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Creative Ideation Meets Relational Support: Measuring Links Between these Factors in Early Adolescence

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This study examines measurement of creative ideational behaviors alongside factors of student engagement that may play a role in the development of students' creative potential during early adolescence in school. Two studies used exploratory and confirmatory factor analyses, cross-validation, and invariance testing of 2 extant measures with multiple samples of 6th grade students in the United States. Key findings show that reduced versions of the Runco Ideational Behavior Scale for Students (RIBS-C) and the student engagement instrument (SEI) demonstrated a close fit to the data and sufficient evidence of reliability and validity. In addition, flexibility in creative ideation showed consistently high correlations with relational support with peers and teachers and educational aspiration and relevance. Results provide greater precision for future measurement and support for developmental and sociocultural theories of creativity in the learning environment. This study also reinforces the cognitive perspective that distinguishes properties of fluency and flexibility.

In learning, the choice to express a personally creative interpretation or idea may depend on balancing risk of potential costs with hope for potential benefits—social ridicule versus recognition, for example (Beghetto, 2009). During early adolescence, the support provided in the environment, along with an individual's established intellectual capital, may dictate these expectations and choices (Eccles & Roeser, 2011). As research has found that perceived curricular meaningfulness predicts valuing of school (Roeser, Eccles, & Sameroff, 2000), relevance of content may influence the investment in creative ideational activity of students. In highly structured environments, such as classrooms, creative ideational behaviors and the social mechanisms influencing them set up cognitive and motivational patterns that may play a role in the development of creative potential (Eccles & Roeser, 2011). As others have noted (e.g., Beghetto, 2016), the role that relational support and content relevance play in creative ideational behavior needs more attention in educational contexts. Through rigorous analysis of extant measures, the aim of this study was to extend the understanding of creative ideational behavior and relational support for early adolescent students in middle level settings.

A PLURALITY OF CREATIVITY THEORIES

Kozbelt, Beghetto, and Runco's (2010) encouragement for a pluralism in creativity research guided this study. Common everyday creative thinking and behaviors are deeply personal (e.g., Kauffman & Beghetto, 2009), develop through firsthand exploration in a permissive environment (Helson, 1999; Russ & Schafer, 2006), and also emerge from cognitive (Runco, 1994; Ward, Smith, & Finke, 1999) and metacognitive processes (Davis, 1999). Other theories suggest that creative ideas and acts, witnessed and judged by an audience, are situated in sociocultural contexts (Glăveanu, 2013) and transpire in a nested system (Sawyer, 2006), such as students, within classrooms, within schools, and within communities. Still others combine elements of psychoeconomic, social-emotional, and learning theory perspectives

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(Beghetto, 2016), suggesting that an everyday creative idea or act emerges from personally meaningful insight to be either accepted or rejected in a social and cognitive transaction. In these transactions, the idea or act moves from an individual's interior into the external world for feedback and validation, much like the four and six Ps models suggest (Rhodes, 1961; Runco, 2004). A plurality of contrasting but complementary perspectives inform this investigation of adolescent creative ideational behavior in the school context.

Creative Ideation and Early Adolescence in School

Given the fragility of early adolescent development and identity formation (Eccles & Roeser, 2011; Meeus, van de Schoot, Keijsers, Schwartz, & Branje, 2010) and the myriad sociocultural pressures of middle level educational settings, a plurality of perspectives on creativity is most appropriate. As Beghetto's (2016) model of creative learning asserts, simply providing the opportunity for students to validate their creative interpretations may not be enough. For students to take the risk to externalize their personally creative idea, growing their own understanding and contributing to that of others, may depend on a sense of security (Beghetto, 2009) and expected value in the investment (Sternberg & Lubart, 1992). During adolescence, student creative ideational behavior may link to a sense that education in school is relevant to life and may be forming domain specificity, as some theories suggest (see Kozbelt et al., 2010). In the face of heightened social pressure and a need for independence—hallmarks of early adolescence—relational support and relevance may be especially salient to creative thinking patterns.

Developmental Factors of Creative Ideation

Past studies found a myriad of slumps and bumps during adolescence in the development of creative ideational behavior (Barbot, Lubart, & Besancon, 2016). Lau and Cheung (2010) found sixth- and seventh-grade slumps for a Chinese sample among verbal and figural divergent thinking dimensions, where female students' scores surpassed their male counterparts from seventh-grade onwards. Unfortunately, one can't be sure if that sex differential relates to specific developmental, environmental, or sociocultural factors in the Chinese context, such as decreased relational support or an enlarging role of masculinity for male students. Claxton, Pannells, and Rhoads (2005) found a slump in sixth grade in the US context, as well. As Barbot et al. (2016) noted, depending on the type of person-level creative resources (e.g., divergent thinking vs. insight ability) these empirical slumps are reversed in other studies (e.g., Charles & Runco, 2001; Kleibeuker, de Dreu, & Crone, 2013). This inconsistency of findings suggests that theoretical perspective and methodological choices play a role in the field's understanding of the development of creative ideational behavior.

Barbot pointed out that changes in motivational orientations, such as decreased openness to experience identified in adolescent boys (Branje, Van Lieshout, & Gerris, 2007), may play a systematic role in the development of other person-level creative resources. Moreover, He and Wong (2015) linked level of stress, partly due to school transition, to a slump in creative potential during early adolescence. From a social-psychological perspective, changes in motivational orientation may be in response to the "contextual and cultural demands" dictated by the environment (Barbot et al., 2016, p. 38) and may influence further development of creative ideation. By bridging the field of school engagement to that of creativity, this present study investigates these links.

School Context

In schools, creative process and production take on a very social form, with a seemingly omnipresent audience either encouraging or rejecting the expression of individual meaning. In their model of student engagement, Fredricks, Blumenfeld, and Paris (2004) included the need for relatedness; logically, this need may undermine the practice of creative ideation if general relational support and relevance is low. If the development of creative ideational behaviors depends on opportunities to practice, apply, and habituate, as Kleibeuker et al.'s (2013) results suggest, then sense of relational support and relevance may determine access and uptake of these opportunities. Given the personal dimension of everyday creativity and the social pressures experienced in adolescence, relational support may be a precondition for the development of creative ideational behaviors and the resulting creative potential.

Psychometric Perspective

The psychometric perspective would ask: Can one measure ideational creative behaviors effectively in adolescence and, if so, how? Because Wallach and Kogan (1965) validated the use of divergent thinking tasks to predict creative potential, their approach has remained a cornerstone in the study of creativity. Responding to a need for an improved criterion for creative potential, Runco, Plucker, and Lim (2001) created the Runco Ideational Behavior Scale to treat creative ideational behaviors as a product. Aligned to the psychometric perspective, their measure focused on creative flexibility—the capacity to think of different types of ideas or solutions—and creative fluency—the capacity to think of many ideas or solutions. After modifying the scale for younger students, the first study to analyze the validity of the student form, after modifying the scale for younger students, tested four theories and found that the data fit a product and process model best (O'Neal, Paek, & Runco, 2015). However, their study did not explore other potential

models, such as one that might account for the domain-specific purposes of creative ideational behaviors (Baer, 2015).

Research Goals

This study presents the first attempt to conduct a rigorous testing of structural validity and invariance of that scale across multiple samples. In doing so, this study aimed to ensure that the scale measured the construct of creative ideational behavior with sensitivity and precision for the aspects most relevant to adolescent learners. This investigation examined the dimensions of creative ideation and engagement through two occasions of cross-sectional quantitative measurement with different samples. A pilot phase (Study 1) and a cross-validation study (Study 2) explored how the measures performed with the population of interest and to test the robustness of the resulting models. The following research questions target the reliability and validity of measures of creative ideational behaviors and student engagement.

1. For measures of creative ideation and student engagement, do the pilot sample data in Study 1 fit a model with the factors established in prior research, adequately? If prior models are not adequate, are there other theoretically relevant models that fit the pilot sample data?
2. Do the data from the validation sample in Study 2 fit these new models? If not, through a process of local fit-testing, item reduction, or exploratory factor reconfiguration, do the data adequately fit revised models?
3. Do different samples replicate adequate fit, structural validity, and composite reliability?
4. Do components of the structural configurations of the revised models demonstrate invariance across multiple samples, and how do the latent factors relate across constructs and measures?

The pair of studies examined multiple samples of 6th-grade students in eight middle schools across four school districts in the Northwestern United States to explore the technical adequacy of measures of student engagement and creative ideation. The procedures outlined in the following pages were used to collect data from the pilot sample in Study 1 and cross-validation samples in Study 2 in the same setting for the measures outlined below.

STUDY 1

The aim of this pilot study was to test the technical adequacy for the diverse population of interest and eliminate or reword items that did not function adequately. Though iterative exploratory factor analysis was used to refine the measures, the study began with a confirmatory factor analysis (CFA) testing the models suggested by measurement authors and past research. In subsequent tests, the wording of items were checked to determine potential confusion or irrelevance and items were eliminated that did not demonstrate adequate communality.

Method

Participants and Setting

For the pilot study, conducted in the spring of 2015, a sample of 6th grade students (n = 187) was administered the full version of the Runco Ideational Behavior Scale for Children (RIBS-C). This same sample in addition to 6th-grade students from another school (n = 273) was administered the student engagement instrument (SEI). Samples included all 6th grade students from participating schools, except those who declined enrollment in the study (< 2%). Demographic statistics were similar to those detailed in Study 2.

Middle schools participating in this study were recruited from both fringe rural and urban locales in small and mid-size cities in the Pacific Northwest. According to US Census Bureau data (2015), the county from which the sample derived includes a population that is 90.1% White, with 20% of persons living below the poverty level, and 27.7% of persons 25 or older completing a Bachelor's degree of higher. The eight large middle schools spanned the 6th through 8th grade. Ranging from 50–95% free/reduced-price meals eligible, the schools all served high proportions of students living in poverty. All participating schools served high levels of racial and ethnic minority students when compared to state averages. Half of the schools selected for this study were engaged in a school improvement initiative in an effort to remediate low math and reading proficiency using arts integration strategies. As such, participating schools were dealing with a range of challenges during the period covered by this study, such as leadership turnover, student transience, a range of competing initiatives, and budgetary shortfalls.

Data Collection

Following standardized administration protocol, classroom teachers administered the measures using an online survey format. In advance, teachers received written and verbal instructions and troubleshooting support. Teachers announced that the survey was a part of a research project, that it was not a test, and that teachers would not see student responses. Creative divergent thinking tasks (e.g. "Name as many things as you can that a spoon could be used for") were placed between different measures to increase student interest and break up potential response patterns. The administration protocol allowed teachers to help students

by clarifying any vocabulary or terminology they found confusing. Students completed the survey over one class period (45 min). Students with reading challenges or limited English language ability were provided a second class period to finish, if needed. Students completed the survey during a month-long window in the spring of 2015 for Study 1 and fall of 2015 for Study 2.

Measures

The self-report RIBS-C employed a 5-point frequency of behavior scale ranging from *never* (1) to *almost always* (5). The complete RIBS-C was tested for structural validity with our spring pilot, including all 30 items, four of which were contraindicative and required reverse coding when scores were totaled. Runco, Walczyck, Acar, Cowger, Simundson, and Tripp (2014) suggested that these items target the theoretical opposite of constructs of interest, may diminish the response set patterns (e.g., marking all responses positive), but may need to be eliminated for analyses. Past research with the adult version of the RIBS assessments demonstrated some evidence of a two-factor model for fluency and flexibility (Runco et al., 2001, 2014; Tsai, 2015). O'Neal, Paek, and Runco (2015) published the first validity study of the children's version and compared the goodness-of-fit of different models that represented multiple theories of creativity. O'Neal et al. retained all but five items in their two-factor model and report model fit to be adequate (CFI = .930, RMSEA = .034) according to Hu and Bentler (1999). Given that those results were not available at the time of our pilot study, exploratory factor analyses were used here to detect an adequate model.

The SEI is a self-report measure of psychological, emotional, and cognitive indicators of student engagement. The SEI employs a 5-point Likert scale ranging from *totally disagree* (1) to *totally agree* (5) with a middle term for neutral responses (3). Appleton, Christenson, Kim, and Reschly (2006) and Lovelace, Reschly, Appleton, and Lutz (2014) completed exploratory factor analyses and convergent, concurrent, and predictive validity studies and found some evidence of adequate robustness of the instrument. For example, the 35-item, 6-factor model (described in Table 3) reached a CFI of 0.97, a close fit by Hu and Bentler's (1999) criterion, but also produced a large and statistically significant Chi-square value (χ^2= 2,780, $p < .001$) and an RMSEA value of .065.

Results

The structure of extant measures was analyzed with an iterative process that would situate the cross-validation in Study 2. The iterative process to refine the measures followed the research questions to (a) test reliability and validity from prior research using factor analysis, (b) eliminate items with low common variance ($r < .50$) with other common factors, and (c) finalize a common factor model that appeared both conceptually and empirically related to the theoretical models of creative ideational behavior and relational support. Exploratory factory analysis (EFA) was chosen over alternative approaches, such as principal component analysis, because EFA can detect the common variance accounted for by an unobservable latent variable among measured variables and the unique variance of each variable, including error, not accounted for by a common factor (Preacher & MacCallum, 2003). *Mplus* data analysis software (Muthen & Muthen, 1998–2011) was used to conduct factor analyses and address the first research question, which provided goodness-of-fit statistics to use in evaluating models. Robust maximum likelihood (MLR) was chosen as the estimator and Geomin oblique rotation in factor analysis to allow factors to correlate in the analysis (Preacher & MacCallum, 2003).

RIBS-C

Detailed in Table 1, the data from the pilot study (n = 187) did not fit the suggested two-factor CFA model, as demonstrated by inadequate goodness-of-fit statistics (Hu & Bentler, 1999). For example, Hu and Bentler recommend a CFI ≥ .95 and an RMSEA value closer to .06. Kline (2016) also recommended a statistically nonsignificant χ^2. Table 2 details the results from each stage of factor analysis. Subsequently, to investigate the third research question and explore other models and factor structures, all 30 items were used in an initial EFA and produced a four-factor model with inadequate fit. An initial 12 items were eliminated. These (a) were weakly correlated to a common factor ($r < .50$), (b) loaded evenly across factors, or (c) lacked adequate construct relevance to the emerging latent vari-

TABLE 1.
Goodness-of-fit indices for models of the RIBS-C and SEI identified using confirmatory and exploratory factor analysis given data from pilot sample in study 1

Model	*df*	χ^2	*SRMR*	*CFI*	*RMSEA (90% C.I)*
Runco Ideational Behavior Scale for Children					
2-factor CFA (30 items)	376	788.54*	.085	.66	.077 (.07, .08)
4-factor EFA (30 items)	296	503.55*	.053	.83	.061 (.05, .07)
5-factor EFA (18 items)	73	90.26	.027	.98	.036 (.00, .06)
5-factor EFA (15 items)	40	59.15*	.025	.97	.051 (.02, .08)
Student Engagement Instrument					
6-factor CFA (35 items)	545	1,082.23*	.090	.85	.060 (.06, .07)
6-factor EFA (35 items)	493	1,100.65*	.055	.83	.067 (.06, .07)
5-factor EFA (22 items)	131	197.13*	.027	.96	.043 (.03, .06)
4-factor EFA (19 items)	101	145.48*	.027	.97	.040 (.02, .05)
3-factor EFA (15 items)	63	86.41*	.028	.98	.037 (.01, .06)

Note. CFA was conducted first to test the models previously published for each measure. For RIBS-C, N = 187 and for SEI, N = 273. CFI = comparative fit index; RMSEA = root mean square error of approximation. *$p < .05$.

TABLE 2.
Goodness-of-fit indices of models for the RIBS-C and SEI in the confirmatory-exploratory and cross-validation factor analysis components of the 3-step model-tesing process in study 2

Model	*df*	χ^2	SRMR	*CFI*	*RMSEA (90% C.I.)*
Runco Ideational Behavior Scale for Children (RIBS-C)					
Sample 1 Exploratory CFA (n = 301)					
5-factor (15 items)	80	159.45*	.052	.93	.057 (.04, .07)
4-factor (12 items)	48	88.75*	.045	.96	.053 (.04, .07)
4-factor (11 items)	38	61.03*	.037	.98	.045 (.02, .07)
Sample 2 cross-validation CFA (n = 317)					
4-factor (11 items)	38	65.25*	.040	.96	.048 (.03, .07)
Sample 3 cross-validation CFA (n = 312)					
4-factor (11 items)	38	94.08*	.042	.94	.069 (.05, .09)
Student Engagement Instrument (SEI)					
Sample 1 Exploratory CFA (n = 301)					
3-factor (15 items)	87	342.88*	.074	.82	.096 (.09, .11)
3-factor rev. (15 items)	87	222.99*	.072	.90	.070 (.06, .08)
3-factor (11 items)	41	85.61*	.044	.96	.058 (.04, .08)
Sample 2 cross-validation CFA (n = 317)					
3-factor (11 items)	41	75.93*	.047	.96	.050 (.03, .07)
Sample 3 cross-validation CFA (n = 312)					
3-factor (11 items)	41	70.60*	.049	.96	.047 (.03, .07)

Note. CFI = comparative fit index; SRMR = standardized root-mean-square residual; RMSEA = root mean square error of approximation with 90% confidence interval included in parantheses.

*$p < .05$.

ables. Through EFA, the five-factor structure met criteria for good fit (see Table 1). An additional three items that did not show significant pattern coefficients ($p < .05$) with a common factor and appeared to show weak construct relevance with any of the five factors were removed. Though the goodness-of-fit statistics were marginally better for the 18-item five-factor model, the 15-item five-factor model was chosen for the sake of parsimony. The following factors were identified in the retained items: (a) future-oriented flexibility and fluency, (b) fluency of new ideas, (c) fluency of improvement on existing ideas, (d) flexibility, and (e) ideational self-efficacy.

SEI

Using the full 35-item measure, CFA of the data did not adequately fit the 6-factor model suggested by past research. As Table 1 indicates, no identified models improved fit with all 35 items. Upon closer examination and two more iterations of exploratory factor analysis, 13 items (a) did not appear relevant to the engagement factors of interest to this study, (b) loaded evenly on more than one factor, or (c) loaded weakly ($r < 0.50$) on any factor in the model. Illustrated in Table 1, by eliminating the 13 items, the model fit improved and met the criteria for close fit, but two of the factors evidenced factor loadings of common items. Examining the content of items and factor structures in EFA, the 35-item SEI was reduced to a 15-item, three-factor solution that appeared to represent the most salient factors for our program of inquiry—(a) control and relevance, (b) relationships at school, and (c) school climate—and aligned to the original factors proposed by Appleton et al. (2006).

Discussion

Though the χ^2 remained significant ($p < .05$) for both models, the sample size and data limited our ability to test models with a greater number of factors, and these statistics may have been the result of our sample sizes, which were close to or greater than n = 200. The models identified by the data both support our original intent of each measure and diverge slightly to elaborate theory further. The iterative approach taken to analyze, review, and reduce items set up model convergence that differed from both the factor structure (i.e., item pattern coefficients) and the specific factor labels describing subscales in prior research. Both measures were reduced to half their original length by eliminating items that (a) did not show strong pattern coefficients with a latent variable, (b) did not relate well to engagement factors of interest (e.g., support from parents in the SEI), or (c) showed wording or concepts that may have caused inconsistent interpretations across our sample. This step of variable exploration is a critically important phase to generate and test hypotheses that undergird a new program of inquiry. As Kline (2013, p. 177) wrote, EFA and CFA "support inductive reasoning but do not produce definitive, incontrovertible results. [There is a] false belief that the name assigned to a factor by a researcher means that the hypothetical construct is understood or even correctly labeled." For the purposes of this study, the latent variables were labeled with names that described the new sets of indicators discovered. These decisions reflected the best interpretation of the latent variables within the bounds of current theory and the context of the sample and study. Given that the models identified in the EFA could be an artifact of data, cross-validation of these models with new samples is imperative before proper evaluation can be made.

STUDY 2

The primary goal of this study was to confirm validity of the refined versions of the RIBS-C and the SEI models identified in Study 1 for use in the longitudinal program of inquiry. Secondarily, the study aimed to create the most reliable and valid set of items and reduce burden on students by eliminating items that did not function well for the population of interest. Third, analysis of correlations across factors included in both measures sought out evidence of discriminant and convergent validity (Rosenthal & Rosnow, 2008) and identified patterns of theoretical interest.

Method

The method in Study 2 followed the same data collection procedures, but included a much larger sample to undergo cross-validation.

Sample

Like Study 1, Study 2 included students from several convenience sample middle schools, established through participation in a grant-funded program development and research study. The full sample of students who participated in the Study 2 administration of the measures (n = 1,025) represented over 95% of the population of 6th grade students enrolled at the schools; less than 5% were excluded due to declining consent to participate in the study. The full sample of students identified as 77% White, 5.5% Multiracial, 3.1% Black, 3% American Indian/Alaska Native, 1.3% Asian, and 1.1% Native Hawaiian/Pacific Islander with 12.5% of the sample identified as Hispanic and an additional race category and 9% identified only as Hispanic. In the full sample, 52% were male students and 48% were female; 2.7% of students were identified as English language learners and 13.7% were identified for special education.

For the purpose of cross-validation and invariance testing of final models produced in factor analysis, this sample of participating 6th grade students was split into three randomized samples roughly equal in size, using a randomly generated variable created in IBM SPSS version 22 (IBM Corp, 2013). For the measures of interest missing data ranged from < 5% to 12% for individual indicators and was dealt with by using full information maximum likelihood (FIML) in analyses (Graham, 2009).

Results

Factor analysis was conducted using robust maximum likelihood estimation in M*plus* data analysis software (Muthen & Muthen, 1998–2011), which by default uses FIML to account for missing data.

RIBS_C

As this study represents the second published use of the RIBS-C in empirical research, a modified version of the original RIBS for adults, we examined the internal reliability and validity of the RIBS-C scores to ensure valid and reliable use for future research and for robust contributions to theory.

Step 1: Initial CFA. To address the second research question, CFAs (Kline, 2016) were conducted on each scale, using models determined by EFA in Study 1. The goodness of fit (GOF) of the initial CFA was evaluated based on Hu and Bentler (1999) strict criteria for close fit—specifically, χ^2, CFI, root mean square error of approximation (RMSEA), and standardized root mean residual (SRMR). CFA tested the five-factor model established by EFA in the Study 1; GOF reached a SRMR = .052, CFI = .93, and RMSEA = .057 with a statistically significant χ^2 value (see Table 2). Given that these results did not meet the strict criteria for fit suggested by Hu and Bentler (1999), we concluded that the data did not provide an entirely satisfactory fit to the model.

Step 2: Local fit-testing and exploratory factor analysis. Given the extensive reconfigurations required in the pilot EFA, it was not a surprise that the model did not reach adequate GOF with the new sample. To address the third research question, local fit-testing was planned, a step recommended by Kline (2016) even when fit appears close by standard GOF statistics. The standardized pattern coefficient of each item, the variance explained (R^2) by the model for each item, and residual correlations between items were analyzed. The following local fit-testing decision rules applied to item reduction to improve fit of the measurement model: remove items with small path coefficients $\lambda_i < .50$, low variance explained by the model $R^2 < .50$, and residual correlations above .10 (Kline, 2016) with associated standardized residual z-scores above the .01 critical value, C. R. = 2.33. If large configuration restructuring seemed necessary, EFA would be conducted with the same sample to explore better structural configurations to test again in CFA. As in Study 1, this stage required multiple steps of examining individual item construction, reducing variables showing weak relatedness to common factors, testing model-fit in CFA, and choosing a final model to test empirically with the cross-validation sample.

After proceeding with fit examination, the *ideational self-efficacy* factor and items proved to be problematic (e.g., weak coefficients and residual correlations above .10) and were eliminated. Illustrated in Table 2, the four-factor model appeared to improve the fit. Upon local fit-testing inspection, one future-oriented item appeared problematic. The content of this item included aspects of fluency and flexibility with a variation on the phrasing from the other future-oriented items (i.e. "have different thoughts" compared to "have ideas"). After removing this one item, testing the model, and calculating a chi-square different statistic $(\chi^2_D(10) = 88.75 - 61.03 = 17.72)$, improved fit was marginally statistically significant at the .10 level in the χ^2 distribution; GOF for this model (χ^2 (38) = 65.25, $p < .05$, SRMR = .037, CFI = .98, and RMSEA = .045) met Hu and Bentler's strict criteria for close fit. Examining the residual correlations exposed two concerns between RIBS-C items 8 with 22 and 1 with 28. Given these combined results, this model was retained for cross-validation. The examination of remaining items refined the labels for latent factors.

Step 3: Cross-validation. To address the third research question, the revised models of each measure underwent a repeated CFA with cross-validation Samples 2 and 3.

Building from the five-factor model produced in Study 1, Step 2 confirmed four of the five factors that the data fit to closely producing the four-factor model. This new CFA aimed to cross-validate the four-factor model. GOF for the four-factor model met Hu and Bentler's strict criteria for close fit to the data from Sample 2 ($\chi^2(38) = 65.25$, $p < .05$, SRMR = .040, CFI = .96, and RMSEA = .048). Upon local fit examination, four residual correlations were found above the .10 threshold suggested by Kline (2016) and had a standardized *z*-score above the C.R. = 2.33 critical ratio—RIBS-C items 3 with 24, 19 with 24, 24 and 25, and 27 and 28.

Step 4: Measurement invariance testing. Measurement invariance between Samples 2 and 3 used the stepwise process recommended by Cheung and Rensvold (2002) and Kline (2016) in IBM Amos software (Arbuckle, 2006). Using sample 2 as the referent group, the $\Delta\chi^2$ was examined after adding invariance constraints to the model for sample 3. In response to research question 4, measurement invariance was tested to learn about the comparability and generalizability of the GOF statistics and model parameter estimates across the three samples. Sample 2 served as the calibration sample in a nested series of tests of increasing parameter constraints and Sample 3 served as the final cross-validation sample. The unconstrained four-factor model was applied to Sample 3 with all parameters freely estimated. As can be seen in Table 2, some indices for Sample 3 degraded slightly from the indices produced by Sample 2; yet, GOF still demonstrated that the model achieved a relatively close fit. To statistically test differences between distinct parameter components of the model, the following comparisons increased constraints in three separate steps: (1) constrained pattern coefficients (Λfixed), (2) factor variances and covariances (Λ, Φfixed), (3) item residual variance ($\Lambda, \Phi, \Theta_\delta$ fixed).

Given that the sample size of approximately 300 students per sample was not so large as to make every difference statistically significant, analysis relied on the change in chi-square statistic ($\Delta\chi^2$) to detect acceptable evidence of invariance (Kline, 2016). Statistically significant $\Delta\chi^2$ ($\Delta\chi^2 = [7] = 15.41$, $p = 3$) was found at the first step up the hierarchy of additional constraints from unconstrained to constrained pattern coefficients, assuming the unconstrained model to be correct. Fixed factor variances and covariances were statistically significant ($\Delta\chi^2[17] = 29.27$, $p = .03$) and the final step constraining item residual variance was not significant ($\Delta\chi^2$ [28] = 39.56, $p = .07$).

To examine the unique effect of pattern coefficients on the significant difference between samples, the parameter constraint of each item in independent steps was removed. When the pattern coefficient from the latent factor, *creative flexibility*, to item 8 was freed, the $\Delta\chi^2$ for this component was no longer statistically significant ($\Delta\chi^2$ [6] = 5.60, $p = .47$). This unconstrained parameter from Step 1 was retained and each factor variance and covariance parameter was freed to test model invariance between Samples 2 and 3. When the factor covariance between *creative flexibility* and *future-oriented fluency* ($\Delta\chi^2$ [15] = 21.65, $p = .12$) and *future-oriented fluency* and *fluency of literary ideas* ($\Delta\chi^2$ [15] = 24.22, $p = .06$) were freed to vary in independent steps, model invariance was not rejected. Additionally, when factor variance for *creative flexibility* ($\Delta\chi^2$ [15] = 16.20, $p = 37$) was free to vary, model invariance was not rejected. Given these results of local invariance testing of pattern coefficients and factor variances and covariances, partial measurement and structural invariance for the four-factor model of the reduced version of the RIBS-C was substantiated (Kline, 2016). Resulting pattern coefficients and factor covariances for the four-factor model are detailed in Figure 1.

Reliability and validity. To report reliability of each factor consistent with the factor analysis approach, the composite reliability or factor rho coefficient (Raykov, 2004) used Equation 1 (Kline, 2016). Composite reliability incorporates the sum of pattern coefficients for each factor ($\Sigma\lambda_i$), the factor variance(Φ), and the sum of residuals for each variable ($\Sigma\Theta_{\delta\ ii}$).

$$\rho = \frac{(\Sigma\lambda_i)^2\Phi}{(\Sigma\lambda_i)^2\Phi + \Sigma\Theta_{\mathrm{ii}}} \quad (1)$$

The composite reliability of each latent factor was calculated using parameters from Sample 3. The following results for the four RIBS-C factors indicate adequate-to-good reliability for all four factors: (a) *future-oriented fluency* (CR = .87), (b) *fluency of literary ideas* (CR = .65), (c) *inventive fluency* (CR = .80), and (d) *creative flexibility* (CR = .87). Table 3 details the structural coefficients showing evidence of discriminant validity among the variables and factors. Items from the factor of *inventive fluency* show the largest off-pattern coefficients on the factor *fluency of literary idea*, an expected result.

Student Engagement Instrument

The analyses for the SEI followed the same analytic rationale and steps detailed in the results for the RIBS-C.

Step 1. To address Research Question 1, CFA was conducted with the three-factor model established by EFA in the pilot study. This test resulted in GOF statistics showing poor fit to the data; SRMR = .074, CFI = .82, and RMSEA = .096 with a statistically significant χ^2 value detailed in Table 2.

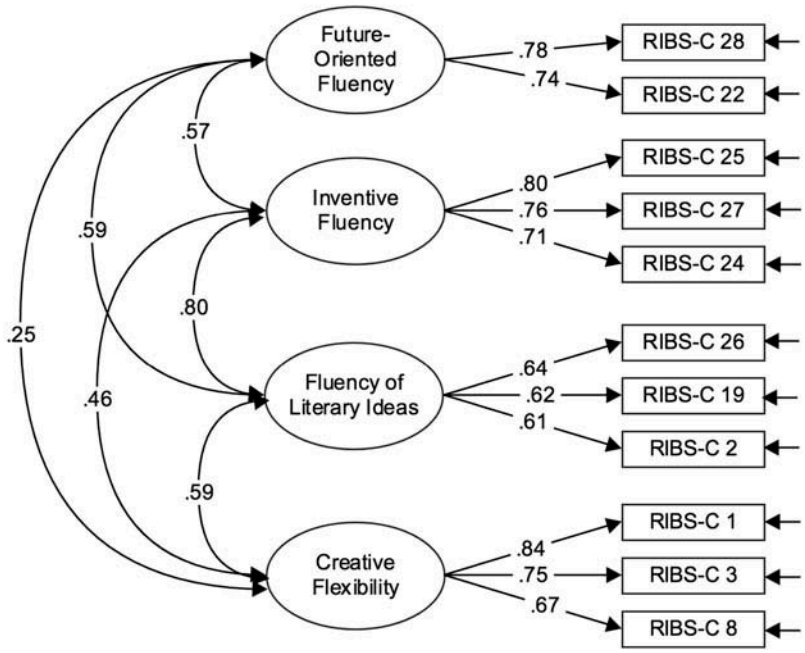

FIGURE 1. Standardized pattern/regression coefficients on latent constructs for four-factor model of RIBS-C. All coefficients were statistically significant at $p < .001$. Rectangle boxes represent the observed variables or items from the measure. Arrows pointing at boxes represent the residual variance of each item. The ovals represent the latent variables of groups of items sharing the most common variance. Curved lines represent correlations between latent variables. Arrows pointing from ovals to boxes identify the regression or pattern coefficients of each item on their latent variable.

TABLE 3.
Structure coefficients from CFA with sample 3 for four-factor model of the Runco Behavioral Ideational Behavior Scale for Children (RIBS-C)

	Structure Coefficients			
Item	*Future-oriented Fluency*	*Inventive Fluency*	*Fluency of literary ideas*	*Creative flexibility*
Ideas about future (RIBS-C22)	**.744**	.427	.439	.185
Ideas for 10 years from now (RIBS-C28)	**.799**	.447	.460	.194
Ideas about an invention (RIBS-C25)	.437	**.762**	.609	.347
Ideas for something to sell (RIBS-C27)	.456	**.795**	.636	.362
Ideas about a movie plot (RIBS-C24)	.407	**.710**	.567	.323
Ideas for a better book title (RIBS-C19)	.357	.484	**.606**	.355
Ideas for better book ending (RIBS-C2)	.368	.498	**.624**	.366
Ideas for stories, poems, art (RIBS-C26)	.375	.508	**.635**	.372
Think of several solutions (RIBS-C3)	.209	.383	.493	**.841**
Look at problem in different ways (RIBS-C8)	.165	.303	.390	**.665**
Take time to explore solutions (RIBS-C1)	.187	.343	.441	**.752**

Note. Structure coefficients are the implied standardized correlations between items and each factor as a result of the CFA. Item wording is abbreviated for most items. All structure coefficients significant ($p < .05$).

Step 2. Given the poor fit of the model to the data indicated by these results, EFA found the strongest pattern coefficients to four items to be from a factor other than that proposed by the original three-factor model, suggesting substantial reconfiguration of the factor labeled *school climate*. Based on these results, a new three-factor model was tested, labeling the factors (a) *relationships with peers*, (b) *relationships with teacher*, and (c) *educational aspiration and relevance*. Tests of this model retaining all 15 items found some evidence of closer but inadequate fit to the data based on recommended strict criteria (Hu & Bentler, 1999). Using the local fit-testing decision rules to examine individual items, SEI item 10 ("school rules are fair"), items 26 and 35 (accuracy and relevance of "grades" and "tests"), and item 28 ("I have a say about what happens to me at school") met the criteria for elimination from the factor for *relationships with teachers*. Moreover, these items did not substantively fit into the factor as well as the remaining

items. GOF statistics for this model reached strict criteria for close fit to the data, reported in Table 2.

Step 3. To test the comparability and generalizability of the revised three-factor model, Sample 2 was used for cross-validation; GOF statistics listed in Table 3 were quite comparable for the two samples. Upon local fit examination, three residual correlations were above the .10 threshold, suggested by Kline (2016) as a potential concern, and showed standardized *z*-scores above the CR = 2.33 critical ratio—SEI item 7 with 21, 13 with 19, and 14 with 27.

Step 4. In response to research question 4, the identical procedure detailed previously for the RIBS-C tested the assumption of measurement invariance across the three samples. As can be seen in Table 2, the GOF indices remained stable from Sample 2 to Sample 3 when all parameters were unconstrained, suggesting invariance and close fit to the data in both samples. In the first step to test invariance of each component of parameters, the difference between pattern coefficients for Sample 2 and 3 was not found to be statistically significant ($\Delta\chi^2$ [8] = 11.95, p = 15). In the next step up the hierarchy of additional constraints, differences in both the factor variances and covariances ($\Delta\chi^2$ [14] = 34.17, p = .002) and item residual variances ($\Delta\chi^2$ [25] = 47.43, p = .004) were statistically significant at the .05 level, assuming the unconstrained model to be correct. These results indicated measurement invariance in the pattern coefficients but measurement variance with parameters in the other two structural components.

All pattern coefficients were constrained and each factor variance and covariance parameter was freed to test model invariance between Samples 2 and 3. When the factor covariance between *relationships with students* and *relationships with teachers*, as well as the factor variance of *educational aspiration and relevance*, were freed to vary across the two samples, measurement variance was no longer significant ($\Delta\chi^2$ [12]= 19.88, p = .07). Retaining those unconstrained parameters from Step 2, we tested each item residual variance independently and did not find a single item residual variance that contributed uniquely to the significant difference between samples. Given these results of local invariance testing of factor variances and covariances and item residual variances, the three-factor model for the SEI met criteria for partial measurement and structural invariance (Kline, 2016).

Reliability and Validity

Equation 1 calculated the composite reliability of each latent factor using pattern/regression coefficients, factor variance, and unique item residual variance from Sample 3. Detailed in Figure 2, the following results for the three SEI factors indicated adequate-to-good reliability for all three factors: (a) *relationships with students* (CR = .75), (b) *relationships with teachers* (CR = .81), and (c) *educational aspiration and relevance* (CR = .84). Table 4 details the structural coefficients showing strong evidence of discriminant validity among the variables and factors.

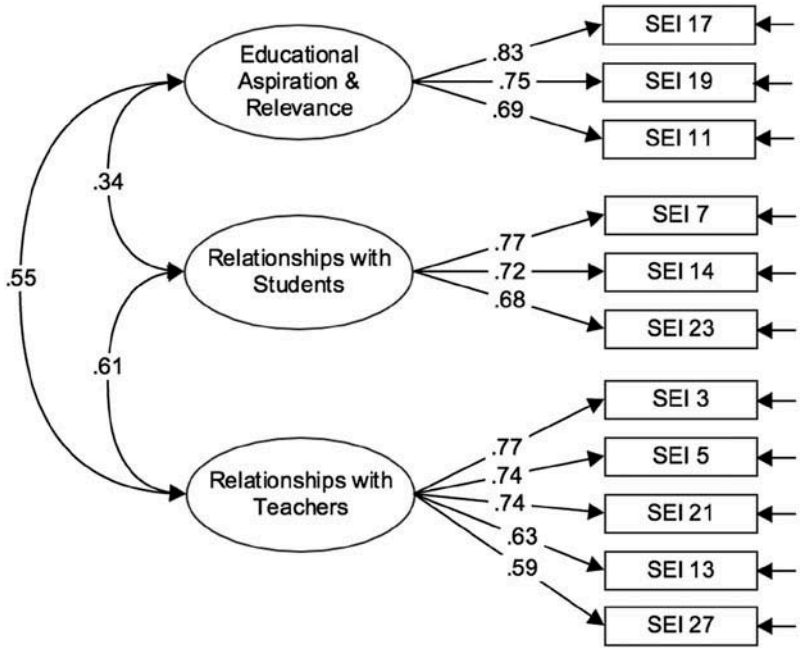

FIGURE 2. Standardized pattern/regression coefficients on latent constructs for three-factor model of SEI. All coefficients were statistically significant at p < .001. Rectangle boxes represent the observed variables or items from the measure. Arrows pointing at boxes represent the residual variance of each item. The ovals represent the latent variables of groups of items sharing the most common variance. Curved lines represent correlations between latent variables. Arrows pointing from ovals to boxes identify the regression or pattern coefficients of each item on their latent variable.

TABLE 4.
Structure coefficients from CFA with sample 3 for four-factor model of Student Engagement Instrument (SEI)

	Structure Coefficients		
Item	*Education Aspiration & Relevance*	*Relationships with Students*	*Relationships with Teachers*
I plan to continue my education following high school. (SEI17)	**.854**	.253	.476
School is important for me achieving my future goals (SEI19)	**.808**	.239	.450
Going to college after high school is important. (SEI11)	**.729**	.216	.406
Students at my school are there for me when I need them. (SEI7)	.234	**.790**	.403
I enjoy talking to students here. (SEI23)	.217	**.733**	.374
Students here respect what I have to say. (SEI14)	.203	**.686**	.350
My teachers are there for me when I need them. (SEI3)	.439	.402	**.788**
Adults at my school listen to the students. (SEI5)	.408	.373	**.731**
Overall, adults at my school treat students fairly. (SEI21)	.402	.368	**.721**
Most teachers at my school are interested in me as a person, not just as a student. (SEI13)	.327	.299	**.586**
I feel safe at school. (SEI27)	.309	.283	**.554**

Note. Structure coefficients are the implied standardized correlations between items and each factor as a result of the CFA. All structure coefficients significant ($p < .05$).

TABLE 5.
Correlations between latent factors from the RIBS-C and SEI in a fully-latent measurement model

Factors	*1*	*2*	*3*	*4*	*5*	*6*
1. RIBS-C Future-oriented Fluency	–					
2. RIBS-C Inventive fluency	.58**	–				
3. RIBS-C Fluency of literary ideas	.58**	.80**	–			
4. RIBS-C Creative flexibility	.26**	.46**	.58**	–		
5. SEI Educational aspiration & relevance	.13	.16*	.35**	.50**	–	
6. SEI Relationships with students	.20**	.18*	.15	.33**	.51**	–
7. SEI Relationships with teachers	.35**	.23**	.47**	.46**	.55**	.30**

Note. RIBS-C factors are from the Runco Ideational Behavior Scale for Children and SEI factors are from the Student Engagement Instrument. $N = 312$. *$p < .05$ **$p < .01$.

Discriminant Validity. In the fully-latent measurement model including all retained items and factors of the RIBS-C and SEI, correlations found in Table 5 between creativity and engagement factors ranged from small and nonsignificant to medium. Those results provide some evidence of discriminant validity between creativity and engagement factors and support the expectations that links would exist between creative ideation and relational support and educational relevance. Other than those found among fluency factors, some of the largest correlations were found between creative flexibility and the engagement factors. Notably, the smallest correlations were found between the engagement factors and inventive fluency—types of ideas mostly situated outside of school. Fluency of literary ideas demonstrated a high correlation with relationships with teachers. Though the issue of method variance may be at play in these interfactor correlations, these results provide some evidence of discriminant validity and empirical evidence of links across these two aspects of student development.

Discussion

The first important theoretical contribution of this study is the demonstration of distinct types of creative ideational behaviors in terms of both domain-specificity and distinguished properties of flexibility and fluency. In early adolescence, there appears to be tendencies toward creative fluency in one area over another. Items that captured whether or not students generated inventive ideas (e.g. "a good plot for a movie or TV show" or "about a new invention") shared distinct construct convergence, diverging from fluency items focused on ideas about ones' future and fluency of new ideas focused on the literary arts. Importantly, future-oriented fluency (i.e., frequency of ideas about one's future) did not relate to educational aspiration and relevance, which suggests that the connection between students' typical

educational experiences and what they envision for their future may be weak in early adolescence.

Notably, relational support from teachers showed a correlation twice as large for fluency of literary ideas as that of inventive fluency. This result may not be surprising in the likely event that inventive ideation does not find as receptive an audience with teachers in middle school as creative ideation with a literary or artistic focus. As a second contribution to theory, the findings that discriminate between fluency and flexibility in creative ideational behavior reinforce the cognitive perspective on creativity that distinguishes properties of these two dimensions. For the early adolescent sample, creative ideational flexibility demonstrated the strongest, most consistent relation across engagement factors of relational support from peers and teachers and educational aspiration and relevance. It is possible, then, that the development of creative flexibility may have an influence on these factors of school engagement that research indicates predict changes in students' social-emotional well-being and motivational orientation during adolescence (see Eccles & Roeser, 2011). Creative flexibility may be a highly salient aspect of creative behavior to early adolescent students. A causal relation needs further investigation, but the development of creative ideational flexibility may have several positive ramifications beyond creative potential alone.

GENERAL DISCUSSION

This research sought to establish internal consistency and construct validity for two measures in order to support the continued theoretical and empirical work on the development of creativity during adolescence. The intent was to reduce the number of items to ensure efficient, yet reliable measures. To enable future longitudinal research, this study aimed to ensure that the items selected from extant measures effectively targeted latent variables of interest. The results reported initial factor structures from a pilot study followed by a review of local fit of individual parameter estimates, variance, covariance, and residuals to determine the best model for the data. Finally, models refined further through cross-validation and calibration samples.

Several aspects of this study may limit our findings. MacCallum, Widaman, Zhang, and Hong (1999) recommended that the ratio of sample size to number of variables, low communality among variables, or the ratio of number of variables to the number of factors (e.g., overdetermination) may cause poor model fit. Given that the pilot samples for the two measures was $n < 200$ and the number of variables in each scale was greater than 30, to be retained in an acceptable model, items required strong communality with a latent factor. For instance, the sample-to-indicator ratio applied to the EFA with our pilot sample was about 6:1 for the RIBS-C and 8:1 for the SEI; however, the ratio was much larger (20:1) for the final analyses with samples used for cross-validation of reduced measures. Though small samples may have contributed to the poor fit of models in the pilot study EFAs and may limit our conclusions about the scales more broadly, this limitation may also have been an advantage to help reduce the number of weaker items and, therefore, reduce the testing burden on students. Still, some good items may have been lost. Other potentially confounding variables inherent in the design of the study, include (a) differential order effects due to reduction of items, (b) effects of administering the assessment to 6th grade students in the spring (pilot) versus the fall (cross-validation), and (c) differential measurement error across samples that can result with self-report items and a diverse student sample (e.g., wide range of reading levels and interpretability of items).

Implications for Practice

For the development of ideational behaviors to become embedded in student learning, the dimensions of flexibility and fluency each require unique strategies. These learning behaviors and related pedagogical strategies may be highly interrelated to the dimensions of relevance, aspiration, and relational support, especially for students managing the sociolinguistic, racial-ethnic, or socioeconomic marginality in environments dominated by middle-class norms (Garcia-Reid, Reid, & Peterson, 2005). For instance, Glăveanu and Beghetto (2017) urged a seismic shift from a paradigm that privileges sameness in pedagogy and curriculum to one that recognizes, values, and acts on difference in perspectives and orientations. This new approach would require creative flexibility for both teachers and students. Teachers implicitly and explicitly establish the norms and behaviors of the audience of peers that reciprocate student expression on a daily basis. If diversity of perspectives and possibilities is not valued, the resulting *sameness* of ideas may stunt the development of creative flexibility, especially for those holding perspectives that are traditionally marginalized in public education. Not surprisingly, Dai, Tan, Marathe, Valcheva, Pruzek, & Shen (2012) found that 8th grade students in schools with more diverse socio-economic make-up demonstrated lower levels of creative potential. These results may be much less a result of student ability and potential and more a result of a pedagogy of sameness that represents common school-based norms that reflect White middle-class cultures. In sum, if students feel less relational support from teachers and less secure among peers, the typical *sameness* of classroom discourse, curriculum, and outcomes may develop ideational inflexibility, inadvertently.

Future Directions

Future research should consider various theoretical perspectives to test for convergent validity of the RIBS-C

and SEI (e.g., divergent thinking, creative self-efficacy, and support for creativity) as well as discriminant validity (e.g., conformity, failure avoidance, and anxiety). Though CFA differs from exploratory factor analysis, it is no less exploratory by nature and requires methodical and theoretical inspection to be cognizant of revealed limitations and insights. As many other researchers have experienced, our CFA required both large and small adjustments to converge on a model with close fit to the data that replicated over multiple samples. We found the process of describing newly revised latent constructs of extant measures to be an important part of the model-building and hypothesis-testing phase. Our study hints at the layers of assumptions researchers bring to the practice of measuring complex and contextually situated constructs, especially among diverse populations.

The resulting latent factors of relational support targeted the basic level needed for social-emotional well-being in school. Indeed, those factors may capture some of the bridge in Beghetto's (2016) model between the intrapsychological and interpsychological stages of creative learning. Developmental models should be analyzed to learn more about the moderating role of relational support and relevance in the development of creative ideational behaviors during adolescence. Moreover, continued development of items that test additional domains (e.g., sports, science, or music) and contexts (e.g., home, the outdoors, or school) could be important to capture the diversity of students' creative ideational activity. The current *creative flexibility* factor targets a domain-general flexibility but within the context of problems needing a solution. This generality may be advantageous to allow students to make meaning of the context, but it also may miss the opportunity to distinguish between different types of challenges (e.g., social, mathematical, or artistic). Developing items to test a model of context- and domain-specific creative ideational flexibility would fill this gap.

The procedures and results reported in this study provide insights that may support further theoretical developments in the field of creativity, especially as it relates to the sociocultural influences of school during adolescence for marginalized populations. For factors of creative ideation and student engagement to support improved teaching and learning in middle schools, theoretically, psychometrically, and practically sound measurement is needed. This study brings the field one step closer.

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