-up.

Junior Eysenck Personality Questionnaire (JEPQ)

This study used the JEPQ [18] to assess participants' personality traits. It comprises 81 true or false questions which constitute three dimensions in terms of psychoticism, neuroticism, and extroversion. The Cronbach's α of the JEPQ were good both for the baseline (.80) and panel (.81) assessments. Moreover, mean raw scores of the three traits did not show significant differences between two waves, indicating that students in the present study had stable personalities by late adolescence. As a result, this study only used baseline personality traits as variables for predicting subsequent behavioral problems.

Life Event Checklist (LEC)

The LEC [19] was used to assess participants' life events over the past year. Participants filled out the presence (yes vs. no) of the 46 events in LEC. The first 18 items represent independent events which refer to uncontrollable events by the individual, e.g., the death of a family member. The rest 28 items represent dependent events that could happen through personal manipulation, such as making the honor role. For each event endorsed, the respondent was further inquired about the type (positive vs. negative) of the event. To explore the effects of different types of events, independent and dependent events were further categorized by "positive" and "negative" in this study. Therefore, four types of life events in terms of positive independent, negative independent, positive dependent, and negative dependent were categorized in this study. Cumulative numbers and types of events were then used in the analyses. Cronbach's α for the current sample was .80 to .86.

Schedule for Affective Disorders and Schizophrenia for School-Age Children and Adolescents (K-SADS-E)

Current and lifetime major depressive disorder (MDD) was diagnosed by using the K-SADS-E [20] based on the DSM-IV criteria. It was found to be an adequate tool for epidemiological research among Taiwanese adolescents [14]. This research also included depression types that were not fully met MDD criteria, including dysthymic disorder (DD), minor depressive disorder, subsyndromal symptomatic depression (SSD) [21], and other subthreshold depression. For convenience, they were all categorized as "subthreshold depression" wherever necessary. Adolescents with no depressive disorders at both waves were categorized as non-depressed group.

■ Data analysis

Participants with more than 10% missing of the questionnaire were excluded from the analyses. For those who include but with incomplete data ($n=142$), multiple imputation procedures were employed to impute the missing values by using the Markov Chain Monte Carlo method. The tenth imputation value was used as final result. Partial correlations were used to examine the correlations among behavioral problems, personality traits, and life events after controlling for gender, age, and school system. The interactions between personality traits and types of life events on behavioral problems were tested in the multiple regression models controlling for gender, age, and school system. Conceptually, the "diathesis-stress model" is supported if some personality trait(s) interact only with negative life events (with the interaction term a positive regression coefficient) but not with positive ones; whereas the "differential susceptibility theory" is supported if some personality trait(s) interact with both negative and positive life events (with the interaction term a positive regression coefficient for the former and a negative one for the latter). All models were tested by separating depressed and non-depressed adolescents to examine the influence of depressive status. To further delineate the patterns of interaction, personality traits were categorized as high and low levels according to the cutoff point of 25th percentile of the raw scores of JEPQ subscales. Sobel test [22] was performed to clarify whether a specific type of life event was a mediational variable on the pathways of personality traits to behavioral problems. To meet temporality, baseline personality traits and behavioral problems at follow-up was used for analyses. Life events assessed at follow-up were analyzed as possible mediational variables because they occurred in the past year. To conduct Sobel test,

direct effects (represented as c') were subtracted from the total effects (represented as c) between predictive variables (personality traits) and outcome variables (behavioral problems). A value of $(c-c')$ significantly different from 0 represents mediational effects existed. The 95% confidence interval (CI) for the $(c-c')$ value was calculated using bootstrapping method; and the number of simulation was set at 5,000 make sure the 95% CI for the $(c-c')$ value can be converged and stable [23].

Results

Demographic characteristics and lifetime prevalence of depressive disorders

Of the 354 adolescents, there were approximately equal amount between females ($n=172$, 48.6%) and males ($n=182$, 51.4%). The majority were the eleventh graders ($n=167$, 47.2%) or the tenth graders ($n=153$, 43.2%); and the twelfth graders were relatively minor ($n=34$, 9.6%). The average age was 16.7 (SD=0.7). More participants attended general high schools ($n=224$, 63.3%) than vocational high schools ($n=130$, 36.7%).

Lifetime prevalence rates of MDD at baseline and follow-up were estimated as 11.30% (40/354) and 16.38% (58/354), respectively. For DD, minor depression, SSD, and other subthreshold depression, the lifetime estimation at baseline were 2.54%, 1.98%, 0.56%, and 3.67%, respectively. Six months later, the rates were substantially elevated to 3.39%, 3.39%, 1.13%, and 8.76%, respectively. Due to a low prevalence of each depressive diagnosis in our adolescent sample, we combined participants with subthreshold depression and MDD as the depressed group ($n=98$) in the subsequent analyses to avoid insufficient statistical power.

Compared with non-depressive group, depressed adolescents had higher neuroticism (12.00 vs. 9.21, $t=-4.61$, $p < 0.001$), extroversion (14.98 vs. 14.55, $t=-0.75$, $p=0.45$), and psychoticism scores (2.16 vs. 2.00, $t=-0.75$, $p=0.45$). They also had more independent (2.03 vs. 1.45, $t=-2.62$, $p < 0.05$), dependent (4.12 vs. 3.46, $t=-2.18$, $p < 0.05$), negative dependent (1.37 vs. 0.91, $t=-3.01$, $p < 0.01$), positive independent (0.69 vs. 0.45, $t=-2.28$, $p < 0.05$), negative independent (1.28 vs. 0.97, $t=-1.79$, $p = 0.07$), and positive dependent life events (2.57 vs. 2.24, $t=-0.71$, $p=0.48$). The Internalizing (17.10 vs. 13.42, $t=-3.57$, $p < 0.001$) and Total Problems scores (51.77

vs. 45.45, $t=-2.61$, $p < 0.05$) were significantly higher.

Partial correlations between variables

Table 1 shows the partial correlations among baseline variables separated by depressed and non-depressed adolescents. After considering corrections for multiple comparisons, variables in the non-depressed group were more likely to be correlated with each other than those in the depressed group. Life events of non-depressed adolescents were not only related to each other but also had significant correlations with different behavioral problems (especially Externalizing and Total Problems) and personality traits; whereas none of them, except for the negative dependent events, had significant correlation with behavioral problems or personality traits among depressed adolescents. For both depressed and non-depressed adolescents, there were significant positive correlations between behavioral problems ($r=.49$ to $.89$) and between behavioral problems and neuroticism ($r=.49$ to $.76$). Psychoticism had a positive correlation with Externalizing ($r=.61$), Total Problems ($r=.36$), and neuroticism ($r=.36$) among depressed adolescents. The panel data shared similar results with the baseline ones; therefore, the explanation was omitted.

Moderating effects

After controlling for gender, age, and school system, only neuroticism showed significant interaction with positive independent life events among depressed adolescents ($b=-.35$, $p=.019$) and with positive dependent life events among non-depressed adolescents ($b=.10$, $p=.032$) in predicting internalizing behavioral problems (Figure 1). No interactions were found between personality traits and life events in the occurrence of externalizing behavioral problems.

Mediational effects

Table 2 shows the results of Sobel test by depressed and non-depressed adolescents. For depressed adolescents, the effect of neuroticism could be mediated by negative dependent events on Total Problems ($(c-c')=.27$, 95% CI: .01 to .63), Externalizing ($(c-c')=.07$, 95% CI: .01 to .19), and Internalizing ($(c-c')=.09$, 95% CI: .01 to .22). No other types of life events showed mediational effect between personality traits and behavioral problems.

As for adolescents without depressive disorders, high levels of neuroticism still exhibited effects

Table 1: Partial correlation coefficients among study variables at baseline (above diagonal: subjects with depressive disorders, n=98; under diagonal: subjects without depressive disorders, n=256).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Internalizing	—	.49*	.89*	.75*	-.28	.20	.23	.16	.20	.17	.38*	.05	.01
(2) Externalizing	.49*	—	.78*	.53*	.07	.61*	.28	.27	.20	.26	.39*	.10	-.02
(3) Total Problems	.87*	.79*	—	.76*	-.13	.36*	.28	.23	.22	.23	.47*	.07	-.05
(4) Neuroticism	.72*	.49*	.72*	—	-.28	.36*	.24	.30	.15	.29	.36*	.14	-.05
(5) Extroversion	-.33*	.13	-.11	-.19	—	.17	.14	.12	.09	.13	-.03	.05	.13
(6) Psychoticism	.25*	.55*	.43*	.26*	.15	—	.29	.27	.22	.26	.21	.10	.13
(7) Total life events	.22	.40*	.33*	.17	.28*	.28*	—	.79*	.90*	.71*	.64*	.41*	.71*
(8) Independent LE	.18	.24*	.25*	.13	.09	.15	.72*	—	.49*	.87*	.41*	.59*	.32
(9) Dependent LE	.19	.40*	.30*	.17	.30*	.30*	.89*	.34*	—	.46*	.66*	.18	.84*
(10) Negative independent LE	.21	.28*	.28*	.14	.11	.14	.64*	.86*	.33*	—	.39*	.13	.33
(11) Negative dependent LE	.26*	.39*	.35*	.31*	.11	.34*	.61*	.31*	.64*	.34*	—	.17	.19
(12) Positive independent LE	.03	.06	.05	.03	.04	.09	.39*	.60*	.14	.13	.07	—	.09
(13) Positive dependent LE	.07	.24*	.14	.02	.31*	.15	.69*	.20	.81*	.15	.11	.16	—

Notes. All analyses were controlled for gender, age, and school system.
 Above diagonal: subjects with depressive disorders; under diagonal: subjects without depressive disorders.
 * $p < .00035$ according to the Bonferroni correction for multiple comparisons (.05/144)

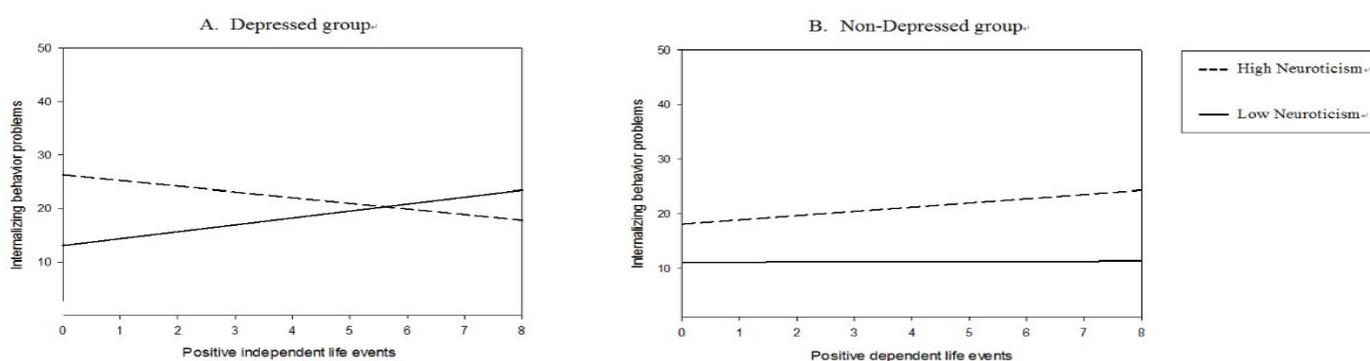


Figure 1: Clnteraction patterns of numbers of positive life events with levels of neuroticism on the scores of internalizing behavioral problems. (A) Showing the positive independent life events among depressed adolescents; (B) Showing the positive dependent life events among depression free adolescents.

on all types of behavioral problems through the mediation of negative dependent events. Moreover, negative dependent events also served as a mediator between psychoticism and all behavioral problems. For negative independent events, the mediational effect only emerged for neuroticism on the Total Problems and Externalizing. Total life events could mediate all dimensions of personality traits on Total Problems and Externalizing. The relationships between extroversion trait and all behavioral problems could also be mediated by total life events and dependent events.

Discussion

The main findings of the present study were that only neuroticism trait interacts with positive life events in the development of internalizing

behavioral problems. In addition, the pathway depends on whether depression exists and the type of positive events. Depressed young people who have high levels of neuroticism traits and who have been exposed to positive independent life events would be less likely to develop internalizing behavioral problems. This finding suggests that adolescents with different levels of neuroticism may differ in how they respond to uncontrolled positive life events and thus express these differences with regards to internalizing problems. During depressed period, uncontrolled positive life events may serve as buffers or protectors against internalizing behavioral problems in adolescents with high neuroticism trait. As neuroticism trait interacted only with positive life events but not with negative events in this study, the interplay of neuroticism and life events on the development

Table 2: Mediation effects of life events on the relationships between personality traits and behavioral problems, stratified by depressive status of adolescents.

Life events at follow-up as potential mediator	Depressed adolescents (n=98)						Non-depressed adolescents (n=256)					
	Neuroticism		Extroversion		Psychoticism		Neuroticism		Extroversion		Psychoticism	
	(c-c')	95% CI	(c-c')	95% CI	(c-c')	95% CI	(c-c')	95% CI	(c-c')	95% CI	(c-c')	95% CI
Behavioral outcome: Total Problems												
Total	.14	-.02 to .44	.10	-.09 to .32	.04	-.53 to .81	.08*	.01 to .20	.29*	.12 to .49	.29*	.01 to .68
Independent	.08	-.04 to .32	-.01	-.17 to .15	.01	-.42 to .62	.06	-.01 to .15	.07	-.05 to .22	.16	-.04 to .45
Dependent	.14	-.06 to .47	.17	-.05 to .42	-.00	-.64 to .83	.05	-.01 to .15	.25*	.09 to .43	.20	-.01 to .52
Neg. independent	.16	-.03 to .49	-.04	-.25 to .17	.19	-.33 to 1.00	.09*	.01 to .20	.03	-.10 to .19	.22	-.05 to .59
Neg. dependent	.27*	.01 to .63	.07	-.22 to .38	.65	-.16 to 1.86	.23*	.09 to .40	.04	-.15 to .22	.64*	.13 to .22
Pos. independent	.03	-.08 to .14	-.05	-.20 to .07	.15	-.12 to .57	-.01	-.04 to .03	.01	-.03 to .11	.01	-.06 to .11
Pos. dependent	.01	-.09 to .21	.06	-.09 to .23	-.22	-.82 to .24	-.01	-.04 to .03	.01	-.16 to .18	-.01	-.13 to .09
Behavioral outcome: Internalizing												
Total	.06	-.01 to .16	.04	-.04 to .15	.02	-.23 to .34	.01	-.01 to .04	.10*	.04 to .17	.06	-.01 to .18
Independent	.03	-.02 to .11	-.00	-.06 to .06	.01	-.16 to .26	.01	-.01 to .03	.02	-.01 to .06	.03	-.02 to .11
Dependent	.06	-.03 to .17	.08	-.02 to .20	-.01	-.29 to .34	.01	-.01 to .04	.09*	.03 to .17	.05	-.04 to .16
Neg. independent	.06	-.01 to .17	-.02	-.10 to .07	.09	-.13 to .45	.01	-.01 to .04	.01	-.03 to .05	.06	-.02 to .17
Neg. dependent	.09*	.01 to .22	.03	-.09 to .16	.25	-.06 to .74	.06*	.01 to .20	.01	-.05 to .08	.23*	.05 to .45
Pos. independent	.01	-.03 to .07	-.02	-.10 to .03	.09	-.05 to .30	-.00	-.01 to .10	.00	-.02 to .03	-.00	-.03 to .03
Pos. dependent	.01	-.06 to .10	.04	-.03 to .12	-.13	-.44 to .09	.00	-.01 to .02	.02	-.05 to .08	-.01	-.08 to .04
Behavioral outcome: Externalizing												
Total	.03	-.01 to .12	.02	-.02 to .07	.01	-.12 to .19	.04*	.01 to .09	.09*	.04 to .17	.12*	.01 to .27
Independent	.01	-.03 to .09	-.00	-.05 to .03	.00	-.10 to .14	.03	-.00 to .07	.02	-.02 to .08	.06	-.02 to .17
Dependent	.03	-.02 to .13	.03	-.01 to .10	-.00	-.14 to .19	.02	-.01 to .07	.07*	.02 to .14	.08*	.01 to .22
Neg. independent	.04	-.03 to .14	-.01	-.07 to .03	.04	-.07 to .25	.04*	.01 to .09	.01	-.03 to .07	.08	-.02 to .22
Neg. dependent	.07*	.01 to .20	.02	-.06 to .10	.15	-.03 to .45	.08*	.03 to .14	.01	-.04 to .06	.17*	.03 to .34
Pos. independent	.01	-.04 to .06	-.02	-.06 to .03	.04	-.05 to .20	-.00	-.02 to .01	.01	-.01 to .04	.01	-.02 to .05
Pos. dependent	.00	-.02 to .05	.00	-.05 to .05	-.03	-.19 to .10	-.01	-.03 to .01	.01	-.05 to .07	.01	-.03 to .06

Notes. (c-c') refers to the difference of 'total effect' and 'direct effect.' The higher value of (c-c') shows, the more likely mediational effect exists.

All 95 % CIs were derived from the bootstrapping estimations after 5,000 simulations. * refers to the 95 % CI of (c-c') uncovered zero.

of internalizing behavioral problems of our findings cannot be fully explained by diathesis-stress model or differential susceptibility hypothesis. The interaction pattern of high neuroticism with positive life events among non-depressed adolescents was different from that of their depressed counterparts. For those with high levels of neuroticism, the more positive dependent life events experienced, the higher internalizing problem scores showed. Generally, stresses can be triggered by positive life events, especially controllable ones such as making the honor role [24], and people usually try to overcome such stress to earn feelings of happiness and joy. Nevertheless, adolescents with high neuroticism traits appear to be less able to conquer the stresses derived from the positive life events and therefore develop subsequent internalizing problems. This point of view is supported by some recent study [5].

In addition to moderating effects, this study also showed mediational effects between personality and life events. For adolescents free of depressive

disorders, behavioral problems were not affected by single pathway or restricted factors. Many individual (personality trait) or environmental adversities (negative life events) were able to trigger a variety of behavioral problems through different pathways. However, once adolescents suffered from depressive disorders, mechanisms from the interplay of personality and life events to occur behavioral problems appeared to be suppressed. Only adolescents with high levels of neuroticism were able to exhibit behavioral problems through the mediation of negative dependent events. Effects of other personalities with stressful life events on behavioral problems became relatively insignificant. One possible explanation is that in experiencing depression, individuals with high levels of neuroticism are prone to adopting more coping actions [25], which is more likely to generate negative dependent events and then resulting consequent behavioral problems.

In light of stress generation theory [11], in which depressed individuals generate stressful

situations that lead to recurrence, findings of the present study may be an extension of Hammen's theory. That is, the mechanism may be attributed, in part, to some predisposition factors such as personality traits and may be applied to other behavioral problems since a variety of behavior problems were predicted by dependent events [26] and the relationships between depression and neuroticism as well as between dependent events and neuroticism have been repeatedly reported.⁶ Recent evidence implied that stress generation theory appears to have its genetic basis as the relationships between daily stressors and negative effects were partly attributed to genetic factors [27] and the risk of onset of major depression could be influenced by genetic factors through altering the sensitivity of individuals to the depression-inducing effect of stressful life events [28]. Interestingly, genetic influences on life events appear to be mediated by personality [29]. Due to neuroticism trait may potentially share the same genetic basis with internalizing disorders such as mood and anxiety disorders [30], and neuroticism may play an "endophenotype" role of enhancing the genetic signal for behavioral problems' causal process [31], and negative dependent life events may also participate in such pathway as a mediator or moderator between neuroticism and occurrence of depression [30], we suggested that there might be a pathway of occurrence of behavioral problems proceeds from genetic background to switch on the expression of personality traits and then generate negative dependent life events that trigger the occurrence of those problems in adolescents. Existence of depression appears to feedback on the pathway to reinforce the effect of neuroticism (or suppress the effects of other personality traits) on producing negative life events, which in turn leads to subsequent behavioral problems.

This inference also links our findings to the scar mechanism. The essence of the scar mechanism is that individuals with depression may develop some characteristics that persist even after the depression is recovered or remitted. These characters, in turn, make the individuals more susceptible to subsequent depression occurrences. Adolescence is the key time period for personality and cognitive development, the adverse dimensions of personality traits and negative cognitive patterns brought about by depression could leave long-term or even permanent distortion and cause subsequent onset of depression [16]. In addition, once adolescents

become depressed, they might leave personality scars to lower the threshold of personalities and negative life events for the subsequent occurrence of depression [6], which further support kindling hypothesis [12]. Notably, scar mechanism may also have its genetic basis because there were share genetic or environmental backgrounds with emotional/behavioral problems, depression, cognition, neuroticism, and negative dependent events [31,33,34]. The emotional function and cognitive function were linked through the genetic polymorphism of the neural process [30]. As such, once suffered from depression, adolescents' personality or cognitive scars emerged through the mediating effects of shared genetic or environmental factors, which increased susceptibility toward negative dependent events to further cause subsequent behavioral problems. Depression during adolescence may cause negative dependent events to happen more easily by increasing the levels of neuroticism or the susceptibility of neuroticism towards negative dependent events. Depression itself is able to lower an individual's tolerance towards negative dependent events as well. Therefore, depressed adolescents could develop behavioral problems even when they faced limited numbers of life events.

Limitations

The findings of this study should be considered in the context of several limitations. First, although a longitudinal study was used, we cannot rule out the possibility that effects of some life events on behavioral problems may actually be the reverse causation or the students who perceived higher levels of depression and presented higher self-reported levels of neuroticism highlighted these traits and symptoms also by perceiving more negative dependent and independent events. Second, the high attrition rate of twelfth graders who experienced more stressful life events could result in a less significant mediational effect for some types of events. Third, participants selecting from only one county restricts our findings to generalize to other adolescent samples. Fourth, we cannot control for baseline behavioral problems while using the Sobel test. Finally, due to a high comorbidity between depressive disorders and behavioral problems, as well as the complicated relationship between neuroticism and depression, the mediational pathway of neuroticism-negative dependent events-behavioral problems observed in depressed adolescents in this study may be the

expression of the mediational effect of negative dependent life events between neuroticism and depressive disorders. Despite its limitations, this study delineated different moderating patterns of positive life events between depressed and non-depressed adolescents in the relationship between neuroticism and internalizing behavioral problems. A specific mediational mechanism of negative life events between personality traits and behavioral problems in depressed adolescents was also proposed. Moreover, this study did not support the diathesis-stress model and differential susceptibility theory in the explanation of the interplay between neuroticism and life events in developing internalizing behavioral problems. Yet we intent to propose a theoretical extension and integration for stress generation theory, kindling theory, and scar mechanism in describing the mediating effect of negative dependent life events. It outlines directions for future research aimed at clarifying mechanisms among psychosocial factors and establishes strategies for preventing behavioral problems in adolescents.

Many behavioral problems initiated during adolescence and track into adulthood. Our study found that neuroticism traits play an important role on the development of adolescent's behavioral problems. This is especially the case when adolescents are with high depressive symptoms. To identify this high risk group, it is a more feasible way by assessing students' personality traits than by evaluating

their psychopathology for school personnel. Screening for mental illness such as depressive symptoms can lead to a labeling effect which may consequently increase adolescent's stresses and affect their health [35]. As such, assessing personality traits was more conservative and acceptable as compared to that of depressive symptoms. Once the high risk group can be successfully identified within school, it is easier for school personnel to effectively introduce or provide appropriate resources and take necessary actions. For example, middle schools may provide mental health courses or intervention programs for students to improve their coping skills with negative events and enhance their positive feelings and thinking about things happened around. It is also important to build a friendly school environment and infrastructure to improve students' quality of life. Through these implementations, behavioral problems in adolescents may be effectively reduced.

Acknowledgements

This study was supported, in part, by the research grants from the National Science Council, Taiwan (NSC96-2314-B-040-030) and from Chung Shan Medical University (CSMU93-OM-B-011). The authors thank all of the school teachers, students and personnel for their participation and assistance in this project. We would also like to acknowledge the hard work of Chun-Wei Chiang, Wen-Ying Shiu, and Chih-Ching Yang in collecting data.

References

- Ingram RE, Luxton DD. Vulnerability-Stress Models. In: Development of Psychopathology: A vulnerability stress perspective. Edited by Hankin BL, Abela JRZ. Thousand Oaks, CA, Sage Publications, 32-46 (2005).
- Belsky J, Pluess M. Beyond diathesis stress: differential susceptibility to environmental influences. *Psychol. Bull* 135(6), 885-908 (2009).
- Ellis BJ, Boyce WT, Belsky J, et al. Differential susceptibility to the environment: an evolutionary-neurodevelopmental theory. *Dev. Psychopathol* 23(1),7-28 (2011).
- Belsky J, Bakermans-Kranenburg MJ, Van Ijzendoorn MH. For better and for worse: Differential susceptibility to environmental influences. *Curr. Dir. Psychol. Sci* 16(6), 300-304 (2007).
- Overbeek G, Vermulst A, De Graaf R. Positive life events and mood disorders: Longitudinal evidence for an erratic lifecourse hypothesis. *J. Psychiatr. Res* 44(15),1095-1100 (2010).
- Yang HJ, Chiu YJ, Soong WT, et al. The roles of personality traits and negative life events on the episodes of depressive symptoms in nonreferred adolescents: a 1-year follow-up study. *J. Adolesc. Health* 42(4), 378-385 (2008).
- Kendler KS, Karkowski LM, Prescott CA. Causal relationship between stressful life events and the onset of major depression. *Am. J. Psychiatry* 156(6), 837-841 (1999).
- Petty CR, Rosenbaum JF, Hirshfeld-Becker DR, et al. The child behavior checklist broad-band scales predict subsequent psychopathology: A 5-year follow-up. *J. Anxiety. Disord* 22(3), 532-539 (2008).
- Lewinsohn PM, Steinmetz JL, Larson DW, et al. Depression-related cognitions: antecedent or consequence? *J. Abnorm. Psychol* 90(3), 213-219 (1981).
- Fanouso AH, Neale MC, Aggen SH, et al. A longitudinal study of personality and major depression in a population-based sample of male twins. *Psychol. Med* 37(8), 1163-1172 (2007).
- Hammen C. Generation of stress in the course of unipolar depression. *J. Abnorm. Psychol* 100(4), 555-561 (1991).
- Kendler KS, Thornton LM, Gardner CO. Stressful life events and previous episodes in the etiology of major depression in women: an evaluation of the "kindling" hypothesis. *Am. J. Psychiatry* 157(8), 1243-1251 (2000).
- Yang HJ, Soong WT, Chiang CN, et al. Competence and behavioral/emotional problems among Taiwanese adolescents as reported by parents and teachers. *J. Am. Acad. Child. Adolesc. Psychiatry* 39(2), 232-239 (2000).
- Yang HJ, Soong WT, Kuo PH, et al. Using the CES-D in a two-phase survey for depressive disorders among nonreferred adolescents in Taipei: a stratum-specific likelihood ratio

Mediational Effects of Life Events on the Relationship Between Personality and Behavioral Problems among Depressed and Non-Depressed Adolescents Research

- analysis. *J. Affect. Disord* 82(3), 419-430 (2004).
15. Joiner TE. Depression's Vicious Scree: Self-Propagating and erosive processes in depression chronicity. *Clin. Psychol* 7(2), 203-218 (2000).
 16. Nolen-Hoeksema S. Further evidence for the role of psychosocial factors in depression chronicity. *Clin. Psychol* 7(2), 224-227 (2000).
 17. Achenbach TM, Rescorla LA. Manual for the ASEBA School-Age Forms & Profiles, Burlington, VT: University of Vermont Research Center for Children, Youth, & Families (2001).
 18. Eysenck HJ, Eysenck SBG. Manual of the Eysenck Personality Questionnaire. London: Hodder & Stoughton Educational (1975).
 19. Johnson JH. Life events as stressors in Childhood and Adolescence. Beverly Hills, CA, Sage Publications (1986).
 20. Chambers WJ, Puig-Antich J, Hirsch M, et al. The assessment of affective disorders in children and adolescents by semistructured interview. Test-retest reliability of the schedule for affective disorders and schizophrenia for school-age children, present episode version. *Arch. Gen. Psychiatry* 42(7), 696-702 (1985).
 21. Judd LL, Rapaport MH, Paulus MP, et al. Subsyndromal symptomatic depression: a new mood disorder? *J. Clin. Psychiatry* 55(Suppl), 18-28 (1994).
 22. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Meth. Instrum. Comput* 36(4), 717-731 (2004).
 23. Shrout PE, Bolger N. Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychol. Methods* 7(4), 422-445 (2002).
 24. Davila J, Steinberg SJ, Kachadourian L, et al. Romantic involvement and depressive symptoms in early and late adolescence: The role of a preoccupied relational style. *Pers. Relatsh* 11(2), 161-178 (2004).
 25. Cuijpers P, Steunenbergh B, Van Straten A. Actions taken to cope with depressed mood: the role of personality traits. *Aging. Ment. Health* 11(4), 457-463 (2007).
 26. Ingoldsby EM, Shaw DS, Winslow E, et al. Neighborhood disadvantage, parent-child conflict, neighborhood peer relationships, and early antisocial behavior problem trajectories. *J. Abnorm. Child. Psychol* 34(3), 303-319 (2006).
 27. Jacobs N, Rijdsdijk F, Derom C, et al. Genes making one feel blue in the flow of daily life: a momentary assessment study of gene-stress interaction. *Psychosom. Med* 68(2), 201-206 (2006).
 28. Kendler KS, Kessler RC, Walters EE, et al. Stressful life events, genetic liability, and onset of an episode of major depression in women. *Am. J. Psychiatry* 152(6), 833-842 (1995).
 29. Saudino KJ, Pedersen NL, Lichtenstein P, et al. Can personality explain genetic influences on life events? *J. Pers. Soc. Psychol* 72(1), 196-206 (1997).
 30. Kendler KS, Kuhn J, Prescott CA. The interrelationship of neuroticism, sex, and stressful life events in the prediction of episodes of major depression. *Am. J. Psychiatry* 161(4), 631-636 (2004).
 31. Gottesman II, Gould TD. The endophenotype concept in psychiatry: etymology and strategic intentions. *Am. J. Psychiatry* 160(4), 636-645 (2003).
 32. Gatt JM, Clark CR, Kemp AH, et al. A genotype-endophenotype-phenotype path model of depressed mood: integrating cognitive and emotional markers. *J. Integr. Neurosci* 6(1), 75-104 (2007).
 33. Neiss MB, Stevenson J, Legrand LN, et al. Self-esteem, negative emotionality, and depression as a common temperamental core: a study of mid-adolescent twin girls. *J. Pers* 77(2), 327-346 (2009).
 34. Uliaszek AA, Zinbarg RE, Mineka S, et al. The role of neuroticism and extraversion in the stress-anxiety and stress-depression relationships. *Anxiety. Stress. Coping* 23(4), 363-381 (2010).
 35. Yap MB, Wright A, Jorm AF. The influence of stigma on young people's help-seeking intentions and beliefs about the helpfulness of various sources of help. *Soc. Psychiatry. Psychiatr. Epidemiol* 46(12), 1257-1265 (2011).