The Influence of Gender and Scientific Program Experience on Postgraduates' Creativity

Yuan ZHAOa, Wang-Bing SHENb,*, Chun-Hua SHIC,∗ and Mei-Cun Lid

Institute of Applied Psychology and School of Public Administration, Hohai University, Nanjing, China, 210098

asdjnzhaoyuan@163.com, bwbshenhhu@126.com, cchunhuashi828@sina.com, dmeicun19@126.com

*Corresponding author

Keywords: Postgraduate, Creativity, Gender, Program Experience.

Abstract. This study aimed to empirically investigate the influence of China postgraduates’ both gender and participation in research projects. A sample of 260 postgraduates (106 males and 143 females) from a China university performed the Kaufman domains of creativity scale and the questionnaire on scientific project participation. The results showed that the female’s performance in everyday creativity was significantly better than the male, whereas the male’s performance in scientific creativity was significantly better than the female. The amount of research project participation could also affect postgraduates’ creative performance, with a markedly better performance for the students participating in two or more projects than others. These results suggest gender and participation in research projects both greatly contribute to the postgraduates’ creative performance.

Introduction

Creativity is the ability of individuals to produce ideas and products that are novel and unique. It is not only the advanced expression of human intelligence, but also plays an important role in scientific creation, social progress and technological innovation. Creativity is known as the source of human civilization [1]. Since 1995, Chinese government has initiated a series of national policies related to innovation and creativity. In the 13th Five-year Plan, president Xi said, “We should expand the autonomy of colleges and institutes, give more rights of dominion and decision to innovative talents”. Stimulating the graduate students’ creativity is an important subject of scientific research management in China [2].

Gender is an essential factor influencing divergent thinking. Existing studies have revealed a significant difference in many fields such as thinking styles, intelligence, spatial capability, and creative thinking. Stavridou and Furnham [3] found that female usually perform significantly better in divergent thinking, which means, their thinking is more fluency, originality and flexibility. However, Kaufman [4] used a sample of 3552 students from high school and college as subjects. They were required to individually complete domains of creativity scale. The study showed that male had a better performance in divergent thinking and had higher self-evaluation in scientific analysis. Recently, an increasing number of studies have reported gender and educational level as an interaction effect working in creativity. As for educational level, the female who get college education level are having significant advantages in all dimensions of divergent thinking than the female who only received primary or secondary education. But educational level has no effect on the male’s performance in
divergent thinking. The fluency scores of women who have college degree are higher than the male with same level in education. It can be seen that education or professional training is a key factor influencing individuals’ creative thinking.

In fact, gender also impact individuals’ performance in convergent thinking. For example, Shen found that in convergent thinking, male have certain advantages. They are better at using existing knowledge and experience to analyze the problem [5]. In 1985, Richardson [6] made a survey of 320 16-year-old men and women and found that women had a significantly better performance than men in the RAT. Furthermore, people who perform well in creativity also show the differences between male and female. For example, Helson [7] found that mathematicians of different genders behaved differently in creativity. Compared with creative women, creative men are more professionally participative. They have higher self-acceptance, stronger aspiration, and they hope for a sense of accomplishment in scientific researches. Exploring the impact of gender on postgraduates’ performance of creativity can provide theoretical insights into policy-making on professional training and higher education on postgraduate students.

Now the challenge for graduate students is the need to grow into an independent learner. They need to have better academic supports and clear directions on what they should do during the study [8]. And scientific research is the most important way of learning and progressing of them [8]. Taking part in high-level research projects is the essential pillar for them to enhance personal ability. In research projects, students can acquire and develop learning experience, and learning experience can facilitate self-actualization, creativity, and the understanding of new concept. In this way, students can promote the effect of learning, and they have more opportunities to develop their diversity and flexibility [9]. In research projects, postgraduates can meet with entrepreneurs, engineers, scientists and other outstanding people. They can be regarded as the models for postgraduates to encourage them in improving self-employment and innovation [10]. They can also promote the development of postgraduates’ creativity and stimulate their learning motivation [9].

As we have seen from previous studies, gender and participation in research projects are two factors that affect the creativity of postgraduates, but there are little papers about how they influence it. By doing a questionnaire survey, this paper examined the creative performance, as well as gender and scientific program experience, which could aim at determining the impact of gender and participation in research projects on creativity.

Methods

Participants

A sample of 260 postgraduates from a China university were recruited and required to individually complete a set of questionnaires. A total of 260 questionnaires were handed out in classes. 249 valid samples were consisted of 106 males (42.57%) and 143 females (57.43%). The number of postgraduates who haven’t participated in research projects is 137 (55.02%). The number of postgraduates who participated in research projects only for once is 63 (25.30%). The number of postgraduates who participated in research projects more than twice (including twice) is 49 (19.68%).
Research Tools

The Kaufman domains of creativity scale was revised by Tu and Fan [11] in China to measure postgraduates’ creativity in different domains. This scale is consisted of 50 questions and measured five domains of creativity that includes everyday creativity, scholarly creativity, performance creativity, scientific creativity and artistic creativity.

The score on this scale was based on Likert’s five-scale, 1 means has little creativity and 5 means has a lot of creativities. The Cronbach’s alpha in five domains were respectively 0.80, 0.87, 0.92, 0.89, 0.88 in this study and Tu and Fan[11] reported the Cronbach’s alpha of this scale in five domains were respectively 0.80, 0.76, 0.86, 0.78 and 0.81 in their study. The scale was extensively used to measure students’ creativity, the external validity has been shown to be acceptable [4, 11].

Results and Analysis

We used descriptive and inferential statistics to analyze the data. There are two parts in descriptive statistics which include means and variables’ standard deviations. In inferential statistics, we used Pearson’s correlation and stepwise multiple regression analysis to analyze the data. The results are showed in Table 1 to 3.

Descriptive Statistics

Table 1 shows male postgraduates’ and female postgraduates’ performance of creativity in different domains. According to Table 1, the means of the participants’ performance in everyday creativity, scholarly creativity, performance creativity, scientific creativity and artistic creativity are 35.51, 32.41, 24.24, 23.78 and 27.77. This implies that they have a better performance in everyday creativity than other domains. We regarded gender (male/female) as independent variable and participants’ performance in different domains as dependent variable, and used independent t-test to study it. In everyday creativity, female postgraduates’ score was significant higher than male postgraduate (t=-3.20, p<0.01, Cohen's d=-0.36). But in scientific creativity, the result was opposite to everyday creativity (t=3.95, p<0.001, Cohen's d=0.48).

<table>
<thead>
<tr>
<th>Scores</th>
<th>Gender Males(n=106)</th>
<th>Females(n=143)</th>
<th>Total (N=249)</th>
<th>t</th>
<th>Cohen's d^1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
</tr>
<tr>
<td>Everyday creativity</td>
<td>32.97</td>
<td>12.19</td>
<td>37.39</td>
<td>8.53</td>
<td>35.51</td>
</tr>
<tr>
<td>Scholarly creativity</td>
<td>31.82</td>
<td>6.60</td>
<td>32.84</td>
<td>7.48</td>
<td>32.41</td>
</tr>
<tr>
<td>Performance creativity</td>
<td>23.25</td>
<td>9.71</td>
<td>24.97</td>
<td>9.59</td>
<td>24.24</td>
</tr>
<tr>
<td>Scientific creativity</td>
<td>26.32</td>
<td>9.25</td>
<td>21.89</td>
<td>8.37</td>
<td>23.78</td>
</tr>
<tr>
<td>Artistic creativity</td>
<td>26.98</td>
<td>8.02</td>
<td>28.35</td>
<td>7.29</td>
<td>27.77</td>
</tr>
</tbody>
</table>

^1Cohen’s d was computed through the website: http://www.cognitiveflexibility.org/effectsize/

The Performance on Different Creativity Domains of Postgraduates Who Take Part in Different Amount of Projects

Table 2 shows that different amount of projects influences the performance of creativity in different domains. According to Table 2, we found that there are 37 postgraduates (55.02%) haven’t participated in any scientific research projects, 63 postgraduates (25.30%) have only joined one project and 49 postgraduates (19.68%) have taken part in many projects. It can be
seen that the participation of postgraduates in projects needs to be improved. In Table 2, “0” means the participants haven’t taken part in any project; “1” means they only have joined 1 project; “many” means they have taken part in 2 or more projects before. We used project amount as independent variable and participants’ performance in different domains as dependent variable. The participants’ performance between the two groups were compared with analysis of variance (ANOVA). As the result shows, only in scientific creativity, “more” group’s score was significant higher than others ($t=5.15, p<0.01, \text{Cohen's } d=-0.41$).

Table 2. Means, standard deviations of the performance on different creativity domains for postgraduates take part in different amount of project.

<table>
<thead>
<tr>
<th>variables</th>
<th>Project amount</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0(n=137)</td>
<td>1(n=63)</td>
<td>many(N=49)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everyday creativity</td>
<td>34.39</td>
<td>10.80</td>
<td>37.14</td>
<td>9.37</td>
<td>36.55</td>
<td>10.64</td>
<td>1.81</td>
<td>-0.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scholarly creativity</td>
<td>32.12</td>
<td>7.29</td>
<td>32.76</td>
<td>7.00</td>
<td>32.76</td>
<td>6.91</td>
<td>0.25</td>
<td>-0.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance creativity</td>
<td>23.88</td>
<td>8.83</td>
<td>24.27</td>
<td>11.05</td>
<td>25.20</td>
<td>10.13</td>
<td>0.34</td>
<td>-0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific creativity</td>
<td>22.15</td>
<td>8.26</td>
<td>25.54</td>
<td>10.29</td>
<td>26.04</td>
<td>8.53</td>
<td>5.15**</td>
<td>-0.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artistic creativity</td>
<td>26.98</td>
<td>8.02</td>
<td>28.35</td>
<td>7.29</td>
<td>27.77</td>
<td>7.62</td>
<td>-1.40</td>
<td>-0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inferential statistics

The result of stepwise multiple regression analysis is shown in Table 3 and Table 4. We used gender and project amount as predictors, and participants’ performance in different domains as criterion [12]. According to Frazier’s suggestion, before conducting stepwise multiple regression analysis, we should transform gender and project amount into dummy variable [13]. The encoding of gender variables are male=“0” and female=“1”. In the process of encoding of “project amount”, we used “many” as control group. “Project_dummy 1” represents “0” compare with “many”, and “project_dummy 2” represents “1” compare with “many”.

As shown in Table 3 and 4, gender and “project_dummy 2” can predicted and explained 7% of changes in everyday creativity ($R^2=0.07$), and they can also predicted and explained 8% in scientific creativity ($R^2=0.08$).

Table 3. the results of the stepwise multiple regression of everyday creativity.

<table>
<thead>
<tr>
<th>The order of input variables</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$</th>
<th>$B$</th>
<th>Beta($\beta$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Comparison of boys and girls</td>
<td>0.21</td>
<td>0.04</td>
<td>0.04</td>
<td>10.81**</td>
<td>-4.73</td>
<td>-0.23</td>
</tr>
<tr>
<td>2. Comparison of 0 group with many group</td>
<td>0.26</td>
<td>0.07</td>
<td>0.02</td>
<td>8.54***</td>
<td>-3.22</td>
<td>-0.15</td>
</tr>
</tbody>
</table>

Table 4. the results of the stepwise multiple regression of scientific creativity.

<table>
<thead>
<tr>
<th>The order of input variables</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$</th>
<th>$B$</th>
<th>Beta($\beta$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Comparison of boys and girls</td>
<td>0.23</td>
<td>0.05</td>
<td>0.05</td>
<td>13.91***</td>
<td>3.67</td>
<td>0.21</td>
</tr>
<tr>
<td>2. Comparison of 0 group with many group</td>
<td>0.29</td>
<td>0.08</td>
<td>0.03</td>
<td>10.85***</td>
<td>-3.05</td>
<td>-0.17</td>
</tr>
</tbody>
</table>
Discussion

The Influence of Gender on Postgraduates' Creativity

Creative thinking is an important psychological foundation that drives the progress of scientific technology and the human development of society and culture. The difference had been demonstrated in creative thinking between male and female by many specialists and learners. In this research, the differences were embodied in the field of everyday creativity and scientific creativity, in which the scores of female subjects significantly higher than the male subjects in everyday creativity, but the scores of male subjects significantly higher than female subjects in scientific creativity.

The purpose of postgraduates’ education is not only to teach them knowledge, but also to enable students to master the learning methods and techniques, and to use them to solve a variety of problems. Therefore, postgraduates should not only be outstanding in scientific creativity, but also have a wealth of everyday creativity to deal with the various problems in life. Everyday creativity is the creativity shown in daily life, mainly involves “deal with interpersonal relationship” and “solve daily life problems”. Kaufman [11] suggested that EQ is essential in everyday creativity. Compared with undergraduates, postgraduates’ mental maturity is more mature. Some of them have worked a period of time before they joined campus, so their life experience is more abundant.

Although Baer’s study showed a gender equality in creative potential [14], the males advantage in the creative achievements of the real world is clearly visible, and they always have outperform females in mathematics and science [15]. Karwowski [16] also supported that male performance is better than female in creativity and clarified the reasons for it. He selected 3594 subjects in Poland for a creative test. The overall results of the study are same as those of many previous studies: There is no significant difference in the level of creativity between men and women, but the variability of men is higher than that of women which means there are many highly creative talents in the male group. From the results of this study, the reason why male’s scientific creativity is significantly higher than that of women is probably because of the greater number of high-quality talents in male postgraduates, and these highly creative men show high scientific creativity.

Under different cultures’ influences, adolescents have shown gender difference in scientific creativity. Male's scientific creativity is superior to female in oriental cultural backgrounds, and female’s scientific creativity is better than male in western cultural backgrounds [17]. The pattern of gender difference of postgraduates in this study is consistent with the adolescents in the east. From above, we have concluded that the influence of culture are unconsciously and inveterately. In general, women are considered to bear the duty to disseminate cultures, to rely on collectivity, to obey the man and to avoid disagreeing with others. Females show commendable social skills when they are at a young age. On the contrary, men are considered to be more confident, more independent and have stronger ability to think independently [18]. So the impact of culture may lead to a significantly better performance for female in everyday creativity than male, and male have a better performance in scientific creativity than female.

What is noteworthy is that, most parts of the research on adult creativity have been concerned about men, little about the creativity of women [19, 20]. However, with the development of female educational level, the study of female creativity is particularly
important. When the women complete a university level education, they not only have the equal creativity performance with men, but they will beyond them [19]. It can be seen that after university education, if women continue studying they may have a better performance in creativity than men. In this study, there is no significant difference in scholarly creativity, performance creativity and artistic creativity between women and men. In everyday creativity, women have a significant better performance than men. These showed the development and improvement of female creativity under the influence of social environment and education.

The Influence of Joining Scientific Research Projects on Postgraduates' Creativity

Creative capabilities, critical thinking skills and some professional qualities are very important to higher education [21]. To postgraduates, cultivating their professional quality of science may be more important than others. Through higher education, they should not only acquire knowledge, but also get some special skills and technical qualifications [22]. This is the requirement of higher education sector. They need these skills to step into society. Taking part in specific projects plays an important role in acquiring knowledge and skills to deal with problems [23]. However, in this research, we found the number of postgraduates who have participated in projects is not large enough, only 19.68% of them have taken part in many projects. Similar to our findings, in the study of Lu and Sha, 21.8% of the postgraduates have never participated in project. Only 7.2% of the postgraduates have participated in more than four projects [24]. Although the number of postgraduates participating in projects is influenced by their grades, academic level, innovation ability and other factors, in China, the number of postgraduates who have participated in project is not as ideal as expected, and needs to be improved.

For undergraduates, Downie [25] found that participating in research projects can promote the development of their creativity. There are lots of advantages of taking part in research projects for undergraduates, such as having the opportunity to conduct a research project under the supervision of an active researcher in the last year; gaining the experience of the latest research results of professors; participating in scientific seminars. Downie [25] believed that integrate research projects into teaching process, can not only promote the undergraduates’ learning result and creativity, but also promote the performance of postgraduates’ creativity. This kind of learning is valuable to the whole higher education system.

Compared with traditional educational system, project-based education can improve their creative capability and self-direction [21]. As shown in the results of our study, the postgraduates who took part in many projects have a significantly higher scientific creativity than who didn’t participate in the research project or who only participated in one project. When postgraduates join in research projects, they should design and produce some ideas or products by themselves. In this process, they may get limited supervision and help from their teachers.

The term “study” refers primarily to advanced skills and high-level skills that related to work. We can assess a person’s ability by studying that whether he or she has a capacity to produce results through projects in a team [26]. As Stevens and Campion suggested the basis of innovation is creativity. Creativity is an idea which come from discovering, promoting, discussing and modifying with individuals and groups [27]. Good teamwork is an important factor in creating innovative products and ideas. When postgraduates join in research projects, teamwork can increase the likelihood of producing effective outcomes, provide clearer team goals and improve work efficiency.
Conclusions

Through our research, in general, postgraduates have best performance in everyday creativity. Gender can influence the performance of postgraduates’ creativity. The everyday creativity performance of female was significantly better than male, while the scientific creativity performance of male was significantly better than female. The number of participating in research projects can also affect the creative performance of postgraduates. The students who have taken part in two or more projects had significantly better performance in scientific creativity than others. The female postgraduates who have participated in many projects will perform better in everyday creativity, while the male postgraduates who have participated in many projects will perform better in scientific creativity. This suggests that we need to adopt strategies to promote them to participate in more projects to improve their scientific creativity in the process of training.

Acknowledgement

The study was funded by Natural Science Foundation of China (No. 31500870) and the Fundamental Research Funds for the Central Universities (2014B15314).

References


[10] Pang W., Plucker J.A. Recent transformations in China's economic, social, and education policies for promoting innovation and creativity [J]. The Journal of Creative Behavior, 2012,


