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Continuity of Academic Intrinsic Motivation From Childhood Through Late Adolescence: A Longitudinal Study

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Two aspects of continuity, stability of individual differences and means, were examined in a longitudinal study from the middle elementary through the high school years. Two hypotheses regarding individual-difference stability were supported with structural equation modeling in both the general–verbal and math domains: (a) Academic intrinsic motivation is a stable construct throughout these years, and (b) with advancement in age, academic intrinsic motivation becomes increasingly stable. A third hypothesis, that the mean level of academic intrinsic motivation declines over these ages, also was supported, and significant linear trends were obtained, but it was also found to be modified by particular subject areas, with math showing the greatest decline and social studies showing no significant change. The combination of these 2 aspects of continuity places those with low motivation early in their schooling particularly at risk.

The issue of continuity is of central importance for understanding development. Continuity, the connectedness of development over time (Emde & Harmon, 1984; Lerner et al., 1996), is central for theory building and validation of theoretical positions, prediction of future development, and determining the significance of responses at particular ages (Kagan, 1971). When studying continuity, stability is key for examining each of these.

Longitudinal research is essential for assessing stability of individuals over time and hence provides the avenue for determining a construct's links across ages. Further, multivariate techniques allow for theory testing as well as assessment of different models. The purpose of the present research is to investigate the continuity of academic intrinsic motivation in a longitudinal study from the middle elementary through the high school years. The present research provides a unique and first-time examination of the magnitude of continuity of academic intrinsic motivation over this period. It is interesting that despite the proliferation of research concerning intrinsic motivation and learning, little is known about the continuity of academic intrinsic motivation over this extensive time frame. The significance of this issue concerns providing a deeper understanding of the development of academic intrinsic motivation, which may then provide a foundation for educational practice.

Intrinsic motivation concerns the performance of activities for their own sake, in which pleasure is inherent in the activity itself (Berlyne, 1965; Deci, 1975; Eccles, Wigfield, & Schiefele, 1998). Though different researchers may conceive of intrinsic motivation slightly differently (see Murphy & Alexander, 2000), this definition provides a shared commonality amongst them. Academic intrinsic motivation specifically focuses on school learning (A. E. Gottfried, 1985, 1990). When the construct of academic intrinsic motivation was first proposed (A. E. Gottfried, 1985), it was based on intrinsic motivation theory and research (see A. E. Gottfried, 1985), including pleasure derived from the learning process itself (Berlyne, 1971); curiosity (Berlyne, 1971; Maw, 1971); the learning of challenging and difficult tasks (Lepper, 1983; Pittman, Boggiano, & Ruble, 1983); persistence and a mastery orientation (Harter, 1981; Lepper, 1983); and a high degree of task involvement (Brophy, 1983; Nicholls, 1983). Whereas findings for academic intrinsic motivation relate specifically to the school and educational domain, they also have implications for the realm of intrinsic motivation as a whole, as its conceptual foundation and definition were derived directly from intrinsic motivation theory and research.

Academic intrinsic motivation concerns enjoyment of school learning characterized by a mastery orientation; curiosity; persistence; task endogeny; and the learning of challenging, difficult, and novel tasks (A. E. Gottfried, 1985, 1990; A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998; A. E. Gottfried & A. W. Gottfried, 1996). This construct has substantial validity and significance for effective school functioning. Children with higher academic intrinsic motivation have higher achievement, more fa-

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vorable perceptions of their academic competence, and lower academic anxiety from childhood through adolescence (A. E. Gottfried, 1985, 1990; A. E. Gottfried, Fleming, & A. W. Gottfried, 1994; A. E. Gottfried & A. W. Gottfried, 1996; A. W. Gottfried, A. E. Gottfried, Bathurst, & Guerin, 1994). Whereas there has been much attention paid to the relationships between intrinsic motivation and learning and performance, there has been less emphasis on research studying the longitudinal course of its development from the middle elementary through the high school years. Longitudinal research on the developmental aspects of intrinsic motivation per se has been concentrated on infants and young children (Messer, 1993; Morgan & Harmon, 1984), perhaps because of the influence of the early conceptualizations of intrinsic motivation, which concentrated on infant and early childhood development (Hunt, 1966; White, 1959), or a view that the early years provide a foundation for future motivation and education (McCall, 1995), with low to moderate stability during infancy and early childhood (see overview by Morgan & Harmon, 1984).

The present research comprises a longitudinal study of the development of academic intrinsic motivation from middle childhood through late adolescence and encompasses the span of school years from middle elementary through the end of high school. In prior research with the same sample, stability of academic intrinsic motivation was shown to increase during the early elementary grades, ages 7 through 9 (A. E. Gottfried, 1990), evidenced by stronger and more consistent correlations.

Subsequently, we have concentrated on studying academic intrinsic motivation beginning at age 9 to later ages. The reason for this is that, beginning at age 9 and thereafter, academic intrinsic motivation is measured with a single instrument, the Children's Academic Intrinsic Motivation Inventory (CAIMI; A. E. Gottfried, 1986), which is differentiated into Reading (English), Math, Social Studies (History), Science, and School in General. Prior to age 9, an abbreviated version of the CAIMI, the Young Children's Academic Intrinsic Motivation Inventory (Y-CAIMI; A. E. Gottfried, 1990), was used, which consists of fewer items, response choices, and subject areas than the CAIMI. By utilizing the CAIMI, a consistent instrument at age 9 and thereafter, any differences that emerge across the ages cannot be attributed to different instruments, hence controlling for measurement error. In our previous work (A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998), neither continuity nor stability was specifically studied; instead, our focus was the role of the socializing environments. No hypotheses were advanced regarding the nature of stability over time, nor was the complete range of ages available. In the present study, academic intrinsic motivation data were available at ages 9, 10, 13, 16, and 17 years.

In the present study, two types of continuity are studied: (a) cross-time stability of the individual's position within the group (individual-difference stability; Lightfoot & Folds-Bennett, 1992)—also called "rank-order consistency" (Roberts & DelVecchio, 2000)—and (b) group stability across time (stability of means; e.g., Block, 1971; Block & Robins, 1993; Guerin & A. W. Gottfried, 1994; Roberts & DelVecchio, 2000). Studying both individual-difference and mean stability provides an opportunity to examine a more complete picture of continuity (e.g., Asendorpf, 1992; Block & Robins, 1993; Guerin & A. W. Gottfried, 1994; Roberts & DelVecchio, 2000).

Stability of position provides information pertinent to understanding the predictability of academic intrinsic motivation across time, yielding essential information as to when motivation appears to solidify as opposed to being more malleable. There has been an absence of research studying this type of continuity with regard to academic intrinsic motivation across the age span represented in the present research. A longitudinal study of first through sixth graders concerning expectancy-value motivation (Wigfield et al., 1997) reported on stability correlations in competence beliefs and subjective task values, providing some information about motivation stability for younger children in a related but not identical domain.

Studying the continuity of means allows for examining across the ages cross-time group stability and change and the trajectory of group means; that is, does the level of academic intrinsic motivation increase, decline, or stay the same over time? Hence, whereas there can be stability of motivation regarding the position of the individual in the group, the absolute level of motivation may change for the group as a whole.

Regarding stability of an individual's position, we predicted that academic intrinsic motivation would show positive and statistically significant relationships over time. This hypothesis was advanced on the basis of our prior research that evidenced positive and statistically significant relations between academic intrinsic motivation over time through age 13 (A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998). Another issue examined through individual-difference stability is whether academic intrinsic motivation tends to become increasingly stable with advancing age or whether the relationships are fairly constant over time. Several lines of evidence would lead to the prediction that academic intrinsic motivation tends to become more stable over time. Because academic intrinsic motivation increased in stability from ages 7 through 9 years (A. E. Gottfried, 1990), it would be reasonable to expect that this increase in stability would be found across the adolescent years as well. Further, other constructs such as intelligence (Asendorpf, 1992), personality (Roberts & DelVecchio, 2000), temperament (Guerin & A. W. Gottfried, 1994), and competence beliefs (Wigfield et al., 1997) have shown increasing stability with increasing age. In a recent meta-analysis of rank-order stability of personality traits across the life span, the relationship between age and personality stability was positive (Roberts & DelVecchio, 2000). Hence, on the basis of a broad array of studies across varying constructs, we advanced these predictions of stability.

Regarding stability of group means, there tends to be a decline across a wide range of school-related attitudes and motivations across the school years (e.g., Anderman & Maehr, 1994; Eccles et al., 1998; Lepper, Sethi, Dialdin, & Drake, 1997; Wigfield et al., 1997). However, academic intrinsic motivation per se has neither been examined longitudinally with respect to this type of stability over the age range presented here, nor have studies of intrinsic motivation extended as far into late adolescence as the present research (e.g., Harter, 1981; Lepper et al., 1997).

Whereas intrinsic motivation has been reported to decline across ages through Grade 9 (Harter, 1981; Lepper et al., 1997), there has been an exception to this with regard to subject area. For example, in prior cross-sectional studies (A. E. Gottfried, 1985), the role of subject areas emerged as a significant factor in the group stability of academic intrinsic motivation. From elementary through junior high school, academic intrinsic motivation in reading declined, but academic intrinsic motivation in social studies increased. There were no reliable mean changes across these years in other academic areas (i.e., Math, Science, School in General). In related research, subject area specificity has been found across grades with regard to increases and decreases in liking of, and attitudes toward, subject areas (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Haladyna & Thomas, 1979; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991; Wigfield et al., 1997). In the present study, as the CAIMI is differentiated into subject areas and an extensive age range is studied, we investigated the role of subject areas in the trajectory of mean changes across the ages. Hence, whereas we predicted, on the basis of prior research, a general decline in motivation, we also expected that this would be differential depending on the specific subject area examined. Therefore, subject area was examined to determine whether it plays a role in the stability of academic intrinsic motivation. This dimension of the research also yields important theoretical data regarding the globality or specificity of the construct of academic intrinsic motivation.

On the basis of prior evidence, both within this longitudinal study and in other research (as explained earlier), we advanced the following hypotheses: (1) Academic intrinsic motivation is a stable construct over time, from childhood through late adolescence; (2) academic intrinsic motivation becomes increasingly stable over time; and (3) the mean level of academic intrinsic motivation declines from childhood through late adolescence. Subject area domains were examined for all hypotheses. Hypotheses 1 and 2 concern individual-difference stability, and Hypothesis 3 concerns the stability of means.

Method

Study Design

This study is part of the Fullerton Longitudinal Study, which was initiated in 1979 when the participants were 1 year of age. At ages 9, 10, 13, 16, and 17, participants' academic intrinsic motivation was assessed. These ages were selected as they allowed for the comprehensive measurement of academic intrinsic motivation from childhood through late adolescence. The CAIMI (A. E. Gottfried, 1986) was administered at each of these ages to measure academic intrinsic motivation.

In this research, Hypotheses 1 and 2 (specified in the introduction) were tested with structural equation modeling. By specifying a priori theoretical foundations of the construct and predictions about the relationships between motivation at earlier and later ages, structural equation modeling tests the goodness of fit and, hence, the plausibility of the model. Thus, longitudinal paths were predicted and tested (see Figure 1). We expected that the direct paths would be positive and statistically significant, supporting Hypothesis 1, and that the magnitude of paths would increase over time, supporting Hypothesis 2. Hypothesis 3 was tested with a repeated measures multivariate analysis of variance (MANOVA). Polynomial contrasts were performed.

Participants

At the initiation of the Fullerton Longitudinal Study in 1979, the sample consisted of 130 infants. All children who entered the study had been term babies of normal birth weight and had no neurological or visual abnormalities. During the course of the study, children were assessed in the university laboratory at 6-month intervals from 1 to 3.5 years and at yearly intervals beginning at age 5. At each assessment, a comprehensive battery of standardized measures was administered to examine development across a broad variety of domains (e.g., cognitive, social, behavioral, academic). Details regarding the longitudinal study may be found in A. E. Gottfried, Bathurst, and A. W. Gottfried (1994), A. W. Gottfried and A. E. Gottfried (1984), and A. W. Gottfried et al. (1994).

The number of children whose academic intrinsic motivation was measured was 107, 107, 108, 112, and 111 at ages 9, 10, 13, 16, and 17, respectively. The retention rate of this study was substantial, with no less than 80% of the original sample returning at any assessment. Because of the longitudinal nature of the study, and missing values across the various measures at different times, the final number of participants in the structural equation modeling and the MANOVA was 96.

The socioeconomic status of the sample represented a wide, middle-class range, from semiskilled workers through professionals, as determined by the Hollingshead Four-Factor Index (A. W. Gottfried, 1985). Of the 96 children, 43 (45%) were girls and 53 (55%) were boys. The percentages of girls and boys in this sample were similar to the representation of the genders across the study (e.g., see A. W. Gottfried et al., 1994). The ethnicity of the sample was predominantly European American (92%), with a small percentage of children of varying ethnicities (e.g., Hispanic, East Indian, Hawaiian, Iranian). There was no evidence of attrition bias throughout the course of the study (Guerin & A. W. Gottfried, 1994). Attrition was due to families moving out of the area, and throughout the course of the study, we located as many participants as we could and included them, even at long distances. Further, in Roberts and DelVecchio's (2000) meta-analysis of personality consistency, the effect of attrition was shown to be negligible in cross-time consistency across the life span.

Academic Intrinsic Motivation

Children's academic intrinsic motivation was assessed with the CAIMI (A. E. Gottfried, 1986), a reliable and valid instrument (A. E. Gottfried, 1986). The CAIMI was developed to measure enjoyment of learning; an orientation toward mastery; curiosity; persistence, task endogeny; and the learning of challenging, difficult, and novel tasks in the subject areas of Reading, Math, Social Studies, Science, and for School in General. The CAIMI was originally developed to measure academic intrinsic motivation in elementary through middle school students (A. E. Gottfried, 1985, 1986). A high school version of the CAIMI (CAIMI–HS) was subsequently developed, which was adapted slightly for high school students to more accurately reflect the subject areas of more advanced students (A. E.

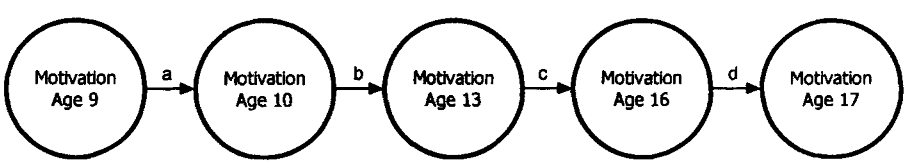

Figure 1. Longitudinal path model for continuity of academic intrinsic motivation from ages 9 through 17. Letters indicate Paths *a* through *d*.

Gottfried, 1998).[1] The number of items, and their content, for both the CAIMI and CAIMI–HS are identical. The only difference between the CAIMI and CAIMI–HS pertains to the names of two subject area scales. In the high school version, reading is referred to as "English," and social studies is referred to as "history." Hence, the CAIMI yields Reading, Math, Social Studies, Science, and School in General subscale scores, which are appropriate for children in the elementary through middle school years, and the CAIMI–HS yields English, Math, History, Science, and School in General subscale scores, which are appropriate for high school students. For the CAIMI, coefficient alphas for the subject area subscales range from .89 to .93; coefficient alpha for the School in General subscale is .83 (A. E. Gottfried, 1986). For the CAIMI–HS, coefficient alphas for the subject area subscales range from .93 to .95; coefficient alpha for the School in General subscale is .91 (A. E. Gottfried, 1998). Thus, the instrument has substantial internal consistency. Construct validity of the CAIMI has also been reported throughout the school years (A. E. Gottfried, 1985, 1986, 1990, 1998; A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998).

Children completed the CAIMI during the laboratory assessments at ages 9, 10, 13, 16, and 17. Total subscale scores were used for data analyses, with higher scores corresponding to higher motivation.

Analytic Strategy and Measurement of the Constructs for Structural Equation Models: Individual-Difference Stability

Analyses were conducted in two phases to test Hypotheses 1 and 2. In the first phase, which tested Hypothesis 1, the structural path coefficients (*a*, *b*, *c*, and *d*, in Figure 1) were not constrained. Assuming confirmation of Hypothesis 1 (paths are positive and statistically significant), Phase 2 tested whether the stability of prediction increased over the ages. In general, increased stability implies increasingly larger path coefficients over time. Testing of Hypothesis 2 requires first constraining the four paths (*a*, *b*, *c*, *d*) to be equal, then relaxing the constraints if the model does not fit. Hypothesis 2 is rejected if the paths for earlier years are stronger than later paths or if all paths are essentially equal.

On the basis of past research indicating the greater specificity of the CAIMI Math subscale and the greater uniqueness of math as a subject area in academic intrinsic motivation, and to be consistent with our past structural equation modeling analyses (A. E. Gottfried, 1985, 1990; A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998), we evaluated two different subject area models in each phase (Phases 1 and 2). One model, referred to as the "general–verbal model," consisted of all subscales of the CAIMI except for Math (Reading [English], Social Studies [History], Science, School in General). The other model, referred to as the math model, consisted of the CAIMI Math subscale.

For the general–verbal model, a latent academic intrinsic motivation factor was created at each age, as was previously done (A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998), by combining Reading (English), Social Studies (History), Science, and School in General CAIMI subscales to reduce the number of variables to a manageable set that was conceptually consistent with the theoretical formulations. To keep the models' ratio of sample size to number of freely estimated parameters sufficiently large, variables were combined by averaging to create two indicators for each of the five intrinsic motivation factors (ages 9, 10, 13, 16, and 17). Reading (English) and School in General subscale scores were averaged, and Social Studies (History) and Science subscale scores were averaged. The decision to combine Reading with School in General and Social Studies with Science subscales was based on our research and rationale that the former two are the more general of these four and hence should be combined and that the latter two are more subject specific and should be combined. Their significant contributions to the latent General–Verbal factor across all studies supported our formation of the factor in this way (A. E. Gottfried, Fleming, & A. W. Gottfried, 1994, 1998). Further, to have the present research consistent and comparable with our prior research, we decided to keep the factors and indicators the same. In the math models, a latent factor could not be used because math intrinsic motivation was a single indicator at each age.

Analytic Strategy and Measurement: Stability of Means

A doubly multivariate, repeated measures MANOVA was conducted on the CAIMI subscale scores from ages 9 through 17. Two repeated measures factors were included: Age (9, 10, 13, 16, and 17 years) and Subject Area Subscale (Reading [English], Math, Social Studies [History], Science, and School in General). Gender of participant was included as a between-subjects factor.

Results

All structural models for both the general–verbal and math models were estimated and tested with the EQS program (Bentler, 1995). Estimation and significance testing was based on the variance–covariance matrices, although standardized path values are reported to facilitate interpretability. Variances and covariances for the variables used in the structural equation models are presented in the Appendix. The variance–covariance matrix was rescaled by multiplying the CAIMI scores by an appropriate constant to make the scaling of the variables more similar (Bentler, 1995).

In Phase 1, we tested Hypothesis 1, which predicted that all paths were positive and statistically significant. Hence, in the first phase, the structural paths were not constrained. The direct paths from each age to the next age (Paths *a*, *b*, *c*, and *d*, in Figure 1) were free parameters, with all other structural paths between ages fixed at zero. For example, the path from age 9 to age 13 motivation was fixed at zero. The testing of the models was primarily theory driven. However, it is often the case in testing models that minor modifications need to be made to improve model fit, without affecting the basic findings and confirmation of the major hypotheses (Bentler, 1995). Thus, we were prepared to make minor post hoc adjustments to the models on the basis of the EQS program's Wald Test (for fixing nonsignificant parameters) and Lagrange Multiplier Test (for freeing fixed parameters) and examination of large standardized residuals (to help detect correlated errors) as necessary in order to achieve a closer fit to the data. For example, if significant paths are discovered between ages other than those specified (e.g., from 9 to 16), they are not detrimental to Hypothesis 1 as long as the postulated paths remain positive and statistically significant. A second phase of analyses was conducted to test Hypothesis 2, which predicted that the stability of academic intrinsic motivation would increase over age.

Testing Structural Hypotheses: General–Verbal Model

Hypothesis 1. For the general–verbal model, the initial test yielded the following: $\chi^2(31, N = 96) = 121.15, p < .001$. Several fit indexes were also computed. The Bentler-Bonett normed fit index (NFI) was .85, the Tucker-Lewis (non-normed) fit index (TLI) was .83, and Bentler's comparative fit index (CFI) was .88. The Root Mean Square Error of Approximation (RMSEA) was .18. All free loadings and structural path coefficients were statis-

[1] Permission to adapt the CAIMI to the high school version may be requested from Psychological Assessment Resources (1-800-331-TEST).

tically significant (all $ps < .001$). The path coefficients for Paths *a, b, c,* and *d* were .76, .71, .87, and .93, respectively.

The significant chi-square and fit indexes indicated that the model could be improved. Indeed, in autoregressive models, errors for the same latent variables over several time periods are often correlated. Different ways of modeling correlated errors have been discussed by Jöreskog and Sörbom (1977). Without a much larger sample, the number of free parameters required by these methods often leads to unstable estimation; thus, we could not realistically estimate all parameters that the model would allow under ideal conditions as an a priori model. Instead, to obtain a better fitting model, we freed just a few correlated errors based on an examination of largest standardized residuals. The four that were freed were all associated with the reading–general indicators; they were between ages 9 and 10, 13 and 16, 13 and 17, and 16 and 17.

The resulting model fit the data well, $\chi^2(27, N = 96) = 31.53$, $p = .25$. All of the fit indexes looked very good as well, NFI = .96, TLI = .99, CFI = .99, RMSEA = .04. All free loadings and structural path parameters remained statistically significant (all $ps < .001$).

As expected, there was a good fit when reasonable modifications were made to account for correlated errors. In confirmation of Hypothesis 1, all path coefficients were positive and significant.

Hypothesis 2. To test the second hypothesis, the correlated error model was modified from Hypothesis 1 such that all structural paths (*a, b, c, d*) were constrained to be equal. Three constraints were imposed, that is, the paths from *a* to *b*, *b* to *c*, and *c* to *d* were all equal. This model fit the data, $\chi^2(30, N = 96) = 39.04$, $p = .12$; NFI = .95, TLI = .98, CFI = .99, RMSEA = .06. However, the Lagrange Multiplier Test suggested releasing the constraint that path $b = c$, $\chi^2(1, N = 96) = 6.74$, $p < .01$.

The final model was only partially constrained, $\chi^2(29, N = 96) = 31.61$, $p = .34$; NFI = .96, TLI = 1.00, CFI = 1.00, RMSEA = .03. The Lagrange Multiplier Test suggested no further changes in release of constraints. This model is displayed in Figure 2. The results were consistent with Hypothesis 2, specifically that the stability of general–verbal academic intrinsic motivation increased significantly over time, beginning at age 13. The free factor loadings for the measurement portion of the model were also positive and statistically significant (all $ps < .001$). The final model with standardized path coefficients is shown in Figure 2.

Testing Structural Hypotheses: Math Model

Hypothesis 1. For the math model, the initial test yielded the following: $\chi^2(6, N = 96) = 25.36$, $p < .001$; NFI = .79, TLI = .71, CFI = .83, RMSEA = .19. The initial beta weights were positive and statistically significant, confirming Hypothesis 1. For Paths *a, b, c,* and *d,* these were .28, .29, .53, and .63, respectively ($p < .01$ for Paths *a* and *b*; $p < .001$ for Paths *c* and *d*). However, the Lagrange Multiplier Test suggested that a path be freed from age 9 to age 16, $\chi^2(1, N = 96) = 9.78$, $p < .01$. Also, to further improve the model, one correlated error was freed (between ages 10 and 16). These modifications resulted in a better fitting model, $\chi^2(4, N = 96) = 5.56$, $p = .23$; NFI = .95, TLI = .97, CFI = .99, RMSEA = .07.

Hypothesis 2. With the four regression weights constrained to be equal, the model yielded the following: $\chi^2(7, N = 96) = 18.66$, $p < .01$; NFI = .85, TLI = .85, CFI = .90, RMSEA = .13. However, the Lagrange Multiplier Test suggested releasing the restriction that Path $c = d$, $\chi^2(1, N = 96) = 10.73$, $p < .001$. With the release of this constraint, the model achieved a better fit, $\chi^2(6, N = 96) = 6.51$, $p = .37$; NFI = .95, TLI = .99, CFI = 1.00,

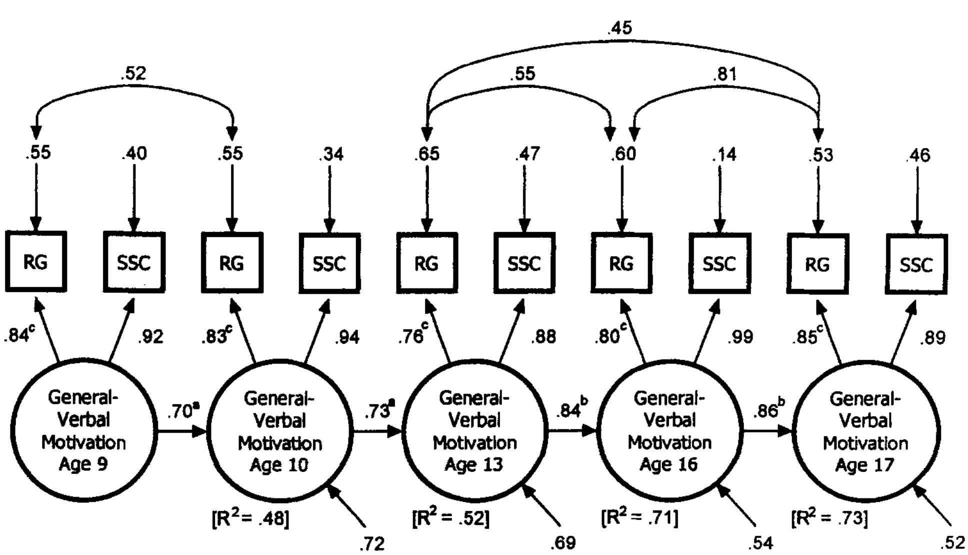

Figure 2. Results of Phase 2 longitudinal path model for general–verbal academic intrinsic motivation. Path parameters were standardized to facilitate interpretability; significance tests for paths were based on unstandardized values. Latent variables are represented by circles, and manifest variables are represented by squares. RG = composite of CAIMI Reading (English) and School in General subscales; SSC = Composite of CAIMI Social Studies (History) and Science subscales. For all free loadings and structural paths, $p < .001$. [a]Paths constrained to be equal (estimated at .64 prior to standardization). [b]Paths constrained to be equal (estimated at .87 prior to standardization). [c]This path was fixed at 1.00 prior to standardization.

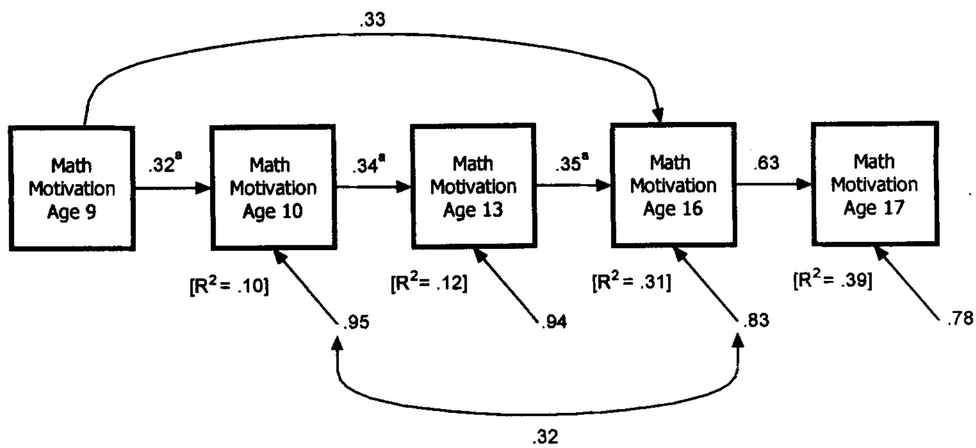

Figure 3. Results of Phase 2 longitudinal path model for math academic intrinsic motivation. Path parameters were standardized to facilitate interpretability; significance tests for paths were based on unstandardized values. Squares represent manifest variables. For all free structural paths, $p < .001$. [a]Paths constrained to be equal (estimated at .33 prior to standardization).

RMSEA = .03. The Lagrange Multiplier Test suggested no further changes in releases of constraints. Thus, Hypothesis 2 was confirmed, with a significant change in regression weights occurring between ages 16 and 17. The model with standardized coefficients is shown in Figure 3.

Indirect effects. In both the general–verbal and math models, positive, significant indirect effects were obtained for academic intrinsic motivation between successive years. These are presented in Table 1 for the final models. Not only does academic intrinsic motivation have direct effects from one age to the next, it also has an impact on the motivation at subsequent ages through motivation at earlier ages.

MANOVA

Hypothesis 3 was tested with a doubly multivariate MANOVA (using the Statistical Program for the Social Sciences [SPSS]) with one between-subjects factor—Gender (boys, girls)—and two within-subjects factors—Age (9, 10, 13, 16, and 17) and CAIMI Subject Area Subscale (Reading [English], Math, Social Studies [History], Science, School in General). Results for the multivariate *F* are reported with the Greenhouse-Geiser correction for degrees of freedom due to significant sphericity effects (see A. W. Gottfried et al., 1994). Following any significant effects, simple effects were conducted by using Bonferroni corrections to adjust the *p* values to control for Type I errors (A. W. Gottfried et al., 1994). On the basis of these analyses, there were no reliable gender differences obtained either as a main effect or in interaction with other variables.

Table 1
Indirect Effects for General–Verbal and Math: Final Models

Age	Age 13	Age 16	Age 17
	General–Verbal		
9	.51*	.43**	.37**
10		.61**	.52**
13			.72**
	Math		
9	.11*	.04	.23**
10		.12*	.07*
13			.22**

Note. Standardized paths are presented. Significance is based on unstandardized values. Thus, values that appear to be similar may differ in significance level.
$^{*}p < .01$. $^{**}p < .001$.

Whereas both age, $F(3.02, 283.92) = 13.93$, $p < .001$, and subject area, $F(3.24, 305.02) = 246.64$, $p < .001$, resulted in significant main effects, these were modified by a significant interaction between age and subject area, $F(9.17, 861.86)$, $p < .001$. To test Hypothesis 3, the most important effects concern the age factor. Inasmuch as subject area alone, without age, was not of particular significance in this study, and age alone was not meaningful because it was modified by the interaction, we focus on the results of the interaction. Within each subject area, there was a statistically significant effect for age, with the exception of social studies (history), for which age was nonsignificant: Reading (English), $F(4, 91) = 4.42$, $p = .003$, Math, $F(4, 91) = 20.54$, $p < .001$, Social Studies (History), $F(4, 91) = .51$, $p = .728$, Science, $F(4, 91) = 6.08$, $p < .001$, and School in General, $F(4, 91) = 3.16$, $p = .018$.

To test Hypothesis 3, which predicted that academic intrinsic motivation would decline across childhood through adolescence, polynomial contrasts were computed, with the expectation that there would be a significant downward monotonic trend in the scores. Statistically significant linear trends were obtained for Reading (English), $F(1, 94) = 10.00$, $p < .01$, $\eta^2 = .10$, Math, $F(1, 94) = 66.27$, $p < .001$, $\eta^2 = .41$, Science, $F(1, 94) = 20.61$, $p < .001$, $\eta^2 = .18$, and School in General, $F(1, 94) = 5.55$, $p < .05$, $\eta^2 = .06$, indicating a significant decline of motivation across those years. In addition to these linear trends, the Reading, Math, and Science subscales also had a small percentage of variance attributable to other components. A significant cubic component

Table 2
Means and Standard Deviations for Academic Intrinsic Motivation by Subject Area and Age

	Age				
Subject area	9	10	13	16	17
Reading					
M	94.75	93.78	90.33	86.02	88.26
SD	19.99	17.82	17.15	17.43	16.98
Math					
M	100.54	96.64	93.76	85.95	87.02
SD	16.27	16.87	16.01	16.17	16.32
Social Studies					
M	90.66	92.66	90.58	89.85	90.52
SD	20.50	20.10	18.41	14.19	14.01
Science					
M	98.82	97.91	92.37	89.50	90.43
SD	18.96	17.28	17.31	16.05	16.64
School in General					
M	69.87	69.00	68.51	66.85	68.10
SD	8.35	9.06	8.29	8.53	8.60

Note. Age is in years. Reading refers to Reading (ages 9, 10, and 13) and English (ages 16 and 17), and Social Studies refers to Social Studies (ages 9, 10, and 13) and History (ages 16 and 17). The School in General subscale has lower means because it consists of fewer items (18) than do the subject area scales (26 each).

trend was obtained for Reading (English), $F(1, 94) = 6.08$, $p < .05$, $\eta^2 = .06$, and Science, $F(1, 94) = 6.15$, $p < .05$, $\eta^2 = .06$. For Math, a small percentage of variance was attributable to a quartic component, $F(1, 94) = 4.21$, $p < .05$, $\eta^2 = .04$. Means and standard deviations for the CAIMI subscales across the ages are presented in Table 2.

The eta-squared values (i.e., effect sizes) indicating amount of variance accounted for by the contrast show that the largest developmental decline occurred for Math followed by Science. Reading and School in General also declined, although the decline for School in General was quite small. The cubic trend for Reading and Science can be accounted for by a slight increase in motivation scores from ages 16 to 17. Whereas all previous ages declined to age 16, there was an increase at age 17 compared with age 16. Indeed, inspection of all the subject areas indicates either a rebound of motivation at age 17 or at least a stabilization of scores. For Math, the significant quartic component appears to be due to the steepness of the drop in means inasmuch as math begins as the highest but drops to be similar to other subject areas.

Hypothesis 3 received support from these analyses, although additional trends were also obtained. In general, academic intrinsic motivation declines significantly from middle childhood through late adolescence. However, the drop in motivation was modified by particular subject area. The greatest decline occurred for Math, followed by Science and Reading, whereas there was no significant decline for Social Studies. School in General was likewise affected by a decline, albeit small, as one can see from the means being similar to each other and the eta-squared for the linear trend accounting for a small amount of variance. Academic intrinsic motivation appears to end its descent by age 16, as there was no further deterioration after that period, and in some instances there was a slight increase.

Discussion

This research simultaneously identifies continuity across two dimensions: the individual within the group and the group over time. The findings were consistent in supporting Hypotheses 1 and 2, which predicted that academic intrinsic motivation is a stable construct from childhood through late adolescence that becomes increasingly stable for both the general–verbal and math areas.

Academic intrinsic motivation is a construct yielding substantial individual-difference rank-order stability that increases significantly in the adolescent years. By age 9, a substantial degree of academic intrinsic motivation has developed, in which each prior age serves to predict the subsequent age. For both the general–verbal and math models, the significance of the direct paths shows that each age in turn predicted each subsequent age (with the addition of a direct path from age 9 to age 16 in math). In addition, the significant indirect paths provide evidence of continuity of academic intrinsic motivation across the entire age range by impacting more distant ages through intermediary ones. Academic intrinsic motivation appears to undergo cumulative development inasmuch as each previous age not only directly predicts the next age but also impacts motivation throughout the entire age range via the indirect effects. In general, the individual's position becomes more predictable, on the basis of the multiple correlations and path coefficients. Whereas path coefficients were somewhat lower in the math than in the general–verbal models, the use of observed rather than latent variables may be responsible for this inasmuch as latent factors provide better control over error. Further, it is important to note that the findings are not specific to the nature of one school but are generalizable across schools, teachers, and geography because the children were in different schools with different teachers and lived in different geographic areas, both within and outside of California.

In addition to generalizing across educational settings, the findings regarding rank-order stability have important implications for generalizing across motivational theories. The results of the present research and of Wigfield et al. (1997) in the expectancy-value realm bear enough similarity to suggest that stability in motivation across time can be expected to increase with age in academically related motivational domains.

Another aspect of generalizability concerns the similarity of the present findings with those of a meta-analysis of personality consistency across the life span (Roberts & DelVecchio, 2000). First, as in the present research, personality constructs showed increasing stability over time. Second, the stability coefficients across our models were similar enough to those reported by Roberts and DelVecchio (2000) to further support confidence in our findings indicating that stability in academic intrinsic motivation is a phenomenon consistent with stability in allied fields. Furthermore, the significant increases in individual-difference stability during adolescence for both general–verbal (at age 13) and math intrinsic motivation (at age 16) are in accord with "steplike" increases in personality consistency found across the years by Roberts and DelVecchio (2000).

Regarding mean stability, there is similarity between the present findings and those obtained with regard to school-related intrinsic motivation (Harter, 1981; Lepper et al., 1997) and a wide range of school-related attitudes and achievement motivations (Anderman

& Maehr, 1994; Eccles et al., 1998; Wigfield et al., 1997). Across studies, motivation and attitudes tend to decline across the years.

The mean decline of academic intrinsic motivation over the ages for Math, Science, and Reading, and the absence of decline for Social Studies, indicates that academic intrinsic motivation is related to school curriculum. These findings of differentiation of developmental trends in academic intrinsic motivation across subject areas were supported in previous research conducted cross-sectionally with three separate populations (A. E. Gottfried, 1985). In that work, academic intrinsic motivation significantly declined in reading and significantly increased in social studies but showed no significant changes in the other subject areas or school in general. The present research exceeds these prior findings because the age range extended through late adolescence. Hence, the present research provides a more complete picture across the ages, and being longitudinal, allows each subject area to be examined holding constant for cohort instead of across different groups. Regardless of these differences between studies, results are consistent in showing that the decline in academic intrinsic motivation was related to specific subject areas and that social studies did not suffer adverse effects. The present longitudinal findings, combined with previous cross-sectional findings (A. E. Gottfried, 1985), indicate that the decline in academic intrinsic motivation is not a general developmental or ontogenetic one, nor is it inevitable. These findings do raise the issue of why some areas suffer a greater decline than others.

Prior explanations regarding general declines across ages in intrinsic motivation include an increasingly extrinsic school atmosphere, a progressive increase in the adverse effect of extrinsic consequences on intrinsic motivation, and increasingly controlling school environments (Eccles et al., 1998; Harter, 1981; Lepper et al., 1997). Other general school conditions also may adversely affect academic intrinsic motivation. For example, academic intrinsic motivation has been shown to be inversely related to academic anxiety (A. E. Gottfried, 1985, 1990, 1998). As children progress through middle and high school, it is possible that school environments become increasingly fraught with anxiety as competition for grades and school activities plays an important role in future college admissions and career pathways. In addition, because parents' use of task-extrinsic motivational practices is inversely related to their children's academic intrinsic motivation (A. E. Gottfried, Fleming, & A. W. Gottfried, 1994), home environments also may play a role in the decline of motivation. Whereas it is beyond the scope of the present study to identify factors that produce a decline, all of these provide plausible avenues for future research.

Such general explanations, however, do not elucidate subject area differentiation. Actual aspects of the subject matter itself, or the way it is taught, may be important to examine. The present findings regarding declining math and science motivation dovetail with the national concern raised by the nation's poor performance on the Third International Math and Science Study in 1995–96, particularly in 8th and 12th grades (Ozgun-Koca & McCann, 1999).

As the greatest decline in the present study occurred in math, this further supports our previous findings that math is a unique subject area regarding academic intrinsic motivation. Perhaps the conditions that are detrimental to other subject areas, and to school in general, are more detrimental for math. Several aspects of math itself could also contribute to this downward shift. Math has been perceived by high school students to be harder than other subjects (American Association of University Women, 1994; Eccles, Adler, & Meece, 1984; Stodolsky, 1988) . Further, the present results for math and social studies are compatible with Stodolsky and colleague's analyses of math compared with social studies curriculum. For example, fifth-grade students reported that they would be able to learn social studies, but not math, on their own, indicating that social studies is perceived as easier (Stodolsky, Salk, & Glaessner, 1991). In a survey of high school teachers (Stodolsky & Grossman, 1995), those teaching math experienced less autonomy with regard to course content than did social studies teachers. Perhaps teachers communicate their lack of autonomy to students, or perhaps the curriculum allows for less student autonomy as well. Similarly, Stodolsky (1988) found that there were more diverse routes to learning social studies than math, which is typically directed by teachers. Perhaps students perceive greater autonomy in learning social studies.

Concepts of ability also may adversely affect math motivation. Grouws and Lembke (1996) stated that, for math in comparison with other subject areas, individuals have lower expectations of success, do not believe that most people have the ability to do math in comparison with reading or writing, and don't see the need for math outside of school. Such views may be related to lower academic intrinsic motivation. It may be that only the most intrinsically motivated can forge through higher level math.

Regardless of the decline in academic intrinsic motivation over time, from age 16 to 17 there is a slight increase in motivation. To our knowledge, this is the first report in the literature of such a pattern. Inasmuch as the cessation of the decline occurs at the end of high school, it may be that students' patterns of high school performance are already known to them, the prospect of applying for college may serve as a wake-up call, and that their future directions are more charted than they have been in the past.

The results are significant for understanding the academic patterns of students across their school years. Although it is heartening that younger children have less stabilized academic intrinsic motivation through their early adolescence, the strong degree of stability even in the elementary years, particularly in the general–verbal domain, is rather sobering. The data imply that if one is to intervene to enhance academic intrinsic motivation, it had better be early in a child's schooling. Not only do children remain relatively stable in their peer group as they develop, but this stability increases in adolescence, and the entire group also experiences a downward shift across almost all subject areas.

As a result of the two trends identified in this research, that is, considerable individual-difference stability and a general downward shift in most areas, children who begin this sequence with lower motivation during childhood are likely to be at a greater disadvantage over the age span. Early motivational assessment during childhood could serve to identify children who may be at risk for both low motivation and low academic performance. In view of our prior work showing that academic intrinsic motivation is positively related to school achievement from childhood through adolescence (A. E. Gottfried, 1985, 1990, 1998; A. E. Gottfried, Fleming, & A. W. Gottfried, 1994), students who begin this sequence with lower academic intrinsic motivation may also be at risk with regard to their academic performance, particularly because it is likely to intensify over the adolescent years as a result of the occurrence of the increase in individual-difference stability and downward group shift. The importance of this possible conjoint effect of being lower and the downward shift should be given more attention in the future.

Clearly, it would be efficacious to prevent a slide in intrinsic motivation for school learning through teachers' and parents' implementation of practices and supportive environments that have been shown to be related to higher levels of intrinsic motivation. With regard to the tasks themselves, on the basis of motivation theory and research, teachers should enthusiastically introduce new materials and design tasks that are of optimal or moderate difficulty; utilize incongruity, novelty, surprise, and complexity; relate to students' interests; and are meaningful to students (Covington, 2000; A. E. Gottfried, 1983; Stipek, 1996). Teachers' provision of student choice and greater autonomy is likely to create more intrinsically motivating conditions (Deci & Ryan, 1992; A. E. Gottfried, 1983; Grolnick & Ryan, 1989; Ryan & Stiller, 1991). Parents may also facilitate intrinsic motivation for school learning by using task-endogenous as opposed to extrinsic motivational practices (A. E. Gottfried, Fleming, & A.W. Gottfried, 1994), allowing more child autonomy for homework and school-related tasks (Ginsburg & Bronstein, 1993; Grolnick & Ryan, 1989) and providing more intellectually stimulating home environments (A. E. Gottfried et al., 1998). Further, the suggestion that motivation in school declines over the years as a result of adverse effects of extrinsic consequences on intrinsic motivation and increasingly controlling school environments (Eccles et al., 1998; Harter, 1981; Lepper et al., 1997) supports the suggestions for interventions regarding increasing the autonomy of students and reducing the use of extrinsic consequences. Such practices should be implemented early and consistently throughout a child's schooling to prevent this pattern of low motivation from being established.

The construct of academic intrinsic motivation maintains a strong degree of continuity, or stability, during a child's education, from middle elementary through the high school years. It may not be easy to change academic intrinsic motivation in adolescence. Again, this underscores the importance of implementing motivational assessments during the elementary school years so that strong and weak areas of academic intrinsic motivation may be determined, and appropriate educational planning may occur, early in a child's education to encourage areas of strength and to reduce or prevent areas of weak motivation. Further, the present research should serve as a heuristic for further theoretical work to detail the specific mechanisms of cumulative change and continuity throughout the school years.

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Appendix

Table A1
Variances and Covariances Used to Test General–Verbal Models

Variable	1	2	3	4	5	6	7	8	9	10
1. RG9	170.73									
2. SSC9	174.12	306.04								
3. RG10	103.61	109.75	152.45							
4. SSC10	117.58	175.20	159.47	271.03						
5. RG13	65.97	80.36	69.27	93.30	136.97					
6. SSC13	100.98	129.59	106.24	160.81	128.97	264.69				
7. RG16	63.10	79.45	58.65	72.54	97.74	112.29	136.41			
8. SSC16	97.36	106.24	99.81	124.51	101.97	165.68	127.45	191.70		
9. RG17	54.12	77.13	52.36	60.40	83.21	102.47	113.25	114.35	133.09	
10. SSC17	84.60	113.15	79.08	94.62	79.95	122.93	98.26	141.27	118.83	182.39

Note. $N = 96$. Variances appear in the diagonal entry. Covariances appear below the diagonal. RG = composite of Children's Academic Intrinsic Motivation Inventory (CAIMI) Reading (English) and School in General subscales (corresponding numbers indicate age); SSC = composite of CAIMI Social Studies (History) and Science subscales (corresponding numbers indicate age).

Table A2
Variances and Covariances Used to Test Math Models

Variable	1	2	3	4	5
1. Math9	.80				
2. Math10	.23	.83			
3. Math13	.19	.23	.78		
4. Math16	.30	.34	.40	.74	
5. Math17	.25	.26	.36	.51	.86

Note. $N = 96$. Variances appear in the diagonal entry. Covariances appear below the diagonal. Math9 = score on the Children's Academic Intrinsic Motivation Inventory (CAIMI) Math subscale at age 9; Math10 = score on the CAIMI Math at age 10; Math13 = score on the CAIMI Math at age 13; Math16 = score on the CAIMI Math at age 16; Math17 = score on the CAIMI Math at age 17.

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