

# Effects of Proactive Personality and Social Centrality on Learning Performance in SPOCs

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**Abstract:** Due to the adaptability and manageability in small-scale class teaching, Small Private Online Courses (SPOCs) have become a highly important learning apparatus in higher education. However, what psychological and social factors affect learning outcomes in SPOCs remains to be explored. This study aims to investigate the effects of proactive personality and social centrality on learning performance in the SPOCs context. On the one hand, we examine the independent effects of proactive personality and social centrality respectively. On the other hand, the combined effect of them is studied to gain a comprehensive understanding of the roles of psychological and social factors in students' SPOCs learning process. Results from correlation analyses indicate that proactive personality and social centralities are significantly correlated with learning performance. Further regression and ANOVA analyses demonstrate the applicability of the two models of indirection and interaction effects respectively.

## 1 INTRODUCTION

In recent years, due to the high student dropout rates in Massive Open Online Courses (MOOCs), Small Private Online Courses (SPOCs) have gained increasing attention for their appropriateness and manageability in small class teaching (Kaplan and Haenlein, 2016). SPOCs are online courses that only offer a limited number of places and therefore necessitate some form of formal enrolment (Filius et al., 2018). SPOCs are characterized by students' intense intention to complete and considerably meaningful interaction (Uijl et al., 2017). However, not all students favour and match this new form of learning mode, as students are different in psychological and social attributes (Liu et al., 2018). Therefore, it is necessary to examine what factors affect learning outcomes in SPOCs to advance their adoption and promotion.

Personality, one of the best known variables in the psychological field, has been reported to be closely related to students' learning (e.g., Gatzka and Hell, 2018). However, most of the existing

studies in this area are limited to the roles of Big Five personality and traditional learning environments (Keller and Karau, 2013). Besides, students' social positions in the network emerging from interaction are also important for learning process and success (Carceller et al., 2015; Kilduff and Brass, 2010). Again, it remains to be unclear whether the above relations apply for the SPOCs context.

To address the research gap, this paper aims to deal with the associations among proactive personality, social centralities and learning performance in SPOCs. Specifically, proactive personality is chosen for its strong link with cognitive or motivational factors in learning process, such as self-efficacy (Brown et al., 2006; Major et al., 2006), while social centralities are good indicators of students' positions in the learning network (Carceller et al., 2015).

This paper is organized as follows. In Section 2, we review the definition of proactive personality and social centralities, and related research about their relationships with learning performance in the educational field with online learning for particular. The design of this study is presented in Section 3.

Results are showed in Section 4. Section 5 concludes findings in this study.

## 2 RELATED WORKS

Proactive personality, usually defined as “the relatively stable tendency to effect environmental change”, was proposed to explore the effect of dispositional factors on individuals’ proactive behaviour or proactivity (Batesman and Crant, 1993). Individuals with a high level of proactive personality are more likely to take initiatives to change the environment and persevere until meeting expectations. In the educational context, proactive personality was found to be linked with students’ feeling of self-efficacy and motivation to learn. (Major et al., 2006; Prabhu et al., 2012), which were good predictors of better learning outcomes. Meanwhile, trait activation theory (Tett and Burnett, 2003) points out that environmental factors are important for the expression of specific trait. As SPOCs empower students with various opportunities in terms of choosing when, where and what to learn and interact (Uijl et al., 2017), learners in these environments are free to exhibit their proactivity. Thus, proactive personality may play an important role in SPOCs learning.

Social centralities, including degree, closeness and betweenness centrality, are often used to determine an actor’s position in a network (Burt et al., 2013). To be specific, degree centrality measures the number of links incoming to an actor or outgoing from an actor, closeness centrality is related to how long would it take to propagate the information from one actor to the rest, betweenness centrality gives an idea about which actors connect groups of actors. In the educational field, an actor often represents a student. Given the importance of social attributes in online learning, a plenty of literature has begun to examine and verify the relationships between social centralities and learning performance (e.g., Hernández-García et al., 2015; Liu et al., 2018). For example, Liu et al. (2018) explored the relationship between social centralities and outcomes and found that learners in the central position tended to perform better than their counter-parts.

Apart from the independently determinant roles of social positions and individual personality on learning performance, there is an increasing trend in educational psychology with online learning in particular that attempts to explore the combined effect of these two factors. According to the developmental contextualism (Vondracek and Fouad,

1994), proactive personality and social centralities might exert their combined effect in the following ways: 1) Indirect-effect model, namely, proactive personality has a positive effect on social centralities, which in turn lead to better performance; 2) Interaction effect model, namely, the effects of social centralities on performance will be different in various levels of proactive personality, and vice versa. However, while some studies on students’ online learning have suggested the need to examine the combined effect of psychological and social factors on learning outcomes (e.g., Hernández-García et al., 2015), empirical evidence is still limited. Therefore, this study attempts to test the aforementioned two models of indirection and interaction effect in SPOCs context.

## 3 EMPIRICAL RESEARCH

### 3.1 Research Questions

Considering the increasing popularity of SPOCs in higher education and the aforementioned gaps in the previous literature, this study aims to address the following two questions:

- (1) Do proactive personality and social centralities affect the learning performance of students in SPOCs?
- (2) What is the combined effect of proactive personality and social centralities on students’ performance in SPOCs?

Based on previous findings (not confirmed for the specific case of SPOCs yet), our hypotheses are as follows:

- (1) The greater the level of a student’s proactive personality, the greater the students’ performance;
- (2) The greater the level of a student’s social centralities, the greater the students’ performance;
- (3) Proactive personality has a positive effect on students’ centrality, which in turn leads to a better performance; namely, the indirection effect model;
- (4) There is an interaction effect of proactive personality and social centralities on students’ performance.

### 3.2 Research Objects and Dataset

We conducted our study in a SPOC course called “Freshman Seminar” which was opened in the autumn of 2016 in a Chinese university. The course was designed to help every freshmen make a personal plan of career development. The SPOC platform allowed students to learn from the materials

(e.g., video, PPT or text) uploaded by the assistant or the instructors. An additional forum was used to support students' online discussions. A total of 204 freshmen and 8 instructors participated in this course, and they generated 11607 posts altogether. Three measures of social centrality (degree, closeness and betweenness centrality) were computed using Gephi 0.9.2 based on the interaction of students.

To capture the level of proactive personality, a Chinese version of proactive personality scale revised by Shang and Gan (2009) was adopted to survey the participants. Besides, students' performance data was assessed by a rating of their final work in a mark ranging from 1 (very bad) to 5 (very good). Unluckily, only 177 students' data of proactive personality and performance are available due to incomplete answers or not handing in their homework on time.

### 3.3 Data Analysis

In order to address the first two hypothesis, correlation analyses using SPSS 22.0 were performed to understand the relationship between proactive personality, social centralities and students' performance. To validate the third hypothesis, model 4 (mediation model) from the SPSS macro PROCESS was performed to examine the mediating role of social centralities in the relationship between proactive personality and learning performance. Finally, we followed the data processing method of Lin et al. (2015) to test the last hypothesis. In this method, students in this course are divided into two groups based on the two independent variables. In terms of proactive personality, a student with an above-mean score is placed in the high-level group of proactive personality, while the remaining students are placed in the low-level one. Also, the same method is applied to social centrality. Then, a two-way ANOVA and a subsequent test of simple main effects are conducted to test the interaction effect of proactive personality and social centralities on learning performance.

## 4 RESEARCH RESULTS

### 4.1 Social Network Characteristics of Students

Figure 1 displays the sociogram by degree by the 204 students and 8 teachers of the SPOC course. The

sizes of the nodes are used to identify students' degree with larger nodes representing a more central position. Colours are used to identify students' performance and teachers: teachers are in blue, students scoring 4 or above are in orange, students scoring 3 or below are in green, the remaining students are in yellow.

In terms of density, it was 0.101 with no isolated student in the network. The average distance between students was 1.92, indicating that most people could be connected through only one student apart. The network degree centralization was 97.21 with students' network sizes ranging from 1 to 169. Above 25% of the students had more than 48 partners in their individual network (namely, the group that they directly communicated with), while other 25% had less than 14 ones.

### 4.2 Preliminary Analysis

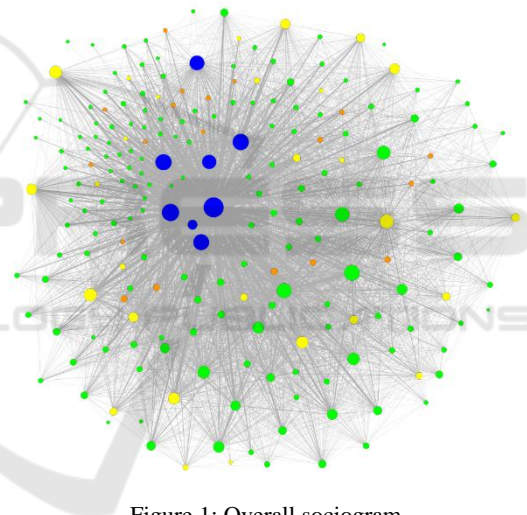


Figure 1: Overall sociogram.

Table 1 shows the descriptive statistics of proactive personality, social centralities and performance. Students rated their perceived level of proactive personality above the midpoint ( $M = 3.97$ ,  $SD = 0.48$ ). Also, students' performance data was above the midpoint ( $M = 3.86$ ,  $SD = 0.48$ ).

Table 2 shows the correlations between proactive personality, social centralities and performance. Normal distribution of students' performance and proactive personality is confirmed by the analysis, but that is not the case of the other measures. Therefore, we conduct parametric correlation analysis (Pearson's  $r$ ) and non-parametric analysis (Spearman's  $\rho$ ). Shaded cells in Pearson's correlation section represent variables where normal distribution could not be assumed. From Table 2, there is a significant but low

Table 1: Mean and standard deviation of proactive personality, social centralities and performance.

	Proactive centrality	Degree centrality	Closeness centrality	Betweenness centrality	performance
Mean	3.97	39.77	0.54	60.65	3.86
Standard deviation	0.48	35.68	0.07	215.34	0.48

Table 2: Correlations among proactive personality, social centralities and performance.

	Proactive personality		Performance	
	Spearman's rho	Pearson's r	Spearman's rho	Pearson's r
Degree centrality	0.19*	0.23**	0.20**	0.26**
Closeness centrality	-0.01	0.00	-0.07	-0.09
Betweenness centrality	0.17*	0.12	0.22**	0.14
Proactive personality	-	-	-	0.53**

\* p < 0.05  
 \*\* p < 0.01

Table 3: Regressions testing the indirection effect model.

Regression equation		Fitting index			Significance of coefficients			
outcome	predictors	R	R <sup>2</sup>	F	β	t	LLCI	ULCI
DC	PP	0.23	0.05	11.02	0.23**	3.32	0.09	0.36
BC	PP	0.12	0.01	1.70	0.12	1.30	-0.06	0.29
LP	DC	0.55	0.30	28.04	0.14*	2.34	0.02	0.26
	PP				0.50***	6.71	0.35	0.64
LP	BC	0.53	0.29	28.56	0.08*	2.06	0.01	0.15
	BB				0.52***	7.10	0.38	0.66

DC = degree centrality; BC = betweenness centrality; PP = proactive personality; LP = learning performance; LL = lower limit, CI = confidence interval, UL = upper limit.

Table 4: Two-way ANOVA testing the interaction effect model.

Source	SS	df	MS	F-value
PP × DC	2.01	1	2.01	11.03 **
PP × CC	0.42	1	0.42	2.15
PP × BC	0.62	1	0.62	3.23

Table 5: Tests of the simple main effects of proactive personality and degree centralities on performance.

Source	SS	df	MS	F-value
PP within DC (1)	0.98	1	0.98	5.34*
PP within DC (2)	6.85	1	6.85	37.35***
DC within PP (1)	0.27	1	0.27	1.23
DC within PP (2)	1.79	1	1.79	8.23**

(1) = low-level group, (2) = high-level group  
 \*\*\* p < 0.001

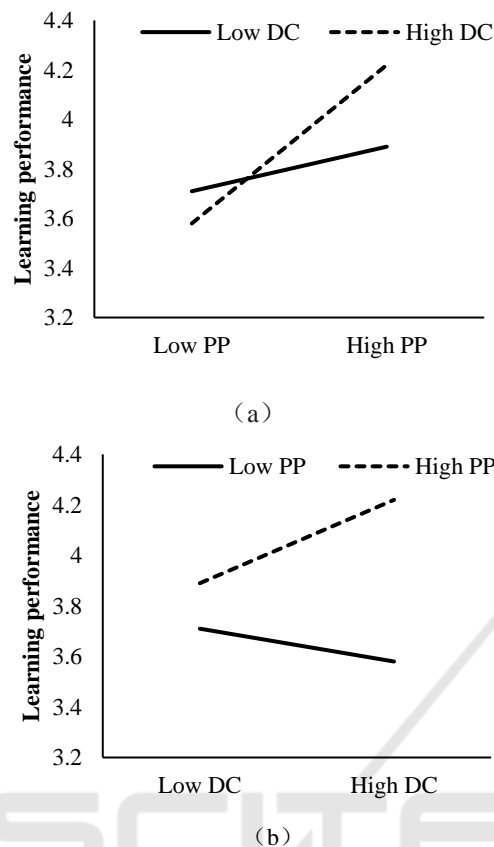


Figure 2: Interaction plots of the effects of proactive personality and degree centrality on performance: (a) The effect of proactive personality on performance at different levels of degree centrality, (b) The effect of degree centrality on performance at different levels of proactive personality.

positive relation between degree, betweenness centrality and performance or proactive personality. However, this is not case for closeness centrality. Besides, the correlation between proactive personality and performance is significantly positive. Therefore, the former two hypotheses are supported.

### 4.3 Regression Analysis and ANOVA

As closeness centrality is not significantly correlated with proactive personality and performance, it is not included in the test of the third hypothesis. Table 3 presents the results of the test of degree and betweenness centrality as mediators in the association between proactive personality and learning performance; namely, the test of indirection effect model. From table 3, proactive personality positively predicts degree

centrality ( $\beta = 0.23, p < 0.01$ ), which in turn positively predicts learning performance ( $\beta = 0.14, p < 0.05$ ). However, proactive personality does not predict betweenness centrality ( $\beta = 0.12, p > 0.05$ ), even though the effect of the latter variable on learning performance is significant ( $\beta = 0.08, p < 0.05$ ). Further, the overall test of indirection effect indicates that the value is 0.01 with 95% confidence interval ranging from -0.01 to 0.03. Therefore, the third hypothesis is confirmed for degree centrality, but not for betweenness centrality.

Table 4 presents the results of the two-way ANOVA. The interaction effect of proactive personality and degree centrality on learning performance is significant, while that is not the case for the interaction effects of the other two social centralities and proactive personality. Then the simple main effects of proactive personality and degree centrality were separately tested, the results can be seen in Table 5. Proactive personality significantly predicts performance in both groups of degree centrality, but the effect is higher for students with high level of degree centrality. On the other hand, degree centrality significantly predicts performance only for students with high level of proactive personality. The interaction plots can be seen in Figure 2.

## 5 CONCLUSIONS

Our study leads us to some interesting results about the relationships among proactive personality, social centralities and students' performance in SPOCs. Specifically, we examined the bivariate correlation among them and tested the effects of indirection and interaction. The conclusions are as follows:

Proactive personality, as an individual attribute beyond Big Five in the personality domain, is significantly and positively correlated with learning performance, while social centralities as social attribute also have a significantly positive link with it. According to the proactive motivational state proposed by Parker et al. (2008), proactive personality is beneficial for learners as its affordance of activating higher level of self-efficacy and motivation to learn. Besides, social network theory (Krause et al., 2007) highlights that students in the central position of learning network are more likely to have access to valuable resources for learning.

Both of the indirection and interaction effect model are validated. On the one hand, proactive personality is an antecedent of social centrality,

which in turn contributes to a better performance. This finding challenges the traditional view of structural determinism (a theoretical perspective which highlights that social attributes are the major determinant of human activities, and do not recognize the effect of individual attributes on social ones) and supports a decisive effect of individual attributes on social ones. On the other hand, those who possess both a high level of proactive personality and social centrality can benefit most from SPOCs learning. This finding can be interpreted in the context of ecological systems theory (Darling, 2007), which posits that individual and social attributes interact to influence personal development.

Based on the above research findings, we can obtain some significant implications about SPOC learning. Firstly, SPOCs forum should be well designed to activate students' proactive personality, such as gamified design (Ding et al., 2018), or the adoption of unstructured discussion forums (Salter and Conneely, 2015). Secondly, social collaboration or cooperation should be advocated in students' learning in SPOCs. For example, Virtue (2017) adopted small groups and moderators to enhance students' interaction in online writing courses. Finally, instructors and educators are suggested to build suitable learning environment for students in accordance with their aptitudes.

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