The Development of Creativity in Upper Elementary School Students: Gender Differences and the Role of School Support

Authors: Zhang Jinghuan, Zhang Jinghuan

Date: 2020-07-10T00:00:00+00:00

Abstract

Creativity is regarded as a core competency for adolescents to excel in a rapidly changing environment. Developmental psychologists have devoted tremendous efforts to studying the development of creativity, yet no consensus has been reached. Researchers have identified numerous factors influencing creativity development, including individual differences (e.g., gender differences) and school environments during growth. Moreover, these studies have not meticulously characterized the developmental trajectory of creativity from both initial level and growth rate perspectives. Integrating these potential factors influencing creativity development and addressing the limitations of existing research, the present study designed a longitudinal investigation to examine the developmental trajectory of creativity among upper elementary school students, analyze at the between-person level how gender and school support (including teacher support and peer support) influence this trajectory, and investigate at the within-person level whether changes in school support lead to changes in creativity development.

Two hundred and three fourth-grade students from three elementary schools (109 boys and 94 girls, mean age = 10.43 years, SD = 0.62 years, at the first testing phase, T1) participated in a three-year longitudinal study and were assessed three times (T1, T2, T3). The Runco Creativity Assessment Battery (Figural Divergent Thinking Test from rCAB) and the Perceived School Climate Scale were used to measure creativity and school support, respectively. The research project was reviewed and approved by the Ethics Committee of Shandong Normal University, and informed consent was obtained from participants' parents. This study used SPSS 22.0 and HLM 6.08 software to manage and analyze data, conducting a series of statistical analyses including descriptive statistics, correlation analysis, and multilevel linear analysis to explore the

developmental trajectory of creativity and the potential relationship between school support and creativity development.

The research findings are as follows: (1) Creativity fluency among upper elementary school students from grades 4 to 6 exhibited a linear growth trend, whereas creativity flexibility and originality showed nonlinear growth trends. Additionally, the initial level of creativity was positively correlated with its growth rate. (2) Individual differences existed in the initial levels of fluency, flexibility, and originality, as well as in the growth rates of fluency and originality. (3) The initial levels of flexibility and originality were significantly higher among upper elementary school girls than among boys. (4) At the between-person level, the interaction between teacher support and gender significantly predicted the initial level of flexibility; teacher support significantly and positively predicted the initial level of fluency and the growth rate of originality. (5) At the within-person level, changes in teacher support significantly and positively predicted the development of fluency.

This study represents the first longitudinal research in the domestic creativity field in recent years. The findings contribute to deepening the understanding of developmental patterns of creativity in elementary school students and offer practical guidance for fostering creativity among upper elementary school students.

Full Text

The Development of Creativity in Upper Elementary School Students: Gender Differences and the Role of School Support

ZHANG Jinghuan[1]; FU Mengmeng[1]; SHA Sha[2]; XIN Yuwen[1]; CHEN Peipei[1]

([1] School of Psychology, Shandong Normal University, Jinan 250014, China)
([2] Army Command College, Nanjing 210032, China)

Abstract

This study conducted a three-year longitudinal assessment of 203 fourth-grade students (through sixth grade) and employed multilevel analysis to examine developmental trends in creativity, gender differences, and the impact of teacher and peer support on creative development. Results indicated: (1) Fluency among fourth- through sixth-grade students showed a linear growth trajectory, while flexibility and originality exhibited nonlinear growth patterns, with positive correlations between initial levels and growth rates. (2) Girls demonstrated higher initial levels of flexibility and originality than boys. (3) Teacher support positively predicted boys' initial flexibility levels, as well as fluency' s initial level and originality' s growth rate. (4) The development of teacher support positively predicted the development of fluency.

Keywords: creativity; school support; gender difference; longitudinal study; upper elementary school students

Introduction

Creativity represents the product of interaction among ability, process, and environment, defined as the capacity to produce novel and appropriate products accepted by specific sociocultural contexts (Plucker, Beghetto, & Dow, 2004). Creativity plays a vital role in individual adaptation and future development, regarded as a core competency for adolescents to thrive in a rapidly changing world (Florida, 2002). To effectively cultivate creativity in upper elementary students, we must first understand the fundamental developmental trends, influencing factors, and underlying mechanisms of creativity during this period, particularly within contemporary Chinese cultural contexts. This constitutes the first research question addressed in this paper. Gender differences in creativity development represent a fundamental issue, yet previous research has yielded inconsistent conclusions regarding gender effects on creativity. Building upon the first question, this study examines whether developmental trends in creativity among upper elementary students exhibit gender differences—our second research question.

Creativity is a highly complex ability characterized by its close relationship with environmental context (Maker, Jo, & Muammar, 2008). For elementary students, both family and school environments constitute important life contexts. While numerous studies have investigated family environment influences on creativity development (Li, Wang, & Shi, 2004; Ren, Li, & Zhang, 2017; Shan, Gao, Li, Xu, & Li, 2019), research on school environmental impacts remains insufficient. The elementary years represent a critical transition from family-centered to school-centered life, with practical innovation ability identified as a core competency in the new era. Social support represents a key factor affecting creativity development (Amabile, 1996). Supportive school environments derive from two primary sources: teachers and peers (Day, Fish, Grossman, & Russell, 2020; Guo, Li, Wang, Ma, & Ma, 2020). How do teacher support and peer support influence creativity development in upper elementary students? This constitutes our third research question.

Given creativity' s significance in child development, researchers have published extensive studies on developmental trends and influencing mechanisms (Camp, 1994; Charles & Runco, 2001; Cheung, Lau, Chan, & Wu, 2004; Hu, Wan, & Yu, 2011; Wo, Wang, Liu, & Lin, 2009). However, most existing research has employed cross-sectional designs or short-term longitudinal studies, focusing primarily on between-individual relationships. No studies have simultaneously examined school support' s predictive effects on creativity at both between-individual and within-individual levels. Between-individual effects reveal how school support predicts creativity at the individual differences level,

while within-individual effects examine covariation between changes in school support and creativity development within individuals. This study adopts a longitudinal design and multilevel analysis to investigate creativity development trends in upper elementary students and whether school support can predict and explain individual differences in creativity development at both between-individual and within-individual levels.

1.1 Developmental Trends in Creativity

Torrance (1968) conducted the earliest longitudinal study on creativity development in elementary students, identifying a "fourth-grade slump" phenomenon. Torrance speculated that children' s need to conform to classroom expectations during their initial school years contributed to this slump. This finding generated substantial research interest, yet conclusions regarding peak and trough periods in creativity development remain inconsistent. Smith and Carlsson (1990) conducted cross-sectional studies showing creativity declining from second to third grade, reaching its nadir, then peaking from fifth to sixth grade, leading them to infer that genuine creativity development begins between fifth and sixth grade. Camp (1994) found in a longitudinal study of grades 1-12 that creativity increased from grades 4-6, decreased from grades 6-9, then rose again through grade 12. Conversely, some studies found originality declining from grades 4-6 while idea elaboration increased from grades 6-9 (Claxton, Pannells, & Rhoads, 2005). Charles and Runco (2001) discovered that fluency peaked in fourth grade, significantly higher than in third or fifth grades. Maker et al. (2008) found creativity increasing from kindergarten through sixth grade without significant fluctuations.

Within Chinese cultural contexts, researchers have also accumulated findings. Cheung et al. (2004) found creativity continuously increasing from grades 4-6 among Hong Kong students. Li et al. (2004) reported that fluency and flexibility in practical creativity showed growth trends from grades 4-6. Wo et al. (2009) found overall creativity increasing from grades 4-6. Hu et al. (2011), using a self-developed technological creativity test, identified a peak in fifth grade and a trough in sixth grade. However, these studies employed cross-sectional designs, with no large-scale longitudinal reports available.

Inconsistencies in existing research reflect both the complexity of individual creativity development and methodological limitations. First, most studies used cross-sectional designs, which, despite providing general developmental information, cannot reveal true developmental patterns due to cohort effects. Second, existing longitudinal studies employed small sample sizes—for example, 25 participants in Claxton et al. (2005) and 33 in Camp (1994)—resulting in unstable findings (Lau & Cheung, 2010). Moreover, previous research was primarily conducted in Western cultural contexts, with Chinese-based studies mostly cross-sectional. This study employs longitudinal design to accurately capture creativity development trends among Chinese upper elementary students within their specific cultural context. Finally, previous findings represent general trends

for sample populations, lacking detailed examination of both initial levels and growth rates in creativity development and their influencing factors.

Addressing these limitations, this study utilizes longitudinal design and multilevel analysis to investigate creativity development trends from both initial level and growth rate perspectives.

1.2 Gender Differences in Creativity Development Trends

Regarding gender differences in creativity, early Chinese research by Zheng and Xiao (1983) found middle school boys significantly outperformed girls in creative thinking flexibility. Shi et al. (1999) found no significant gender differences in numerical, figural, and practical creative thinking among Chinese and German elementary students. Wo et al. (2009), using a self-developed adolescent creative thinking test, found girls significantly outperformed boys in divergent thinking fluency and flexibility. Hu et al. (2011) found no significant overall gender differences in technological creativity among 9-15-year-old students.

In summary, existing research has primarily focused on gender differences in creativity developmental levels rather than growth rates, though differential cognitive development speeds represent an important aspect of gender differences (McArdle, Grimm, Hamagami, Bowles, & Meredith, 2009). Therefore, this study employs longitudinal design to examine whether gender differences exist in both initial levels and growth rates of creativity among upper elementary students.

1.3 The Relationship Between School Support and Creativity

According to creativity component theory, supportive environments constitute important variables for creativity development (Amabile, 1996). School support represents a crucial social support source beyond family support. Upon entering school life, teachers and peers become significant others, making school support derive from both teacher and peer sources (Day et al., 2020; Guo et al., 2020). Empirical creativity research demonstrates that teacher support and peer support significantly influence student creativity development. For instance, Torrance and Myers (1970) found that when teachers foster respectful, relaxed, and open classroom climates, students' creative idea expression is enhanced. Ma (2009) meta-analyzed school variables affecting creativity, finding that teacher encouragement of creative and reflective thinking promoted creativity development. Choi (2004) confirmed in a three-month longitudinal study that teacher support positively predicted student creativity. Han, Hu, and Jia (2013) analyzed group structure effects on elementary students' creative problem posing, finding that peer-interactive learning methods—that is, supportive peer relationships—better promoted creative question generation. While these studies separately confirmed teacher and peer support effects, none examined their interactive impact on creativity.

More importantly, these studies examined between-individual effects of school

support on creativity, yielding results that mixed between- and within-individual effects (Galla et al., 2014). Therefore, it is necessary to examine interactive effects at both between-individual and within-individual levels separately. Additionally, previous research predominantly used cross-sectional designs, focusing on how environmental factors affect creativity developmental levels rather than examining individual differences in creativity growth rates and their causes. Creativity is dynamic, and environmental influences permeate its entire developmental process, affecting not only specific time points but also the overall developmental "speed." Therefore, longitudinal design is necessary to examine environment-creativity relationships from a developmental perspective.

In summary, this three-year longitudinal study investigates creativity development trends among upper elementary students (grades 4-6), examining at the between-individual level how gender and school (teacher/peer) support affect creativity initial levels and growth rates, and at the within-individual level whether school (teacher/peer) support covaries with creativity.

Method

2.1 Participants

Using cluster random sampling, 203 fourth-grade students were selected from three ordinary elementary schools in a city for three annual assessments (T1, T2, T3). At initial testing, participants' mean age was 10.43 years (SD = 0.62), including 109 boys and 94 girls. Maternal education: 39.9% bachelor' s degree or above, 48.8% below bachelor' s but above high school (including high school graduates), and 11.3% below high school. Paternal education: 48.7% bachelor' s degree or above, 41.9% below bachelor' s but above high school, and 9.4% below high school.

Longitudinal studies often encounter missing data. In this study, some participants were lost due to school transfers or absences. Two hundred three participants completed T1, 198 completed T2 (5 lost), and 178 completed T3 (20 lost). Chi-square and t-tests revealed no significant differences between attrition and complete-case participants in gender ($^{2}(1) = 0.46$, $p = 0.500$) or T1 measures of fluency, flexibility, originality, teacher support, and peer support (ts < 1.73, ps > 0.05), indicating no systematic attrition.

2.2 Measures

2.2.1 Creativity Assessment This study used the figural tasks from Runco and colleagues' creativity assessment battery (rCAB) to measure creativity in upper elementary students. In these tasks, participants are presented with simple line drawings and asked to list all possible objects the drawings could represent within four minutes. The battery includes three sets of figural tasks, each containing three drawings. Different sets were used at each testing occasion to avoid practice effects. The instrument demonstrates good reliability and

validity in previous research (Ren et al., 2017; Runco et al., 2011). Following the Creativity Testing Service guidelines, all tasks were scored on three dimensions: fluency, flexibility, and originality. Fluency refers to the number of ideas generated; flexibility indicates the number of categories represented, reflecting mental set-breaking; originality scores ideas based on novelty, assigning 1 point to ideas generated by $ \$5\% $ of participants and 0 otherwise.

The scoring procedure is illustrated using one task. First, an Excel file was created for each drawing task, with raters entering each participant' s ID and all generated ideas. Raters then reviewed and eliminated inappropriate responses. Finally, two raters classified and evaluated all ideas through multiple rounds of review and discussion to determine category counts, category assignments for each idea, and counts of original ideas. For example, responses to a "spiral line" drawing were classified into 10 categories (daily life, entertainment, architecture, animals/plants, etc.). If a participant listed 10 ideas across 3 categories, with 4 ideas generated by $ \$5\% $ of participants, their fluency, flexibility, and originality scores would be 10, 3, and 4, respectively. The creativity measure was administered three times at one-year intervals with consistent procedures. Inter-rater reliability ≥ 0.95. Internal consistency reliabilities were: fluency = 0.75, 0.78, 0.77; flexibility = 0.69, 0.71, 0.70; originality = 0.64, 0.62, 0.63.

2.2.2 School Support Teacher and peer support were measured using items from Jia et al.' s (2009) adapted Perceived School Climate questionnaire, which demonstrates good reliability and validity (Jia et al., 2009). Teacher support (7 items) assessed teachers' emotional and academic support (e.g., "My teachers care about me"). Peer support (13 items) measured emotional support among peers (e.g., "Students are friendly to each other"). Both used 4-point scales (1 = never to 4 = always). Both measures were administered three times at one-year intervals. Internal consistency reliabilities were: teacher support = 0.83, 0.89, 0.90; peer support = 0.89, 0.90, 0.92.

2.2.3 Family Socioeconomic Status (SES) Family SES was computed from parental occupation and education. Occupations were categorized into 16 types and scored based on professional/technical level: "farmer" and "unemployed" = 1; "worker" and "self-employed" = 2; "salesperson," "driver," and "other" = 3; "doctor," "teacher/researcher," "accountant," and "military" = 4; "lawyer," "engineer," "manager," "civil servant," and "private business owner" = 5. Parental education included six categories from "elementary school or below" to "graduate degree," scored 1-6. Following Fan et al. (2012), parental occupation and education were converted to z-scores due to different ranges, then subjected to principal component analysis. SES was computed as: SES = (β_1 × Z_{father}*{occupation}* + β_2 × *Z*{mother}*{occupation}* + β_3 × *Z*{father}*{education}* + β_4 × *Z*{mother}_{education}) / _f, where β_1-β_4 are factor loadings and _f is the first factor' s eigenvalue. Higher scores indicate higher SES.

2.3 Procedure

After obtaining informed consent from school administrators and parents, group testing was conducted by class, with two trained examiners (psychology graduate students) per class. Training covered instructions, questionnaire content, examiner responsibilities, and precautions.

2.4 Data Analysis Strategy

Data from 203 valid questionnaires were coded and entered into a database for analysis using SPSS 22.0 and HLM 6.08. First, descriptive statistics and Pearson correlations examined relationships among creativity, teacher support, and peer support across three time points. Second, HLM 6.08 built unconditional models to assess creativity developmental trends. Gender (a time-invariant factor) was then added to examine gender differences. Third, school support (a time-varying factor) was added to examine its predictive effects on creativity trends.

Missing data in longitudinal studies were addressed using Little' s MCAR test (Little, 1988), which indicated completely random missingness, $^{2}(15) = 15.49$, $p = 0.417$. Subsequent multilevel analyses allowed for missing data using Restricted Maximum Likelihood (REML) estimation.

Results

3.1 Descriptive Statistics and Correlation Analysis

Table 1 presents means, standard deviations, and correlations for all variables.

Pearson correlations revealed significant positive correlations among fluency, flexibility, and originality at each time point (r = 0.73-0.81 at T1, 0.74-0.82 at T2, 0.55-0.91 at T3, all ps < 0.01), indicating shared creativity components. Moderate stability was observed across time points for each dimension: fluency (r = 0.46-0.59), flexibility (r = 0.38-0.45), originality (r = 0.37-0.46). Teacher support showed significant positive correlations across time points (r = 0.30-0.54) and with creativity measures at various time points (r = 0.14-0.30). Peer support also demonstrated significant cross-time correlations (r = 0.39-0.62) and associations with creativity (r = 0.15-0.25). Gender correlated negatively with T2 fluency, flexibility, originality, and T1/T2 peer support (r = -0.20 to -0.15), indicating girls scored higher.

3.2 Longitudinal Measurement Equivalence

Measurement equivalence was tested for the school support latent variable to ensure comparability across time. For variables with more than three items, item parceling reduced items to three (Lucia, Tomotaka, & Petr, 2017). Confirmatory factor analysis (CFA) in Mplus (version 7) examined measurement equivalence of teacher and peer support across three time points. Weak invariance tests (Table 2) showed ΔCFI < 0.01 and non-significant chi-square differences (ps > 0.05),

supporting factor loading equivalence (Liang, Yang, & Yao, 2019). Following Bai and Chen (2004), the school support scale demonstrated adequate measurement equivalence across time points.

3.3 HLM Null Model Analysis

Null models were established to calculate intraclass correlation coefficients (ICC) before HLM analysis, indicating the proportion of total variance attributable to between-individual differences. Results (Table 3) showed that 50%, 29%, and 22% of variance in fluency, flexibility, and originality, respectively, resulted from between-individual differences, justifying multilevel analysis (Zhang, Lei, & Guo, 2003).

3.4 Creativity Development Trends

Unconditional models tested whether creativity trajectories were linear or nonlinear. Following multilevel principles (Zhang et al., 2003), time was coded as a Level-1 predictor (0, 1, 2 for T1-T3). Model 1 (unconditional linear growth) and Model 2 (unconditional quadratic nonlinear growth) were compared (Table 3).

Fixed effects (Table 3) showed fluency' s linear intercept and slope were significant (11.15 and 1.12, ps < 0.001), while the quadratic term was non-significant ($\beta_{20} = 0.35$, p $= 0.256$), indicating linear rather than nonlinear growth. Fluency showed significant linear increase across three time points. Flexibility and originality showed significant linear slopes (0.42 and 1.58, ps < 0.001) and significant quadratic terms (0.92 and 1.38, ps < 0.001). Model comparisons revealed the quadratic models fit significantly better than linear models for flexibility and originality (^{2} differences = 85.02 and 106.55, df = 3, ps < 0.001). Therefore, quadratic growth models were adopted: flexibility, y = $0.92x^2$ - 1.4x + 5.1; originality, y = $1.38x^2$ - 1.13x + 3.68. Figure 1 [Figure 1: see original paper] shows both dimensions initially declined, then accelerated after inflection points. First derivatives identified inflection points at 0.76 for flexibility and 0.41 for originality, indicating lowest points between fourth and fifth grades, followed by accelerating growth, with originality accelerating earlier than flexibility. Correlations between intercepts and slopes (Tau) were 0.34 for fluency, 0.57 for flexibility, and 0.25 for originality, indicating that students with higher initial creativity levels also showed faster growth.

Random effects showed significant between-individual variance in intercepts and growth parameters (ps < 0.001), suggesting other variables influence creativity development. Subsequent analyses examined gender and school support effects. Non-significant random effects for flexibility's linear slope and originality's linear slope (ps > 0.05) led to excluding these parameters from between-individual analyses (Zhang et al., 2003). Within-individual residual variances were 11.83, 0.99, and 2.89 for fluency, flexibility, and originality, respectively.

3.5 Gender Differences in Creativity Development Trends

Conditional models examined gender differences, controlling for SES and school effects (two dummy variables for three schools). Since flexibility and originality scores can be contaminated by fluency, fluency was controlled in these models (Reiter-Palmon, Forthmann, & Barbot, 2019; Runco et al., 2011). Gender was dummy-coded (0 = girls, 1 = boys). Model 3 results (Table 4) showed no significant gender differences in fluency intercept or slope or originality quadratic slope (ps $>$ 0.05). However, significant gender differences emerged for flexibility initial level (β_{01} = -0.34, SE = 0.15, p = 0.028) and originality initial level (β_{01} = -0.62, SE = 0.29, p = 0.035), with girls scoring higher than boys.

3.6 Predictive Effects of School Support on Creativity

Full models (Model 6) examined teacher and peer support effects. Level-1 modeled within-individual changes in predictors and outcomes across three time points, with time-varying predictors group-mean centered. Level-2 examined between-individual effects, using intercepts and slopes from Level-1 as outcomes and time-invariant predictors grand-mean centered. Results appear in Table 4.

3.6.1 Between-Individual and Within-Individual Effects Between-individual level: Model 4 showed teacher support significantly predicted fluency intercept (β_{05} = 1.82, SE = 0.67, p = 0.008) but not slope (β_{15} = 0.25, SE = 0.46, p = 0.591), explaining 4.5% of intercept variance. Model 5 showed teacher support remained significant for fluency intercept (β_{05} = 1.81, SE = 0.91, p = 0.047) when controlling for peer support, while peer support showed no significant effects (ps $>$ 0.05). Model 6 showed no significant interaction effects (ps $>$ 0.05).

For flexibility, teacher support significantly predicted intercept (β_{05} = 0.59, SE = 0.16, p $<$ 0.001), explaining 8.2% of variance. This effect remained significant when controlling for peer support (β_{05} = 0.68, SE = 0.19, p = 0.001). Peer support and interaction terms showed no significant effects (ps $>$ 0.05).

For originality, teacher support did not predict intercept (β_{05} = 0.52, SE = 0.32, p = 0.103) but significantly predicted quadratic slope (β_{25} = 0.24, SE = 0.11, p = 0.027), explaining 3.2% of variance. This effect persisted when controlling for peer support (β_{25} = 0.29, SE = 0.13, p = 0.021). Peer support showed no significant effects (ps $>$ 0.05), nor did interaction terms (ps $>$ 0.05).

Within-individual level: Model 5 showed teacher support development significantly predicted fluency development (β_{40} = 0.91, SE = 0.43, p = 0.036), explaining 0.8% of variance, while peer support did not (β_{50} = -0.83, SE = 0.50, p = 0.099). Neither support predicted flexibility (β_{40} = 0.18, p = 0.096; β_{50} = 0.04, p = 0.777) or originality development (β_{40} = 0.24, p = 0.203; β_{50} = 0.11, p = 0.594). Model 6 showed no significant interaction effects on any dimension (ps $>$ 0.05).

3.6.2 Supplementary Analysis Since teacher support predicted flexibility initial level and gender differences existed in flexibility initial level, we tested whether gender moderated the teacher support-flexibility relationship. Adding the interaction term to Model 5 for flexibility revealed a significant interaction ($\beta = 0.38$, SE = 0.14, p = 0.008). Follow-up analyses showed teacher support significantly predicted flexibility initial level among boys ($\beta = 1.10$, SE = 0.23, $p < 0.001$) but not girls ($\beta = 0.08$, SE = 0.31, p = 0.786).

Discussion

This study examined developmental trends, school support effects, and gender differences in upper elementary students' creativity across fluency, flexibility, and originality dimensions. Findings revealed: (1) fluency showed linear growth while flexibility and originality showed nonlinear growth, with positive correlations between initial levels and growth rates; (2) teacher support predicted creativity at both between-individual and within-individual levels; (3) gender differences emerged in initial creativity levels and in how teacher support predicted creativity. We discuss these findings in three areas.

4.1 Developmental Trends in Upper Elementary Students' Creativity

This study characterized creativity development through both growth rates and initial level-growth rate relationships, finding significant growth across all three dimensions from grades 4-6. This aligns with Li et al. (2004), Maker et al. (2008), and other studies (Camp, 1994; Cheung et al., 2004; Wo et al., 2009). We further specified that fluency grew linearly while flexibility and originality followed nonlinear (quadratic) trajectories. This growth can be attributed to three factors: First, adequate knowledge bases are necessary for creativity (Amabile, 1996). As children advance, accumulated knowledge and experience facilitate creative performance. Second, elementary years mark the transition from concrete to abstract logical thinking, enabling better internalization of prior knowledge and enriching ideation (Zhu & Lin, 2002). Third, abstract thinking is closely linked to language, requiring advanced verbal abilities for clear expression (Xu, 1994). Though our task was figural, verbal responses were required, and improved verbal skills facilitate creative idea expression.

Flexibility and originality differed from fluency, showing temporary declines between fourth and fifth grades before accelerating—consistent with Torrance' s "fourth-grade slump." Our study clarifies that flexibility and originality, not fluency, exhibit this slump. Some studies failing to find this pattern may have used total creativity scores where fluency dominated, creating confounding effects (Reiter-Palmon et al., 2019; Runco et al., 2011).

The positive correlation between initial level and growth rate suggests students with higher initial creativity also develop faster. This may reflect both intrinsic factors—genetic characteristics and brain development differences in creativity-related regions (Zhang & Zhang, 2020; Nęcka, 2011)—and extrinsic factors,

where high-creativity children receive more environmental encouragement, and supportive environments accelerate their development. Genetic characteristics may also make some children more susceptible to positive environmental influences (Zhang, Han, Si, & Zhang, 2018).

4.2 The Role of School Support in Creativity Development

This study found strong associations between teacher support and positive creativity development. Teacher support predicted fluency' s initial level and within-individual development, and crucially, predicted originality' s growth rate—creativity' s core variable (Runco, 2010). This indicates teacher support is a primary facilitator of creativity development in upper elementary students. This may occur because elementary students are adult-oriented, operating at an authority-oriented stage of moral development where they actively seek adult (teacher) support and approval (Chen, 2008), making them highly sensitive to teacher support. Self-Determination Theory posits three basic psychological needs: competence, relatedness, and autonomy (Deci & Ryan, 2000). As school is the primary learning context and teachers are its leaders, teacher support fulfills relatedness needs, fostering competence and autonomy. Research shows teacher support promotes exploratory behavior (Liu & Zhang, 2005), generates positive emotional experiences and self-evaluations (Shi, Wang, Xu, & Liu, 2016), and stimulates idea generation. Positive emotions, self-affirmation, and emotional support facilitate innovation (Man, Li, & Zhang, 2015) and original thinking expression (Zhang, Liu, Ren, Sun, & Yu, 2016). These results reaffirm that supportive school environments, particularly teacher support in upper elementary grades, are crucial for creativity development.

4.3 Gender Differences in Creativity Development and Influencing Factors

Girls showed significantly higher initial levels in flexibility and originality, possibly due to faster language development in elementary girls. Research indicates girls have advantages in verbal ability, emotional sensitivity, and interpersonal communication, with earlier psychological development than boys (Shen, Liu, Shi, & Yuan, 2015), extending to creativity development.

Importantly, while boys generally showed lower flexibility than girls, teacher support positively predicted boys' flexibility, suggesting boys are more environmentally sensitive than girls. Previous family environment research found maternal warmth positively predicted boys' creative thinking (Shan et al., 2019). Our findings similarly show teacher support significantly predicts boys' flexibility initial level, indicating boys' greater sensitivity to environmental factors and that targeted teacher support can compensate for boys' flexibility deficits.

4.4 Implications, Limitations, and Future Directions

This study represents the first longitudinal investigation of creativity development among mainland Chinese upper elementary students in recent years, analyzing initial levels, growth rates, and school support effects at both between- and within-individual levels. Findings reflect creativity development characteristics among post-2000 birth cohorts in contemporary Chinese educational and cultural contexts. The identification of generally increasing creativity with distinct patterns for different dimensions, individual differences in initial levels and growth rates, and teacher support's positive prediction of originality growth rate suggests deeper individual difference factors beyond environment—possibly genetic, early environmental, or gene-environment interactions warranting future research.

Our three-year design identified a slump between grades 4-5, but could not pinpoint exact timing. Future research should add assessments between these grades to precisely characterize developmental trajectories, guiding future study design. The finding that teacher support is the primary predictor suggests upper elementary creativity education should emphasize teacher support and guidance, particularly for boys' flexibility development, offering practical implications.

Limitations include: First, using divergent thinking tasks, though considered optimal for measuring creative potential (Acar & Runco, 2019) and widely used as a standard paradigm (Dietrich, 2018), captures only one aspect of the complex creativity phenomenon. Future research should combine multiple measures. Second, while we focused on school support as a primary environmental influence, the modest variance explained suggests other factors (genetic, family) are important. Future studies should integrate multiple influences. Third, our variable-centered approach examined general developmental trends. Despite within-individual analyses, future research could employ person-centered approaches to examine heterogeneous developmental trajectories and influencing factors for different subgroups.

Conclusion

1. Fluency showed linear growth from grades 4-6, while flexibility and originality showed nonlinear growth. Initial levels positively correlated with growth rates across all three dimensions, with significant individual differences in initial levels and in growth rates for fluency and originality.
2. At the between-individual level, teacher support positively predicted fluency' s initial level and originality' s growth rate. At the within-individual level, teacher support development positively predicted fluency development.
3. Significant gender differences favored girls in flexibility and originality initial levels. Teacher support' s positive prediction of flexibility initial level showed gender differences: significant for boys but not for girls.

References

Acar, S., & Runco, M. A. (2019). Divergent thinking: New methods, recent research, and extended theory. *Psychology of Aesthetics, Creativity, and the Arts*, 13(2), 153−158.

Amabile, T. M. (1996). *Creativity in context: Update to "the social psychology of creativity"* . Boulder, CO: Westview Press.

Bai, X. W., & Chen, Y. W. (2004). Measurement equivalence: Conception and test conditions. *Psychological Science*, 12(2), 231−239.

Camp, G. C. (1994). A longitudinal study of correlates of creativity. *Creativity Research Journal*, 7(2), 125−144.

Charles, R. E., & Runco, M. A. (2001). Developmental trends in the evaluative and divergent thinking of children. *Creativity Research Journal*, 13(3−4), 417−437.

Chen, J. J. L. (2008). Grade-level differences: Relations of parental, teacher and peer support to academic engagement and achievement among Hong Kong students. *School Psychology International*, 29(2), 183−198.

Cheung, P. C., Lau, S., Chan, D. W., & Wu, W. Y. H. (2004). Creative potential of school children in Hong Kong: Norms of the Wallach-Kogan creativity tests and their implications. *Creativity Research Journal*, 16(1), 69−78.

Choi, J. N. (2004). Individual and contextual predictors of creative performance: The mediating role of psychological processes. *Creativity Research Journal*, 16(2−3), 187−199.

Claxton, A. F., Pannells, T. C., & Rhoads, P. A. (2005). Developmental trends in the creativity of school-age children. *Creativity Research Journal*, 17(4), 327−335.

Day, J. K., Fish, J. N., Grossman, A. H., & Russell, S. T. (2020). Gay-Straight alliances, inclusive policy, and school climate: LGBTQ youths' experiences of social support and bullying. *Journal of Research on Adolescence*, 30(S2), 418−430.

Deci, E. L., & Ryan, R. M. (2000). The "what" and the "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227−268.

Dietrich, A. (2018). Types of creativity. *Psychonomic Bulletin & Review*, 26(1), 1−12.

Fan, X. H., Fang, X. Y., Liu, Y., Lin, X. Y., & Yuan, X. J. (2012). The effect of social support and social identity on the relationship between perceived discrimination and socio-cultural adjustment among Chinese migrant children. *Acta Psychologica Sinica*, 44(5), 647−663.

Florida, R. (2002). *The rise of the creative class.* New York: Basic Books.

Galla, B. M., Wood, J. J., Tsukayama, E., Har, K., Chiu, A. W., & Langer, D. A. (2014). A longitudinal multilevel model analysis of the within-person and between-person effect of effortful engagement and academic self-efficacy on academic performance. *Journal of School Psychology*, 52(3), 295−308.

Guo, J., Li, M., Wang, X., Ma, S., & Ma, J. (2020). Being bullied and depressive symptoms in Chinese high school students: The role of social support. *Psychiatry Research*, 284, 112676.

Han, Q., Hu, W. P., & Jia, X. J. (2013). The influence of the group member construction of peer interaction on the primary school students' creative problem finding. *Journal of Psychological Science*, 36(2), 417−423.

Hu, W. P., Wan, X. T., & Yu, L. (2011). The development of technological creativity of children and adolescents. *Psychological Research*, 4(2), 24−28.

Jia, Y., Way, N., Ling, G., Yoshikawa, H., Chen, X., Hughes, D., ···Lu, Z. (2009). The influence of student perceptions of school climate on socioemotional and academic adjustment: A comparison of Chinese and American adolescents. *Child Development*, 80(5), 1514−1530.

Lau, S., & Cheung, P. C. (2010). Developmental trends of creativity: What twists of turn do boys and girls take at different grades? *Creativity Research Journal*, 22(3), 329−336.

Li, J. Z., Wang, W. Z., & Shi, J. N. (2004). Children' s creativity development and the effect of family environment. *Acta Psychologica Sinica*, 36(6), 732−737.

Liang, L., Yang, J., & Yao, S. (2019). Measurement equivalence of the SDQ in Chinese adolescents: A horizontal and longitudinal perspective. *Journal of Affective Disorders*, 257, 439−444.

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, 83(404), 1198−1202.

Liu, Y. Y., & Zhang, D. J. (2005). An experimental research on the relationship between young children' s exploratory behaviors and teachers' attitudes. *Psychological Development and Education*, (3), 94−98.

Lucia, K., Tomotaka, U., & Petr, M. (2017). Roles of attachment relationships in emerging adults' career decision-making process: A two-year longitudinal research design. *Journal of Vocational Behavior*, 101, 119−132.

Ma, H. H. (2009). The effect size of variables associated with creativity: A meta-analysis. *Creativity Research Journal*, 21(1), 30−42.

Maker, C. J., Jo, S., & Muammar, O. M. (2008). Development of creativity: The influence of varying levels of implementation of the discover curriculum model, a non-traditional pedagogical approach. *Learning & Individual Differences*, 18(4), 402−417.

Man, D. H., Li, Y. J., & Zhang, J. H. (2015). Relationship between parental control, self-esteem and primary school student' s social creativity. *Studies of Psychology and Behavior*, 13(1), 81−86.

McArdle, J. J., Grimm, K. J., Hamagami, F., Bowles, R. P., & Meredith, W. (2009). Modeling life-span growth curves of cognition using longitudinal data with multiple samples and changing scales of measurement. *Psychological Methods*, 14(2), 126−149.

Nęcka, E. (2011). Memory & creativity. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity* (2nd ed., pp. 88−93). San Diego: Academic Press.

Plucker, J., Beghetto, R. A., & Dow, G. (2004). Why isn' t creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, 39(2), 83−96.

Reiter-Palmon, R., Forthmann, B., & Barbot, B. (2019). Scoring divergent thinking tests: A review and systematic framework. *Psychology of Aesthetics, Creativity, and the Arts*, 13(2), 144−152.

Ren, F. F., Li, Y. J., & Zhang, J. H. (2017). Perceived parental control and Chinese middle school adolescents'creativity: The mediating role of autonomous motivation. *Psychology of Aesthetics, Creativity, and the Arts*, 11(1), 34−42.

Runco, M. A. (2010). Divergent thinking, creativity, and ideation. In J. C. Kaufman & R. J. Sternberg (Eds), *The Cambridge Handbook of Creativity*. New York: Cambridge University Press.

Runco, M. A., Noble, E. P., Reiter-Palmon, R., Acar, S., Ritchie, T., & Yurkovich, J. M. (2011). The genetic basis of creativity and ideational fluency. *Creativity Research Journal*, 23(4), 376−380.

Shan, M. X., Gao, Y., Li, W. F., Xu, F. F., & Li, G. Y. (2019). Relationship between parenting style and creativity thinking: The moderation role of gender. *China Journal of Health Psychology*, 27(9), 1430−1435.

Shen, W. B., Liu, C., Shi, C. H., & Yuan, Y. (2015). Gender differences in creative thinking. *Advances in Psychological Science*, 23(8), 1380−1389.

Shi, B. G., Wang, L. J., Xu, L., & Liu, X. (2016). Effects of teacher-student relationships on students' creativity: A moderated mediation model. *Psychological Development and Education*, 32(2), 175−182.

Shi, J. N., Xu, F., Zhou, L., & Zha, Z. X. (1999). Gender differences from the result of cross-cultural study on technical creativity of children from China and Germany. *Acta Psychologica Sinica*, 31(4), 428−434.

Smith, G. J., & Carlsson, I. M. (1990). *The creative process: A functional model based on empirical studies from early childhood to middle age*. Madison, CT: International Universities Press.

Torrance, E. P. (1968). A longitudinal examination of the fourth-grade slump in creativity. *Gifted Child Quarterly*, 12(4), 195−199.

Torrance, E. P., & Myers, R. E. (1970). *Creative learning and teaching.* New York, NY: Dodd, Mead, & Company.

Wo, J. Z., Wang, Y. H., Liu, C. M., & Lin, C. D. (2009). Development of creativity: The evidence from Chinese adolescents. *Psychological Science*, 32(3), 535−539.

Xu, Z. Y. (1994). The relationship between the child' s development of language and cognition (thought). *Acta Psychologica Sinica*, 26(4), 347−353.

Zhang, J., Han, X., Si, S., & Zhang, S. (2018). The interaction of TPH1 A779C polymorphism and maternal authoritarianism on creative potential. *Frontiers in Psychology*, 9, 2106−2113.

Zhang, J., Liu, X., Ren, F., Sun, X., & Yu, Q. (2016). The effects of group diversity and organizational support on group creativity. *Acta Psychologica Sinica*, 48(12), 1551−1560.

Zhang, J., & Zhang, S. (2020). The association of TPH genes with creative insight performance. *Psychology of Aesthetics, Creativity, and the Arts*, 14(1), 87−93.

Zhang, L., Lei, L., & Guo, B. L. (2003). *Applied multilevel data analysis.* Beijing: Educational Science Publishing House.

Zheng, R. C., & Xiao, B. L. (1983). A study on the creativity of high school students. *Acta Psychologica Sinica*, 15(4), 445−452.

Zhu, Z. X., & Lin, C. D. (2002). *Thinking development psychology.* Beijing: Beijing Normal University Publishing House.

The development of creativity in senior primary school students: Gender differences and the role of school support

ZHANG Jinghuan[1]; FU Mengmeng[1]; SHA Sha[2]; XIN Yuwen[1]; CHEN Peipei[1]

([1] School of Psychology, Shandong Normal University, Jinan 250014, China)
([2] Army Command College, Nanjing 210032, China)

Abstract

Creativity has been emphasized as a key competence for adolescents to achieve success in the rapidly changing world. Although developmental psychologists have put tremendous efforts into identifying the developmental trajectory of creativity, no consensus has yet been reached. Researchers have found many factors that potentially affect the development of creativity, including individual

differences (such as gender differences), and the influence of the classroom environment. Besides, previous studies have not examined the creativity trajectory taking both the initial level and the growth speed into consideration. To address these flaws, the present study adopted a longitudinal design to explore the creativity development of senior primary school students through the between-person comparisons of different gender groups and school supports (the support from teachers and peers) as well as the within-person changes in response to the changing supports from schools.

Two hundred and three Grade-4 primary school students (109 boys and 94 girls, mean age = 10.43 years, SD = 0.62 years, during the first phase of the test, T1) from three elementary schools participated in the three years' longitudinal study and were assessed for three times (T1, T2, T3). Runco Creativity Assessment Battery (figural divergent thinking tests from rCAB) and Perceived School Climate Scale were used to measure creativity and school support, respectively. The study project was reviewed and approved by the Ethics Committee of Shandong Normal University and obtained the informed consent of parents of the participants. The data were managed and analyzed using SPSS 22.0 and HLM 6.08 software. A series of analyses, including descriptive, correlation, and multilevel analyses, were conducted to explore the developmental trajectory of creativity and the potential relationship between the school support and creativity.

The results of the study were as follows: (1) The fluency of creativity of senior primary school students from grade 4 to 6 showed a linear growth trend, while the flexibility and originality of creativity showed a non-linear growth trend. In addition, the initial level of creativity was positively correlated with its growth speed. (2) Individual differences existed not only in the initial levels of fluency, flexibility, and originality, but also in the growth speed of fluency and originality. (3) Senior primary school girls performed significantly higher at initial levels of flexibility and originality than their male counterparts. (4) On the between-person level, the interaction between teacher support and gender significantly predicted the initial level of flexibility; teacher support significantly positively predicted the initial level of fluency; teacher support significantly positively predicted the growth speed of originality. (5) On the within-person level, time-varying teacher support significantly positively predicted time-varying fluency.

The current study is, to our knowledge, the first exploration to describe the developmental trajectory of senior primary school students' creativity in Mainland China using a longitudinal design. These findings will deepen the understanding of developmental rules of creativity, and provide implications for the cultivation of creativity among senior primary school students.

Key words: creativity; school support; gender difference; longitudinal study; senior primary school students

Note: Figure translations are in progress. See original paper for figures.