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Ze Wang¹ and Ihui Su¹

Abstract

This study examined the longitudinal factor structure of general self-concept and locus of control among high school students over a 4-year period, with data from the National Educational Longitudinal Study of 1988. Measurement invariance was tested over time and across gender and ethnic groups; second-order piecewise latent growth models were applied to study changes. In all analyses, Likert-type scale items were correctly treated as ordered-categorical variables and methodology was used accordingly. Results suggested that the measurement structure of general self-concept and locus of control was stable over time and across groups. In addition, both constructs decreased and then increased during the 4-year period. The female group and the White group followed the pattern of changes of the total sample. The male group and the three ethnic minority groups (Asian/Pacific Islander, Hispanic, and Black) differed from the total sample in their change patterns. Further, group differences were observed in the two constructs at the base year.

Keywords

general self-concept, locus of control, measurement invariance, NELS: 88, piecewise latent growth model

Judge, Locke, and Durham (1997) identified four core self-evaluations: self-esteem; generalized self-efficacy; neuroticism; and locus of control. Later this agglomerate core self-evaluation construct was equated to general self-concept (Judge, Hurst, & Simon, 2009). Despite the definitional differences among self-esteem, generalized self-efficacy, and general self-concept, empirical evidence from correlations and items designed to measure them suggest that they are similar (Judge, Erez, Bono, & Thoresen, 2002; Smith, 1989). In very broad terms, general self-concept is defined as an individual's perception of himself or herself (Shavelson, Hubner, & Stanton, 1976). It represents the accumulation of a person's beliefs about his or her attributes, feelings, and knowledge over time (Byrne, 1984). A related construct, locus of control is defined as an individual's generalized expectancy to perceive the environmental reinforcement either as

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contingent upon one's ability (internal control) or as the force beyond one's control and due to chance (external control; Levenson, 1981; Rotter, 1966). Contingent reinforcement is a strong mechanism through which children form their locus of control (Galejs, Hegland, & King, 1985).

General self-concept and locus of control are different constructs and are moderately correlated ($r = .52$; Bono & Judge, 2003). Both constructs are related to success in academics and psychological well-being (e.g., Byrne, 1996; Findley & Cooper, 1983; Karayurt & Dicle, 2008; Marsh, 1990a; Song & Hattie, 1984; Wood, Saylor, & Cohen, 2009). However, there is not much research on how the two constructs change over time during high school. High school is an important stage in a person's life. As high school students grow up, their core self-evaluations begin to become more stable. The focus of this study is to examine the stability of these two important self-evaluation constructs (self-concept and locus of control) among high school students. In addition, we examined gender and ethnic group differences.

Development of General Self-Concept and Locus of Control

Cognitive abilities and socialization experiences contribute to the development of the self (Harter, 2012). Increasing cognitive abilities allow individuals at young ages to integrate and differentiate various domains of experiences to postulate their self-evaluations. Gradually, children obtain the ability to make realistic judgments about their competence during elementary school years (Harter, 1982). Later, during adolescent years, children are able to perceive the self as consisting of internal or psychological characteristics and begin to develop a more abstract self-concept. The adolescent years are an especially important developmental stage for self-concept (Kling, Hyde, Showers, & Buswell, 1999). McCarthy and Hoge (1982) have found significant increases in perceived general self-concept using both longitudinal and cross-sectional data from students in grades 7 through 12. Other studies have found that adolescents' self-concept gradually becomes stabilized during these developmental stages (Yeung & Lee, 1999).

Research has also shown that one's locus of control is age-related and depends on past history of reinforcement and behavioral expectancies (Lloyd & Hastings, 2009). The development of internal or external locus of control is a process of internalization along which social values and orders are adopted as a person's self-identification or self-knowledge (Ryan & Connell, 1989). For example, Sedlak and Kurtz (1981) found that younger children (i.e., preschoolers) tend to accept imperfect cause-effect explanations due to their limited memory span and verbal skills, whereas children ages seven to nine are more likely to use casual schema and systematically combine multiple causes to derive inferences. In another study, Ruble, Feldman, Higgins, and Karlovac (1979) compared four age groups (ages 5-6, ages 7-8, ages 9-10, and high school students) in terms of locus of control and use of information in the development of casual attributions; they found that students in older age groups use more consensus information in casual judgment and in self-attribution.

Gender and Ethnic Differences in General Self-Concept

Males have higher general self-concept than females (Kling, et al., 1999) although males' advantage may be small (Marsh, 1990b). With a longitudinal sample of high school students, Chubb, Fertman, and Ross (1997) investigated gender differences in general self-concept over time; they found that females have significantly lower scores than males across the 4 years of high school. In contrast, findings by Connell, Stroobant, Sinclair, Connell, and Rogers (1975) suggest that male students' self-concept increases from age 12 to 18, whereas female students' self-concept declines between ages 12 and 13, changes little up to age 17, and then increases afterwards. Block and Robins (1993) found that females' general self-concept decreases and males' general self-concept increases across the 14- to 23-year-old age group; they suggested that gender

differences in self-concept stem from differential socialization experiences because society tends to give more autonomy to males than to females in that age group.

Past studies have found that Blacks and Whites are different in self-concept. However, the direction of differences reported is inconsistent in those studies (see Harris & Stokes, 1978; Kenny & Adriana, 2009). A few studies have also examined other ethnic groups. For example, Kenny and Adriana (2009) found that Blacks had lower general self-concept than Hispanics. Worrell (2002) found that White gifted students had significantly higher self-concept than Asian American gifted students.

Gender and Ethnic Differences in Locus of Control

Gender differences have also been reported in locus of control (e.g., Kolotkin, 1994). A 3-year longitudinal study by Kulas (1996) suggested that male students had more internal locus of control than female students at the beginning of the study and that male students reported more internal locus of control during the first 2 years of the study and then reported more external locus of control during the third year of the study, whereas female students reported more external locus of control throughout the 3 years of the study.

There are also ethnic differences in the development of locus of control. Swinton (1991) suggested that Blacks demonstrated a stronger belief in external locus of control than Whites due to Blacks' disadvantaged economic status. In addition, cultural orientation and contexts are likely associated with personal beliefs of internal versus external locus of control. Hsieh, Shybut, and Lotsof (1969) found that Anglo-American students raised in a culture that values independence and individualism were more likely to have a higher level of internal locus of control than Chinese American students or students in Hong Kong. McLaughlin and Saccuzzo (1994) examined differences in locus of control among Caucasian, Filipino, Latino, and African American children and found that Caucasian children had more internal locus of control than the other groups.

Testing Measurement Invariance for Latent Factors With Ordered-Categorical Indicators

Researchers in scale development have begun to pay attention to an important issue in measurement—measurement invariance. In the past, the focus of scale development was on internal consistency (i.e., reliability) and validity. Group comparisons on constructs measured by those scales focused on comparisons of group means. Recently, with the advancement of multiple group confirmatory factor analysis (MGCFA), researchers have used this technique to compare other psychometric characteristics of measures such as factor loadings, intercepts, variances, and covariance, in addition to factor means (e.g., Gregorich, 2006; Wu, Li, & Zumbo, 2007). However, in social sciences, indicators are usually measured with Likert-type scale items whose level of measurement is best considered as ordered-categorical rather than interval. With ordered-categorical indicators, measurement invariance via MGCFA is conceptualized differently than with interval indicators. There are in general two different but related methodologies applied to ordered-categorical indicators. The first one is Item Response Theory where ordered-categorical responses are modeled directly. The other is the conceptualization of latent response variables, as studied by Muthen and others (e.g., Millsap & Yun-Tein, 2004; B. O. Muthen, 1984). Despite theoretical advancement in measurement invariance of ordered-categorical variables, there have not been many applications. For measurement invariance models with ordered-categorical indicators, constraints on thresholds and factor loading are “in tandem because the item probability curve is influenced by both parameters” (L. K. Muthen & Muthen, 2012, p. 485).¹ For the default measurement invariance model with ordered-categorical indicators in Mplus, L. K. Muthen and

Muthen (2012) recommend that thresholds and factor loadings be constrained to be equal across groups simultaneously. Further, for model identification purposes, scale factors should be fixed at one in one group and free in the other groups.²

Research Questions and Statistical Analyses

This study has two purposes. The first purpose was to investigate the factorial structure of general self-concept and locus of control of high school students. We were interested in answering two questions: (a) Does the structure of general self-concept and locus of control of high school students change over time? and (b) are there gender or ethnic differences in the factorial structure of these two constructs? Our second purpose was to investigate the trajectories of general self-concept and locus of control among high school students. We were interested in answering two additional questions: (c) How do high school students' general self-concept and locus of control change over time? and (d) are there gender and ethnic differences in the developmental trajectories of these two constructs?

We had four stages of statistical analyses, corresponding to the four research questions. First, we tested measurement invariance of general self-concept and locus of control over time. At each of the three waves (base year, first follow-up, and second follow-up), there were two latent variables representing general self-concept and locus of control. In the analysis model, we constrained factor loadings and thresholds of the same Likert-type scale item to be equal across the three waves. Second, to test measurement invariance across groups, we constrained factor loadings and thresholds of the same Likert-type scale item to be equal across groups. If measurement invariance over time existed (i.e., first stage results suggested measurement invariance), we would constrain factor loadings and thresholds over time and across groups simultaneously (e.g., the factor loading for one item would be the same at three waves and in different groups). If measurement invariance over time for particular items did not exist, we would only impose group equality of factor loadings and thresholds within each wave (e.g., the factor loading for one item would be the same for different groups at each wave, but factor loadings were allowed to be different at different waves). Third, we used bivariate second-order piecewise latent growth models to examine the trajectories of general self-concept and locus of control. For each construct, three second-order growth factors (initial, difference1, difference2) were specified to account for the initial level of the construct, change in that construct between base year and first follow-up, and the change in the same construct between the first and second follow-ups. If measurement invariance over time was not met (first stage analysis), factor loadings and thresholds for noninvariant items were allowed to be different over time. At the fourth stage, multiple-group bivariate second-order latent growth models were tested for the gender groups and ethnic groups, respectively. Multiple-group analyses allowed us to test group differences in the initial level of constructs and change trajectories. In this study, we considered two grouping variables: gender and ethnicity. The ethnic groups were Asian/Pacific Islander, Hispanic, Black, and White. Effect sizes of changes over time were reported as Cohen's d_z and effect sizes for group differences were reported as Cohen's d (Cohen, 1988).

For all analyses, model fit was assessed with the following indices and criteria: root mean square error of approximation (RMSEA) and its entire confidence interval below 0.05 (MacCallum, Browne, & Sugawara, 1996); and comparative fit index (CFI) and Tucker-Lewis Index (TLI) greater than 0.95 (Hu & Benter, 1998, 1999).³

Data Source

The current study is based on data collected in three waves in the National Educational Longitudinal Study of 1988 (NELS:88). The three waves of data were collected in 1988 (base

year), 1990 (first follow-up), and 1992 (second follow-up). The base-year sample consisted of 24,599 students at eighth grade. Student sample refreshing was implemented for the follow-up studies. In the present study, we only included students who participated in all three waves and who were considered eligible to enter the study at the base year. Data were weighted using a weight variable that corrects for unequal probability sampling and those cases with a zero value on this weight variable were automatically excluded during analyses (Ingels, 1994). The sample size in this study was 10,827. Among these students, 92.2% had received a diploma or GED by the time a third follow-up study was conducted in 1994, 46.7% were male, and 53.3% were female. The ethnic composition was 6.7% Asian/Pacific Islander, 12.6% Hispanic, 8.9% Black, and 69.9% White.

Development of Two Measures

In NELS:88, there were seven items that were conceptually related to general self-concept and six items to locus of control. However, two items that were conceptually related to general self-concept had high multicollinearity (polychoric correlations were .72, .79, and .80 in the base year, first follow-up, and second follow-up, respectively) and their wordings were redundant (“I feel useless at times” and “At times I think I am no good at all”). Thus, one item (“I feel useless at times”) was dropped. Similarly, one item that was conceptually related to locus of control (“Chance and luck are very important for what happens in my life”) and that was redundant with another item (“In my life, good luck is more important than hard work for success”) was dropped. Exploratory factor analysis (EFA) with the remaining 11 items suggested a two-factor model but three items (“At times I think I am no good at all,” “I feel I do not have much to be proud of,” and “When I make plans, I am almost certain I can make them work”) cross loaded on both factors and were therefore dropped. Confirmatory factor analysis (CFA) with the remaining eight items, four for the general self-concept construct and four for the locus of control construct at each wave (i.e., a six-factor CFA model) fit the data well (RMSEA = .023 with 90% CI [.022, .024], CFI = .96, TLI = .96; see Table 1). In addition, the four general self-concept items were consistent with other studies using the NELS:88 data (Marsh, Parada, Yeung, & Healey, 2001). Since the original items were correctly treated as ordered-categorical, we did not use composite scores based on their observed means or sums to operationalize the two constructs. Instead, we model them as latent factors with ordered-categorical indicators in later analyses. A higher value on the latent factors indicated more general self-concept, or higher internal control.

Results

Testing for Measurement Invariance Over Time

We conducted a CFA and constrained thresholds and factor loadings for the same indicators over time (see Figure 1). Model fit was good (RMSEA = .022 with 90% CI [.021, .023], CFI = .96, TLI = .96; see Table 1). Standardized factor loadings from this model are shown in Table 2. The correlation between general self-concept and locus of control was .58, .60, and .51 at the base year, first follow-up, and second follow-up, respectively. These correlations are similar to the correlations reported in previous research (Bono & Judge, 2003).

Testing for Measurement Invariance Across Groups

Since measurement invariance over time existed, the within-model constraints as shown in Figure 1 for the same item over time were kept. In addition, to test measurement invariance across gender groups, equality constraints of factor loadings and of item thresholds across the

Table 1. Model Fit Indices.

	#Parameters	χ^2	DF	RMSEA	90% CI RMSEA	TLI	CFI
Six-factor CFA model	111	1,771.11	237	.023	.022 .024	.96	.96
MI over time	51	2,056.71	297	.022	.021 .023	.96	.96
MI over time and gender groups	102	2,249.01	594	.022	.021 .023	.97	.96
MI over time and ethnicity groups	204	2,873.52	1,188	.023	.022 .024	.97	.97
Second-order piecewise latent growth model total sample	55	1,938.08	293	.022	.021 .023	.96	.96
Second-order piecewise latent growth model gender group comparisons	106	2,169.51	590	.022	.021 .023	.97	.96
Second-Order Piecewise Latent Growth Model Ethnicity Group Comparisons	208	2,871.21	1,184	.023	.022 .024	.97	.97

Note. MI = measurement invariance. Item thresholds and factor loadings were constrained to be equal across group for MI models.

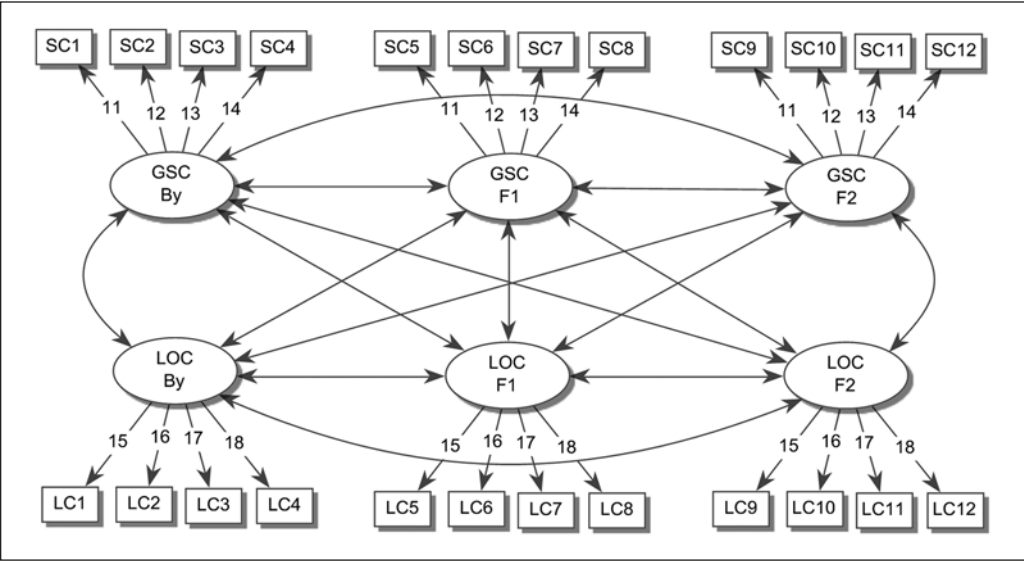


Figure 1. Factor model of general self-concept and locus of control with measurement invariance over time (base year, first follow-up, second follow-up).

male and female groups were added. Similar cross-group constraints were imposed to test measurement invariance across ethnic groups. However, the latent factor means and factor variances and covariances were allowed to vary across groups. Good model fit indices suggested measurement invariance across gender as well as ethnicity (see Table 1).

Table 2. Standardized Factor Loadings From Measurement Invariance Over Time Model.

	Base year		First follow-up		Second follow-up	
	GSC	LOC	GSC	LOC	GSC	LOC
I feel good about myself	.78		.78		.79	
I feel I am a person of worth, the equal of other	.67		.75		.81	
I am able to do things as well as most other people	.60		.71		.78	
On the whole, I am satisfied with myself	.81		.79		.81	
I do not have enough control over the direction my life is taking		.60		.65		.64
In my life, good luck is more important than hard work for success		.45		.48		.56
Every time I try to go ahead, something or somebody stops me		.67		.71		.79
My plans hardly ever work out, so planning makes me unhappy		.72		.75		.81

Note. GSC = general self-concept; LOC = locus of control.

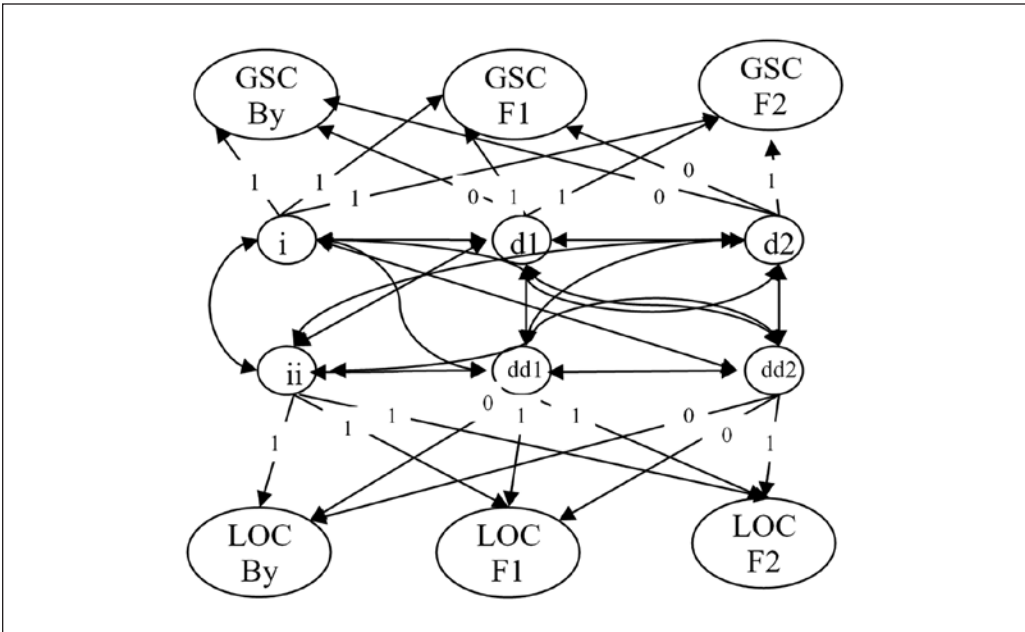


Figure 2. Bivariate second-order piecewise latent growth model.

Second-Order Piecewise Latent Growth Model

The bivariate second-order piecewise latent growth model of general self-concept and locus of control, shown in Figure 2, was used to examine the trajectories of these two constructs. For model identification purposes, the residual variances of factors representing latent constructs

Table 3. Effect Sizes of Changes and Differences.

	Base year to first follow-up		First follow-up to second follow-up		Base year difference compared to reference group ^a	
	GSC	LOC	GSC	LOC	GSC	LOC
Total Sample	−0.21***	−0.21***	0.32***	0.14**	—	—
Male	−0.27***	−0.28***	0.29***	−0.06	—	—
Female	−0.15***	−0.22***	0.34***	0.39***	−0.36***	0.01
Asian/Pacific Islander	−0.34**	−0.10	0.32*	0.05	0.09	−0.17*
Hispanic	−0.23**	−0.07	0.45***	0.21	0.02	−0.26***
Black	−0.12	0.11	0.14	−0.20	0.50	−0.27
White	−0.24***	−0.48***	0.36***	0.24***	—	—

Note. GSC = general self-concept; LOC = locus of control. Changes over time are reported as Cohen's d_z and differences across groups are reported as Cohen's d . A negative change indicates a decrease. A negative difference indicates a lower value, compared to the reference group.

^aMale group is the reference group for gender differences and the White group is the reference group for ethnicity differences.

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

(i.e., GSCBy, GSCF1, GSCF2, LOCBy, LOCF1, LOCF2) were set to zero. The variances of these second-order growth factors (i, d1, d2, ii, dd1, dd2) were estimated. In addition, the means of growth factors i and ii representing the initial amount of general self-concept and of locus of control, respectively, were set to zero while the means of the other growth factors (d1, d2, dd1, dd2) were freely estimated.

The model fit indices are in Table 1. Results from the total sample model suggested that there was a significant decrease in general self-concept from base year to first follow-up and a significant increase in the same construct from first follow-up to second follow-up. The same pattern was observed for locus of control. However, the effect sizes of these changes were small (see Table 3).

Second-Order Piecewise Latent Growth Model Across Groups

In multiple group analyses, the means of the growth factors i and ii were fixed at zero for the reference group only (male for gender group comparisons and White for ethnic group comparisons), while their means were freely estimated in the comparison groups. Model fit for both types of comparisons was good (Table 1).

Gender Group Comparisons. As shown in Table 3, for females, the average trajectories of general self-concept and locus of control were similar to that for the total sample (i.e., a significant decrease before a significant increase). For males, the average trajectory of general self-concept was similar to that for the total sample; however, locus of control decreased significantly from base year to first follow-up, without a significant change between the first and second follow-ups. In addition, females had significantly lower general self-concept than males at the base year, but the gender difference in locus of control at the base year was not statistically significant.

Ethnic Group Comparisons. As shown in Table 3, the White group had similar trajectories to those of the total sample with regards to both constructs. For both Asian/Pacific Islander and Hispanic

groups, general self-concept decreased and then increased. In contrast, general self-concept for the Black group did not change significantly over time. Interestingly, locus of control did not change statistically significantly over time for the three minority groups. Compared with the White group, the Black group had significantly higher general self-concept at the base year; however, there was no difference at the base year between the White group and the Asian/Pacific Islander or the Hispanic group. All three minority groups had significantly lower locus of control than the White group at the base year.

Discussion

Related to the first two research questions, we found that the *measurement structure* of high school students' general self-concept and locus of control were stable over time and across gender and ethnicity. This stability suggests that during high school, the two constructs can be measured reliably.

Related to the third and fourth research questions, we found that the average general self-concept and locus of control was not stable over time and/or for different groups. The longitudinal instability of general self-concept was consistent with some previous research with adolescents (Marsh, 1990b; McCarthy & Hoge, 1982) although the direction of change in these studies was not consistent. In this study, a sample of high school students was examined and our findings showed that general self-concept changed over a 4-year period. It is likely that high school students' self-perceptions may begin to stabilize and the fluctuations reported during these 4 years may simply reflect the stabilization process. The Asian/Pacific Islander group experienced the largest decrease in general self-concept from the base year to first follow-up; and the Hispanic group experienced the largest increase in general self-concept from the first follow-up to the second follow-up. These results indicate that different ethnic groups may have experienced high school differently.

Past research has examined locus of control and its antecedents and its relations with other constructs (e.g., Crandall & Crandall, 1983; Galejs et al., 1985; Karayurt & Dicle, 2008). However, there has been little research on the change of locus of control itself. In this study, we found that not only locus of control was different over time and/or across groups but also the changes over time in this construct were not the same for different groups. The White group experienced the largest decrease in locus of control from the base year to the first follow-up; and the female group experienced the largest increase in locus of control from the first follow-up to the second follow-up.

This study examined the two constructs of general self-concept and locus of control at a global level. However, these constructs may be operationalized at more specific levels. For example, Marsh (1990b) recommended researching the multidimensional and hierarchical structure of self-concept. Furthermore, a person's locus of control may be affected by situational environmental factors (Schunk, Pintrich, & Meece, 2008). Therefore, future research should examine the stability of specific self-concepts and situational causal attributions.

As for limitations of the study, the current study included less than half of all students who participated in NELS:88 study during the base year. One reason for the inclusion of only 50% of the students was the high attrition rate that occurred over the 4-year period of the study. The attrition rate poses a threat to the external validity (i.e., generalization) of the findings of the current study. Future research may examine different samples to cross-validate results from the current study. However, the major findings, (i.e., the measurement structure of general self-concept and locus of control is stable; and the means of these two constructs change over time and differ across gender and ethnicity), contribute to the current literature on psychological development of high school students in the United States by demonstrating the longitudinal factor structure of two important core self-evaluation constructs.

Findings of the current study offer several implications for practitioners. First, over the 4-year period of the study, high school students' general self-concept and locus of control did not remain the same. They decreased during the first 2 years and then increased. Based on this finding, two years into high school seems a vulnerable time for students' self-evaluations. Practitioners should pay attention to students at this stage and make efforts to find ways that help students to maintain positive self-evaluations. Second, the Asian/Pacific Islander group experienced the largest decrease in general self-concept in the first 2 years of the study; and the White group experienced the largest decrease in locus of control during the same period. These suggest that efforts to intervene should focus on the different needs of different ethnic groups. Third, it is interesting to notice that, in the base year of this study (i.e., first year in high school), gender difference was prominent for the general self-concept construct while ethnic differences were salient for the locus of control construct. Female students had lower general self-concept than male students; and Asian/Pacific Islander and Hispanic students had lower locus of control than White students. The findings again suggest differentiated interventions for different groups.

Declaration of Conflicting Interests

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Notes

1. It is statistically possible to constrain the thresholds and factor loadings separately for some indicators, or to constrain some, but not all, thresholds for indicators. For a discussion about the minimum number of constraints required for model identification with ordered-categorical indicators, see Millsap and Yun-Tein (2004).
2. This is when the Δ parameterization was used with the Weighted Least Squares Estimator. Mplus also provides a θ parameterization with the same estimator. With the θ parameterization, residual variances, instead of scale factors, are fixed at one in one group and free in the other groups.
3. Hu and Benter (1998, 1999) suggested a 2-index presentation strategy that includes standardized root mean square residual (SRMR) and one of the following: Tucker-Lewis Index (TLI), Bollen's fit index (BL89), relative noncentrality index (RNI), CFI, γ hat, McDonald's centrality index (Mc), and RMSEA. However, SRMR is not reported in the Mplus output when the Weighted Least Squares Means and Variance Adjusted Estimator, the estimator recommended for analysis with ordered-categorical dependent variables (Beauducel & Herzberg, 2006), is used.

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