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Influences of Social and Educational Environments on Creativity During Adolescence: Does SES Matter?

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It is well established that there is an academic achievement gap between students from high and low socioeconomic family backgrounds. However, how being brought up and living in different socioeconomic backgrounds impacts adolescent development, particularly their creative capabilities and creativity-related personality traits, is not well understood. This study compared creative capabilities and traits of 8th grade students of 2 school districts: a suburban, upper-middle class community and an urban community with a large proportion of families under poverty, located in a northeastern state. The results provide compelling evidence for a creativity gap. The study also found a possible mediating role of academic achievement and intrinsic cognitive motivation, suggesting that the psychosocial processes and mechanisms leading to the creativity gap are tractable. Implications of the findings for optimal adolescent development and social interventions are discussed.

It is well established that there is an academic achievement gap between students from high and low socioeconomic family backgrounds (Byrnes, 2003; Frederickson & Petrides, 2008; McLoyd, 1998; Murdock, 2000). Multiple factors, mechanisms, and pathways through which low SES puts students at risk for academic failure have also been researched in depth (Grissmer, Williamson, Kirby, & Berends, 1998). They involve, among others, parental supervision, material resources, and intellectual stimulation and value.

The question of a possible *creativity gap* between high and low socioeconomic status (SES) or, more broadly, of social and educational underpinnings of SES underlying the development of creative potential, has not been brought up and well addressed. One reason for the lack of research attention is that creativity is often conceptualized and researched as an individual differences variable (e.g., Prabhu, Sutton, & Sauser, 2008). A preliminary search in the PsycInfo database found a bulk of empirical research focused on personality factors in relation to creativity, whereas empirical research on the SES-related factors on the development of creativity is sparse and sporadic, most conducted back in 1980s or earlier. Limited evidence points to a distinct advantage enjoyed by children of higher SES over children of low SES, not only in academic achievement but in creative thinking as well (Lichtenwalner & Maxwell, 1969; Milgram, 1983; Ogletree, 1971); this phenomenon seems prevalent across cultures (e.g., Vijayalakshmi, 1980). Most studies traced this difference to early child-rearing practices and parenting styles (Harrington, Block & Block, 1987; Lichtenwalner & Maxwell, 1969), however, findings are not conclusive (see Miller & Gerard, 1979).

In a more recent study, Niu (2007) explored the interplay of individual factors (intelligence, personality, motivation, thinking styles and knowledge) and environmental factors (family and school) on creativity among Chinese students. After controlling for intelligence, Niu found that social factors alone predicted as much variance in creativity as all the individual factors combined. In an intervention study, Tsao (2008) found that guided

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play in the classroom promoted children's creativity in writing and conversation (see also Moore & Russ, 2008). In a longitudinal study, Gottfried, Gottfried, Bathurst, and Guerin (1994) found that children's intrinsic motivation was related to parental encouragement for task endogeny. Together, this body of research suggests a set of psychosocial factors potentially mediating SES and creativity.

Another reason for the lack of research on SES and creativity is that standard, reliable measures of achievement are easier to obtain than those of creativity. Theoretically, creativity can be measured in multiple ways, with different psychological underpinnings. For example, creative thinking can be operationalized in many ways, such as thinking divergently (Torrance, 1972), constructing and combining broad categories (Cropley, 2000), or formulating and working with paradoxical ideas (Rothenberg, 1979). Also open to debate is the issue of the extent to which creativity can be seen as an ability dissociated from experience and knowledge. Runco, Dow, and Smith (2006) compared two types of performance: standard divergent thinking tasks (e.g., "List uses for a shoe") and more knowledge-based ideation. They found evidence for a distinct knowledge basis for creative ideation. Mumford, Marks, Connelly, Zeccaro, and Johnson (1998) also found a domain-specific correlate of divergent thinking. Evidence seems to suggest an experiential and knowledge basis of creative ideation. Nevertheless, when divergent thinking performance of children was used to predict adult real-life creative achievement, it demonstrates higher predictive validity than a measure of intelligence (Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005; Plucker, 1999).

An interest in SES and creativity put stakes on developmental and educational underpinnings of creativity during adolescence (Dai & Shen, 2008). In keeping with the research tradition, creativity in this study was defined and assessed in two broad categories: divergent thinking and personality traits closely related to creative expressions. Divergent thinking is the ability to generate many ideas that are appropriate to the task at hand (fluency), and flexible in crossing the boundary of categories (fluency) and original in terms of rarity (originality). Divergent thinking is enhanced not only through cognitive development, but also through an education that supports an enriched, inquisitive, open mind. Although divergent thinking is assessed using performance measures, creative traits are defined as a set of motivational, attitudinal, and behavioral tendencies or proclivities conducive to creative ideation and productivity, and typically measured by self-report instruments. The underlying assumption regarding the relationship between SES and creativity is that traits such as openness to experience and intrinsic cognitive motivation are likely nurtured early on in one's life, but can be enhanced (or hindered) by one's social and educational environments during adolescence.

Particularly relevant to this study are different home environments and educational experiences in school as perceived by students from high and low SES backgrounds. This study posited that parents with higher levels of education will more likely support and engage their adolescent children in a variety of intellectual activities and encourage the expression of those personal characteristics conducive to creativity. One hypothesis was that the ethos and resources of a high-SES neighborhood and school district are more likely to be supportive of explorative, intellectually stimulating activities. Therefore, the study selected two school districts that have contrasting SES, but otherwise are comparable. Along the same line of logic, the study included several psychosocial measures such as how students perceived the social-contextual support for individuality and creative expressions and how intrinsically motivated they are to pursue cognitive tasks.

RESEARCH QUESTIONS

The following research questions were addressed in the study:

1. Are there major differences in divergent thinking and creativity-related personality traits between students of the two school districts, which feature contrasting socio-economic characteristics?
2. Do parent education levels make a difference despite the fact their children live in a low-SES community? Do school effects compensate for low SES family effects?
3. Do parent education, school (and neighborhood) type, academic achievement (grades), perceived parent and teacher support for the expression of personal characteristics conducive to creativity, and creative inclinations predict adolescent creative capabilities as measured by a set of divergent thinking tasks?

METHODS

Participants

A total of 234 eighth-grade students participated in the study in the spring semester of their academic year. One hundred and twenty six came from an urban middle school and 108 from two middle schools in a suburban school district, all located in a northeastern state. The two school districts are comparable in school size (an average of 508 vs. 541 students), the number of teachers (39 vs. 41), limited English proficiency (0.6% vs. 2.2%),

and ethnic makeup (90.2% vs. 87.1% White), but different in the number of students eligible for free lunch (5.1% vs. 40.3%) and parental education levels (80% vs. 18% graduate degrees, and 4% vs. 50% not having college education). The records of 5 students were excluded from data analyses due to a large number of missing values for each of the cases, resulting in a final sample of 229 students.

Instruments and Procedures

Some basic demographic information such as gender and age were obtained through a questionnaire. Information was obtained on both father and mother's education (whenever applicable): (a) middle school, (b) high school, (c) college undergraduate, and (d) graduate school. Self-reported academic achievement, in terms of "the grade that best reflects your achievement" ranging across A, B, C, D, and U, was also obtained in science/math and language arts/social studies, respectively. The instruction made it clear that "best reflects" means "most accurately reflect" one's actual achievement in the past year. Besides, measurements used for the study included (a) a 4-item divergent thinking test, (b) a 72-item questionnaire assessing creativity-related traits, and (c) an 18-item questionnaire assessing one's perceptions of teacher and parent support for the development of creativity-related personality traits.

Measures of divergent thinking. A four-item creativity test, adapted from an instrument for a multinational research project (Shen, 2005), was used for the study. The original instrument contains one item tapping into scientific creativity ("List as many questions as possible about a planet you like to travel"), two tapping into technological inventiveness (improving the design of a toy dog and designing an apple-picking machine), and two traditional divergent thinking tasks (drawing as many items as possible using parallel lines, for example, a pencil; and dividing a square into four equal areas in as many ways as possible). Because the item of designing an apple-picking machine is not a divergent thinking task (requiring the participant to construct a design, rather than generating multiple ideas), only the other four items were used to ensure consistency of the measurement, as well as the diversity of construct representation. For example, the *planet* and *toy dog* questions have a distinct domain-specific component. All written responses were coded consensually by two research team members, and entered into a computer program (Zhang, 2005) especially designed for managing coded data and generating divergent thinking scores (see Appendix A). Each item produced three scores: (a) fluency: a simple count of the number of responses; (b) flexibility: the number of categories the responses fall into; 14 broad categories were identified for the *planet* question, 21 for the *toy dog* question, 21 for the *parallel lines* question, and 16 for the *dividing a square* problem (see Appendix A for the names of categories for the former three items); and (c) originality, based on how frequently a specific response was given by the total sample. Two points were given for a response of less than 5% chance of occurrence, and 1 point for a response of 5–10% chance.

Measures of creativity-related traits. An inventory of 72 statements was developed to measure various aspects of personal characteristics known to be conducive to creative ideation. They include self-confidence (7 items from the *Creativity Assessment Packet*; Williams, 1980; e.g., "Compared with the people I know, I am a more confident person."), adventurousness or risk taking (e.g., 5 items from the *Creativity Assessment Packet*; e.g., "It's exciting for me to try out new games and activities."), curiosity (8 items from the *Creativity Assessment Packet*; e.g., "I like to ask questions that others have not thought of."), openness to experience (8 items from the NEO PI-R Personality Inventory; Costa & McCrae, 1992; e.g., "I found it interesting to learn and develop new hobbies."), and intrinsic motivation for cognitively demanding activities or the need for cognition (13 items from the Need for Cognition inventory; Cacioppo, Petty, Feinstein, & Jarvis, 1996; e.g., "After finishing a difficult intellectual task, I feel relieved rather than find great satisfaction out of it"); norm-doubt (5 items, from the 16PF Questionnaire; Liu, 1970; e.g., "My interest towards certain people and things changes quite easily."), independence (11 items from the 16PF Questionnaire; e.g., "When I need to find an address in an unfamiliar city, I would often turn to the city's map for help."); persistence (10 items from the Creative Tendency Scale; Wang, 2003; e.g., "Sometimes I am quite determined to do something on the next day, but when the next day comes, that determination fades away"), and self-acceptance (5 items from the California Psychological Inventory; Gough, 1987; e.g., "In my eyes, my father is an ideal man"). A 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5) was used for this self-report instrument.

Measures of perceived teacher and parent support. There were 9 teacher items and 9 parent items in this set of statements. This questionnaire was developed in conjunction with instruments of creative inclinations as an attempt to assess the extent to which teachers and parents support self-confidence, curiosity, adventurousness, openness to experience, and intrinsic motivation for cognitive engagement, among other creative inclinations. For example, an item tapping into

parental support for adventurousness and openness to experience states that "My parents encourage me to try out new things, even though it may lead to failure." An item tapping into teacher support for intrinsic task motivation states that "When I am engrossed in solving and thinking about a problem, my teachers encourage me to keep going even when it delays my other work." A 5-point Likert scale was used, ranging from *hardly ever* (1) to *almost always* (5).

Procedures. With the support of the administrative staff of three middle schools from two school districts, the divergent thinking test and the creativity-related traits questionnaire were administered to the 8th-grade participants in small groups. The total time offered to participants was 50 minutes. The total time participants actually took to complete the tasks varied from a half hour to 60 minutes. Participants were given either a movie ticket or an art craft present upon the completion of the tasks as a token of thanks. Participation is voluntary through parental consent and student assent, and the reward or the token of thanks was not part of invitation (i.e., not used as incentives).

RESULTS

Preliminary Analysis

Since there were missing values in some cases, given the small sample size of our study, a decision was made to impute the missing data. The missing data in ParentEd, scgrade, artgrade, and AgeinMon were replaced by school means, and the missing data in the 90 Likert-type items and in the creativity measures were imputed by EM algorithm (Schafer, 1997), using SAS PROC MI. To reduce the dataset to manageable variables, image factor analysis (Jöreskog, 1969) with varimax rotation was conducted with gender, age by month, and the 90 self-report items, with the number of derived common factors determined by examining the scree plot as discussed in Pruzek (2005). Six common factors were extracted, accounting for 28% of the total variance. The six factors were conceptually meaningful and thus assigned the following labels, respectively, with alpha reliabilities and numbers of items reported in the parentheses: (a) perceived teacher and parent support ($\alpha = .77$, $n = 12$), (b) self-confidence ($\alpha = .85$, $n = 16$), (c) intrinsic cognitive motivation or need for cognition ($\alpha = .84$, $n = 14$, (d) openness to experience ($\alpha = .64$, $n = 13$), (e) adventurousness ($\alpha = .74$, $n = 10$), and (f) artistic imagination ($\alpha = .59$, $n = 8$). Six variables were derived by averaging the item cores. Five items with high complexity values and low communality values were not included. Other 14 items were excluded from forming the six variables because their inclusion would make interpretation of the factors conceptually difficult.

For the divergent thinking test scores, the within-item intercorrelations of fluency, flexibility, and originality and across-item correlations among four measures of fluency, flexibility, and originality were examined. As within-item intercorrelations of the three indexes (on average .72 for *planet*, .92 for *parallel lines*, .79 for *square*, and .81 for *toy dog*) were higher than across-item intercorrelations of fluency, flexibility, and originality, respectively (on average .38, .29, .32 for the three respective measures), the results support a domain- or task-specific interpretation (Runco et al., 2006). Therefore, the four task measures were used to form a composite measure of creativity. Aggregating the performance across the four tasks not only better represents a diverse set of task conditions set up to measure creative ideation but also enhance the reliability of the measure. The alpha reliability for the composite measure of creativity is .86.

Means, standard deviations, and zero-order intercorrelations of all relevant variables are presented in Table 1. For descriptive purposes, mean scores on each dimension for the high SES school and low SES school are listed on the right side of the table. As can be seen, all measures of achievement and psychosocial variables are in favor of the former.

Effects of School and Parental Education

To address the first research question about the differences in creativity between the two school districts, two side-by-side boxplots were used (see Figure 1) to visualize the differences. Comparing with that of the low-SES school district ($n = 118$), the creativity composite score of the high-SES school district ($n = 111$) had a wider range and a higher mean. The two independent sample t statistic was -6.85 with a degree freedom of 181 and a p-value of 0.0002, and the corresponding Cohen's d was -1.02.

To address the second research question regarding relative contributions of school and parent education, a univariate analysis of variance (ANOVA) was conducted, with the composite score of creativity as a criterion variable, and school type (high SES vs. low SES) and parent education (two levels: undergraduate or below, and graduate) as two predictors. The reason that parent education only had two levels was because the high SES school only had four students whose parents only had high school education, thus not sufficient for an ANOVA analysis; therefore, parent education codes for the high school and undergraduate levels were combined. The results indicate that there were statistically significant main effects of school type ($F_{(1,\ 225)} = 15.12$, $p = .0002$, partial $\eta^2 = .063$) and parent education

TABLE 1
Means, Standard Deviations, and Correlations of Environmental and Personal Variables Related to Creativity Capabilities and Creative Inclinations (sample size = 229)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*High SES*	*Low SES*
1. Grade in M/Sci	N/A										4.53	3.68
2. Grade in LA/SS	.51	N/A									4.58	4.22
3. PT support	.17	.26	.77								3.43	3.34
4. Self-confidence	.41	.20	.21	.85							3.57	3.15
5. Artistic imagination	.03	.18	.11	-.03	.59						3.30	3.25
6. Cognitive motivation	.41	.22	.10	.61	.08	.84					3.43	2.83
7. Adventurousness	.19	.24	.22	.11	.11	.25	.74				3.90	3.64
8. Openness	.17	.20	.19	.06	.34	.12	.39	.64			3.63	3.34
9. Creative composite	.38	.32	.12	.27	.05	.36	.14	.21	.86		125.82	83.81
Means	4.10	4.39	3.23	3.36	3.28	3.12	3.77	3.49	104.17			
SD	.97	.74	.83	.70	.60	.69	.57	.47	50.28			

Note. On the diagonal are alpha reliabilities. Grade in M/Sci = self-reported grades in math/science; Grade in LA/SS = self-reported grades in language arts/social studies. PT Support = perceived parent and teacher support for developing creativity-related characteristics; Cognitive Motivation = Need for Cognition; Openness = Openness to Experience. (On the right columns).

High SES = mean scores for high SES schools, Low SES school = mean scores for low SES schools.

($F_{(1, 225)} = 5.6$, $p = .019$, Partial $\eta^2 = .024$), but the parent education by school type interaction effect was not.

Since parent education and school type was highly correlated ($r = .64$), and the main effect of school type on creativity was confounded by the effect of parental education, the score differences between students of the two school districts with matching parent education were examined. The results (Figure 2) indicate that for the higher parental education level (parents having graduate degrees), the high-SES school district ($n = 90$) outperformed the low-SES school district ($n = 20$) by a large margin (131 vs. 91). For those whose parents did not have a graduate degree, the high-SES school district ($n = 21$) also outperformed the low-SES school district ($n = 98$) by a notable margin (103 vs. 82). As indicated, the students of the lower parent education background but who were with the high-SES school district performed better than the students of the higher parent education background but who were with the low-SES school district (103 vs. 91), suggesting a school compensatory effect.

Mediating Effects of Psychological Variables

To address the third research question, a hierarchical multiple regression was computed with the composite

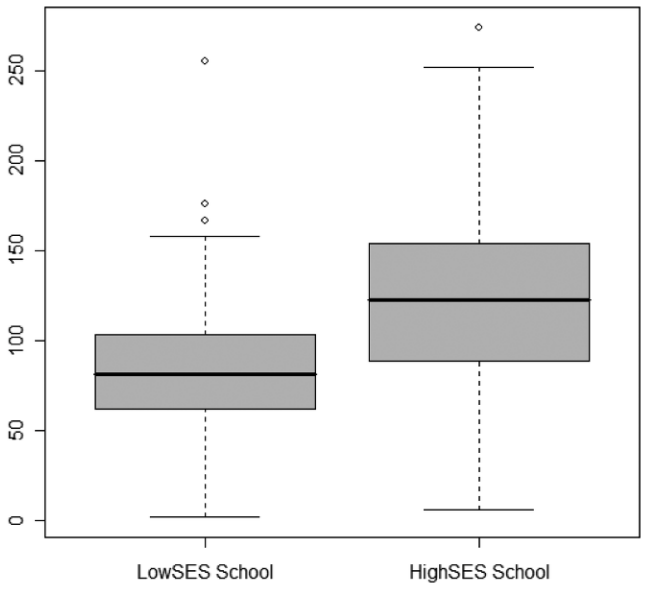

FIGURE 1 Side-by-side boxplots to compare the creativity composite score of the low SES school district and that of the high SES school district.

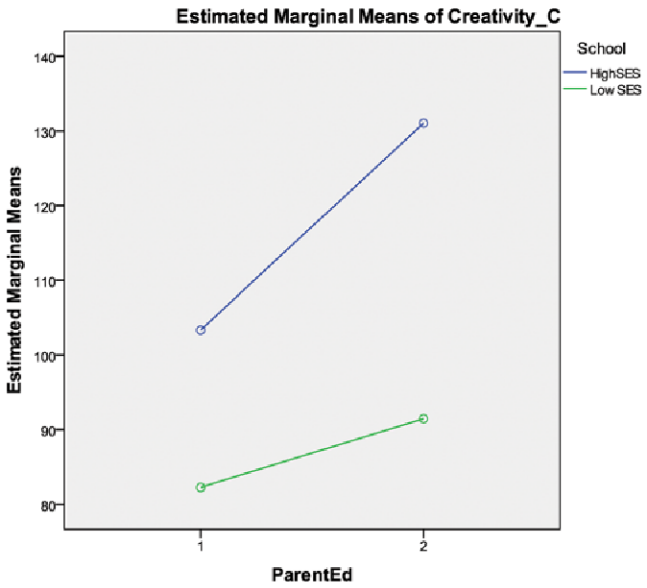

FIGURE 2 Plotting mean scores of creativity by school types and parent education levels. (Figure is provided in color online.)

measure of creativity as a criterion variable. The rationale for this analysis was that adding achievement and psychosocial variables would substantiate the question of how high-SES school effects on creativity might be mediated by relevant psychosocial variables. In this analysis, school type and parent education level (two dummy variables) were entered in the first step, grades in science/math and language arts/social studied combined, and the perception of teacher and parent support (TPSuport) were entered in the second step. Since the variables of self-confidence and cognitive motivation were highly correlated ($r = .55$), and the variables of adventurousness and openness were also significantly correlated, these two sets of variable were combined and entered in the third step. The variable *artistic imagination* was not correlated with the measure of *creativity*, and therefore was not included in the regression analysis (see Table 2).

The results show that school type and parent education combined accounted for 20% of the variance in the measure of creativity. When academic achievement (grades in language arts/social studies and math/science combined) and the perception of teacher support were entered into the equation, they accounted for additional 6% of the variance. And the two combined measures of creative inclinations (self-confidence, cognitive motivation, adventurousness, and openness to experience) accounted for additional 1.5% of the variance. Together, the model accounted for 27% of the variance in the composite measure of creativity. Predictors that yielded standardized regression coefficients statistically different from zero in the final model were school type ($\beta = .18$, $p = .025$), grades combined ($\beta = .21$, $p = .003$), and self-confidence and cognitive motivation combined ($\beta = .14$, $p = .04$). Students who were from the suburban school district, who have higher academic achievement, and who were more confident and cognitively motivated, tended to perform better on the measure of creativity.

DISCUSSION

This study used two demographic variables, schools attended (and the local communities these students live in) and parent education levels, as two main predictors of a measure of divergent thinking. The distinct difference found in favor of the high-SES schools provide clues as to how school, home, and neighborhood environments might have impacted the development of creative potential in term of fluent, flexible, and original ideation during adolescence. The findings suggest a creativity gap, analogous to the well-researched achievement gap, between those living and studying in upper-middle-class suburban school districts and those living in mixed lower- to middle-class school districts. The results regarding the respective effect of school type relative to that of parent education seemed to suggest a school compensatory effect, rather than parent education compensatory effect, as school effects overrode parent education effects, although the two are highly correlated so that an synergistic explanation may be a better alternative. A central question is how to explain this difference developmentally.

The second set of variables under investigation was psychosocial in nature and meant to provide social-contextual conjectures and explanations: school achievement and perceived teacher and parent support for the development of creativity-related characteristics. The results seemed to indicate a distinct school achievement effect on creativity, not perceived teacher and parent support, both in terms of zero-order correlations and regression weights. Why the effect of perceived teacher and parent support was not as salient can be open to many explanations, such as the self-report nature of the measure; reporting one's own performance tends to be more accurate than reporting how significant others treated themselves. But a more direct explanation is that variations in perceived supporting environments have less direct bearing on the current performance than

TABLE 2
The results of a hierarchical multiple regression analysis with creative ability (composite measure) as a dependent variable

	β step 1	R^2	β step 2	R^2	$R^2\Delta$	β step 3	R^2	$R^2\Delta$
Step 1:								
School type	.3**		.23**			.18*		
Parent education	.19*	.20**	.13			.13		
Step 2:								
Grades combined			.25**			.21**		
Teacher support			.04	.25**	.06**	.02		
Step 3:								
Confidence/Motivation						.14*		
Adventurousness/Openness						.03	.27**	.015

Note. All decimals are rounded up to two digits. β is standardized regression coefficient. $R^2\Delta = R^2$ increase.
*$p < .05$. **$p < .01$.

variations in school achievement, which has a direct performance component. A distinct effect of academic achievement on the measure of creativity is not difficult to understand. The *planet* item and *toy dog* item entail creative ideation that is knowledge-rich; that is, one has to have rich knowledge backgrounds to produce many novel ideas about what questions to ask about a planet (in the case of the *planet* item) and how to change structural and functional features of a toy dog. Even for the *square* item, many innovative ways to divide a square into four equal parts found in high performers in this study demonstrate good geometric knowledge as well as mathematical inventiveness, thus is to some extent domain-specific (Runco et al., 2006). It is also conceivable that even the most traditional divergent thinking tasks such as the one used in the presented research, with parallel lines to draw objects, also require world knowledge (Feldhusen & Goh, 1995).

The third set of variables in the predictive equation, self-confidence and intrinsic motivation to engage in cognitively demanding activities (i.e., cognitive motivation), was also psychosocial in nature, meant to explain long-term developmental effects on creativity, as these variables show enduring individual differences and developmental continuity rather than varying from situation to situation. The results of the positive impact of cognitive motivation and self-confidence suggest possible mediation of both academic achievement and intrinsic motivation, arguably two of the most important educational outcomes. As differences on these measures were evident between the two school districts (Table 1), it can be inferred that school and parent effects on creativity may be mediated by these psychosocial variables.

At a conceptual and theoretical level, stable individual differences and long-term developmental changes and differences may play an important role in how social and educational experiences shape development of creativity. As indicated in the study, academic achievement was associated with how adolescents performed on the creativity tasks, as well as how they were motivated to pursue intellectually challenging tasks. These variables are likely relational (reflecting a person–environment interface or ecology) rather than residing either in the social context or in the person. Certain individual temperament or personality characteristics and abilities conducive to creativity are likely meshed with or enhanced by certain environmental structures, or negatively, hindered by a lack of educational resources and intellectually stimulating environment (Neitzel & Stright, 2004). Nevertheless, it is unlikely that all the effects of parent education and school type found in this study can be reduced to individual differences. Thus, the findings support the argument that both individual and environmental influences may jointly contribute to creativity development (Niu, 2007).

A theoretically and practically important finding of the study is that creative potential, as indicated by fluent, flexible, and original ideation, is associated with two major schooling outcomes: academic achievement and intrinsic cognitive motivation. The role of intrinsic cognitive motivation (or need for cognition; Cacioppo & Petty, 1982), among other inclinations, provides a bridge between the environmental conditions and creative expressions, and suggests a likely person-context reciprocal process leading to high performance on the measure of creativity as well as typical academic achievement tasks.

As a preliminary effort to understanding the social and educational impact on creativity, this study has its limitations. School type and parent education are all social addresses (Bronfenbrenner, 1992), which are social–structural but not social–psychological process variables. They need to be unpacked empirically to reveal their underpinnings. For example, more information is needed to understand how the two school districts differed in terms of curriculum and instruction, and how the situation of educational resources and social capital in these neighborhoods or communities differed. Until these questions are answered, psychosocial explanations for the data are still conjectural, although the pattern of meditational effects that bridge school type and parent education on the one hand and creative performance on the other provide important clues and leads.

There are profound policy and practical implications of a possible creativity gap, no less than the well-researched academic achievement gap. The issue not only concerns equity, the equal right to an enriched social and educational environment, and ultimately, the equal opportunity for creative expression and productivity; it also raises new possibility for increasing social capital so that optimal adolescent development can be facilitated. Better school investment coupled with parental investment in children's intellectual development in terms of knowledge building and intellectual interests seems to be a viable way of promoting the development of creativity and enhancing creative performance.

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APPENDIX A. CODES AND CATEGORIES OF DIVERGENT THINKING AND COMPUTERIZED SORTING

14. Categories for the *Planet* Question

ET, biology, resource, structural properties, climate, physical environment, physical attributes, time, space relationship, origins and future, survival, science/technology/military, exploiture, and special sight

21. Categories for the *Toy Dog* Question

Change, add, change color, change figure, conformity, detach, magnify, shrink, movement, pose, material, re-arrange, overturn, sound attraction, visual attraction, smell attraction, feeling attraction, substitute, remove, expression, and making it intellective

21. Categories for the *Parallel Lines* Question

Food, animal, plant, design, body parts, universe, vehicle, stationary, appliances, commodity, things for spatial usage, things for building, things for physical culture, musical instruments, toy, dresses, sight, weapon, ghosts and spirits, abstractions, and experimental equipment

Computer Program (Zhang, 2005) for data sorting and management: Screen display (left column: words; right column: categories)