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Family processes, beliefs about intelligence, and openness as predictors of English language learners' creative problem solving

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Family Processes, Beliefs About Intelligence, and Openness as Predictors of English Learners' Creative Problem Solving

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ABSTRACT

There has been a pressing need in creativity research to discover interactive relationships that can predict creative problem solving, particularly in the fastest growing demographic segment in public schools, immigrants. This study examined the best predictor for creative problem solving attributes of English Language Learners (ELLs) among family processes, beliefs about intelligence, and openness. 198 mathematically promising third graders in seven public schools were selected and administered questionnaires on their family processes, beliefs about intelligence, openness to experience, and creative problem solving attributes. It was found that the Asian English learners' creative problem solving were predicted better with their incremental Beliefs about Intelligence (effort), whereas confidence was a better predictor for Hispanic students.

I. Introduction

The Purpose

The purpose of this paper is two-fold: 1) To compare differences between major immigrant ethnic groups in family processes, belief about intelligence (BAI), openness, and creative problems solving attributes; and 2) To examine the predictive relationship among family processes, BAI, openness, and creative problems solving attributes. Results will shed light on the significant relationships that warrant extra focus for parents, educators, and policy-makers who are interested in maximizing children's creative problem solving potential.

Theoretical Framework

In the field of creativity research there has been a glaring lack of empirical creative studies on differences in ethnicity, particularly as it relates to the rapidly growing immigrant population. According to the 2010 U.S. Census, Latinos and Asians were the two fastest growing ethnic groups in the United States. Since 2000, they have both increased about 43.0%, compared to the relatively stable single-digit growth rates of non-Hispanic Whites and Blacks. Because of this immigrant surge, English Language Learners (ELLs) have become the fastest growing sub-segment in public schools (National Education Association, 2008; Flynn & Hill, 2005).

Creative research, however, has not reflected this sense of urgency, in light of the innovation imperative for the 21st century global competitive advantage. Instead, there is much more extant literature on the impact of *culture* on creativity (Glaveanu, 2010; Kharkhurin & Motalleebi, 2008; Westwood & Low, 2003; Lubart & Sternberg, 1998; Amabile, 1983), or the benefits of cultural and ethnic diversity on creativity, especially in organizational environments (Beycan-Levent & NijKamp, 2010; McLeod, Nobel, & Cox, 1996; Leung & Chiu, 2008, 2010; Leung, Maddux, Galinsky & Chiu, 2008; Cox, 1991).

Only a small handful of studies explored the differences in ethnicity and its impact on creativity; and within this group, most investigate older populations and almost none focus on the crucial formative years (Lynn, 2007; Kaufmann, 2006; Paletz & Peng, 2009). Though Cho, Han, & Ahn (2005), Cho & Hwang (2006), Cho (2007), Cho & Lin (2011) and Lin (2010) all variously

studied the influence of family processes, motivation, or beliefs about intelligence on CPS, the samples have all been ethnically homogeneous (i.e., East Asian).

What is missing in current literature is empirical data on ethnic group differences in a diverse society that might provide better understanding of the formative determinants of creativity. Renowned psychologist Torrance (1962) indicated the consensus that development of creative talent in the formative years was indeed critical. This paper sought to fill the gaps from extant literature to explore the interactive effects of family, one's personality and self-perception, and creative problem solving ability through an ethnic immigrant lens. Such an emphasis at a time of astounding immigrant growth and diversity in the U.S. has been needed in order to truly understand what it takes to develop innovation for the 21st century.

II. Methods

Research Questions

1. Are there significant differences among ethnic groups and between gender in family processes, belief about intelligence (BAI), openness, and creative problems solving attributes?
2. Are there significant predictive relationships among family processes, belief about intelligence (BAI), openness, and creative problems solving attributes?

Research Design and Data Analysis

This is a non-experimental/correlational research study carried out using archived data that has already been collected as a part of a Jacob K. Javits Grant, *Project HOPE*, with seven elementary public schools in New York City with a generally high population of Limited English Proficiency (LEP) students. Mathematically-promising third grade ELL students were selected based on the teacher checklist filled out for the entire third grade ELL student population. Then, parents of selected students were notified via letters (which included consent forms) in English, Spanish, and Chinese.

Participating students were administered questionnaires on their family processes, creative problem solving strategies, beliefs about intelligence, and their openness to experience. Along with general demographic information and personal characteristics (e.g., reading, self-study hours, and preference for challenging tasks), the test took approximately 45 minutes. Teachers were given the option to administer these questionnaires over two sessions. Finally, teachers collected and mailed the completed surveys to the researcher to be analyzed.

First, *t-tests* were used to examine differences between gender and between ethnic groups, on family processes, BAI, openness, and CPS attributes. Next, *correlational analysis* was used to measure the strength of the relationships between the variables of family processes, BAI, openness, and CPS attributes. Finally *regression analysis* and *path analysis* were conducted to find any predictive relationships of the same variables (family processes, BAI, openness, and CPS attributes).

III. Data Sources

Sample

The participants were comprised of 198 mathematically promising 3rd grade students (55% male and 45% female) from seven New York City public schools who were identified as English Language Learners (ELL). Mathematically promising students are those whom teachers recommended as showing math potential, though not necessarily gifted. Students were selected based on results from a ten-item teacher checklist, which related to students' prior achievement, industrious attitude toward math challenges, and teacher observations. Using a 4-point Likert scale (ranging from "seldom or never" to "often"), teachers answered items such as *The student is eager to solve challenging math problems*, or *The student solves math problems without the need for manipulatives*. Along with these ten items, teachers also rated the child's overall math achievement and English proficiency from a scale of 1 (low) to 4 (high). Overall, 46% of ELL students were deemed mathematically promising out of the total ELL population (N=431) from the seven schools. There were a total of 1,308 third grade students in the seven schools.

Instruments

There were four self-reported surveys administered to participating students, with each detailed below: *family processes*; *creative problem solving attributes*; *openness to experience*, and *beliefs about intelligence*.

Family Processes. The *Family Processes* survey was adapted from the *Korean Inventory of Parental Influences* (Cho, 2003) for elementary level ELL students, which in turn was modified from Campbell's (1994) original *Inventory of Parental Influence* that measured 44 items of six factors. Student participants responded from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) on their perception of certain family processes during school. Family process factors of *Pressure for Intellectual Development* (e.g., "My parents took me to the library."), *Inter-parental communication* (e.g., "When my mom had to decide about my education, she discussed with my dad."), and *Paternal Involvement* (e.g., "At home, my father explained about what I asked.") were combined to create an index named "Positive Family Processes." *Pressure* (e.g., "My parents are only happy when I get perfect grades.") was considered a negative family process. Cronbach's alpha ranged from .91 to .93 with high reliability. CFAs were conducted for each factor and the goodness-of-fit and lack-of-fit indices showed that the model is reasonably adequate, with GFI ranging from .920 to .983 and RMR from .036 to .086. RMR and GFI for each factor were .058 and .928, respectively, for Pressure for Intellectual Development; .042 and .956, respectively, for Inter-parental communication; and .051 and .953, respectively, for Father's Involvement.

Creative Problem Solving (CPS) Attributes. The self-reported creative problem solving attributes questionnaire was modified from Lin's (2010) *Creative Problem Solving Attributes Inventory* (CPSAI), taking into account the elementary and ELL student sample, and used to determine students' attributes in CPS. This 4-point Likert scale ranges from 1 (Seldom or Never) to 4 (Always). The theoretical bases of the CPSAI was adopted from Cho's Dynamic System Model of Creative Problem Solving (2003) and Treffinger's Creative Problem Solving (1989), and was divided into four subscales: Divergent thinking (e.g., "I can think about solving problems in different ways.); Convergent thinking (e.g., I try to find out main ideas of any problem),

Motivation (e.g., I work hard and usually solve difficult problems by myself.); and Environment (i.e., the combination of the above three and general knowledge/skills that parents nurture, such as "My parents give me enough time to come up with many ideas when I am trying to solve a problem."). Cronbach's alpha of the items showed reasonable internal consistency on the data of Motivation (α=80), Environment (α=.88), Divergent Thinking (α=.89), and Convergent Thinking (α=.94) subscales, but minimally adequate reliability on the General Knowledge and Skills (α= .65) subscale. Predictive validity was examined with Pearson correlational analysis, which revealed a statistically significant correlation between overall CPSAI and MCPSAT scores (r=.44, p=.001), indicating a medium-sized correlation. Pearson correlation coefficients were also conducted between each CPSAI subscale and the MCPSAT score. The MCPSAT significantly correlated with the subscales of Divergent Thinking (r=.34, p=.001), Convergent Thinking (r=.38, p=.001), Motivation (r=.36, p=.001), and General Knowledge and Skills (r=.45, p=.001), but not with the Environment subscale.

Openness to Experience. Testing for "Openness to experience" was modified from the *Five Factor Personality Inventory-Children* (FFPI-C; McGhee, Ehrler, & Buckhalt, 2007), a self-report inventory used to assess personality dispositions in children and adolescents and is one of the five factors of personality. The FFPI-C was normed on a sample of 1,284 participants in 18 states, which approximated the characteristics of the U.S. population on geographic area, gender, race, ethnicity, exceptionality status, and age (McGhee et al., 2007). Of the 75 total personality items, (15 items for each of the five personality dimensions), 15 items were used in this study to examine students' openness to experience.

Reliability was tested for content (homogeneity of items) and time sampling, with both showing acceptable to high reliability: coefficient α ranging from .74 to .86 for content and .84 to .88 for time sampling. Coefficient alphas for items related specifically to 'openness to experience' were found to be .75. Such homogeneity of items indicates there is minimal bias toward different groups and are similar to other personality inventories for the younger set (e.g., *The Children's Personality Questionnaire-Revised*; Porter & Cattell, 1992).

Four indexes of model fit were computed: chi-square (χ^2), goodness of fit index (GFI) and adjusted goodness of fit index (AGFI), and root mean square error of approximation (RMSEA). All indexes indicated that the structure of the FFPI-C corresponds to the basic structure of personality as hypothesized by the five-factor model, with Openness to experience showing good fit (GFI=.95). Chi-squared analysis showed acceptable ratio (df:χ^2 between 5 and 7) with degrees of freedom for four out of the five scales.

For the *Openness to experience* questionnaire, a five-point Likert scale was used, ranging from *Strongly disagree* (1) to *Strongly Agree* (5). Classroom teachers from the seven participating schools reviewed the clarity and readability of the test items for their third grade ELL students.

Belief About Intelligence. The original BAI scale was developed by Dweck and her colleagues (Dweck, Chiu, & Hong, 1995). Incremental BAI was measured by seven items, three of which were reverse-coded (e.g., "My intelligence is good, but there is nothing much that I can do to improve my intelligence."). The Incremental BAI score is the average rating on the seven items using a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Reliability of this scale was

relatively good with Cronbach's α ranging from .75 to .83. Goodness of fit demonstrated the model was reasonably adequate ($\chi 2$ (14) =569.02, p<.001, GFI=.872, RMR=.099).

The Confidence in Intelligence Scale, part of BAI, was modified from six items initially developed by Dweck (1999) in which students reported the strength of their subjective convictions that their intelligence is high (e.g., "I am confident that I am smart enough to be successful."). Reliability of this scale was relatively good with Cronbach's α between .83 and .88. Goodness-of-fit showed it was reasonably adequate ($\chi 2$ (20) =466.304 p<.001, GFI=.905, RMR=.068).

IV. Results / Conclusions

Overall, there were high correlations among family processes, openness, belief about intelligence, and attributes related to creative problem solving. Between the two largest ethnic groups, Latinos and Asians, Latinos scored consistently higher in all four variables, though not significant: total positive family processes (p=.051); the subscales paternal involvement (p=.068); confidence BAI (p=.055); openness (p=.083); total CPSAI (p=.097); and CPSAI motivation (p=.085). However, two subscales were *significantly* higher: CPS convergent thinking (p=.017) and CPS environment (p=.039). This suggests that: 1) Latino students perceived they were better able to pinpoint concrete and correct answers, and that 2) they perceived their parents fostered a more supportive environment for solving creative problems by asking questions or by displaying satisfaction at such endeavors. Tables 1-4 summarize the findings by variable.

Table 1
Ethnic Differences for Positive Family Processes

	N	*M*	*SD*	*p value (2-tailed)*
Positive Family Processes Total				.051
Hispanic	97	2.32	0.81	
Asian	33	1.99	0.92	
Press for Intel Development				.142
Hispanic	100	1.99	1.12	
Asian	32	1.64	1.28	
Cohesive/Communication				.234
Hispanic	98	2.42	0.93	
Asian	35	2.19	1.01	
Paternal Involvement				.068
Hispanic	101	7.29	1.14	
Asian	36	6.08	1.08	

Table 2
Ethnic Differences for Beliefs About Intelligence

	N	*M*	*SD*	*p value (2-tailed)*
BAI Total				.068
Hispanic	88	3.71	0.46	
Asian	33	3.53	0.46	
Incremental BAI				.880
Hispanic	98	3.89	0.58	
Asian	34	3.74	0.60	
Confidence BAI				.055
Hispanic	91	3.54	0.57	
Asian	35	3.33	0.54	

Table 3
Ethnic Differences for Openness

	N	*M*	*SD*	*p value (2-tailed)*
Openness Total				.083
Hispanic	96	3.84	0.57	
Asian	34	3.64	0.58	

Table 4
Ethnic Differences for CPSAI

	N	*M*	*SD*	*p value (2-tailed)*
CPSAI Total				.097
Hispanic	98	3.13	0.59	
Asian	31	2.84	0.88	
CPSAI Divergent Thinking				.670
Hispanic	103	2.89	0.75	
Asian	35	2.82	0.99	
CPSAI Convergent Thinking				.017**
Hispanic	102	3.19	0.63	
Asian	34	2.78	0.90	
CPSAI Motivation				.085
Hispanic	102	3.01	0.69	
Asian	35	2.69	0.98	
CPSAI Environment				.039**
Hispanic	103	3.34	0.73	
Asian	34	2.94	1.01	

** $p<.01$ level.

The next step sought to present a graphic conceptualization of the relationship among the variables, through structural equation modeling (SEM). Using AMOS 17.0, this path analysis determined the structural model that would best illustrate the interaction among family processes, openness, BAI, and creative problem solving attributes. If the goodness-of-fit is at least adequate, the model argues for the likelihood of the postulated relationship among those variables.

Results of path analysis demonstrated that family processes predicted personal characteristics such as beliefs about intelligence (or confidence in one's own intelligence), which predicted one's openness, which in turn predicted CPS attributes. However, depending on the ethnic group, the better predictor for openness between two different BAI was different. For Asian students, incremental belief about intelligence (i.e., the belief that more effort will make you smarter) predicted openness better (See Figure 1), whereas the confidence in one's own intelligence predictive openness better for Latino students (See Figure 2).

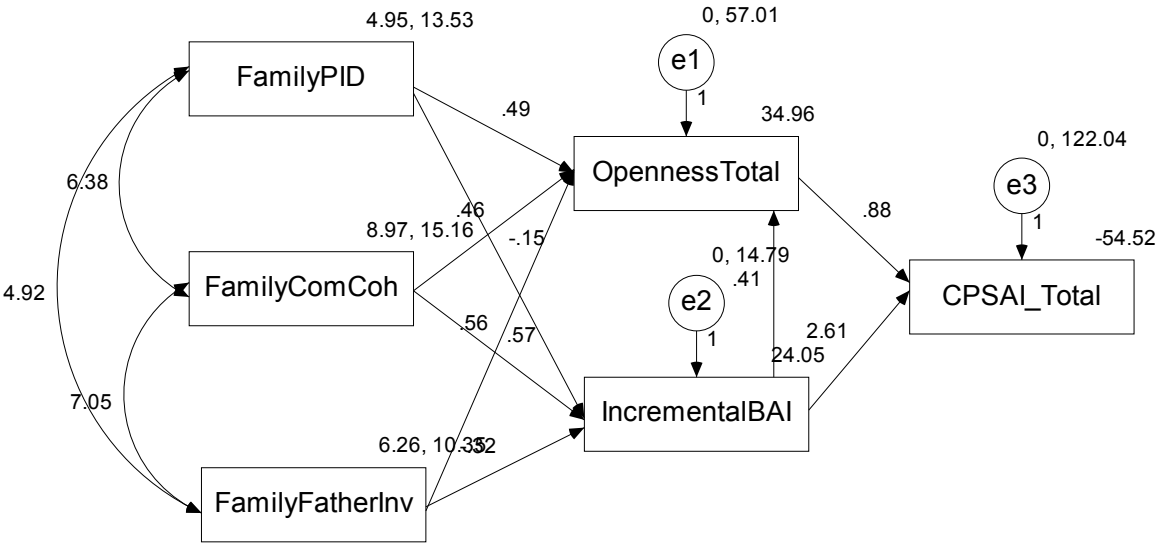

Figure 1. Asian model of predictive relationships among family processes, openness, incremental BAI, and CPSAI using unstandardized path coefficients.

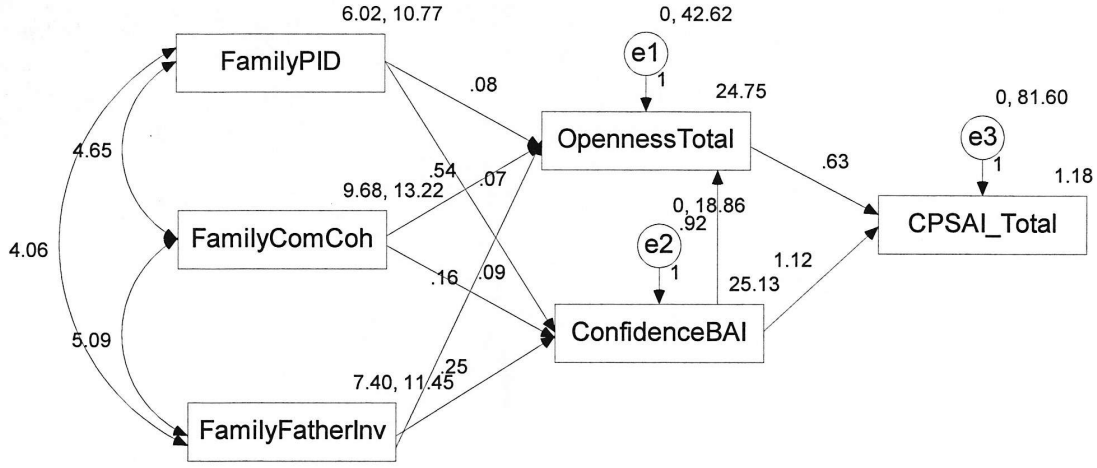

Figure 2. Latino model of predictive relationships among family processes, openness, incremental BAI, and CPSAI using unstandardized path coefficients

Building on existing research that optimize personality with organizational environments to increase creativity in the workplace, this study sought to understand how the global personality dimension of openness that prior research suggests are related to creativity may be related to children's creative attributes in a family setting. Specifically, do certain aspects of family processes predict or influence a child's openness to new experiences? If so, can that openness lead to desired attributes related to creative problem solving? Along with affective disposition

are the beliefs about one's intelligence, which can also influence creative performance. Finally, what are the strengths and direction of those relationships among different ethnicities?

This current study seeks to add to the literature in at least two ways. First, unlike the plethora of creative personality studies in the work place, it is among the first to study the relationship in a much younger population and from an ethnic perspective. Second, it contributes to an important area in education often neglected in current reform – the role of family processes on a child's disposition that can lead to creativity. Most research on families and creativity do not consider the effects on a child's personality and perception of his own intelligence, instead relying mostly on environmental influences. By investigating the interactive effects of family processes, personality, beliefs about intelligence, and attributes related to creative problem solving, this paper can lead educators, parents, and policymakers to a better understanding of the determinants of creative problem solving ability.

Limitations

As with any study, there are certain limitations. In terms of internal validity, the characteristics inherent in this particular ELL population in New York City may cause a selection bias, as they may not be representative of populations in other states. Though questionnaires were modified and evaluated for English language learners (ELL) in the elementary level, there is the possibility of instrument bias due to the reliance on self-reports. Also, because the CPSAI is relatively new, it may also cause some instrumental bias until it has been fully tested in other longitudinal studies.

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