The relationships between bilingual learning, willingness to study abroad and convergent creativity

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Abstract

Convergent creativity is a form of creative thinking that uses existing knowledge or traditional methods to analyze available information and generate an appropriate solution. The differences in the performance of participants in convergent creativity caused by bilingual learning is a popular research area in creativity. A final sample of 68 participants was asked to complete the remote associates test (RAT). The results indicate that a moderate positive correlation exists between bilingual learning and convergent creativity. Students who want to study abroad perform better on the RAT than those who do not, and this effect is mediated by second language proficiency. These findings suggest that improving students' English proficiency and increasing their opportunities to study abroad maybe effective ways to promoting convergent creativity.

Keywords: Convergent creativity, Insight, Language, Overseas experiences

Introduction

What is creativity?

Creativity is defined as the ability of a group or an individual to generate original and appropriate problem solutions (Runco, 2007; Moraru, Memmert, & van der Kamp, 2016). Creativity is an advanced expression of human intelligence and plays an important role in scientific creation, social

progress and technological innovation. Guilford (1967), a past president of the American Psychological Association, noted that creativity mainly includes divergent creativity and convergent creativity. The former refers to how individuals generate new information and produce a wide variety of outputs from the same source in a novel way. Divergent creativity is mainly evaluated by tasks such as the Torrance Test of Creative Thinking (TTCT) (e.g., Humble, Dixon, & Mpofu, 2018) and the Alternative Uses Test (AUT) (e.g., Hao, Xue, Yuan, Wang, & Runco, 2017). In contrast, convergent creativity refers to the cognitive process in which individuals use existing knowledge or traditional methods to analyze given information and obtain the best answer (Lee & Therriault, 2013; Ritter, Abbing, & Van Schie, 2018). The processes of convergent creativity include the evaluation of the divergent creativity stage and the selection of ideas, or a full range of phases ranging from evaluation to implementation (Coursey, Williams, Kenworthy, Paulus, & Doboli, 2018). In real life, many different tasks rely on the use of convergent creativity because this type of creativity is part of creation, and the skillful use of convergent creativity can be critical for creative idea production (Vries & Lubart, 2019). The emphasis on convergent creativity is largely attributed to Simon's study investigating problem solving and the application of Mednick's study on the RAT (Shen, Liu, Shi, & Yuan, 2015). Currently, convergent creativity is primarily measured by tasks such as classical insight problems (e.g., Chein, Weisberg, Streeter, & Kwok, 2010) and the RAT (e.g., Alici, Özgüven, Kale, Yenihayat, & Baskak, 2019; Shen, Yuan, Liu, & Luo, 2016). The RAT was used as the experimental material in this study, which originated from the theoretical model proposed by Mednick in 1962 about the relationship between associative behavior and creativity (Benedek & Neubauer, 2013). Guilford highlighted the importance of divergent creativity, which has led convergent creativity to be overlooked. Although convergent creativity has long been on the outskirts of creative research, with the rapid development of research on brain-based insight, an increasing number of scholars have begun to pay attention to this important issue (Shen et al., 2015).

The influence of bilingual learning and willingness to study abroad on creativity

Accompanying the development of globalization and international trade, cultural migration and exchange activities such as immigration, transnational study, and multilanguage learning have become increasingly frequent (Cheng & Leung, 2013; Shen & Yuan, 2015). In different countries, people need to understand and absorb as well as accept the influence of different cultures, which might be an important requirement for people to adapt to the rapid development of modern society. Thus, cultural activities have an impact on people's ways of thinking.

Rohan, a young entrepreneur mentioned in Tadmor, Galinsky and Maddux's study (2012), lived in five different countries. Rohan stumbled upon some cocoa plantations in Mexico and became fascinated by them. Subsequently, in France, Rohan discovered a chocolate shop that inspired his imagination. Using Aztec-themed designs, Rohan organically combined the pre-Hispanic roots of cacao and the chocolate products that we currently consume. This example highlights how multicultural experiences and exposure to new cultures inspire new ideas. Multicultural experiences refer to all direct and indirect experiences of contact or interaction with elements and/or members of foreign cultures (Hu, Gu, Liu, & Huang, 2017); such experiences can facilitate the performance of individual creativity by improving individual enlightenment learning, distance

79 imagination and concept formation and by generating novel ideas through unfamiliar culture
80 (Wang & Wang, 2018). Under these circumstances, individuals draw new ideas from different
81 cultures and integrate them in novel ways in problem-solving scenarios. Integrating seemingly
82 unrelated concepts in different cultures helps to extend the conceptual category in the brain
83 (Maddux, Adam, & Galinsky, 2010; Wang & Wang, 2018). Shen and Yuan (2015) summarized
84 Maddux's and other scholars' studies (de Bloom, Ritter, Kühnel, Reinders, & Geurts, 2014; Fee
85 & Gray, 2012; Maddux & Galinsky, 2009; Yi, Hu, Scheithauer, & Niu, 2013) and concluded that
86 both long-term and short-term multicultural experiences can boost individual creativity and that
87 improvement in cognitive fluency is among the most obvious outcomes. There are two main
88 reasons for this phenomenon: On the one hand, people with both long- and short-term multicultural
89 experiences have a wide understanding of different cultures, so they can better establish
90 connections between ideas from different cultural sources. On the other hand, extensive exposure
91 to different cultures can sometimes produce conflicting views. This state of mind helps
92 multicultural individuals overcome fixed cognition, eliminate the structured and conventional
93 methods of addressing problems, and stimulate creative thinking (Cheng & Leung, 2013). In
94 addition, when individuals are exposed to foreign cultures with a learning mindset, they might
95 elicit a comprehensive emotional response, such as the recognition of some excellent qualities or
96 admiration for some achievements in foreign cultures, which can also enhance creativity (Cheng,
97 Leung, & Wu, 2011). In conclusion, in this era of globalization, multicultural experiences will
98 create important cognitive benefits (Cheng et al., 2011; Wang & Wang, 2018).

99   Existing studies have shown that the length of time people have lived abroad and their overseas
100 experiences can predict their creative ability (e.g. de Bloom et al., 2014; Fee & Gray, 2012;
101 Maddux & Galinsky, 2009; Shen & Yuan, 2015). However, some studies have found that a certain
102 proportion of those who travel abroad fail to achieve success in the new culture (e.g., Mendenhall
103 & Oddou, 1985; Wederspahn, 1992). While some scholars believe these failures may be due to the
104 lack of adjustment or the psychological discomfort experienced when living abroad (Maddux &
105 Galinsky, 2009), evidence regarding the relationship between adjustment and performance is
106 contradictory (Tadmor et al., 2012). One potential reason is the willingness to study or stay abroad.
107 Some individuals might have no willingness to study or stay abroad (a lack of openness to new
108 countries, cultures, or things) even if they are in foreign countries. Undoubtedly, many people—
109 including students, teachers, and technicians—plan to study abroad but are still in the process of
110 preparation. As Figure 1[1] reports with respect to Chinese students studying abroad, as Chinese
111 society develops, an increasing number of people have taken advantage of the opportunity to study
112 abroad, and people increasingly study or plan to study abroad (Li & Sun, 2018). The intention to
113 study abroad may be related to creativity, and students who have plans to study abroad usually
114 have better creative performance than those who do not have such plans (Lee, Therriault, &
115 Linderholm, 2012). However, few studies to date have explored this interesting issue. Based on
116 existing studies, we are inclined to support the results of Lee and colleagues (2012).

117 **Figure 1.**

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[1]Data were collected from the National Bureau of Statistics of China (http://www.stats.gov.cn/).

118   The main reason for the hypothesis that the intention to study abroad may be related to creativity
119   is that Chinese students who want to study or work abroad must improve their English language
120   proficiency. Many studies have confirmed that bilingual learning can promote creativity (e.g.,
121   Cummins, 1979; Hommel, Colzato, Fischer, & Christoffels, 2011; Wang & Cheng, 2016). From
122   the perspective of students' creativity in English learning, English proficiency is the most important
123   factor determining students' ability to create in English (Wang & Cheng, 2016). In fact, many
124   studies have confirmed the influence of second language proficiency on creativity in children.
125   Kharkhurin (2011) used thirteen examples from 1966 to 1999 to illustrate that bilingual children
126   outperformed monolingual children in divergent thinking traits such as fluency, flexibility,
127   elaboration, and originality. Similarly, the effect of second language proficiency on creativity has
128   been supported by some studies involving adults. For example, the performance of bilingual
129   college students on the Abbreviated Torrance Test of Russian-English was better than that of
130   English monolingual college students (Kharkhurin, 2010). This phenomenon is not confined to
131   one country: in the United Arab Emirates (UAE), Farsi-English bilinguals revealed advantages in
132   originality in thinking compared to native speakers from the same educational group (Kharkhurin,
133   2009). The Chinese scholar Ni (2012) combed through previous studies on the relationship
134   between bilingual learning and creativity and suggested that students with a higher second
135   language proficiency, earlier exposure to a second language and greater length of exposure to a
136   second language have significantly improved creativity, such as in insightful problem solving
137   (IPS).

138   **The influence of socioeconomic status (SES) on creativity**

139   Prior studies have attempted to research creativity as a behavior resulting from an interaction
140   among cognitive abilities, individuality, and social environment, but few studies have examined
141   the role of SES, such as family income, in creative thinking (Parsasirat et al., 2013). Recently,
142   some scholars have begun to explore the relationship between family income and creativity. For
143   example, Kim and Lee (2015) reported that children from low-income families have fewer
144   opportunities to engage in scientific experiences than other children; however, through creative
145   science activity programs, their scientific attitude, self-esteem and self-efficacy will be
146   significantly improved. SES is an important factor in the educational environment, and it is one of
147   the crucial elements influencing creativity. SES can promote children's creative thinking as early
148   as the age of 6 (Jankowska & Karwowski, 2018). Castillo-Vergara, Galleguillos, Cuello, Alvarez-
149   Marin and Acuña-Opazo (2018) investigated students from 75 educational institutions through
150   Quality and Educational Context Questionnaires to determine SES; these questionnaires were
151   mainly used to determine the educational level of the students' parents and the monthly income of
152   their family. The researchers also used the Multifactorial Evaluation of Creativity (EMUC) test to
153   measure the performance of creativity including fluency, flexibility, and originality. The results
154   showed that as the socioeconomic level increases, so does the ability to innovate. Similarly,
155   Sánchez and Salinas (2008) suggested that people with the highest SES levels perform better in
156   the language arts, mathematics, and science, while low-income groups show the opposite results.
157   Based on the above research, it can be speculated that good economic conditions in a family are a
158   key factor in promoting the development of creativity, or a good environment is at least a

159   contributing factor. Undoubtedly, in mainland China, a stable income is necessary for studying
160   abroad. Therefore, this study will investigate the income of the participants through questionnaires,
161   and it will explore the relationship between income and creativity and the intention to study abroad.
162   **The present study**
163   Since the reform and opening-up, China's economy has developed rapidly, and a booming
164   economy has emerged. Meanwhile, with strong economic support, the government has paid
165   increasing attention to cultivating high-quality innovative students. Thus, the state intends to
166   improve students' creativity and academic performance through international exchange.
167   Bilingualism not only plays an important role in cross-language communication but also fulfills
168   social culture and psychological cognitive functions. In recent decades, the relationship between
169   bilingualism and cognitive ability has become a popular topic in pedagogy and psychology.
170   Discussion of this issue has not reached a unanimous conclusion (Paap, Johnson, & Sawi, 2015),
171   but on the whole, most scholars believe that bilingual teaching and multicultural experiences do
172   not burden learners or hinder their growth (e.g., Alesina, Harnoss & Rapoport, 2016; de Bloom et
173   al., 2014; Shen & Yuan, 2015). In contrast, bilingual teaching and multicultural experiences are
174   necessary cultural, economic, and political resources for both the country and the individual.
175   Although the influence of bilingualism on creativity has been studied in depth, few studies have
176   focused on the exploration of convergent creativity. Therefore, this study aimed to examine the
177   impact of bilingual learning and willingness to study abroad on convergent creativity based on
178   previous research.

179   ## Materials & Methods

180   **Participants**
181   In total, 76 healthy undergraduates (35 male; age_M=20.32 years, age_{SD}=2.10 years) participated
182   in this study. Of the participants in this experiment who spoke Chinese as their first language, 66
183   (86.8%) participants spoke one foreign language (English), 8 (10.5%) participants spoke two
184   foreign languages, 2 (2.6%) participants spoke three foreign languages, and all participants spoke
185   English as a second language. Eight of the 76 participants were excluded from the data analysis
186   (10.53%) for the following reasons: One participant did not provide thoughtful responses to the
187   RAT problems, and the other participants required longer than 20 s to answer one of the RAT
188   problems (Shen et al., 2016a; Shen et al., 2019). A final sample of 68 (32 male; age_M=20.37 years,
189   age_{SD}=2.18 years) participants was used in this study, including 28 students who planned to study
190   abroad and 40 students who did not. All participants had normal or corrected-to-normal vision and
191   had no experience with any similar experiments. Before the experiment, the participants provided
192   written informed consent, and they received RMB 10 Yuan at the end of the study. The study was
193   approved by the Ethics Committee of Human Research Protection of Hohai University.
194   **Materials**
195   **Convergent creativity task**
196   According to Mednick's model, convergent creativity is primarily measured by the RAT; highly
197   creative people show higher associative fluency, and they perform better on the RAT (Benedek &
198   Neubauer, 2013; Shen et al., 2016a). A typical RAT contains three unrelated words (e.g.,

199   rat/blue/cottage), and participants are asked to find a fourth word (e.g., cheese) that serves as an
200   associative link to the stimulus test (Alici et al., 2019; Benedek & Neubauer, 2013). In this study,
201   53 Chinese RAT problems (Ding, et al., 2014; Shen et al., 2016a; Shen et al., 2019; Shen, Hommel,
202   Yuan, Chang, & Zhang, 2018) were used as the experimental materials, including five problems
203   (two difficult and three simple problems) used during the practice session. Forty-eight problems,
204   including 24 difficult and 24 simple problems, were used in the formal experiment. These
205   problems can occasionally lead to feelings of insight depending on the participants' judgment.
206   Each item contained three different Chinese words (命/男/学, i.e., in English,
207   *destiny/male/learning*) that prompted the participants to respond with a single solution character
208   (生, i.e., in English, *person*). The complete solution consisted of three Chinese phrases (生命/男
209   生/学生, i.e., in English *life/men/student*); participants can score one point for each correct answer
210   (up to 48 points). When the score is higher, the performance of divergent creativity is better. The
211   Cronbach's α of this test was 0.92, indicating strong internal reliability (Shen, Yuan, Liu, Yi, &
212   Dou, 2016). Furthermore, this test has been used in many studies (e.g., Shen et al., 2016a; Shen et
213   al., 2016b), indicating it has good external validity. During this test, the provided problems
214   (horizontally placed) and their corresponding solutions appeared in the center of the screen in
215   boldface 24-point type, black on gray.

216   Bilingual Proficiency and Overseas Experience Questionnaire

217   This questionnaire included 14 items regarding the basic information of the participants, such
218   as their experiences with learning a foreign language, experiences with studying abroad, plans to
219   study abroad, parents' overseas experiences, and monthly household income. The main purpose
220   of this questionnaire was to collect basic information about the participants, especially regarding
221   their intention to study abroad and second language proficiency. Each item required the
222   participants to choose the most suitable option from the choices given. The item regarding second
223   language proficiency, which had a total of five options ranging from very proficient (1) to not
224   proficient (5), was emphasized. According to the Chinese English Scale (CES) (published in *The
225   Results of Linking IELTS and Aptis to China's Standards of English Language Ability Press
226   Conference*), the participants provided detailed explanations to the experimenter before the test. If
227   the participant's International English Language Testing System (IELTS) score was greater than
228   7.5 or he or she had passed the College English Test-8 (CET-8) (mastering approximately 8,000
229   words), Option 1 was selected. If the participant had an IELTS score greater than 6.5 or they had
230   passed the College English Test-7 (CET-7) and had mastered approximately 7,000 words, Option
231   2 was selected. If the participant passed the College English Test-6 (CET-6) or the College English
232   Test-4 (CET-4) (mastering approximately 5,000 words), Option 3 was selected. If the participant
233   learned English in primary school but had not passed the CET-4, Option 4 was selected (mastering
234   approximately 2,000 words). Finally, if the participant only knew a few English words (fewer than
235   500), Option 5 was selected (e.g., Schachter, Kimbro, & Gorman, 2012; Müller, 2016). In special
236   cases, if the participant found it difficult to judge their English level, it was assessed by a
237   vocabulary test (Hommel et al., 2011). In this study, all participants were able to clearly determine
238   their second language proficiency (all Chinese college students are required to take different
239   English language tests). Thus, the participants did not take the vocabulary test.

240 **Positive and Negative Affect Scale (PANAS)**

241 To exclude potential interference by pre-experimental emotions in the results, the Positive and
242 Negative Affect Schedule (PANAS–State: Watson, Clark, & Tellegen, 1988) was used. The
243 PANAS contains 20 one-word adjective items reflecting positive affect (PA) and negative affect
244 (NA), and each subscale includes 10 (positive/negative) items (Watson et al., 1988). The PA and
245 NA subscales showed no correlation (r=0.14), which corroborates the results reported in previous
246 studies (e.g., Heubeck & Wilkinson, 2019; Leue & Beauducel, 2011). The respondents were asked
247 to rate the items on a 5-point Likert-type scale (1=very slightly or not at all to 5=extremely). The
248 alpha coefficients of the overall scale, the PA subscale, and the NA subscale were 0.86, 0.81, and
249 0.91, respectively, indicating strong internal consistency.

250 **Creative Self-Efficacy Instrument**

251 To rule out the possible impact of creative self-efficacy on the results of the RAT, this study
252 used a four-item Creative Self-efficacy Instrument (Tierney & Farmer, 2002) measured on a scale
253 ranging from 1 (strongly disagree) to 7 (strongly agree). A sample item was "Suggests new ways
254 of performing work tasks". In a study conducted by Tierney and Farmer, this instrument showed
255 a good level of reliability (manufacturing, α=0.83; operations, α=0.87). In this study, the
256 Cronbach's α was 0.85.

257 **Procedures**

258 The participants required approximately 30 minutes to finish the experiment. First, the
259 participants completed a questionnaire about their basic information according to their actual
260 situation. After this section, the participants were asked to complete the PANAS based on their
261 current mood. Finally, the participants responded to the RAT problems, which were designed and
262 presented by E-prime 2.0 (Psychology Software Tools, Inc., Pittsburgh, PA, USA).

263 **Figure 2**.

264 Before the formal experiment, the participants completed a 5-item practice session to become
265 familiar with the experimental process. Then, the participants completed 48 RAT problems as
266 shown in Figure 2. Each trial began with a "+" fixation in black on a computer screen to keep the
267 participants focused on the screen. Then three words appeared in the center of the monitor in Song
268 style, No. 28, black. The problem was displayed on the screen until the participants answered the
269 problem or 20 s had passed. If the participant solved the problem, they could press the space bar
270 on the keyboard and enter the answer stage after a 500 ms interval. On this screen, the participants
271 had unlimited time to type in the answer, and they pressed "Enter" to indicate they had finished
272 this stage. Finally, a 500 ms interval represented the end of the trial with a grayish screen.

273 **Statistical data analysis**

274 Data were input and analyzed using SPSS Version 20.0 for Windows (SPSS Inc., Chicago, IL,
275 SUA). The difference between the group that planned to study abroad and the group that did not
276 on RAT performance and language was analyzed through independent-samples t-tests. Second
277 Language proficiency is a rank-ordered variable, and so between-group differences were tested by
278 the Mann-Whitney U test (Isohashi et al., 2013). The Pearson and Spearman correlation were used
279 to analyze the relationships between the variables (Puth, Neuhauser, & Ruxton, 2014). The

280 mediating effect of second language proficiency was measured by nonparametric bootstrapping,
281 and Hayes's (2013) process was used in the analysis.

Results

Correlations

284 The RAT is often used to explore the phenomenon of creative thinking, especially when
285 examining insight into problem solving. The averages of the RAT score, monthly household
286 income, and bilingual proficiency were 20.53 (SD=5.90), 8842.65 RMB (SD=10082.13), and 3.43
287 (SD=0.70), respectively. Table 1 presents the correlations between the RAT performance and the
288 individual differences measured in the study. One valuable result was that proficiency in a second
289 foreign language was strongly correlated with the RAT score (r=0.45, p<0.01), as was the
290 willingness to study abroad (r=-0.29, p<0.05).

291 **Table 1.**

Influence of willingness to study abroad on convergent creativity

293 This study examined the influence of overseas experiences[2] and willingness to study abroad on
294 the participants' performance on the RAT. First, the results of the PA and NA subscales were
295 analyzed to rule out the effect of natural emotions on the performance on the RAT. The group that
296 planned to study abroad and the group that did not showed no difference on the PA (t=-0.87,
297 p=0.39>0.05, Cohen's d=-0.21) and NA (t=1.17, p=0.25>0.05, Cohen's d=0.31) subscales. Thus,
298 the additional variable of natural emotions was excluded from this study. The results of the
299 Creative Self-Efficacy Instrument revealed no difference between the group that planned to study
300 abroad and the group that did not (t=1.61, p=0.11>0.05, Cohen's d=0.40).

301 Table 2 reports the difference in the performance on the RAT between two groups, a group of
302 participants who planned to study or work abroad and a group of participants who did not.
303 According to an independent-samples t-test, the participants who planned to study abroad had
304 significantly higher scores than those who were not (t=2.48, p=0.016<0.05, Cohen's d=0.62). This
305 result suggests that people who want to study or work abroad perform better at solving RAT
306 problems than those who do not. The average monthly household income of the participants who
307 intended to study abroad was 11767.86 yuan, while that of the participants who did not plan to
308 study abroad was 6795.00 yuan, with a significant difference between the two groups (t=2.05,
309 p=0.044<0.05, Cohen's d=0.54). Thus, the family income of those who wanted to study abroad
310 was significantly higher than that of the students who did not. Furthermore, as shown in Table 3,
311 students who wanted to study abroad were significantly more proficient in English than students
312 who did not (p<0.01).

313 **Table 2.**

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[2]Overseas experiences were measured by the number of short-term (less than two weeks) and long-term (more than two weeks) studies or trips abroad by the participants (Shen & Yuan, 2015). In this study, only 9 (13.3%) participants had short-term experience traveling abroad, and only 2 (2.9%) participants had been abroad for more than two weeks. Most participants did not have experience studying, traveling or working abroad.

314   **Table 3.**

315   To further explore the influence of bilingual learning and willingness to study abroad on RAT
316   problem solving, a backward regression analysis was employed to analyze the RAT problem
317   scores (Tanksale, 2015). The monthly household income, number of foreign languages spoken by
318   the participants, willingness to study abroad, and number of times the participants and their parents
319   had traveled abroad were input to predict the performance on the RAT problems. Only second
320   language proficiency predicted the score on the RAT (B=0.47, SE=0.92, β=0.47, t=4.36, p<0.001).
321   **Mediating effect of second language proficiency**
322   According to Hayes (2013), this study adopted nonparametric Bootstrap to explore the
323   mediating effect of second language proficiency between willingness to go abroad and RAT
324   solved, which was executed based on the PROCESS macro and the observed variables (Jach, Sun,
325   Loton, Chin, & Waters, 2018). By sampling the original data, 5,000 samples were extracted to
326   estimate the 95% confidence of the mediation effect test (Calvo-Mora, Ruiz-Moreno, Picón-
327   Berjoyo, & Cauzo-Bottala, 2014; Yang, Liu, & Chen, 2018). The 95% confidence (LLCI=-3.30,
328   ULCI=-0.61) of the indirect effect did not include 0; thus, the mediating effect of second language
329   proficiency was significant. The regression analysis results are shown in Table 4. According to
330   regression model 1, willingness to go abroad has a significant predictive effect on second language
331   proficiency. According to model 2, when both willingness to go abroad and second language
332   proficiency are included in the model, the predictive effect of the RAT solved was significant, but
333   the direct effect of willingness to go abroad on the RAT score was not significant; therefore, second
334   language proficiency had a complete mediating effect between the two variables. The mediation
335   analysis results of each outcome variable are displayed in Figure 3 through a presentation of the
336   unstandardized path coefficients of each model.

337   **Table 4.**

338   **Figure 3.**

339 ## Discussion

340   The purpose of this study was to experimentally investigate the relationships between bilingual
341   learning, willingness to study abroad and performance on a Chinese variant of the RAT problems
342   as an index of convergent creativity. This research showed that bilingual learning was positively
343   correlated with RAT performance. Students who were willing to study abroad performed better on
344   the RAT than students who were not, but this effect was mediated by second language proficiency.
345   On the basis of previous studies, the results are discussed according to the aspects of bilingual
346   learning, overseas experience and family income.
347   **The relationship between bilingual learning and convergent creativity**
348   Bilingual learning is a requirement for compulsory education in China. As early as 1979,
349   Cummins (1979) proposed the advantages of bilingual learning, which can help learners form two
350   sets of language systems in their brain to create a special cognitive mechanism. In the process of

351 language selection, the suppression of the nontarget language can improve the suppression control
352 function of bilingual learners. Similarly, practicing a target language can strengthen the function
353 of selective focusing. Moreover, code-switching between two languages helps individuals
354 overcome psychological patterns and achieve strategy adjustment and conversion (Costa,
355 Hernández, & Sebastián-Gallés, 2008). Many studies have explored the impact of multilingual
356 learning on creative thinking and its mechanisms of action. Ricciardelli (1992a) performed a meta-
357 analysis of 25 studies published between 1965 and 1992 and found that approximately 80% of
358 bilingual and multilingual learning experiences can improve individuals' creative thinking.
359 Moreover, this conclusion was confirmed in the author's experiment (Ricciardelli, 1992b), which
360 found that highly proficient bilinguals scored significantly higher on fluency in creative thinking,
361 imagination, and language fluency than monolingual or low-proficiency bilinguals.
362 This study provided an important finding about convergent creativity in the literature: Second
363 language proficiency is strongly correlated with the RAT score and can predict performance on
364 RAT problems. On the one hand, this result is consistent with some previous findings, such as
365 those reported by Hommel and colleagues (2011). The authors' study included 42 young healthy
366 participants who were asked to complete the RAT and an English vocabulary test. The results
367 showed that high-proficiency bilinguals performed better than low-proficiency bilinguals on the
368 RAT. A study involving Russians (Spanakos, 2001), in which 278 middle school students were
369 recruited as participants and a series of tests was used to measure their divergent and convergent
370 creativity, obtained similar results. These results showed that bilingual participants outscored
371 monolingual participants on convergent creativity. On the other hand, some studies, such as that
372 conducted by Vries and Lubart (2019) to investigate scientific creativity, have reached the opposite
373 conclusion. Interestingly, these authors found that culture-related variables were significantly
374 negatively correlated with the originality of divergent and convergent scientific creativity and
375 noted that the reason may be the mediating role of personality, personal information, and cultural
376 adaptation. Finally, regarding the prediction of second language proficiency, Wang and Cheng
377 (2016) drew a conclusion similar to that found in this study: English proficiency can significantly
378 predict metaphoric creativity. This finding suggested that English ability is an important factor in
379 predicting creativity. In summary, most studies have reported the influence of multilingual or
380 linguistic learning on creative thinking, especially convergent creativity (Shen & Yuan, 2015).

The relationship between studying abroad and convergent creativity

382 Numerous studies have confirmed that overseas experiences can influence people's creative
383 thinking. For example, people with one year of immigration experience had a significantly higher
384 score on creative thinking fluency than those without such experience (Fee & Gray, 2012).
385 Surprisingly, in an examination of the impact of short-term overseas experience on individual
386 creative thinking with a traceable pre-post-test design, de Bloom et al. (2014) found that studying
387 abroad for only two weeks can promote fluency. Regarding convergent creativity, Maddux and
388 Galinsky (2009) explored the effect of foreign experiences on the RAT. The results showed that a
389 sample of individuals who had lived abroad performed significantly better on the RAT than a
390 sample of people who had not lived abroad. In addition, this temporary facilitative effect of foreign
391 experiences was strongest among the participants who had lived abroad the longest. In summary,

both long- and short-term overseas experiences may have a positive effect on individual creative thinking.

The above results could not be analyzed in this study because the proportion of participants with overseas experience was too small: only 13.2% have short-term overseas experience and 2.9% have long-term overseas experience. All participants were students (56 undergraduates and 10 postgraduates). Although the participants were adults, they often had insufficient social experience, limited living expenses and heavy academic pressure; thus, the participants may not have had the opportunity to study abroad. Therefore, most participants did not have experience studying, visiting, or working abroad. However, as expected, cultural factors were related to convergent creativity; people who want to go abroad tend to have stronger critical thinking skills and a stronger desire for expressing themselves, such as being adventurous, culturally savvy or globally cosmopolitan (Adam, Obodaru, Lu, Maddux, & Galinsky, 2018; Martin, Katz-Buonincontro, & Livert, 2015). Frändberg and Handelshögskolan (2015) conducted biographical narrative interviews with 22 adults; they found that the decision regarding the plan to study or work abroad was typically described as highly personal. People with this intention usually believe they can improve themselves and develop creative ideas in a foreign country. Notably, the intention to study abroad was significantly positive correlated with the performance on the RAT. This finding corresponds to the study of Lee and colleagues (2012), who used the Abbreviated Torrance Test for Adults (ATTA) and the Cultural Creativity Task (CCT) to measure the creativity level of three types of participants: those who have studied abroad, those who plan to study abroad, and those with no plan to study abroad. On both scales, the results showed that students who plan to study abroad scored higher than students who did not.

The reason for the above finding might be related to the mediating effect of second language proficiency. To face the challenges of an increasingly globalized world, second language proficiency is becoming increasingly important for students who want to obtain better educational opportunities (Schoepp, 2018). In China, to study abroad, students must pass an English test, such as the IELTS or the Test of English as a Foreign Language, to prove that they have the language ability to live and study abroad. Through interviews with 32 students in Guangzhou who want to go abroad, Wu (2018) found that this group wanted to improve their second language proficiency through overseas study experience, and they were willing to invest time into passing the English tests. This finding may be because excellent performance on the English tests (e.g., IELTS) not only demonstrates students' English ability but also predicts their academic success (Schoepp, 2018). Therefore, students must exert considerable effort to improve their English skills so they can perform well on English tests.

Going abroad is an opportunity for individuals to come into contact with a strange environment, characterized by novelty and accompanied by completely different values, cultural identities and behavioral habits (Adam et al., 2018). Individuals who want to go abroad are usually more open to new experiences; for example, they are more intellectually curious about foreign cultures and more receptive to cultural instruction, increasing the irregularity and cultural relevance of their approach to insight problems (Cho & Morris, 2015; Martin et al., 2015). Silvia, Nusbaum, Berg, Martin and O'Connor (2009) suggested that openness to new experiences plays an important role

in the performance of creativity, with two main aspects: openness (including imagination, creativity, and aesthetics) and intellect (including thinking and reasoning). Their experiment included 189 students (Silvia et al., 2009), and their personalities, divergent thinking, creative achievement and creative self-efficacy were measured through questionnaires. From the latent variable models, they found broad effects of openness to experience to creativity. Similarly, the results from Schilpzand, Herold and Shalley's (2011) study with 31 graduate student teams indicated openness is significantly related to team creativity. For intellect, individuals can improve their cultural intelligence by mastering and transmitting their multicultural experience (Hu et al., 2017). Cultural intelligence makes individuals aware of cultural differences, and they can master other cultural knowledge well, which provides them with new ways of thinking and with new concepts. These new inputs create more possibilities for them to view things from different perspectives and contribute to the performance of creativity (Cheng & Leung, 2013; Hu et al., 2017). Through a questionnaire survey of 310 international students, Hu and colleagues (2017) found that cultural intelligence was significantly correlated with creativity, partially mediating the relationship between multicultural experiences and creativity. Based on the above studies, people who intend to go abroad may perform better on the RAT because of their higher openness to experience.

Family income is a key factor that should be considered in study abroad plans and even in the preparation of bi- or multilingual learning. Family income performs an important function in the educational and growth processes. For example, in China, high-income families receive the greatest educational benefits, while low-income families have the lowest investment in children's specialty training (Zhang, Zhang, Zhang, Xiang, & Wang, 2015). Similarly, family income has a significant independent predictive effect on early childhood language ability after controlling for children's age and gender (Li, Li, & Li, 2012). Income is also related to children's cognitive development in foreign countries, as shown by the Panel Study of Income Dynamics (PSID) in America. The study showed that the level of income was associated with Woodcock-Johnson (W-J) Achievement Test scores, and that income stability was associated with W-J applied problem scores and the Behavior Problem Index (BPI), even after including all controls in the models (Yeung, Linver, & Brooks–Gunn, 2002). In addition, among the different indicators of SES, only income showed significant associations with children's emotional health status. Therefore, good and stable economic conditions are crucial for studying abroad (Hercog & van de Laar, 2017) and can provide material security for students to study abroad and achieve professional and personal goals (Doppen, An, & Diki, 2016).

Over the last ten years, the number of Chinese students studying abroad has grown rapidly, but more than 90% of these students choose to study abroad at their own expense. This number is mainly determined by the economic strength of their families. Therefore, family income is the most important factor affecting the number of students studying abroad (Li, 2018). In China, among children under the age of 15, the proportion of children who travel abroad for further study is 13.02%, and the proportion of children who may be sent abroad in the future is 23.58%. Families with such plans are often high-income families (Sun, Du, Zhao, & Li, 2016). The influence of high family income on creativity might be another reason for the significant positive correlation

474   between the willingness to study abroad and convergent creativity.

Conclusions and future recommendation

476   In conclusion, this study reveals that bilingual learning is positively correlated with convergent
477   creativity. When a student's English level is higher, the student scores better on convergent
478   creativity as measured by the RAT. Students' plans to study abroad and their convergent creativity
479   abilities are significantly related, with students who want to study abroad performing better on the
480   RAT. This facilitation might relate to the mediation of second language proficiency.

481   At present, few studies have examined the relationship between bilingualism and convergent
482   creativity. This study not only explored this issue but also searched for a connection between
483   convergent creativity and life plans.

484   This study had several limitations. First, in this study, we used the PANAS and Creative Self-
485   Efficacy Instrument to control for the influence of emotions and creative self-efficacy on the study.
486   Emotions are an important factor affecting individuals' creativity (e.g., Lin, Tsai, Lin, & Chen,
487   2014), and the PANAS is a common tool used to measure emotions in many studies (e.g., Ceci &
488   Kumar, 2016; Fernandez-Abascal & Diaz, 2013). Creative self-efficacy has a positive and direct
489   influence on achievement goals (Bang & Reio, 2017; Puente-Diaz & Cavazos-Arroyo, 2018) and
490   other personality factors (Karwowski, Lebuda, Wisniewska, & Gralewski, 2013). In many studies
491   investigating creativity, creative self-efficacy is used as a moderator variable (e.g., Gong, Huang,
492   & Farh, 2009; Wan, Tsai, & Tsai, 2014). However, measuring more irrelevant variables, such as
493   novelty-seeking and the motivation to study abroad, is necessary to further ensure the accuracy of
494   the results and to clarify the underlying mechanisms leading to the results. Second, in China, all
495   college students are required to take different English language tests; thus, assessing second
496   language proficiency using the Bilingual Proficiency and Overseas Experience Questionnaire is
497   effective and convenient. However, if other groups of participants are included, such as workers
498   or children, it is best to use a vocabulary test (Hommel et al., 2011). Third, this study showed that
499   the intention to study abroad was related to performance in convergent creativity; in future
500   research, the causes of this result could be explored by measuring other relevant variables, such as
501   openness to experience. Furthermore, a considerable number of studies from diverse groups has
502   validated the effectiveness of such a tool to measure the convergent creativity of Chinese people
503   (Ding, et al., 2014; Shen et al., 2016a; Shen, et al., 2018; Shen et al., 2019; Wu, Chang, & Chen,
504   2017). With the deepening of research on creativity worldwide, an increasing number of people
505   may be interested in the creativity of Chinese people, so this tool must be further promoted and
506   verified. To contribute to the attenuation of the controversy on this hot issue (Paap & Greenberg,
507   2013), further studies are also needed to explore the cognitive and neural mechanisms of bilingual
508   learning and the willingness to study abroad on convergent creativity and the difference between
509   convergent creativity and divergent thinking. This study explores only the relationship between
510   variables. Thus, causal inferences are difficult to make. The reasons for the correlations between
511   these variables may be possible to identify through the cognitive and neural mechanisms. Through
512   a more comprehensive analysis of these issues, effective measures to enhance students' creativity
513   may be proposed from the perspective of educational policy.

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514 **References**

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Correlations between RAT performance and individual variables

Table 1: Correlations between RAT performance and individual variables.

	RAT solved
Income	0.13
Second language proficiency	0.45**
Willingness to study abroad	-0.29*

2 *$p<0.05$, **$p<0.01$, ***$p<0.001$

The difference RAT performance and income in two groups.

Table 2: The difference RAT performance and income in two groups.

	Planning to study abroad (*n*=28)	Not planning to study abroad (*n*=40)	95% CI	*t*	Cohen's *d*
	M±SD	*M±SD*			
RAT solved	22.57±5.03	19.10±6.10	±2.75	2.48*	0.62
Income	11767.86±14704.17	6795.00±3807.75	±4756.95	2.05*	0.54

The difference language proficiency in two groups (Mann-Whitney *U* test).

Table 3: The difference language proficiency in two groups (Mann-Whitney *U* test).

	1	2	3	4	5	*Mean Rank*	*P*-value
Planning to study abroad (*n*=28)	1	2	17	8	0	27.41	0.006
Not planning to study abroad (*n*=40)	0	1	15	22	2	39.46	

Results of hierarchical regression.

Table 4: Results of hierarchical regression.

Model	Independent variable	Dependent variable	*B*	*t*	*SE*
1	Willingness to go abroad	Second language proficiency	0.48	2.96**	0.16
2	Second language proficiency	RAT solved	-3.57	-3.67***	0.97
	Willingness to go abroad		-1.75	-1.28	1.37

Figure 1

Number of students stu Number of students studying abroad (1978-2017) .
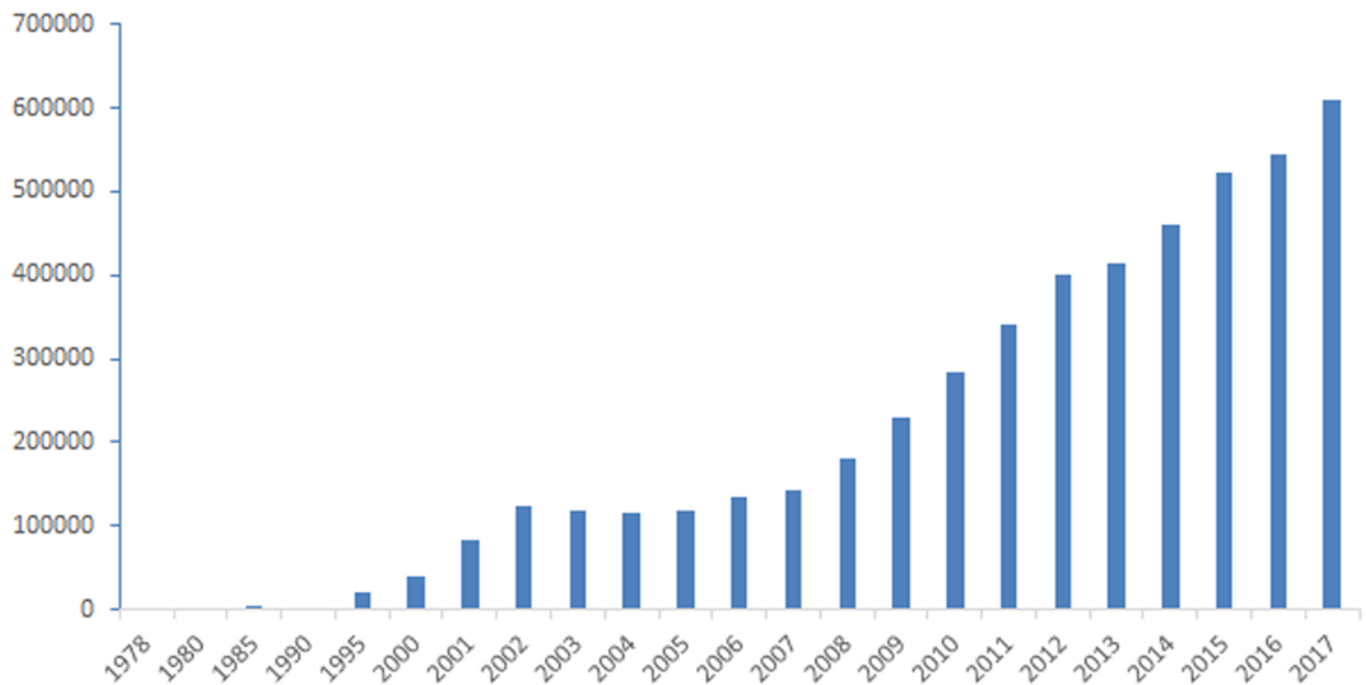
Figure 2

Process of the convergent creativity task.
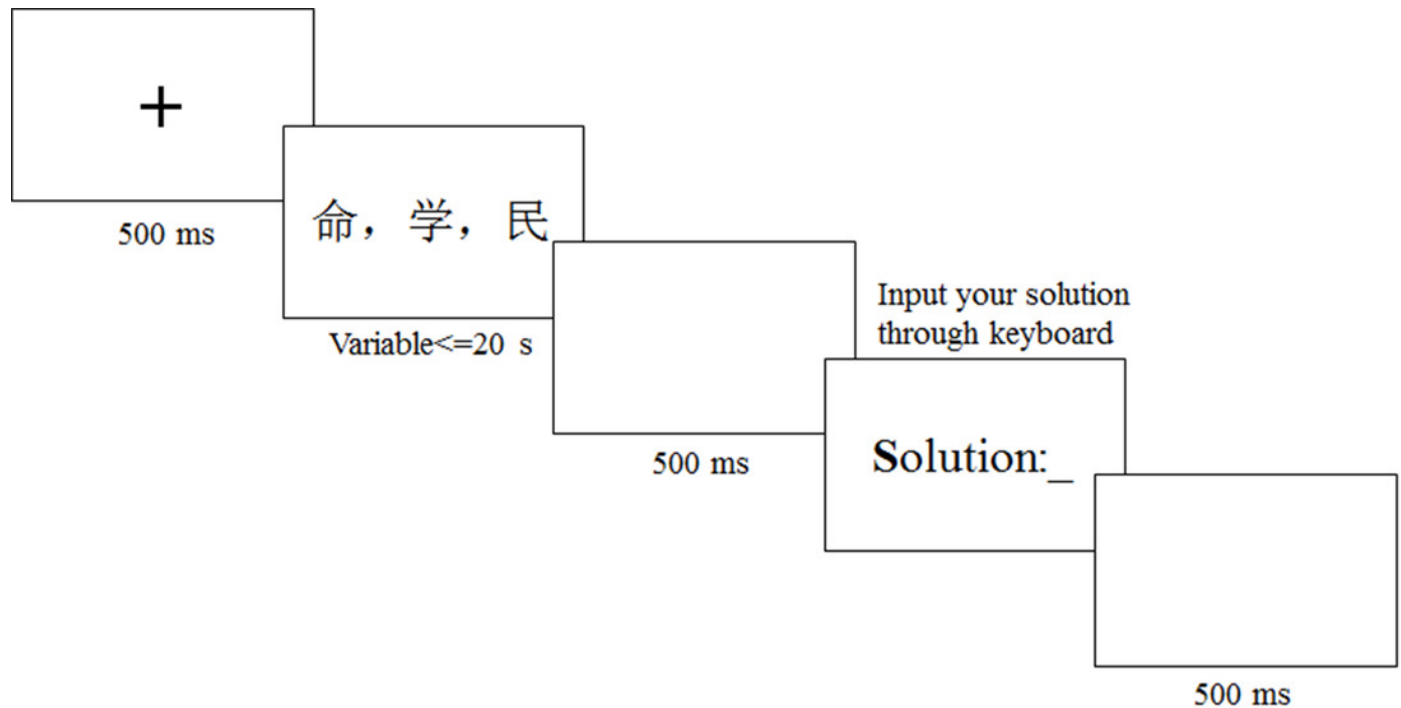
Figure 3

Mediating effect of second language proficiency.