

# Aussie -Sino Studies

**4**  
**2017**

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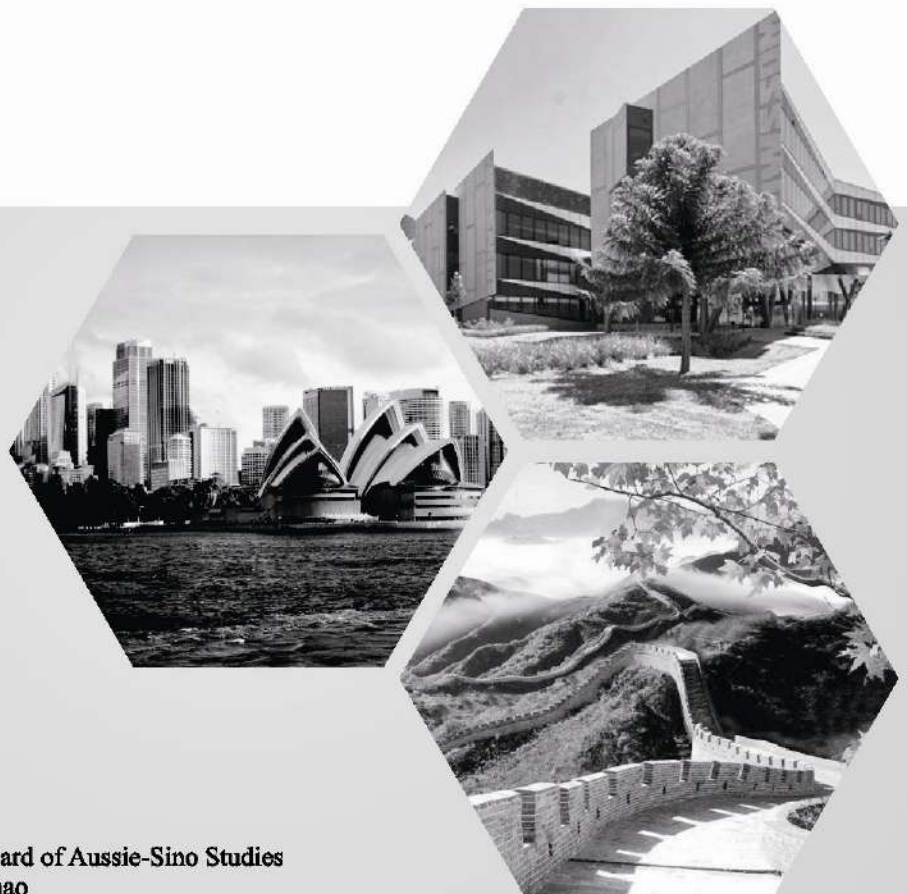
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# Ownership Structure and Corporate Performance under Market Socialism: Empirical Analysis of Listed Companies in China

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**Abstract:** *Purpose*, The purpose of this paper is to quantitatively analyse the relationship between the presence of government as shareholder, and corporate performance, using financial data for listed non-financial firms in China from 2000 to 2014. *Design/methodology/approach*, This study discusses the reclassification of shareholders, and empirically examine the relationship between government ownership and corporate performance, mainly using the fixed-effects panel model, after comparing with pooled OLS model and random-effects panel model. *Findings*, The results show that government ownership and corporate performance have a non-linear U-shaped correlation using whole sample data. The U-shaped relationship between government's shareholding ratio and growth potential is reconfirmed in sub-sample of local state-owned enterprises but not in central state-owned enterprises. For private enterprises, the higher the shareholding ratio of the government is, the worse is the company's performance. Corporate profitability improves when the attributes of shareholder and CEO coincide. *Practical implications*, The overall results suggest that privatization of general state-owned enterprises is desirable. However, for strategically important companies involved in national security, national control should be strengthened or they could remain unlisted. *Originality/value*, This study applies the reclassification of shareholders, such as the difference between state-owned corporate shareholders and private corporation shareholders, whereas prior literatures don't pay any attention to the difference.

**Key words:** corporate governance, market socialism, ownership structure, board of directors

## Introduction

In 2014, the Chinese economy, which had sustained high growth for 20 years, began to slow down. From the viewpoint of investigating the reasons for the so-called miracle economic growth, and measuring the policy responses to the "New Normal", it is critically important to examine the function and role of corporate governance, on which the government has strong influence. With the deepening of state-owned enterprise reform, since 2015, state-owned enterprises (SOEs) have begun a new round of reorganization reform. For example, two China's largest steel producers, Baosteel merges with Wuhan Iron and Steel to improve the industry concentration, and to resolve excess capacity problem. COFCO Group and Chinatex Corp merge to facilitate scale effect and to improve the competitiveness of SOEs. Investigating the impact of state ownership on the performance of enterprises and enterprise activities can therefore help for the decision making of future reorganization reform of state-owned enterprises and also for the following privatization reform.

As the biggest market socialist country in the world,

China's economy is most distinguished by the initiatives taken by the government. Many researchers have shown the effects that the government as a shareholder has on firms, but neither the theory nor the empirical analysis results are unified. First, as mentioned by Shleifer and Vishny (1998), politicians tend to pursue their own interests and government acts as the "grabbing hand". Estrin and Perotin (1991) further argue that government gives preference to its political interests over maximization of the firms' value. Many empirical analyses with respect to listed firms in China support "grabbing hand" theory by showing that firms with high government ownership have more transactions between interested parties (Huyghebaert and Wang, 2012), or more severe agency problems (Chen and Al-Najjar, 2012). On the other hand, the "helping hand" theory suggests that local governments can promote the growth of economy (Qian, 2003, Blanchard and Shleifer, 2001), and government acts as an alternative governance mechanism when law enforcement is weak. There are also analyses that show a convex relationship between government ownership and corporate performance (Tian and Estrin, 2008, Liu *et al.*, 2012, Sun *et al.*, 2002, Wei *et al.*, 2005). Most previous studies use data before 2000, however, a series of important corporate governance reforms took place

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after 2000. The clear provision about the adoption of modern enterprise system was made in 1999, independent directors were formally introduced from 2001, and split-share structure reform (SSSR) during the 2005-2007 converts the non-tradable shares into tradable shares. Through all these reforms, both the ownership structure and corporate governance mechanism of SOEs have largely changed. The majority shareholder is no longer the only effective monitoring mechanism, the impact of the proportion of state-owned shares on the company's performance has been different after 2000. Therefore we use a longer time span, from 2000 to 2014, to retest this relationship between the government as a shareholder and corporate performance.

In addition, previous studies ignore the difference between state-owned corporation shareholders and private corporation shareholders, and classify both of them as legal person shareholders. Some previous studies combine the state shares with legal person shares together and show that they perform similar roles. That is because most shareholders of legal person shares are other state-owned institutes or state-owned corporations, which are controlled by different levels of government. However, the situation becomes dramatically different after SSSR. We can find more private corporation shareholders in the top 10 shareholders list, and they have gradually played an important role in corporate governance. So it will be problematic if we still use legal person shareholder as a proxy variable of SOE shareholder or simply combine the state shares with legal person shares to denote the government's ownership. Therefore, the major difference between this study and previous research lies in the manner of processing governance variables. This research divides legal person shareholders into state-owned corporation shareholders and private corporation shareholders, and define the sum of ownership ratio of state and state-owned corporates as "State Ratio".

Using financial data for listed non-financial firms from 10 industries in China from 2000 to 2014, we find government ownership and corporate performance has a non-linear U-shaped correlation. This result suggests that if the government is not the largest shareholder, the government tends to prioritize issues such as politics and social stability rather than maximizing corporate value. Therefore, a government shareholding ratio lower than 50% tends to exacerbate corporate performance at the expense of the interests of minority shareholders. However, once the shareholding ratio of the government exceeds a certain threshold, it is more likely that the company is able to balance these interests and corporate performance improves. The U-shaped relationship between government's shareholding ratio and growth potential is reconfirmed in local state-owned enterprises, whereas not in central state-owned enterprises. For private enterprises, the higher the shareholding ratio of the

government is, the worse is the company's performance. The overall results suggest that privatization of general state-owned enterprises is desirable. However, for strategically important companies involved in national security, national control may need to be strengthened.

The rest of this paper is organized as follows. Section 2 surveys previous studies. Section 3 describes the formal changes in the corporate governance system of China's listed firms, and presents our hypotheses. Section 4 describes the data and variables used in this research. Section 5 presents the regression results. Section 6 offers concluding remarks.

## 1. Survey

Shleifer and Vishny (1998) discuss the "grabbing hand" of government under various economic systems. They demonstrate that politicians tend to take advantage of the system to pursue their own interests, and recommend the privatization of state-owned enterprises. Estrin and Perotin (1991) argue that as the shareholder of firms, government gives preference to its political and economic interests over maximization of the firms' value. The authors particularize "prevalence of public service," "redistribution of wealth," and "employment maintenance" as the political and economic interest. However, these interests might be inconsistent with each other, and might be modified frequently. Again, these factors decrease the effectiveness of state-owned enterprises. On the other hand, Qian (2003) analyzes economic reform in China, and concludes that local governments contribute significantly to promoting the growth of the private economy as a result of protecting township-village enterprises to secure their fiscal revenue and increasing public investment.

The results of the empirical analysis with respect to listed firms in China are not uniform. Huyghebaert and Wang (2012) state that firms with high government ownership have more transactions between interested parties and more labor surpluses, which is consistent with the theory of the "grabbing hand." Bai *et al.* (2004) demonstrate that firms with government as their largest shareholder or with the largest shareholder of high ownership present lower corporate value. Chen and Al-Najjar (2012) argue that the higher is the ownership that the government holds, the more inefficient is corporate management and the more severe are agency problems. In addition, the authors point out that the efficiency of the monitoring mechanism worsens and the compensation of board members increases in the case of high government ownership.

On the other hand, a large number of researchers study the "helping hand" of government. Liu *et al.* (2012) study 970 listed firms before and after the world financial crisis of 2008, and find that state-owned firms (whose controlling shareholder is government) did not perform worse during the crisis period compared to usual business periods, although their performance

is usually bad. The authors show a U-shaped relationship between large shareholder<sup>1</sup> ownership and firm performance, that is, expropriation tends to occur when the large shareholders' ownership is low, but improved resistance to crisis can be expected when the large shareholders' ownership is high. Similarly, Tian and Estrin (2008) point out a U-shaped relationship between government ownership and corporate performance. The authors show that when government ownership increases, voting rights and cash flow rights become higher simultaneously<sup>2</sup>, which alleviates the agency problem. In particular, under such circumstances as in China, where the quality of law enforcement is low, governance of large shareholders is expected to be high. Blanchard and Shleifer (2001) demonstrate that compared with Russia, China's private economy has developed rapidly, and help from local government plays an important role.

There are also some studies suggesting a U-shaped relationship between government ownership and corporate performance. Wei *et al.* (2005) investigate the relationship between Tobin's Q and state ownership, institutional ownership (legal person) and their combined effects, using privatized firms from 1991 to 2001. Although legal person shareholder may have great incentive to monitor management than state shareholder, their results show similar U-shaped relationship with Tobin's Q. They explain the results in terms of the fact that these institutional shareholders are owned by government and are forced to behave like state shareholder. Sun *et al.* (2002) also find nonlinear relationship between government ownership and corporate performance, using the data for the listed companies from 1994 to 1997. They highlight the positive effect of government ownership, but indicate that the improvement of companies' performance is a result of gaining monopoly rents instead of improvement of management efficiency.

## 2. Transition of Corporate Governance in China and Hypotheses

### 2.1 Reform of Stock Ownership Structure

Prior to 2005, the shares of Chinese listed firms were divided into two types: tradable shares that can be traded on the capital market and non-tradable shares that cannot. In the early 1990s when stock exchanges were established in Shanghai and Shenzhen, regulations concerning the initial listing had not yet been developed, and thus, entrepreneurs could buy their own shares and keep them, making it impossible for shares of firms to trade in the open market. Such non-traded shares owned by individuals were only a part of this picture; most were state-owned stocks held by the government or state-owned enterprises. When state-owned enterprises were listed, in order to prevent the government from losing control of the company,

the government deliberately created non-tradable stocks. Since then, because there is no clear definition of the shareholders of state-owned enterprises, the status of non-tradable shares has been maintained. Non-tradable shares cannot be traded in the open market, but can be traded between corporations only with the permission of the China Securities Regulatory Commission<sup>3</sup>.

On September 4, 2005, the certification board announced the "Circular of China Securities Regulatory Commission on Distributing the Measures for the Administration of the Share-trading Reform of Listed Companies" (hereafter, Administration Measures), as a result of which, non-tradable shares were reformed to allow trading alongside tradable stocks. A specific concrete reform plan was created for each company, and it could be implemented if approval was received from the general shareholders' meeting. By the end of 2007, these plans had been implemented in 97% of companies (Li *et al.*, 2011). However, transactions cannot be made immediately upon completion of approval of procedures for non-tradable stock transactions. The Administration Measures stipulated that within 12 months of implementing the reform plan, sale of non-tradable shares within a range not exceeding 5% of the total number of shares is possible, and within 24 months, sale of non-tradable shares within a range not exceeding 10% of the total number of shares is possible. State-owned enterprises are more strictly restricted. On June 30, 2007, the "Interim Measures for the Administration of State-owned Shareholders' Transfer of Their Shares of Listed Companies" (hereafter, the Interim Measures) were announced, which stipulate that when selling non-tradable shares of state-owned shareholders, the following two conditions must be satisfied: for companies with less than 1 billion shares, less than 5% of shares can be sold in 3 consecutive fiscal years and for companies with more than 1 billion shares, 50 million shares or less than 3% can be sold in this timeframe; and it is impossible to transfer control rights of listed companies.

As mentioned above, the ownership structure for state-owned enterprises has been mainly reformed, but there is little research on its effects. Most data used in previous research<sup>4</sup> on the government shareholding ratio and corporate performance are from before 2005, and thus, cannot include the impact of the reform of the ownership structure. Therefore, in this study, we investigate this issue using data from 2000 to 2014. Based on previous studies, we propose the following two hypotheses on the "grabbing hand" and "helping hand."

**Hypothesis 1.** The higher is the government shareholding ratio, the easier it is for corporate value, and thereby corporate performance, to decline.

**Hypothesis 2.** The higher is the government shareholding ratio, the easier it is for companies to obtain production resources by utilizing close relationships with the government, thereby improving corporate performance.

### 2.2 Adoption of Modern Enterprise System

Under the old enterprise regime, a communist party committee, employee representation committee, and labor union committee, referred to as the “three old committees,” held voting rights regarding the corporate’s operations. In 1994, the adoption of the Company Law<sup>5</sup> signaled the start of China’s modern enterprise system. And in 1999, government made clear provisions about “two-way entry”, which means that the members of the “three old committees” could mutually be appointed to the board of directors, supervisory board, or management, referred to as the “three new committees” under the new enterprise regime<sup>6</sup>.

### 2.3 Introduction of Independent Directors

Independent directors were introduced as an option for listed firms in 1997. There were only 27 firms that introduced independent directors in 1999, but this had increased to 70 in 2000, and more than 200 by June 2001. The Guidelines for Introducing Independent Directors to the Board of Directors of Listed Companies were issued in August 2001, according to which, listed firms had to introduce at least two independent directors by June 30, 2002, and one-third of the total board by June 30, 2003.

## 3. Data and Variables

### 3.1 Data Description

We collect financial data from China Listed Firms’ Corporate Governance Research Database provided by GTA (CSMAR Solution) from 2000 until 2014. This comprehensive database includes all companies listed on the Shanghai and Shenzhen stock exchanges.

Information on corporate governance, such as that on shareholders and executives, is used 1 year ahead of the financial data. Therefore, corporate governance data are required from 1999 to 2013, although we use data on only three time points, for 1999, 2006, and 2013.

With respect to target companies, we include 347 chemical companies, 321 electromechanical manufacturing companies, 209 general machine manufacturing companies, 175 information and communication industries, 164 construction and real estate companies, 131 commercial companies, 100 service companies, 96 transportation equipment manufacturers, 45 mining companies, and 22 transportation companies from 10 industries. In total, for 2014, 1610 companies out of 2586 companies listed on both exchanges are included in the dataset<sup>7</sup>. In addition, considering survival bias, we target new entry companies and companies that have delisted during the period of study.

### 3.2 Definition of Variables

Explained variables are two corporate performance measures, namely, return on assets (ROA) and return on equity (ROE), one growth measure, that is, Sales Growth, and one financial structure measure, that is, DEBT (debt ratio).

Much previous research on listed companies in China

focuses on evaluating corporate value and corporate performance using stock price data; however, in this study, we use only corporate financial data. The main reason is that China’s capital market is still incomplete, the stock price fluctuates drastically, the stock turnover rate is high, and the average holding period is short, and thus, the stock price cannot reflect corporate performance correctly. In fact, some studies (Bai *et al.*, 2004; Yu & Ashton, 2015) point out that financial information accurately represents corporate performance rather than market information, such as stock prices.

The key explanatory variables that represent the structure of corporate governance are ownership structure variables. We classify the top 10 shareholders into five types, and define the ownership ratio of each group as the ownership structure variables. They are the State Ratio (ownership ratio of state and government-affiliated corporations), Private Ratio (ownership ratio of private enterprises), Foreign Ratio (ownership ratio of foreign capital), Person Ratio (domestic individual ownership ratio), and Director Ratio (ownership ratio of management and directors).

Previous research classifies the ownership ratio into four groups: national holding, domestic corporation holding, foreign ownership, and individual holding. National holding is the same as ownership ratio of state. However, domestic corporation holding is problematic, as it contains the ownership of both government-affiliated corporations and private enterprises whose corporate attributes are completely different. This is because the government might influence listed companies through state-owned corporations. In this study, we analyze domestic corporations separately for government-based corporations and private corporations. We examine the corporates’ annual reports, and if the largest shareholder is the government or another state-owned enterprise, we define the corporation as government affiliated, otherwise private.

In addition to the government’s shareholding ratio, we use the following two dummy variables to investigate the state-owned enterprise and the private enterprise:  $over50\_dummy = 1$  when more than 50% of the company’s shares are owned by the government, and  $control\_dummy = 1$  when the largest shareholder is the government.

Regarding control variables, there are possibilities of “economies of scale” and “diminishing effect of profit and growth,” and thus, we use the total assets (TASS) to control the company size. The larger is the size of the board of directors, the more experts and the greater diversity of the directors are considered. On the other hand, as the number of people increases, latent problems arise, such as free lighters, and many previous analyses have pointed out that monitoring efficiency is poor. Thus, the size of the board of directors is controlled by the number of directors ( $board\_number$ ). Many discussions have been held about the independence of the board of directors. One



opinion emphasizes that in the case of high independence, as monitoring capability is superior, corporate performance improves. On the contrary, the other viewpoint highlights negative effects, that the monitoring function and the advisory function of the independent director are restricted owing to less accessibility to internal information, and the influence on corporate performance is limited. The number of independent directors, ID\_number, is taken as a proxy variable of the independence of the board of directors. We use the debt ratio DEBT to control the financial strength of the company when analyzing the profitability and growth potential of a company. In addition, based on previous research, we use the total shareholding ratio of the top 10 shareholders (top10) to control the concentration of a firm’s ownership structure. Generally, for companies with large shareholders, such as family companies, conflicts of interests between major shareholders and minority shareholders are serious and corporate value is considered impaired. However, in the case of developing countries, where the legal system is not complete and the governance mechanism from the capital market cannot be demonstrated, high concentration is evaluated as an effective alternative governance mechanism.

Table.1 shows the definition of all variables used in this study.

**3.3 Statistical Description**

Table 2 presents the descriptive statistics. ROA, ROE, and sales growth rate are 7.32%, 13.06%, and 20.54% on average, respectively, indicating rapid growth of the Chinese economy in recent years. The debt ratio of 47% or more shows the high dependence of listed firms on bank loans in China.

The majority of shares of approximately 27% of the companies in the sample are held by the government. In more than half of the companies, the government is the largest shareholder. Privatization is progressing but government control is still strong. As can be observed from the shareholding ratio, there is a limit to the degree of openness of China and the entry of foreign capital remains low. As in previous research, there are few institutional arrangements, such as executive holdings and stock options, and thus, the ratio of executive ownership is only 2.39%. The total shareholding ratio of the top 10 shareholders is 56.24%, indicating that the concentration of the corporate ownership structure is high. The government ownership ratio of state-owned enterprises is high, and in the case of private enterprises, the holding ratio of private corporations or officials up to the second in charge is also high.

The correlation coefficients between variables are shown in Appendix 1. The correlation between Over 50 \_ dummy and control \_ dummy, and that between Over 50 \_ dummy or control \_ dummy and the shareholder’s ownership ratio are high. Since the correlation between the government’s ownership ratio (State\_ratio), the executive ownership ratio (Director\_ratio), and the shareholder variable other than the foreign ownership ratio

(Foreign\_ratio) appears to be somewhat high, individual regression analysis is undertaken.

**4. Regression Results and Discussion**

**4.1 Corporate Governance and Corporate Performance**

As mentioned in subsection 4.1, we use a dataset consisted of listed firms from 10 industries with analysis period from 2000 to 2014. As we also focus on entrance firms and delisted firms to avoid survival bias, this dataset should be accurately described as unbalanced panel data. As is well-known that by using panel data—a combination of time series and cross-sectional data, we can compare the performance between firms, those with different corporate governance structure, in the same year. Also, we can judge how the decisions made in former year, like fired an independent director or hire a new one, affect the profitability of later accounting years.

We use the pooled OLS model, fixed-effects model, and random-effects model in our regression analysis. But by using pooled OLS analysis as equation (1), we fail to control for variables that cannot be observed or measured like cultural factors or difference in business practices across companies. Meanwhile, the fixed-effects model controls for all time-invariant differences between the companies.

When using fixed-effect model, regression equation turns to equation (2). Although it looks just similar to equation (1),  $\alpha_i$  absorbs all the time-invariant variables. And industry dummy, as one kind of time-invariant variables, will be unnecessary.

We can also use random-effects model when dealing with panel data as equation (3). Random-effects model allows us to include time-invariant variables that may influence the predictor variables. However, some variables may be omitted and causing some bias in this model.

According to the results of Hausman test, fixed-effect analysis is the most desirable, and thus, we present only the results of the fixed-effects analysis in this paper.

$$Profitability = \alpha + \beta_1 Corporate\ Governance\ variable - \beta_2 Control\ variables + \beta_3 year + \beta_4 industry + \epsilon \tag{1}$$

where:  
 Profitability: ROA, ROE  
 Corporate Governance variables: shareholder ownership ratio variables.

Control variables: top10 (ownership concentration). TASS (company size), DEBT (debt ratio), board\_number (number of directors), and ID\_number (number of independent directors),

$$Profitability = \alpha + \beta_1 Corporate\ Governance\ variable - \beta_2 Control\ variables + \beta_3 year + \epsilon \tag{2}$$

~~Profitability =  $\alpha + \beta_1$  Corporate Governance variable +~~

~~$\beta_2$  Control variables~~

$$+ \beta_3 \text{size} + \beta_4 \text{leverage} + \mu + \epsilon \quad (3)$$

$\epsilon$ : within-entity error term

$\mu$ : between-entity error term

Table 3 shows the analysis results of the impact of shareholders' attributes on the profitability of the company. The explained variable of Model 1-5 is ROA, and that of Model 6-10 is ROE. Comparing Models 1 and 2, or Models 6 and 7, when the government is the largest shareholder, but its holding ratio is relatively low, the profitability of the company appears to be low. However, if the government owns more than 50% of the company's shares, the impact on the profitability of the company becomes insignificant. This result is similar to a previous study introduced in Section 3 showing a U-shaped relationship between the government's shareholding ratio and corporate performance. Therefore, in Models 5 and 10, we include the government's shareholding ratio and its squared term in the analysis. The result indicates that although the profitability of the company worsens as the shareholding ratio of the government increases, the negatively influence declines.

Models 3 and 8 compare the impact of various shareholders on companies' profitability. In these models, compared to individual investors, the higher are the shareholding ratios of private corporate shareholders, executive shareholders, foreign investors, and government-affiliated shareholders, the worse the companies' profitability becomes. In general, individual investors in China are found to be strongly speculative and do not hold shares over the long term; thus, individual investors are considered not to have a positive impact on corporate performance owing to their lack of enthusiasm for monitoring the enterprises. Appendix 1 shows that the possibility of multiple collinearity exists because the government's shareholding ratio is highly correlated among other shareholders' shareholding ratios. The coefficient of the government ownership ratio becomes significantly negative in Models 4 and 9 when individually considering the effect of the government's shareholding ratio. This result rejects Hypothesis 4 on the "helping hand" and supports Hypothesis 3 on the "grabbing hand."

Regarding another explanatory variable, the top 10, the concentration degree of stockholding structure shows significantly positive results in all analyses. Different from developed countries, in China, where the legal system is not complete, the existence of major shareholders is evaluated as a kind of effective governance means.

Table 4 presents the results of the influence of shareholders on the sales growth rate. When the government is the largest shareholder, the relationship between the shareholding ratio and sales growth is U-shaped. However, there are no significant differences observed between the attributes of the five types of shareholders.

Table 5 presents the influence of shareholders on debt ratio. We consider it reasonable to lower debt from a high average value of about 50% of the debt ratio at the end of the high economic growth period. The shareholding ratio and debt ratio of the government have an inverted U-shaped relationship. From the perspective of improving financial structure, it can be said that it is desirable to expedite privatization, but at the same time, it is also a good choice to nationalize important companies in strategic industries.

#### 4.2 Revalidation of Impact of Corporate Attributes, Attributes of Shareholders and Performance

In the previous Subsection 5.1, we analyze the influence of internal governance on corporate performance using all samples. However, different corporate attributes might mean that there are differences in the influence of government shareholding ratio. As a shareholder or investor of a state-owned enterprise, the State Assets Supervision and Administration Committee works for the interests and obligations, but central state-owned enterprises are managed by the SASAC of the State Council, and local state-owned enterprises by the SASAC of various local governments. As mentioned in Section 2 on preceding research, the government might act to impair the enterprise value of state-owned enterprises for political or personal interests, but the political purposes of the central and local governments are not consistent in the first place. Moreover, since the effectiveness of the law decreases as it moves away from the central government, it is considered that pursuing the interests of bureaucrats as individuals is likely in rural areas. For this reason, in this subsection, we classify enterprises into central state-owned enterprises, local state-owned enterprises, and private enterprises, and undertake an analysis of these subsamples.

There were 112 central state-owned enterprises that are directly managed by the State Assets Supervision and Administration Committee of the State Council in 2014. They are large-scale companies of core industries, such as China National Nuclear Corporation, Aviation Industry Corporation of China, and China National Petroleum Corporation. There were more companies before 2014, but the list of 112 companies is what is available from the website of SASAC for 2014. Most central government-owned enterprises are 100% owned by the government, and many of them are unlisted companies. Instead of these characteristic enterprises, companies in which the central government or central state-owned enterprises accounts for more than half of the top 10 ownership are defined as central state-owned-affiliated enterprises in this study. State-owned enterprises that are not funded by central government or central state-owned enterprises are defined as local state-owned enterprises, and the others are defined as private enterprises.

##### 4.2.1 Statistical Description by Attributes

Table 6 provides a statistical description of the data. According to Table 6, we observe there are many local

state-owned enterprises and private enterprises. The central state-owned-affiliated enterprises account for about one-third of local state-owned enterprises. The latter enterprises have the highest profitability and growth potential. Private enterprises appear to have a slightly lower debt ratio. The government ownership ratio of private enterprises is about 6% on average, and the maximum value is smaller than the average value of central state-owned-affiliated enterprises and local state-owned enterprises. However, the size and independence of the directors are almost the same. Private enterprises and local state-owned enterprises have ownership concentration of 55%, while central state-owned-affiliated enterprises have ownership concentration of nearly 60%.

#### *4.2.2 Analysis Results of Shareholders by Company Attributes*

Panel A, Panel B and Panel C of Tables 7 summarize the analysis results of central state-owned-affiliated enterprises, local state-owned enterprises, and private enterprises, respectively. Regarding ownership structure, there is no significant result in the case of central state-owned enterprises. Coinciding with analysis results using whole sample, for local state-owned enterprises with the largest number of samples, the government's shareholding ratio and growth potential are U-shaped. Although there does not appear to be a U-shaped relationship between profitability and government holding ratio, when the largest shareholder is government, profitability declines; if the government owns more than 50% of the shares, the coefficient becomes positive although it is not significant. For private enterprises, the higher the shareholding ratio of the government is, the worse is the company's performance.

Table 8 presents the results of internal governance of a subsample and the debt ratio. Although notation is omitted for the control variable, the result is almost the same as that for the whole sample. The relationship between the government's ownership ratio and the debt ratio is a non-linear U-shape for central state-owned-affiliated enterprises, which is different from the whole sample. In the case of private enterprises, there is a linear relationship between the debt ratio and government holding ratio; that is, the debt ratio rises as the government holding ratio increases. For private enterprises, it turns out that when the government becomes a shareholder, the degree of tolerance for risk increases and it is easy to procure funds, such as bank loans.

### **5. Conclusion**

This study presents the influence on corporate performance of government as a shareholder and by means of personnel control, such as appointment of management teams. We report firm-level regression results for 10 industries, including the chemicals, electromechanical manufacturing, general machinery manufacturing, information communication, construction and

real estate industries, using financial data between 2000 and 2014, as well as corporate governance data for 3 years: 1999, 2006, and 2013.

The major difference between this study and previous research lies in the manner of processing governance variables. We discuss the reclassification of shareholders in our analysis, whereas previous studies ignore the difference between state-owned corporate shareholders and private corporation shareholders. Accessibility to data after the stock reform in 2005 enables us to conduct an analysis over a longer span of 14 years.

The main analysis results are as follows. First, as presented in previous research, we confirm a U-shaped relationship between the government's shareholding ratio and the profitability and growth potential of the company. In other words, a relatively low government shareholding ratio is negatively associated with the profitability and growth potential of an enterprise. However, when the government owns more than 50% of the company's shares, an increase in the government shareholding ratio improves corporate performance. On the other hand, there is an inverted U-shaped relationship between the government's ownership ratio and the debt ratio, and it is found that if the government owns a share ratio exceeding a certain threshold, an increase in its shareholding ratio improves the soundness of corporate finance. This result suggests that if the government is not the largest shareholder, the government tends to prioritize issues such as politics and social stability rather than maximizing corporate value. Therefore, a government shareholding ratio lower than 50% tends to exacerbate corporate performance at the expense of the interests of minority shareholders. However, once the shareholding ratio of the government exceeds a certain threshold, it is more likely that the company is able to balance interests and corporate performance improves.

Second, depending on the attributes of the company, the role of the government as a shareholder is different. In local state-owned enterprises, a U-shaped relationship is found, but in the case of central government enterprises and companies invested in by central government enterprises, the ownership ratio of the government is found to have no influence on performance. Moreover, the higher is the government shareholding ratio in private enterprises, the worse is corporate performance. The overall results suggest that privatization of general state-owned enterprises is desirable. However, for strategically important companies involved in national security, national control should be strengthened and they should remain unlisted.

Third, using the total value of the shareholding ratio of the top 10 shareholders, we measure the concentration of the ownership structure of listed companies. Although the concentration level is high at 56% on average, an effect of improving corporate performance is confirmed. It can be

observed that high concentrations are valued as effective means of governance in developing countries, such as China, where the legal system is not complete.

## End note

- [1] Large shareholders are defined as those whose shareholding ratio is more than 5%.
- [2] Divergence between voting rights and cash flow rights is rare in China.
- [3] There are few transactions between individuals but they do exist.
- [4] Tian and Estrin(2008), Sun, Tong and Tong(2002), Wei, Xie and Zhang(2005)
- [5] Company Law of People's Republic of China.
- [6] "Decision of several major issues concerning the reform and development of state-owned enterprises" published in 1999, after the Fourth Plenary Session of the 15th Central Committee of China.
- [7] This number is based on 2014, and when tracing back to the past, the number of companies decreases. There are only governance data for only 949 companies in 1999.

## References

- Bai C.-E., Q. Liu, J. Lu, F. M. Song, and J. X. Zhang, 2004, "Corporate governance and market valuation in China," *Journal of Comparative Economics*, Vol. 32, pp. 599–616.
- Blanchard O. and A. Shleifer, 2001, "Federalism with and without political centralization: China versus Russia," IMF Staff Working Papers, Special Issue.
- Chen C. and B. Al-Najjar, 2012, "The determinants of board size and independence: Evidence from China," *International Business Review*, Vol. 21, pp. 831–846.
- Estrin S. and V. Perotin, 1991, "Does ownership always matter?" *International Journal of Industrial Organization*, Vol. 9, No. 1, pp. 55–73.
- Fan J. P. H., T. J. Wong, and T. Y. Zhang, 2007, "Politically connected

CEOs, corporate governance, and post-IPO performance of China's newly partially privatized firms," *Journal of Financial Economics*, Vol. 84, pp. 330–357.

- Huyghebaert N. and L. H. Wang, 2012, "Expropriation of minority investors in Chinese listed firms: The role of internal and external corporate governance mechanisms," *Corporate Governance: An International Review*, Vol. 20, No. 3, pp. 308–332.
- Li K., T. Wang, Y.-L. Cheung, and P. Jiang, 2011, "Privatization and risk sharing: Evidence from the split share structure reform in China," *Review of Financial Studies*.
- Liu, Chunyan, Konari Uchida, and Yufeng Yang, 2012, "Corporate governance and firm value during the global financial crisis: Evidence from China," *International Review of Financial Analysis*, Vol. 21, pp. 70–80.
- Qian, Y., 2003, "How reform worked in China," *William Davidson Working Paper Number 473 June 2002*
- Shapiro D., Y. Tang, M. J. Wang, and W. Y. Zhang, 2015, "The effects of corporate governance and ownership on the innovation performance of Chinese SMEs," *Journal of Chinese Economic and Business Studies*.
- Shleifer A. and R. Vishny, 1998, *The Grabbing Hand: Government Pathologies and Their Cures*. Cambridge, MA: Harvard University Press.
- Sun Q., Tong W H S. and Tong J., 2002, "How does government ownership affect firm performance? Evidence from China's privatization experience," *Journal of Business Finance & Accounting*, Vol. 29(1 - 2), pp. 1-27.
- Tian Lihui and Saul Estrin, 2008, "Retained state shareholding in Chinese PLCs: Does government ownership always reduce corporate value?" *Journal of Comparative Economics*, Vol. 36, pp. 74–89.
- Wei Z., Xie F. and Zhang S., 2005, "Ownership structure and firm value in China's privatized firms: 1991–2001," *Journal of financial and quantitative analysis*, Vol.40(1), pp. 87-108.
- Yu M., J. K. Ashton, 2015, "Board leadership structure for Chinese public listed companies," *China Economic Review*.

## Tables

**Table.1 Definition of Variables**

Variable	
Sales_growth	Sales growth rate
DEBT	Debt ratio
ROA	Operating income/total assets
ROE	Net income/capital
Variables of Ownership Structure	
over50_dummy	Dummy variable, government holding ratio> 50% = 1

control_dummy	Dummy variable, government is the largest shareholder = 1
State_ratio	Government ownership ratio
Private_ratio	Private corporate ownership ratio
Person_ratio	Domestic individual ownership ratio
Foreign_ratio	Foreign capital ownership ratio
Director_ratio	Official shareholding ratio of company
Control Variables	
TASS	Total assets
board_number	Number of directors
Top10	Total shareholding ratio of top 10 shareholders
ID_number	Number of independent directors

**Table.2 Descriptive Statistics**

variable	mean	p50	min	max	sd	N
sales_growth	20.54	15.41	-61.95	274.46	36.39	17,448
DEBT	47.59	47.78	-19.47	199.68	22.64	19,444
ROA	7.32	5.1	-99.86	99.65	13.5	19,624
ROE	13.06	8.87	-298.76	287.17	28.63	19,578
over50_dummy	0.27	0	0	1	0.45	15,428
control_dummy	0.54	1	0	1	0.5	15,428
State_ratio	29.09	27	0	99.37	25.35	15,428
Private_ratio	17.03	5.17	0	91.64	21.3	15,428
Person_ratio	5.91	0.5	0	76.52	13.93	15,428
Foreign_ratio	1.82	0	0	71.56	5.85	15,428
Director_ratio	2.39	0	0	79.77	9.3	15,428
top10	56.24	57.57	0.6	100	15.82	15,428
TASS	6,732.36	1,435.45	0.13	2390000	48,955.61	19,686
board_number	9.1	9	4	19	2.05	15,407
ID_number	2.63	3	0	7	1.4	15,352

**Table.3 Attributes of Shareholders and Corporate Profitability**

Variable	ROA					ROE				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10

over50_dummy	0.0472									-0.292
control_dummy										-2.17***
State_ratio										
Private_ratio										
Foreign_ratio										
Director_ratio										
State_ratio2										
top10										
lnTASS										
DEBT										
_cons										
r2_w	0.142	0.143	0.144	0.142	0.143	0.0413	0.0419	0.0427	0.0416	0.0422
N	15127	15127	15127	15127	15127	15050	15050	15050	15050	15050

Note: \* p<.1; \*\* p<.05; \*\*\* p<.01

**Table.4 Attributes of Shareholders and Corporate Growth**

Variable	sales_growth	sales_growth	sales_growth	sales_growth	sales_growth
over50_dummy	-0.755				
control_dummy					
State_ratio					
Private_ratio					
Foreign_ratio					
Director_ratio					
State_ratio2					
top10					
lnTASS					
DEBT					
_cons					
r2_w	0.038	0.0383	0.0385	0.038	0.0386
N	14045	14045	14045	14045	14045

Note: \* p<.1; \*\* p<.05; \*\*\* p<.01

**Table.5 Attributes of Shareholders and Debt Ratio**

Variable	DEBT	DEBT	DEBT	DEBT	DEBT
over50_dummy	-1.37***				
control_dummy		1.74***			
State_ratio			0.033	0.0112	.169***
Private_ratio			0.0271		
Foreign_ratio			-0.015		
Director_ratio			-.132**		
State_ratio2					-.00247***
top10	-.0784***	-.0899***	-.114***	-.0957***	-.0649***
lnTASS	3.85***	3.86***	3.86***	3.86***	3.81***
_cons	17.3***	16.1***	17.5***	17.2***	14.9***
r2_w	0.0606	0.061	0.061	0.0602	0.0627
N	15135	15135	15135	15135	15135

Note: \* p<.1; \*\* p<.05; \*\*\* p<.01

**Table.6 Statistical Description by Attributes**  
**Panel A Central State-Owned-affiliated Enterprises**

variable	mean	p50	min	max	sd	N
ROA	5.42	4.14	-43.28	81.04	8.93	2349
ROE	9.42	8.08	-244.97	168.35	20.51	2345
sales_growth	19.32	15.56	-61.49	268.03	34.08	2157
DEBT	48.53	48.56	4.24	1.15E+02	19.79	2348
over50_dummy	0.61	1	0	1	0.49	1956
control_dummy	0.99	1	0	1	0.08	1956
State_ratio	53.27	54.27	19.21	96.15	14.4	1956
Private_ratio	2.77	0.72	0	33.66	4.73	1956
Person_ratio	0.57	0	0	20.44	1.87	1956
Foreign_ratio	2.05	0	0	39.06	6	1956
Director_ratio	1.25	0	0	41.52	5.32	1956
TASS	26,809.16	2,624.26	53.88	2.39E+06	132602.55	2350
board_number	9.67	9	5	19	2.15	1960
ID_number	2.72	3	0	7	1.57	1955
top10	59.91	60.19	20.42	98.68	14.7	1956

**Panel B Local State-owned Enterprises**

variable	mean	p50	min	max	sd	N
ROA	9.63	5.9	-99.86	99.65	15.59	10036
ROE	17.44	10.14	-259.81	277.24	31.3	10028
sales_growth	21.33	15.81	-61.89	274.07	36.28	8496
DEBT	49.35	49.67	-19.47	196.89	21.34	9947
over50_dummy	0.49	0	0	1	0.5	6246
control_dummy	0.98	1	0	1	0.14	6246
State_ratio	49.04	49.7	2.82	99.37	15.93	6246
Private_ratio	4.19	1.24	0	37.68	6.47	6246
Person_ratio	0.94	0	0	21.54	1.94	6246
Foreign_ratio	1.07	0	0	40.72	4.11	6246
Director_ratio	0.61	0	0	33.75	3.04	6246
TASS	4,202.26	1,233.99	0.51	861733.56	18,488.70	10073
board_number	9.36	9	4	18	2.14	6239
ID_number	2.35	3	0	8	1.59	6209
top10	55.86	57.18	3.38	100	15.81	6246

**Panel C Private Enterprises**

variable	mean	p50	min	max	sd	N
ROA	4.74	4.52	-95.17	92.14	10.77	7239
ROE	8.14	7.91	-298.76	287.17	25.94	7205
sales_growth	19.95	14.74	-61.95	274.46	37.22	6795
DEBT	44.83	44.46	0.71	199.68	24.88	7149
over50_dummy	0	0	0	1	0.05	7338
control_dummy	0.06	0	0	1	0.23	7338
State_ratio	5.94	2.5	0	47.18	7.97	7338
Private_ratio	31.64	33.07	0	91.64	22.58	7338
Person_ratio	11.51	1.75	0	76.52	18.58	7338
Foreign_ratio	2.4	0	0	73.44	6.96	7338
Director_ratio	4.16	0	0	79.77	12.62	7338
TASS	3,745.34	1,448.99	0.13	530825	13,660.42	7263
board_number	8.73	9	4	19	1.86	7318



ID_number	2.85	3	0	6	1.09	7298
top10	55.66	57	0.6	100	16	7338

Note: \* p<.1; \*\* p<.05; \*\*\* p<.01

**Table.7 Attributes of Shareholders and Performance**  
**Panel A1 Central State-owned-affiliated Enterprises (Profitability)**

Variable	ROA	ROA	ROA	ROA	ROE	ROE	ROE	ROE
over50_dummy	-0.647				-0.394			
control_dummy		-3.79				-8.06		
State_ratio			-0.178	-0.108			1.18**	-0.344
Private_ratio			-0.127				1.3**	
Foreign_ratio			-0.167				1.5**	
Director_ratio			-0.216				1.01*	
State_ratio2				0.000615				0.00284
lnTASS	.935***	.915***	.982***	.966***	6.99***	6.97***	6.96***	7.08***
DEBT	-.176***	-.176***	-.177***	-.177***	-.459***	-.46***	-.45***	-.463***
top10	.121***	.107***	0.277	.141***	.185**	.181***	-1.03**	.211*
_cons	-2.63	1.7	-2.19	-0.516	-40***	-31.8***	-38.5***	-32.6***
r2_w	0.159	0.159	0.159	0.159	0.113	0.114	0.117	0.114
N	1913	1913	1913	1913	1910	1910	1910	1910

**Panel A2 Central State-owned-affiliated Enterprises (Growth Potential)**

Variable	sales_growth	sales_growth	sales_growth	sales_growth
over50_dummy	-6.36*			
control_dummy			-2.12	
State_ratio				-1.96*
Private_ratio				-1.86*
Foreign_ratio				-1.59
Director_ratio				-2.25*
lnTASS	1.54		1.44	2.09
DEBT	.366***		.363***	.347***
top10	.444**		.283*	2.21**
_cons	-36.6**		-28.1	-33.5**
r2_w	0.0855		0.0839	0.0865

N	1796	1796	1796	1796	1796	1796	1796	1796
<b>Panel B1 Local State-owned Enterprises (Profitability)</b>								
Variable	ROA	ROA	ROA	ROA	ROE	ROE	ROE	ROE
over50_dummy	0.585				-0.0174			
control_dummy		-2.05**				0.265		
State_ratio			-0.223**	-0.00697			0.00632	.439**
Private_ratio			-0.253**				-0.0504	
Foreign_ratio			-0.251**				-0.169	
Director_ratio			-0.29**				-0.262	
State_ratio2				0.000269				-0.002
lnTASS	1.29***	1.25***	1.34***	1.28***	1.57**	1.57**	1.58**	1.65**
DEBT	-0.204***	-0.204***	-0.205***	-0.204***	-0.273***	-0.273***	-0.272***	-0.274***
top10	.0922***	.106***	.333***	.0881***	.26***	.259***	0.264	
_cons	-2.36	-0.548	-3.32**	-2.13	-10.4*	-10.7*	-10.5*	-12.5**
r2_w	0.185	0.185	0.186	0.185	0.0431	0.0431	0.0434	0.0424
N	6069	6069	6069	6069	6039	6039	6039	6039
<b>Panel B2 Local State-owned Enterprises (Growth Potential)</b>								
Variable	sales_growth	sales_growth	sales_growth	sales_growth	sales_growth	sales_growth	sales_growth	sales_growth
over50_dummy	-1.56							
control_dummy				-6.75				
State_ratio					-0.558		-0.979***	
Private_ratio					-0.62			
Foreign_ratio					-0.225			
Director_ratio					-1.04			
State_ratio2							.00965***	
lnTASS	3.35***	3.26***	3.26***	3.26***	3.59***	3.59***	3.55***	
DEBT	0.00748	0.00748	0.00949	0.00949	0.00708	0.00708	0.00872	
top10	.265***	.265***	.242***	.242***	0.809	0.809	.272**	
_cons	-20.7**	-20.7**	-13.1	-13.1	-22.7**	-22.7**	-0.971	
r2_w	0.0328	0.0328	0.033	0.033	0.0332	0.0332	0.0349	
N	5527	5527	5527	5527	5527	5527	5527	

**Panel C1 Private Enterprises (Profitability)**



over50_dummy	0.736			-0.854			(omitted)		
control_dummy		-6.4			4.31**			7.11***	
State_ratio			-0.481***			-0.0523			.239***
State_ratio2			.00355**			-0.000345			
r2_w	0.259	0.259	0.262	0.0997	0.1	0.1	0.0375	0.0408	0.0416
N	1913	1913	1913	6073	6073	6073	7149	7149	7149

Note: \* p<.1; \*\* p<.05; \*\*\* p<.01

#### Appendix Correlation Matrix

	ROA	sales_growth	over50_dummy	control_dummy	State_ratio	Private_ratio	Person_ratio	Foreign_ratio
ROA	1							
sales_growth	0.254	1						
over50_dummy	0.019	-0.001	1					
control_dummy	-0.076	-0.042	0.56	1				
State_ratio	-0.027	-0.014	0.801	0.857	1			
Private_ratio	-0.010	0.018	-0.423	-0.635	-0.604	1		
Person_ratio	0.145	0.054	-0.234	-0.391	-0.364	-0.145	1	
Foreign_ratio	0.051	0.003	-0.047	-0.083	-0.075	-0.074	0.081	1
Director_ratio	0.095	0.025	-0.111	-0.153	-0.179	-0.105	-0.020	-0.063
state_CEO	-0.018	-0.016	0.156	0.226	0.213	-0.122	-0.166	-0.053
insider	0.057	0	-0.128	-0.135	-0.149	0.024	0.126	0.051
outsider_CEO	-0.022	0.008	-0.087	-0.104	-0.119	0.138	0.017	-0.024
top10	0.145	0.066	0.428	0.057	0.341	0.16	0.116	0.186
DEBT	-0.269	0.018	0.039	0.136	0.111	0.051	-0.269	-0.063
TASS	-0.011	-0.009	0.094	0.065	0.105	-0.042	-0.042	0.118
board_number	-0.015	-0.007	0.144	0.192	0.194	-0.062	-0.171	0
ID_number	0.113	-0.018	-0.166	-0.161	-0.199	0.039	0.125	0.058

#### Appendix Correlation Matrix (continued)

	Director_ratio	state_CEO	insider	Outsider_CEO	top10	DEBT	TASS	board_number	ID_number
Director_ratio	1								
state_CEO	-0.067	1							
insider	0.042	-0.566	1						
outsider_CEO	0.024	-0.175	-0.344	1					
top10	0.115	-0.024	-0.054	0.012	1				
DEBT	-0.113	0.106	-0.07	-0.012	-0.082	1			
TASS	-0.015	0.036	0.006	-0.03	0.109	0.06	1		
board_number	-0.035	0.065	-0.055	-0.038	0.058	0.098	0.061	1	
ID_number	0.075	-0.012	0.121	0	-0.091	0.004	0.111	0.146	1

# Construction and Early Warning of Coal Industry Security Measurement System in China

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**Abstract:** Coal consumption has a basic position in China's energy consumption. This is determined by China's coal resources and production characteristics. The comprehensive evaluation of coal industry security is the premise and basis for the security strategy and planning of coal industry and the coal industry security decision. This article from the coal production, distribution, international trade, consumption of four reproduction aspects, constructs the comprehensive coal security measurement system of China. It carries on the empirical analysis. On this basis, the paper constructs the early warning mechanism of coal security in china.

**Key words:** China's coal Security, measurement system, early warning

## Introduction

Energy security is a major theoretical issue with global and strategic significance in China's economic, technological and social development. This is an urgent problem to be solved in government management. It is related to national energy and national economic security strategy. China's energy reserve characteristic, which is "rich in coal, poor in oil, little gas", the characteristic of economic development, and the apparent advantage of coal in cost, all decided coal remains the primary energy source in China and coal's predominant role in national primary energy consumption structure is difficult to be changed in a short time. Resource and production characteristics of coal decided its status in national energy consumption.

Coal security is not only an important research subject concerning energy security, but also an important component of economic security. It is directly related to both the sustainable development of the coal industry and national economic security. The reliability of coal supply and stability of coal price have a huge impact on the normal development of national economy. All these factors above make coal security issues become a focus in our country's theoretical circle and also one of the frontier problems of China's economic security research. The integrate evaluation of coal security is the premise and basis for coal industry to make security strategy, planning and security decisions. So, discussion on coal security evaluation of the basic theory, construction of the coal industrial security evaluation index system and selecting the suitable evaluation method comprehensively evaluate coal security. On this basis, this paper establishes the coal security management system. This promotes coal industry health and sustainable development. It is of great

theoretical value and practical significance.

The risk issue in China's four coal procedures, which are production, distribution, international trade and consumption, surfaced gradually, and this must be paid attention to. In production procedure, we have a low level of mechanization of mining and frequent coal mine accidents. The death toll of coal mine accidents and the fatality rate per million tons of coal are much higher than the world's other coal powers. The coal production from rural coal enterprises takes only less than 40% of the state's total output, but it is responsible for about 70% of country's death toll within coal industry. The unparallel situation between China's production zones and consumption zones makes "how to transport coal" a major problem. The total amount of global coal trade in 2009 was 800 million tons, and China changed from the traditional coal exporting country into the importing one. The annual net import was 103 million tons and for the first time China became a net coal importer. Experts predicted China's annual import of coal may reach 800-1000 million tons in 10 to 15 years. If this prediction comes true, due to the huge amount of coal imports from China, the price of coal will inevitably be lifted by international traders, just like what happened to iron ore. Low level of consumption pattern of coal will cause serious pollution; excessive coal mining will lead to environmental catastrophe; coal mining also will cause damage and pollution to water resources; the air pollution through coal mining process mainly comes from the soot and sulfur dioxide generated by the spontaneous combustion of coal mine gas and gangues. Moreover, the coal mine methane emission to the atmosphere is not only a waste of clean energy, but also causes serious damage to the atmospheric environment of the mining zone, which greatly aggravates global

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warming and influences climate change. Furthermore, the low utilization rate of coal combustion results in serious environmental problems. Air pollution has big influence on farmland, crops, plants, and human health. About 50% of the coal is used for power generation, and coal-fired power generation costs hugely and economically on air, water pollution and human health.

### 1. The basic framework of coal security measurement system in China

China's coal industry security measurement system is

composed of a number of interrelated and interactive evaluation indicators. It is an organic whole with a certain hierarchy. The selection of indicators has a direct impact on the scientific and persuasive results. In this paper, 1 comprehensive index, 4 first level indexes and 28 second level indexes are constructed. The 1 comprehensive index is China coal industry security index. The 4 first level indicators are coal production security index, coal distribution security index, coal international trade security index and coal consumption security index. 28 second level indexes cover four aspects of coal production, distribution, international trade and consumption (see Table 1).

**Table.1 Comprehensive measurement index system of coal industry security in China**

Comprehensive index	First level indexes	Second level indexes
Coal industry security index of China	Coal production security index	coal reserve production ratio
		elastic coefficient of coal reserves
		elastic coefficient of coal production
		production concentration degree (CR4)
		township coal mine production proportion
		township Coal Mine mortality rate of one million tons
		proportion of foreign capital industrial output value
		foreign capital accounted for the proportion of coal industry profits
	Coal distribution security index	Ex-factory price growth rate of coal product
		railway freight transport ratio
		Coal railway coal accounted for the proportion of total coal transport volume
		average distance of reasonable rate of coal railway
		market share of foreign capital
		coal stock ratio
		coal export dependence
		coal exports share of world exports
	Coal international trade security index	foreign trade index of coal
		coal import dependence
		coal import concentration
		share of world imports of coal imports
		coal imports accounted for the proportion of total imports of goods
		long term coal import capacity index
		ratio of coal production and coal consumption
		self-sufficiency rate of coal consumption
	Coal consumption security index	coal consumption intensity
		coal consumption elastic coefficient
		coal consumption accounts for the proportion of total energy consumption
		alternative energy consumption accounts for the proportion of total energy consumption

### 2. Application of coal security measurement system in China

In this paper, the two level multi index methods are used to

evaluate the security of China's coal industry. Specific steps are as follows:

The first step is to analyze the four industrial sectors of coal industry reproduction. On this basis, some of the indicators are

refined constitute the four sectors of the coal industry security index evaluation index. The second step is to delineate the scope of each index and the scope of the security rating of the alarm range on the basis of analysis of relevant literature. The third step is to convert the original value of each index into the evaluation value according to the alarm limit. The fourth step is to determine the weight of the index system using principal component analysis of SPSS software. The fifth step is divided each index numerical value into measure model of sub index evaluation system to calculate the coal security index of four industrial sectors. The coal security index of the four industrial sectors is used as the numerical value of the comprehensive evaluation system. The sixth step is to repeat the fourth step and the fifth step process. Finally, the comprehensive index of China's coal industry security is obtained. From 1995 to 2016 of 28 indicators of the original data come from *the BP world energy statistics 2015*, *Chinese Statistical Yearbook (1996-2016)*, *Chinese Energy Statistics Yearbook (2000-2002, 2007-2016)*, *Chinese Coal Industry Yearbook 2004* and *China Coal Industry Yearbook 2006*.

The original data was collated to get the original value. According to the nature of the indicators, the original values are calculated from positive index formula, reverse index formula and moderate index formula. The original value of the index is converted into a numerical value. Then use the principal component analysis of SPSS18.0 software to determine the weight of each index. China coal industry security index evaluation index model is obtained.

China coal production security index, coal circulation security index, coal international trade security index and coal

consumption security index from 1995 to 2016 are named  $X_1$ - $X_4$ . We get some useful information such as the correlation coefficient matrix, the variance decomposition principal component extraction and analysis table, the initial factor load matrix using principal component analysis.

The three principal component expressions are:

$$F_1=0.303055ZX_1+0.621302ZX_2+0.606909ZX_3-0.39261ZX_4$$

(formula 1)

$$F_2=0.842554ZX_1+0.179706ZX_2-0.43699ZX_3+0.260229ZX_4$$

(formula 2)

$$F_3=-0.24446ZX_1+0.443339ZX_2+0.209239ZX_3+0.836957ZX_4$$

(formula 3)

Among them,  $F_1$ ,  $F_2$  and  $F_3$  represent the three principal components.  $ZX_1$ - $ZX_4$  represent the standardized data  $X_1$ - $X_4$ .

From these datum, we calculated the principal component model.

$$F=\frac{T_1}{T_1+T_2+T_3}F_1+\frac{T_2}{T_1+T_2+T_3}F_2+\frac{T_3}{T_1+T_2+T_3}F_3$$

(formula 4)

We calculate the weights of the principal component model F. Therefore, we can get the measurement model of China's coal security measurement system:

$$F=0.29331X_1+0.411535X_2+0.180998X_3+0.114157X_4$$

(formula 5)

Taking the data into the measurement model of China's coal security measurement system, we can get the measurement results of China coal security index from 1995 to 2016 (see Table 2).

**Table.2 Measurement results of China coal security index in 1995-2016**

Year	Calculate score	Year	Calculate score
1995	59.35	2006	62.67
1996	54.94	2007	60.51
1997	54.67	2008	56.68
1998	49.27	2009	52.05
1999	52.73	2010	57.12
2000	58.85	2011	60.04
2001	67.31	2012	61.86
2002	63.14	2013	63.21
2003	59.72	2014	64.35
2004	64.38	2015	65.02
2005	64.92	2016	66.84



**Figure.1 China coal security index trend**

**3. China coal security early warning and Enlightenment**

From table 2, China's coal security situation is located in the level of slight insecurity level before 2001. The situation from 2001 to 2007 has picked up and is located in the level of basic security. But from 2008 to 2010, the situation has fallen into the level of slight insecurity level. After 2011, the situation is in the basic security level. These indicate that in recent years China's coal security has improved year by year. But the situation is still not optimistic. Only by taking effective measures, can we guarantee the security of our strategic industry.

On the basis of the measurement of coal security in China, we can establish the early warning mechanism of coal security in

china. According to table 3, China's coal safety between 1995 and 2016 is in the light of the degree of police alarm and the extent of the police alarm.

Especially between 2005 and 2009, the rate of deterioration is very rapid. Therefore, it is necessary to establish China's coal security measurement and early warning mechanism as soon as possible. We establish and improve early warning data reporting platform, early warning information customization and distribution platform, early warning data mining analysis platform. Thus, we can realize the resource sharing and complementary advantages of the industry early warning system and the government management department in order to realize the safe and healthy development of China's coal industry.

**Table.3 China coal security early warning system**

Security type	Excellent	Good	Secondary	Low grade	Poor		
Security level	Highest security	High security	Medium security	Low insecurity	Moderate insecurity	Severe insecurity	Crisis
Alarm type	No alarm		Light alarm	Moderate alarm	Heavy alarm	Giant alarm	
Corresponding score	90—100	80—89	70—79	60—69	40—59	30—39	0-29
Signal	○		△	☆	▲	●	

**References**

Duan Yi. *Analysis of coal industry ecological security evaluation. Zhongzhou coal*, 2013, (04): 34-37.

Fang Shuqiong. *The evaluation index system of national energy security building. China conditions*,2008(3):32-36.

Gu Haibing. *Index system of China's economic security early warning. Journal of National School of Administration*, 2007, (1):49-52.

Li Dongmei. *A preliminary study on the concept and evaluation index system of coal industry safety. China mining industry*, 2011, (05): 38-40.

Li Jiang. *The method of determining the weight of coal mine safety evaluation index system. safety*, 2009, (8):6-9 .

Liu Ke. *Research on the transition path of China's coal industry from the perspective of industry security. Beijing Jiaotong University*, 2016:89-102.

Wang Wei. *The pressure and upgrading of coal industry under the constraint of energy security. coal economics research*, 2012, (11): 56-59.

Wang Yongbao. *Safety analysis and quantitative estimation of coal industry in China during the period of 11th Five-Year. China mining*, 2007, (3): 30-33.

Wu Yuping. *Safety analysis and quantitative estimation of coal industry in China during the period of 11th Five-Year. soft science*, 2007, (2):34-37.

Wu Yuping. *Safety evaluation of coal industry based on fuzzy group decision making model. industrial technology and economy*, 2011, (6): 59-64.

Ye Weiping. *The three important characteristics of national economic security and Its Enlightenment to China. The study of Marxism*, 2008, (10):35-40.

Yong Chao. *China coal industry safety evaluation. Beijing Jiaotong University*, 2014:73-79.

Zhang Yixiang. *Chinese coal industry ecological security evaluation and policy recommendations. theory monthly*, 2011, (2): 163-165.

OECD, *Energy Security and Competition Policy 2007*, 14Jan.2008, <http://www.oecd.org>.



# Affected Countries Struggle to Resolve North Korea Crisis

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**Abstract:** On 11 September 2017, the United Nations Security Council passed new resolution with fresh sanctions, considered toughest against North Korea so far to rein its nuclear weapons program. When President Trump on taking over tried to outsource the problem of resolving North Korean Crisis to China presumably in exchange of some trade concessions, his administration overlooked this crisis. This paper analyses how the affected countries such as China to resolve this crisis.

**Key words:** North Korea, Crisis, affected countries, solutions

## 1. Current state of North Korean crisis

On 11 September 2017, the United Nations Security Council passed new resolution with fresh sanctions, considered toughest against North Korea so far to rein its nuclear weapons program. Under these sanctions, the annual export of oil and fuel products to the country would be cut from about 8.5 million barrels to two million. Donald Trump sees UN sanctions as “Just a small step towards what is ultimately needed to rein in Pyongyang over its weapons programs”. The resolution came a week after Pyongyang conducted its sixth and largest nuclear test, having launched 13 ballistic missiles this year. North Korea claims to have tested an extremely powerful H-bomb. Ahead of the UN Security Council meeting Pyongyang says that it would cause the US “the greatest pain and suffering it had ever gone through in its entire history”. Sanctions against North Korea have so far been ineffective to deter them.

China agreed to fully enforce the resolution after it was presumably watered-down. The US-drafted resolution initially called for an oil embargo on North Korea, an asset freeze and travel ban on its leader Kim Jong-un. But media reports said it had been toned down to win the support of China supported by Russia, both holding UN veto power.

Post sanctions, North Korean state agency threatens to use nuclear weapons to “sink” Japan and reduce the USA to “ashes and darkness” in retaliation against harsher UN sanctions. On 15th September 17, North Korea fired an intermediate-range ballistic missile that flew over Hoakkaido, Japan before landing in the northern Pacific Ocean, which rattled Japan. North Korea firing of ballistic missiles into the sea over Japan certainly keeps South Korea and Japan on their toes, besides

demonstrating its capability to strike Guam, signaling US.

US Secretary of State Rex Tillerson urged China and Russia to do more to rein in North Korea. He said “China and Russia must indicate their intolerance for these reckless missile launches by taking direct actions of their own. China said it “opposes” the test, but reiterated its call that “all parties” should exercise restraint. The Security Council called an emergency meeting the same day and once again condemned the highly provocative action of North Korea. Pyongyang continues to defy sanctions. US continues to examine all options including military options to deal with it. The situation on the Korean Peninsula continues to be complicated and sensitive enough to ignite a conflict.

## 2. Affected countries struggle to resolve Crisis

### *2.1 Is the Logic of North Korea to continue Nuclear Misadventure justified?*

While North Korea justifies it, as a defensive, survival measures against US threat of their regime changes efforts in Iraq, Afghanistan, Syria and other countries not having nuclear capabilities, and not following its dictate. The threat from US regional allies has also been given as an excuse. The Korean war is also an unforgettable historical event when US might was used against them.

The North Korean ambassador while speaking to an Indian News Channel WION on 21 June, 2017, had expressed their willingness to talk to US, but without preconditions. He also indicated their willingness for being open to the idea of moratorium and talking about it.

Washington Post in its article “These 5 things help make sense of North Korea’s nuclear tests and missile launch” had brought out five basic reasons, as possible logic for nuclear

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misadventure by repeated nuclear tests in Southeast Asia. Basically, it all amounts to Kim Jong-un trying to retain unhindered autocratic use power, and demonstrating his strength to his countrymen, keeping his 'Nuclear program', and 'Hate America tag' as a rallying point for his leadership, generating faith in him, and generating spirit of nationalism and anti-American sentiments. The alleged assassination of his brother in Malaysia is also being linked to a possibility of eliminating any future contender for power.

The recent threat of missile attack on Guam by North Korea (later called off), and renewal of missile attack by them on 15 September 2017 over Japan, demonstrating its capability to attack Guam, indicate that North Korea is going well beyond the justification of its survival need. It is perhaps an effort by Kim Jong-un to just to save himself, his regime and his power, sacrificing regional peace and perhaps national interest of North Korea, with innocent people of the country getting deprived of their basic needs. Kim's fantasy of seeking 'Military Equilibrium with US' seems to be driving him crazy.

### ***2.2 Is North Korea a liability or it's a Chinese Double game?***

The renewed missile test besides isolating Pyongyang has put China in Tight spot, for not putting enough pressure on them. Despite China's announcement earlier to suspend all imports of coal from North Korea for the rest of the year, to deprive North Korea financially (Coal exports makes up about 35 percent of North Korea's economy. 90 percent of its trade is with China which is based on coal export) is being viewed as 'Too little and too late' because it is also estimated that China's trade with North Korea has increased tenfold over last 15 years. This indicates that North Korea prospered with China's help to reach the current stage of being capable of creating a global crisis in line with its Frontline Strategy. North Korea is continuing with its nuclear misadventure, and despite China being party to UN Resolution is being looked upon to put more pressure on them, being their economic lifeline.

The continuation of nuclear adventure by North Korea means either China does not have enough leverage on North Korea, or China is deliberately not putting pressure on them. Now China as well as Russia are concerned about deployment of THAAD in South Korea, post visit by General Mattis, arguing that the system could be used to spy on Chinese missile flight tests. In my opinion China or Russia may not be keen to invite and support a nuclear war by North Korea, will be looking for a peaceful solution, but may not be in a position to address the insecurities of North Korea (especially their leader). China's current domestic occupation may also not favor inviting such a trouble. How sincerely will China implement the UNSC resolution is anyone's guess, but it will redefine its credibility, global image and its future dream of being a responsible world power.

If North Korea initiates a conflict, I do not visualize Chinese significant involvement except asking all parties to calm down, which it is doing even now. They have already made it clear that if North Korea invades another country, China will not defend them. The dilemma will be if US attacks North Korea, where I feel that China may give moral and material support to North Korea and not enter the war directly like 1950-53. The possible advantages are not worth the risk. Chinese psychological warfare machinery and propaganda will definitely become more active to deter US and its allies. This idea has also been adopted by North Korea, which continues to issue provocative statements on daily basis.

### ***2.3 Is there a Role for India?***

Admiral Harry Harris, commander of the US Pacific Command, feels that India could play some role in this crisis as he said "I think India's voice is a loud voice, which people pay attention to. So, I think that India could help North Korea, perhaps, understand the seriousness by which the United States views that threat." While India had some historical, diplomatic and trade links with North Korea, and it entertained some space science students in the past, India has repeatedly raised its concerns against North Korea's nuclear tests, and continues to do so. India's has been raising issues about Pakistan having reportedly sold nuclear technology related documents to North Korea. If North Korean Technology develops further, a reverse flow to Pakistan may be a serious concern for India. North Korea has been more supportive towards Pakistan on Kashmir issue.

In this crisis India continues to condemn the North Korean missile tests, has been implementing the sanctions imposed against it by the US and has strapped its trade links (which is even less than a billion USD) with North Korea early this year. While the expectations are welcomed but Indian leverage in this crisis is very limited.

### ***2.4 What is the Way out of the Current Crisis?***

As per New York Times (13 September, 2017), North Korea has resumed work at its underground nuclear testing site, as the country vowed to keep expanding its nuclear arsenal despite the latest United Nations sanctions. Despite heavy sanctions, North Korea remains in defiant mode saying that it would "redouble the efforts to increase its strength to safeguard the country's sovereignty and right to existence" and establish "practical equilibrium with the U.S." As per Sputnik News (11 September, 2017) 'Pyongyang appears to utilize the "Bluff and Bluster" strategy. Create a geo-political crisis and request compromise from opposing forces, assuming they can be rewarded since other nations want to prevent war'.

Russian President Vladimir Putin refuses to recognize North Korea's 'nuclear status' on the grounds Pyongyang "poses a security threat in Northeast Asia." He has gone along with UN sanctions, on a pragmatic note has said that North

Korea would choose to “eat grass” before giving up its nuclear program, indicating that sanctions alone will not help. Some authors have gone to other extreme, talking of third world war with North Korea as a trigger. I do not subscribe to this fantasy that so many responsible matured nations can start fighting a war due to irresponsible actions of one country/leader.

Tough implementation of sanctions along with smart diplomacy involving all concerned parties, who have direct concerns in this crisis, is a more positive and hopeful way forward to diffuse the crisis. The Russian role is often underplayed but is significant in this crisis, as they are equally affected by THAAD, and were also a player in watering down the sanctions, besides the key players to include US, North Korea, China, South Korea and Japan. In my opinion a track 2 talks between six parties must commence immediately. While it is understandable that US will not like to talk directly with North Korea under pressure of their irresponsible actions, but someone on their behalf will have to convince the present regime of North Korea that the threat to their survival is not the US strategic aim, so long they give up their nuclear misadventure. Conversely someone has to convince Kim that he can neither save himself or his regime if he continues with such provocative activities, despite China repeatedly advising US to tone down the threat. US expectations of North Korea totally giving up their nuclear arsenal is also “Too ambitious, too late”. China cannot be relied much for resolution due to their own interests as explained earlier.

The hopeful part is that through the conversation of its Ambassador to India, North Korea has conveyed their willingness to talk to US, but without preconditions, and being

open to the idea of moratorium. This can be taken forward diplomatically, without giving an impression of US and other global players falling prey to North Korea’s “Bluff and Bluster” strategy. Posturing of US for military action also needs to be on the card, but military action must be the last resort. I do not subscribe to the idea of \$ 8 million humanitarian aid by South Korea to deserving people of North Korea, at a time when their own leader, who is responsible for their welfare is going around threatening other regional countries, showing no mercy towards their own people. Any softening up of any affected country will embolden North Korea for more irresponsible misadventures, and will not go well with US and affected allies. The tendency of nuclear blackmailing either by North Korea or Pakistan must be arrested. The Trump administration continues to struggle for a viable solution, and statements like ‘Effective and Overwhelming response’ alone will not help. As of now it will have to be seen how US will respond.

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## References

- <http://www.express.co.uk/news/world/853500/North-Korea-news-Kim-Jong-un-threatens-World-War-3-USA-Donald-Trump-latest-WW3>.
- <https://sputniknews.com/analysis/201709111057281836-north-korea-what-is-to-be-done>.
- <http://www.scmp.com/news/china/diplomacy-defence/article/2111068/will-latest-un-sanctions-have-any-effect-north-korea>.
- <http://www.wionews.com/videos/the-interview-wion-talks-to-north-korea-s-ambassador-kye-chun-yong-3886>.

# Research on Evaluation System for Precision Identification of Students from Low-income Families: Take Zhenjiang City of Jiangsu Province as an Example

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**Abstract:** The identification of students from low-income families is the most groundwork in student financial assistance, the precondition and important guarantee for implementing national student financial aid policy, determining funding targets and achieving the precision of fund work. In light of this, only ensuring precision identification of students from low-income families can make educational assistance serves the students and society better. This study based on domestic and foreign researches of identification of students from low-income families, taking Zhenjiang for example, putting forward to build the evaluation index system for precision identification of students from low-income families from four dimensions: family human resources, family economic resources, personal comprehensiveness and special circumstances. Relevant countermeasures and suggestions are provided for optimizing identification standard and financial assistance system of students from low-income families and improving the precision of student financial assistance work.

**Key words:** students from low-income families; precision identification; evaluation index system; analytic hierarchy process

## Introduction

In 2016, Ministry of Education puts that in the whole period of the 13th Five-year Plan, student financial assistance work will establish an precise funding mechanism in the form of "financial assistance for all students from low-income families" and realize "three cannot be less": including all economically disadvantaged students into the scope of funding to ensure that "not one student less"; implementing all projects in place to ensure that "not one project less"; paying all funds timely and fully to ensure that "no one penny less". As we all know, China is a populous country with large-scale students in school, and because of the family conditions, community economy, regional environment and other complex reasons, from the stage of compulsory education to higher education, students from low-income families still account for a large proportion in school. At the same time, this paper puts that identification and fund management of students from low-income families are the core of student financial assistance work. Only identifying students from low-income families precisely, classifying them accurately, arranging funding management procedures properly, the financial assistance work can be ensured in place. If occurring "the needed one didn't be chosen, the chosen one didn't be fund timely and in place" and

so on, students may not be able to complete their studies owing to economic pressure, and more likely to have mental illness and then can't carry out life and study, thus affecting personal development and even the ability to serve the community. Thus, the research on precision identification of students from Low-income families is both of great theoretical value and practical significance.

However, so far, from a nationwide perspective, it has been difficult to make the financial assistance system of students from low-income families perfect, and the allocation of assistance resources has not been optimized enough. We believe that an important reason for the lack of precision of economically disadvantaged students' fund work is that in-depth theoretical research of student financial assistance is mainly focused on higher education, while the researches on preschool education, compulsory education, general high school education are relatively few, the study of precision funding standardization, scientific theory and operation are more lacking, directly affect the further development of practice. This requires further strengthening of theoretical research on other levels of education except higher education according to the local reality, guiding practice with a clearer theory, and effectively improving the precision of financial aid. Based on above statements, taking the

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financial assistance work of students from low-income families as the object and based on current financial assistance policies of Zhenjiang and the analysis of effect, this study attempts to construct an evaluation index system for precision identification of students from low-income families, which can be operated, verified, developed and promoted, and effectively improve the pertinence and effectiveness of student funding work. This study will help to make up for the lack of research on the financial assistance system of students from low-income families, and will help to promote the deepening of the research on precision financing assistance, which will help the country and the local governments to carry out financing assistance work of students from low-income families.

According to the questionnaire result of Questionnaire Survey on Student Financial Assistance in Jiangsu Province collected in Zhenjiang, which was organized by the Jiangsu Provincial Education Department in March 2016, we found that of the more than 5,000 samples of economically disadvantaged students in Zhenjiang, the proportion of unfunded students reached 29.14% in compulsory education stage, 23.16% in ordinary high school education stage, 23.40% in secondary professional education stage. According to the principle of "the needed one should not be missed, the improper one should not be helped", the funding identification work of different education stages in Zhenjiang needs to be improved.

**1. Determination of the index system**

**1.1 The principles of the establishment of index system**

The principles what the identification index system of

students from low-income families should followed by are: (1) the index system should be scientific and systematic, that means the content of the index should be concise, clear and precise, which are not duplicated and omitted, and can be compared; (2) the index system is layered, which means each index and its' corresponding specific contents are not intersected; (3) the selection of indicators is representative and objective, at the same time it can be quantified; (4) the design of the index should conform to some certain norms to protect the identification work against the impact of the job staff's quality and business ability, and improving the degree of standardization to ensure the accuracy of the results; (5) the index should be operable, which means the family economic situation of students can be judged according to the identification index system after it has been built.

**1.2 Determination of the index system for precision identification of students from low-income families**

At present, there is no unified standard for the determination of students from low-income families. However, some scholars give some index systems according to certain survey, although it is not universal, it can provide some basis and reference for us.

Through analyzing the existing funding identification research and excavating the factors causing student's family economic difficulties fully, this paper constructs four first level indexes for precision identification, including family human resources, family economic resources, personal comprehensiveness and special economic situation. Details are shown in table 1.

**Table.1 The index system for precision identification of students from low-income families**

First level indexes	Secondary indicators
<b>u<sub>1</sub></b> Family human resources	<b>u<sub>11</sub></b> Family structure(Single parent, orphan, disabled or divorced family)
	<b>u<sub>12</sub></b> Occupation of family member
	<b>u<sub>13</sub></b> The educational level of parents
	<b>u<sub>14</sub></b> The health situation of family members
<b>u<sub>2</sub></b> Family economic resources	<b>u<sub>15</sub></b> Family population
	<b>u<sub>21</sub></b> Family annual per-capital income
	<b>u<sub>22</sub></b> Income source
	<b>u<sub>23</sub></b> Household fixed assets
	<b>u<sub>24</sub></b> Education expenditure
	<b>u<sub>25</sub></b> The region of family
<b>u<sub>3</sub></b> Personal comprehensiveness	<b>u<sub>26</sub></b> Household register
	<b>u<sub>31</sub></b> Physical condition
	<b>u<sub>32</sub></b> The education condition of morality and intelligence
<b>u<sub>4</sub></b> Special economic situation	<b>u<sub>33</sub></b> Consumption level in school
	<b>u<sub>41</sub></b> Emergencies
	<b>u<sub>42</sub></b> Natural disasters

The situation of family human resources is examined from five aspects. (1) Family structure. Generally speaking, if students

come from less labor families, such as single parent families, orphaned families, disabled families and divorced families, the

proportion of economic difficulties is more than normal families. (2) Occupation of family member. According to survey and research, more than 80 percent of economically disadvantaged students come from rural families, whose parents are ordinary farmers. (3) The educational level of parents. Because the history and national conditions of our country, cultural level of most parents in rural families is not high, causing them can only take manual labor, mainly farming work. However, the income of agricultural job is low under the background of labor surplus and cheap labor force in China. (4) Family population. There are many children and elders in families, causing the burden of population is heavy and the household expenditure is relatively large, and making economic situation of family more difficult. (5) The health situation of family members. For ordinary families, once family members have serious illness, it will bring very heavy burden, even years of savings in the home run out, and finally carry on massive debts. On the one hand, huge amounts of medical expenses of family members' illness will beyond family's ability to bear, leading to the emergence of family economic difficulties; on the other hand, because of illness, family members cannot create their own income and become a burden to their families, which can lead to family financial difficulties. Therefore, the health situation of family members is one of the criteria that should be established in the identification of students from low-income families.

The situation of family economic resources is examined from six aspects. (1) Family annual per-capita income. Comparing with the minimum living security line at home place, it can be concluded whether the economic income of the student's family can maintain its normal life by comparing family annual per-capita income with the minimum living security line at home place. (2) Income source. Including grandparents' salary or pension, rental income of housing or store, parents' salary income, parents' wage income, relatives' rescue and government assistance etc., this can be used to determine what maintains basic life and whether the income sources are stable. Unstable income can bring some risks and instability to family economic life. (3) Household fixed assets. Including owned house and vehicle. Under China's current economic conditions, the fixed assets of many families concentrated in real estate, so it can basically determine family's economic situation according to the building size, the owned number and the location of real estate. (4) Education expenditure. The proportion which accounts for household income can be used to measure family's burden on students' education. (5) The region of family. Which can be divided into Jingkou District, Runzhou District, Dantu District, Yangzhong city, Dangyang city and Jurong city. The living level of each district is different, so it should set different determined standards for different areas. (6) The household register. It can be divided into rural, cities and towns and urban household registration. Generally speaking,

economic hardship from rural areas is much greater than those from urban. Although the current living level makes most students from rural areas have no worries about the problem of food and clothing, the relative economic difficulties are still the most important factor that must be considered in the determination of economic difficulties.

The situation of individual comprehensiveness can be considered by three aspects. (1) Physical health condition. It can be divided into three level indexes: disability, illness and health. Students with disabilities and illnesses should be given a certain amount of study and life support. (2) The education condition of morality and intelligence. The problem of psychological health in the education condition of morality and intelligence should be paid more attention in every school nowadays. For students with mental health problems, the school should know the source of the problem. For the students who are self-contemptuous because of family economic difficulties, the school should make a certain degree of psychological counseling. In a word, it should not only help them solve the economic difficulties, but also undertake from psychological counseling. The students who have excellent academic performance and self-reliance but have difficulties in the family economy can be given some certain subsidize to help them finish their studies. (3) The consumption level in school. It can indirectly reflect the authenticity of students' family economic difficulties.

Special economic situation can be considered by two aspects, including of emergencies and natural disasters. During the determination of students from low-income families, there are many cases, such as sudden fire, the main labor force in the family encounters accidents and so on, which can all lead to a sudden deterioration in the family economic situation, or even lost some or all of the income of the family, leaving the family in a great trouble. Each year in the process of economic hardship determination, the accident situation in the family should be considered as one of the criteria, and it should evaluate the level of difficulty. The impact of natural disasters on the ordinary household is more serious, a minor disaster may lead to crop failures, wasted a year of hard and sweat, most serious situation maybe homeless and penniless. Among them, drought and flood have the largest proportion, which are the most harmful. The natural disasters should be one of the criteria for the determination of students from low-income families, which is meaningful to reflect the true situation of students' families.

## **2. Construction of evaluation index system for precision identification of students from low-income families**

### **2.1 Theoretical Basis**

It's very complicated to build evaluation index of students from low-income families, which may refer to many indicators through continuous refinement. For such kind of a large and complex index system, firstly applying the analytic hierarchy

process to divide the system into several hierarchical associated sub-indexes and comparing the same level sub-indexes in pair according to the importance, secondly constructing judgment matrix and then check, finally, figuring out results. These indexes weights which come from qualitative and quantitative calculation are very scientific and more convincing.

Analytic Hierarchy Process (AHP) is a multi-target decision method combining qualitative analysis with quantitative analysis, which was put forward in the early 1970s by T.L.Saaty, a famous operational research expert and a mathematics professor at the University of Pittsburgh. It is an effective tool of decision analysis to solve complex multi-criteria and multi-objective decision making problems. Its basic thought is to divide the problem into component factors by the hierarchy according to the nature of the problem and the goal to achieve, and then group into recursion order hierarchy structure by dominance relations. For the factors in the same layer, compare between every two factors and get the relative importance weights among all factors. When you calculate the importance of the factors from the next layer, not only this layer but also upward layer's weighting factors should be considered. Calculate it layer by layer until the last layer, generally, the last layer's weighting factors just are final results used to compare all the schemes.

**2.2 Steps to build AHP model**

*(1) Clarifying the research target*

The determination of index system and weight of economically disadvantaged students are important components of the research. It is necessary to realizing functional properties and the relations between the elements in order to ensure that practical problems can be solved in the research process.

*(2) Constructing hierarchical structure model*

Determining target layer: Describing the problem to be solved. Target layer of this study is to determine the weight of factors influencing the students' family economic difficulties, achieving quantitative precision identification of economically

disadvantaged students, and assigning ratings to their poverty.

Determining criterion layer: Clarifying what indicators are suitable for measuring the problem to be solved. In this paper, these indicators are family human resources, family economic resources, personal comprehensiveness, and special economic situation.

Determining index layer: Finding out specific indexes and factors under criterion layer, which are shown in table 1.

*(3) Constructing judgment matrix*

Turning the index system into questionnaire, based on 30 class teachers' judgment that work at the frontline for identification of economically disadvantaged students, and fully soliciting opinions and suggestions of the financial aid office staff, working together with them to compare the importance of indicators at the same level and collect the results. After that, determining the degree of importance according to the results and the method of AHP, and building a set of perfect mathematical structure model by using linear mathematical statistics analysis. The judgment matrix is as follows:

$$A = \begin{bmatrix} a_{11} & \dots & a_{1j} & \dots & a_{1m} \\ \dots & \dots & \dots & \dots & \dots \\ a_{i1} & \dots & a_{ij} & \dots & a_{im} \\ \dots & \dots & \dots & \dots & \dots \\ a_{m1} & \dots & a_{mj} & \dots & a_{mm} \end{bmatrix} = (a_{ij})_{m \times m} \quad (1)$$

In this judgment matrix, the following conditions must be meet:

$$\begin{cases} a_{ii} = 1 \\ a_{ij} = \frac{1}{a_{ji}} \quad (i, j = 1, 2, \dots, m) \end{cases} \quad (2)$$

The dimension of the judgment matrix is represented by m, and  $a^{ij}$  represents judgment value of importance of i relative to j in the same level indicators indicator, which is divided into the following five levels in general:1, 3, 5, 7, 9. Judgment basis is T.L.Saaty relative importance scale table, which is shown in table 2.

**Table.2 Ratio scale table of relative importance**

Index score	Contents
1	Compare two elements' influence degree, <i>i</i> is the same as <i>j</i> .
3	Compare two elements' influence degree, <i>i</i> is a bit stronger than <i>j</i> .
5	Compare two elements' influence degree, <i>i</i> is stronger than <i>j</i> .
7	Compare two elements' influence degree, <i>i</i> is much stronger than <i>j</i> .
9	Compare two elements' influence degree, <i>i</i> is absolutely stronger than <i>j</i> .
2、4、6、8	Compare two elements' influence degree, <i>i</i> is between adjacent level and <i>j</i> .
1/2,1/3,...,1/9	Compare two elements' influence degree, <i>i</i> is a bit or absolutely stronger than <i>j</i> .

*(4) Hierarchical single sorting and consistency check*

In AHP, people's understanding of things has some features as subjectivity and diversity, and judgment consciousness is not completely consistent, so judgment matrix needs to be tested. The most common calibration method is consistency test in AHP,

which includes hierarchical single sorting check and hierarchical total sorting check. The study starts with hierarchy single sorting.

Hierarchy single sorting: Normalizing eigenvectors W corresponding to the maximum characteristic root in the

judgment matrix A, and then figuring out important degree of the same level relative to the parent level and showing them.

Calculation method of eigenvectors and the maximum characteristic root: Basics of hierarchy single sorting consistency test is calculating the maximum characteristic root  $\lambda_{max}$  and eigenvectors W. Common methods are power series method, root method and sum and product method. Next, calculating the maximum characteristic root  $\lambda_{max}$  and eigenvectors W by the method of sum and product .

Step1, normalize each column of judgment matrix:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^m a_{ij}} \quad (3)$$

Step2, sum normalized matrix according to the row:

$$v_i = \sum_{j=1}^m b_{ij} \quad (4)$$

Step3, normalize  $V_i$ :  $w_i = \frac{v_i}{\sum_{i=1}^m v_i}$  (5)

Table.3 RI value of scale

Order	1	2	3	4	5	6	7	8	9	...
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	...

Then using the scale value RI to calculate the value of CR:

$$CR = \frac{CI}{RI} \quad (8)$$

If  $CR < 0.1$ , the judgment matrix has a satisfactory consistency, the eigenvectors  $W = [w_1, w_2, \dots, w_m]$  can be used as the weight of this layer indicators. If  $CR \geq 0.1$ , it needs to be reevaluated by experts to adjust the judgment matrix until  $CR < 0.1$ .

(5) Hierarchical total sorting and consistency check

After hierarchical single sorting, getting each factor's weight according to upward layer' factors, then further calculating importance weights of all scheme layer factors relative to the target layer, which called hierarchical total sorting. For example, layer A of matrix contains m factors  $A_1, A_2, \dots, A_m$ , their weight relative to factor U of upward layer are  $a_1, a_2, \dots, a_m$ , the weight relative to  $A_i$  of factors  $B_1, B_2, \dots, B_n$  contained in layer B which is the next layer of layer A are  $b_{i1}, b_{i2}, \dots, b_{in}$ , so the weight  $u_1, u_2, \dots, u_n$  of  $B_1, B_2, \dots, B_n$  which relative to U is:

$$u_i = \sum_{i=1}^m a_i b_{ij} \quad (j=1,2, \dots, n) \quad (9)$$

Table.4 The first level indexes judgment matrix and its' weight of economically disadvantaged students' identification

Indicators	$u_1$	$u_2$	$u_3$	$u_4$	$W_0$
$u_1$	1	1/5	5	1/3	0.1330
$u_2$	5	1	9	3	0.5577
$u_3$	1/5	1/9	1	1/7	0.0417
$u_4$	3	1/3	7	1	0.2676

$W = [w_1, w_2, \dots, w_m]^T$  W is eigenvectors of judgment matrix.

Step4, calculate the maximum characteristic root of judgment matrix:

$$\lambda_{max} = \frac{1}{m} \sum_{i=1}^m \frac{(AW)_i}{w_i} \quad (6)$$

With this, consistency test can be performed by eigenvectors and the maximum characteristic root of judgment matrix. Firstly, get the consistency index CI:

$$CI = \frac{\lambda_{max} - m}{m - 1} \quad (7)$$

In addition, T.L.Saaty measured the different order with 500 samples in different size and get the RI value as shown in table 3.

Hierarchical total sorting also requires consistency check, This process is carried out from the bottom to the top. Assuming that the consistency index of layer B factors  $B_1, B_2, \dots, B_n$  on  $A_i$  is  $C_i$ , random consistency index is  $R_i$ , so  $B_1, B_2, \dots, B_n$  the composite consistency index of  $B_n$  with respect to U is:

$$CR = \sum_{i=1}^m a_i C_i / \sum_{i=1}^m a_i R_i \quad (10)$$

The same single hierarchical sorting  $CR < 0.1$ , then the result of hierarchical total sorting is considered to be satisfactory. Otherwise, adjust the judgment matrix.

2.3 Evaluation index system and its' weight

When determining the weight of first level indexes, determine the effect weight of first level indexes  $U = \{u_1, u_2, u_3, u_4\}$  on the target economically disadvantaged students. It is easy to compare them because U contains fewer indicators. According to the importance of the first level indexes assign the value of scale 1, 3, 5, 7, 9. According to the meaning table of comparison matrix scale, comparing between every two factors and get the judgment matrix table 4.



Thus, the judgment matrix A is:

$$A = \begin{bmatrix} 1 & 1/5 & 5 & 1/3 \\ 5 & 1 & 9 & 3 \\ 1/5 & 1/9 & 1 & 1/7 \\ 3 & 1/3 & 7 & 1 \end{bmatrix}$$

Normalize matrix A by column:  $b_{ij} = \frac{a_{ij}}{\sum_{i=1}^m a_{ij}}$  (11)

$$B = [b_{ij}] = \begin{bmatrix} 0.1087 & 0.1216 & 0.2273 & 0.0745 \\ 0.5435 & 0.6081 & 0.4091 & 0.6702 \\ 0.0217 & 0.0676 & 0.0454 & 0.0319 \\ 0.3261 & 0.2027 & 0.3182 & 0.2234 \end{bmatrix}$$

Sum matrix B by line:  $v_i = \sum_{j=1}^m b_{ij}$  (12)

$$V = [v_i] = \begin{bmatrix} 0.5321 \\ 2.2309 \\ 0.1666 \\ 1.0704 \end{bmatrix}$$

Normalize it by column and calculate the eigenvector:

$$w_i = \frac{V_i}{\sum_{i=1}^m V_i} \quad (13)$$

$$W = [w_i] = \begin{bmatrix} 0.1330 \\ 0.5577 \\ 0.0417 \\ 0.2676 \end{bmatrix}$$

Calculate maximum characteristic root of judgment matrix:

$$\lambda_{\max} = \frac{1}{m} \sum_{i=1}^m \frac{(AW)_i}{w_i} \quad (14)$$

$$AW = \begin{bmatrix} 1 & 1/5 & 5 & 1/3 \\ 5 & 1 & 9 & 3 \\ 1/5 & 1/9 & 1 & 1/7 \\ 3 & 1/3 & 7 & 1 \end{bmatrix} * \begin{bmatrix} 0.1330 \\ 0.5577 \\ 0.0417 \\ 0.2676 \end{bmatrix} = \begin{bmatrix} 0.5422 \\ 2.4008 \\ 0.1685 \\ 1.1444 \end{bmatrix}$$

$$\lambda_{\max} = \frac{1}{m} \sum_{i=1}^m \frac{(AW)_i}{w_i} = \frac{1}{4} * (\frac{0.5422}{0.1330} + \frac{2.4008}{0.5577} + \frac{0.1685}{0.0417} + \frac{1.1444}{0.2676}) = 4.1747$$

Carry out consistency check for hierarchical single sorting:

$$CI = \frac{\lambda_{\max} - m}{m - 1} = \frac{4.1747 - 4}{4 - 1} = 0.0582$$

$$RI = 0.90$$

$$CR = \frac{CI}{RI} = \frac{0.0582}{0.9} = 0.0647 < 0.1$$

It has been proved that the judgment matrix A has satisfactory consistency. The values of eigenvectors  $W = (0.1330, 0.5577, 0.0417, 0.2676)$  respectively mean the weight of degree of economic difficulties  $u_1$  of economically disadvantaged students reflected by first level indexes family human resources, the degree of economic difficulties  $u_2$  of economically disadvantaged students reflected by first level indexes family economic resources, the degree of economic difficulties  $u_3$  of economically disadvantaged students reflected by first level indexes personal comprehensiveness, the degree of economic difficulties  $u_4$  of economically disadvantaged students reflected by first level indexes special economic situation.

In the same way, the weight of the secondary index of family human resources is determined, and the judgment matrix of the family human resources is determined by comparisons between every two factors, the result is shown in table 5.

**Table.5 The secondary indexes judgment matrix and its' weight of family human resources**

Indicators	$u_{11}$	$u_{12}$	$u_{13}$	$u_{14}$	$u_{15}$	$W_1$
$u_{11}$	1	5	9	3	7	0.5028
$u_{12}$	1/5	1	5	1/3	3	0.1344
$u_{13}$	1/9	1/5	1	1/7	1/3	0.0348
$u_{14}$	1/3	3	7	1	5	0.2602
$u_{15}$	1/7	1/3	3	1/5	1	0.0678

$\lambda_{\max} = 5.2426 \quad CI = 0.0607 \quad RI = 1.12 \quad CR = 0.0542 < 0.1$

It has been proved that the judgment matrix has satisfactory consistency. For the secondary indicators of family human resources, the impact of family structure on the degree of financial difficulties ( $u_{11}$ ) is the strongest, followed by the impact of the health situation of family members on the degree of financial difficulties ( $u_{14}$ ), and then the impact of occupation of family member ( $U_{12}$ ), again the impact of the family population on the degree of financial difficulties ( $u_{15}$ ), and finally the impact

of the educational level of parents on the degree of financial difficulties ( $u_{13}$ ) is the weakest.

In the same way, the weight of the secondary index of family economic resources is determined, and the judgment matrix of the family economic resources is determined by comparisons between every two factors, the result is shown in table 6.

**Table.6 The secondary indexes judgment matrix and its' weight of family economic resources**

Indicators	u <sub>21</sub>	u <sub>22</sub>	u <sub>23</sub>	u <sub>24</sub>	u <sub>25</sub>	u <sub>26</sub>	W <sub>2</sub>
u <sub>21</sub>	1	2	3	5	4	7	0.3821
u <sub>22</sub>	1/2	1	2	4	3	6	0.2518
u <sub>23</sub>	1/3	1/2	1	3	2	5	0.1639
u <sub>24</sub>	1/5	1/4	1/3	1	1/2	2	0.0638
u <sub>25</sub>	1/4	1/3	1/2	2	1	3	0.0998
u <sub>26</sub>	1/7	1/6	1/5	1/2	1/3	1	0.0386

$\lambda_{max} = 6.1018$   $CI = 0.0204$   $RI = 1.24$   $CR = 0.0164 < 0.1$

It has been proved that the judgment matrix has satisfactory consistency. For the secondary indicators of family economic resources, the impact on the degree of financial difficulties is in the order of family annual per-capital income (u<sub>21</sub>), income source (u<sub>22</sub>), household fixed assets (u<sub>23</sub>), the region of family

(u<sub>25</sub>), education expenditure (u<sub>24</sub>) and household register (u<sub>26</sub>). In the same way, the weight of the secondary index of personal comprehensiveness is determined, and the judgment matrix of the personal comprehensiveness is determined by comparisons between every two factors, the result is shown in table 7.

**Table.7 The secondary indexes judgment matrix and its' weight of personal comprehensiveness**

Indicators	u <sub>31</sub>	u <sub>32</sub>	u <sub>33</sub>	W <sub>3</sub>
u <sub>31</sub>	1	5	3	0.637
u <sub>32</sub>	1/5	1	1/3	0.1047
u <sub>33</sub>	1/3	3	1	0.2583

$\lambda_{max} = 3.0385$   $CI = 0.0193$   $RI = 0.58$   $CR = 0.033 < 0.1$

It has been proved that the judgment matrix has satisfactory consistency. For the secondary indicators of personal comprehensiveness, the impact on the degree of financial difficulties is in the order of physical condition (u<sub>31</sub>), the consumption level in school (u<sub>33</sub>) and the education condition of morality and intelligence (u<sub>32</sub>).

In the same way, the weight of the secondary index of special economic situation is determined, and the judgment matrix of the special economic situation is determined by comparisons between every two factors, the result is shown in table 8.

**Table.8 The secondary indexes judgment matrix and its' weight of special economic situation**

Indicators	u <sub>41</sub>	u <sub>42</sub>	W <sub>4</sub>
u <sub>41</sub>	1	3	0.5
u <sub>42</sub>	1/3	1	0.5

$\lambda_{max} = 2$   $CI = 0$   $RI = 0$   $CR = 0 < 0.1$

It has been proved that the judgment matrix has satisfactory consistency. For the secondary indicators of special economic situation, the impact on the degree of financial difficulties is in the order of emergencies (u<sub>41</sub>), natural disasters (u<sub>42</sub>).

The CR values of the above judgment matrices are all less than 0.1, indicating that each judgment matrix has satisfactory consistency. In summary, the weight and order of all indexes at all levels are calculated, as shown in table 9.

**Table.9 The weight analysis and order of precision identification indexes of students from low-income families in Zhenjiang**

A	u <sub>1</sub>	u <sub>2</sub>	u <sub>3</sub>	u <sub>4</sub>	W	Order
	0.1330	0.5577	0.0417	0.2676		

u <sub>11</sub>	0.5028	0	0	0	0.0669	6
u <sub>12</sub>	0.1344	0	0	0	0.0179	12
u <sub>13</sub>	0.0348	0	0	0	0.0046	15
u <sub>14</sub>	0.2602	0	0	0	0.0346	9
u <sub>15</sub>	0.0678	0	0	0	0.0090	14
u <sub>21</sub>	0	0.3821	0	0	0.2131	1
u <sub>22</sub>	0	0.2518	0	0	0.1404	2
u <sub>23</sub>	0	0.1639	0	0	0.0914	5
u <sub>24</sub>	0	0.0638	0	0	0.0356	8
u <sub>25</sub>	0	0.0998	0	0	0.0557	7
u <sub>26</sub>	0	0.0386	0	0	0.0215	11
u <sub>31</sub>	0	0	0.637	0	0.0266	10
u <sub>32</sub>	0	0	0.1047	0	0.0044	16
u <sub>33</sub>	0	0	0.2583	0	0.0108	13
u <sub>41</sub>	0	0	0	0.5	0.1338	3
u <sub>42</sub>	0	0	0	0.5	0.1338	4

Carry out consistency check for hierarchical total sorting:

$$CI_{total} = \sum_{i=1}^m (w_i * CI_i) = 0.1330 * 0.0607 + 0.5577 * 0.0204 + 0.0417 * 0.0193 + 0.2676 * 0$$

Calculate the result:  $CI_{total} = 0.0203$

$$RI_{total} = \sum_{i=1}^m (w_i * RI_i) = 0.1330 * 1.12 + 0.5577 * 1.24 + 0.0417 * 0.58 + 0.2676 * 0$$

Calculate the result:  $RI_{total} = 0.8647$

So, the random consistency ratio of hierarchical total sorting

is:

$$CR_{total} = \frac{CI_{total}}{RI_{total}} = \frac{0.0203}{0.8647} = 0.0235 < 0.1$$

The CR values of above 16 secondary indicators are all less than 0.1, so the hierarchical total sorting have satisfactory consistency with the first three comprehensive ranking is u<sub>21</sub>, u<sub>22</sub>, u<sub>41</sub>, that is, the family annual per-capital income, income sources, emergencies have the greatest impact on the evaluation of economically disadvantaged students' identification in Zhenjiang. The weights of the indicators in the hierarchical total sorting shown in table 9 can be used as weights for the identification of economically disadvantaged students.

### 3. Conclusions

Based on the current situation of economically disadvantaged students' financial assistance in Zhenjiang and related researches at home and abroad, this paper builds the evaluation index system for precision identification of students from low-income families in Zhenjiang, which is composed of four first-level indicators And 16 secondary indicators. First-level indicators include four dimensions: family human

resources, family economic resources, personal comprehensiveness and special economic situation. The family human resources include five indicators: family structure, occupation of family member, the educational level of parents, the health situation of family members and family population. The family economic resources include six indicators: family annual per-capital income, income source, household fixed assets, education expenditure, the region of family and household register. The personal comprehensiveness includes three indicators: Physical condition, the education condition of morality, intelligence, consumption level in school. The special economic situation includes two indicators: emergencies and natural disasters.

Using the analytic hierarchy process (AHP) to analyze, judge and calculate factors which reflect students' family financial difficulties of economically disadvantaged students' identification indexes and the secondary indicators which are

included, then getting the corresponding weights of all indicators at different levels. (1) Among the secondary indicators of family human resources, family structure has the strongest effect on identification of students from low-income families, followed by the health situation of family members, and then the occupation of family member, again is the family population, and the educational level of parents has the weakest impact. (2) Among the secondary indicators of family economic resources, the sequence of impact degree on economic difficulties is family annual per-capita income, income source, household fixed assets, the region of family, education expenditure and household register. (3) Among the secondary indicators of personal comprehensiveness, the sequence of impact degree on economic difficulties is physical condition, consumption level in school and the education condition of morality and intelligence. (4) Among the secondary indicators of special economic situation, the sequence of impact degree on economic difficulties is emergencies and natural disasters. Family annual per-capita income, income source, emergencies have strongest impact on the identification of economic difficulties. It should be used into practice as soon as possible to identify the degree of economic difficulties of students, determine whether to fund, the amount of fund, and realize the innovation of identification method of identification of students from low-income families.

The conclusion of this paper has important implications for precision identification of students from low-income families in Zhenjiang.

Firstly, to enhance the precision awareness of students' funding work, the first step is to deepen the ideological understanding. All levels of leading cadres and the staff who participate in students' funding work must deepen the understanding, unify thinking, place the precision funding work in a more prominent position, and continuously improve the precision, effectiveness and continuity of students' funding work. According to the experience of developed countries, improving the level of precision funding to achieve a higher level of education fair needs huge input. To complete this task, Zhenjiang needs to strengthen the cognitive level of researches about students' funding work, to develop and implement a more precise identification index system, to promote refined dynamic management, to innovate funding methods with modern means of information, and all these require a lot of manpower, material and financial inputs, so it is necessary to increase investment. Secondly, Bureau of education of Zhenjiang should actively innovate the working mechanism, promote information sharing of economically troubled families through strengthening the contract with bureau of civil affairs, bureau of human resources and other departments, and keep abreast of the dynamic changes of these high incidence groups through visiting known high incidence groups regularly and irregularly, and bring students

who meet funding standards into the funding system in time to forward the funding work in order to ensure the students funding work in a timely manner, accurate and in place, at the same time carry out classification assistance in a targeted way, and help the implementation of precision funding work.

## References

- CHED. Commission for Higher Education(Philippines)[EB/OL]. <http://www.ched.gov.ph/scholarships/local.html>, 2007-05-31/2007-12-01.
- HIRSCH W Z, WEBER L E.(1999). Challenges Facing Higher Education at the Millennium[M]. Phoenix, Arizona: Oryx Press.
- Jiang Cheng, Zhang Zhi-xin, LI Xiaoqiu(2016). A Comparative Study on Differences in Undergraduate Development between Unidentified Economically Disadvantaged Students and Identified Economically Disadvantaged Students: A Survey Based on University Students in Beijing, Fudan Education Forum. 14(6), 61-66.
- Liu Haijun (2011).The Research on Realizing of University Improved Students Evaluating and Management Information System. Sichuan normal university.
- Luo, S., & Jian, G. (2016). Identification of University Poor Students Based on Data Mining. International Conference on Intelligent Computation Technology and Automation (pp.462-465). IEEE.
- Peng D.Y., Lin N., Ma X.W. (2009). Definition of Poor College Students Based on Fisher Discriminant Analysis Method[C]//2nd Conference of the International-Institute-of-Applied-Statistics-Studies,COMPREHENSIVE EVALUATION OF ECONOMY AND SOCIETY WITH STATISTICAL SCIENCE,1095-1100.
- Saaty, T. L. (1977). A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology*, 15(3), 234-281.
- Saaty, T. L., & Vargas, L. G. (1987). Uncertainty and rank order in the analytic hierarchy process. *European Journal of Operational Research*,32(1), 107-117.
- Saaty, T. L. (1986). Axiomatic foundation of the analytic hierarchy process. *Management Science*, 32(7), 841-855.
- Song Meizhe. (2016). Application of Fuzzy Comprehensive Evaluation to Identification of College Students' Financial Difficulty. *Heilongjiang Researches on Higher Education* ,267, 16-20.
- Tekleselassie, A. A., & Johnstone, D. B. (2004). Means testing: the dilemma of targeting subsidies in african higher education. *Journal of Higher Education in Africa*(2).
- Usher, A. (2004). Are the poor needy? are the needy poor? The distribution of student loans and grants by family income quartile in canada. Online Submission, 44.
- Zhou Xiaoqiang, Chen Yunfei.(2014). Difficulties and Countermeasures of College Students from Poor Families Identified. *Science Tribune*(10).

# Analysis of Deconstruction and Element of Advertising Symbols for Anhua Brick Tea: Based on Comparison of Special Gimmicky Advertisements

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**Abstract:** In order to provide a reference for the agricultural and forestry products, including tea, to successfully carry out brand marketing communication and brand advertising, and provide interpretation samples for the communication of tea culture, the advertising symbol theory and drama factor analysis method are adopted, and the famous Anhua Brick Tea advertisement and the advertisement of Sidao Tea Industry are taken as the sample analysis. The two samples are respectively deconstructed according to the phonic natural language symbol, symbol and body-expression-decoration symbol frame, and are dissected according to the drama elements such as scene, person, action, means and purpose. According to the comparative study, it is believed that the innovation of phonic natural language symbols, the systematic or mutual substitution among the symbols can create the ideal advertisement effect; the arrangement and treatment of “characters” in tea industry advertising theatre should be combined with the psychological demands of the mass consumers who are infiltrating the farming civilization, but the conception and practice of the “purpose” elements enrich and enhance the social value of the symbol consumption of the tea.

**Key words:** Anhua Dark Tea, brand advertisement, symbol, drama element, symbol consumption

## 1. The Proposal of Questions

In the hometown of Brick Tea in China—Anhua County, the tea garden covered an area of 310,000 mu with tea processing capacity of 65,000 tons and tea production output value of CNY 12.5 billion in 2016; the tea industry tax broke through CNY 200 million; Anhua occupied the top of the ten largest ecological tea-producing counties in China and has ranked in the top four of the national key production tea counties for five consecutive years; its brick tea output has raked the top around the country for 10 consecutive years<sup>[1]</sup>.

Brick Tea is fermented tea, one of the six kinds of tea series; in the fifth generation of late Tang Dynasty, Anhua was recorded that “eighty pieces of the red and thin tea weigh a catty”. Anhua is one of the important starting places of tea-horse ancient road, and the “Qianliang Tea” and “Bailiang Tea” produced in Anhua enjoy a reputation both at home and abroad. Both Qianliang Tea and Fuzhuan Tea in Anhua Brick Tea are included in the national intangible cultural heritage list. Anhua Dark Tea has become a national geographical indication product, and its trademark has become well-known in China.

Along with the rise of the Brick Tea industry, Anhua County is based on its own advantages, combines abundant tea

resources, good ecological environment and profound cultural connotation, advocates the development mode of “green processing, brand marketing, universal consumption, healthy drinking”, and focuses on establishing the large-scale tea industry system integrating with tea planting, production, processing, sales and tea culture communication<sup>[2]</sup>.

In the aspect of brand marketing and tea culture communication, the successful promotion of the brand “Anhua Brick Tea” has benefited from the combining ability of many parties and the advertisement communication of TV network media. This paper selects two special gimmicks in these ads as the plot twists to make an analysis and interpretation of the story-shaping representative works, which can provide reference for the follow-up brand marketing communication of Anhua Brick Tea, provide reference for other tea series for brand advertising and provide interpretation paradigms and samples for tea culture communication.

## 2. Theory and Method

### 2.1 Advertising Symbol Theory

The symbol, as an object, is used to represent another object different from itself, a unity of the signifier (form) and the signified (meaning, interpretation, content); the signifier

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means the symbolic form of the identification indicator while the signified means the cognitive significance of the symbol user for the symbol; an indicator is an entity or object indicated by a symbol. The main symbol system of human communication activities, or the symbol system of art, is essentially the variation of “Five symbol systems (phonic natural language symbols such as poetry reading, singing, musical performance; character symbols such as poetry, fiction, painting, calligraphy, emoticons, and body symbols such as dance, drama, film, sculpture; decorative symbols, for example, the makeup of bodies and objects is used to express identity, totem, nationality, sex cues, etc<sup>[3]</sup>. In the later analysis, for simplicity, the emoticons, body symbols and decorative symbols are referred to as “body-expression-decorative symbols”.

Symbols can be divided into ready-made symbols and self-created symbols. Ready-made symbols have the vocabulary of a given meaning (combination) or figurative logo design; the former examples are Brick Tea, Anhua Brick Tea, Qianliang Tea, BaiLiang Tea, etc. The latter example is the trademark of Baisha Creek Brick Tea designed as a seal pattern embedded in “Baisha Creek”; these ready-made symbols themselves have the conventional meanings; when they are combined with the specific products, there will appear the phenomenon that the indicator is close to the symbol, and the existing meaning of the symbol will be transferred to the indicator as an entity or object. When someone regards dark brown Sprite or a carbonated beverage as Brick Tea, the wrong use of the word here is the wrong use of the symbol. Self-created symbols are character combinations without meanings or with ambiguous meanings or abstract logo designs; the former examples are the “three Jian” (Tian Jian, Gong Jian and Sheng Jian), “three Zhuan” (Fu Zhuan, Hei Zhuan and Hua Zhuan), “one Juan” (Hua Juan) in Anhua Brick Tea. The latter examples are the trademark of abstract pattern combinations such as Yi Qing Yuan, Xiang Yi, Gao Ma Erxi, Jiuyang, Xiangfeng and so on in the brand of Brick Tea, the meaning of the self-created symbol is guided and filled by the communication body, otherwise, the meaning tends to be unintelligible or extremely divergent.

It can be seen that the symbol, whether it is ready-made or self-created, can refer to many meanings and contents in multiple directions. Because of the characteristic of the symbol, the advertisement can extend the meaning of the symbol to the breadth and deep excavation. A link between the signifier (form) and the signified (meaning and content) of a symbol is often interpreted by communication.

### *2.2 Analysis Method of Drama Elements*

In the 1960s, the Dramaturgical Criticism spread the study genre, focusing on the significance of speech act from various aspects of philosophy, psychology and sociology, attempting to

sort out the relationship between motivation, action and reality in speech activity and exploring the way people use language to change people’s attitudes and lead to some kind of action. This communication research genre develops the Symbolic Interactionism in the sociology field and thinks that human’s behavior and experience can be regarded as the form of drama, and the human’s self-expression of communication, contact and so on can be regarded as a broad theatrical performance. Kenneth Burke argues that it is most appropriate to use the dramatic stage language to discuss the symbolic acts and spread acts of human beings<sup>[4]</sup>. The terms are such five elements as “scene, character, action, means, purpose”. The analysis method of drama elements summarizes the key links in the system of motivation, communication strategy and effects, such as “scene”; the background and environment of action should be described and alleged; for “action”, what happened in thought or act; its motivation should have sentences or words to describe and allege; for “character”, the person in action and the person in the scene should be described and alleged; for “means”, the means or tools used by the person mentioned above should be described and alleged; for “purpose”, action of the person, the scene in which he is located, the used tools, ways or means, and the intention of the “theatrical performance” should be described and alleged.

The analysis method of the drama elements is applied to the field of communication, and it is studied how to construct the realistic viewpoint of the audience, and it is combined with the advertising semiology to analyze the advertisement communication and discuss how the advertisement can reach the purpose of persuasion through symbolic operation. Advertisement communication matches the signifier and signified of the symbol, the form, meaning and content of the link symbols innovatively and constantly. This kind of innovation is often extracted from the ingenious “scene” of life, shaping the classic memorable “character”, triggering the trembling “action” of the heart, playing the familiar “means” (means or tools), motivating the audience living at present, thus contributing to the improvement of the quality of life’s real consumption “purpose”. In Brick Tea advertisement, the varied combinations of scene, character, action, means, purpose, etc., are full of drama, whose rich deduction breaks through advertisement effects of pure economic measurement.

### **3. Deconstruction and Analysis of Typical Advertisement of Anhua Brick Tea**

There are two reasons for the selection of the typical brand advertising research materials of Anhua Brick Tea; one is based on the convenience of acquisition; both advertisements are brand advertisements of the enterprise and belong to the television network media advertisement, and the other is based on the comparability and Jiuyang Brick Tea

advertisement<sup>[5]</sup>; take the gimmicks as the core; then shoot and edit them into full, 30-second, 15-second, and 5-second ads with unique forms<sup>[6]</sup>. There is something to do with negligence or failure for Sidao Tea Advertisement. Both of them take the gimmicks as plot twists and shape the tea story in the ads.

### 3.1 Jiuyang Brick Tea Advertisement

Jiuyang Dark Tea Advertisement has the more than 30-second full version and a 5-second concentrated version; take the full version as an example; the whole TV network media advertisement is completed in the background of simple and elegant tea room, and the phonic natural language symbol is the brief speech of the compere of middle-aged Brick Tea. The old master of tasting dark tea and young apprentices making the brick tea make a conversation on the scene. The character symbol is composed of traditional calendar, tea-character sign board and other classical information, which appears in the body-expression-decoration symbol, and the baody-expression-decoration symbol is orderly pushed forward according to the process of tea giving and tea tasting; the details are as follows:

Phonic natural language symbol: apart from the background music of folk music played by Erhu, there are: (1) tea giving(compere), master, tea giver(apprentice 1, male); (2) tea giving again(compere), master, drink tea please(apprentice 2, female); (3) the third tea giving(compere), no language (apprentice 3, male), master, please drink good Brick Tea (apprentice 4, male); (4) Brick Tea, I've long been looking forward to meeting you (tasting master), it is Jiuyang Brick Tea (apprentice 4, male), Anhua Jiuyang Brick Tea (tasting master), Ha-ha... (responding to the tasting master, the laughter is full of the tea room); we can communicate with each other with Jiuyang Brick Tea (voiceover).

Character symbol: (1) Twenty-six, a lucky day (traditional calendar); (2) tea (diamond-shaped tea-word signboard hanging in tea house); (3) communicate with each other with Brick Tea (under the product package pattern); (4) Qianliang tea, Jin Fu and Fu Tea made by hands (product packaging pattern in the prominent position).

Body-expression-decorative symbol: (1) Old master of tasting Brick Tea wears the black box old-style glasses and sits in the first place of the four-square table; the compere and the assistants stand on the left hand side and the left side of the standing master, and the young apprentices wait in the front side of the left hand of the master; apprentice 1, male, sits opposite to the master and seems to want to say something, but on the basis of the master's indifference, he leaves away quietly; (2) apprentice 2, female, hands the tea into the master; the master shakes his head and the female apprentice scratches her head left hand unconfidently; (3) apprentice 3, male, just placed three cups of tea on the table and the tea is poured out of the cups because of his nervousness and hurry; apprentice 4,

male, appears on the scene in time and walks towards the table steadily and confidently(saying, please drink the good dark tea, master); (4) the old master has a little surprise on his face. He rasies the tea cup, mixes the tea with tea cap, drinks tea and appraises the tea (saying, Jiuyang Jiuyang ); (5) the words or character symbols like "It's Jiuyang Brick Tea" "Jiuyang Brick Tea uses Brick Tea to communicate with each other" appear; besides, there are the bird cage decoration symbols, its main products such as Qianliang Tea, Jin Fu, Fu Tea in Jiuyang Brick Tea are promoted.

The Jiuyang Brick Tea advertisement with different time period mentioned above continuously cuts the language symbols, the character symbols, the body-expression-decoration symbols; finally the dialogue between the master and apprentices and voiceover are left behind; the old master: Jiuyang Jiuyang; apprentices: It's Jiuyang Brick Tea; Master: Anhua Jiuyang Brick Tea, Ha ha ...; voiceover: Jiuyang Brick Tea uses Brick Tea to communicate with each other!

The scene is the ancient and elegant tea house with the performance of the national music such as Erhu and the performance of the characters; first of all, a serious and nervous atmosphere of drinking tea is created; finally the play end is humorous and relaxing.

There are a large number of characters, a compere and other assistants, an old master drinking tea and many male and female apprentices.

The actions include the loud invitation of the compere in the hall, the young apprentice's gentle tea giving and the old master's ignorance, shaking his head, surprise, and short evaluation, apprentices' or the speaker' clever corrections; in addition to "saying", there are also the master's ignorance, shaking his head and surprise, the apprentices' fear or calmness and self-confidence, scratching the head with confusion and the joy and praise in the hall.

The "misunderstanding" and "error correction" opportunity of "Jiuyang" (the third tone) and "Jiuyang"(the second tone) with different tones are intentionally produced by taking tea tasting as a means.

Its purpose--in the scene transformation from serious, nervous to humorous atmosphere, and in the "misunderstanding" and "error correction" between "Jiuyang" (the third tone) and "Jiuyang"(the second tone), the consumers remember the brand of Anhua Jiuyang Brick Tea.

This advertisement has some merits, one of which is that the "scene" is transformed from the tense to the ease conforming to the communication between people from the strange to the familiar state. People's contact, cognition, and recognition for the product brand also follow the spiritual journey from familiar, closed to relaxed state, and the reserved relationship between master and apprentices is harmonious in

the full praise of “Ha ha ….” because of the dramatic tasting of Jiuyang Brick Tea. The second is that the “character” and “action” are handled skilfully. Although the characters are numerous, their simplicity can be seen from it; the master tasting the tea and the apprentice who appears in time from the serious consequences of poured tea water; although the action has the tea giving, delivery, speech and so on, but in addition to saying “Master, please drink the good Brick Tea”, “Brick Tea, Jiuyang Jiuyang” “It’s Jiuyang Brick Tea” and “Anhua Jiuyang Brick Tea”, other words are omitted. The third is that “misunderstanding” and “error correction” opportunity of character symbols like “Jiuyang” (the third tone) and “Jiuyang”(the second tone) with different tones are intentionally produced by taking tea tasting as a means. This intentionally brings about the humor of the advertisement; people naturally will connect the words like “(master, please drink) good Brick Tea”, the master’s “Jiuyang Brick Tea” and the Jiuyang Brick Tea together so that in the easy and pleasant end scene these symbols, namely, the good Brick Tea, the Jiuyang Brick Tea, Anhua Jiuyang Brick Tea brand are assimilated.

### 3.2 Advertisements of Sidao Tea Industry

The advertisement of Sidao Tea Industry lasts for 45 seconds; the whole television network media advertisement is finished in the chess playing background of the living room and the tea room on the far lens wall with the fan-shaped figure of the tea mountain; the phonic natural language symbol is the dialogue between the old grandfather and the young granddaughter and the voiceover; the character symbol is formed by specially-written characters on the chessboard and product package; the body-expression-decoration symbol is orderly pushed according to the process of the grandfather’s good beginning to the granddaughter winning the success. At the end, there is a middle-aged mother making tea with elegance; the details are as follows.

Phonic natural language symbols: apart from the music background played by Zheng, there are (1) attack (grandfather), oh (granddaughter, lost, delicate voice), ha ha ... (grandfather, win, joy); (2) attack (grandchild), what kind of tea (grandfather, lost, doubt but affirmation and acceptance); (3) Humanistic Brick Tea experience; it is beside you; Tao method is natural, and tea belongs to the world (voiceover, narration, baritone).

Character symbols: (1) Sidao, (2) Sidao (package poster, last line), Tiandao Chadao Shangdao Rendao (package poster, next line)

The body-expression-decoration symbols: (1) a grandfather wears a white shirt with cloth buttons and takes the black chess pieces at the left side of the picture with a sitting position; the granddaughter is dressed in a blue-flower porcelain suit, and the black hair is combed into two long pigtailed, and she takes the white chess pieces at the right side

of the picture with a sitting position. After the chess is lost, she protests coquettishly; (2) The granddaughter gets up, pours out tea with the purple sand tea pot, drinks tea; the empty blue and white porcelain teacups are emphasized; she replaces the chess pieces with an empty cup and puts it in the chess board; (3) the grandfather picks up the paper fan with the bamboo picture, sits leaning against the body and moves the chess pieces with the paper fan, and the special writing “Sidao” is exposed under the letter; (4) in the near lens, a middle-aged mother dressed in a cheongsam and a cape, holds her right hand with three cups and drinks tea elegantly, slightly smiling at the grandfather and granddaughter of the game in the far lens; (5) printing “Sidao (in the first line), Tiandao, Chadao, Shangdao and Rendao (in the next line)” of Sidao tea samples on the package.

Its scene--the wall is displayed with the tea-hill fan-shaped drawing room and the tea-room weiqi game as the scene.

Its characters are simple, composed of old-aged grandfather, young granddaughter and middle-aged mother.

Its actions focus on the game between the two generations of attack, the weiqi term, Dajie, also called Jie, Jiezheng or Zhengjie; both sides from the Kaijie, Tijie, Zhaojie, Yingjie, Tijie again, until the Jie is solved finally, among which the Qiangjie and Xiaojie need the value judgment, which is complex and interesting. Other actions are created around the “Jie”; for example, the granddaughter protests coquettishly after the loss; the mother drinks tea and the empty green porcelain cup is emphasized after the tea was drunk, and the grandfather feels confused with affirmation and acceptance after losing the chess and moves the chess pieces with the paper fan; and the middle-aged mother dressed in a cheongsam and a cape, holds her right hand with three cups and drinks tea elegantly, slightly smiling at the grandfather and granddaughter of the game. Of course, it also includes the voiceover of the male baritone.

It takes the story shaping as a means; the main development venation of the story is the first win of weiqi by grandfather, then the granddaughter get success of attack and turns defeat into victory.

Its purpose is that through the stage performance of the story, try to make the consumers feel that “the human Brick Tea experience is around you” (voiceover, narration), and remember the Sidao Tea Industry of “Tao method is natural, and tea belongs to the world”.

This advertisement has some merits; the first one is to take the plot of grandfather and granddaughter playing weiqi as the means; although the interactions between the grandfather and granddaughter and the middle-aged mother’s elegance, the gaze of the smile and stopping saying are the common scenes in family life, they all show that “the human Brick Tea experience is around you”, which strives to avoid false, big,



empty conditions. Secondly, the “purpose” is preset; no matter the narration of the present characters or the narration changes the low-level needs of tea and makes the people experience the emotional attribution needs of family relationships created by the tea, and improves the demand level of people to the product needs.

The shortcoming of “hard injury”, which can not be ignored by the advertisement, appears in the scene, and it is not difficult to find a bit of common sense in the scene that the first loss of the grandfather (accompanied by a phonic natural language symbol “Jie”) appears in the insignificant scene. The shortcoming can destroy the art life of an advertisement. But the same shortcoming also continues, after granddaughter’s tasting tea, looking for the material and carrying out the value judgment, there isn’t Jie at all. It means to try to use true, small body-expression-decoration symbols instead of fake, big, empty symbols; there are problems in decorative symbols; the purpose of the honor symbol referring to “Tao method is natural, and tea belongs to the world” (voiceover, narrator) also sell at a discount greatly, the purpose of the tea brand symbol of “Sidao (Tiandao, Chadao, Shangdao and Rendao)” impressed to the consumer in an attempt to achieve is questionable.

#### **4. Enlightenment and Reflection**

If the Brick Tea advertisement is classified according to the angle of the symbol and is different from the voiceover type advertisement of the phonic natural language symbol, the Brick Tea advertisement belongs to a scene character frank additional voiceover type advertisement or a strengthening body-expression-decoration symbol type advertisement; if the Brick Tea advertisement is classified from the perspective of the play element, it belongs to the “household” advertisement of the scene and is used as an ad-hoc stunt in the “family, character and action”; if the analysis is carried out from the “purpose” angle of the drama element, the advertisements of Anhua Jiuyang Brick Tea and Sidao Tea Industry can be classified into a class of high-level demand development, because they seek communication, human experience and emotional attribution... these comparisons will bring about a lot of inspiration and reflection.

##### ***4.1 Creation of phonic natural language symbols can create unexpected advertising effects***

In both cases, there is no shortage of too many words in the general advertisement, but in the “Jiuyang” and “Jiuyang” in the advertisement of Anhua Jiuyang Brick Tea, the pun and the intentional design bring about the effect of humor, and fit the public’s appeal of entertainment theme, and improve the public attention of the advertisement.

##### ***4.2 The formal relationship between symbols needs to be systemized***

For phonic natural language symbols, character symbols, body-expression-decoration symbols, their relationship is required to be systematic, otherwise, it often leads to the abortion of advertising design, and even leaves a laughing stock. For example, the two “Jie” in Sidao Tea Industry advertisement as a special phonic natural language symbol is a gimmick in the advertisement, but its body-expression-decoration symbol should be free from Jie, so that the person who knows Weiqi can’t bear to see. This also seriously affects the function of condensed characteristics of phonic natural language symbols.

##### ***4.3 Multi-dimensional visual symbols or experience symbols are more capable of achieving the purposes of advertising theatrical elements***

Body-expression-decoration symbols’ interpretation or design can replace a more monotonous language symbol, and achieve the intended purpose of the advertisement in a more multi-dimensional visual symbol or experience symbol operation. For example, though there are the above mentioned disadvantages for Sidao Tea Industry advertisement, the young mother’s leaning, elegance and body-expression-decoration symbols of grandfather and granddaughter fit perfectly with the phonic natural language symbol “the human Brick Tea experience is around you”, which creates the harmonious atmosphere of family relationship led by Sidao Brick Tea and develops the demand for the emotional attribution of Sidao Brick Tea.

##### ***4.4 The symbol consumption of the “purpose” of advertising theatrical elements is worth mining***

The conception and practice of consumption spiritual value in the “purpose” of advertising theatrical elements gives tea (brand) a richer social value. When the society comes out of the short-term economic times, people’s consumption is more than just satisfying the low-level needs of physiology and security, but the expression of the physical, emotional or adoration, such as social exchange, the realization of self-worth, the worship of aesthetics and the enlightenment of the value of life are becoming more and more important. The satisfaction of the high-level needs of human consumption is focused on commodities or services, and the symbol value or symbol consumption is more loved, and is not the basic use value which is needed for satisfying the low-level needs such as physiology and security. As a result, the love and use of the brand is not so much for the enjoyment of the material than in the possession of the brand symbol or the symbolic meaning on the basis of the enjoyment of the material, thus forming the distinction between identity and status with other members of the society; by comparing them with others, or comparing them with their own past, people can increase their sense of social well-being and enhance their life value and meaning. Two Anhua Brick Tea sample advertisements in the tea (brand)

marketing communication and the brand advertisement's "purpose" element aspect, have carried out beneficial attempts and practice, which is worthy of reference study for other agricultural forest products (brand).

**4.5 The "characters" of advertising theatre elements bear the social civilization behind the consumers**

The "character" arrangement of the middle-aged man in the advertising drama element, whether it is the master of the product in the Jiuyang Brick Tea advertisement or the "grandfather" in the Sidao Tea Industry, is the symbol of authority, and they coincide with the agricultural civilization in peasant-cultivated society "the family has an old one like a treasure", which emphasizes the accumulation of agricultural experience and agricultural knowledge and emphasizes the passing of civilization and the past. Why is the middle-aged male "figure" not a young man or a middle-aged woman? In that case of young people, there may be a lack of age differentiation among the characters in the play, which will wipe out the generation level of the image of the character and influence the effect of the advertisement play; of course, the main reason is that, based on the description of the agricultural civilization mentioned above, in the age in the figure symbol here, the old age may also mean the old path and authority of agricultural experience while the youth means immaturity and status to be confirmed. In the farming civilization, the decline of the status of women after the acquisition phase naturally improves the male status of the agricultural cultivation which requires more power, where the arrangement of middle-aged

male advertising "figure" may be more consistent with the appeal of the Chinese community, which is deeply branded with agricultural civilization for the advertisement of tea agricultural products. The male in the figure symbol may also mean agricultural civilization, although there is very unjust gender discrimination.

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## References

- [1] Wang Kai: "Four-wheel drive" in Anhua Brick Tea Industry of Brand Building Improvement in 2017, China Cooperation Daily, March 14, 2017, Baisha Stream, Version B05
- [2] Zhu Xiangyang, Jiao Hong: The Road of Poverty Alleviation in the Brick Tea Shop--Anhua County, Hunan Province, relying on the fine pro-poor documentary of the Dark Tea industry, the Journal of Farmers' Daily, May 8, 2017, Version 001
- [3] He Xin: The symbol of artistic phenomena--Cultural interpretation[M]. People's Literature Press, 1987, P60-61
- [4] Li Siqu: The Application of Rhetoric and Advertisement Symbols, Journal of Southwest University for Nationalities (Philosophy and Social Sciences), 2000, No. 6, Vol. 21, P75
- [5] Anhua Jiuyang Brick Tea Advertisement Super clear version <http://baidu.ku6.com/watch/5286471088069230956.html?page=video> MultiNeed
- [6] Sichuang Media, Anhua Brick Tea's latest advertisement for Sidao Tea Industry with 45 seconds in 2012 [http://v.youku.com/v\\_show/id\\_XMzc4MTM1ODQw.html](http://v.youku.com/v_show/id_XMzc4MTM1ODQw.html)

# Which Type of Social Network is More Important for Entrepreneurial Learning: An empirical study on Chinese college students

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**Abstract:** National and regional economic growth is closely related to entrepreneurial behaviors, and entrepreneurial learning (EL) is one of the key indicators for predicting, influencing entrepreneurial willingness and behavior. But what of promoting EL?—Can social network enhance EL? If so, which type of social network is more important for facilitating EL? This article conducts an empirical study on Chinese college students, and based on the theory of "the pattern of difference sequence", exploratory puts forward college students' social network contains genetic ties, educational ties and commercial ties, using the method of structural equation models (SEM) to studies the influence of college students' social network on EL. Results show that college students' genetic ties have limited role in EL and only promote cognitive learning, while educational ties and commercial ties can promote college students' experience learning, cognitive learning and practical learning at the same time.

**Key words:** the pattern of difference sequence; social network; entrepreneurial learning; college students

## Introduction

With the coming of global innovation 3.0, entrepreneurial activities play an increasingly important role in promoting economic growth and market innovation. Because of China's realities, college students' entrepreneurship has been widely concerned by the society. Despite the great attention of government and market, college students' entrepreneurship rate and success rate of entrepreneurship have been low for a long time, which are related to the lack of sufficient cognition of college students (Lorz, Mueller, & Volery, 2013). Due to the age and limited experience, college students are relatively lack of experience, system learning of entrepreneurial education, business knowledge and skills, which are the main cause of above double low rates. Wang and Chugh (2014) put forward that successful entrepreneurs achieve their success because they have accumulated rich business knowledge and skills through EL.

Entrepreneurship is a learning process in essence (Minniti & Bygrave, 2001; Politis, 2005; Cope, 2011). Because of the complexity of entrepreneurial process and limitations of the entrepreneur's own resources, knowledge and abilities, learning from social network is increasingly considered to be the key to the success of entrepreneurship. Social network is an important

factor which accord with China's national conditions and characteristics of college students (Zhao et al., 2011). However, scholars have focused on college students learn from classroom and entrepreneurship courses mostly, learning from social network is often ignored. Unlike western society, China is a strong ties society and forms the pattern of difference sequence (Bian, 1997), most researchers believe that strong ties (e.g. parents, relatives, etc.) have stronger impacts on individual behaviors. However, is this conclusion applicable for college students who spending a long life on the campus? Is the pattern of difference sequence of college students' social network different from social people? Which type of social network is more important for college students' EL? The academic community has not yet reached a conclusion.

Thus, this article conducts an empirical research on 587 college students in Yangtze river delta region where entrepreneurial activity is relatively active, and explores the relationship between social network and EL.

## 1. Literature review and hypotheses development

### 1.1 College students' social network

Scholars have focused on the effect of college students' social network on entrepreneurship, employment and so on, most of them view social network as a whole concept, using

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indexes such as network size, heterogeneity, center structure, etc. to measure social network wholly. However, some contrary conclusions were drawn. For example, Xiao & Fan (2014) proved that size of social network is negatively correlated with entrepreneurial intention of Chinese College-graduate Village Official, while Wang Yu & Wang Jian Zhong (2013) drew the opposite conclusion. In fact, different characteristics of network members can lead to differences in resources and information available to individuals, so exploring the effect of different types of social network are of great significance. Compared with social people, college students' social network has low heterogeneity, and it is generally believe that the construction of their social network is mainly based on family and school (Yin Kui et al., 2016). In addition, nowadays more and more college students take part-time jobs and internship, expanding their contact with social people, but few scholars have paid attention to college students' ties with social people. Based on these, this paper identifies three dimensions of college students' social network: genetic ties, educational ties and commercial ties. Genetic ties refer to college students' family relationships, including ties with parents, relatives and so on, educational ties refer to college students' campus relationships, including ties with classmates and teachers, and commercial ties of this article refers in particular to the relationships except genetic ties and educational ties, namely the ties with social people which formed during the process of college students taking part-time jobs, having practical training, starting businesses and other social practice.

### **1.2 Social network and EL**

EL refers to the process of acquiring entrepreneurship knowledge based on prior experience, observation, imitation, and entrepreneurial practice (Cope, 2005; Lumpkin & Lichtenstein, 2005; Politis, 2005; Wang & Chugh, 2014). The popular EL theories are experiential Learning theory, cognitive learning theory and action learning theory. Based on these theories, scholars orient their discussion around three of the most common categories of EL—experiential Learning, cognitive learning, and action learning (Lumpkin & Lichtenstein, 2005; Holcomb, et al., 2009). Based on previous studies and the interviews of college students, this paper divides college students' EL into three dimensions: experiential learning, cognitive learning and action learning. Experiential learning refers to the process of converting previous experience (such as professional knowledge, specialty, tacit entrepreneurial experience, etc.) into entrepreneurial knowledge through reflecting, trial and error, etc.; cognitive learning refers to the process by which college students acquire and absorb entrepreneurial knowledge by observing or imitating other people's behaviors; action learning refers to the process of acquiring entrepreneurial knowledge through hands-on practice (internships, part-time jobs, etc.), also called

"learning-by-doing" (Hamilton, 2006).

#### *1.2.1 Genetic ties and EL*

Genetic ties have the features of trust and mutually benefits, strong ties and sharing knowledge and experience, not only can spread cognition, values, feelings, etc., but also a reliable source of information, knowledge, resources, etc. Parents and relatives can greatly affect college students' confidence through emotional support and spiritual encouragement. As the level of confidence rises, individuals tend to rely on their own experience and actively reflect to promote experiential learning (Minniti & Bygrave, 2001). The social experience, entrepreneurial experience and working experience (including failure experience) of parents, relatives can provide "role model" for college students, and due to intimacy, can deliver more reliable information and tacit knowledge, thus promoting college students' cognitive learning. Practice has proved that stable social relationship plays an important role in the allocation and gain of resources, genetic ties which located at the core of social capital can provide a maximum support with minimum cost, and make individuals more willing to try innovative or risk-taking investment behavior, then promote the action learning. Based on above statements, the following hypotheses are offered for testing:

H1: Genetic ties can promote college students' EL.

H1a: Genetic ties can promote college students' experiential learning;

H1b: Genetic ties can promote college students' cognitive learning;

H1c: Genetic ties can promote college students' action learning.

#### *1.2.2 Educational ties and EL*

School is the main activity place of college students outside the family, and the ties between students and teachers are the main component of college students' social network. Due to similar age and experience, students have more common language, thus they are more likely to become main emotional exchange partner of each other and provide emotional support to promote experiential learning. Group effect of college students' activities is significantly, peer groups tend to become models of each other, and mutual learning is common, so the peers studying and living around especially the excellent ones who have entrepreneurial experience often become role models college students prefer to observe and imitate firstly, and promoting cognitive learning. Classmates can obtain more business information and details, accumulating human capital and social capital through introducing each other part-time jobs and internship, and establishing entrepreneurial teams together to promote action learning. In addition, entrepreneurship education has been carried out for a long time in China, the teaching form has been from single classroom teaching turned into a whole set of education system consist of entrepreneurship

course, entrepreneurship competition, practice, training and internship inside and outside universities and incubator, and can fully arouse college students' experiential learning, cognitive learning and action learning. Teachers are main executors of entrepreneurship education system, and play a vital role. Based on above statements, the following hypotheses are offered for testing:

H2: Educational ties can promote college students' EL.

H2a: Genetic ties can promote college students' experiential learning;

H2b: Educational ties can promote college students' cognitive learning;

H2c: Educational ties can promote college students' action learning.

### 1.2.3 Commercial ties and EL

Compared with past college students, contemporary college students contact more and more frequently with social people due to the open of campus life and social media generalization, so the role of commercial ties is remarkable. For college students, the establishment of ties with social people often based on the introduction of acquaintance, then slowly become friends, so different from the commercial ties of social entrepreneurs which based mainly on economic interests, college students' commercial ties often mixes with emotional communication, and can provide emotional support and spirit encouragement to promote experiential learning. The commercial ties is a weak joint, which can transmit more heterogeneity information (Peng & Luo, 2000), so individuals tend to absorb knowledge by observing and imitating other people's behaviors and activities to promote cognitive learning. In addition, business ties can provide a lot of chance to contact with the society, and help college students learn industry environment and policy changes, deal with enterprise management problems, all of these have positive impact on individuals to participate in practice in order to better grasp the external environment and business opportunities. Based on above statements, the following hypotheses are offered for testing:

H3: Commercial ties can promote college students' EL.

H3a: Commercial ties can promote college students' experiential learning;

H3b: Commercial ties can promote college students' cognitive learning;

H3c: Commercial ties can promote college students' action learning.

## 2. Methodology

### 2.1 Measure of variables

A five-point Likert scale was used to measure social network and EL. College students' social network was measured through network size, frequency of interaction and trust degree (Granovetter, 1973; Lee, 2001; De Carolis & Litzky, 2009), and

total 11 items were adopted. EL were measured by adapting indicators suggested by Zhao et al. (2011) and Shan Biao An et al. (2015), also 11 items were used totally.

### 2.2 Data collection

Questionnaire survey and personal interviews are used to collect sample data. Before questionnaire survey, lots of personal interviews were conducted on college students to collect primary information and revising the questionnaire. Then from February to May in 2017, the large-scale formal survey was conducted in 27 colleges and universities (11 key universities, 12 ordinary universities and 4 academies) in the Yangtze river delta region where there are many colleges and universities and the entrepreneurial activities are active. In all, 800 questionnaires were distributed and 587 valid responses were received resulting in a valid response rate of 73.38 %. Sample data consist of 248 males (42.2%) and 339 females (57.8%), most of their parents and relatives have business background (60.4%). A total of 24.0% of samples are freshmen, 24.7% are sophomores, 21.3% are juniors and 30.0% are seniors. Most of them are majored in economics and management (45.5%), science and engineering (48.4%), literature and law (3.6%), arts (0.3%), medical (0.5%) and others (1.7%).

## 3. Empirical studies and results

### 3.1 Reliability and validity test

Before conducting analysis of structural equation model, the software SPSS19.0 was used to verify the reliability and validity of the instruments. The Cronbach's alpha coefficient of social network instrument and entrepreneurial learning instrument are 0.901 and 0.883, so instruments have good reliability. Exploratory factor analysis results show that KMO value of the social network instrument and entrepreneurial learning instrument are 0.869 and 0.879, and the significance level of Bartlett's spherical test are all 0.000, indicating that the research data is suitable for factor analysis. At the same time, the factor loading of all items exceed the recommended level of 0.50, indicating the convergence validity is good. The social network instrument and entrepreneurial learning instrument can extract 3 factors which eigenvalues are greater than 1, and explain 82.418% and 73.794% of the item variance respectively. In all, the structure validity of instrument is suitable for the study of structural equation model.

### 3.2 Structural equation model test

Software AMOS19.0 was used to test the structural model and hypotheses H1-H3. Firstly, model 1 was established which constructed a second-order model of EL (Fig. 1), and test the influence of genetic ties, educational ties and commercial ties on EL. Secondly, model 2 was established to test the influence of each dimension of social network on the dimensions of EL (Fig. 2). As shown in Fig. 1 and Fig. 2,  $\chi^2/df$  of model 1 and model 2 equate 2.661 and 3.104 (<5.0). RMSEA are 0.053 and 0.066

(<0.08). Main fitting indices are all greater than 0.9 and close to 1 (such as GFI, NFI, RFI, IFI, TLI and CFI), thus, our results

indicate satisfactory model fit.

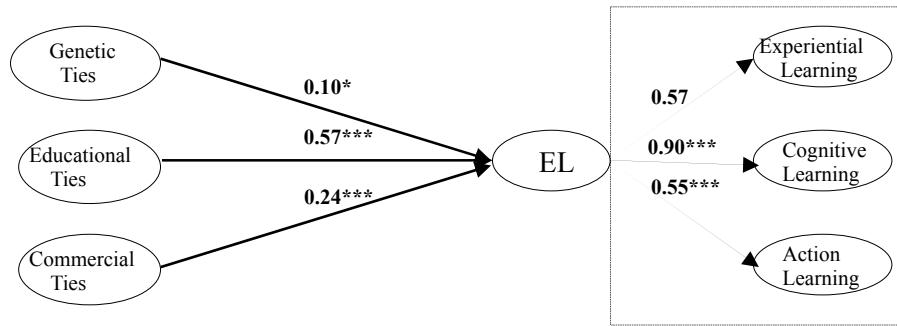


Figure.1 Structural equation model of model 1

$\chi^2/df=2.661$ ,  $GFI=0.921$ ,  $NFI=0.946$ ,  $RFI=0.938$ ,  $IFI=0.966$ ,  $TLI=0.960$ ,  $CFI=0.966$ ,  $RMSEA=0.053$ , \*  $P < 0.05$ , \*\*\*  $P < 0.001$ .

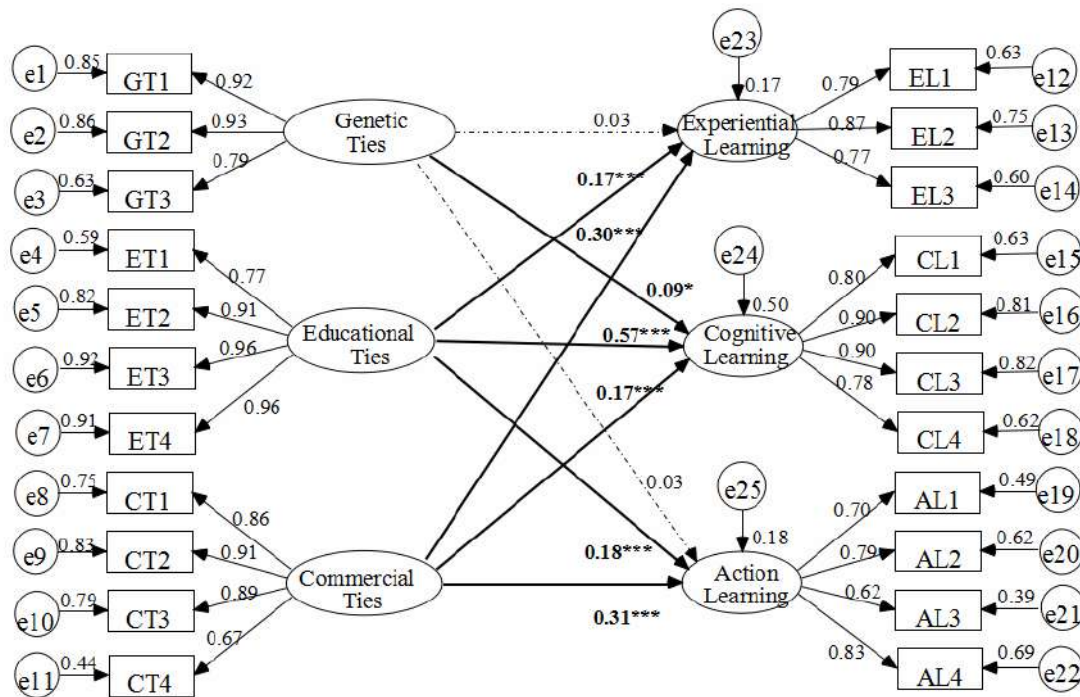


Figure.2 Structural equation model of model 2

$\chi^2/df=3.104$ ,  $GFI=0.911$ ,  $NFI=0.938$ ,  $RFI=0.928$ ,  $IFI=0.957$ ,  $TLI=0.950$ ,  $CFI=0.957$ ,  $RMSEA=0.060$ , \*  $P < 0.05$ , \*\*\*  $P < 0.001$ .

**3.3 Results**

Fig.1 shows that genetic ties ( $\beta= 0.101$ ,  $p < 0.05$ ), educational ties ( $\beta= 0.570$ ,  $p < 0.001$ ), and commercial ties ( $\beta= 0.245$ ,  $p < 0.001$ ) are positively related to EL. Thus, H1-H3 was supported. Fig.2 shows details: genetic ties have a positive effect on cognitive learning ( $\beta= 0.093$ ,  $p < 0.05$ ), but the effect on experiential learning and action learning are not significant. Namely, H1b was verified but H1a and H1c were not verified. Educational ties could promote the experiential learning, cognitive learning and action learning (H2a-H2c got empirical support), and the effect on cognitive learning was greatest ( $\beta=0.57$ ,  $P < 0.001$ ), higher than the effect on experiential learning and action learning. Commercial ties could promote the

experiential learning, cognitive learning and action learning too (H3a – H3c were support), and the impact on action learning was the most significant ( $\beta=0.31$ ,  $P < 0.001$ ), slightly higher than the impact on experiential learning and cognitive learning.

**4. Conclusions and implications**

Educational ties and commercial ties have important influence on college students' EL. The empirical results show that college students' educational ties has the most significant influence on EL, followed by the commercial ties, and both of them can promote experiential learning, cognitive learning and action learning. Based on this, colleges and universities, the enterprise can work together to bring teachers, students and

public figures together to form an innovation ecosystem, and to realize the sharing of information and knowledge by playing the leading role of mentors, the role models of entrepreneurship students and the practice guidance of public figures. For example, colleges and universities exchange college students' new technology with enterprise, in return acquiring real-time market information which enterprise mastered to help improve the technology. Colleges and universities and enterprise reach mutual cooperation to promote the development of whole innovation ecosystem in order to realize the more smooth flow of information and knowledge, and finally provide impetus for college students' EL.

Under the perspective of the new "pattern of difference sequence", the influence of genetic ties on college students' EL has to be further enhanced. The results show genetic ties has the least effect on promoting EL, and only promotes cognitive learning of College students. The Yangtze river delta region is flourishing in economy and the entrepreneurial activities are active, and there are a lot of families with business experience, genetic ties should have an important impact on College Students' EL in theory. However, the second generation prefers to commit to the pursuit of self-value instead of taking over their parents' business or start business as their parents' wishes is not in the minority. In addition, the college students whose parents and relatives have no experience of business due to the generation gap and less effective entrepreneurial guidance can be obtained from family members, so the role of genetic ties needs to be further improved. In view of this, parents should strengthen communication with children, give them more mental and emotional support, and take a positive view of college students' entrepreneurial activities. At the same time, parents should change their thought, learn to let go, effectively encourage college students to strengthen their EL and participation in entrepreneurship practice.

## References

- Bian, Y. (1997). *Bringing strong ties back in: indirect ties, network bridges, and job searches in china*. American Sociological Review, 62(3), 366-385.
- Carswell, M., & Rae, D. (2001). *Towards a conceptual understanding of entrepreneurial learning*. Journal of Small Business & Enterprise Development, 8(2), 150-158.
- Cope, J. (2005). *Toward a dynamic learning perspective of entrepreneurship*. Entrepreneurship Theory & Practice, 29(4), 373-397.
- Cope, J. (2011). *Entrepreneurial learning from failure: An interpretative phenomenological analysis*. Journal of business venturing, 26(6), 604-623.
- De Carolis, D. M., Litzky, B. E., & Eddleston, K. A. (2009). *Why networks enhance the progress of new venture creation: The influence of social capital and cognition*. Entrepreneurship theory and practice, 33(2), 527-545.
- Granovetter, M. S. (1973). *The strength of weak ties*. American journal of sociology, 78(6), 1360-1380.
- Holcomb, T. R., Ireland, R. D., Jr, R. M. H., & Hitt, M. A. (2009). *Architecture of entrepreneurial learning: exploring the link among heuristics, knowledge, and action*. Entrepreneurship Theory & Practice, 33(1), 167-192.
- Lee, D. Y., & Tsang, E. W. (2001). *The effects of entrepreneurial personality, background and network activities on venture growth*. Journal of management studies, 38(4), 583-602.
- Lorz, M., Mueller, S., & Volery, T. (2013). *Entrepreneurship education: a systematic review of the methods in impact studies*. Journal of Enterprising Culture, 21(02), 123-151.
- Lumpkin, G. T., & Lichtenstein, B. B. (2005). *The role of organizational learning in the opportunity-recognition process*. Entrepreneurship Theory & Practice, 29(4), 451-472.
- Minniti, M., & Bygrave, W. (2001). *A dynamic model of entrepreneurial learning*. Entrepreneurship: Theory and practice, 25(3), 5-5.
- Peng M W, Luo Y D. (2001). *Managerial ties and firm performance in a transition economy: The nature of a micro—macro link*. The Academy of Management Journal, 43(3): 486-501.
- Politis, D. (2005). *The process of entrepreneurial learning: A conceptual framework*. Entrepreneurship theory and practice, 29(4), 399-424.
- Shan, Biaoan, et al. (2015). *The impact of entrepreneurial network on entrepreneurial learning in the Chinese context*. Studies in Science of Science,(06), 899-906 +914.
- Wang, C. L., & Chugh, H. (2014). *Entrepreneurial learning: past research and future challenges*. International Journal of Management Reviews, 16(1), 24-61.
- Wang, Yu, & Wang, Jianzhong, (2013). *Research on the influence factors of college students' entrepreneurial intention - based on the perspective of social network relations*. Economy and management, 27(3):64-68.
- Xiao, L., & Fan, M. (2014). *Does social network always promote entrepreneurial intentions? An empirical study in china*. Neural Computing & Applications, 24(1), 21-26.
- Yin Kui.et.al.(2017). *The social network of college students*. Progress in psychological science. 24(8): 1279-1289.
- Zhao, Y., Li, Y., Lee, S. H., & Chen, L. B. (2011). *Entrepreneurial orientation, organizational learning, and performance: Evidence from China*. Entrepreneurship theory and practice, 35(2), 293-317.

# Research and Practice on Cultivating Interests in learning: Guidelines to Online and Offline learning to Help OEC Students Cultivate Learning Initiatives

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**Abstract:** The key point of the reform of teaching methods should be student-centered in order to promote their learning initiatives. Teachers, as guides of students in their learning, sometimes use improper methods, unfortunately acting as the 'killers' of students' learning interests. Studies of 'interests' in the past two decades in the West have shown that the most important influencing factors of individual interests, subject interests, and situational interests, are learning materials and background knowledge. This study is based on the international teaching platform, SAKAI. Constructive learning resources guide the process of learning among OEC students, emphasizing the value of knowledge and emotional factors such as the interaction of learning interest, and repeatedly stimulating students' situational interest in order to help them become subjects with completely independent individual interests.

**Key words:** MBBS, process monitoring, Cultivating Interests in learning, SPOC, SAKAI, online study, flipped class

## Introduction

Liang Qichao, a celebrity in late Qing dynasty, was good at education. The nine children of his were leaders in various fields, three of which were academicians in their era. In his essay, he mentioned that, "mortals should often live in fun", emphasizing the importance of cultivating interests during the upbringing of elites. Recalling the study of interest in the West in recent years, we found that learning interest to a certain extent, can be cultivated. Contrary to cultivating interest, teacher-stereotyped classroom lectures and presentations will put students in a passive learning position. Students will lack learning initiatives, and have poor learning outcomes. Moreover, the teacher's organization of the classroom has nothing to do with the teaching of the subject. The seemingly colorful classroom activities do not necessarily cultivate interest in learning. In contrast, they may even constrain the role of interest in learning. Valuing the inherent law of education and achieving the purpose of education, are the important areas for educators to consider in teaching designs. How to develop theories based on Chinese and Western interests, change the classroom environment into an interesting one, organize and guide more effective teaching activities that conform to the law of interest development, and promote the learning initiative of the students,

are the necessary issues to be considered by every university teacher, and in any course. Educating international students is the forefront of internationalization of education. Medical students' education is a challenge to teachers' teaching ability and methods, because of the teachers' cultural impact and strong professional characteristics. It also shows the teaching reform and educational internationalization of students as a core and unprecedented opportunity.

## 1. Methods for cultivating learning interest

To a certain extent, students' interest in learning is influenced by external environmental factors, but also includes "congenital" elements. Studies have shown that interest arises from the interaction of people with the environment, i.e. the result of the interaction of people with specific contextual content<sup>[1,2]</sup>. Interest also has certain heredity. It is closely related to the areas of the brain where characterization of searching and avoidance behaviors are located, and it is also associated with congenital inheritance. For example, newborns show a wide range of interests in the surrounding social and physical environment<sup>[3]</sup>.

A retrospective analysis of the study of interest in Western learning in the past two decades has found that the factors that affect students' interest in learning are divided into three

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4. The unique project for overseas students' education 2015 in Jiangsu University.

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categories: factors that affect individual interest, factors that affect the situation, and factors that affect the subject interest. For instance, individual interest is influenced by individual knowledge reserves and value reserves <sup>[2]</sup>, and personality traits such as tenacity and conscientiousness. Gender also affects the rate of decline of an individual's interest in a subject. Cooperation between men and women can improve the interest of study partners. Positive factors that influence situational interest include the provision of background knowledge, provision of meaningful choices, the quality of reading materials, provision of subject and domain knowledge, provision of reward for fulfilling expected tasks, the usefulness and relevance of knowledge, reading materials in the form of narration or questions, and so on. The factors influencing subjective interest include the student's appropriate subject knowledge reserve (i.e. too much or too little knowledge reserves will reduce the interest in learning) and the domain knowledge reserves. Emotional factors in reading play a positive role in subjective interest.

Many of the studies that affect interest in learning focus on a single perspective, but the factors that affect the various types of interest are always intertwined. And, whether or not to study interest depends not only on a single factor, but also on the interaction among the three factors <sup>[4]</sup>. An effective way to stimulate interest in learning is to find interest in situations that stimulate students' individual characteristics, family backgrounds, previous interests, and knowledge. In the process of maintaining situational interest, promote the spontaneous manifestation of interest through activities or the development of a particular topic or subject of interest. And in more similar learning activities, repeated stimulation eventually turns into an individual interest. <sup>[5]</sup> The key point of many studies on the influence of learning interest is how to change students' learning interest from situational interest to individual interest.

The theory of Dynamic change of Psychological construction holds that: situational interest only in the constant repetition of the experience can stimulate the development of individual interest. The theory of the interaction between people

and goal suggests that, emotions (positive emotions and emotions that are learned in the task) are highly correlated with the value (the degree to which students are given importance to learning activities), and affect interest <sup>[6,7]</sup>. The domain-learning model suggests that the change in situational interest to individual interests is accompanied by changes in knowledge and learning strategies. Therefore, it is necessary to effectively predict the developmental stage of students' interest, and to monitor the progress of knowledge accumulation and learning strategies, in order to improve the students' learning history. The rate at which students' interests change from situational interest to individual interest, improves. <sup>[8]</sup>

Based on the above theory, a reasonable interest-training course should be planned as a practical way to guide students to develop individual learning interests. Teachers play an indispensable role in achieving this goal. They must be good at communication, love students, be interested in and have much knowledge of what they teach, and have positive emotions that can help students experience what they learn. In the course of teaching, the teachers should give students the opportunity to choose, and be creative, etc. They should also help students learn the knowledge of self-efficacy. Ultimately, it will be realized that students' situational interest will gradually change into individual interest, thereby reducing procrastination and other learning problems. <sup>[9]</sup>

**2. Integration of factors that influence interest, building learning platform, guiding the learning process**

Each student's individual interest-related factors, such as individual knowledge reserves and value reserves, as well as individual character traits such as tenacity and conscientiousness, have been characteristic before one's enrollment. Based on the factors that influence situational interest, we combine various interest-guiding factors in the teaching activities, construct the teaching platform, guide the learning process, and eventually cultivate individual interest (Table 5).

**Table.1 Construction of learning platform and learning process guide and the cultivation of interest-related principles**

Teaching activities	Interest - related factors
1. Build SPOC learning platform	
1.1 Course information	Provide background knowledge such as drug development history or disease treatment history <sup>[2]</sup> Improve the quality of reading materials <sup>[10]</sup> Provide topics and domain knowledge <sup>[11]</sup> Focus on the usefulness and relevance of knowledge <sup>[12]</sup> Provide narrative- or problem-form reading materials <sup>[13]</sup> Provide a meaningful choice <sup>[14]</sup>
1.2 Course notification, quiz, assignment	Provide a reward for accomplishing the expected task <sup>[15]</sup> Pay attention to cultivating students' self – efficacy <sup>[16]</sup> Pay attention to repeated stimulation, and constantly strengthen the principle <sup>[16]</sup>

	Forum, chat room, survey feedback	From shallow to deep, from outside to inside the teaching strategy <sup>[16]</sup>
2. Guide the learning process		
2.1 The teacher prepares himself		Communication skills, love students, love teaching, rich in knowledge <sup>[17]</sup> The importance of learning activities <sup>[18]</sup> Guide positive emotions <sup>[18]</sup>
2.2 Course organization		From shallow to deep, from outside to inside of the teaching strategy <sup>[16]</sup> Focus on cooperation between male and female groups <sup>[19]</sup> Pay attention to cultivating students' self - efficacy <sup>[16]</sup>

Note that SPOC is a short private online course, literally "small-scale restrictive online course", relative to MOOC (massive open online course) in the massive and open. 'Small' refers to the small size of students. 'Private' means that students can meet the requirements to be included in the course of study. SPOC is a mixed learning model that combines classroom teaching and online teaching for College students. It is a very efficient way for the communication and transmission of information. [20,21] SPOC online teaching platform used by our school SAKAI is an open source free course management project sponsored by Stanford University, MIT and Berkeley in 2004, which is characterized by reliability, cooperation and scalability. Teachers and students interact online through the platform for daily teaching-related contents. The system provides features including notification, courses, assignments, quizzes, chat rooms, forums, team management, and statistical analysis that include more than 30 kinds of tools provided by dozens of domestic and foreign famous schools for all ages.

From January 2015 onwards, we randomly divided a particular batch of students into two groups in each semester. One group had online and offline flip classroom guidance sessions and the other group carried out the offline traditional teaching control classes. After five semesters, data from the two groups were analytically compared, using SAKAI statistical analysis tools. We found that the students, through the control and guidance of the online and offline learning process, not only increased their passive online time, but also their active online time was significantly increased. Some students even formed an online review, repeated practice of good habits, undertook learning initiatives, and students' achievement significantly improved. At the same time, the results of the survey revealed that the number of international students' procrastination and excuses were significantly decreased. From this point of view, it was confirmed that poor students' learning difficulties had been partially resolved.

### 3. Analysis of the Effect of Medical Students' Interest

**Table.1 Summary of Questionnaire Results of Procrastination-related Performance of 2016-2017 Autumn Medical Students**

Procrastination	classification of performance	Times*number of people in Control class	Times*number of people in experimental class	T-test <i>p</i>
Do not want to do things related to study	Avoidance	6	3	
Claim to have a task more important than learning	Denial	5	3	
Intensive video games or internet access	Distraction	7	4	
Compare one's learning situation with a worse person	Counterfactual	3	1	<i>p</i> = 0.001
Emphasize the sense of satisfaction outside of learning	Balance	2	1	
Attribute procrastination to external factors	Blaming	10	4	
Ridicule active learners	Mocking	2	0	
Total number		35	16	

From the above results we found that, firstly, interest-oriented SPOC promotes the teaching reform and improves students' achievement. Secondly, SPOC innovative teaching model enables teachers to return to the campus to become genuine leaders of the classroom. Teachers are learners and integrators of curriculum resources. In the classroom, teachers are the organizers of the whole class. They organize student discussions, provide students with guidance, and work together with them to solve any problems encountered. SPOC inspires the teachers' enthusiasm and classroom vitality. Thirdly, SPOC places greater emphasis on giving students a complete and in-depth learning experience. It also stimulates students' initiative and creative potential, and motivates their participation, especially for students with insufficient leaning motivation.

Information resources from the wide network, superior multimedia features, and multi-directional interactive functions make it possible to improve the teaching quality and efficiency. With teachers as the organizers of the curriculum, the tasks and challenges are the comprehensive utilization of various teaching methods, providing students with the opportunities in making choices and undertaking tasks in class, encouraging students to establish the knowledge of self-efficacy, transforming students' interest to individual Interest, and ultimately helping students become the subjects, controllers, motivators, and moderators of their interests. In summary, we use the research and practice of learning interest as a means to guide online and offline learning, and hence cultivate foreign medical students' learning initiatives and interests, in order to provide a reference for their education.

## References

- [1] Renninger, K. A.. Children's play interests, representation, and activity. *Emory symposia in cognition* 3, 127-165 (1990).
- [2] Renninger KA, Hidi S..Student interest and achievement: Developmental issues raised by a case study. *Development of achievement motivation*,2, 173-220(2002).
- [3] Beatty MJ, Heisel AD Spectrum analysis of cortical activity during verbal planning: Physical evidence for the formation of social interaction routines. *Human Communication Research*,33, 48-63.(2007).
- [4] Mitchell M. Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of educational psychology*. 85(3), 424-436 (1993).
- [5] Hidi S. . Interest, reading, and learning: Theoretical and practical considerations *Educational Psychology Review*. 13(3), 191-209 (2001).
- [6] Silvia, P. J. Interest and interests: The psychology of constructive capriciousness. *Review of General Psychology* 5, 270 (2001).
- [7] Schiefele, U. Krapp A. Topic interest and free recall of expository text|Topic interest and levels of text comprehension. The role of interest in learning and development . 8(2)|141-160 (1996).
- [8] Hidi, S. & Renninger, K. A. The four-phase model of interest development. *Educational psychologist* 41, 111-127 (2006).
- [9] Steel, P. The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure.. *Psychological Bulletin*. 133(1), 65-94 (2007).
- [10] Schraw, G. Promoting general metacognitive awareness. *Instructional science* 26, 113-125 (1998).
- [11] Serenko, A., Bontis, N., Booker, L., Sadeddin, K. & Hardie, T. A scientometric analysis of knowledge management and intellectual capital academic literature (1994-2008). *Journal of Knowledge Management* 14, 3-23 (2010).
- [12] Hulleman, C. S., Godes, O., Hendricks, B. L. & Harackiewicz, J. M. Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology* 102, 880 (2010).
- [13] Logtenberg, A., van Boxtel, C. & van Hout-Wolters, B. Stimulating situational interest and student questioning through three types of historical introductory texts. *European Journal of Psychology of Education* 26, 179-198 (2011).
- [14] Schraw, G., Lehman S.Situational Interest: A Review of the Literature and Directions for Future Research *Educational Psychology Review* 13(1), 23-52 (2001).
- [15] Higgins, E. T., Cesario, J., Hagiwara, N., Spiegel, S. & Pittman, T. Increasing or decreasing interest in activities: the role of regulatory fit. *Journal of personality and social psychology* 98, 559 (2010).
- [16] Ainley, M., Corrigan, M. & Richardson, N. Students, tasks and emotions: Identifying the contribution of emotions to students' reading of popular culture and popular science texts. *Learning and Instruction* 15, 433-447 (2005).
- [17] Kerssen - Griep, J.Trees A R,Hess J A. Sustaining the desire to learn: Dimensions of perceived instructional facework related to student involvement and motivation to learn.67(4), 357-381. (2003).
- [18] Brown, J. S., Collins, A. & Duguid, P. Situated cognition and the culture of learning. *Educational researcher* 18, 32-42 (1989).
- [19] Häussler, P. & Hoffmann, L. An intervention study to enhance girls' interest, self - concept, and achievement in physics classes. *Journal of research in science teaching* 39, 870-888 (2002).
- [20] Baggaley, J. MOOC postscript. *Distance Education* 35, 126-132 (2014).
- [21] Fox, A. Patterson D.Crossing the software education chasm. *Communications of the ACM* 55(5), 44-49 (2014).

# Research on Promotion of Young College Teachers' Competence from Perspective of Tacit Knowledge Sharing in Virtual Teams

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**Abstract:** During "Internet plus" era, along with the economic globalization and knowledge diversification, college teachers' occupational competence is increasingly challenged, and young teachers as the main force of teachers, their competence development increasingly affects the quality of higher education in China. However, young college teachers' occupational competency development status is not optimistic. Based on the ability and quality young college teachers should have, the study is exploring the virtual team across organizational boundaries, dynamic and flexible, efficient collaboration of human resource organization form, trying to set up a virtual team dynamic contract operation model based on the path to enhance the five dimensions of interpretation and virtual team competency from the occupation of young college teachers' occupation competency.

**Key words:** virtual team, college teachers, professional competence, creative ability

## Introduction

During "Internet plus" era, the future development of college education has attracted the attention from all walks of life. What's more, lectures play an important role in the development of college education, the construction of teachers team have also been highly valued. The proportion of young teachers in total colleges' teachers is increasing. It is significant to investigate the status young teachers in universities. Teachers in the occupation plight and the path of ascension, affecting the university education whether flourish in the future. Harvard University professor McClelland put forward competency in 1973 for the first time in the book *Testing for Competency Rather Than for Intelligence* (McClelland, D.C., 4). In recent years, the research and application of competency wins closely attention from the scholars of our country, but these studies focus on talent recruitment, performance management, to enhance occupation competency especially for college young teachers is slightly less. In addition, since 1990s, the advantages of virtual teams has received attention and application of economic scholars and organizations in United States, Japan and other developed countries, and also has been successfully applied in the military field and economic practice. Virtual team is the future development direction of the work team (Alan Rossiter, 190), this paper attempts to explore a more effective

mode for universities' operation, teachers' management and science & technology development transferring, all our effort is to seek an effective exploration of practical significance.

## 2. Research on the Professional Competence of Young Teachers in Universities

### 2.1 Connotation of Professional Competence of Young Teachers in Universities

Competence is often called competency or employability. McClelland defined "competence" as: individuals displayed their personal attributes about excellent performance in specific position or organizational environment (McClelland, David C, 338); and Boyatzis defined "competence" as: individual characteristics, motivation, knowledge, characteristics of self image, which could potentially and deeply lead to excellent performance (Boyatzis S, R. E., 208); Spencer defined "competence" as: the characteristics of personal potential surface and deep features of the person who has excellent performance, which differs from mediocrity in an organization. In summary, the young college teachers' occupation competency refers to a professional knowledge, skill, values and personality characteristics.

### 2.2 Structural Dimensions of Professional Competence of Young Teachers in Universities

The competency of different industries has common

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tributes, but its characteristics still cannot be ignored. The study also noted that the Danielson (1996) put forward the teacher occupation competency model in four dimensions, namely, planning, environmental monitoring, teaching ability and professional responsibility; Bisschoff & Grobler (1998) applied a structured questionnaire to explore the depth of teachers competency in eight theoretical levels: learning environment, professional commitment, discipline teaching, basic teaching, reflection ability, cooperation ability, work effectiveness and leadership skills; Hay McBer (2000) put forward the "high performance research-based teacher model", this model covers five competency indexes, such as professional, leadership, thinking, planning/setting expect, and scientific linkage to others. We also notice Iceberg Model, the members' abilities in the organization, just like an iceberg floating on the surface of the water, surfaced factors above water represents benchmark competence ability (which could be called threshold competency), including experience, knowledge, skills, dominant traits and so on; and the potential factors which just below the

surface of the iceberg for the identification of competence ( which could be called differential competency), such as personality, quality, value, attitude, self image, driving force and social motivation, which is difficult to observe, but it is the most valuable part of the competency. A complete competency model is the sum of all these representational and potential traits (C. P. M. Van Der Vleuten, 66).

In summary, the paper suggests that, young college teachers should have professional competency, which include the following five dimensions: teaching ability (teaching skills, oral and written expression ability, grasp the progress of teaching) , scientific research ability (ability to understand the frontier theory, and the corresponding research and exploration ability),continuous learning (discovery, access, the ability to accept new knowledge), personal characteristics (high IQ, high EQ, innovation, hard-working and ambitious) and occupational motivation (University Teachers' work motivation in the occupation belief, occupation identity), as shown in Figure 2.1.

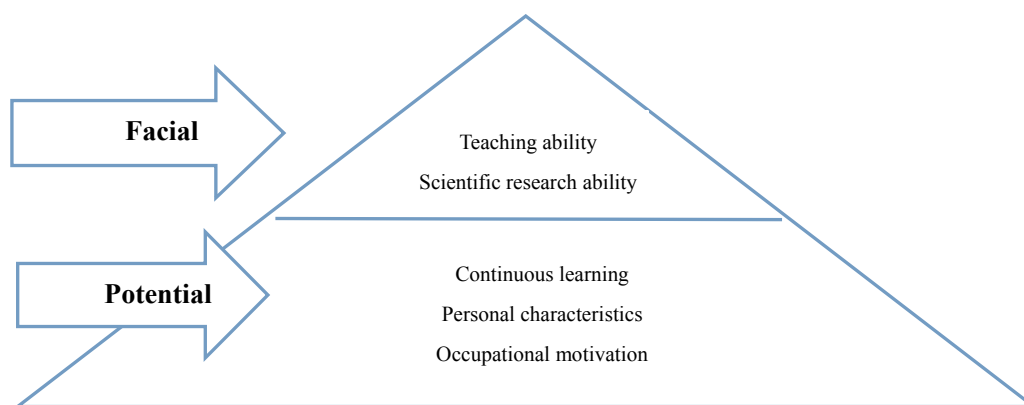


Figure 2.1 Structural Dimensions of Professional Competence of Young College Teachers

### 3. Analysis of Current Development of Young Teachers' Competence in Colleges and Universities

The young college teachers' occupation competency could be classified as five dimensions: teaching ability, scientific research ability, continuous learning ability, personality and occupation motivation, we can find that the young college teachers' competency development is not optimistic, which can be specifically listed as following issues:

#### 3.1 Young College Teachers' Lack of Teaching Skills and Techniques

Since the 1999's enrollment expansion, the number of college students have been increasing quickly. The consequence of the popularization of the higher education is that all the universities and colleges employed a large quantity of teachers to meet their need of education. Most of these employed teachers

are newly graduated masters or doctors. These young teachers' identities and roles have changed essentially in the short training period; they had begun their teaching career before they could successfully apply what they had learned theoretically to the actual teaching practice. The lack of practice in their school time and the *Theory Based Training* of their career training made these new teachers do not have a process of combining the education theory they learned with their teaching practice and a process of re-considering and comprehending. This inevitably lead to their teaching mode, just focus on the theory in book. That is one of the reasons why the university teachers' teaching ability is not strong enough. As a young teacher just stepped onto the teaching platform, they love their occupation, but they do not prepared psychologically and do not have enough experience of training and assistant teaching practice; so it is

very possible that they treat students in spoon-feeding ways. They probably do not have abundant ways of teaching methods, do not know different students conditions; they only teach blindly in their own world and they are even incoherent in their speeches. This is not good for the organization of classroom teaching and cannot expand students' knowledge, which would finally make the students lose their learning interests.

### ***3.2 Young College Teachers' Scientific Research Competence is at a Disadvantage***

The level of scientific research is an important index of a university's ranking. The competition among colleges and universities is the competition of scientific research competence to a large extent. And this is accordingly becomes the important responsibility of each university teacher. The scientific research competence is an important manifestation of teachers' academic competence and working competence. But the development of the young teachers in this area is not satisfactory. First of all, compared to the senior teachers or administrators, young teachers are at a disadvantage in the titles, qualifications, human resources etc. So they are usually having poor competition in subject applying. This makes most of the young teachers in high schools have been struggling in the edge of academy, enthusiastic but helpless. And finally their scientific research level cannot be improved because of the lack of scientific research platform. Secondly, current universities paid much more attention to scientific research than to the teaching competence in evaluation mechanism. The scientific research competence influenced the title evaluation, the positional ranks, and the salary. Under the dual pressures psychologically and physically, young teachers can only trying and trying to find a better and competitive subject. Furthermore, which is more serious, the slim opportunity of applying a subject successfully brings frustration to young teachers. This frustration is not disposable; it may be lifelong. This is in line with what the "Matthew Effect" explains: The individual or the community, in some aspects, such as fame, status, success, will produce a cumulative advantage when successes are achieved; those who achieved successes will have more chances to achieve greater successes. In the field of education, this effect manifests like this: The professors, experts, get more scientific research funds, more social part-time jobs, more learning and training opportunities, and more resources. While the young teachers face the shortage of funds for scientific research, and also they are offered rare opportunities of the academic speeches, training and learning (Dannefer EF, Henson LC, Bierer SB, 722). As a result, young teachers have been always in the situation of lacking support and help. As time goes, their enthusiasm for scientific research has been exhausted, thus their scientific research cannot be trained and improved.

### ***3.3 Young Teachers in Universities Lack Continuous Learning Ability, Fragmentation of Knowledge and***

### ***Individualization***

Faced with each passing day change in science, economy and society, as a young college teacher who trains advanced intellectuals, he must always be in the forefront of his specialized knowledge. Young teachers are energetic and thirst for knowledge, but after all, they have just entered the society and need to deal with the complicated relationships of marriage, work and life, which will, to a certain extent, reduce the concentration of young teachers' expertise in their own profession. In fragmented times, it is difficult for young teachers to acquire systematic knowledge. The huge and fragmentary information will make young teachers mistakenly think that they have mastered the knowledge, and consider "read" as "thinking". Besides the quality of knowledge update is also difficult to upgrade. In the long run, the result is a decline in knowledge and technology, and even stagnation, without the constant pursuit of knowledge, how can young teachers be better qualified for teaching and research work? In addition, due to external exchanges, there are fewer opportunities for continuing education and other training, and lack of reward and punishment mechanism, the continuing learning ability of young teachers is badly in need of training. In the long period of time, the knowledge and skills of college teachers are becoming more and more individualized. But with the rapid development of science and technology, the trend of cross connection and integration of many disciplines is increasing. In modern times, there is no such thing as a mixture of multi discipline cross connection and integration. In the long run, college teachers will be faced with the plight of poor role adjustment, and it is difficult to get out of the career plateau in a short time.

### ***3.4 Some Defects are existed in the Personal Characteristics of Young College Teachers***

Personal characteristics are the driving force in the structure of teacher competence, it is the key factor that influences the performance of individual teachers, and it is also an important factor that leads to the difference of individual competence among teachers. Young teachers in colleges show many advantages in their personal characteristics, such as daring to innovate, strong motivation for achievement, hard work and enterprising spirit, etc. But they also show some personality flaws in some ways, it restricts the development of its competence (Kranov, Ashley Ater, Danaher, Maurice; Schoepp, Kevin, 33). First, the young teachers' professional resilience is fragile. Professional resilience is a symbol of teacher competence. It is the ability and characteristics of individuals to adapt themselves to circumstances, adjust themselves, experience life value & life meaning, identify and adhere to work when they are in adversity. It is one of the standards for teachers' professional maturity. A teacher with a high level of career maturity and competence is bound to exhibit strong tolerance and accommodation in the face of difficulties and

setbacks. Career resilience has a negative effect on Teachers' job burnout, occupational stress and other negative emotions. Young teachers bear more pressure in the field of education and life than middle-aged teachers. In addition, the lack of social experience of young teachers and social resources, resulting in their tolerance is relatively weak than middle-aged teachers. Second, the pursuit of self value is too much. Self worth is the psychological tendency of the individual to accept and affirm the importance of self. According to Maslow's hierarchy of needs, the realization of self-worth is at the top of the hierarchy of needs. As young college teachers standing on the top of ivory tower, good educational background and higher social reputation have given them a strong expectation of their own values. However, when they enter the field of reality, their original vision of work is broken, but many years of educational experience still force them to overcome difficulties and realize their self-worth. Thus, during the process of pursuing value realization, they are eager for quick success and instant gain, learning style, impetuosity, individualism and so on. They may fall into the other extreme, and when they do, their self-identity decreases, and even self denial fails.

### ***3.5 College Young Teachers' professional beliefs are unstable***

The career development of young teachers in universities is confronted with the dangers of unclear orientation, job burnout, lack of ability and separation from students, the particularity of the work leads to the decline of initiative among some college teachers, the dissociation of the concept of work and the vague direction of the vision. College teachers usually bear heavy scientific research and teaching tasks. As for college teachers, scientific research achievements such as papers are highly dominant and the teaching effects are relatively implicit. Therefore, under the drive of limited energy and interest, there has been a general emphasis on scientific research, light teaching evaluation, less attention to the teacher's career planning, development advantages, potential and other. This kind of orientation embodies the extensive use of rigid indexes such as the amount of papers, monographs and the number of projects to be presided over in the selection of teacher evaluation system. However, the efforts of teachers in the process of teaching reform are neglected because of their slow performance and difficulty in quantification. Colleges and universities have too many strict and rigid requirements on scientific research achievements, to a certain extent, which destroyed teachers' teaching enthusiasm and affected the career development plan of teachers in the field of teaching and educating, and has affected the quality of teaching and education to some extent. Moreover, it has an impact on academic morality and subject education. It is easy to mislead university teachers to abandon their scientific career development plan and pursue scientific research results unilaterally. In the long run, under the guidance of this one-sided

evaluation content, it is difficult for college teachers to think deeply about their career growth cycle, and it is more difficult to make scientific career development and career planning. More emphasis on the dominant and measurable aspects of their work and personal orientation, and the "iceberg" is not enough to think about. College teachers need to make more efforts at the potential level.

### **4. Competence Promotion Strategy: a virtual team based on dynamic contract task network**

There are no perfect individuals, only perfect team. During knowledge explosion era, this opinion has been a broad consensus spreading in intellectual circles and management circles. As we all know, university is oriented to cultivate the talents and scientific research. Education and scientific research complement are inseparably interconnected in essence, they both are occupational requirements to college teachers and not a single one can be omitted. However, in the practice of management, young college teachers' personal time and energy are limited, it is difficult to make reasonable arrangements for teaching and research work, occupation competency development is poor, what is more, due to the disciplinary boundaries, knowledge blind spots existence, teachers are required to cooperate with each and establish an efficient team. Under the consideration of cost, physical teaching teamwork mode suffers to more or less restrictions during process of the promotion. In this situation, the zero-cost virtual teaching. Mode has become an optimal choice, but the specific operational mode of virtual teams still needs us to make further exploration.

According to the bottlenecks encountered in the competency development of young university teachers, this paper gives a promotion strategy, which is to organize virtual teams in university based on dynamic contract task internet. In this operation mode, firstly, the dynamic contract acts as a link, then we need to make full use of information and communication technology to strengthen horizontal communication and collaboration, as far as possible to materialize, visualize, merchandise and optimize the virtual characteristic, the optimization characteristics of virtual. Then to weaken the issues generate issues arising from the virtual nature in trust, knowledge sharing and strengthen the flexibility of this feature.

In the process of establishing the virtual team, we need actively organize the core team. The project leader and the core members of the specific project implementation study signed a distribution contract for the main task, at the same time; the core members will also work with the next level of researchers to achieve a certain task redistribution contract. Thus, a running model based on dynamic contract operation network is formed. The core of this operating model is the dynamic contract task network, the reason why we call it dynamic contract task net just

as follows: (1) Many flexible terms are provided on the content, most of which depend on the work condition of the contracting party and the changing of the research environment, and thus the operation has greater flexibility (2) Dynamic contract task net contains a "sequence of contract", which is not used, do not encourage the one-time contract approach, instead of using the "sequence of contract" cooperative behavior constraints, only after the completion of a contract based on clause that can execute the next contract. So the contract has a strong dynamic characteristic.

Dynamic contract should include the following contents: (1) Dynamic trust supervision mechanism. In order to enhance the cohesion of the whole virtual team and make it work on the same problem, it is necessary to solve the problem of trust mechanism, form the trust within the team, and build a team culture. At the same time, because of existence of information and knowledge asymmetry, members of the virtual team in the university may have the behavior of damaging the degree of information and knowledge sharing under the impetus of interests. So in the virtual team operation process, the corresponding dynamic trust supervision mechanism is needed to restrain the behaviors of team members. (2) Information and knowledge sharing mechanism. With a common aim, the team members will each one airs his own views, they will not keep his or her opinion, will not worry about being laughed at or others are superior to them, which is to break the barriers of knowledge, then there is a premise, media and channels of the knowledge sharing must maintain smooth, knowledge sharing media and channels is supported by information technology, knowledge, information exchange and media channel hardware communication. At the same time, as the team members to share their knowledge, just in front of us, how to deal with the issue of intellectual property with positive research, better stimulate team members at the same time, In the process of breaking knowledge barriers and sharing knowledge, different members have different professional backgrounds and thinking methods, Knowledge innovation will be produced to a great extent, however, the completion of these actions cannot be achieved without the incentive mechanism, performance evaluation system and guarantee system to maintain the fairness and good performance of research virtual teams. Because of the protection of intellectual property rights, some of them should be completed through material incentives and non-material incentives, which are also the core content of the incentive mechanism, that is, to improve the research enthusiasm of team members. This is a special manifestation of the incentive mechanism, as a motivating measure and affirmation of its scientific research efforts in the process of the operation of university research teams.

##### **5. Research on the path of enhancing young college teachers' competence**

In the virtual team perspective, study the countermeasures of how to effectively improve the professional competence of young college teachers is relatively complex, thus this study firstly refines professional competence of teachers and extract them to five dimensions; secondly, then, according to the characteristics of the virtual team's cross organizational boundaries, dynamic flexibility and efficient collaboration among the members of the organization, this study proposes a virtual team running model of young college teachers based on dynamic contract task network. Furthermore, this study is intended to study the way how to improve the professional competence of young college teachers under this mode of operation is discussed. Special emphasis is placed on differences among members, complementary, flexibility, coordination, and integrity on this basis (Ndez, Daniel López-Ferná, 38).

##### ***5.1 Young teachers in Colleges and universities develop their practical ability and enhance their teaching ability in virtual teams***

The young teachers in universities should make full use of the power of virtual teams when they preach, teach and dispel doubts, and change the teaching method of the traditional type of standup comedy, In teaching, young teachers should broaden students' knowledge scope, arouse students learning enthusiasm, improve their practical and innovative ability, and train excellent talents in line with the needs of society. What is more, young teachers should also train students' innovative consciousness, train analytical thinking, and help them set up individual ways of doing things. It's easy to know, but difficult to do. Young college teachers in virtual team of should guide the students from "know it" to "do it", On the basis of grasping the subject accurately, young teachers are required to strengthen the cultivation of students' innovative ability, be good at stimulating students' innovative thinking in teaching, encourage students to put forward innovative theories and methods, and devote themselves to the practice of mass innovation, that is to pursue thorough knowledge with practical action. Virtual teams are built according to the needs of the project, and the composition can be adjusted according to the problems arising from the project process. Once the project is completed, the team will end. Therefore, it has a high degree of flexibility. In addition, members are flexible in their work and are no longer limited to laboratories or offices. What's more, it breaks the boundaries of the organization and allows free use of external resources to reduce the pressure on the internal staff. On this basis, the team can streamline the organization and redesign the framework so that members can move in the right direction. In addition, this model reduces the office costs of members, thereby reducing management costs for schools. Besides, it has the advantage in intelligence cost. We can base ourselves on the construction and operation of the virtual team, so that this new form of team can not only lead the research direction and expand the field of



research, but also cultivate the teaching ability through the formation of self-organization mechanism and provide a new path choice for the implementation of university discipline prosperity program.

### ***5.2 Young teachers in Colleges build a learning community in virtual teams to enhance their scientific research ability***

The virtual team of university teachers can effectively improve the scientific research innovation ability through rational technical division of labor. In the process of guiding students' scientific research, the university teachers in the virtual team should highlight the dynamic, flexible, efficient and cooperative human resource organization model with "project as the center", guided by multi-discipline cross connection, integration, and communication, direct students to grasp the direction of scientific research topics, conduct systematic data research, find feasible research ideas, determine scientific research methods, keep up with the progress of research, sum up scientific research results and publish scientific research papers, the whole process of instruction must be fine. Not only can the teachers and students in the research team devote themselves to the study of cutting-edge literature, but also make them keen to capture the forefront of the subject information, careful insight into the nature of innovation. For example, the cooperation of transnational virtual teams also provides an important direction for the development of College Teachers in the future. The virtual team members of various countries break the restrictions of time, space and other organizational boundaries. On the basis of fully understanding the national conditions and culture of each country, they summarize the advantages and disadvantages of development, Based on National College Teachers' individual temperament, personality differences, rational allocation and organic integration of educational background and part-time situation, the development of communication technology makes the global virtual team come true, and external competitive pressures can also become a motivation for each team member to accomplish his or her goals. Team members should be proactive in their work, should be good at long-term, overall, and long-term, sustainable point of view to analyze, study and judge the various problems encountered, and try to be professional, strategic and global. Global virtual team members improve strategizing global vision and decision-making ability; improve the ability to control the overall status of College Teachers' occupation, compaction, growing of college teachers occupation self-confidence and sense of belonging through improving their reputation.

### ***5.3 Young teachers in Colleges and universities enhance their continuous learning ability and speed up knowledge updating in virtual teams***

21st Century is the age of knowledge explosion, during this time knowledge aging accelerates. Continuous learning and the

ability to absorb new knowledge and new skills are an effective guarantee for maintaining professional quality. Under the mechanism of information and knowledge sharing, virtual team members can quickly master information and make scientific decisions by sharing core knowledge and technology, and constantly learning and active updating. The competition between virtual teams essentially depends on expertise and skills, to maximize the integration of resources in a cross organizational boundary, and to play a coordinating role, college teachers share knowledge and wisdom within the team, in the long run, work efficiency will be greatly improved. The technical division of labor and intellectual sharing based on virtual teams are important supports for continuous learning ability; virtual team members can learn information quickly and make scientific decisions only by constantly learning and active learning.

### ***5.4 Young teachers in Colleges and universities enhance their personal characteristics and experience professional resilience in virtual teams***

In the virtual team across time and space characteristics, the virtual team in the team built a culture, which can be called "trust". The university teacher occupation is relatively independent, autonomous, virtual team members of the University also need to have a very strong professional responsibility, consciously, actively responsible for individual tasks and cooperate to complete the task team, smooth, efficient team project objectives. The team members should actively improve their cultural EQ and raise their sense of responsibility so as to enhance their professional competence. The establishment of virtual teams blurs the role of organizational boundaries and is conducive to the establishment of personality traits of college teachers. To build this culture, we should respect the individual and emphasize the individual role. Because the virtual team is different from the traditional team, the members lack of long-term understanding, inevitably lead to misunderstanding, Communication is a powerful way to eliminate misunderstandings and a foundation for building a culture of trust, cultural EQ is also an important factor to promote the effective communication of virtual team members, which includes comprehension ability, emotion awareness ability, respect for others, ability to reflect, social insight and so on.

### ***5.5 Young teachers in Colleges and universities establish correct values and strengthen their professional beliefs in virtual teams***

The establishment of virtual teams has promoted the technology sharing, high achievement motivation and high self-efficacy of young college teachers. To be a member of the University virtual team, the incumbent needs strong motivation, initiative and perseverance. Besides, they should have the courage to meet the challenge, this is the requirement that college teachers need to not only transmit knowledge, but also

create the professional characteristics of knowledge. It is also the inevitable requirement of the openness of the organizational structure of the virtual team, the symbiosis of the members of the organization and the ambiguity of the organizational boundaries. Professional knowledge and skills reserve is the foundation to promote the competence of college teachers. Based on the operation mode of virtual team dynamic contract task network, the trust among young college teachers is deepening, if not the stable operation mode of a fixed team, all of the young university teaching and research staffs are distributed in their respective fields. It's hard to organize spontaneously. This time we need to build a virtual team. It is an inevitable choice in an increasingly complex and volatile external environment. In virtual teams, team members make quick judgments based on the nature of the project, and very efficient and quick to convene relevant teaching and research staff, to enhance the confidence of team members, and from the following point of view to enhance the professional competence. Based on the work environment of mutual trust, it is conducive to the promotion of knowledge and ability of University Teachers (Spencer Jr. L M, Spencer S.M, 102).

## 6. Conclusions

From the study we have found that virtual team operation may also show some disadvantages, such as difficult management, high risk and technical constraint. But as long as managers put some attention to instruction and improvement, these shortcomings can easily be overcome and will not cause a substantial impact on the virtual team. In summary, emptiness is the foundation of reality, and it is the sublimation of reality. I believe that through continuous development and improvement of virtual team, college teachers' occupation competency can be effectively improved, laid a solid foundation for creating a comprehensive strength of teaching & research team entity and even teaching research centers and other research bases in the

future, so as to promote the discipline construction to continuous improvement and prosperity.

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## References

- Alan Rossiter. *Professional Excellence: Beyond Technical Competence* [M]. John Wiley & Sons, Inc., 2008.
- Boyatzis S, R. E. *The Competent Manager: A Model for Effective Performance*[M], New York: John Wiley & Sons Inc. 1982.
- C. P. M. Van Der Vleuten. The assessment of professional competence: Developments, research and practical implications [J]. *Advances in Health Sciences Education*, 1996, Volume 1, Issue 1: 41-67.
- Dannefer EF, Henson LC, Bierer SB, Grady-Weliky TA, Meldrum S, Nofziger AC, Barclay C, Epstein RM. Peer assessment of professional competence[J]. *Med Educ*. 2005Jul;39(7):713-722.
- Kranov, Ashley Ater , Danaher, Maurice; Schoepp, Kevin. A direct method for teaching and measuring engineering professional skills for global workplace competency: Adaptations to computing at a University in the United Arab Emirates [J]. *ICL* 2015 January 21: 29-36.
- McClelland , D. C . Testing for competence rather than for intelligence[J]. *American Psychologist*, 1973(28): 1-4.
- McClelland, David C. Identifying Competencies with Behavioral Event Interviews[J]. *Psychological Science*, 1998(5): 331-339.
- Ndez, Daniel López-Ferná (Department of Training and Research, MeM Group, Madrid, Spain); Lapuerta, Victoria; Casado, M. Luisa. Socio-emotional competences at university: Optimization of learning and professional competitiveness of engineering students [J]. *International Journal of Engineering Education*, 2015, v 31, n 1: 33-41.
- Spencer Jr. L M, Spencer S.M. *Competence at work: Models for superior performance*[M], New York : John Wiley & Sons Inc. 1993.

# Research on Influence of Group Counseling on College Students' EQ Education: Based on Educational Experiments of local Comprehensive College Students

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**Abstract:** An outstanding person may not necessarily have high IQ, but he must have a high emotional intelligence. Emotional intelligence is mainly to cultivate people's quality of emotion, will, tolerance and frustration. Cultivating and improving the emotional intelligence is of great importance to college students. This study explores the practical impact of group counseling on college students' EQ education from the four dimensions of EQ. Taking a sample of students in local comprehensive college, this paper conducts an empirical study on whether group counseling can effectively improve the students' EQ education. Theoretical analysis and experimental results show that after eight weeks of group counseling, the college student's emotional quotient has been significantly improved in terms of emotional cognition, emotional expression, emotion regulation and emotion utilization, proving group counseling is an effective way to educate college students. This article not only reveals that college students' emotional intelligence can be significantly improved through group counseling, but also accumulates new empirical evidence for the emotional education of students in our country, especially college students.

**Key words:** Group counseling; college students; EQ; education experiment

## Introduction

Daniel Goleman, a Ph.D. psychologist at Harvard University in the United States, wrote in his book "Emotional Intelligence," that "human success, with an IQ of only 20% and the most important" other "factor at 80%. The other factor here is "emotional intelligence." The word is originally proposed by Salovey of Yale University in the United States and Mayer of the University of New Hampshire. The word was first formally proposed by Salovey of Yale University in the United States and Mayer of the University of New Hampshire. Emotional intelligence is a kind of intelligence which is neglected by the traditional intellectual theory. It mainly studies the function of emotions, emotions and feelings in intellectual activities and their ability to work closely with cognition to deal with emotional problems. In 1990, Salovey and Mayer defined EQ as: the ability of individuals to monitor and manage their own and others' emotions and emotions, their ability to recognize and utilize these emotional messages, and the ability to use these emotional messages to direct their thoughts and behaviors. Relevant researches show that emotional intelligence is of great significance to individual's work performance and career. It has significant impact on individual's cognitive

intelligence and decision-making behavior, coping efficiency and entrepreneurial innovation ability, leadership and leadership performance, mental health and subjective well-being, the level of emotional intelligence is a key factor determining a person to become a pillar of society or a mediocre (Goleman, 1995). Carnegie, a famous American educator and entrepreneur, once said: "Only 15% of a person's success depends on his knowledge and skills, and 85% rely on his methods and abilities. In the modern society where the division of labor is fine and the competition is fierce, not only high intelligence but also high emotional intelligence are needed. Only the perfect combination of the two can meet the needs of the society for talents. College students represent the future and college students create the future, and winning the future can only be achieved by winning college students. The college student period is the golden period of cultivating and promoting the emotional intelligence. Compared with the traditional cognitive intelligence, the emotional intelligence has higher plasticity. The study shows that the EQ of students, especially college students emotional education greatly beneficial: not only can create a more positive student atmosphere, but also greatly reduce the clinical symptoms of college students due to emotional problems, including anxiety,

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depression, etc. Domestic and foreign scholars have conducted a wide range of discussions and studies on the connotation, function and intrinsic psychological mechanism of EQ and obtained a series of fruitful results. However, for the education of emotional intelligence, it is still in the stage of theoretical exploration. Scholars raised the EQ strategy or program from multiple perspectives, including family education, classroom education, psychological education, etc. But few are actually put into practice, and effective and operational are even more rare. Group Counseling has been widely praised and favored by educators both at home and abroad in recent years for its unique role in perfecting self-concept, regulating interpersonal relationships and promoting mental health, especially in escorting college students. Group counseling is a form of psychological counseling conducted in a group context. Through in-group interaction, members observe, learn and experience in common activities so that members can understand themselves, explore themselves, admit themselves, try to change behaviors and learn new behaviors through a series of psychological interactions. Stimulate individual potential, thereby enhancing the ability to adapt, improve interpersonal relationships, solve life problems. Can group counseling also play a good effect in college students' EQ education?

Talents trained in colleges and universities should not only have a higher level of professional skills, but also should have excellent professionalism, such as good behavior, strong ability to bear, communication skills, communication skills, cooperation ability, adaptability and so on. At present, the family structure of our country is dominated by only children. Long-term misunderstanding of family education and the asymmetry of students' perception of themselves make college students have some problems in emotional intelligence. This study argues that, at present, in addition to strengthen general education and talent education, higher education in our country should pay more attention to students' education of emotional intelligence. During the school to enable students to develop good affordability, communication skills, self-regulatory capabilities, in order to meet the needs of future social development. In this study, an experimental study is conducted on undergraduates in local comprehensive colleges and universities, and the experimental results are analyzed and discussed.

## **1. Research design and implementation**

### **1.1 Research object**

A total of 70 students from two classes in first grade of

local integrated college students were selected randomly as the study group, 35 were randomly selected as the experimental group and the remaining 35 as the control group. The experimental group was  $19.35 \pm 0.99$  years old, and the control group was  $19.68 \pm 0.53$  years old. All participants volunteered to participate. The experimental group in accordance with the design of the EQ training programs for their group counseling training, the control group did not give any intervention.

### **1.2 Research tool**

Emotional Intelligence Scale (EIS) was used as a research tool. The scale was compiled by American psychologist Schutte et al. in 1998 according to Salovey and Mayer's EQ (emotional intelligence) theory. The scale has 33 items in total, including four dimensions: emotion perception, self-regulation and control of emotional and emotional use. Using Likert 5-point scale form. The internal consistency reliability of the original scale is 0.90. The Chinese version of the scale compiled by Wang Caikang (2002) and widely, which has been proved to have good reliability and validity (internal consistency coefficient was 0.83). The internal consistency coefficient of this study was 0.86.

### **1.3 Experimental procedure**

Before the formal implementation of group counseling, first of all, in order to facilitate the follow-up control study, this study according to the theory of emotional intelligence developed a corresponding group counseling implementation plan and program and measured EQ of students in experimental and control group. Subsequently, this study conducted an 8-week EQ education group counseling on the experimental group of 35 students. They were divided into three groups, each with 11-12 people and a local comprehensive college counselor as an assistant. The experimental group conducted group counseling education once a week, each 2 hours, 8 times in a row. One month after the end of group counseling, all students in the experimental group and the control group were again tested for EQ.

#### *(1) Program design*

According to the related theory of emotional counseling and the actual psychological condition of undergraduates, the group counseling program implemented in this study consists of eight topics, which respectively correspond to the four dimensions of emotional intelligence (Emotional perception, emotional use, self-regulation of emotions, emotional control of others). The group leaders consist of expert professors and graduate students with secondary counselor qualification. All of them have extensive group counseling experience. Specific programs shown in Table 2.1:

**Table 1.1 Group counseling (experimental group) program**

Factor	Theme	Main activities	Target
emotional perception	1.icebreaking	“a few flowers bloom”,my heart I show and related knowledge introduction	To build team cohesion and to understand common emotions and emotional intelligence.
	2.emotional perception	surface view, imitation show	
emotional use	3.emotional use	emotional cake, emotional filling	To command the appropriate way to express emotion,vent negative emotions and use positive emotional information to solve problems
	4.negative emotions vent	I want to say, emotional magic cube	
self-regulation of emotions	5.self emotional perception	painting face game, man in the mirror,story of twin	To better understand and manage their emotions on the basis of self-awareness.
	6.Self emotional adjustment	control anger statement training、 Positive emotion training	
emotional control of others	7.Empathy and opinion choice	“the one and only”,tear paper game,permutations	To Learn to empathy, to aware and influence other emotions and to deal with parting emotions
	8.end	my flash pointing, ten years later, enlightenment	

*(2) Preparation phase*

As the first activity, group leaders need to lead members to understand each other, become familiar with and integrate with each other, eliminate the tension and anxiety among members, enhance the interest of group activities, establish the atmosphere and cohesion of group trust, clarify the goals of group counseling, establish group standards, So that members initially formed and feel the sense of belonging to the community.Specific activities during the preparation phase include: group introduction ,icebreaker games, fun grouping, name string skewer, team contract and so on. Through this event, members are encouraged to be familiar with each other and to deepen their understanding of this group so as to establish common team rules and objectives. At end of this activity, members were suggested to pay attention to their own emotional experience in life in the coming week and to share in the next discussion.

*(3) Implementation phase*

The implementation phase includes a 2-7 events and each event has a clear theme. According to the EQ dimension、 relevant influencing factors and the progressive logical sequence that group guidance should follow ,the theme of the activity in turn is emotion recognition、 emotion application、 negative emotion catharsis、 self emotion perception、 self emotion adjustment、 empathy and perspective taking.

In the implementation stage, a series of colorful activities have been carried out to stimulate the enthusiasm of college students.

As in the theme of "emotion recognition", different emotion recognition requirements students show the expression they see by facial expressions and body language and let others distinguish;In the theme of" negative emotions,

in “I want to say to you "link, with music background of language induction technology,we require members to express emotions to whom he would like to thank the people and whom he once hurted.

Finally, the "emotional Cube"lets the members communicate their methods to catharsis emotions.In the activity ,we should pay attention to the way and way of guiding members to understand the appropriate emotional expression. Finally, group leaders summarize, supplement and summarize the methods put forward by members from the perspective of positive psychology.Combining with other methods to manage emotions, such as attention transfer, emotional catharsis, rational anger,self emotion perception with psychological drama "twins" story let the members understand ABC theory.Empathy and perspective taking theme uses "paper game "to let members recognize empathy is important for both emotional expression and effective communication. Using "arrangement" game make members of the team recognize that body language is an effective way to detect and adjust the state of the others’ emotions and understand the importance of nonverbal communication ability.Finally, with the case of the group members themselves, the principles and techniques of other people's emotional management and regulation are discussed.In the whole group counseling process, members and group leaders actively feedback, support and cooperate so that team members feel more positive emotions and experience, making individuals more optimistic and optimistic about their own evaluation and experience. Homework is assigned at the end of each event to consolidate the results of group counseling.In the whole group counseling process, members and group leaders actively feedback, support and cooperate so that team members feel

more positive emotions and experience, making individuals more optimistic and optimistic about their own evaluation and experience. Homework is assigned at the end of each event to consolidate the results of group counseling.

#### (4) The end phase

The eighth activity is the end phase. It is a comprehensive summary of the gains made by the early team activities and the treatment of parting emotions. The eighth activity is the end phase. It is a comprehensive summary of the gains made by the early team activities and the treatment of parting emotions. It is hoped that members can apply what he learned to the reality and continue the active role of group dynamics. The eighth activity is the end phase. It is a comprehensive summary of the gains made by the early team activities and the treatment of parting emotions. It is hoped that members can apply what he learned to the reality and continue the active role of group dynamics. The emotional intelligence scale (EIS) was used again to test the effect of group counseling training to improve

EQ at the end of the activity.

At the end, the experiment promotes the members to find their strengths and build up their confidence through the activity called my flash point, makes the team members greet and look forward to the future with full enthusiasm through language induction technology with "ten years later" as the musical background, gives advice and blessings to each member by using the activity called fillde with wisdom and the members embrace and farewell.

#### 1.4 Data process

Statistical analysis of data using SPSS17.0 statistical analysis software.

### 2. Analysis of the study result

#### 2.1 A significant test of the score of the experimental group and the control group

**Table 2.1 T test of pretest scores between experimental group and control group**

Factor	<i>M</i> ± <i>SD</i>		<i>t</i>
	control group ( <i>n</i> =35)	experimental group ( <i>n</i> =30)	
Emotion perception	3.68±0.99	3.84±0.96	-1.90
Regulation of self emotion	3.90±0.95	3.89±1.03	0.12
Control of others' emotion	3.47±0.97	3.39±1.07	0.91
Application of emotion	3.16±1.06	3.39±1.09	-1.76
Intelligence of emotion	3.57±1.02	3.63±1.03	-1.13

Tip: \*  $p < 0.05$  ; \*\*  $p < 0.01$  ; \*\*\*  $p < 0.001$

According to Table 3.1, there was no significant difference between the experimental group and the control group in the four dimensions of emotion perception: self regulation, self regulation, emotion regulation and emotion application. The overall level of EQ scores difference is extremely significant. Thus, group counseling has a significant impact on students' emotional perception, regulation of self emotion, control of others' emotional and emotional use.

#### 2.3 Analysis and discussion

The results of this study show, before the implementation of group counseling, there is no significant difference in EQ between the experimental group and the control group. After the implementation of group counseling, the students in the experimental group and the control group are significantly different in the EQ scores and all dimensions. This shows that group counseling has a positive significance and plays an important role in improving the EQ of college students.

Previous research indicates that group counseling is significant for stabilizing the subject mood, helping the individual to eliminate negative and negative emotions, and fostering and forming positive emotions. The study of Shimei

Shen(2007) shows that group psychological counseling is beneficial to improving the stability of individual emotions, reducing individual psychological stress and tension, and thus beneficial to mental health. Liwei Xu et al (2009) thoughts that group counseling is of positive significance in improving and alleviating the depression of the subjects. Sai Pan(2010) considers that group counseling makes it easy for group participants to find feelings of acceptance and find common points of concern to each other. They care and support each other in group interaction, making others feel warm and have a sense of belonging and identity. Thus, it makes the members relax their emotions and promotes the individual to reduce psychological defense to improve the emotional state of the group members. In this study, group counseling is applied to EQ education for College Students. In this study, group counseling is applied to EQ education for College Students. The results show that group counseling is also significant to improve the EQ of college students. The reason why it has a significant effect, I think, is mainly due to the following factors: ①. Participants' enthusiasm in the group activity. Jacobs believes that because the team and team

members should cooperate with each other to produce ideal effect, so it is necessary to select the subjects. In this experiment, all the subjects were voluntarily involved. Because all the members have a strong interest in group counseling activities and strong internal motivation to participate in the activities so it has greatly improved its involvement and input in the activities of group counseling. ②. The design of group plan is pertinent. The design of this study is based on interviews with local college counselors and college students, as well as related research on EQ and group counseling. Each subject is reasonable and pertinent to interfere with the different factors of EQ. The consultation program includes starting stage, the implementation stage and the end stage. A variety of counseling techniques enable members to quickly integrate into the group and actively explore themselves. It improves EQ from the four aspects of emotional perception: emotional use, self emotional management and emotional management of others. The design of activities is inherently logical and conforms to the general rules of the development of group guidance, which can effectively improve the EQ of college students. ③. The relevance and richness of group activities. This study which based on the EQ theory and the internal logic of the four dimensions of emotional intelligence separately design concerned and various activities entertaining. Teaching through lively activities arouses students' interest and enthusiasm and gradually deepen the emotional understanding and feelings so as to improve their own EQ at the same time. In addition, there are various forms of group consulting technology, such as games, psychological plays, and music - based language induction technology. These different consulting technologies not only increase the enthusiasm of students to participate in a group, more importantly, different technologies influence students' psychology from different angles and channels, such as cognition, emotion and behavior, so as to improve the effectiveness of consultation. ④. The adequacy of group counseling time. This group counseling is relatively long. Subjects are gradually influenced by group counseling. The interval between each activity is shorter so that the last activity can be effectively strengthened. All these make the effect of experiment can be reflected in the most.

### 3. Countermeasures and suggestions

Based on the status of mental health education of college students in local comprehensive colleges and universities, group guidance can be adopted to carry out mental health education in a planned way.

(1) Make members familiar with each other and adapt to college life as soon as possible. During the freshmen enrollment period, teachers can organize various forms of group activities so that team members can quickly understand

the basic situation of each other, relieving tension and establishing trust among members. Although after entering the university, students will not face the boring and intense learning life in high school, but they still face the heavy learning of public basic courses and professional courses. They also have to wide range of communication and diverse interpersonal relationships. If the students are poor in independence and do not develop good learning habits, they are more likely to meet non adaptation problems. Through group counseling, students communicate with each other, share happiness in life, solve some common problems in learning life and interpersonal interaction, and use group strength to achieve the best guidance effect in a cheerful atmosphere.

(2) Teaching self - awareness and emotional management, interpersonal relationships, and other psychological basic knowledge. Teach through lively activities so that students are easy to accept. The students' psychological health education program requires students to understand the basic knowledge of psychology. The traditional teaching by using of "teacher talk, students listen" mode are boring. Some students play mobile phone, browsing the web, some be sleepy. Group guidance guides students to preview textbook knowledge ahead of time. In class, there are lively and diverse group activities in the classroom.

(3) Improve the students' learning ability and train the sense of team cooperation. Guide the students' career planning and improve their ability to adapt to the society. College students are lack of ability. We can help them learn by team guidance so that they are willing to study, interested in studying, good at study and study efficiently. Group counseling can enable them to list their future goals more scientifically and reasonably, and find out the psychological problems of students when choosing careers, and make appropriate adjustments so as to make career plans suitable for them.

### 4. Conclusions

This study is based on the unique educational background of the university education in China, and focus on whether the group guidance can effectively improve the EQ education of the students, especially the college students. Through the experiment of a certain local comprehensive university student, the experimental conclusion is obtained by comparing the data before and after the experiment. The experimental results show that group guidance is an effective way to improve the EQ of college students. Through group counseling activities, college students' abilities in four dimensions of emotion perception, self regulation, self regulation, emotion regulation and emotion application were significantly improved, thus improving the overall EQ of college students.

## References

- Fei Yu,Huimin Guo,Hui Huang.Study on the relationship between emotional quotient (emotional intelligence) and coping effectiveness of medical students [J].Journal of China Medical University, 2009(1):81-83.
- Goleman D. Emotional Intelligence[M].New York: Bantam Books, 1995.
- Haibo Tang,Shujuan Zhang,Chaochao Liu.The effect of group psychological counseling on EQ (emotional intelligence) training for College Students[J].Chinese Journal of health psychology, 2013 (5): 716~717.
- Irvin D.Yalom, Modyn Leszcz. Group psychotherapy -- Theory and Practice[M].Fifth Edition .Min Li,Mingze Li.Beijing:China Light Industry Press,2010:261-262.
- Liwei Xu,LiliWang.Study on Improving College Students' depression by group consulting[J]. Educational exploration , 2009, 29 (11):141-142.
- Mingjun Pan.A study of EQ (emotional intelligence) on the subjective well-being of College Students [J].School health in China, 2010(4):442~444.
- Mingjun Pan.The relationship between emotional quotient and mental health of College Students [J].School health in China,2012(1):43~45.
- Peiliang Zhu.Study on the relationship between emotional intelligence, cognitive intelligence, personality and decision making of College Students [J].Primary and secondary school education in foreign countries ,2008(11):37-40.
- Qu Chen,Guohong Shi.An empirical study on the relationship between emotional intelligence (emotional intelligence) and entrepreneurial ability of College Students [J].Education management in Colleges and Universities,2013(3):109-113
- Ruth Castillo a,\* , José M. Salguero a, Pablo Fernández-Berrocal , et al. Effects of an emotional intelligence intervention on aggression and empathy among adolescents[M]. Journal of Adolescence, 2013 (36): 883~892.
- Salovey, P, Mayer, J.D. Emotional intelligence[J]. Imagination, Cognition, and Personality, 1990(9):185~211.
- Shimei Shen.Experimental study of group psychological training on improving the level of mental health of College Students[J]. Shandong Social Science ,2007,21(5):159-160.
- Sosik J J, Megsrian L E. Understanding leader emotional intelligence and performance: The role of self-other agreement on transformation leadership perceptions[J]. Group and Organization Management, 1999, 24:367~390.
- Wei Liu editor.Group guidance strategy and technology[J].Beijing: Chinese personnel press,2012:87
- Wei Liu editor.The theory and practice of group guidance[M]. Beijing:Chinese personnel press,2012:6.
- Weiku Wu,Xin Guan,WeiKe Hu.An empirical study of the relationship between the level of emotional intelligence (emotional intelligence) and leadership performance [J]. science and technology management,2011(8):173~179.
- Xiaoqiong Han,Xue Zheng,Biqun Qiu et al.Study on the relationship between emotional intelligence (emotional intelligence) and coping effectiveness of College Students [J].Chinese Journal of Clinical Psychology,2009(1):81-83



# The Phenomenon and Resolving Strategy for Academic Procrastination among College Students

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**Abstract:** Procrastination is a behavior that evades the task. The two key features of procrastination are postponement and irrationality. Procrastination is often manifested by the use of non-urgent tasks instead of urgent ones, with simple and happy work instead of a difficult one. Sometimes procrastinators can delay the task to the "last second" before the cut-off date. Procrastination can lead to mental illnesses such as guilt, discontent, depression, and self-doubt. There is widespread delay in the time spent by College students, and it is estimated that most of College students have procrastination; almost all of them think they are procrastinators. Delay has become an important factor affecting the mental health of College students. In this article, we focus on young people, including College students, and try to understand procrastination from psychological perspective, the causes of the delay, as well as the mechanism and management of procrastination, so as to help young people prevent such behavior, especially College students' academic procrastination.

**Key words:** Academic Procrastination, Procrastinator, College Students, Psychological Perspective,

## Introduction

Procrastination is a voluntary delay in the completion of a task if the expected delay leads to adverse consequences. Procrastination can involve anything in life, such as cleaning rooms, repairing equipment, seeing a doctor, submitting a report, completing an academic mission, or resolving disputes with colleagues, etc. [1] Delay is not necessarily procrastination. "Defer" and "irrational" are two key points of procrastination, which is to say if there is a reasonable reason; delay is not necessarily procrastination, even if a task is delayed. Gregory Schraw and Steel et al. in 2007 proposed that the three characteristics of academic procrastination are: no output, no need, and delay. [2, 3]

Academic procrastination has become an important problem associated with a high incidence of ivory tower. Studies in the eighties and nineties of the last century found that 52% of the students surveyed showed moderate-to-high non self-controlled delays. Forty-six percent, 7.6% and 30.1% of students reported that in their paper writing, exams, and weekly readings, they "always" or "almost always" delay. At present, most universities offer free and fast twenty-four-hour Internet service. But, many College students lack effective time management skills in using the Internet. They often spend their time on simple and

interesting, but irrational things, leading to academic procrastination, which has become a major problem in College. There are as many as 55-65% of people who wish to reduce procrastination during reading, examination, and paper writing. Nearly a quarter of the students reported that they had become obsessed by their habit of delaying. Due to procrastination, the procrastinator may have psychological problems such as guilt, discontent, depression, and self-doubt. [4] Academic procrastinations not only cause psychological problems, but can also lead to serious moral problems for students. A large-scale follow-up study conducted with German College students in 2014 showed that academic procrastination were positively correlated with the frequency of seven different forms of academic misconduct. [5]

This paper summarizes the research on the academic procrastination among College students in the past two decades, in order to understand the phenomenon of procrastination and its solution.

## 1. The performance of the procrastinators

### 1.1 Active and passive procrastinators

In 2005, a study showed that there were two kinds of procrastination: one is the traditional procrastination, called passive procrastination, and the other is proactive procrastination, in which a person finds the pleasure of

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completing any task only under pressure. The latter is called, positive procrastination. The main difference between these two types is that the proactive procrastinators perceive and control time far more than the passive procrastinators.<sup>[6]</sup> It is surprising, however, that the level of academic performance of active and passive procrastinators is similar.<sup>[7, 8]</sup> It is noted that no matter what kind of procrastination it might be, the harm caused is similar for both types.

### 1.2 Eveningness

Procrastination is related to human responsibility and impulsivity. The phenomenon of procrastination decreases with age.<sup>[3]</sup> It is widely known that throughout the life cycle, people's sense of responsibility gradually increases, and a physiological rhythm of morningness is gradually developed from eveningness. Although the cause of procrastination and late sleep is unclear, there is indeed a relationship between them: the more people delay their night sleep, the more likely they develop procrastination. However, in addition to age, there is still an unknown relationship between procrastination and night sleep, which has not been fully elucidated.<sup>[9]</sup>

### 1.3 Fear of the future

Undergraduate survey found that procrastinators pay less attention to the future, and instead are more concerned about what they see now.<sup>[6]</sup> There is a high positive correlation between attitude and procrastination in life and fatalism.<sup>[10]</sup> This finding is consistent with previous studies on procrastination and depression. Fear of failure and success is also related to student procrastination.

### 1.4 Worse grades

In 1997, Tice et al reported that more than one-third of the final exam results could be attributed to procrastination. The grades of procrastinators are worse than those of non-procrastinators. The negative correlation between procrastination and academic performance in a number of studies is consistent and repeatable. In 2006, Howell et al found that the procrastinator's self-judgment was significantly and negatively correlated with the score, even though the procrastination scores obtained with the universal approach were independent of the results.<sup>[11]</sup>

### 1.5 Mental health disorders

Procrastination may be the symptoms of psychological disorders, causing great damage to daily life. Procrastinators may have many neuropsychiatric disorders such as depression, irrational behavior, low self-esteem, anxiety, attention deficit, ADHD, guilt, and stress. Procrastination is a sense of powerlessness, maximizing pain, failure, and vice versa. When a deadline is still far, procrastinators are less likely than non-procrastinators to suffer from stress and physical illness. However, as the deadline approaches, procrastinators report more stress and physical illness. In general, procrastinators suffer more stress and health problems.<sup>[12]</sup> Therefore, for

people with procrastination, it is necessary to see a trained psychiatrist to check for potential mental health problems.

## 2. Procrastination-related psychological factors

### 2.1 Lack of motivation

There is scarcity of motivation, and scientists have put forward the theory of time motivation, which integrates the motivational theory of predecessors and the procrastination meta-analysis results, and summarizes the key predictors of expectation, value, and impulse delay Equation.<sup>[3, 13]</sup> Motivation theory shows that the individual's motivation can be expressed by the following formula (Figure 1). The greater the individual's motivation the less easy the individual will delay, and vice versa.

$$\text{Motivation} = \frac{\text{Expectancy} \times \text{Value}}{1 + \text{Impulsiveness} \times \text{Delay}}$$

**Figure.1 Task Motivation Formula**

Motivation: the desire for specific results; Self-efficacy: the probability of success; value: the reward associated with the results; impulse: the sensitivity of the delay; delay: the time required to effect the plan.

The limitation of the above formula is that the effect of time on the motivation is not taken into account. Time motivation theory adds time factor to the above motivation theory, which can be explained by the example of student academic procrastination: a student who will be taking a final exam in a month's time has two choices; learning and socializing. Students who like to socialize, but want to achieve good grades must choose to learn instead. Initially, the motivation for learning is lower than that of socializing. However, as the study period decreases from a few weeks to a few days, learning motivation would gradually increase beyond social motivation.

### 2.2 The principle of happiness in procrastination

The principle of happiness means avoiding negative emotions and delaying stressful tasks, which may be the cause of the procrastination.<sup>[14]</sup> This assumption implies that stress is another incentive for procrastination. Psychologists believe that this stress-related procrastination is the mechanism by which tasks and decisions are related to the occurrence of anxiety.<sup>[15]</sup>

### 2.3 Perfectionism leads to procrastination

Perfectionists tend to adversely evaluate their performance.<sup>[16]</sup> The perfectionists are very much afraid of being judged by others. They have a high degree of social anxiety, and their mood is also repeatedly low. Traditionally, procrastination has been associated with perfectionism. However, perfectionism can be divided into two types: adaptive and maladaptive perfectionism. The maladaptive perfectionist is more likely to procrastinate and worry than the adaptive perfectionist. Regression analysis found that, besides

the perfectionists who undergo clinical counseling, mild-to-moderate perfectionists usually procrastinate only slightly more than others.<sup>[3]</sup>

#### 2.4 Coping responses

Procrastinators tend to take negative measures such as being evasive or emotional, rather than aiming at the task to

solve the problem.<sup>[17]</sup> Emotion and avoidance provide immediate pleasure to procrastinators, which can reduce stress caused by procrastination. This is very attractive to impulsive procrastinators. The following table lists several emotional responses of procrastinators to tasks (Table 1)<sup>[18]</sup>.

**Table.1 The emotional responses of procrastinators to the tasks**

Coping responses	examples
Avoidance	Getting away from the scene or location of the mission (for example, graduate students avoid entering the laboratory)
Denial	To pretend that the current task is more important than the task being escaped from.
Diversion of attention	Getting oneself immersed in other things that are immediately met in order to prevent awareness of tasks (such as immersing oneself in video games or surfing the Internet)
Counter reality	To compare ones own life with someone whose life is worse (e.g. "Yes, I got a C- in the course, but I didn't perform as bad as the others.")
Balance	Emphasizing one's satisfaction that someone else has achieved in the meantime, instead of doing something else.
Criticism	Attributing the reason of procrastination to external factors beyond their control (e.g. "I do not intend to delay, but this is too hard")
Mockery	Criticize others in a rash and mocking manner in their efforts to achieve their goals.

### 3. Solutions to procrastination

#### 3.1 Spontaneous solution: Student syndrome

"Students Syndrome" means that, students are fully committed to completing the task when the deadline is approaching. A 2002 study showed that many students were aware of their delays and set a due date by the deadline. Setting an early due date will give students a better performance. Studies have shown that after the beginning of the practice, student's engagement a week before the deadline reaches five times that of the sum of the first three weeks.<sup>[19,20]</sup> Academic procrastinators tend to do most of their work in the last week before the deadline.

#### 3.2 Strict schedules and structured procrastination

In fact, there is no specific way to develop a plan to follow for the treatment of procrastination. The way to develop a strict schedule for a task may not apply to everyone. Performing tasks with a flexible schedule may be better than using a rigid schedule.<sup>[21]</sup> The key to overcoming procrastination is to better manage the time, including awareness and use of "power hours". The good way is to follow the natural circadian rhythm to achieve the most productive work. To establish the reality of the goal, it is essential to cherish any "small success". If we know how to balance excellent work with perfect relaxation, our lives will become happier, healthier, and more effective.<sup>[21]</sup>

Procrastination is not laziness just those procrastinators

often tend to spend time outside tasks, which they consider important. John Perry, in the article, "structured procrastination", proposed a "deceit" approach to solving the problem of procrastination. This approach uses the Pyramid scheme, which indicates the importance of the task in order for procrastinators to accomplish the unpleasant tasks at hand. [22] The fundamental meaning of structured procrastination is to make a list of the tasks that must be done, based on the actual situation. The list of tasks is sorted by importance. Very urgent and important tasks are placed at the top and the less important tasks can be placed at the lower level. We can do the tasks at the lower level to avoid the more important ones at the top. If procrastinators are able to take advantage of the deception, they can become productive people.

#### 3.3 Reduce procrastination from childhood

The procrastination shown by young people in the university may have begun from childhood. Meta-cognitive skills such as goal setting, breakdown of tasks, and monitoring of progress, can all be taught by parents to children, and the children can learn these skills. Psychologists say that this is not just to help children develop willpower, but also it is the process of developing their skills. Skills and willpower combine to help children succeed in self-supervision. Here are the ways to guide children to avoid procrastination (Table 2):

**Table.2 A guide for children to avoid procrastination**

The method of avoidance of procrastination	Examples
Reward	Rewarding more often and punishing less.
Moderate expectation	Having more realistic expectations. Do not expect too much. As your child grows up, change parenting skills.
The right to choose	Giving children the choice and responsibility. Do not always tell the child what to do
Establish a positive pattern of self-discipline	Teaching the child how to set goals, breaking down tasks, and monitoring the progress of the tasks.
Understanding	Trying to understand the children as they are still trying to find their own lives
Allow mistakes	Letting your children learn and grow from the consequences of their actions, especially the bad results.
Specifying tasks	Helping children to make their work specific and staged
Structural procrastination	Understanding that procrastination is not laziness; procrastinators are usually very busy doing what they should not do.
Strengthen non-procrastination	Remembering that procrastination is an act of learning

### 3.4 Management of College students' procrastination

If the problem of procrastination can be resolved in childhood, procrastination treatment during College is less important. But psychologist, William J. Knaus, expects that 90 percent of College students procrastinate. Twenty-five percent

of these students are chronic procrastinators. Usually these people will eventually drop out of school. <sup>[23, 24]</sup> In order to overcome procrastination in adults, especially among College students, the following points should be taken into consideration (Table 3):

**Table.3 The Countermeasures to College Students' Procrastination**

Countermeasures	Examples
Solve their own related problems	Seeking ways to eliminate such things as fear, anxiety and lack of concentration, poor time management, indecisiveness, and perfectionism.
Self-assessment	Paying attention to the habits and ideas that lead to procrastination. Assess your goals, strengths, weaknesses, and priorities.
Set goals	Setting realistic goals, and actively linking specific and meaningful goals and tasks.
Adjust daily life	Readjusting the time schedule of daily life
Change the environment	Eliminating or minimizing noise or interference; do your utmost best; reduce daydreaming
Follow the priority	Following your priorities
Positive motivation	Motivating yourself through pleasant activities, social interactions, and constructive interests.
Small success	Solving small problems in a short time, rather than trying to solve the whole thing immediately, and then getting yourself intimidated by it.
Strengthen the results	To prevent relapse of procrastination, reinforce your preset aims based on needs and allow yourself to be rewarded for accomplishing tasks.

The above techniques are not valid for serious procrastinators. Like other addicts, serious procrastinators are also incompetent, and cannot overcome their own problems. Because of the external intervention, procrastinators can get immediate returns, and their symptoms often change. For example, if someone else can regularly accompany the procrastinator to complete problematic tasks, or observe him as

he does things, the incapacity of the procrastinator will decline rapidly; self-confidence will reappear, and the procrastinating habit will be changed. <sup>[25]</sup>

## References

[1] Solomon, Laura J., Rothblum, Esther D. Academic procrastination:

- Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology* 1984;31:503-509
- [2] Schraw GW, Theresa; Olafson, Lori. Doing the Things We Do: A Grounded Theory of Academic Procrastination. *Journal of Educational Psychology* 2007;99:14.
- [3] Steel P. The nature of procrastination: a meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychological bulletin* 2007;133:65-94.
- [4] Beswick G, Rothblum ED, Mann L. Psychological antecedents of student procrastination. *Australian psychologist* 1988;23:207-217.
- [5] Patrzek JS, S.; van Veen, F.; Grunschel, C.; Fries, S. . Investigating the Effect of Academic Procrastination on the Frequency and Variety of Academic Misconduct: A Panel Study". *Studies in Higher Education*. 2014:16.
- [6] Chu AH, Choi JN. Rethinking procrastination: positive effects of "active" procrastination behavior on attitudes and performance. *J Soc Psychol* 2005;145:245-264.
- [7] Hsin Chun Chu ANC, Jin. Rethinking Procrastination: Positive Effects of "Active" Procrastination Behavior on Attitudes and Performance. *The Journal of Social Psychology*;145:10.
- [8] Zhang W, Wang X, Feng T. Identifying the Neural Substrates of Procrastination: a Resting-State fMRI Study. *Scientific reports* 2016;6:33203.
- [9] Beutel ME, Klein EM, Aufenanger S, et al. Procrastination, Distress and Life Satisfaction across the Age Range - A German Representative Community Study. *PloS one* 2016;11:e0148054.
- [10] Ferrari JR, Diaz-Morales JF Procrastination: Different time orientations reflect different motives. *Journal of Research in Personality* 2007; 707:714.
- [11] Howell AJW, D. C.; Powell, R. A.; Buro, K. Academic Procrastination: The Pattern and Correlates of Behavioral Postponement. *Personality and Individual Differences* 2006;40:21.
- [12] Pychyl TAL, J. M.; Thibodeau, R.; Blunt, A. "Five Days of Emotion: An Experience Sampling Study of Undergraduate Student Procrastination (special issue). *Journal of Social Behavior and Personality* 2000;15:5.
- [13] Durakiewicz T. A Universal Law of Procrastination. *Physics Today* 2016;69:1.
- [14] Petersen MA, Norgaard LS, Traulsen JM. Pursuing Pleasures of Productivity: University Students' Use of Prescription Stimulants for Enhancement and the Moral Uncertainty of Making Work Fun. *Culture, medicine and psychiatry* 2015;39:665-679.
- [15] CX Tan, RP Ang, RM Klassen, etc. Correlates of academic procrastination and students' grade goals. *Current Psychology* 2008, 27;27:135-144.:
- [16] Rice KG, Richardson CM, Clark D. Perfectionism, procrastination, and psychological distress. *Journal of counseling psychology* 2012;59:288-302.
- [17] Jackman JM, Strober MH. Fear of feedback. *Harvard business review* 2003;81:101-107, 124.
- [18] Umeh K, Omari-Asor L. Emotional vulnerability and coping styles for resolving decisional conflict. *The Journal of psychology* 2011;145:297-312.
- [19] Ariely D, Wertenbroch K. Procrastination, deadlines, and performance: self-control by precommitment. *Psychological science* 2002;13:219-224.
- [20] Paglis LL, Green SG, Bauer TN . Does adviser mentoring add value? A longitudinal study of mentoring and doctoral student outcomes.. *Research in Higher Education*. 2006;47:451:476.
- [21] Ramsay JR. Assessment and monitoring of treatment response in adult ADHD patients: current perspectives. *Neuropsychiatric disease and treatment* 2017;13:221-232.
- [22] Tuckman BW. Relations of academic procrastination, rationalizations, and performance in a web course with deadlines. *Psychological reports* 2005;96:1015-1021.
- [23] Johnson PE, Jr., Perrin CJ, Salo A, Deschaine E, Johnson B. Use of an explicit rule decreases procrastination in university students. *Journal of applied behavior analysis* 2016;49:346-358.
- [24] Kocoglu D, Emiroglu ON. The Impact of Comprehensive School Nursing Services on Students' Academic Performance. *Journal of caring sciences* 2017;6:5-17.
- [25] Gupta N, Singh VK . Effect of Stress on Working Women Life. *International Multidisciplinary Research journal* 2016;4:71-79.

# On the Cultivation of Scientific Research Thinking for Pathology Postgraduates

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**Abstract:** The cultivation of research thinking in graduate students is crucial to the development of pathology in the future. This research explores the training of postgraduates in systematic research thinking, including improving their professional basic knowledge structure and establishing their professional pathology system; to promote their mastering system scientific knowledge; develop postgraduates' interest in scientific research and innovative thinking; encourage them to participate in academic activities, to enhance exchanges between graduate students; to promote their pragmatic and scientific research behavior; thereby continuously enhance the pathology graduate students' research ability.

**Key words:** Pathology, graduate students, research thinking

## Introduction

Pathology is a comprehensive discipline which based on anatomy, histology embryology, physiology, biochemistry, clinical medicine and other disciplines, and the actual study of disease etiology, pathogenesis and pathology. Pathology can be divided into human pathology and experimental pathology, where experimental pathology is based on animal models of disease or in vitro cultured cells as a material for medical research. Pathology graduate students should not only master a solid theoretical knowledge of pathology, but also actively participate in scientific research, pathological diagnosis and other practical activities, training and training their own research thinking, and gradually self-improvement through study and practice to become an outstanding pathology successor.

### 1. The importance of scientific thinking training for pathology postgraduates

A pathology postgraduate must have a good scientific research thinking as a basic research ability. Pathology graduates through systematic and rigorous research thinking training will enable themselves to obtain good research ability, and stimulate their own research potential, to promote the development of pathology disciplines. According to the research features of pathology, pathology postgraduates need to constantly improve their own knowledge reserve structure, lay a solid foundation for scientific research and develop their own good scientific research thinking; at the same time, on the basis of strict logical thinking, Of the ability to analyze and solve problems, using their own research thinking to carry out graduate research practices, the independent completion of graduate dissertations and thesis defense is crucial (Sun & Chen, 2012).

### 2. Research thinking training for pathology postgraduates

Systematic scientific thinking training for Pathology postgraduates, including improving the professional basic knowledge structure, establishing a pathological professional system;

mastering scientific research; cultivating interest in scientific research and encouraging innovative thinking; encouraging participation in academic activities and strengthening exchanges among postgraduates; seeking being pragmatic and standardizing scientific research and constantly improving the scientific research capabilities of pathology postgraduates.

#### 2.1 Improving the basic knowledge structure and establishing a professional pathology system

In order to expand the postgraduates' knowledge, teachers can explain influential pathology textbooks and research papers, introduce and transfer the frontier hot topics in the discipline to postgraduates so as to establish the professional basic knowledge structure of postgraduates. The main task of the postgraduate supervisor is to focus on developing the abilities of postgraduates to independently study the subject knowledge, pay more attention to guiding the postgraduates' interest in the subject, and give timely thought to their thinking (Wang, Zhan & Zhang, 2013). Pathology postgraduates in the process of training, should learn the basic pathology, experimental pathology, general pathology, molecular biology, tumor pathology, pathology and other basic research methods and other specialized courses. They also need learn some basic medical research methods, such as medical research methods, cell culture and immunohistochemistry courses, to further improve the basic knowledge of pathology structure, the establishment of professional pathology system.

#### 2.2 Mastering scientific research system

Scientific research is a constant exploration of new knowledge in a field of specialization. Starting from current existing knowledge, scientific research is seeking information through various traditional and authoritative methods. When we truly understand the knowledge in this field and discover the fault of knowledge, through continuous collection, integration of information, combined with their own experimental conditions, experimental design (Jin & Liu, 2012).

Pathology postgraduates should take the initiative to think about the process of knowledge generation, training habits of thinking, thereby enhancing their ability to detect problems, paving the way for independent research in the future. In the research of scientific research, the graduate students are required to master a series of

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method steps in the experimental research, such as the method of experimental design, the determination of the experimental precision and the modification of the experimental scheme, as well as the recording and processing of the experimental results, so that the graduate students can master the entire scientific research system: ① Review the relevant literature to clarify the purpose of the experiment; ② experimental program design, project opening report, the design of the program to be realistic, based on existing laboratory conditions and laboratory staff to determine the experience; ③ pre-experiment, pre-experiment can For the formal experiment to provide the best choice of experimental materials, to explore the best experimental conditions, accurate control of irrelevant variables, in order to lay a solid foundation for the conduct of formal experiments; ④ According to the results of the pre-experiment, adjust and modify the experimental design to determine the final experimental program, and then conduct a formal test; ⑤ collect and organize experimental data for statistical analysis; ⑥ summarize the writing papers, the final submission (Huang, Wang & Huang, 2011). Pathology graduate students' scientific thinking is reflected through the process of scientific research to complete a study on a subject, and accordingly write a dissertation and dissertation defense.

### **2.3 Cultivating scientific research interest and encouraging innovative thinking**

In order to ensure the consistency of the research team's research direction, during the training pathological graduate students' interest in scientific research, the supervisors must make the perfect connection between the graduate's point of interest and the team's main research direction. Postgraduate supervisors can guide postgraduates to put forward their scientific research ideas with research value according to their main research directions and encourage postgraduates to design their own research topics independently. Mentors are responsible for guiding and modifying them, and finally discuss and approve them through relevant reviewers. After the graduate student has designed a new subject and passed the project, the graduate student must be responsible for the implementation of his subject. The graduate supervisor and other members in the team should provide support for graduate students' smooth development of related topics, equipment and experimental techniques, etc. Progress and problems need to be regularly reported to instructors and teams, team members to discuss and solve (Wang, He & Ren, 2015). In order to obtain high-quality scientific research, we must have innovative thinking, and the first source of innovation is interest. Therefore, it is of vital importance to cultivate pathology graduate students' interest in participating in scientific research so that graduate students can get in touch with the team's research direction in depth, which will help them to further understand the value and significance of their research so as to arouse the enthusiasm and interest of graduate students in participating in scientific research and to encourage innovative thinking so as to continuously explore actively.

### **2.4 Encourage participating academic activities and strengthen exchanges among postgraduates**

Supervisors should encourage pathology graduate students to actively participate in domestic and international academic presentations and conferences, as well as the school's various academic lectures, seminars, etc. These scientific activities not only

broaden the horizons of graduate students on the one hand, on the other hand to improve the graduate student's knowledge structure, training research thinking ability, enhance the potential of graduate development and other aspects, which have an important role in postgraduate life-long learning for the future and continue to develop a good foundation (Wang, Tu, Wang, 2012). When postgraduates participate in various research and academic activities, because of the same position among graduate students, and thus more intimate with each other, they can speak their minds, think together, inspire their own scientific research inspiration and effectively solve some difficult problems encountered in the scientific research process. Through these pro-active participation process, training graduate students' ability to coordinate and promote common progress among graduate students (Chai, Feng & Chen, 2016).

### **2.5 Seeking truth and regulating research behavior**

Cultivating pathology graduate students pragmatic academic training, cannot be separated from the academic moral education. Pathology graduate students in scientific research should uphold the principle of resolutely resist fraud, seek truth from facts, and actively explore and pragmatic. For violations of academic ethics should promptly detect, and seriously handle and standardize scientific research, which truly cultivate excellent research talent (Li & Liu, 2005).

### **Conclusion**

In short, in order to adapt to the development of today's medicine, pathology graduate students in the new century need not only to have a complete pathological knowledge, but also to have a solid scientific research ability in order to become an outstanding pathology professional.

## **References**

- Chai, J., Feng, X., & Chen, W. (2016). Construction of clinical medicine to enhance self-cultivation thinking of scientific research. *People's Military Medical*, 59 (05), pp. 531-532.
- Huang, J., Wang, C., & Huang, L. et al. (2011). Cultivating Students' Scientific Research Thinking and Scientific Research Ability in Physiological Design Experiments. *Chinese and Foreign Medical Research*, 9 (26), 138-139.
- Jin, G., & Liu, F. (2012). Cultivation of Scientific Research Master's Degree in Scientific Research. *Journal of Capital University of Medical Sciences (Social Sciences Edition)*, (00): pp. 302-303.
- Li, E., & Liu, X. (2005). Necessity of Cultivating Medical Professional Personality of Medical Students. *China Journal of Medical Ethics*, 18 (1), pp. 21-24.
- Sun, X., & Chen, J. (2012). On the stomatology postgraduates' research ability training. *Health Vocational Education*, 30 (19), pp. 5-6.
- Wang, X., Du, J., & Wang, J., et al. (2012). Discussion on the Cultivation of Comprehensive Qualities of Pathogenic Biology Postgraduates. *Advances in Biomedicine*, 12 (34), pp. 6782-6784.
- Wang, K., He, J., & Ren, Y. (2015). Discussion on the cultivation of scientific research ability of oncology graduate students. *Beijing Medical Education*, 23 (06), pp. 990-992.
- Wang, L., Zhan, Y., & Zhang, J. (2013). Cultivation of Anesthesiology Postgraduates' Scientific Research Quality. *Journal of Northwest Medical Education*, 21 (02), pp.273-275.

# Application of Mind Map in the Course of Gynecology and Obstetrics Nursing

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**Abstract:** The objective of the study is to explore the application effect of mind map in the teaching of Obstetrics and Gynecology Nursing. Methods: Combining with the problems in obstetrics and gynecology nursing teaching, combing the modules, each module using the method of thinking map to organize summary. Results: The preliminary teaching practice shows that Mind Map can promote learning efficiency, help students to learn independently and cultivate students' creative thinking ability.

**Key words:** Mind map, obstetrics and gynecology nursing, creative thinking

## Introduction

Mind Mapping is the brainchild of brainpower invented in the 1970s by Tony Buzan, who is a British expert on the brain and memory. Bozan (1993) argues that "the language in which the brain thinks is graphics and associations", therefore, the mind map mostly presents a thinking process through a tree structure with sequential labels, and concretizes radiant thinking. Drawing process with the help of visual tools means to promote the generation of inspiration and the formation of creative thinking. At the same time this method of drawing can characterize the relationship between knowledge and knowledge presentations, so that learners can easily grasp the entire knowledge structure, grasp the knowledge system. On the one hand, it can show the process of thinking, on the other hand, it helps to clarify the level to help learners to make effective thinking and memory (Tian & Jia, 2009).

Obstetrics and Gynecology Nursing is a very important course of major in nursing. The system of knowledge has its own characteristics: it has a large content and covers a wide range of topics including anatomy and physiology of female reproductive system, pregnancy, delivery and puerperium care, gynecological disease care and women Health care, each piece of knowledge linked and relatively independent. The knowledge points are fragmented and abstract. The current teaching process is mostly the teaching mode of teachers 'theory teaching, students' listening and taking class notes. Although this teaching mode can transmit the most information in the shortest time, students can think independently and take the initiative to ask questions There is very little communication between teachers and students. Students in the learning process often feel more learning content, difficult to remember, learning efficiency is low, and the test scores are not satisfactory. Facing the teaching and student learning problems in

this course, our teachers' team in the obstetrics and gynecology teaching practice, explored different teaching modes and methods, introduced the mind mapping into the teaching of obstetrics and gynecology, and it is greatly improving the teaching effectiveness. The method is introduced as follows:

## 1. Applying mind map in gynecology and obstetrics nursing teaching

Mind map has been used in obstetrics and gynecology nursing teaching, through using "guide to explore a collaborative" teaching mode, that is, teachers play a guiding role, triggering students interest in knowledge, generate cognitive needs, stimulate learning motivation, through inquiry Learning to enable students to autonomously construct and complete their own cognitive structure (Chen, 2006).

### 1.1 Mind map in the application of teaching design

We mainly have two ways to teaching design in the application of mind map. The first way is the generalized mind map, (Figure 1). By using this the teacher analyses first of the whole course or teaching unit for teaching objectives to determine the required course to achieve the total Goal, through the teaching objective analysis of the formation of total goals and sub-goals of the relationship between the map, played a key leveled guide, guiding the purpose of teaching.



The second analytic mind mapping applies the mind mapping in the difficult points of knowledge. The pre-class teacher arranges tasks such as setting questions and gives students corresponding guidance, such as providing background materials for exploring problems and clues for solving problems, arouse students' interest

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in inquiry, and make students make a mental map of knowledge difficulties (Figure 2) by means of a learning group team, which serves to encourage students to learn independently, analyze autonomously, and raise questions.



### 1.2 Mind map in application of teaching

Generalized mind map is generally used in the new lesson into the classroom or summary of the new lesson into the use of mind mapping, allowing students to intuitive, specific and clear understanding of learning content and goals. It helps student to learn the heart of the learning framework and thinking in the learning process. If students are inspired by the design of the generalized mind map, through their observation, their perception of doubt, and found problems. This can lead to their cognitive and learning interests, and the interaction of the teaching process has played a very good role in promoting. Using the mind map in the course summary, we can summarize the results, enable students to reproduce the learning process of knowledge points, and at the same time inspire students how to review and grasp the knowledge points.

Analytical mind map drawn by the student team before class, in the process of teaching there are two forms of presentation, the first in the classroom by the student team representatives to display and elaborate their own mind map, and teacher's summary and evaluation. In this way, students participate in classroom teaching, and different teams display different mind maps. It helps students form a learning atmosphere of letting a hundred flowers blossom, a hundred schools of thought contend, and students can learn from each other. During the exchange, teachers and students' mentality can be expanded, and knowledge of key and difficult points in teaching can be analyzed and deepen understood. The second kind of student finishes the pre-assignment task of the teacher's arrangement, initially draws the personal mind map. After finishing teaching, the students further deepen the understanding of the knowledge, and then revises and reconstructs the mind map drawn before the class. Through listening, after-class reflection, correction and reconstruction of mind map, students can deepen understanding and consolidation of knowledge content, so as to achieve the learning objectives.

## 2. The effect of mind map application

### 2.1 improve the teaching ability of teachers

Teachers using lesson plans in lesson preparation can help teachers to better straighten out teaching ideas and grasp the knowledge structure and teaching objectives of the whole chapter. Teachers can focus on teaching objectives and teaching difficulties, focusing on targeted teaching design, and good teaching program is conducive to classroom teaching organization. But the performance of students in the classroom is difficult for teachers to expect, teachers are ready to solve the students' questions and make a brief evaluation of the students' mind maps. This is a great challenge to teacher's classroom organization and teaching. Therefore, the application of mind map in teaching activities can improve the teaching efficiency, improve the teaching level of teachers and improve the teaching ability of teachers.

### 2.2 cultivate students' creative thinking, spirit of exploration, unity and cooperation

Using mind map in this course teaching, we adopt the teaching mode of "guide and explore-cooperation", and under the guidance of teachers' questions, we urge students and teams to access the information, explore and think. We use thinking map to creative thinking to draw and demonstrate the thinking of the problem, understand and summarize the process, exchange ideas in the process of teamwork, and unity and cooperation to complete the task. Therefore, the use of mind map in teaching can increase the enthusiasm of students to participate in teaching, develop students' autonomous learning ability and creative thinking.

## 3. Summary

In summary mind maps provide teachers and students with an efficient teaching strategy and learning method. It proves the efficiency and quality of teaching and learning, and improve teachers' teaching ability. It fosters the development of students' learning ability and creative thinking, and enables students to further understand their knowledge. Therefore, mind mapping is an effective tool to optimize teaching methods, and this teaching method is highly operable and easy to popularize.

## References

- Buzen, I & Buzen, B. (1993). *The Mind Map Book: How to use radiant thinking to maximize your brain's untapped potential*. New York: Plume.
- Chen, YF. (2006). Mind map in the teaching of experimental teaching. *Xi'an Fourth Military Medical University*, pp. 45-50.
- Tian, M., & Jia, J., et al. (2009). Application of mind map in the teaching of oral rehabilitative network. *Beijing Stomatology*, 17 (5): 286.

# Effect Evaluation of Progressive Rehabilitation Nursing on Cardiac Rehabilitation of Patients with Coronary Stent Implantation

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**Abstract: objective:** To observe the progressive rehabilitation nursing to promote the effect of cardiac rehabilitation after coronary stent implantation patients. **Selection methods:** Our hospital from May 2011 to May 2015 treated 150 cases of coronary artery stent implantation in patients with documents review, sorting and analysis, were randomly divided into control group and observation group, control group 75 cases, the conventional nursing methods for auxiliary treatment, the observation group of 75 cases in the control group on the basis of using the method of progressive rehabilitation nursing for auxiliary treatment. **Results:** After treatment, through the data contrast, observation group of patients with physical inspection report, bosom is frowsty attack rate, intensity of exercise tolerance is better than that in control group, treatment effect obvious, difference ( $P < 0.05$ ), with statistical significance. **Conclusion:** Patients with progressive rehabilitation nursing after promoting intravascular implantation of cardiac rehabilitation effect is remarkable, popularization should be applied to clinical medicine.

**Key words:** progressive rehabilitation nursing, coronary artery stent implantation, cardiac rehabilitation effect

## Introduction

Coronary atherothrombotic heart disease is a common circulatory disease in clinical medicine. The main reason is that atherosclerosis of coronary artery leads to stenosis or obstruction of vascular cavity. The main clinical features are palpitation, dyspnea, edema, chest pain, oliguria, coughing, etc. Currently, coronary artery stent implantation is one of the most commonly used surgery for the treatment of coronary atherosclerotic heart disease with a certain authority<sup>[1]</sup>. However, coronary artery stent implantation can not fundamentally solve the problem of atherosclerosis and can't avoid or prevent the situation of coronary artery stenosis after operation. In addition, patients should pay attention to changing their bad living habits after operation, or it may cause infection or other diseases, or lead to slow recovery. After operation, according to the patient's pathological changes, age stages, physical condition and so on, the method of dynamic and static combined treatment is adopted to help the patients to carry on physical movement, which will help the patients to improve the function of the heart. This paper is based on 150 cases of coronary stent implantation from our hospital during May 2011 to May 2015; after operation, the archival data of these patients who accept the routine nursing mode and rehabilitation nursing mode as adjuvant therapy are reviewed, integrated and analyzed, which can be sorted out to make the

following reports.

## 1. Information and Methods

### 1.1 General Information

Select the patient data of 150 cases with coronary stent implantation from our hospital during May 2011 to May 2015; the selected patients meet the diagnostic criteria of coronary heart disease 150 patients with coronary heart disease; the level of their intelligence is normal; they can make daily oral or written communication, and they accept successful percutaneous coronary stent implantation. Among them, 80 patients are male and 70 patients are female, aged 35 to 80 years old; the average age is  $51.3 \pm 3.1$  years old. In addition, the selected patients don't include: patients with acute myocardial infarction, cardiogenic shock and seriously damaged lung function, and the patients without normal language communication for no matter what reason. At the same time, the research is informed and supported by these patients and are approved by the superior department of the hospital. The patients are randomly divided into the control group and the observation group. There are 75 cases in the control group, among which 42 cases are male and 33 cases are female, aged 35 to 78 years old; the average age is 52.6 years old; a questionnaire survey is made to the patients; the risk of coronary heart disease to human body and prevention knowledge are generally understood. Only 3 patients have

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knowledge of intracoronary stent implantation; 63 patients have different degrees of psychological anxiety and negative emotion, among whom 4 patients suffer serious mental malaise, 40 patients have bad living habits and 35 patients like high fat content and salty food. There are 75 cases in the observation group, among which 38 cases are male and 37 cases are female, aged 37 to 80 years old; the average age is 51.4 years old; a questionnaire survey is made to the patients; the risk of coronary heart disease to human body and prevention knowledge are generally understood; most of them could not understand correctly and comprehensively; only 5 cases have knowledge of intracoronary stent implantation; 68 patients have different degrees of psychological anxiety and negative emotion, among whom 5 patients are prone to depression, 42 patients have bad living habits and 30 patients like high fat content and salty food. There is no obvious difference between the general information of the two groups ( $P>0.05$ ), which are comparable.

### **1.2 Nursing Method**

In the control group, the routine nursing method is adopted, and the patient's ECG and blood oxygen saturation are checked strictly by guardianship personnel within 2 days after the operation, and the patient's blood pressure is taken every little time; the changes of vital signs and clinical symptoms of the patients are paid high attention; the body temperature measurement are taken regularly for patients; the patient's pulse and respiratory changes are checked several times; take the venous blood sample of the patient every day to observe the changes of the myocardial enzyme spectrum of the patient, and compare it with the changes of the normal myocardial enzyme spectrum. In case of special circumstances, call medical care personnel to discuss and make formulation of countermeasures. In addition, the medical personnel guide the patient to use and take medicine, and take the corresponding measures to prevent the patient's wound bleeding; the on-duty doctor and nurse record the patient's condition change detail; the clinical manifestations of persistent myocardial angina, acute coronary artery blockage, acute myocardial infarction (AMI), the severe low blood pressure and the disorder of heart rate should be quickly fed back to the attending physician and the corresponding measures should be taken<sup>[2]</sup>. The patients receive the treatment for a certain time; when the condition is stable and after patients are examined and obtained hospital discharge approval, the doctor give the patients normal discharge guidance.

On the basis of the control group, the observation group adopts progressive rehabilitation nursing mode to assist the treatment; the medical staff and the patient's family members carry out the seminar, formulate the patient's nursing plan, set the therapeutic effect target that should be achieved by the progressive rehabilitation nursing auxiliary treatment, and

establish the effect evaluation team of the auxiliary treatment; in each stage, make an exchange summary or improvement plan for the result of examination and evaluation, and the division of labor in the group is clear. In addition, follow-up investigation and visit instruction teams are established. After the patients in the observation group are discharged, the team conducts investigation and visit by telephone, new media or door-to-door visit every other time to instruct the patient to carry out the activities of helping to control the illness, supervise the patients to carry out proper and reasonable sports and develop good living habits and behaviors. The contents that are different from the routine nursing mode are as follows:

#### *1.2.1 Universal knowledge of Coronary Heart Disease*

During the patient's hospitalization, the doctors and nurses make full use of the opportunity of daily routine examination, medication, dressing, etc. to make contact with the patient to explain the knowledge about the related coronary heart disease, such as the harm caused by coronary heart disease to human body, the cause of coronary heart disease and prevention measures, high incidence of coronary heart diseases, clinical symptoms of coronary heart diseases, the advanced medical concept adopted coronary heart artery stent implantation and so on; medical personnel can also introduce patients to see relevant medical books. After the patient obtains the hospital approval, the medical staff shall pay attention to the problems that should be paid attention to after being discharged from the hospital. According to the treatment plan set up by the medical staff and the patient, follow up regularly and return visits, and remind the patient of what kind of correct method should be taken for controlling the illness. The patient shall be invited and persuaded to participate in the activities of controlling the illness when the hospital holds related lectures, or invite the authoritative experts to hospital.

#### *1.2.2 Psychological Guidance for Patients*

Because of suffering from the pain of illness and disabled self-action, the majority of patients have psychological anxiety, fear, irritability and other negative emotions; according to the patient's specific actual situation, medical staff should make positive psychological guidance to the patients. For example, the medical staff should tell the patient how many courses are needed, the duration of each treatment period, the state of illness where patients can be discharged, and tell the patient with the constant development of medical science and technology what kind of advanced method the hospital adopt to treat the coronary heart disease. Our hospital uses the achievements that we treat the coronary heart disease patients with coronary artery stent implantation, and shows the patients related books about how to overcome the disease to encourage patients develop a good mood and improve the self-confidence of overcoming pain<sup>[3]</sup>. In addition, the medical staff can guide the patients to vent their negative emotions and lead the

patient's ideological status to positive development, so that the patient has a good mental state.

### 1.2.3 Dietary intervention for Patients

Food regulates the functioning of the body and limits the amount of heat taken by the patient to reduce the burden of the heart. Medical staff should guide patient to avoid eating high fat, high calorie, high cholesterol and spicy, stimulate food, unable to eat ice or super-cooled food, or too hot food. Have a light-based diet; eat food with more vitamins, cellulose, low fat and low calorie; eat more fruits and vegetables. A consensus should be reached between the medical staff and the patient's family members to exercise strict supervision and control over their diet. For example, if the patient has a bad taste, such as smoking and alcohol, adopt effective measures to compulsorily abstain from smoking and alcohol. The medical personnel can also give the patient explanation of the good eating habits to promote the human body, hold some lectures on healthy eating, constantly strengthen the patient to develop good eating habits.

### 1.2.4 Supervise and Guide the Patient to Carry Out Proper Exercise

Long-term sedentary or long-term bedridden has a negative effect on the patient's condition; the medical staff and the patient's family should establish a reasonable movement plan according to the actual situation of the patient. For example, we can guide the patient's limb arthrosis on the hospital bed, and the patient can sit on the hospital bed and shake the leg joints, move at a certain speed in the room and do some stretching exercises; the time and frequency are stipulated; patients can take deep breaths, raise the legs, bend the waist and put on the vital capacity to improve the vital capacity, enhance the maintenance capacity of blood cells, constantly improve and ensure cardiomyocytes intake of sufficient oxygen. At the same time, doctors and nurses should guide patients and patients' relatives to pay attention to the rhythm in the process of exercise, avoid the application of intensity; if arrhythmia, myocardial contracture, elevation of blood pressure and palpitation appear in the process of exercise, the exercise should be stopped immediately. Give feedback immediately to medical personnel and check them in time<sup>[4]</sup>. After the patient is discharged from the hospital, the daily basic domestic activities can be carried out; patients should live as much as possible in the quiet environment but in the noisy environment; appropriate amount of recreational activities can be carried out and increase the exercise amount according to the actual condition.

### 1.3 Observation Index

According to the body mass index, blood pressure, tightness frequency, ejection fraction and activity tolerance, medical personnel examine, observe and check the changes of the two groups of patients. Check the patient's activity tolerance by getting the patient to climb stairs. According to

the actual situation of the patients, they climb stairs as much as possible. If patients have polypnea in the process of climbing stairs, they can take a rest. The judgment standard is based on the self-sense of the patient<sup>[5]</sup>.

### 1.4 Statistical Research

Make statistics and analysis of the data generated by the two groups by SPSS15.0. In the calculations, the calculated data is represented by the percentage (%) and the group check is done with  $\chi^2$ ; if  $P < 0.05$ , there is a big difference in data, which has the value of statistics.

## 2. Results

According to the observation indexes, the control group and the observation group have achieved some effects. On the one hand, 15 patients in the control group are able to know the relevant knowledge of coronary atherosclerotic heart disease, understand the causes and preventive measures of the disease; 8 patients know the operation of intracoronary stent implantation, and 10 patients have good state of mind. Most patients still have different degree of psychological anxiety and can not change the bad living habits; their diet is not scientific and reasonable. 63 patients in the observation group are able to know the relevant knowledge of coronary atherosclerotic heart disease, understand the cause of disease and preventive measures, and apply the learned theory to actual life. 65 patients know the operation of intracoronary stent implantation, and 62 patients have good state of mind. There are only 13 patients with anxiety and fear, and 75 patients have good living habits and eating habits. On the other hand, the body mass index of the control group is  $(23.1 \pm 1.5) \text{kg/m}^2$ , systolic pressure  $(152 \pm 8.2) \text{mm-Hg}$ , diastolic blood pressure  $(95.6 \pm 9.71) \text{mm-Hg}$ , chest tightness seizure frequency  $(10.61 \pm 1.5)$  times per month, ejection fraction  $(0.68 \pm 0.06)$ , climbing stairs  $(52 \pm 6.3)$  floor per time. The body mass index in the observation group is  $(19.11 \pm 1.25) \text{kg/m}^2$ , systolic pressure  $(123 \pm 7.1) \text{mm-Hg}$ , diastolic pressure  $(72.1 \pm 6.9) \text{mm-Hg}$ , chest tightness seizure frequency  $(4.5 \pm 1.3)$  times per month, ejection fraction  $(0.72 \pm 0.08)$ , climbing stairs  $(75 \pm 5.6)$ . The specific data are compared between the observation group and the control group, and there are great difference in the related knowledge, living habits, eating habits, body mass index, blood pressure condition, chest tightness seizure frequency, ejection fraction and activity tolerance of coronary atherosclerotic heart disease for patients ( $P < 0.05$ ), which has the value of statistics.

## 3. Discussion

In the modern medicine, coronary artery stent implantation is one of the most commonly used methods in the treatment of coronary atherosclerotic heart disease, which has the advantages of minimal trauma, rapid recovery and obvious

effects. The coronary stent implantation can strengthen the heart function, bring the hope of rehabilitation to the patient, but after implanting the stent, there are many problems. On the one hand, the stent will damage the vascular endothelial tissue of the heart, cause the accumulation of platelets, cause thrombosis, and cause vascular obstruction, which requires patients to develop a regular and healthy living habits. On the other hand, coronary atherosclerotic heart disease needs to maintain proper amount of exercise, enhance the oxygen uptake of cardiac muscle cells, control blood pressure effectively and reduce the amount of cardiac function; at the same time, patients should pay attention to eating habits and reduce the concentration of serum lipoprotein cholesterol and enhance the oxygen transfer function of red blood cells.

Progressive rehabilitation is carried out mainly from the patient's psychological guidance, dietary intervention guidance, guidance of related diseases and health knowledge, guidance of exercise-assisted treatment and so on, which completely meets the needs of diseases modifying for patients. Through the popularization of the related knowledge of coronary heart disease, it is helpful for the patients to correctly understand the disease and to actively cooperate with the medical staff to treat them, so as to enhance the confidence of curing the disease. Psychological guidance for patients improves the psychological enduring capacity, helps the patient to set a good state of mind and helps the patient to recover; the diet intervention to the patient reduces the concentration of blood lipoprotein cholesterol in the patient, reduces the frequency of illness, and eliminates some unsafe factors for patients. Supervising and instructing the patients to carry on proper amount of exercise improves the patient's physique level, strengthens the patient's myocardial cell oxygen carrying capacity, alleviates the patient's heart load and benefits the improvement of the illness. According to the results of the

study, the patients in the observation group have greatly improved their health awareness, good habits and eating habits, which promotes the recovery of the disease. In addition, the body mass index (BMI), blood pressure (BP), onset frequency, ejection fraction and activity tolerance of the patients in the observation group are significantly higher than those in the control group ( $P < 0.05$ ), which shows that the recovery effects of heart are obvious.

To sum up, the effects of progressive rehabilitation on the recovery of heart are obvious after intracoronary stent implantation.

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## References

- [1] Feng Yun. Nursing Application of Progressive Rehabilitation Nursing in Coronary Stent Implantation[J]. Five Ward Areas of Chongqing Affiliated University Town Hospital. 2014,(07): 155-157.
- [2] Ye Yongmei. Effects of Rehabilitation Nursing on Cardiac Rehabilitation After Intracoronary Stent Implantation[J]. Department of Nursing Care, Xiasha District, Yifu Hospital Affiliated to the Medical College of Zhejiang University. 2014(10): 35-36.
- [3] Zhang Haifang. Research on Anxiety and Depression of Patients with Coronary Heart Disease After Percutaneous Coronary Intervention[J]. Xinxiang Medical University. 2013,(04): 76-78.
- [4] Tian Yunzhen; Zhu Jianping. Analysis of Influence Factors of the Quality of Life of Patients After Coronary Stent Implantation and Nursing Countermeasures[J]. Department of Cardiology, Shaoxing Central Hospital. 2015(05): 99-101.
- [5] Zhou Xiujuan; Zhang Guangyuan; Chen Meijiao. Psychological Nursing of Patients with Cardiac Stent Implantation[J]. Radiology Department, Kaiping Central Hospital. 2014(04):131-133.

# Li Hongzhang and China Merchants Steamship Bureau

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**Abstract:** Li Hongzhang, one of the most important figures in the late Qing dynasty, founded the China Merchants Steamship Bureaus in 1872, the starting point of the development of China's modern shipping industry. He has spared no efforts for the growth of China Merchants Steamship Bureau, economically making a series of supporting measures such as special delivery for tribute grain, official grants and loans and preference for debts and taxation, and politically unyieldingly adherence to the policy of official supervision and non-government operation of China Merchants Steamship Bureaus under the public pressure. Unfortunately, the government reinforced the controlling of this bureau due to the personal political strategic shrinkage of Li Hongzhang and tight fiscal policy of Qing government as well as lessons from its previous operation. The feeble growth of China's modern shipping industries can be traced back to the ups and downs of this bureau as a representative of China's modern shipping industries.

**Key words:** Li Hongzhang, shipping industry in late Qing Dynasty, China Merchants Steamship Bureau

## Introduction

Li Hongzhang, the founder of the China Merchants Steamship Bureau in 1872, is one of dominant characters in the late Qing dynasty. This bureau is the turning point for Westernization Movement from self-reliance to the pursuit of wealth, and the beginning of modernization of China Merchants Steamship Bureau. Political and economic supports of Li Hongzhang to the China Merchants Steamship Bureau have not only promoted the modernization of this bureau but broken the monopoly of foreign merchants to China's shipping industry. And it also has finished the tasks of delivering the northern tribute grains to the north and of "slightly graping the profits of shipping industry from foreign merchants". From previous research fruits on Li Hongzhang perspective, although many a scholar has engaged in the study of Li Hongzhang and numerous criticisms to the China Merchants Steamship Bureau and Li Hongzhang can be found, all research achievements have attached great importance to the operating system of "official supervision and non-government operation" of China Merchants Steamship Bureau, and yet less focused on the detail studies on combination of this company with the development of modern shipping industry. This paper has chronically analyzed the role of Li Hongzhang in initial difficulty, development and expansion and stagnation of modern shipping industry so as to explain the role of Li Hongzhang in the initial formation of shipping industry and the establishment of modern shipping system and to explore the

feeble growth of China's modern shipping industry.

## 1. Social intercourse and struggle: the role of Li Hongzhang in the initial development of China Merchants Steamship Bureau

After the opening of five trading ports, foreign merchant companies flooded into the Yangtze river and southern-east coastline under the protects of treaties and systems, and almost monopoly China's shipping industry, resulting in extreme difficulty for the northern delivery of tribute grain. To solve the problems of no ship for delivering tribute grain and learn foreign advanced shipping technology, it was primitive that tribute grain be transported by ships with mechanical power. Furthermore, as Westernization Movement went on, the demands to find new channel of financial resources was one of motivations to develop shipping industry.

Li Hongzhang had long been highly interested in setting up modern shipping industry and taken initiative to find ways for steamship delivery and strongly promoted the development of shipping industry. Under the background of doubts of colleagues to the establishment of China merchants steamship Bureau, he had made endeavors in many ways to lobby many a associate to understand the merits and disadvantages of this company. He had played a vital role in assisting and protecting the growth of the company facing a severe difficulty at its early development stage, making efforts to convince co-workers to agree that tribute grain should be delivered by and public funds and reliefs granted to the company.

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### **1.1 The background of China merchants steamship bureau founded by Li Hongzhang**

Foreign businessmen poured to China to engage in steamship industry after the opening of five-trading ports. Shanghai alone had 15 companies running steamship in early 1960s. Foreign ships were well-known for rapid speed, convenience, safety and security. "It takes more than a month from Shanghai to Tianjin by large junk; however, it only needs a day by ship" (Association of Chinese Historians, 1954). The ship delivery had largely reduced the transportation loss. It was faster and safer than large junk. It was often the case that huge damages were caused during the long distance delivery, as pirates typically robbed large junk teams. While foreign ships had no worries about that situation as they were armed with artillery and protected by insurance corporations. As Chen Lanbin put it in his report, ship delivery was convenient and had no extra fees for transition and also guaranteed by insurance companies which would compensate its loss according to the original price should accidents take place. However, Chinese ship was quite inconvenient. The gulf between Chinese and western ships was huge. Chinese businessmen and folks had scrambled into foreign ships for decades. As a result, foreign ships continuously increased while Chinese civilian vessels constantly fell. The number of the former enjoyed a persistent rise, expanding any places for ship delivery from the coastline to the mainland. Consequently, the number of latter will gradually lower to zero (Chen, 1875).

Various preferential and privileges granted by Sino-foreign unequal treaties are essential to the rapid development of foreign ships. *The Trade Regulations for the Five Treaty Ports* and its *Risk Management Provisions* provided taxation preference for foreign businesses. With the payment of import tax, only 2.5% of the tax for the sub-port was needed before foreign ships delivered their products to Chinese inland. Thus China lost the effective measure of restricting foreign ships by tax rate to protect the shipping industry from domestic capitals, which was favorable to the development of foreign shipping industry. In March 1863, the Qing government canceled its restriction on sales of beans shipped by foreign businesses, bringing even more convenience to foreign shipping industry, and a disaster at the same time to the domestic sand ship industry.

With the help of fast, convenient, safe and reliable foreign ships, along with the regulatory protection, these money-seeking foreign banks earned huge profit with a cheap freight. The net profit of the shipping company of Russell & Co. in 1867 reached 810023 taels, nearly 6 times as much as the profit last year; from 1868 to 1870, the annual net profit surpassed 700 thousand taels, with the average profit rate of more than 40% in the 3 years. The capital of Russell & Co. increased from 1.25 million taels in 1867 to 1.875 million taels

in 1868; in 1870, it possessed 17 ships, a total tonnage of 25827 tons, and assets of nearly 2.4 million taels (Zhang, 2007).

Steamship for imperial transport was one of the main reasons for the rise of China's modern shipping industry. A vigor foreign shipping industry almost destroyed sand ship industry that once had shouldered the imperial transport, which brought great difficulties to the Qing government's transport. Imperial water transport in the Qing Dynasty has always been regarded as "the supreme mission" and "it is decisive for the government as it is the source for officials' salary and imperial subsistence" (Liu, 1988). At that moment, learning advanced shipping technologies from western countries to transport imperial grains through steamships became imperative. At the beginning of the 1860s, Augustine Heard & Co. even attempted to monopolize China's imperial water transport, which increased the vigilance of the Qing government.

The Qing government's financial urgency of finding fiscal support partly explained the development of the shipping industry. Due to years of wars, its finance was in jeopardy. Meanwhile, that a large number of military industries established in the Westernization Movement in the 1860s required even more funds to ensure their operation made it harder for the Qing government to financially support itself. "Every way to make money has been used and their potential became exhausted; now it is quite dangerous that businesses and people are all in predicament. (Gu & Dai, 2008)" In addition, the profits from the shipment on the Yangtze River and coasts were deprived by foreign ships, which was even more agitating for Westernization officials and Chinese merchants seeking for a lucrative way. "Since foreign businesses entered these trade ports, they have robbed the domestic mercantile shipping of large profits and the interests of inland merchants and citizens (Xia, 1982)." Therefore, the establishment of civilian enterprises for more funds was quite normal. Furthermore, compared with other westernization industries, the ship industry featured less short-term investment, high profit and flexible financial turnover, and thus Li Hongzhang, on behalf of the advocates of the Westernization, founded China Merchant Steamship Bureau in 1872.

### **1.2 Li Hongzhang and the Establishment of China Merchants Steamship Bureau**

The intrusion of foreign steamships had such a huge impact on the industry of sand ships that no suitable ships were available for water transport. New steamships were thus duly considered.

In 1866, Li Hongzhang, who was appointed as the governor of Jiangnan (Now Jiangsu, Anhui and Shanghai) and Jiangxi Province, met Ying Bao, the governor of Wusong Region, to discuss about how to alleviate water transport

difficulties. Familiar with the business in south of the Yangtze River, Ying Bao put forward that “large sailing vessels can be procured officially for water transport (Plywood ships: foreign ships frequently sailing on the ocean within the Qing’s territory. They are very strong with two layers of wood and metal skin)” as he thought the way would “share the profits and rights from foreign countries” and, in the long term, “benefit both our own country and people’s lives”. Though it was the last resort, as Li Hongzhang considered, it was still somewhat feasible, so he submitted his statement to the Ministry of Foreign Affairs in the Qing Dynasty that “it is the last resort; there is no other ways to handle the problem”. Based on Li Hongzhang’s suggestion, the Qing Government decided that, on the one hand, foreign ships be procured for water transport, and on the other hand, since there had been many Chinese businessmen purchasing foreign ships, those businessmen be recruited to transport part of rice arranged to be sent to the capital (Institute of Modern History in the Central Academy of Taipei, 1957).

In the same year, Li Hongzhang stipulated *The Draft Regulation on Procurement and Manufacture of Big Sailing Vessels and Other Ships by Chinese Businessmen*, which, revised by the Ministry of Foreign Affairs, was finally named *Regulation on Procurement and Manufacture of Foreign Fire-wheel Sailing Vessel and Other Ships by Chinese Businessmen*. It stressed that the ships purchased from foreign businesses “no longer belong to foreign countries” and their captains “should be Chinese” (Institute of Modern History in the Central Academy of Taipei, 1957). The regulation was issued next year by the Qing Government. Facing the rapid increase of foreign ships in China, Li Hongzhang first pointed out that the procured sailing vessels can replace sand ships for water transport and stipulated detailed regulation for the popularity of vessels. Its promulgation and implementation was a sign that the Qing Government realized a rising transport of vessels was effective in coping with problems of water transport, which was also a cornerstone for the establishment of China Merchants Steamship Bureau.

In early 1872, Song Jin, the cabinet secretary, proposed to dismantle the Jiangnan Manufacture Bureau and Fuzhou Ship Building Bureau, triggering a heated discussion about the prospect of China’s shipping industry.

In 1865, the Jiangnan Manufacture Bureau was founded by advocates of the westernization movement in Shanghai; in 1866, Fuzhou Ship Building Bureau was established in Mawei, Fujian Province. Both of them were large-scale ship building enterprises in China, but they came under severe criticism for such reasons as their huge manufacture costs, the large amount of expenditure of ships maintenance and wages of soldiers on the ships, as well as mismanagement. In January 1872, Song Jin reprimanded that building warships “costs too much”, and “it is actually worthless depletion in disguise of a long-term

promising cause”. He asked for cancellation of the two bureaus by stating that “it is utterly useless to strive for a thing unnecessarily beneficial by exhausting the wealth (Bao et al, 2008)”.

The advocates of westernization movement, led by Li Hongzhang, lambasted Song Jin’s proposals. Li made most of proposals to convey his greatest opposition against the cancellation of the two bureaus. On June 20, 1872, in his *Statement of Not Canceling Ship Building Enterprises*, Li Hongzhang stated that the conservatives who maintained cancellation were “confined to words and sentences but ignorant of the turning point in the thousand years of history; the cancellation stems from those who are only satisfied with the temporary steady circumstances but mindless of the trauma for the country since two or three decades ago as well as how to stabilize the country and confront foreign powers.” He also considered that the spending on every aspect of the country can be reduced in expect soldiers, fortification, weapons and warship building. Haphazard saving expenditure will not strengthen a country.

As to the criticism of huge costs, Li Hongzhang said, “The ship building in Fujian...and Shanghai are long-term projects for the country. I know they are quite expensive and we need a long time to see their effect, but we must develop our ship building now lest we should regret in the future for not investing in the part. These bureaus are now not able to be dismantled, because all of our efforts and prospects shall be ruined if we give up on it. Besides, our investment in ship building will become nothing, only to be a laugh stock for others and encourage enemies to intrude.” Thus here is the corollary: “From all these analysis, it is quite clear that the projects should not be canceled (Bao, et al, 2008).” His statement was so sincere and profound that Song’s proposal was denied as the westernization advocates insisted.

After the sparking discussion about China’s industry of shipping, an agreement seemed to have been reached about “merchants steamship” as a way of developing China’s shipping in the imperial court, but there still existed disputes on shipping development among officials and their subordinates from northern and southern factions. Southern officials was not in favor of a merchant bureau because of its possibility of dissipating the profits of traditional sand ship industry. For instance, Shen Bingcheng was concerned that “the increasing popularity of steamships procured by Chinese merchants” would “make traditional tariffs slump”; He Jing, the governor of Jiangnan and Jiangxi, was always inert to the merchant bureau. Not only did he refuse to support it, but also considered “the plan of merchant bureau can be deferred.” For this, Li Hongzhang wrote to He Jing to indicate that Wu Dating “knows nothing about the circumstances”; Feng Juguang “is only able to follow others’ ideas”; and Shen Bingcheng “has



selfishness” (Li, 2008). In the letter Li Hongzhang did not cite He Jing’s name, but it was quite clear that he indirectly reproached him. When He Jing was busy with his parent’s funeral, Zhang Shusheng took over his post, who was once a subordinate of Li Hongzhang. Li wrote to him to strive for his support: “During the nearly 20 years when we cooperated, have you seen me determined to do anything that had no certainty of success? Have you seen me flinch as I was determined to do anything?” He pointed out that “the water transport is not a large-scale one”, but “it is a progress for the country, business, finance and military in thousands of years to come” (Li, 2008), which was of great significance. Zhang Shusheng showed his support in return. In retrospect, Li Hongzhang still felt stressful: “Thanks to the agreement of Zhejiang Province, thanks to Governor Zhenxuan (Zhang Shusheng) changing his mind, official steamships can commence their production (Li, 2008).” Li Hongzhang’s efforts were rewarded by the establishment of China Merchants Steamship Bureau in January 1873 in Shanghai as the threshold of China’s modern shipping industry.

As mentioned above, with foreign shipping companies flooding into China, traditional sand ship industry was destroyed and the imperial water transport was threatened. Along with an urge to finance the westernization movement, developing shipping by steamships became a tendency. Li Hongzhang was highly interested in such shipping, stipulating the regulation to start its popularity. China’s modern shipping industry was not, however, smooth from scratch. There was no agreement between northern and southern officials for its huge costs in the preliminary stage and devastating effect on the profit of traditional sand shipping.

In teeth of the inertia of southern officials, Li Hongzhang, instead of frustration, tried to persuade or reproach them from the perspective of the country, and provided finance and food support to guarantee its establishment. It is safe to say that the key part of the establishment was Li Hongzhang’s firm support for it under pressure from public opinion and thus he was the pioneer of China’s modern shipping industry.

## **2. Support and maintenance: Li Hongzhang and the development of China Merchants Steamship Bureau (1873-1884)**

At first, China Merchants Steamship Bureau encountered such difficulties as shortage of stock and blockade of foreign businesses, but Li Hongzhang provided his support for the newborn China Merchants Steamship Bureau by taking economic measures like special imperial water transport paths, official funds, and tax and debt cut. His political support was one of the reasons for its rapid rising. In the first decade of the bureau, Li Hongzhang brought more management power to businessmen and prevented it from the influence of officials,

winning satisfactory results.

### **2.1 Economic Support for China Merchants Steamship Bureau**

Li Hongzhang’s economic support for China Merchants Steamship Bureau lay in special imperial water transport paths, official funds as well as tax and debt cut.

But it was utterly hard to raise capital initially. The first appointed general manager, Zhu Qi’ang, found no ways to handle it. The famous Chinese businessman Hu Xueyan “refused to join in for fear of the retaliation of foreign businesses”; though Li Zhenyu agreed at first, he “eventually declined for disputes among the members”. Despite hundreds of measures taken, only ten thousand taels of silver was raised, and businessmen in Shanghai have not provided ready fund as they wished 100 thousand taels. Considering the circumstances, Li Hongzhang (2008) asked for imperial support of 200 thousand shi (1 shi=28 kilograms) in rice “transported by merchant steamships” to maintain the finance of the bureau.

Water transport charge accounted for an important part of the bureau’s income. “30 percent of charge can guarantee no deficit” (Yi & Hu, 2005), which was an advantage in its competition against foreign steamships. With the initial difficulties overcome, Li Hongzhang always maintained the bureau’s management of imperial water transport. Subsequent to the transport of the 20-thousand-shi imperial rice in 1872, new policies were stipulated in favor of the bureau. In 1873, the ratio of sand ships to steamships was 8:2. A rising steamship bureau and a shrinking sand ship industry changed the ratio to 6:4 (Wu & Yao, et al, 1918) within a short period. In November 1877, Li Hongzhang noted, in his statement of *Marine Transport of Official Resources Assigned to the Merchant Bureau*, that “40-50 percent of the imperial rice transported through the waters in Jiangsu and Zhejiang should be shipped by the steamships of the bureau without less amount”; and that apart from the imperial rice, other resources of Chinese merchants for water transit were required to be transported by the steamship bureau: Li Hongzhang (2008) claims that “Resources of Chinese merchants for official use, if necessary to take water transport, should be shipped by the China Merchants Steamship Bureau according to the regulation (p. 499).” All those incessant efforts were paid back because from the 26<sup>th</sup> year in the reign of the Emperor Guangxu (1900), saying by Wu Xin & Yao Wen et al (1918) that “the steamship transport was in charge of all imperial water transport (p.15).”

Besides, Li Hongzhang capitalized on his social network to obtain more imperial rice for the bureau’s water transport. As it was said above, when He Jing was busy with his parent’s funeral and Zhang Shusheng took over his post as the governor, Li Hongzhang seized the opportunity to persuade him to only support the steamship bureau but also promise to provide 100-thousand-shi imperial rice in Jiangsu and another 100

thousand in Jiangbei for northward transport of the bureau (Ni, 2007). How much attention Li Hongzhang paid to the merchant

steamship bureau can be fully seen from his making use of his political resources to help the bureau out of hardships.

**Figure.1 Imperial Rice Transported by China Merchants Steamship Bureau (Unit: Tael)**

Years	Rice Amount (dan)	Transport Charge Ratio	Total Income (Rice Amount × Transport Charge Ratio)
June 1873	170000	0.60	102000
1873-1874	250000	0.60	150000
1874-1875	3000000 <sup>1</sup>	0.60	180000
1875-1876	450000	0.60	270000
1876-1877	290000	0.60	174000
1877-1878	523000	0.60	313800
1878-1879	520000	0.60	312000
1879-1880	570000	0.60	342000
1880-1881	475415	0.531	252445
1881-1882	557000	0.531	295767
1882-1883	580000	0.531	307980

Source: Li Zhigang: *Li Hongzhang and Modern Enterprises: China Merchants Steamship Bureau, 1872-1885*

Note 1: As cited from the original text. It seems a typo of the author for the rice amount surged without a large increase in the total income.

Apart from more imperial rice for the bureau, Li Hongzhang directly borrowed official fund for it. Because of the initial capital-raising difficulties, he borrowed 200 thousand chuan of official fund (135 thousand silver taels) from the payment of Zhili (Now Hebei Province) for the

procurement of steamships. Resources show that Li Hongzhang's 50 thousand taels of private investment was included in the initial fund raised by Zhu Qi'ang (Chen, 2013), which can prove his support for the bureau.

**Figure.2 The Borrowed Fund and Official Fund for the China Merchants Steamship Bureau (Unit: Tael)**

Year	Total Borrowed	Official Fund	Proportion of Official Fund (%)
1873-1874	123023	123023	100.00
1874-1875	649595	136957	21.08
1875-1876	1438357	353499	24.58
1876-1877	3234088	1866979	57.73
1877-1878	3819702	1928868	50.50
1878-1879	3153588	1928868	61.52
1879-1880	3056746	1903868	62.28
1880-1881	2620529	1518867	57.96
1881-1882	3537512	1217967	34.43
1882-1883	3334637	964292	28.92
1883-1884	2270852	1192565	52.52
1884-1885	2169690	1170222	53.93
1885-1886	1882232	1065254	56.60
1886-1887	1418016	793715	55.97
1887-1888	1260535	688241	54.60

Source: Li Zhigang: *State Ownership of the China Merchants Steamship Bureau, 1878-1881*

Li Hongzhang (2008) usually emphasized the commercial nature of the bureau: "Official sector is in charge of general guideline, and businesses are responsible for details" (p. 533), so official capitals were immensely invested only when the bureau was in trouble. As Figure 2 shows, the proportion of official fund in all borrowed fund was so large as to reach 60%, mainly because Russell & Co. from the US was merged into

the bureau in 1877, when Shen Baozhen, the governor of Jiangnan and Jiangxi at that time, invested 1 million taels as the "official capital" into the bureau and required it to pay back the principal and interest, which sustain the high proportion of official fund.

Previously, a lot of scholars did not consider Li Hongzhang played an effective role in the merger, but

Professor Yi Huili (2009) of East China Normal University pointed out that “given the management system of the merchant steamship bureau, merger would not proceed without the authorization of Li Hongzhang ... He kept keen passion toward the merger. (p. 45) ” The author highly agreed to the opinion. Though there was no direct financial support for the merger, Li Hongzhang proactively got involved in the negotiation with Sheng Xuanhuai, Tang Tingshu and Shen Baozhen to “blend” all these parts and make a difference in the merger.

With the merger of Russell & Co., the merchant steamship bureau was in economic hardship because on the one hand foreign businesses reduced prices for competition and on the other hand the government should pay back a large amount of loans. To weather the hardship for the bureau, Li Hongzhang suggested deferring the payment of the interests from official stocks in the first three years. Later on, he proposed in his statement (2008) that the interests be paid after the 6<sup>th</sup> year of the Emperor Guangxu in 1880 (p.325).

In Figure 2, the second crest of the official fund proportion appeared after 1883 because of, as the author inferred, the financial storm in Shanghai, when money houses went bankrupt, the merchant bureau failed to operate smoothly and the Chinese-French War broke out. Under the circumstances, the bureau had to be sustained with the official support. In 1886, the financial storm as the bureau went through, it still faced severe economic downturn, so Li Hongzhang made a statement for approval of three preferential policies: “(1) the bureau’s ships return with no freight and the export tax for loading in the three northern ports is cut by 20%; (2) the bureau’s ships load the hatbox tea from Hubei to Tianjin, six qian (a measure of currency) of export tax levied for every jin (about 596 grams) and half taxation for re-import exempted; (3) transport charge of the bureau’s ships is paid with reference to the charge of sand ships (4 qian 3 fen 1 li for )” (Li, 2008, p. 325). All these policies contributed much to the bureau’s recovery.

Official fund was an important support for westernization enterprises as they were in difficulties. Li Hongzhang helped them out of predicaments and prevented them with such measures as official fund and preferential policies.

### ***2.2 Endeavored to Sustain the Status of Businesses in the Bureau***

Li Hongzhang has noted that the bureau should be officially supervised, and operated by businesses in 1872, appointing Tang Tingshu to stipulate regulations favorable for businesses such as *The Regulations of China Merchants Steamship Bureau* and *Regulations for Merchant Steamships* to keep their dominance in the bureau. In 1880, however, the competition of Xiang and Huai factions triggered rumors of “nationalizing the bureau”. Faced with the pressure of public

opinion, Li Hongzhang tried to prevent the bureau from the official control for better operation.

One of the purposes of westernization enterprises was “distracting the profits from foreign businesses”, which meant directly confronting them, so it was not appropriate for the government to operate these enterprises. That the enterprises stood at the front competing and the government backed up must be better for enterprises for their advantages can interact.

When formulating the framework of the bureau in 1872, Li Hongzhang (2008) put forward that it should be supervised by the government and operated by businesses, and the latter dominated: “The government sets the guideline and rectifies the problems, leaving businesses to stipulate relevant treaties for their own demand ... Surplus or deficit are their own responsibility, irrelevant to the government (p. 258)”. When Tang Tingshu was appointed as the general secret for businesses in 1873, he stipulated new regulations for the bureau and businesses that approved the dominance of businesses and the role of the government. The regulations for businesses ordered “steamships are managed by businesses”; the chairman of the board should be elected by businessmen: “the board chairman is planned to elect”. In the regulations for the bureau, new capitals must “be raised by business members”; significant events should be “discussed by stockholders”; the board chairman had a say, able to ask for a change of the general secretary by countersigning (The Transportation History Compilation Committee of the Ministry of Transportation and Railway, 1931, p. 147). Compared with the regulations of Zhu Qi’ang, new ones brought more rights to shareholders, showing its commercial nature.

To prevent government intervention, the regulations strictly limited the power of the government: “As long as something is to be done by the businesses, it should be managed according to the norm for easier execution. Now an experienced businessman is going to be elected to assist the secretary general; other personnel must be selected based on a strict criterion and inertia is not allowed. Commissioners are not to be arranged, and such posts as document writer, copier and office attendant should be canceled for saving more expenditure. The funds are supposed to be recorded in journals every day, every month and every year. When there is something to be reported in terms of the business within the bureau and the calculation, it can be stated according to the original version without another special registration so as to avoid red tape (The Transportation History Compilation Committee of the Ministry of Transportation and Railway, 1931, p. 148).” To reduce the bureaucratic working, the board chairman checked the accounts for less embezzlement and wasting.

Under that political environment, the conservative were at war with new westernization enterprises, among which the

bureau under the government supervision and businesses management was naturally coming under the censure of those conservative officials. In 1877, the Censor Dong Tanghan stated that “the Merchant Steamship Bureau be immediately restructured for its status”, and that the bureau should be “managed by northern and southern commercial officials” to have a “more strict inspection without more expenditure.” That meant to impose more government control on the bureau.

Li Hongzhang repudiated by saying that the bureau “took the capital from businesses as the principal and was managed according the regulations, and it had been stated in the 11<sup>th</sup> year under the reign of the Emperor Tongzhi (1872) that the businesses rather than the government took the responsibility for the surplus and deficit.” And because “the business related to steamship transport is a part of the westernization, it should not be intervened too much by the government. It was totally different from those institutions that are established and funded by the government,” so the bureau was supposed “to be managed by businesses instead of government (Li, 2008, p.48).”

But it was only a start. In 1880, Wang Xianqian, the official in the Imperial College, set off an impeachment on the steamship bureau, considering “the bureau was in a mess and an array of problems (Association of Chinese Historians, 1954, p.39)” and maintaining it should be handled by appointing commissioners and managed by the government. An official in Hunan, Liu Kunyi, pointed out from the perspective of the government that if the government took the dominance, “businesses and the market would not be interested in the industry, so businesses must have their own status”. Therefore a makeshift was produced: “1.4 million taels was invested into the bureau as the official capital in the same way as private capital was put into it (Association of Chinese Historians, 1954, p.44)”. According to this, the bureau was purchased by the government, going against its commercial nature.

In face of the criticism of officials in Hunan, Li Hongzhang not only renewed the policy of “businesses for management and government for support”: “support means that the government provides assistance when there were problems. As long as the bureau pays back the official fund, its surplus and deficit are not related to the government ... It is the businesses rather than the government that is responsible for its economy,” but also stressed that a state-owned bureau will impose a huge strike on businessmen: “Wang Xianqian cast another doubt, perplexing those businesses. I am afraid that people involved in the bureau would be so confused that disagreement may distract them and undermine the industry (Association of Chinese Historians, 1954, p. 61).”

Meanwhile, in order to keep the confidence of inner merchants of the bureau, Li Hongzhang removed Ye Tingjuan, who supported a state-owned bureau, from the post in the

bureau, and took a radical measure to sustain the commercial system of the bureau by empowering the management to Liu Kunyi. “I dare not to shift my responsibility for the bureau, but Wang Xianqian said Shanghai and most ports along the rivers are within the jurisdiction of southern part so commissioners in that area should be appointed as the general manager. How can I go off limits to give others a handle against myself? Besides, despite a sign of recovery in the bureau, I am not sure about my ability to choose the personnel, but I want to recommend Liu Kunyi, the southern official for better way of selecting people and alleviating the waves of public opinions to protect the rights in the bureau. If it is determined, please appoint Liu Kunyi as the general secretary, and I will not interfere with its business (Association of Chinese Historians, 1954, p.61).”

Eventually in the competition of power in the bureau between official in Hunan and Huai, Li Hongzhang won. In the summer of 1881, Yixin, the Prime Minister, decided that “the bureau should be managed by Li Hongzhang”, and that “the decision has been made through discussion with other officials and disagreement will not be accepted”(Association of Chinese Historians, 1954, p.68). After the story of a “state-owned” bureau, it kept its businesses-managed system with the efforts of Li Hongzhang.

The bureau was always under the control of the government, but why did Li Hongzhang stick to the principle that it should be managed by businesses? One of the reasons was that it was “quite hard to raise the fund (Xia, 1982, p. 368)” for industrial enterprises. “Gathering the power of various businesses is an easier way” if it was managed and financed by businesses. Another reason was that the stock and management from businesses would bring more profit than those of the government did. A quote of Zuo Zongtang can better reflect the reason: “if it is managed by the government, there will be more problems. Production’s quality cannot be guaranteed and the fund can be in shortage.” “It is quite hard to tackle the problems from the government management, so letting businesses responsible for its operation is better for there can be less expenditure and more profit. But it seem that the government should guide the businesses for their management at first.” (Zuo & Deng, 1986, p. 368)

In conclusion, economically, Li Hongzhang took such policies as the special management rights, borrowing official funds and tax cut to help the bureau out of the predicament, improve its competence against foreign businesses and prevent the environment for its development. Politically, he prevailed in the competition against the conservative and the faction in Hunan, and weather the pressure from negative opinions toward the bureau to guard the system under the government supervision and businesses management for a benign internal environment for the bureau’s development. His economic and political measures accelerated its expansion and increased its

stock price, forcing Jardine Matheson and Swire to sign the parity contract and reaching balance between these enterprises in East Asia.

### 3. Shrinking and More Control: Li Hongzhang and the stagnant China Merchants Steamship Bureau (1885-1901)

In 1883, Sheng Xuanhuai joined the bureau with the help of the financial storm in Shanghai. As the “supervisor”, he first stipulated the regulations such as *Ten Principles for Selecting the Personnel* and *Ten Principles for Financing* to impose more government control on the bureau; second, he refused to raise capital and invest in ships; and last, he increased the reward for the government and the investment into new westernization enterprises. There were various reasons for more control, and the most fundamental reason was that Li Hongzhang could bring less support for the bureau because he was criticized by the public after the Chinese-French War.

#### 3.1 Sheng Xuanhuai into the Bureau

In 1883, the outbreak of a financial storm in Shanghai closed money houses and impeded the bureau’s finance. Xu Run was removed from his post because of his disclosed embezzlement for speculation. At the same time, Tang Tingshu was visiting abroad, and he was moved from the bureau to manage Kaiping Coal Mine. Sheng Xuanhuai asked Li Hongzhang for a post as the “supervisor” of the bureau in attempt to dominate. The bureau was always a government-supervised and business-managed enterprise, but it experienced two stages with different government imposition. If the first decade of the bureau (1873-1883) is dominated by businesses, the government took the hold when Sheng Xuanhuai mastered the bureau in 1883.

First, he filled out a large amount of the bureau stocks in

low prices, and “shared 40-50% of the stock” (Fan, 1985, p.258) in 1887, becoming the largest shareholder, but his silver bullet in the bureau was the imperial authority to “supervise and renovate the bureau”. As he went into the bureau, he revised the regulations, the first of which became: “A commissioner should be appointed for careful inspection; personnel and finance are arranged by the commissioner.” The ninth articles of *The History of Transportation: Navigation Affairs* says, “(The board chairman) can be removed if incompetent (1931, p.157).” He seemed to be the imperial official to override other chairmen and to randomly switch the personnel. No wonder he was criticized that he “overrode businesses with his official identity and cheated other officials as a businessman (Yi & Hu, 2005, p.243).”

“Stingy” can best describe him in the bureau. He was totally not interested in attracting new capitals and procuring new ships. In 1891, Xie Jiafu maintained that Xu Run, who had become down and out, can be recruited, but Xu (2012, p.49) was repudiated because his opinion that “new ships should be procured to reach the economic balance was different from Sheng’s”. According to the author, Sheng’s “stingy” policy stemmed from the immense government loan and foreign debts. Procurement of ships would incur officials’ criticism when the economy was unstable. To keep his post and himself from censure, he implemented “stingy” policies that stagnated the bureau’s business.

Stingy as he was for the bureau’s business, he invested too much into other westernization enterprises and rewarded a large sum to the government. His bureau became his own “private accountant office”. Li Hongzhang gave him an appropriate comment: “He attempted to do a big business when he sought a high-ranked post.”

**Figure.3 The Bureau’s Investment in Emerged Enterprises (1885-1901)**

Year	Investment
1885	Over 60900 taels for Jingmen Mine of Anhui; 210 thousand taels for Kaiping Mine
1888	Kaiping Mine basically paid back the principal and interest
1891	100 thousand taels for the Looms Bureau
1896	Stock of 800 thousand taels for the Imperial Bank of China
1898	100 thousand taels for the equity of Hubei iron works, which owned 20000 taels of equity Taiwan Trading Bureau (Taiwan Business Bureau)
1899	100 thousand taels for Pingxiang Coal Mine equity
1901	800 thousand taels for the shares of the Imperial Bank of China; 274 thousand taels for Hubei iron works’s shares; and 164400 taels for the shares of Pingxiang Coal Mine

Source: Li Zhigang: *Operation and Management Problems of China Merchants Steamship Bureau, 1872-1901*

**Fig.4 Financial Support for Government from China Merchants Steamship Bureau**

Year	Amount	Usage
The 17 <sup>th</sup> Year of Guangxu (1891)	100000	Disaster Relief
20 <sup>th</sup> (1894)		
25 <sup>th</sup> -29 <sup>th</sup>	55200	The Birthday Celebration of the Empress Dowager Cixi
25 <sup>th</sup> -29 <sup>th</sup>	380000	Reward Official Funds to the Government
(1899-1903)	300000	The Second-round Support for the Northern Faction
27 <sup>th</sup> (1901)		
29 <sup>th</sup> (1903)	34600	Northern Faction
Total	20000	
	889800	

Source: Li Zhigang: *Operation and Management Problems of China Merchants Steamship Bureau, 1872-1901*

As Figure 3 and Figure 4 show, from 1885 to 1901, the bureau's investment to other emerging Westernization enterprises has reached more than 262 teals in total, and nearly 90 taels were served to the court during the ten years, with a total of nearly 3.5 million taels. It should be noticed that in 1877, the total amount for purchasing Russell & Co. was only 2.22 million taels of silver, but as Sheng Xuanhuai took office, the investment to new westernization enterprises alone has surpassed the number. Besides, Sheng's foreign investment was only approved by Li Hongzhang, while the board chairman was never consulted, which meant the bureau has become a titular business-managed enterprise. It was no wonder that Zheng Guanying complained that "The use of the bureau's funds was never discussed with the shareholders but only with the governor for his approval, which went against the norm of business ..... If the power was conferred in such a way regardless of any shareholders ... it would be intolerable to see the secretary general rob the public fund for private purposes." (Xia, 2013, p.1007)

### 3.2 The Reasons for More Government Control on the Bureau

Through the discussion above, we can clearly see that after 1883, when Sheng Xuanhuai took the office, the government's control on China Merchants Steamship Bureau was obviously strengthened.

Ostensibly, the government imposed more control on the bureau was a decision made from its experience and lessons. In Sheng Xuanhuai's *Overview* of the bureau, he said, "Tang Tingshu and Xu Run gradually dominated the bureau ..... They were so unscrupulous that everything in the bureau was corrupted. The Bureau had severe problems and heavy deficit, and it is impossible that if the government sees it happen without any action to protect the bureau ..... profits will not be engulfed by foreign businesses! (*The History of Transportation: Navigation Affairs*, 1931, p.157)" Sheng Xuanhuai seemed to change the situation in which Tang Tingshu and Xu Run "dominated" the bureau, but as mentioned above, the measures he took not only failed to change the situation, but aggravated

its severity. Therefore the reason cannot explain the government control on the bureau.

In the author's opinion, Li Hongzhang's political strategic contraction was the fundamental reason for the government control on the bureau after 1883. After 1872, when Zeng Guofan died, Li Hongzhang and his forces in Huai became prosperous. He won the appreciation and appointment of the central government leaders such as Yixin and Yixuan so that his political prestige was greatly improved. His westernization enterprises such as Jiangnan Manufacturing Bureau and China Merchants Steamship Bureau were popular at the same time. Li Hongzhang was able to sponsor these enterprises quite easily. But after 1883, however, his conservative military strategy and appeasement in the Chinese-French War brought him severe criticism in the court, especially the scathing censure from the Qingliu faction. Although his political status has not faltered, Li Hongzhang was pushed to a dangerous situation. Not only did he actions were controlled, but even every move was inspected by every sector. On top of it, the financial storm in Shanghai had the embezzlement of Xu Run and Tang Tingshu exposed. In order to protect himself, he had to give up the previous business strategy for the bureau and supported more government control. Li Hongzhang's political contraction to rescind the policy for the bureau was the main reason for more government imposition.

In addition, the financial shortage of the Qing government was also responsible for its strengthened control in the late period. At the beginning of the 1880s the Chinese-French war and the Japanese threat to North Korea forced the government to spend a large sum on military for security, which meant it did not have sufficient funds to support westernization enterprises. Instead of helping the westernization enterprises, the government required them to serve more to sustain the government operation. It also reflected that the government was in hard trouble in terms of finance.

With Sheng Xuanhuai entering the bureau in 1883, he imposed more control on it, worsening and even stagnating the operation in the bureau. The main reason for the government

control were to deal with the problems from the management of Tang Tingshu and Xu Run, the political retreat of Li Hongzhang and the financial shortage of the Qing government. Among the three reasons, Li Hongzhang's political retreat and his withdrawing the protection for the business-managed system should be the most important and fundamental reason.

### Conclusion

To sum up, Li Hongzhang made an indelible difference in the development of China Merchants Steamship Bureau. In the early period (1872-1883), Li Hongzhang, with his political influence, promoted modern shipping industry and established the bureau by overcoming various difficulties. Meanwhile, he provided economic support for the bureau by granting the special rights for transporting imperial resources, borrowing official funds and preferential taxation and debt policies; politically he insisted a business-managed system in spite of much opposition, which helped create a congenial environment and effective protection for its development. In the late period (1883-1901), the government strengthened its control mainly because of Li Hongzhang's political strategic retreat, the tight finance of the Qing government and the renovation based on the previous lessons. Li Hongzhang spared no efforts for the bureau, and thus contributed to the birth and growth of modern China's shipping industry. He was the pioneer of the industry, propelling its development.

Indeed, Li Hongzhang founded and supported China Merchants Steamship Bureau, promoting the development of China's modern shipping industry and making remarkable achievements, but we have to admit that the ups and downs of the bureau were completely at the mercy of him. As Professor Li Zhigang (1990) from the University of Queensland said, "the main problem of the bureau was that its system was highly dependant on Li Hongzhang rather than on the law". The author extremely agrees with this view. We can see from the analysis that it was not capital and management policies but the situation of some political powers in some factions that decided the development of China's modern shipping industry. A clear understanding of this fact will help us to understand the reasons why China's modern shipping industry became stagnant.

### References

- Association of Chinese Historians. (1954). *Imperial Statement by Li Hongzhang, the Governor of Zhili, on the 27th in the Third Lunar Calendar of the 6th year of Guangxu, Westernization Movement (VI)*, p. 39. Shanghai: Shanghai People's Press.
- Association of Chinese Historians. (Eds). (1954). *Imperial Statement by Wang Xianqian, Official in the Imperial College, on the 26th in the Tenth Lunar Calendar of the 6th year of Guangxu, Westernization Movement (VI)*, p. 44. Shanghai: Shanghai People's Press.
- Association of Chinese Historians. (Eds). (1954). *Imperial Statement by Li Hongzhang, the Governor of Zhili, on the 21st in the Second Lunar Calendar of the 7th year of Guangxu, Westernization Movement (VI)*, p. 61. Shanghai: Shanghai People's Press.
- Association of Chinese Historians. (Eds). (1954). *Imperial Statement by Li Hongzhang, the Governor of Zhili, on the 21st in the Second Lunar Calendar of the 7th year of Guangxu, Westernization Movement (VI)*, p. 61. Shanghai: Shanghai People's Press.
- Association of Chinese Historians. (Eds). (1954). *Imperial Statement by Yixin, the Prime Minister, on the 14th in the Fourth Lunar Calendar of the 7th year of Guangxu, Westernization Movement (VI)*, p. 68. Shanghai: Shanghai People's Press.
- Institute of Modern History in the Central Academy of Taipei (1957 Eds.). *Coastal Defense, A: Purchasing Warships and Cannons*. pp. 851-858. Taipei: Institute of Modern History in the Central Academy of Taipei
- Institute of Modern History in the Central Academy of Taipei (1957 Eds.). *Coastal Defense, A: Purchasing Warships and Cannons*. pp. 861-862. Taipei: Institute of Modern History in the Central Academy of Taipei.
- Reports of Shen Baozhen on First Day of Fourth Lunar Month of Tongzhi Eleventh Year. Association of Chinese Historians: Westernization Movement (Fifth / 1954 version), P.115*. Shanghai: Shanghai People's Publishing House.
- Reports of Tai Chang Shi Chen Lanbin on 24<sup>th</sup> Day of Tenth Lunar Month of Gang Xu Second Year. Association of Chinese Historians: Westernization Movement (Sixth /1954 version),P.9*. Shanghai: Shanghai People's Publishing House.
- Bao, J. et al. (2008). *The History of the Qing's Western Affairs, Tongzhi 9, Vol. 86, p.3407*. Beijing: Zhonghua Book Company.
- Bao, J. et al. (2008). *The History of the Qing's Western Affairs, Tongzhi 9, Vol. 86, p.3476*. Beijing: Zhonghua Book Company.
- Chen, Y. Q. (2013). *Report on Investigation of the Document in the Committee of China Merchants Steamships Bureau by National Government, p. 480*. Beijing: Social Science Academic Press.
- Fan, B. C. (1985). *The Rise of China's Shipping Industry, p.258*. Sichuan: Sichuan people's press.
- Liu Jinzao (Qing Dynasty). (1988). *A Comprehensive Research on Literature in the Qing Dynasty, P. 3148*. Zhejiang: Zhejiang Ancient Books Publishing House.
- Li, Z. G. (1990). Operation and management problems of china merchants steamship bureau of 1872-1901. *Collection of Modern History Department of the Central Research Institute, 19*.
- Li, H. Z. (2008). *In Return for Governor He Xiaosong, Complete Works of Li Hongzhang, letters to friends and colleagues, Vol. 12, p.477*. Anhui: Anhui People's Press.
- Li, H. Z. (2008). *In Return for Governor Zhang Zhenxuan, Complete Works of Li Hongzhang, letters to friends and colleagues, Vol. 12, p.481*. Anhui: Anhui People's Press

- Li, H. Z. (2008). *In Return for Inspector Sun Zhutang, Complete Works of Li Hongzhang, letters to friends and colleagues, Vol. 12, p.483.* Anhui: Anhui People's Press
- Li, H. Z. (2008). *Proposal on Pilot Merchants Steamships, Complete Works of Li Hongzhang, proposals, Vol. 5, p.258.* Anhui: Anhui People's Press
- Li, H. Z. *Complete Works of Li Hongzhang, Letter Three P.242. On the Wage Raising for the Navy to the Governor.* Gu, T. L. & Dai, Y. (Eds.). (2008). Anhui: Anhui Education Press.
- Li, H. Z. *Additional Report on the Business in the Merchant Bureau, Complete Works of Li Hongzhang, proposals, Vol. 9, p. 48.* Anhui: Anhui People's Press.
- Li, H. Z. *Proposing the Merchants Bureau's Funds Reduction, Complete Works of Li Hongzhang, proposals, Vol. 7, p. 458.* Anhui: Anhui People's Press.
- Li, H. Z. (2008). *Following the Resolution to Support the Merchants Bureau, Complete Works of Li Hongzhang, proposals, Vol. 11, p. 325.* Anhui: Anhui People's Press.
- Li, H. Z. (2008). *Proposal on Pilot Merchants Steamships, Complete Works of Li Hongzhang, proposals, Vol. 5, p. 258.* Anhui: Anhui People's Press.
- Li, H. Z. (2008). *Marine Transport of Official Resources Assigned to the Merchant Bureau, Complete Works of Li Hongzhang, proposals, Vol. 7, p. 499.* Anhui: Anhui People's Press,
- Li, H. Z. (2008). *Statement on the Rectification of China Merchants Steamships Bureau, Complete Works of Li Hongzhang, proposals, Vol. 7, p. 533.* Anhui: Anhui People's Press.
- Ni, Y. P. (2007). *Li Hongzhang and the Marine Transport of Imperial Rice in the Late Qing, Anhui Historical Studies, pp. 94-98.*
- The Transportation History Compilation Committee of the Ministry of Transportation and Railway. (1931). *The History of Transportation: Navigation Affairs, Vol.1, p. 147.* Shanghai: Shanghai Minzhi Press.
- The Transportation History Compilation Committee of the Ministry of Transportation and Railway. (1931). *The History of Transportation: Navigation Affairs, Vol.1, p. 148.* Shanghai: Shanghai Minzhi Press.
- The Transportation History Compilation Committee of the Ministry of Transportation and Railway. (1931). *The History of Transportation: Navigation Affairs, Vol. 1, p.157.* Shanghai: Shanghai Minzhi Press.
- The Transportation History Compilation Committee of the Ministry of Transportation and Railway. (1931). *The History of Transportation: Navigation Affairs, Vol. 1, p.157.* Shanghai: Shanghai Minzhi Press.
- Wu, X. & Yao, W. et al. (1918). *Continued Account of Shanghai County, Vol. 7, p. 15.* Shanghai: Nanyuan Account Bureau.
- Wu, X. & Yao, W. et al. (1918). *Continued Account of Shanghai County Vol. 7, p. 15.* Shanghai: Nanyuan Account Bureau
- Xia, D. Y. (1982). *Comments on the Circumstances. Works of Zheng Guanying, P. 93.* Shanghai: Shanghai People's Publishing House.
- Xia, D. Y. (1982). *Works of Zheng Guanying, p.704.* Shanghai: Shanghai People's Press.
- Xu, R. (Qing dynasty). (2012). *Autobiographical Chronicle by Xu Yuzhai, p.49.* Jiangxi: Jiangxi People's Press.
- Xia, D. Y. (Eds). (2013). *The Second Part of Crisis in Prosperity 3, p.1007.* Zhonghua Book Company.
- Yi H. L. & Hu, Z. (Eds). (2005): *China Merchants Steamships Bureau and Modern China, p. 183.* Beijing: China Social Science Press.
- Yi, H. L. & Hu,Z. (Eds). (2005). *China Merchants Steamships Bureau and Modern China, p. 243.* Beijing: China Social Science Press.
- Yi, H. L. (2009). *The Merger of Russell & Co. into China Merchants Steamships Bureau and the "Trade War Theory", The Sea of History, p. 45.*
- Zuo, Z. T. & Deng, Y. S. (Eds.). (1986). *Complete Works of Zuo Zongtang, p.368.* Changsha: Yuelu Press
- Zhang, H. S. (Eds.). (2007): *History of China Merchant Steamship Bureau, P. 7.* Beijing: China Social Sciences Press.



# Conservation of Historical and Cultural Towns and Villages in China

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**Abstract:** Historical and cultural towns and villages (HCTVs) in China homes to a large variety of fascinating tangible heritage, intangible heritage and natural landscapes. These legacies characterised from ancient history, architecture, society, humanity, aesthetics, philosophy and folk custom, are significantly undervalued. The conservation and protection strategies are conventionally understood as nominal rather than substantial. And even some hot-button issues remain off limits. In this article, the knowledge map case study provides a unique opportunity to data mining and cluster analysis precisely bibliographic references from 1995 to 2015, and scrutinize the research front. We address critical review on selected pressing issues that resides potential burgeoning territories, and the perspective of methodological considerations would be also envisaged and discussed.

**Key words:** China, historical and cultural towns and villages (HCTVs), tangible heritage, intangible heritage, natural landscape

## Introduction

China is a country of exceptional diversity and the most populous country with a population of over 1.3397 billion (Peng, 2011) increased from 1.2375 billion in 1995, and China has a long, rich history with an almost unbroken cultural tradition extending back to some 5,000 years ago. Its cultural and natural heritage sites record the formation and development of the Chinese people. The most fascinating feature of China consists of its very diverse rural areas with their individual traditions, ways of life, and working methods to the links uniting us all in processes of exchange and dialogue. In 1885, an urgent appeal James B. Angell made for “a thorough investigation of existing usages and laws in towns and villages of China” (Angell, 1885). For Historical and Cultural Towns and Villages (HCTVs), one of the most significant aspects is their intense interaction with their environment, which has resulted in the reshaping of very diverse and fascinating cultural landscapes. However, the outstanding cultural and natural legacy and a long tradition of conservation and restoration practices in HCTVs are poorly understood yet (Gruber, 2007).

The year 2015 marks the 70<sup>th</sup> anniversary since UNESCO was founded in 1945 to develop the “intellectual and moral solidarity of mankind” as a means of building lasting peace. At the turn of 2015, nurturing and safeguarding of the status quo of the distinctive cultural forms of the HCTVs in China, as well as

the processes of their production, has emerged as a key concern for professionals at home and abroad. Therefore, the essential challenges would be to propose coherent perspectives opened up by reflection on HCTVs and their intrinsic values. Those challenges identify a main thread among the wide range of possible interpretations, and thereby clarify how they can become beneficial to the action of the international community. That is the essential purpose of the present methodological considerations and arguments.

## 1. China's villages: beyond the research front

What's scientific research front in the progressive knowledge domain of China's towns and villages? There are several key questions should be addressed by this case study. What's the latest research front on China's towns and villages? How did the research front evolve over the last two decades? What are the hottest research-front terms? Which papers are associated with these terms?

### 1.1 Modeling: Knowledge Domain Visualization

The pattern of bibliographic references indicates the nature of the scientific research front (Price, 1965). Spatio-temporal dynamics are identified in terms of the most active topical areas and cited references via scientometrics (Mingers & Leydesdorff, 2015). Latest developments are identified in terms of newly emerged clusters and knowledge domains (C. Chen, Dubin, & Kim, 2014). The primary goal of knowledge domain

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visualization (KDViz) is to detect and monitor undescribed evolution of the knowledge domain of China's towns and villages.

The central idea of KDViz is to calculate co-citation counts within each time-sliced segment and then merge adjacent networks into resultant networks. Co-citation metrics could be normalized as cosine coefficients (C. Chen, 2004). Suppose two documents respectively are  $D_i$  ( $1 \leq i \leq n$ ) and  $D_j$  ( $1 \leq j \leq n, i \neq j$ ), then the cosine coefficients can be defined as follows,

$$CC_{ij} = C_{ij} / \sqrt{C_i \times C_j}$$

Where  $C_i$  and  $C_j$  represent the citation counts of  $D_i$  and  $D_j$ , respectively.  $C_{ij}$  represents the co-citation count between  $D_i$  and  $D_j$ . Obviously,  $C_{ij} \leq \min(C_i, C_j)$ ,  $0 \leq CC_{ij} \leq 1$ . When  $C_{ij} = C_i = C_j$ ,  $CC_{ij} = 1$ , while when  $C_{ij} = 0$ ,  $CC_{ij} = 0$ . In CiteSpace, Cosine, Dice, and Jaccard similarity coefficients are available to measure link similarity. Kamada and Kawai's algorithm is used in normalized mapping procedure (Kamada & Kawai, 1989). Although more efficient meta-ranking algorithms (Ennas, Biggio, & Di Guardo, 2015) and visualization mapping and clustering algorithms (Kudelka, Kromer, Radvansky, Horak, & Snasel, 2015) are potential candidates in KDViz, the topic is beyond the scope of this article.

### 1.2 Knowledge Map Study: from 1995 to 2015

In 1965, Derek J. de Solla Price firstly coined the item "research front", which represents the state-of-the-art thinking of a research field (Price, 1965). It is generally known that scientific literatures characterized by two distinct citation half-lives of papers: classic papers with persistently high citations and transient ones with their citations peaked within a short period of time. To characterize the transient nature of the research field — China's towns and villages, CiteSpace (C. Chen, 2004) is used to detect transient patterns of bibliographic references in the past 20 years, visualize emerging trends, and demonstrate a true nature picture of the above target domain (hereafter this text will be abbreviated as 20-year Knowledge Map Study).

In KDViz, the input data for CiteSpace III (version 3.9. R6 64-bit) were retrieved from citation index databases via the Web of Science based on a topic search for articles published between 1995 and 2015 on China's towns and villages. The scope of the search included four topic fields in each bibliographic record: author, title, source, and abstract. The search was limited to articles (include book reviews) in English only. Networks of co-cited references representing literatures are constructed and visualized based on the resultant dataset of 2,441 hits, which matched our query of the 34,304,420 records retrieved in the Web of Science. The 20-year time span between 1995 and 2015 was divided into eleven 2-year time slices, and top 60 most-cited

or occurred items from each slice was selected for later analysis. Three sets of threshold levels, namely citation frequency threshold ( $f_c$ ), co-citation frequency threshold ( $f_{cc}$ ), and co-citation coefficient threshold ( $f_{cos}$ ), were set as follows: (4, 4, 20), (4, 4, 20), and (4, 4, 20), and hereby  $cosine \geq 0.15$ .

Figure 1 shows an overview visualization and panoramic image by cluster analysis with 2,422 bibliographic records over weight threshold, pivotal 510 nodes and 121 clusters. Visually salient nodes and clusters indicate that top-10 active research fields notably introduced by archaeologists, environmentalists, economists, parasitologists, anthropologists, demographers, ecologists, sociologists, zoologists and agriculturists.

Figure 2 shows a timeline view of 121-cluster hybrid network of cited articles (intellectual bases) and citing terms (research fronts) on China's towns and villages based on eleven 2-year slices. The emerging trends involved in bibliographic references from 1890 to 2014, with several 'gaps'. Early in 1890, the first pivotal-point research stems from an English entomologist Peter Cameron (1847-1912) who contributes to a knowledge of the Hymenoptera Orientalis of the oriental zoological region identified by Figure 2 (Cameron, 1897). The 'gaps' emerges at about from 1890 to 1938, from 1940 to 1954, and from 1966 to 1976 respectively. In fact, cultural and natural heritage conservation had a troubled history in Maoist China (1949-1978). Although the Chinese Ministry of Culture of the PRC paid great attention to archaeology and cultural relics work in the 1950s and early 1960s, outside these fields neglect was often the kindest fate an ancient monument could be accorded. The governments waged an active onslaught against temples, walls and other ancient monuments as the physical embodiment of a denigrated feudal past. The depredations of 'the Cultural Revolution' deeply affected all of those who, in the late 1970s and 1980s, sought to salvage what remained in its wake (S. H. Ahmad, 1967).

The Zhongguo Yingzao Xueshe (Chinese Architectural Society, 1930-1946), named for the Song dynasty treatise on ancient architecture titled Yingzao Fashi, was a group of intellectuals devoted to the study, documentation and preservation of ancient Chinese architecture. This society and many of the impressive elderly generation of conservators and researchers characterised the Republican period (the 1950s and the early 1960s). Liang Sicheng (1901-1972) is recognized as the "Father of Modern Chinese Architecture", and the author of China's first modern history on Chinese architecture and founder of the Architecture Department of Northeastern University in 1928 and Tsinghua University in 1946. The influence of Liang Sicheng on the development of conservation practice in China beginning in the 1930s have been investigated (Agnew & Demas, 2002; Lai, Demas, & Agnew, 2004). He was the Chinese representative on the Design Board which designed the United

Nations headquarters in New York. He discovered and analysed the first and second oldest timber structures still standing in China, located at Nanchan Temple and Foguang Temple at Mount Wutai. Luo Zhewen, a student of Liang Sicheng, is one of China's leading scholars of ancient architecture, especially that of the Great Wall. He is also one of the initiators and rapporteurs of the *Declaration of Qufu*, which is one of the most important guidance documents for cultural and natural heritage conservation practices in China. Several foreign scholars, including the art historian Wilma Fairbank who conducted pioneering fieldwork at the Wu Liang Shrine in Shandong, were also involved with the Chinese Architectural Society. Later, in tandem with the development and application of the nation and localized basic principles in China, scholars from various disciplines to address the ways in which cultural and natural heritage has been invented, valued, and managed in late imperial, modern, and contemporary China. Development of case studies of sites in China and research and writing on conservation practice in China and its relation to Western practices continues. On the whole, the top-20 keywords demonstrates the hottest research front in the past two decades. After twisting the further abundant information from the term nodes from Figure 2 manually and carefully, we recognize that several active topics involved in as following: township-village enterprise (TVEs) (*enterprise, provider's opinion, contract service, and etc.*), health and epidemiological survey (*schistosomiasis, arsenic, selenium, cataract surgery, controlled trial, and etc.*), rural economic system (*economic development, growth, and etc.*), peasant-worker (*rural settlement, rural youth, adult women, Philippine, and etc.*), *chengzhongcun* (*chengzhongcun, distinct urban space, and etc.*), and environmental archaeology research (*Devonian, hymenoptera, dongting lake region, and etc.*). As a case in point, TVEs that previously "Commune and Brigade Enterprises" dating from the Great Leap Forward of 1958 to 1961 had served the rural areas. Since the State Council of the PRC first officially used the term "TVEs" in March, 1984, there is a resurgence of interest in this active field and further investigations have been carried out by scientists at home and abroad in this scenario (Chang & Wang, 1994; Weitzman & Xu, 1994). Subsequently, recent advances in tentative mechanisms of TVEs have opened a burgeoning subjects, especially in comparative economics domain (Chu & Song, 2015; Du, Lu, & Tao, 2015).

Figure 3 shows a timezone view of 121-cluster hybrid network of cited articles and citing terms on China's towns and villages based on eleven 2-year slices. Based on Figure 2, Figure 3 further demonstrates the emerging trends involved in bibliographic references from 1995 to 2015. The top-5 keywords uncovers the hottest research front in the past two decades as following: *schistosoma japonicum* infection, China's township, urban village (refers to *Chengzhongcun* in Figure 2), and village

enterprise. China's township, urban village, and village enterprise, as the accompaniments with the rise of the urban territorialisation of rural areas and the geographic distribution of the Chinese population reshaped by an unprecedented rural-to-urban migration, draw public attention spontaneously (Bloom, Canning, & Fink, 2008; Glaeser, 2011; Normile, 2008; Peng, 2011; X. J. Yang, 2013).

Figure 4 shows a geographic map of co-author networks from 1995 to 2015 generated by Google Earth, where white lines connecting co-authors in their locations. We may choose to view co-author relations found in any specific year. Here, the density of lines is proportional to the collaborative strength between co-authors from their locations in the static map. In this study, the intensive cooperation between authors in the field of China's towns and villages mainly comes from China, USA, England, Australia, Japan, Canada, Germany, Netherlands, Switzerland, and France (Top-10 Countries) in the past 20 years. As a case in point, over past decades native professionals jointed with overseas counterparts have carried out a series of health and epidemiological survey, which had a positive effect on a massive scaling up of malaria prevention and treatment in China. According to the *2014 World Malaria Report* by the WHO, malaria mortality rates declined by 47% worldwide and particularly impressive achieved >75% decrease in case incidence in 2013 in China. While the major plasmodium species of parasites is *P. falciparum* (73%), *P. vivax* (23%), China reported just nine indigenous cases of *P. falciparum* malaria in 2013 and 71 of *P. vivax* and is aiming to eliminate malaria nationally by 2020. Figure 5 shows how malaria mortality rates have changed since 2000. Partly, those joint research created a favourable impetus that contributed to the public hygiene movement in China that resulted in a sharp drop in mortality from infectious diseases in the past decades (Mou, Griffiths, Fong, & Dawes, 2013; Peng, 2011).

### 1.3 What's the research front?

The use of CiteSpace III provides a unique opportunity to data mining and cluster analysis precisely the number of bibliographic references, and identifies the research front on China's towns and villages. It also help us to scrutinize pivotal bibliographic references, evaluate potential virgin territories on a relative level, and the perspective of methodological considerations would be envisaged. The object of study in intensive research is 'urban' rather than 'rural'. In most literatures, as a vague concept, the notion of 'rural area' refers to an area outside of cities and towns, and are used most frequently. Unfortunately, there is no notable literatures specialized in the field of conservation of cultural and natural heritage on HCTVs in China recognized in this study yet.

Until recently, the following domains in the field of China's towns and villages seek to understand and the underlying mechanisms should be uncovered:

(1) Policy non-transparency (Horsley, 2007), and effectiveness of law enforcement are long-standing problems but still uncultivated territory. The statutory documents on HCTVs adopted by international organizations and Chinese authorities, must affirm basic principles, strengthen assessment, improve enforcement, and enhance governance.

(2) The hierarchical structure of the administrative divisions of PRC and its efficiency is poorly understood yet (Cartier, 2013; Chan, 2007; Schmidt, 2000). HCTVs in China almost governed by counties, as a critical joint in the complicated administrative structure, their efficiency should be clearly demystified and contextualized.

(3) Most literatures focus on microscopic qualitative analysis on specific case study rather than macroscopic and comprehensive quantitative analysis the whole nation. And most of those case studies always focus on settlements of Han population in eastern or western regions rather than those in central regions and other minorities' settlements. Most literatures attached the more importance to tangible culture than intangible culture and natural landscape (Y. Ahmad, 2006).

(4) As the legacy keepers of HCTVs, locals' living conditions (including the rich-poor gap, self-sufficiency abilities, land use, urbanization impacts, diverse climate, education level, dynamic environmental reciprocity, biodiversity, and so on) need to be given enough attention and reassessed (Wei & Zhang, 2015). The inhabitants in HCTVs should be encouraged to enjoy and nourish those legacy voluntarily.

(5) The quintessence extracted from ancient history, architecture, society, humanity, aesthetics, philosophy, and folk custom reflected from tangible and intangible culture in HCTVs, are significantly undervalued (Y. Ahmad, 2006).

There are still puzzling rings with no beginning and no ending in the fields motioned above and some hot-button issues remain off limits (Bloom et al. 2008, Normile 2008, Glaeser 2011, Peng 2011, Yang 2013, Bai et al. 2014). Actually, the 20-year Knowledge Map Study reveals a proposed multidimensional model of research domains that reside rich ore. It is impossible to cover all those pressing issues in this article, therefore, only a few are selected for later discussion.

## **2. Conservation and Restoration of HCTVs: Challenges and Opportunities**

From the above 20-year Knowledge Map Study, while the Chinese Cultural Revolution devastated Chinese cultural and natural heritage and resulted in the destruction of many significant sites, domestic scholars resurged with passion to contribute to related fields broadly since 1980s. With revitalization of China's cultural and natural heritage conservation, there has been a new emphasis on the identification and understanding of local traditions.

On October 8, 2003, the Ministry of Housing and

Urban-Rural Development (MOHURD) and the State Administration of Cultural Heritage (SACH) jointly announced the first list of National Historical and Cultural Towns and Villages (NHCTVs). This action is said to be an important milestone of unveiling the protection of HCTVs in a positive and transformative way. As an indispensable and important component of historic and cultural and natural heritages of China, HCTVs have preserved a great number of complete ancient streets and buildings, also inherited abundant precious historic information in economy, society and culture, forming valuable protosomatic resources. All these excellent 'living heritages' witness the continuous but ill-fated history, the crystallization of culture and art, and the precious wealth of the nation. As of February 19, 2014, there are 252 towns (Figure 6) and 276 villages (Figure 7) on the approved list of 528 NHCTVs, since the first batch of HCTVs has been approved by the State Council. And there are thousands of provincial HCTVs authorized by local governments of provinces, autonomous regions and municipalities. At the same time, a series of binding policies and pragmatic strategies issued by the central government and local authority guides HCTVs routine practice in the right way where it should be. As rich rewards, we would benefit a lot from those practices:

First of all, the action of conversation and restoration also witnesses the enormous potential for promoting peoples' own identity recognition and patriotism passion, and enhancing national cohesion. The 'living heritages' - tangible and intangible heritages are not only indicators of Chinese glory ancient history, but also the common wealth of all human.

Since joined the International Convention Concerning the Protection of World Cultural and Natural Heritage in 1985, China has 47 world heritage sites to date, ranking second in the world only running after Italy; of these 33 are cultural heritage sites, ten are natural heritage sites, and four are cultural and natural (mixed) sites. Since 2004, China has made the first large-scale renovations on seven world cultural heritage sites in Beijing - the Ming Tombs, the Great Wall, the Forbidden City, the Temple of Heaven, the Summer Palace, the Grand Canal, and the 'Peking Man' site at Zhoukoudian, all of which are planned for completion before 2008. In addition, China has a rich non-material cultural and natural heritage, with several of them inscribed on UNESCO's list of Masterpieces of the Oral and Intangible Heritage of Humanity. From 'Ancient City of Ping Yao' (1997) to 'Old Town of Lijiang' (1997), as well as from 'Ancient Villages in Southern Anhui - Xidi and Hongcun' (2000) to 'Kaiping Diaolou and Villages' (2007), more and more HCTVs features the World Heritage List (WHL). Nowadays, it is worth mentioning that those conservation and restoration experiences on world heritage sites also set up best practice paradigms for other HCTVs.

As shown in Figures 6 and 7, the 528 NHCTVs are widely

distributed in China. Notably, the 528 NHCTVs and the 47 world heritage sites are mostly distributed in the following provinces: Jiangsu, Zhejiang, Anhui, Jiangxi, Guangdong, Guizhou, Sichuan, Chongqing, Shanxi, Gansu, Hebei, Henan, Hubei, Hunan, Fujian and Yunnan (as shown in Figure 6, 7, 9). It is not hard to find that NHCTVs are closely related to the above world heritage sites. In other words, the more NHCTVs agminate regions tend to be much more world-class heritage sites.

Besides, whatever history, architecture, society, humanity, aesthetics, philosophy, and folk custom reflected from tangible and intangible culture, share with us huge and precious thinking and knowledge repository. As a case in point, the two traditional villages of Xidi and Hongcun have exercised great influence in a number of fields, including architecture, environment, industrial design, aesthetics, and literature. Their overall planning, architectural style, and landscape design provide admirable models for the construction of human settlements. The profound historical experience of water system, its living environment and ecological awareness as well as its practical values such as washing, fire prevention, irrigation, ornamentation, and so on. Zhang Da roughly reviewed on the protection of water environment in HCTVs (Da & Yun, 2010). In fact, those wisdoms would open and enlighten contemporary spatial structure, street design, channels and plumbing system, vernacular dwellings, as well as environmental philosophy for both urban and rural settlements.

Last but not least, it is of vital significance to improving the popularity of best practice paradigms all over in China, implementing protection agenda and formulation, and promoting and booming cultural and natural heritage tourism undoubtedly (Li, Wu, & Cai, 2008; C. H. Yang, Lin, & Han, 2010). In 2012, the tourism industry directly accounted for nearly 4% of GDP, and China National Tourism Administration (CNTA) expects this to reach 4.5% in 2015 (OECD, 2014). The authentic and well preserved historical character of those HCTVs have attracted considerable attention from historians, architects, artists, as well as visitors. Certainly, it's worth noting that too much visitors can degrade the regional community. This situation can result in over-depletion of the historic property and assets.

However, since some HCTVs showing hard-won improvements and others demonstrating an appalling lack of momentum, the protection strategies of HCTVs always make us fluctuate between hopes and fears.

### **3. The looming crisis: Challenges and Opportunities**

China's unbalanced urbanization strategy is leading to excessive growth of mega-cities while ignoring the country's small cities, towns, and villages, which remain small, impoverished, and poorly developed (Cao, Lv, Zheng, & Wang, 2014). The level of urbanization in China before the 1980s was

quite low, and it increased very slowly over time (Peng, 2011). However, China's urbanization increased from 30.96% to 54.41% between 1995 and 2014 (Figure 8), but that figure does not include migrant workers registered as residing in rural areas. By 2020, some 60% of the population will live in cities, according to government estimates. Unfortunately, China's urbanization has developed far ahead of its economic growth. As a consequence, China's urban economic advantages are being offset by the perennial overcrowding urban, air and water pollution, environmental degradation, increased uncultivated land, rural hollowing, and severe labour shortage in its rural communities (Bloom et al. 2008, Normile 2008, Glaeser 2011, Peng 2011, Yang 2013, Bai et al. 2014).

Local executives often rhapsodize about the appetite for rich heritage in HCTVs, since they are beautiful business cards and brand image prolocutors of cities. But there is a consensus that the historical and cultural heritage in HCTVs will continue to decrease. The priority of rapid economic development in China may be one of the decisive factors, but not the only determine answer to these questions. The underlying mechanisms is conventionally understood as nominal rather than substantial.

#### ***3.1 Diversity Dilemmas: The Needs for Research and Development***

Although the scope of heritage, in general, is now agreed internationally to include 'tangible' and 'intangible' as well as 'environments', the finer terminology of 'heritage' has not been streamlined or standardized, and thus no uniformity exists between countries (Y. Ahmad, 2006). There are 528 NHCTVs, thousands of HCTVs authorized by local governments, and some world heritage sites in those HCTVs to date (as shown in Figure 6, 7, 9). They are all featured by very diverse fascinating tangible heritage, intangible heritage and natural landscapes. This variety constitutes one of the difficulties of their protection, but it also makes their preservation all the more important. The preservation of variety in a civilization is one of the core issues of protection agenda.

Cultural landscapes in HCTVs might be more prone to be disregarded than tangible and intangible heritage comparatively. For example, urban planners seem to treat nature as if it does not exist. The growing pressure on the scarce and precious water resource is severely undermining natural hydrological regimes and further endangering the environment in urban and rural regions (Lu and Ran 2011). The disappearance of cultural landscapes will also have an impact on the biodiversity in the region. Especially in regions where the cultivation of land is very difficult, the people have had to develop specialised techniques to adapt to the local agro-ecological conditions (Cao et al., 2014; Long, 2014; Xi, Zhao, Ge, & Kong, 2014). Their practical knowledge and efforts to secure ecological stability and avoid erosion in order to ensure sustainable cultivation of the

available land is crucial to the preservation of the local ecosystems and the diversity of cultivated plants. Only through their work in the individual ecological habitats could they become familiar with the differences in the demands, the flexibility, and the reactions of the cultivated plants.

The Chinese Premier has declared “war on pollution”, and China formally began implementing its revised Environmental Protection Law (EPL) on 1 January 2015 (He, Zhang, Mol, Lu, & Liu, 2013). The new EPL provides weapons for this war, but their effectiveness will depend on enforcement, particularly in China’s developing rural regions. In fact, application of environmental laws in rural, less developed areas has been much weaker than in cities. Because of protests by middle-class city dwellers, factories have relocated to rural middle and western China, causing serious environmental degradation (R. Chen, de Sherbinin, Ye, & Shi, 2014; H. Yang, Flower, & Thompson, 2012; H. Yang, Huang, Thompson, & Flower, 2014).

The new EPL looks good on paper, but local bureaus have often attempted to reconcile conflicting goals of economic development and environmental protection, and overlapping responsibilities further weaken EPL enforcement. As an eco-demonstrator of urban development existing in harmony with the environment—even on an ecological treasure like Chongming, Dongtan’s backers hope it will offer a new model for other bureaus (Normile, 2008). Unfortunately, it will be difficult to copy the model wholly to other cities or even rural communes because of Shanghai’s financial and institutional support. On the other hand, without the ongoing work of the local farmers, this knowledge and the cultural landscapes, which have developed over centuries, will be lost in a very short time. Unfortunately the present development is towards more uniform land use, which makes the farmers increasingly dependent on fertilisers, pesticides, and seeds (R. Chen et al., 2014). After all, tourists buy tickets for stereotyped unbroken-expanse seas of rape flower. This expected loss of cultural heritage would also endanger many animal and plant species. Strengthening new EPL enforcement in these areas is essential to avoid the spread of contamination.

### **3.2 Reappraisal of inhabitants’ living conditions in HCTVs**

Generally, scholars and professionals are expected nominally to be the dominant force in conservation of HCTVs, rather than local inhabitants. But in fact, this is not the case. Those HCTVs are among the most characteristic examples of traditional Chinese towns and villages. They always have maintained their original form, in harmony with the natural environment to a remarkable degree. Their inhabitants are linked by blood ties, agriculture is the main economic activity, serious consideration is given to the geomantic environment, traditional customs are maintained, and there is a high degree of social stability. Therefore, local inhabitants should be optimal legacy

keepers who enjoy and nourish those legacy voluntarily. But their living conditions is one of the most important long-standing but long-neglected issue.

The huge migration involved in the process of urbanization has always been regarded as one of the motive forces of China’s economic growth and development (Peng, 2011).

By 2012, 262 million people had migrated to urban areas. The majority of the rural-to-urban migrants are men, who seek higher wages in cities but leave their children, spouses, and aging parents in their natal towns and villages. The labour shortage in HCTVs has led to increased uncultivated land and hastened significant changes to traditional agricultural practices (Sutton et al., 2011) and handicraft techniques. Worse, the scale and pace of urbanization promise to continue at an unprecedented rate, as well as current trends rural-to-urban migrants hold. There is a consensus that the growth of new urban residents will undoubtedly imply mounting pressures for many migrants-target cities (Bai, Shi, & Liu, 2014; Bloom et al., 2008; Glaeser, 2011; Normile, 2008; Peng, 2011; X. J. Yang, 2013). But the concomitant impacts on migrants-source rural areas are always overlooked unconsciously (Hvistendahl, 2014).

For decades, the Chinese government collects copious data, but much is secret, and what isn’t classified is often unreliable (Hvistendahl, 2010). Without doubt, government-backed national survey is the best opportunity to provide abundant fodder for data-starved scientists hoping to track how China’s rapid development is shaping societal values. The Chinese Family Panel Studies (CFPS) may first endeavour to document the body of information on urban and rural families. Although CFPS are always controversial national surveys for their limitations and drawbacks (Brewer, 2010; Hvistendahl, 2010, 2013), the imperfect solution, more often than not, still let us embrace the profile of living conditions of rural inhabitants. On May 13, 2015, the National Health and Family Planning Commission (NHFPC), first delivered a working report – *Chinese Family Development Report 2015*. This report is based on a national survey – ‘Chinese Family Development follow-up investigation’ – organized by the commission last year, which covered 32,494 households and 184,439 people in 1,624 villages, 321 counties and 31 provinces, autonomous regions, and municipalities. This report allows us to analyse dynamics within families as well as make comparisons across neighbourhoods, and there are several impressive findings should be taken into considerations:

Firstly, there is a huge gap of family incomes between urban and rural areas, as the income of the top 20 percent families is 19 times the income of the bottom 20 percent families. For all seniors, the external financial support mainly comes from their children. Rural seniors rely more heavily on their children financially than their urban counterparts.

Secondly, in rural areas, left-behind children make up 35.1

percent of all children living there, left-behind wives represent 6.1 percent of all wives, and left-behind senior parents account for 23.3 percent of all seniors.

Moreover, public services for families in rural communities is significantly lower than in urban communities. Those results help us understand comprehensively and systematically the basic situation of family in rural communities, as well as urban counterparts.

Little attention is devoted to the impacts of socioeconomic and political factors; China's social, economic, and cultural variants mean that we may never exactly grasp what lies ahead in terms of future demographic trends (Mou et al., 2013). Also, little is known about how urbanization will change millions of Chinese farmers' demographic behaviour and further affect future demographic trends (Wei & Zhang, 2015). Fortunately, China introduced a Western-style pension system in the late 1990s, and the system today is divided along rural-urban lines and regionally fragmented with decentralized financial and administrative management (Cai & Cheng, 2014). By the end of 2010, the Urban Basic Pension System covered 257 million urban residents, or about 40% of the urban population. In addition, 100 million rural people—15% of all population living in the countryside—have joined the new rural social pension system. However, the existing social protection arrangements, including pension, in China is in itself inequitable and therefore tends to broaden the urban-rural and regional gap rather than narrowing it.

### ***3.3 HCTVs are vulnerable to natural hazards***

Recent relentless natural hazards have wiped away large blocks of fragile wooden buildings and claimed thousands of lives in HCTVs. As a case in point, Wuyuan County is a county of Jiangxi province, east of China. Wuyuan, on the boundary of three provinces in Jiangxi's northeastern corner. Renowned for a magnificent landscape dotted with strange caves, deep secluded rocks and numerous historic sites, Wuyuan is one of the cradles of Huizhou culture, which was nurtured by booming trade and featured strong influences of clans and Confucianism. Wuyuan County, including 5 NHCTVs – Wangkou village, Sixi village, Yan village, Likeng village and Hongguan village, which is home to some of the best-preserved ancient architecture dated back to the Tang Dynasty (AD 618-907), since its remoteness and inconvenient transportation protecting its villages from too many visitors.

Each of the past 6 years, those villages have been hit and besieged by heavy or torrential rainfall, flash floods, typhoon, mudslides, landslides and other natural hazards, and so many historical and cultural heritage ravaged and damaged directly in those hazards, including ancient buildings. Deteriorated soil erosion and climate change-derived torrential rains are always blamed for such disasters (Hessler, 2010). However, one more crucial factor is the lack of consideration of physical

environment during urban expansion. In fact, those ancient villages have the profound historical experiences of embracing with exceptional and comprehensive water systems to against natural hazards like floodwater (Da and Yun 2010). The open watercourse runs through all the houses in the entire village and forms ponds, and the checkerboard pattern of streets, lanes and kanats follow the watercourse in turn led to significant lowering of water levels and the severe silting of watercourses.

Lu and Ran also argued that rapid urban expansion has occupied almost all the floodplains and alluvial fans, and the water pathways are strictly confined to an extraordinarily narrow channel, which severely undermines the natural regime of fluvial systems (Lu & Ran, 2011). Water flow can easily exceed transport capacity of the narrowly contained channels, and the people living on the floodplains and alluvial fans are extremely vulnerable to floods and mudflows.

China has dramatically diverse climates in the north and the south of its vast territory. Those HCTVs, almost governed by counties, have developed in different regions, in different climates and natural environments, but they have certain features in common (Figure 10). They are usually located at the base of a mountain, alongside rivers or lakes, they have regular spatial layouts of quiet, narrow alleys, and picturesque gardens at the mouths of the rivers, have maintained their original form, in harmony with the natural environment to a remarkable degree. All historic cultures in those surviving HCTVs are vulnerable under the impact of irreversible trends as a result of social development and modernization, as well as natural hazards more frequently. Their overall planning, architectural style, and landscape design provide admirable models for the construction of human settlements. To immune radical changes, nowadays, it is time for us to seek the long-term strategy balance between human and nature, and seriously respect our ancient's wisdoms that constitute exceptional testimony to the traditional culture of the region and all humanity.

### ***3.4 Shifting pollution from urban to rural areas***

China's green movement is awakening and starting to receive global attention, and non-governmental organizations (NGOs) may suspend some planned industrial plants likely to cause widespread pollution via violent green protests (Gilbert, 2012). But moving factories crossing an ecological "red line" from cities to rural areas is becoming more common. For example, the relocation by local government of a US\$1.4-billion paraxylene plant from Xiamen City in Fujian province to the less-developed Gulei Town was not welcomed by residents (H. Yang et al., 2012).

Worse, little help from green NGOs or media attention always received when locals persuaded officials to scrap those relocations plans, although the protests also seem to be shifting from rural areas — such as when 500 villagers who feel that their lives are threatened by pollution and environmental damage

in eastern Zhejiang province, they demonstrated in 2011 outside a solar-panel factory for discharging waste into local rivers. As a result, there are more than 200 cancer-cluster villages where pollution is suspected as the major cause of death (H. Yang et al., 2012). Those chronic relocations may result in major water pollution within large-scale areas, and over-exploitation of underground water also damaged the ecosystem of the surrounding area.

### **3.5 Alleviation of Interior pollution in HCTVs: farms on the backline**

China consumes nearly one-third of the world's fertilizer, and the pesticide usage per unit area is 2.5 times the world average (R. Chen et al., 2014). According to the Reports on China's Soil Pollution Survey, aside from industrial plant waste and mining operations, the unsustainable use of chemical fertilizers and pesticides is a main human cause of widespread soil pollution. But interior pollution has been retarded in HCTVs for years.

First of all, farmers are not struggling for heavily dependent upon agricultural income via intensive farming and over-harvesting from cultivated land any more. The abuse of chemical fertilizers and pesticides remitted dramatically for cost-effectiveness consideration.

Besides, farmers would be subsidized to improve fertilizer use efficiency and encouraged to adopt organic and biodynamic farming methods that are not reliant on heavy input of chemicals. And soil remediation projects would be implemented to improve the polluted soil gradually.

### **4.6 Biodiversity recurrence signals opportunity for ecosystem restoration**

HCTVs are characterised as admirable models for the construction and biodiversity of human settlements. But now, biodiversity loss has been shown to lead to increased human, animal, and plant diseases. Of the 16,928 species that are threatened with extinction worldwide, almost 800 are in China; 25% of China's species are endangered, and 233 vertebrate animal species are facing extinction (X. J. Yang, 2013). The soaring rate of cancer in those "cancer villages" reflect the damage done to the health of its people.

On the other hand, loss is not insignificant fact that local inhabitants in HCTVs are witnessing a dynamic reciprocity with surrounding environment and landscape with gradual alleviation of pollution. Some extinct species sensitive to circumstances are rejuvenating again for the ever-promoting plasticity of environment recent years. As strong evidence, *Triops cancriformis* (Bosc, 1801–1802), or tadpole shrimp, is a species of tadpole shrimp found in Europe, the Middle East and Japan (Foggin, 2014; Wandesforde-Smith, Denninger Snyder, & Hart, 2014; Xu, Sun, & Liu, 2014). It is generally believe that *Triops cancriformis* is one of the oldest animal species still in existence to date (Møller, Olesen, & Høeg, 2003). As biological

miracles, although living wild insect *Triops cancriformis* is rarely reported, those living insects have rediscovered in freshwater ponds and pools of villages in Inner Mongolia and Sichuan in China in recent years. They are all generally considered "the oldest living fossil" because basic prehistoric morphology has changed little in the last billions of years (Sonnenfeld & Denninger Snyder, 2014; Xie, Gan, & Yang, 2014). Those indicators for ecosystem restoration always gently tap our shoulders for a whole.

However, we also should pay more attention on those new potential agricultural pests, since *Triops cancriformis* has been reported as a pest of rice in Europe, *Triops longicaudatus* in California and Japan, and *Triops granarius* in Africa (Crossland, 1964).

## **5. Conclusion**

Heritage constitutes a source of identity and cohesion for communities disrupted by bewildering change and economic instability. Creativity contributes to building open, inclusive and pluralistic societies. Both heritage and creativity lay the foundations for vibrant, innovative and prosperous knowledge societies. For years, China has made considerable progress in strengthening the protection of the status quo of the distinctive "living" historical and cultural forms of HCTVs, as well as the processes of their production. But looming crisis make us fluctuate between hopes and fears, we cannot declare a victory party over our pullback from the brinks yet. The 20-year Knowledge Map Study provides a unique opportunity to visualize evolution of knowledge domain, scrutinize the research front, clear up the sources and get to the bottom of problems, suit the remedy to the cases, and finally strengthen governance from the root of the crisis.

We try to propose impending research front in the near future that would reside the following domains: intangible culture; natural landscape; policy non-transparency and data dearth; legal framework and effectiveness of law enforcement; the administrative structure and its efficiency; inhabitants' living conditions; urbanization impacts; land use and plan. In effect, each domain of the proposed multidimensional model signals opportunity for us to disclose many pressing issues that cry for answer. As potential virgin territory, each domain should be stitched along its own dimensionality, as well as interweaved a net with other domains via interdisciplinary intervention.

Overall, as a macroscopic background, it is poised to become an experiment in innovative rural planning would be worrisome. Partially as a response to China's ambitious stride toward modernization as well — and its implementation relied heavily on government administrative systems with financial and other incentive and disincentive measures. Therefore, interplays among the progressively interdisciplinary fields are expected in



the further development that will finally help us penetrate to revivification of dynamic true nature under this intertwined picture. The latest generation of studies ripe for seductive endeavour in each extensible domain has not yet produced simple answers, but it is reframing the questions—a sure sign of progress.

## References

- Agnew, N., & Demas, M. (2002). *Principles for the Conservation of Heritage Sites in China English-language Text (Second printing with revision, 2004)*. The Getty Conservation Institute. Retrieved from [http://www.getty.edu/conservation/publications\\_resources/pdf\\_publications/pdf/china\\_prin\\_heritage\\_sites.pdf](http://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/china_prin_heritage_sites.pdf)
- Ahmad, S. H. (1967). China's "Cultural Revolution." *International Studies*, 9(1), 13–54. <http://doi.org/10.1177/002088176700900102>
- Ahmad, Y. (2006). The Scope and Definitions of Heritage: From Tangible to Intangible. *International Journal of Heritage Studies*, 12(3), 292–300. <http://doi.org/10.1080/13527250600604639>
- Angell, J. B. (1885). A Need for a Careful Study of the History of China. *Science*, 6(147), 479. <http://doi.org/10.1126/science.ns-6.147S.479>
- Bai, X., Shi, P., & Liu, Y. (2014). Realizing China's urban dream. *Nature*, 509(7499), 158–160. <http://doi.org/10.1038/509158a>
- Bloom, D. E., Canning, D., & Fink, G. (2008). Urbanization and the wealth of nations. *Science*, 319(5864), 772–775. <http://doi.org/10.1126/science.1153057>
- Brewer, T. D. (2010). Putting census data to work. *Science*, 329(5994), 901–902. <http://doi.org/10.1126/science.329.5994.901-a>
- Cai, Y., & Cheng, Y. (2014). Pension Reform in China: Challenges and Opportunities. *Journal of Economic Surveys*, 28(4), 636–651. <http://doi.org/10.1111/joes.12082>
- Cameron, P. (1897). Hymenoptera orientalia, or contributions to a knowledge of the Hymenoptera of the Oriental Zoological Region. Part VI. *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 41, 1–27. <http://doi.org/10.1080/00222930709487308>
- Cao, S., Lv, Y., Zheng, H., & Wang, X. (2014). Challenges facing China's unbalanced urbanization strategy. *Land Use Policy*, 39, 412–415. <http://doi.org/10.1016/j.landusepol.2013.12.004>
- Cartier, C. (2013). What's territorial about China? From geopolitical narratives to the "administrative area economy." *Eurasian Geography and Economics*, 54(1), 57–77. <http://doi.org/10.1080/15387216.2013.791198>
- Chan, K. (2007). Misconceptions and Complexities in the Study of China's Cities: Definitions, Statistics, and Implications. *Eurasian Geography and Economics*, 48(4), 383–412. <http://doi.org/10.2747/1538-7216.48.4.383>
- Chang, C., & Wang, Y. J. (1994). The nature of the township and village enterprise. *Journal of Comparative Economics*, 19(3), 434–452. <http://doi.org/10.1006/jcec.1994.1111>
- Chen, C. (2004). Searching for intellectual turning points: progressive knowledge domain visualization. *Proceedings of the National Academy of Sciences of the United States of America*, 101 Suppl., 5303–5310. <http://doi.org/10.1073/pnas.0307513100>
- Chen, C., Dubin, R., & Kim, M. C. (2014). Emerging trends and new developments in regenerative medicine: a scientometric update (2000 – 2014). *Expert Opinion on Biological Therapy*, 14(9), 1295–1317. <http://doi.org/10.1517/14712598.2014.920813>
- Chen, R., de Sherbinin, A., Ye, C., & Shi, G. (2014). China's soil pollution: farms on the frontline. *Science*, 344(6185), 691. <http://doi.org/10.1126/science.344.6185.691-a>
- Chu, S. N., & Song, L. (2015). Promoting Private Entrepreneurship for Deepening Market Reform in China: A Resource Allocation Perspective. *China & World Economy*, 23(1), 47–77. <http://doi.org/10.1111/cwe.12099>
- Crossland, N. O. (1964). New Agricultural Pests in Africa. *Nature*, 202(4930), 342–343. <http://doi.org/10.1038/202342a0>
- Da, Z., & Yun, S. H. I. (2010). Research Progress of Water Environment Protection in Historical and Cultural Towns and Villages. *Journal of Landscape Research*, 2(11), 84–90.
- Du, J., Lu, Y., & Tao, Z. (2015). Government expropriation and Chinese-style firm diversification. *Journal of Comparative Economics*, 43(1), 155–169. <http://doi.org/10.1016/j.jce.2014.07.003>
- Ennas, G., Biggio, B., & Di Guardo, M. C. (2015). Data-driven journal meta-ranking in business and management. *Scientometrics*, 105(3), 1911–1929. <http://doi.org/10.1007/s11192-015-1751-y>
- Foggin, J. M. (2014). Managing Shared Natural Heritages: Towards More Participatory Models of Protected Area Management in Western China. *Journal of International Wildlife Law & Policy*, 17(3), 130–151. <http://doi.org/10.1080/13880292.2014.953391>
- Gilbert, N. (2012). Green protests on the rise in China. *Nature*, 488(7411), 261–262. <http://doi.org/10.1038/488261a>
- Glaeser, E. (2011). Cities, productivity, and quality of life. *Science*, 333(6042), 592–594. <http://doi.org/10.1126/science.1209264>
- Gruber, S. (2007). Protecting China's Cultural Heritage Sites in Times of Rapid Change: Current Developments, Practice and Law. *Asia Pacific Journal of Environmental Law*, 10(3 & 4), 253–301. Retrieved from <http://ssrn.com/abstract=1236382>
- He, G., Zhang, L., Mol, A. P. J., Lu, Y., & Liu, J. (2013). Revising China's Environmental Law. *Science*, 341(6142), 133–133. <http://doi.org/10.1126/science.1235000>
- Hessler, P. (2010). Q&A: Peter Hessler on urbanization in China. Interview by Jane Qiu. *Nature*, 464(7286), 166. <http://doi.org/10.1038/464166a>
- Horsley, J. P. (2007). China adopts first nationwide open government information regulations. Retrieved January 27, 2016, from [https://www.law.yale.edu/system/files/documents/pdf/Intellectual\\_Life/Ch\\_China\\_Adopts\\_1st\\_OGI\\_Regulations.pdf](https://www.law.yale.edu/system/files/documents/pdf/Intellectual_Life/Ch_China_Adopts_1st_OGI_Regulations.pdf)
- Hvistendahl, M. (2010). Survey to reveal true face of Chinese society. *Science*, 328(5978), 554–555. <http://doi.org/10.1126/science.328.5978.554>

- Hvistendahl, M. (2013). The Numbers Game. *Science*, 340(6136), 1037–1039. <http://doi.org/10.1126/science.340.6136.1037>
- Hvistendahl, M. (2014). While emerging economies boom, equality goes bust. *Science*, 344(6186), 832–5. <http://doi.org/10.1126/science.344.6186.832>
- Kamada, T., & Kawai, S. (1989). An algorithm for drawing general undirected graphs. *Information Processing Letters*, 31(1), 7–15. [http://doi.org/10.1016/0020-0190\(89\)90102-6](http://doi.org/10.1016/0020-0190(89)90102-6)
- Kudelka, M., Kromer, P., Radvansky, M., Horak, Z., & Snašel, V. (2015). Efficient visualization of social networks based on modified Sammon's mapping. *Swarm and Evolutionary Computation*, 25, 63–71. <http://doi.org/10.1016/j.swevo.2015.10.002>
- Lai, G., Demas, M., & Agnew, N. (2004). Valuing the past in China: the seminal influence of Liang Sicheng on heritage conservation. *Orientalism*, 35(2), 82–89.
- Li, M., Wu, B., & Cai, L. (2008). Tourism development of World Heritage Sites in China: A geographic perspective. *Tourism Management*, 29(2), 308–319. <http://doi.org/10.1016/j.tourman.2007.03.013>
- Liu, J., & Yang, H. (2009). China fights against statistical corruption. *Science*, 325(5941), 675–676. [http://doi.org/10.1126/science.325\\_675](http://doi.org/10.1126/science.325_675)
- Long, H. (2014). Land use policy in China: Introduction. *Land Use Policy*, 40, 1–5. <http://doi.org/10.1016/j.landusepol.2014.03.006>
- Lu, X. X., & Ran, L. (2011). China flood havoc highlights poor urban planning. *Natural Hazards*, 56(3), 575–576. <http://doi.org/10.1007/s11069-011-9720-0>
- Mingers, J., & Leydesdorff, L. (2015). A review of theory and practice in scientometrics. *European Journal of Operational Research*, 246(1), 1–19. <http://doi.org/10.1016/j.ejor.2015.04.002>
- Møller, O. S., Olesen, J., & Høeg, J. T. (2003). SEM studies on the early larval development of *Triops cancriformis* (Bosc) (Crustacea: Branchiopoda, Notostraca). *Acta Zoologica*, 84(4), 267–284. <http://doi.org/10.1046/j.1463-6395.2003.00146.x>
- Mou, J., Griffiths, S. M., Fong, H., & Dawes, M. G. (2013). Health of China's rural-urban migrants and their families: A review of literature from 2000 to 2012. *British Medical Bulletin*, 106(1), 19–43. <http://doi.org/10.1093/bmb/ldt016>
- Normile, D. (2008). China's living laboratory in urbanization. *Science*, 319(5864), 740–743. <http://doi.org/10.1126/science.319.5864.740>
- OECD. (2014). *OECD Tourism Trends and Policies 2014*. OECD Publishing. <http://doi.org/10.1787/tour-2014-en>
- Peng, X. (2011). China's Demographic History and Future Challenges. *Science*, 333(6042), 581–587. <http://doi.org/10.1126/science.1209396>
- Poo, M. (2004). Cultural reflections. *Nature*, 428(6979), 204–205. <http://doi.org/10.1038/428204a>
- Price, D. J. de S. (1965). Networks of scientific papers. *Science*, 149(3683), 510–515. <http://doi.org/10.1126/science.149.3683.510>
- Schmidt, A. C. (2000). The Confuciusornis Sanctus: An Examination of Chinese Cultural Property Law and Policy in Action. *Boston College International and Comparative Law Review*, 23(2), 185–227.
- Sonnenfeld, D. a., & Denninger Snyder, K. (2014). Wildlife Conservation and Protected Areas in China: A Law and Policy Bibliography. *Journal of International Wildlife Law & Policy*, 17(3), 152–163. <http://doi.org/10.1080/13880292.2014.953394>
- Sutton, M. a, Onema, O., Erisman, J. W., Leip, A., van Grinsven, H., & Winiwarter, W. (2011). Too much of a good thing. *Nature*, 472(7342), 159–161. <http://doi.org/10.1038/472159a>
- Wandesforde-Smith, G., Denninger Snyder, K., & Hart, L. a. (2014). Biodiversity Conservation and Protected Areas in China: Science, Law, and the Obdurate Party-State. *Journal of International Wildlife Law & Policy*, 17(3), 85–101. <http://doi.org/10.1080/13880292.2014.953371>
- Wei, Y., & Zhang, L. (2015). Involuntary Bachelorhood in Rural China. *China Report*, 51(1), 1–22. <http://doi.org/10.1177/0009445514557388>
- Weitzman, M., & Xu, C. (1994). Chinese township-village enterprises as vaguely defined cooperatives. *Journal of Comparative Economics*, 18(155), 121–145. <http://doi.org/10.1006/jceec.1994.1020>
- Xi, J., Zhao, M., Ge, Q., & Kong, Q. (2014). Changes in land use of a village driven by over 25 years of tourism: The case of Gougezhuang village, China. *Land Use Policy*, 40, 119–130. <http://doi.org/10.1016/j.landusepol.2013.11.014>
- Xie, Y., Gan, X., & Yang, W. (2014). Strengthening the Legal Basis for Designating and Managing Protected Areas in China. *Journal of International Wildlife Law & Policy*, 17(3), 115–129. <http://doi.org/10.1080/13880292.2014.953380>
- Xu, J., Sun, G., & Liu, Y. (2014). Diversity and Complexity in the Forms and Functions of Protected Areas in China. *Journal of International Wildlife Law & Policy*, 17(3), 102–114. <http://doi.org/10.1080/13880292.2014.953378>
- Yang, C. H., Lin, H. L., & Han, C. C. (2010). Analysis of international tourist arrivals in China: The role of World Heritage Sites. *Tourism Management*, 31(6), 827–837. <http://doi.org/10.1016/j.tourman.2009.08.008>
- Yang, H., Flower, R., & Thompson, J. (2012). Rural factories won't fix Chinese pollution. *Nature*, 490(7420), 342–342. <http://doi.org/10.1038/490342d>
- Yang, H., Huang, X., Thompson, J. R., & Flower, R. J. (2014). Soil Pollution: Urban Brownfields. *Science*, 344(6185), 691–692. <http://doi.org/10.1126/science.344.6185.691-b>
- Yang, X. J. (2013). China's rapid urbanization. *Science*, 342(6156), 310. <http://doi.org/10.1126/science.342.6156.310-a>

Figure.1 A 510-node merged network of co-cited articles on China's villages (1995–2015) based on eleven 2-year slices

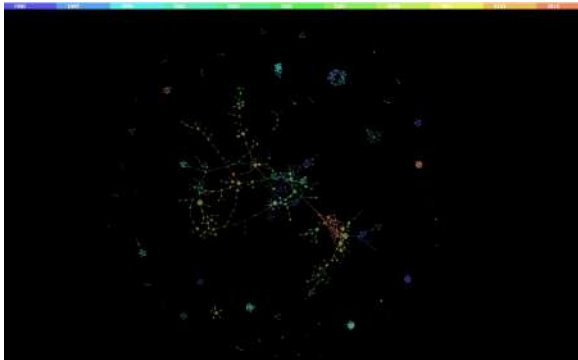


Figure.2 A timeline view of 121-cluster hybrid network of cited articles and citing terms on China's villages based on eleven 2-year slices

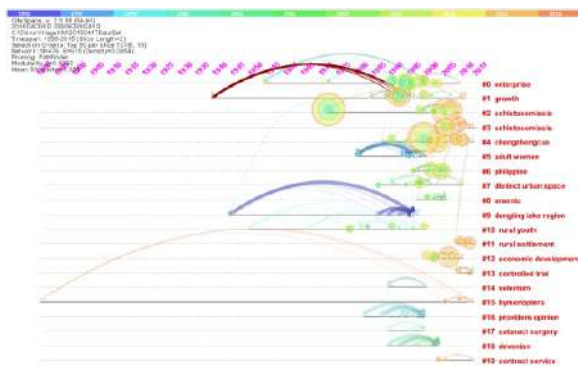


Figure.3 A timezone view of 121-cluster hybrid network of cited articles and citing terms on China's villages based on eleven 2-year slices

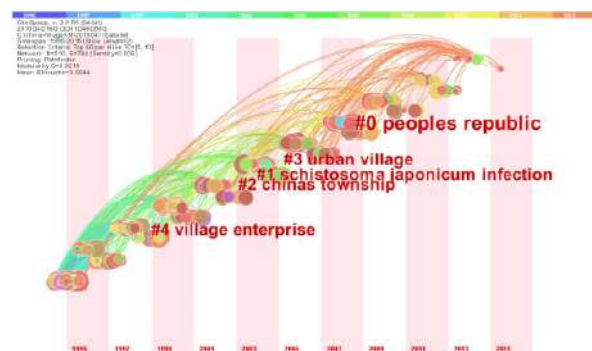


Figure.4 A geographic map of co-author networks from 1995 to 2015 generated by Google Earth

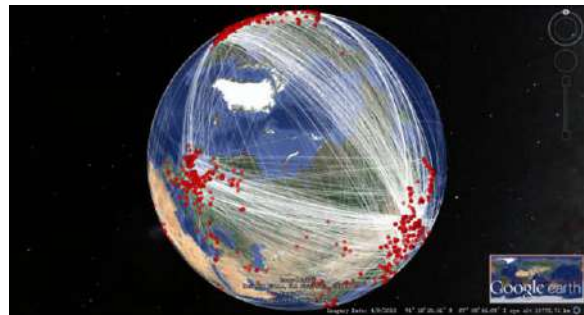


Figure.5 A geographic map of percentage change in malaria mortality rates (2000–2013)

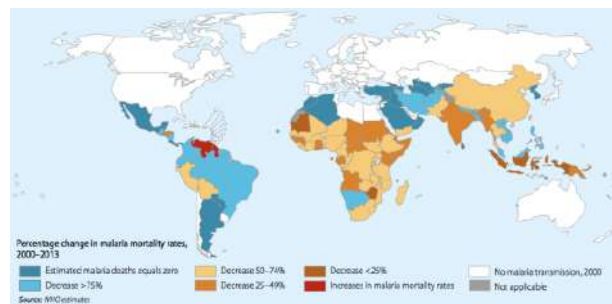
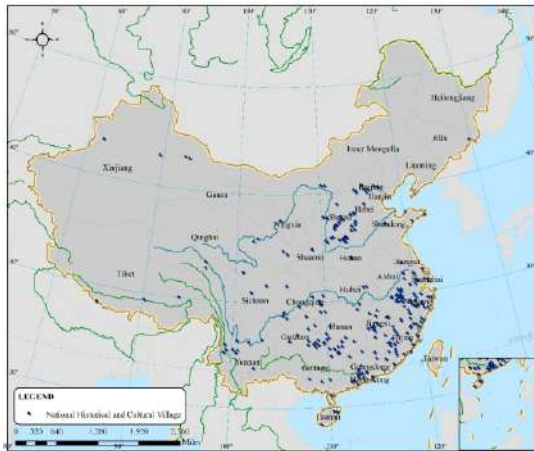


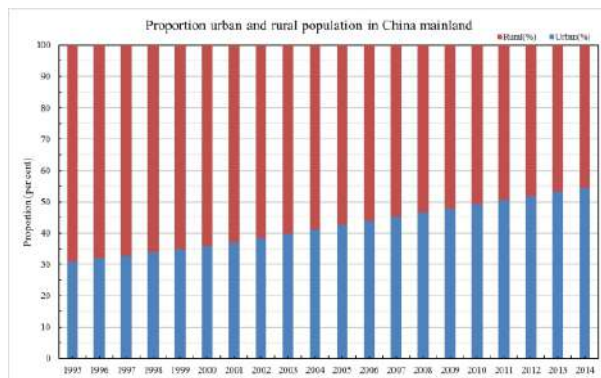
Figure.6 Distribution of 252 towns on the approved list of 528 NHCTVs



**Figure.7** Distribution of 276 villages on the approved list of 528 NHCTVs



**Figure.8** Proportion urban and rural population in China mainland



Source: United Nations, Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision*

Notes: For statistical purposes, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China

**Figure.9** Distribution of 47 UNESCO World Heritage Sites in China



Sources: UNESCO. <http://whc.unesco.org/en/syndication>.

Notes: Some the labels of the World Heritage Sites are invisible on account of dense

**Figure.10** Map of 2853 county-level divisions in China mainland



Source: China Statistical Yearbook 2014, "Divisions of Administrative Areas in China (End of 2013)"

Notes: Taiwan is not included in figure, and disputed areas are given as neutral a treatment as possible

# The Special Function of Red 紅 with symbolism in Li Shangyin's Poems

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**Abstract:** The study reviewed 550 poems written by Li Shangyin, who was a famous Chinese poet of the late Tang Dynasty. It is found that *Red* appears 56 times and can be catalogued by three groups of literature function. The first group is the original consciousness, the second *group* is the corresponding relations, and the last is as a Décadent symbol. This paper explores a special function of *red* 紅, with relevant typical symbols in Li Shangyin's poems and possible suggestive influence to later Chinese literati literature.

**Key words:** Li Shangyin, poem, symbolism, Red, literature

## Introduction

Red, the most popular warm colour in Chinese folk customs, symbolizes happiness, joy, and good fortune. However, based solely on this understanding, some of the phenomena in Chinese literature and their accompanying sentiment would be difficult to grasp. This essay explores a special function of *red* 紅, with relevant typical symbols in Li Shangyin's (813-858) poems and possible suggestive influence to later Chinese literati literature.

This research explores 550 poems written by Li Shangyin from *Complete Tang Poems* (1960). *Red* appears 56 times and can be catalogued by three groups of literature function. The first group is the original consciousness, the second *group* is the corresponding relations, and the last is as a Décadent symbol. The original consciousness appears 14 times and reflects the basic meaning or symbol of *red* in Chinese literature; that of red colour, joy, warmth, and sometimes femininity. The corresponding relations of *red* appears 20 times referring to the function that corresponds to other colours, such as green. The first two functions of *red* are intuitive and will not be the main discussion of this research. The Décadent symbol function of *red* appears 22 times, accounting for nearly 40% of the poems with the 紅 character, and will be analyzed in this research denoted as 'décadent red'. Décadent *red* describes a style of aesthetics, which is 'elegies on the brilliant fading past' (Jiang 2016).

Late Tang Dynasty poems have a historical heaviness, and give a particularly penetrating power to the magnificence of the previous Tang Dynasty, recollecting the aristocratic past. *Red*, as a décadent symbol in these 22 poems, often appears in either an elegant decayed scene or within the characters' sentimental ambience. It takes the form of 殘 (damaged, incomplete; the images examples are waning autumn days 殘秋, dying candle 殘

燭 etc.) 4 times, 寒 and 冷 (cold, disappointed, fear) 6 times, 斷 (broken) 7 times, 淚 (tear) 3 times, 死 (death, impassable; the image example is a stagnant pool of water, eg: 十番紅桐一行死) 5 times, 散 and 離 (separated) 4 times, 危 (dangerous, frightening) 2 times, and as 啼 and 悲 (mournful, sad, to cry) 6 times. Obliteration of beauty is the greatest tragedy (Lu 1925). *Red*, as the most beautiful colour in Chinese customs, describes various pretty plants, womanhood, and presents the wonderful images of a red candle (紅燭), a red chamber (紅樓), and the lotus tear (紅淚). The destruction or disillusionment of *red* images touches the reader's soul, heart, and mood quietly yet deeply.

Some images with splendid red colour but not necessarily with the character 紅 were created in Li Shangyin's poems, such as setting sun (夕陽), dying sun (殘陽), peony colour stairs (丹梯), and the light of a candle (蠟照). These images are symbolic of décadent *Red*, convey a sentiment of melancholy, or serve as a foil to the décadence. The best known imagery of this type is of the 'setting sun (夕陽)' created in Li Shangyin's poem *Climbing Le You Yuan*. During Li's life, the Tang dynasty went to the late stage, experiencing great political instability. Li registered his concerns and dissatisfaction not only by using allusions (Yu, 1990) but also by creating new symbols.

The last sentence is very striking: the beauty of the setting sun is incomparable, however muses that the gloomy dusk is approaching (夕陽無限好, 祇是近黃昏). Many readers regard this line of writing as introspective, attributing it to his personal life, and his declining state of health. It also more generally relates to the declining of a great age, and human condition - reflecting on one's life in old age, as death approaches. The incomparable image functions as a foil to set off the 'degradation

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and decline', and helps to provoke a strong sense of 'helpless desperation' (Luo and Ye, 2011) in the reader.

There are a multitude of reasons behind this melancholic sentiment. Li's life was filled with career setbacks and his talent was underappreciated in the society. Tang dynasty was a glorious age with political, economic, and cultural achievements and was one of China's greatest eras. However, its eventual fall due to the aforementioned political turmoil and factional fighting was foreseeable. The symbolism of a beautiful period of time and the ability to look back nostalgically whilst identifying that the close of this great dynasty was approaching is a powerful tool used, bringing together the 'personal, social, and natural' (Wu 1998, 188). When compared to Western *décadent* writing, such as that of Baudelaire, a similar view of the sun and its transient properties as a symbol for life (Baudelaire 1853, 189) can be seen. This conjured imagery reflects that directly of Li. The 'nostalgic raptures' and the 'memories of opium' that Baudelaire speaks of are also seen in Li's poems (Wu 1998, 188). Similar as it is to Baudelaire's poems, Li eliminates the 'rhetoric and ornament' elements (Wu 1998, 188) normally associated with *décadent* writing. However, the beauty and symbolism are not watered down, and this is the power of Li's writing. Many of Li Shangyin's poems share some common features with Western *décadent* aesthetics. In French literature and arts, a *décadent* symbol aims to express the disillusionment with over-luxurious and sophisticated works, such as those of Baudelaire and Verlaine. British poetry aims to reflect the beauty of strange, subjective, unique moments and their disappearance with this symbol, showcased in the writings of Oscar Wilde (Burdett 2014).

The function of *Décadent red* is not intuitive but has possibly nourished later literati literature and aesthetics. After the Tang dynasty, a confrontation between melancholy and aestheticism appeared more frequently in both Song poetry (*Ci* of Song Dynasty), like that of Li Qingzhao (1084-1151) and Yan Jidao (1137-1110), and Yuanqu (a form of poetry and opera of Yuan Dynasty), showcased by Kong Shangren (1648-1718). While not originating from Li Shangyin's poetry, in his work it shines with symbolism and aestheticism. Comments claim that Li Shangyin's 'extraordinarily ornate language conveys extraordinary melancholy (語極艷, 意極哀)' (Jiang 2016). Another good example is the most recent title of the most outstanding traditional novel in Chinese literature history – *Dream of the Red Chamber*. This novel's name was altered

several times. All previous names are intuitively related to the plots, but readers and scholars rarely discuss the actual connotations of 'Red Chamber'. However, in considering the *Décadent* symbol, the name would be easy to understand and appreciate. One could even better translate the name to 'Dream of the Splendid Mansion', or more directly, 'Dreams, Beauty and the Disillusionment'.

The mood of Chinese ancient poetry is criticized by Western readers due to the sentimental feelings conveyed and the generally grey background colour (Qian 1978). Professor Qian Zhongshu accepted these comments and pointed out that this matches aesthetic appreciation of traditional Chinese literati and some Western poems (1978, 43-44). *Red*, and likewise, a flamboyant background or images, play a significant role in subconsciously influencing Chinese literati's aesthetic value. The law of 'unity of opposition' applies to the aesthetic value between Chinese folk customs and literati appreciation.

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## References

- Baudelaire, C. (1853). 'Further Notes on Edgar Poe', in *Selected Writings on Art and Literature*, trans. P.E. Charvet (Harmondsworth: Penguin, 1972), p. 189.
- Burdett, C. (2014). Aestheticism and decadence, *Fin de siècle*. Retrieved from <https://www.bl.uk/romantics-and-victorians/articles/aestheticism-and-decadence>.
- Jiang, X. (2016). *The Late Tang Dynasty and Southern Tang Dynasty Poems* [video file]. Taipei. Retrieved from [https://www.youtube.com/watch?v=N\\_4Q64OWtn0](https://www.youtube.com/watch?v=N_4Q64OWtn0).
- Lu, X. (1925). Rediscussion of the Fall of Leifeng Pagoda, Yu Si, Beijing, Vol 15.
- Luo, Y. and Ye, Y. (2011). *A Concise History of Chinese Literature*. Leiden: BRILL.
- Peng, D. (1960). *Quan Tang Shi (Complete Tang Poems)*. Beijing: Zhonghua Book Company.
- Qian, Z. (1979). Chinese Poems and Literati Painting, *Xin Yu Si*, Shanghai: Shanghai Ancient Books Publishing House.
- Wu, F. (1998). *The Poetics of Decadence: Chinese Poetry of the Southern Dynasties and Late Tang Periods*. New York: State University of New York Press, p.188.
- Yu, T. (1990). *Li Shangyin: The Poetry of Allusion*. PhD. The University of British Columbia.

# The Influence of the Reform of the Trial-centered Litigation System on the Criminal Procedure at the First Instance

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**Abstract:** The Forth Plenary Session of the Eighteenth CPC Central Committee proposed the “promotion of the reform of the trial-centered litigation system” and pointed out the direction for further advancing the criminal judicial impartiality. For the criminal procedure at the first instance, there are two requirements in the reform of the trial-centered litigation system; in the horizontal direction, the trial-based approach should be realized firstly in the relation of investigation, prosecution and trial; in addition, it should focus on court trial at the trial stage. In the longitudinal trial structure, a solid first instance should be built, and the authority position of the first instance in the recognition of facts should be established; at the same time, the function of each level of trial should reasonably be defined and adjusted; it can be ensured that the first instance resides in the position of “center of gravity” in the whole criminal procedure system.

**Key words:** A trial centre; criminal procedure at first instance; trial substantiation

## Introduction

*The Decision of the Central Committee of the CPC on the Comprehensive Promotion of Certain Important Problems in the Rule of Law*, approved by The Forth Plenary Session of the Eighteenth CPC Central Committee, clearly puts forward “promotion of the reform of the trial-centered litigation system”, which points out the direction for further improving litigation system, ensuring the judicial impartiality and improving the credibility of the judiciary. This paper aims at exploring the influence of the reform of the trial-centered litigation system on the criminal procedure at first instance. On the one hand, we must correctly understand the essence of the trial-centered litigation system; on the other hand, we should explore the effective ways to reform the trial-centered litigation system in the existing criminal justice system and environment, with the criminal procedure at first instance as the dimension.

## 1. On the Essence of the Reform of the trial-centered litigation system

### 1.1 Background and Objectives of the Reform

In recent years, the personnel handling a case have not paid enough attention to the court trial in judicial practice of our country; some key evidence has not been collected or collected in accordance with the law; the cases of entering the court have not reached the requirements with clear case facts as well as accurate and sufficient evidence, so that the trial cannot proceed. The

deviation of the evidence rule and the code of conduct resulted in the poor quality of the criminal justice. In the judicial practice, there is deviation for the understanding and implementation of the basic principles in the division of responsibility, mutual cooperation and restriction stipulated by the constitution of our country. In a period of time, the investigation is emphasized while the trial is ignored; the words like “mighty police, the dominant law officers and the disadvantaged court” are popular. In this case, the authority of the judicial trial is lost and the judicial justice is damaged. The masses and the parties litigants ignore and have poor concept in the res judicata of the effective judgment and judicial power of the people’s court; the judgment or ruling of the people’s court shall be difficult, the execution of the judgment or the determination of the people’s court shall be difficult to implement and execute; even some parties resist the execution; they hand in the petition letter but don’t believe in law; the case shall not be dealt with; in some places, people use money to solve lawsuits and petition letters, which makes the judicial justice lost and brings serious injury to the social justice.

The aim of promoting the reform of the trial-centered litigation system is to play the final judgement function of the trial procedure and play the restriction and guidance function on the pretrial procedure, ensuring the decisive effect of court trial on fact-finding, the identification of evidence, the protection of the right to appeal and the impartiality of the judge so as to clear the chaos in the judicial practice of the criminal procedure mentioned above; the entity justice of the case can be realized through the procedural justice of the court trial; the outstanding problems that

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restrict the criminal judicial impartiality can be solved and it can be ensured that the facts and evidence of the investigation and prosecution of cases can be examined by the law. The function and effect of criminal judgment must be understood by modern judicial concept, which is the last checkpoint of social fairness and justice, plays a leading role in the whole society and must have the value of fairness and justice. The nature, neutrality of trial and finality of procedure determine that we must insist on focusing on trial; the procedural law, judicial law and rule of law rule require that we should insist on trial-centered doctrine in order to realize the real trial independence.<sup>[1]</sup> Only in this way can the trial be positioned as the last line of defense, and the referee is authoritative.

### ***1.2 Understanding of "Taking the Trial as the Center"***

"Taking the Trial as the Center" has three different meanings:

Firstly, the trial is the centre of the whole criminal litigation procedure. For the proceedings like the case registration, investigation, prosecution and enforcement, the criminal liability of defendants can be determined only at the stage of the trial. In the whole criminal procedure consisting of investigation, prosecution, trial and so on, although the litigious activities are carried out around the criminal responsibility of the accused person, the investigation and prosecution procedure belongs to the preparatory procedure; the determination of the criminal suspects' criminal liability has only procedural meaning in the investigation stage as well as the stage of investigation and prosecution, and has no guilt legal effect; it has no decisive effect on the criminal liability of the defendant in the trial stage.<sup>[2]</sup> The case materials formed during the investigation and prosecution stage can only be used to make procedural decisions applicable to coercive measures and prosecutions, and the conviction sentences in the trial can only be based on the evidence directly investigated by the court, and cannot be based on the case materials formed during the investigation and prosecution stages.

Secondly, the court trial is the centre of the entire trial procedure. The trial stage itself is a complex process, and its activities are diverse, including pre-trial preparation, trial of the court, and various activities outside the court. Taking the trial as the center emphasizes the decisive link in the trial process of the court trial, which realizes the leading role of the court trial on the pre-trial and post-trial proceedings. Because the right of conviction is the core of the right of criminal trial, the court trial is the key link to determine the existence of the defendant's criminal liability for the procedures like pre-trial preparation and delivery of written judgement; the power that determines whether the defendant is guilty is exercised by the people's court.

Thirdly, the first instance is the centre of the entire trial system. The fundamental problems to be solved by the court trial are the fact finding of the case as well as the adoption and exclusion of the evidence; the settlement of such problems is not made easier by the increase of the trial level; on the contrary, the

longer the trial level is, the longer the required time is, the farther the distance from the truth is, and the more difficult it is to solve. Therefore, "the ideal centralism should be the first-trial centralism".<sup>[3]</sup>

At the same time, it is worth noting that taking the trial as the centre is to strengthen the function of the trial on the basis of adherence to the division of responsibility, mutual cooperation and restriction stipulated by the constitution of our country. The pre-trial stages like investigation, review and prosecution are the premise and basis of the trial; the trial-centered litigation system will not be constructed if breaking away from the pre-trial stage; the promotion of the reform of the trial-centered litigation system is not to weaken the meaning and function of the pre-trial procedure; on the contrary, it is to raise higher standards and requirements for the review and prosecution work. The main body of the reform of the trial-centered litigation system is not only the people's court, but it needs the resultant force of the court, the public security, the prosecutor and the defense lawyer to carry out the idea of "taking the trial as the center".

## **2. Path exploration of the reform of the trial-centered litigation system with the criminal procedure at first instance as dimensionality**

The first task of the reform of the trial-centered litigation system is to cultivate the modern judicial concept and accurately position the trial power. The court trial is the last working procedure of the criminal procedure. It is the last defense line to realize the fairness and justice and prevent the wrong case. The effective referee must have both the *res judicata* and authority; the court trial of the people's court must exclude all interference, make independent trial, and only obey the law.

From the institutional level, the reform of the trial-centered criminal procedure system should be carried out in two directions:

In the horizontal direction, firstly, the trial should be taken as the center, and the relationship between investigation, review, prosecution and trial should be rationalized; secondly, the court trial should be taken as the center in the trial stage; the authority of the court's judgment comes from a fair trial, and the court itself cannot be divorced from the court trial to determine facts.

In the longitudinal structure, the authority status of the first instance in the recognition of facts should be established, and it is ensured that the first instance is in the position of "centre of gravity" in the whole criminal procedure system.

### ***2.1 Relationship between Investigation, Review, Prosecution and Trial: Realization of "Trial Centralism"***

The core requirement of taking the trial as the center is formed in the trial procedure as the judge's case information. It doesn't mean neglecting the investigation, review and prosecution procedure, and the investigation, review and prosecution are the preparation of the trial; the quality of the collected and applied evidence is related to the trial justice; the high-quality



investigation and prosecution can prevent the wrongs from the source. However, from the point of view of the litigation structure, in order to ensure that the case information serving as the basis of the judgment is formed in the trial, it is necessary to manually cut the channel of investigation and prosecution information entering smoothly into the trial procedure.<sup>[4]</sup> Therefore, it is necessary to realize the trial centralism, resist the indictment-only doctrine and handle the public prosecution function and the legal supervision function of the people's procuratorate correctly.

Under the structure of adversary system, it is more effective to block the flow of pre-trial information due to the existence of a series of systems and rules. Insist on the confrontational litigation mode, that is, the judge is centered, and the prosecution and defense are equal. The chief judge is the chief of a court who should lead the court and command the court; the two sides shall obey the command of the court. In the legal relation of litigation, the prosecution and the defense acting as the prosecution function are equal and even equivalent.

The transformation from the file transfer doctrine to the indictment-only doctrine is realized. Under the system of full-case file transfer, as the judge has already known the case and the litigation evidence before the court, it is easy to form the pre-judgement and pay too much attention to the accuser's evidence and reason in the court trial, thus affecting the fair judgement. The indictment-only doctrine is put in place to avoid the judge's contacting and inspecting any case file and evidence material prior to the opening of the court, thereby completely cutting the connection between the investigation procedure and the judicial proceedings of the court.

The public prosecution function and the legal supervision function should be handled correctly. The judicial supervision of the People's Procuratorate has only the suggestions and the posteriori; in the course of the court trial, especially in the court, the trial can not be influenced by the legal supervision. The People's Procuratorate shall propose the opinions on making corrections for the court trial activities against the proceedings after the court trial; at the same time, it shall be submitted in the name of the People's Procuratorate, and it can't be submitted until it is reported to the chief procurator.

### **2.2 Trial: Realization of "Trial Centralism"**

The so-called trial centralism, that is, the trial case is based on the court trial; the fact evidence is investigated in the court; the conviction sentencing debate is in the court; the judgment result is formed in the court; the judgment result is formed in the court; the direct speech principle is fully implemented; the illegal evidence exclusion rule is strictly enforced. The court trial is the core of the reform of the litigation system in the center of the trial, and it is the key link of the trial as the centre. The specific requirements of the trial are reflected in the following three aspects: firstly, all the evidence of the conviction and punishment must be investigated in the court, and cannot be judged only through the examination of

the file outside the court; the evidence that isn't investigated in the court cannot be used as the basis for the conviction and sentence; secondly, it is essential to fully guarantee the defense's benefit of argument, cross-examination and debate right; thirdly, the outcome of the judgement must be formed on the court to ensure that the case judgment is not affected by the external factors of the court.

The court's recognition and treatment of the case is based on both the full discussion and the defense of the evidence and the legal opinions of both parties in the court trial; the right to participate in the procedure and right to defense of the accused are guaranteed effectively; the basic principles of the open trial, the direct words and centralized trial have been fully implemented and reflected; all kinds of evidence; the fact finding and the application of law formed on the basis are the most scientific and fair. Therefore, the reform of the pre-court meeting, the improvement of the court system of the witness and the appraisal, the adherence to the rule of evidence and the rule of exclusion of illegal evidence are the important path of the substantive reform of the court trial.

In order to limit and avoid the effect of the information before the court trial and outside the court on the judgement, it is necessary to further reform and improve the pre-court meeting system. The basic function of the pre-court meeting system is to make full preparations for the centralized and successful trial of the court, clarify the focus of the dispute between the two parties and solve the procedural problems in the case. This "sufficiency", however, is limited, that is, the pre-court meeting should not prejudice the right of the accused to obtain a fair trial. While the pre-court meeting is a tripartite forum for three parties, there is a lack of procedural safeguards provided by a formal trial procedure; therefore, substantive issues that are closely related to the conviction of the accused should not be discussed in the pre-court meeting.

taking the trial as the center requires the judge to judge evidence, find out the truth and determine the penalty in person, which can change the current judge's written investigation mode, get rid of the reliance on the record of the file and play the role of the court trial; all the evidence shall be provided and verified by both parties in the court, which means that the system of the witness and appraiser appearing in the court must be implemented, and the issues that the witness and appraiser are difficult to be present at the case, attend the court and tell the truth can be solved. At the same time, it also puts forward higher demands on the participation of both parties in litigation and the application of evidence, and it is demanded that the work of the criminal defense lawyer be made into substance, which not only needs to establish and perfect the solid defence of the case, but also needs to improve the procedural defense of the case, aiming at the procedural justice and the entity justice, and comprehensively advance the criminal defense work.

The rule of evidence judgment and illegal evidence exclusion must be adhered to. The principle of evidence judgment means

that the case determination of adjudicatory personnel must be based on the evidence; the facts of the case cannot be determined if there is no evidence. The principle of evidence judgment is one of the basic principles of modern evidence law. In order to guarantee the proof power and the evidence ability of the evidence, we must strictly implement such links of evidence application like legal collection, fixation, custody, delivery, show, cross-examination, identification, authentication and so on in strict accordance with the law.<sup>[5]</sup> There are two urgent problems to be solved in persisting in the rule of illegal evidence exclusion. One is that the judiciary authorities aren't willing to, don't want to and don't dare to exclude the illegal evidence in the proceedings, have shaken the implementation of this rule, afraid that the case determination can't proceed smoothly and the lawsuit cannot proceed. Second is that the definition of illegal evidence and the legislative provisions of exclusion range are unclear; especially for "threats, enticement and deception", the law does not specify their meanings; the means of illegally obtaining evidence are various, which is urgent to be clearly defined by the judiciary.

### 2.3 *The Relationship of Litigation Review: Realization of "Centralism of First Instance"*

In practice, the Chinese criminal trial carries out the two-tier trial system; the appeal procedure is not only the relief to the accused, but also is designed as the superior court's supervision and examination mechanism for the lower court's judgement. At the same time, the appeal is designed into a low-cost, low-risk litigation action—— there is no need to give the reasons for the appeal, and the appeal trial adopts the principle of "non-punishment of appeal" to eliminate the worries of the parties. With regard to the scope of the proceedings, the second instance is subject to a comprehensive review, which allows for a comprehensive and comprehensive review of the facts of the first instance, the application of the law and even the sentence without the limitation of the scope of the appeal. Therefore, the second instance is not only the re-trial of the case, but also the continuation of the first instance, which can accept new evidence and hear new facts. Therefore, the higher the trial level is, the greater the power is; the center of gravity of the whole criminal case procedure system also moves up; accordingly, the first instance has lost the position of the procedural gravity.

In fact, that first instance is the most recent judicial procedure whose space and time distance is the shortest from the case; the possibility of the destruction or loss of the articles left in the case scene are small; the impression that remains in the memory of the witness is also clear; it is the nearest from the case truth; the possibility of ascertaining the facts of the case is the largest.<sup>[6]</sup> The realization of the essence of court trial at the first instance, the accurate determination of the facts and the correct application of the law can lay a solid foundation for the effective prevention of the wrongs. On the contrary, if the first instance proceedings is in

the form, the possibility of erroneous judgement in subsequent judicial proceedings will increase. On the other hand, the high-quality first instance procedure could be a solid support for the criminal justice system, effectively relieving the pressure of the central judiciary authorities. Therefore, it is very necessary to carry out the trial as the center and realize the first instance center.

### 3. Conclusion

The Forth Plenary Session of the Eighteenth CPC Central Committee proposed the "promotion of the reform of the trial-centered litigation system", which is of great theoretical and practical significance in the context of China's criminal litigation system and practice. The promotion of the reform of the trial-centered criminal litigation system needs to judicial procedure should be established in the relation of investigation, examination and prosecution and trial stage; the key is to properly block the impact of the investigation file information on the trial judgement. At the trial stage, it is necessary to carry out the idea of "taking the trial as the center", and the key is to ensure that the important witness attending court as a witness and strengthen the guarantee of the right to pledge to the accused. In the longitudinal review structure, it is ensured that the first instance procedure is in the position of gravity of the whole program system on the basis of fact finding. Practice shows that if the substantiation cannot be realized in the trial, the operation of all other judicial proceedings will become meaningless "idle", and the procedure justice will never be started, which will inevitably lead to the wrong case. On the other hand, if we can attach great importance to the substantive function of the court trial, the fact evidence can be truly investigated in the court, the conviction and sentencing debate is in the court, and the result of the judgment is formed in the court, these can lay a reliable foundation for the fair judgement.

### References

- [1] Shen Deyong. On the Reform of the Trial-centered Litigation System[J]; Jurisprudence of China, 2015,(3).
- [2] Zhang Jixi. A Trial-centered Litigation System[J]. Legal Sciences, 2015,(3): 44-52.
- [3] Wei Xiaona. Reform of the Trial-centered Litigation System[J]. Study of Law, 2015,(4).
- [4] Chen Guangzhong. Preliminary Exploration on the Reform of Trial Center and Relevant Litigation System[J]. Constitutional Forum, 2015,(3).
- [5] Ye Qing. Several Thoughts on the Reform of the Trial-centered Litigation System[J]. Law, 2015,(7).
- [6] Fan Chongyi. On the Reform of the Trial-centered Litigation System[J]. Academic Journal of Zhongzhou, 2015,(1).

# Research on Relationship between Corporate Governance and Social Responsibility of Chinese Private Listed Company: A Review Based on Pharmaceutical Manufacturing Industry

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**Abstract:** Studies have found that the level of private listed companies in pharmaceutical industry to fulfill their social responsibilities is influenced by sector, external constraint and other factors, but to a large extent, it is determined by the its governance structure. Based on relevant research data from 102 private listed companies in pharmaceutical industry listed by the Shanghai Stock Exchange and the Shenzhen Stock Exchange from 2012 to 2014, studies analyzed the relationship between corporate governance and social responsibility in private listed companies in pharmaceutical industry. Further researches have found that enhancing self-discipline, stipulating the proportion of independent directors, increasing executive compensation and other initiatives conduce to the improvement of the governance structure of private listed companies and promote the implementation of their social responsibility.

**Key words:** Pharmaceutical manufacturing industry, Private listed companies, Governance structure, social responsibility

## Introduction

Since reform and opening-up, private economy in China has been booming, becoming one of the most dynamic communities in the national economy. In the process of its development, two problems attract increasing attention; the first problem is the improvement of corporate governance structure, and the commitment of corporate social responsibility being the second. Due to the relatively high degree of marketing in the pharmaceutical industry and less restrictions in administrative access, the growth of private enterprises is very rapid. Focus enterprises have emerged in the pharmaceutical economy in only ten years, such as Joincare Pharmaceutical Group Industry Co., Ltd. Shanghai Fortune Industrial Co Ltd, Hongtaok, Xiuzheng pharmaceutical group, Shandong Buchang Pharmaceuticals Co., Ltd and many other enterprises; Meanwhile, since the 1990s, with the deterioration of the ecological environment, resources depletion and the growing problems such as labor protection, corporate social responsibility has quickly become the focus which was relatively forgotten in the social economy before. Particularly in recent years, some pharmaceutical industries in China have developed in an excessive speed, but on the other hand, they are

widely questioned by focus on making a profit while defying corporate responsibility. Since 2006, at least eight major phytotoxicity incidents have occurred in our country. They caused the death or serious harm of part of patients and extremely negative social impact. To some extent, this left the regulators in pharmaceutical enterprises in the firing line. This raises an issue that what kind of social responsibility should pharmaceutical manufacturing enterprises commit as a specific industry? Meanwhile, the close contact between social responsibility and corporate governance has gradually attracted attention of many scholars in recent years. A sound corporate governance structure plays an important role to protect shareholders' equity, strengthen government regulation and promote orderly development of the market. Therefore, it is of great theoretical and practical significance to study and reveal this relationship and standardize the governance structure of private listed companies to improve the commitment of their social responsibility. Thus, this paper aims at making a clear division of the social responsibility boundary of private listed companies (such as shareholders, employees, community and environment) to study the relationship between corporate governance and corporate social responsibility in pharmaceutical manufacturing industry.

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## 1. Theoretical foundation and review of the literature

### 1.1 Private listed company governance

Private listed companies refer to listed companies actually controlled by a single natural person or a number of natural persons. On the respect of Corporate Governance (Corporate Governance), OECD (Organization for economic cooperation and development) made a definition in the corporate governance principle, it is a system for managing and controlling an industrial and commercial company. And it can be believed that it clearly stipulates the rights and responsibilities of all participants (such as the board of directors, managers, shareholders and other stakeholders).

According to corporate governance theory, there are two kinds of conflicts of interest; they are the conflict of interest between the big shareholders and the minority shareholders, as well as the shareholders and the management. Based on this consideration, this study suggests that private listed company's governance includes: (1) ownership structure of private listed companies. The analysis of ownership structure constitutes the starting point of the study of the governance mechanism in private listed companies; (2) the basic situation of the actual controller of the enterprise, which is used to reveal the status of ultimate control of private listed companies. The author will mainly study the types of control methods, the control level, channels for enhancing control power and corresponding violations. (3) Relevant study on internal governance. It means the situation of separation between management and shareholders, tenure and internal checks and balances; (4) Main characteristics of private listed companies governance.

### 1.2 Social responsibility

The social responsibility of listed companies, especially private listed companies are increasingly popular in recent years. This study considered that the employment size of the modern enterprise and extent of its impact on the community is far from classical enterprise. 'Authority-responsibility model' believes that corporate social responsibility comes more from the social power he possesses. Scholars at home and abroad, such as Raymond Bauer, Joseph Mcguire, Archie Carol, Hong Bigang, Zhao Hui, Shen Hongtao and other scholars, they all defined the corporate social responsibility from different dimensions and perspectives. Although the expressions and emphases of these scholars are different, they all pointed out the core of social responsibility that is the responsibility of the organizations to promote and safeguard social interests beyond profit. Hong Bigang (2007) divided the boundary of social responsibility of private listed companies based on enterprise life cycle theory, it includes three part: boundaries of law, morality and voluntariness; Zhao Hui (2007) believed that the social responsibility of private listed companies Should be followed by the four levels, which are legal responsibility, economic responsibility, ethical responsibility and charitable responsibility; Shen Hongtao (2007) believed that corporate social

responsibility comes from the social power he possesses.; Jiang Wanjun (2010) investigated the social responsibility of private listed companies by economic indicators (E-series), social indicators (S-series), natural indicators (N-series) and other perspectives, and he listed a series of indicators.

This study suggests that the pharmaceutical industry is a concentrated area of private enterprises, and private listed companies in pharmaceutical manufacturing have distinct characteristics from other types of enterprises, such as diversification of capital, normalization of competition, diversification of formats and so on. Thus, through synthetically consideration this study suggests that the social responsibility of private listed companies in pharmaceutical manufacturing refers to the corresponding obligations undertaken by enterprises in the pursuit of their own interests at the same time, includes the responsibilities of the employees (or employees), the responsibility to consumers, the responsibility for the protection and rational use of the environment and resources, the social responsibilities of the community, charitable behaviors and so on.

### 1.3 Relationship between corporate governance and social responsibility: homology, segregation and integration

#### ① Homology

Although corporate governance is manifested in various institutional arrangements, decision-making mechanisms and organizational design, the root of these designs and arrangements remains a significant fiduciary duty. At the same time, many corporate governance arrangements is extensive around the checks and balances of responsibility, the core of which is to emphasize the tasks that an enterprise should undertake to investors, employees and government. Thus, 'responsibility' is not only a social responsibility, but also one of the theoretical cores of corporate governance. In spite of their respective theoretical systems, corporate governance and social responsibility have different emphases on the expression of 'responsibility', they coincide in core.

#### ② Shunt

After the emergence of issues of corporate governance and corporate social responsibility at the same time there are also shunt in the course of theoretical development: first of all, the objects of study are different. At the beginning of the development of corporate governance theory, the principal-agent problem brought by the separation of two rights is emphasized. Since then, the scope of research has been expanding, and in-depth research has been carried out on the coordination and motivation among various stakeholders in the enterprise. The main objects of study include the internal and external stakeholders and their relationship. The objects of research on corporate social responsibility theory is always around the relationship between enterprise and society, and takes CSR as the core concept and main objects of study. Secondly, empirical research methods are adopted in corporate governance. While in the study of social responsibility theory, more attention

has been paid to the social nature of enterprises, and the methods are normative analysis and conceptual analysis. It always make the enterprise as an objective social entity .Thirdly, In the process of corporate governance and the split development of corporate social responsibility, corporate governance has ignored and resisted social responsibility.

### ③ Fuse

Although modern enterprises' corporate governance and corporate social responsibility have their own emphasis on the connotation and research direction, scholars develop and improve their own independent theoretical system the concept of responsibility is consistent in both study areas, which has also become the origin of the integration of the development of the corporate governance and social responsibility in days to come. In April ,2010, Five ministries, including the Ministry of Finance and the Securities Regulatory Commission jointly issued the relevant guidelines for corporate social responsibility have been formally put forward in the supporting guidelines for enterprise internal control, highlighting that enterprises should take corporate social responsibility seriously from the external perspectives ,such as environmental protection, as well as internal product safety, product quality and workers' rights and interests. Thus, this study suggests that, with the internationalization and competition of the world economy, corporate governance and corporate social responsibility are bound to move towards integration. 'Responsibility', the common kernel essence provides a deep foundation and an organic premise to the integration of corporate governance and social responsibility.

## 2. research hypothesis and model construction

### 2.1 Research hypothesis

The factors affecting the social responsibility of private listed companies in pharmaceutical manufacturing should be measured from two perspectives: Firstly, from a standard opinion, they are factors of content and principle; Second, from an empirical perspective, they are specific influencing factors of social responsibility behavior. The former is greatly influenced by the social contract, so that different enterprises can achieve effective consensus because of their different external environment and their own characteristics, which approximately covers economic, legal, ethical and other responsibilities. Whether the consensus is well aligned with the behavior of the enterprise depends on the ethical awareness and behavior of the enterprise. The latter is bound by the enterprise's internal governance mechanism, external governance environment and many tangible and intangible resources of the enterprise. The most direct consequence is that the corporate social responsibility agrees with the corporate governance principle and responds to the feedback process. For relatively mature and stable private listed companies, the influence of the level of legalization in the external governance environment is more obvious; As for the different arrangements of internal

governance structure of private listed companies, different arrangements of the corporate governance structure can affect the changes of corporate social responsibility more obviously than the degree of governance from the external environment. Based on the analysis above, taking the characteristics of pharmaceutical manufacturing industry into consideration, this paper proposes the following four hypotheses:

Hypothesis 1 (H1): The social responsibility of private listed companies in pharmaceutical manufacturing industry is affected by internal governance structure and corporate governance environment (law, market competition, government responsiveness). The more perfect is the governance structure and environment, the better the performance of social responsibility

Hypothesis 2 (H2): The different arrangement of internal governance structure of private listed companies in pharmaceutical manufacturing industry will have a significant impact on their social responsibility, but the relationship of arrangement of the internal governance structure and shareholding ratio is not a simple linear relationship.

Hypothesis 3 (H3): The compensation of senior managers is positively related to the social responsibility of private listed companies in pharmaceutical manufacturing industry.

Hypothesis 4 (H4): relationship between the proportion of independent directors and corporate social responsibility may not be obvious.

## 2.2 Research design

### ① Research model design

In view of the research content, the following regression analysis model is put forward:

$$CSP = \alpha + \beta_1 OC + \beta_2 IDP + \beta_3 \ln 1. \text{ research model design} + \beta_4 \ln SIZE + \beta_5 LEV + \beta_6 YEAR + \epsilon$$

$$CSP = \alpha + \beta_1 OC + \beta_2 IDP + \beta_3 \ln 1. \text{ research model design} + \beta_4 \ln SIZE + \beta_5 LEV + \beta_6 YEAR + \epsilon$$

### ② Construction of index system

This article selects the ownership structure, the board structure and the incentive mechanism to reflect the governance structure of the private listed companies in the pharmaceutical manufacturing industry. Specifically, ownership concentration (OC) means ownership structure, proportion of independent directors (IDP) represent the structure of Board of Directors, and the salary of senior management staffs representing incentives mechanism.

Evaluation indicators of Social responsibility are as follows:

Shareholder income contribution rate (PLCCSP1) = dividends payable ÷ revenue

Creditors income contribution rate (PLCCSP2) = financial costs ÷ revenue

Employee income contribution rate (PLCCSP3) = cash paid to and on behalf of employees ÷ revenue

Customer income contribution rate (PLCCSP4) = operating costs ÷ revenue

Vendor income contribution rate (PLCCSP5) = cash paid for purchasing of goods and services ÷ revenues

Government income contribution rate(PLCCSP6) = (all taxes-tax refunds received) ÷ revenue

Public service contribution rate (PLCCSP7) = donation costs ÷ revenue

In this paper, the subjective evaluation method is adopted to set up the weights of corporate social responsibility evaluation indicators. According to the different extent impact of China's management, academics and other circles, the author will put

forward a suitable weight. This weight meets the requirements that government departments manage private listed companies and monitor the dynamic performance of its social responsibility. The specific weight values are as follows: shareholder weighted 8%; creditors dimension 10%; employee dimension 24%; customer dimension 18% supplier dimension 10%; government dimension 12%; public good dimension 18%.

### ③ Research variable

The specific variable settings are shown in Table 1:

**Table.1 Model variables and their interpretation**

variable	Symbol	Name	Definition
Explained variable	CSP	Contribution rate of corporate social responsibility	$\sum \text{CSP}_i \times Q_i$
	OC	Ownership concentration	Proportion of shares held by the largest shareholder
Explanatory variable	IDP	Proportion of independent directors	Number of independent directors / board of directors
	ln FTS	Senior management compensation	The natural logarithm of the sum of the top three salaries of senior managers
	ln SIZE	company size	The natural logarithm of the total assets
Control variable	LEV	Asset liability ratio	Assets / liabilities
	YEAR	Year	2008-2010

### ④ Research samples and data sources

This paper selects 102 private listed companies in pharmaceutical manufacturing industry listed on the Shanghai stock exchange and the Shenzhen Stock Exchange for 3 years in

2010-2012 consecutive years as the research sample, and uses SPSS17.0 statistical software and EXCEL.

### 2.3 Empirical analysis

The results of regression analysis are shown in Table 2.

**Table.2 result of regression analysis**

Model	Coefficient a				
	Non standardized coefficient		standardized coefficient		
	B	Standard error	Trial version	t	Sig.
constant	0.806	0.840		1.149	0.034
OC	0.011	0.003	-0.024	-0.289	.024*
IDP	0.063	0.182	0.027	-0.345	.016*
ln FTS	0.107	0.147	0.067	-0.727	.001**
ln SIZE	0.117	0.096	0.115	-1.216	.000**
LEV	0.521	0.063	-0.635	8.262	.000**
YEAR1	0.766	0.047	0.013	0.834	0.421
YEAR2	0.734	0.043	-0.014	-0.935	0.375

a dependent variable: CSP

### Significant correlation was found at 0.01 levels; \* was significantly related to the level of 0.05

The above empirical results show that the concentration of shares and the proportion of independent directors have a significant impact on the social responsibility of private listed companies in pharmaceutical manufacturing at 5% level. The impact of executive team member compensation, corporate size and asset liability ratio on the social responsibility of private listed companies is significant at the level of 1%. Therefore, the validity of H1, H2, H3 and H4 is verified by the results of the empirical analysis.

Ownership concentration is negatively related to corporate social responsibility. It indicates China's private listed companies in pharmaceutical manufacturing industry still cannot put off "private enterprises" and "family enterprise" predecessor. Although the company listed as a public one, here is still the tendency of excessive centralization in the process of corporate governance. Therefore, appropriate decentralization of shares is not only the needs of the sustainable development of private listed companies, but also the

necessary measures to promote the performance of their social responsibilities. The proportion of independent directors is positively related to corporate social responsibility. This indicates that although there are still loopholes in the independent director system of Listed Companies in China, which needs to be further improved, to some extent, they have played a restraining role and urge the fulfillment of social responsibility of private listed companies.

### 3. Conclusions

To sum up, to improve the governance of private listed companies and the implementation of corporate social responsibility are two important issues in the study of modern enterprises. Therefore, In view of the importance of private listed companies in China's national economy, the organical combination of this two is of great significance for the healthy development of the sustainable development of private listed companies and the whole economic society. However, simply taking corporate social responsibility as the external influence factors of corporate governance structure cannot provide a solid theoretical basis for their integration and development, and it also cannot clarify various doubts about corporate social responsibility from academic and practical circles. Thus, this essay is based on the theory of corporate governance and corporate social responsibility, and it sorts out the theory that the same core theory of this two is "responsibility". In view of the particularity of private listed companies in pharmaceutical manufacturing industry, The author selected representative indicators to build main dimensions in corporate governance, such as ownership structure, board structure and incentive mechanisms, and the essay constructed the index system to quantize social responsibility of private listed companies, it put forward hypothesis and did the empirical validation. The result is a private listed company's governance structure and social responsibility has significant correlation conclusion.

Meanwhile, there are something especially worth noting. First of all, in different governance structure and contract relations between enterprises, social responsibility connotation and category private listed companies facing has been in continuous dynamic evolution in different development stages of enterprise. More and more requirements of corporate governance should not only maximize shareholder interests, but also meet the different requirements of stakeholders. It makes corporate behavior and social expectations become more and more consistent, which further improves the connotation of governance as an organizational system

and design. Secondly, the definition of the governance structure of private listed companies involves all aspects of the internal and external environment of the company .Thus, the action, such as dispersing the ownership of enterprises, regulating the proportion of independent directors effectively and increasing the salaries of executives, can further improve the corporate governance structure to help private listed companies achieve the ultimate goal of the effective implementation of the social responsibility . And implementation of social responsibility of private listed companies will also react on the governance structure, promoting its continuous improvement, making the company's development entering a virtuous circle. Thirdly, effective balance between corporate governance and corporate social responsibility of private listed companies is of great importance in the current economic globalized and competition world.

### References

- [1] Carroll AB. A three-dimensional conceptual model of corporate social performance [J]. *Academy of Management Review*, 1979, (4): 497- 505.
- [2] Chris, Marsden. The New Corporate Citizenship of Big Business: Part of the Solution to Sustainability? [J]. *Business and Society Review*, 2000, Volume 105 Issue 1, 8- 25.
- [3] Chen Honghui, Jia Shenghua. The Evolution of the Concept of Corporate Social Responsibility and Development: Based on a Comprehensive Understanding of the Social Contract [J]. *China Industry Economic*, 2003, (12): 85- 92.
- [4] Wang Najing, Liu Qingshang, Zhao Yaowen. *The Introduction of Social Responsibility* [M]. Economic Science Publishing House, 2006.
- [5] Li Qihua. Research on Social Responsibility of private company [J]. *Zhejiang Social Science*, 2011, (10): 133-142.
- [6] Gao Hanxiang, Zheng Jixiao. Relationship Between Corporate Governance and Social Responsibility: Homology, Segregation and Integration [J]. *Accounting Research*, 2010, (6) :32-37.
- [7] Li Weiguo. Perfection Legislation of the Independent Director System of Listed Companies in China [J]. *Legality and Society*, 2007, (4).
- [8] Zhang Ran. Corporate Social Responsibility and Governance Structure in Disaster [J]. *Inheritance*, 2008, (7)
- [9] Empirical analysis of governance of Junior private listed company [R]. 2010.
- [10] Wang Dongmei, Sun Zhaoliang. Research on Relationship Between Social Responsibility and Enterprise Value –Based on an empirical analysis of panel data in listed companies. *Economic and Management*, 2011(9):17-21.
- [11] Xu Aijun. Hospital Social Responsibility and Governance Structure: Based on an Integrated Perspective [J]. *China Health Management*, 2009(3):387-390.

# Water Pollution Management of the Mekong River

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**Abstract:** The increasing population has more demand for fresh water. The conflicts will happen in a lot of places, such as regions between countries, sub-national areas in countries. This study analyses water problems and conflicts in Mekong River countries. Through collecting data and documents, it will analyse and conclude current water pollution situation of it. In the end, this paper suggests several recommendations and to discuss which methods are more suitable for the transformation and management of Mekong Basin under a good environment of sustainable development.

**Key words:** Water pollution, Mekong river, Water management, Cooperation

## Introduction

As the longest river in Southeast Asia, the Mekong flows for approximately 4,800 km from its source on the Northeast rim of the Tibetan Plateau, in China, along and the borders of or through Myanmar and Lao PDR, Thailand, Cambodia, and into Viet Nam's delta, where it empties into the South China Sea. The Mekong River Basin's catchment area is approximately 795,000 km<sup>2</sup> (which makes it the 21<sup>st</sup> largest river basin in the world). Total runoff annually is 475,000 million m<sup>3</sup> (which makes it the world's 8<sup>th</sup> largest river). Cities, industries, agriculture and mining pollution becoming more serious and also make conflicts in utilization. Serious pollution of agriculture, industry and developing cities impacts the people's clean water use. At present, there are about 50% of world's population settles down in city region, a number of them in the quickly developing and unplanned metropolitan cities of the developing world. Rapid urban growth will lead to severe results on water resources (Uitto & Duda, 2002).

## 2 Study Methods

### 2.1 Data collection

It is proposed that analysis of historical and analysis of documents are the most appropriate way. Key planning instruments and related documents, including government reports, academic papers, and media accounts in both Chinese and English, will be reviewed and analyzed on the subject of water management issues in the following areas:

- a) Water pollution source and situation in China and other 5 countries
- b) Planning for water quality management in the Mekong River

- c) Current legislation in China and other 5 countries
- d) Planning practices and strategies in other countries including for European international rivers

### 2.2 Data analysis

Through all data and documents, it will analyze and conclude current water pollution situation of Mekong River. The European international rivers have the mature experiences of water pollution, such as the Rhine. Compared with these advanced experiences, it will summarize some river laws examples and experiences suitable for Mekong River.

## 3 Water Quality Issues in Mekong River

### 3.1 Agriculture

Although fertilizer can improve the yield of rice, it is another chemical pollutant (Petersen, 2003). Rapid agriculture developments will lead to changes of cultivation in farmland. However, new agricultural practices could make more toxic substances, nutrient loads and contaminant flow into the Mekong River (MRC, 2010). According to the Vietnam Ministry of Agriculture and Rural Development (Petersen, 2003), the quantity of agricultural chemicals increased by three times between the late 1980s and mid-1990s in Vietnam. On the one hand, in paddy rice farmland, increased planting areas and fertilizers usage resulted in the improvement of food production. On the other hand, more fertilizers usage in agriculture means it is a potential nutrients contributor to rivers in the lower Mekong basin (MRC, 2008). According to Dung (1994 cited in Petersen, 2003) fertilizer use impact on the environment including 'eutrophication, the contribution to the acidification of soil, regional acid precipitation, locally reduced air quality, dust pollution and problems with plant and animal growth'. The utilization of supplementary feeds in shrimp production also has

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polluted the Mekong Basin. According to Petersen (2003), these pollutants could exacerbate the soil acidification, impacts of eutrophication and poor plant growth.

### 3.2 Industry

Industry in the Lower Mekong Basin is at a primary stage but developing rapidly. By reason of deficiency of infrastructure and transport facilities, there are few industries in the Mekong Delta (ADB, 2009 cited in MRC, 2010). There is an example of industrial pollution. Cantho City is the capital of Vietnam nearby Mekong Delta, which is also the centre of food-processing enterprises. The seafood processors are the main resources of pollution to the regional farmlands and watercourses near these factories (Danh et al., 2006). This kind of enterprise is a potential threat for water quality in Mekong River, but there are no particular data or specific information to prove industry contamination in the mainstreams of the Mekong Rivers (MRC, 2008). According to the MRC (MRC, 2008), water sample testing showed that industrial pollution effects were small in 2003 and 2004.

### 3.3 Mining

Heavy metal pollution caused by mining action, certain manufacturing industries and urban areas is one of the main environmental problems (Hart, Jones & Pistone, 2001; Song et al., 2013). According to Song et al. (2013), because many lead and zinc mines were close to the tributaries with large-scale gold mining, two tributaries, the Heihui and Mengjia rivers (in Yunnan Province, China), have been polluted by arsenic and copper respectively. In addition, Jiuzhou (main stream of upper Mekong River in China) is contaminated by zinc and lead. However, it is good to see that there is a decreasing

trend from upstream to downstream of the Upper Mekong River due to the dilution effect of the stream (Song et al., 2013).

In the lower Mekong Basin, mining activities are now increasing. Until now, mining was concentrated in regions of Laos and in areas of Cambodia near the Thailand border. The extraction and processing of minerals do not currently cause water quality problems. Cyanide is used in the process of gold mining and solid retention dams control leaching of cyanide and other heavy metals. In the lower Mekong Basin, the major potential issues in the field of gold mining are catastrophic failure of retention dams (tailings dams) and spill of chemicals (e.g. during transport on the Mekong River) (MRC, 2008).

### 3.4 Domestic wastewater

In Thailand, Laos, and Cambodia the main sources of pollution are from urban wastewater, industrial solid wastes, and agricultural residues. Because these cities have high population density, more urban sewage discharges to the Mekong River and the tributaries. The Mekong River water quality and aquatic ecosystems are at risk of adverse effects by hazardous materials mix with high organic loads which carried by these municipal wastewater (MRC, 2010).

### 3.5 Hazardous waste generated by Ships and ports

Based on wastes origin, content and properties, port wastes can be sectioned into hazardous and non-hazardous. Ports provide the interface to the land waste management and disposal system for ships. Ports comprise activities and operations from personal to industrial levels, so many kinds of types of hazardous waste can be generated MRC (2013) (Table 1 and Table 2).

**Table.1 Ship generated hazardous waste**

Waste type	Pollutant
Oily waste:	E.g. bilge water, sludge, used lubricating oil, dirty ballast water, oily tank washings and fuel residues.
Noxious liquid substances:	E.g. dirty polluted ballast water, cargo residues containing noxious liquid substances, tank washings.
Sewage:	Toilets and urinals scuppers; medical premises via wash basins, wash tubs and scuppers located in such premises
Cargo-associated waste:	Cargo associated hazardous: luggage, lining and package materials, plywood, paper and cardboard containing hazardous cargo
Maintenance waste:	soot, machinery deposits, scraped paint, deck sweeping, wiping wastes, oily rags

**Table.2 Port generated hazardous waste**

Waste type	Pollutant
Contaminated dredged material:	E.g. heavy metals (Construction works and dredging may be subject to hazardous waste management).
Packaging containing residues of hazardous material:	E.g. pesticides, insecticides, herbicides and fertilizers packaging, coolants, adhesives, oils, hydraulic fluids, brake fluids, greases.
Asbestos:	Roof sheets and slates, lagging on the boiler and central heating, boiler flue, interior walls and gaskets.
Polychlorinated Biphenyls (PCBs):	Transformers, capacitors, heat transfers and hydraulic systems.
Waste electrical and electronic equipment:	IT equipment and telecom devices (e.g. personal laptops, printers, fax), lighting equipment and other equipment
Batteries and accumulators:	E.g. calculators, watches, radios, clocks, camera, forklifts and straddle carriers
Waste oils:	E.g. hydraulic oils, engine, gear and lubricating oils, insulating and heat transmission oils.

Hazardous cargo remnants:	Leakage of bulk or dry cargo on quays
Wastewater:	Waterfront drainage will bring contaminated silt/sand, oils, minor hazardous cargo spills into the river.
Oil/Noxious substances spills:	Accidents and incidents can occur involving the spill of oil products and/or noxious substances on quays or river surfaces.
Other hazardous waste:	E.g. oily rags, oil filters, contaminated barrels etc
Vehicle and Equipment Maintenance:	E.g. solvents, oil filters, coolants, workshop oil packaging, antifreeze, brake fluids, batteries, accumulators, electronic equipment, waste oils, contaminated rags and dry cleaning agents.
Building/Ground Maintenance:	E.g. herbicides, insecticides, fertilizer packaging, pesticides, asbestos, electrical equipment, resins.
Lighting:	E.g. fluorescent lamps, high intensity discharge lamps, other electronic and electrical equipment.
Electrical Substations:	E.g. PCBs, electronic or electrical device.
Warehouses:	E.g. electrical and electronic device, asbestos, hazardous cargo remnants.
Offices:	E.g. cartridges, dry cleaning agents, surfactants containing hazardous substances, batteries, electrical and electronic device and wastewater.
Handling and storage of hazardous cargo:	E.g. cargo remnants, contaminated waterfront drainage and storm water run-off, oil and toxic substances spills.
Fuelling area:	E.g. oily rags, contaminated storm water run-off and oil leaks and spills.
Public access:	E.g. wastewater, batteries.

#### 4 Current Treatment methods of Mekong River

##### 4.1 Agreement in Mekong River Basin

In view of the main Statutes of 1957, 1965, 1975, 1978, and 1995, the transboundary water management for lower Mekong Basin has been for more than 50 years (Browder, 1998 cited in Ringler, von Braun & Rosegrant, 2004). The Mekong development project was begun in 1957 by the United Nations Economic Commission for Asia and the Far East (ECAFE). In the past few decades, the 4 lower riparian countries (Cambodia, Laos, Thailand and Vietnam) have cooperated together in a joint Mekong collaboration for purpose of utilizing and exploiting the Mekong River in order to benefit of people. The 2 upper riparian nations, China and Burma, did not join this program. The four

lower Mekong nations reached an agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (the Mekong Agreement) in 1995. The concept of sustainable development was adopted in this agreement. This shows a remarkable forward step for Mekong riparian states in dealing with the water resources issue (Pichyakorn, 2002).

##### 4.2 Cooperation

The Mekong region has fast growing economics and potential market. It has caused wide international concern over the recent years. A great number of organization and institution become focus on it and had decided to take part in development and management of Mekong River basin, such as the Multilateral Development Banks, the United Nations (Table 3).

**Table.3 Main international cooperation activities in Lancang-Mekong Subregion (He, Hsing & Li, 1997)**

Action name	Sponsor	Major participants	Main objectives	Regional extent	Content	Progress
Mekong River Commission (MRC)	UN,1957	Cambodia, Laos, Thailand and Vietnam	Development and management for water and other resources	Lower Mekong Basin, the area is about 60×10 <sup>4</sup> km <sup>2</sup> , population is about 50 million	Hydropower, irrigation, fishery, construction of hydrometeorological station etc.	After 1957, MRC focused on water conservancy, hydropower project construction, Hydrometeorological network and construction of Lower Mekong Basin. After 1995, it changed the emphasis on hydropower project and sustainable development of mainstream.

Greater Mekong Subregion (GMS)	ADB, 1992	Cambodia, China, Laos, Burma, Thailand and Vietnam	Focus on infrastructure construction and economic cooperation of basin	China (Yunnan Province) and other 5 Basin State, the whole area is about $233 \times 10^4$ km <sup>2</sup> , population is about 233 million.	Energy, transportation, environment, communications, tourism, poverty alleviation	Ministerial meetings have been held many times, completed the project framework, started some priority projects (e.g. road)
Association of Southeast Asian Nations (ASEAN)	Malaysia, Singapore and Thailand	China, Burma, Laos, Vietnam, Cambodia and other ASEAN countries	Integrated economy of ASEAN and Mekong River Basin	Southwest China, Southeast Asian nations. The whole area is about $580 \times 10^4$ km <sup>2</sup> , population is about 620 million.	Agriculture, industry, transportation, energy, tourism, communications, human resources, development and trade etc.	Ministerial meetings have been held many times, consulted with 8 framework of priority field, signed 2 agreements (ASEAN Framework Agreement on Comprehensive Economic Cooperation and Agreement on general preferential duties)
Forum for Comprehensive Development of Indochina (FCDI)	Japan, 1993	Cambodia, Laos, Vietnam	Coordinated the relationship between investors and contributors, promoted economic and social development	Indochina three nations, The whole area is about $75 \times 10^4$ km <sup>2</sup> , population is about 90 million.	To raise funds, infrastructure, human resources development	Set up infrastructure committee and branches of human resources development advisory group, Finished infrastructure planning
Quadripartite Economic Cooperation (QEC)	Thailand, 1993	China, Burma, Laos, Thailand	Implementation of Regional development potential	The boundary of Lancang river and lower Mekong river, Area: $18 \times 10^4$ km <sup>2</sup> , population is about 50 million.	Infrastructure construction, trade and investment, resources development and biodiversity protection	Held many coordination meetings, no official cooperation framework and planning

Action name	Sponsor	Major participants	Main objectives	Regional extent	Content	Progress
Mekong Development Research Network (MDRN)	Canada, 1992	Cambodia, China, Laos, Burma, Thailand and Vietnam	Scientific research and information exchange	Mekong river Basin, The whole area is about $81 \times 10^4$ km <sup>2</sup> , population is about 60 million.	Comprehensive development and management of Mekong River Basin	Set up the network office, communication of results (Investigation on the current situation of Mekong River Basin and The environmental research of Mekong basin)
ASEAN economic ministers and Japan Ministry of International Trade and (AEM-MITI)	Japan, 1994	Cambodia, Laos, and Vietnam	Strengthen the economic link between Indo-China countries and the ASEAN	The whole area is about $110 \times 10^4$ km <sup>2</sup> , population is about 58 million.	To promote investment and trade	set up a working group for these 3 countries
GMAKF	Japan, 1996	Same as GMS	To establish blueprint and enhance mutual understanding	Same as GMS	Do the research of development strategy, project planning Ecological Research, Evaluation of development projects, Biodiversity development research, sustainable development research, Human rights, ethnic minority culture	Finished the research of GMS development strategy
Non-governmental organization (NGOs)	Non-government institution of Asia, Europe, America and Australia	Non-government institution of 4 countries in lower Mekong River	Environment and biodiversity protection	Cambodia, Laos, Thailand and Vietnam	Biodiversity development research, sustainable development research, Human rights, ethnic minority culture	Focus on Thailand's NGOs, have the united action with NGOs of Asia, Europe, America and Australia
FVCL	American 1998	Cambodia, Laos, and Vietnam	To promote social and economic cooperation and academic exchange	Cambodia, Laos and Vietnam. The whole area is about $110 \times 10^4$ km <sup>2</sup> , population is about 58 million.	Society, economy and environment	Held many forum of ministerial meetings

### 5. Inadequacy of current management

There is inadequacy in Mekong River current management. This study summarize 3 main reasons. Lack of unified coordination authority, Imperfect water pollution legislation, Lack of information and data.

#### 5.1 Lack of unified coordination authority

There are three main organizations in the Mekong River Basin, each with different rationales, members, goals and weaknesses.

Although the Mekong River Commission (MRC) was established in the Mekong River Basin, it did not include China and Burma. China is the source of the Mekong River, so MRC

should include it, and it is a major disadvantage of the MRC. Therefore, upstream countries do not have a voice in the commission.

Development of the Greater Mekong Sub-region(GMS) is guided by the GMS Economic Cooperation Program, founded by the Asian Development Bank (ADB). Compared with the MRC, the GMS covers all riparian nations including China and Burma (Hensengerth, 2009). But the GMS is only a step towards improving project cooperation as the current cooperation programs do not pay enough attention to water pollution and environmental

protection (Du, 2010).

In spite of common interests among the four riparian states, the Quadripartite Economic Cooperation (QEC) lost support quickly compared to the GMS. The key issue of the QEC was that it adopted a make-or-break approach; because of the fast structure development, the QEC did not establish the confidence platforms necessary for its purpose (ensuring upstream Mekong's navigability). The QEC did not call for trusted third party mediation and NGO participation (Hensengerth, 2009) (Table 4).

**Table.4 MRC, GMS and QEC (Hensengerth, 2009)**

Project	Origin of Initiative	Year of Formal Establishment	Rationale	Outcome
Mekong River Commission (MRC)	Extra-regional	1995	Integrated Water Resources Management	Stalled
Greater Mekong Sub-region (GMS)	Intra-regional	1992	Economic Development	Successful
Quadripartite Economic Cooperation (QEC)	Intra-regional	2001	Economic Development	Failed

**Table.5 Member States (Hensengerth, 2009)**

Greater Mekong Sub-region (GMS)	Mekong River Commission (MRC)	Quadripartite Economic Cooperation (QEC)
Vietnam	Vietnam	/
Cambodia	Cambodia	/
Laos	Laos	Laos
Thailand	Thailand	Thailand
Myanmar	/	Myanmar
China	/	China

### **5.2 Imperfect water pollution legislation**

Current conventions pay less attention to water environment protection of river basins. In the face of increasingly serious water pollution, riparian states cannot carry out water pollution prevention and control work through a cooperation approach (Du, 2010). The Mekong River is a transboundary river, flowing through six riparian states with different, imperfect and impertinent water legislation and policies. If there were no unified laws and regulations regarding the trans-boundary river basin level, current agreements would easily collapse.

### **5.3 Lack of information and data**

At present, an instrumental database has been established for the Mekong River basin, headed by the secretariat of the MRC. The information is out of date and incomplete, especially regarding the field of deforestation, soil erosion and sediment deposition. This data and documents are collected and categorized by the administrative unit of each country, province and county. At the same time, the basin lacks evaluation of the environmental impacts of these activities, making it difficult to provide enough information to be the basis of decision making. This kind of situation will be the main obstacle for river basin planning, policy-making and project implementation. It also becomes the

primary sources of mistrust and misunderstanding between countries.

## **6 Recommendations**

### **6.1 Cooperation in the Mekong River Basin**

Practice has proved that integrated management organization has made a great contribution in water pollution control of transboundary rivers. The cooperation topic should deal with issues of concern such as ecological environment protection, hydropower development and climate change.

### **6.2 Improvement of supervision**

A supervision system should be established for the entire Mekong River. The supervision system needs to formulate as soon as possible and be adapted for a local context, such as a unified environmental standard, joint detection, public participation, information sharing and pollution control (Wang, 2012).

### **6.3 Funding support**

Poverty is the barrier to environmental protection. Environmental protection of the Mekong River cannot singularly depend on the financial support of six riparian countries and the ADB's investment. This funding does not go far enough, hence it fund should be procured in other ways.

#### 6.4 Pollution source control and Emergency treatment

It is vital for factories to improve their recycling of wastewater and waste residue. Through strengthening construction of sewage disposal facilities and reducing wastewater discharge, the concentration of heavy metal material may decrease significantly. At the same time, this should restrict the development of high-polluting and high-water usage industries. More industries can then adopt the advanced technology in order to improve and maintain environmental protection (Zhao & Li, 2013).

Due to the uncertainty of emergency pollution incidents, it is easy for pollution to cause serious destruction to the environment. This calls for strengthening of early-warning systems and risk management mechanisms in the Mekong River Basin. The Rhine has been subjected to a severe sudden water pollution incident; in order to avoid such incidents occurring again, the ICPR established effective early-warning systems and emergency mechanism.

Based on the Rhine experiences, Mekong organizations should establish early-warning systems and emergency mechanisms step-by-step. Based on the early-warning system and model, the riparian countries will receive the pollution warning early and take appropriate measures to prevent the spread of pollution (Du, 2010).

#### 7 Conclusions

Although there are many successful treatment methods of river management, it is not possible that the riparian countries of the Mekong system will entirely adopt the method. Because all the countries that the Mekong River flows through are developing countries, they have backward economies; economic development has become an important goal of the whole Mekong Basin (Du, 2010). For the moment, balancing economic development and environmental protection is an important problem. If the experience of the Rhine is applied to the Mekong River, it will be altered specifically to the Mekong's characteristics. Further studies could be centred on the transformation of the Rhine River's management success to discover approaches making the Mekong Basin a suitable environment for sustainable development.

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#### References

- Danh, L. T., Le Thanh Phong, L. V. D., Truong, P., & Director, T. V. N. (2006 October). Wastewater treatment at a seafood processing factory in the Mekong Delta, Vietnam. Paper presented at Fourth International Vetiver Conference, Caracas, Venezuela.
- Du, J. (2010). Water pollution prevention and control mechanism of Lancang-Mekong River- European river pollution management experience (Unpublished master's thesis), Kunming University of Science and Technology, China.
- Hart, B. T., Jones, M. J., & Pistone, G. (2001). Transboundary water quality issues in the Mekong River Basin. MRC Vientiane, Laos.
- He, D. M., Hsing, T. K., & Li, Z. J. (1997). The international subregional cooperation and sustainable development of Lancangjiang-Mekong River. *Studies in International Technology and Economy*, 43 (3), 24-30.
- Hensengerth, O. (2009). Transboundary river cooperation and the regional public good: The case of the Mekong River. *Contemporary Southeast Asia: A Journal of International and Strategic Affairs*, 31(2), 326-349.
- MRC. (2008). An assessment of water quality in the Lower Mekong Basin. In Ongley, E. & Burnhill, T. (Eds.), MRC Technical Paper No.19. Lao PDR: Mekong River Commission.
- MRC. (2010). The Mekong River report card on water quality: assessment of potential human impacts on Mekong River water quality.
- MRC. (2013). Waste management guidelines- prepared for Chiang Saen Commercial Port area.
- Petersen, E. (2003). Valuing environmental water demands in the Mekong River Basin. Paper prepared for the Australian National University.
- Pichyakorn, B. (2002). Sustainable development and international watercourse agreements: The Mekong and the Rhine. *International Union for the Conservation of Nature (Draft 30 June 2002)*.
- Ringler, C., von Braun, J., & Rosegrant, M. W. (2004). Water policy analysis for the Mekong River Basin. *Water International*, 29 (1), 30-42.
- Song, J. Y., Fu, K. D., Su, B., Huang, Q. S., Huang, J. C., & Zhang, J. L. (2013). Spatial distribution of heavy metal concentrations and pollution assessment in the bed loads of the Lancang River System. *ACTA Geographica Sinica*, 68 (3), 389-397.
- Uitto, J. I., & Duda, A. M. (2002). Management of transboundary water resources: lessons from international cooperation for conflict prevention. *The Geographical Journal*, 168 (4), 365-378.
- Wang, X. (2012). Research on the Cooperation Mechanism of Lancang-Mekong River Water Resource. *Around Southeast Asia*, (10), 73-76.
- Zhao, Z. J. & Li, Y. L. (2013). Current pollution situation and pollution control in Yunnan section of Upper Lancang River. *Environmental Science Survey*, 32 (5), 68-70.

# Study on Anti-wear and Anti-friction Properties of Graphene and T203 Complexity

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**Abstract:** In order to study the lubrication properties of graphene and T203, graphene was first characterized by scanning electron microscopy (SEM). After understanding the basic conditions of graphene, the oil additives of different concentrations of graphene and T203 were configured. The lubrication performance and synergistic lubrication effect of graphene with T203 were experimentally tested by four-ball friction and wear testing machine, and the mechanism of the joint action was analyzed. The experimental results show that the graphene materials used in this paper are multi-layered and have some impurities and defects. Adding a small amount of graphene in base oil can significantly improve lubrication, and in the test sample range, the best quality score of graphene used with dispersant span - 80 is 0.03%. Graphene and dialkyldithiophosphate zinc phosphate(T203) additive have good synergistic effect.

**Key words:** grapheme, anti-wear and anti-friction, complexity, synergistic effect

## Introduction

Graphene has a good self-lubricating property, having a lower coefficient of friction than graphite in theory. Some progress has been made in the study of graphene as a lubricant additive. Huang Haidong<sup>[1]</sup> and others using the method of mixing ball mill prepared nano-graphite, the thickness of 10 ~ 20nm, the average diameter of about 1um. He Qiang<sup>[2]</sup> and others made the oil-based nano-Cu particles with an average particle size of 10 nm were prepared by liquid phase preparation. Nanometer copper particles of different mass fraction were added to N40 base oil, and their properties were investigated by four-ball testing machine. They found the 0.5wt% oil-soluble nano-copper is the best, grinding spot diameter and friction coefficient are significantly lower than the base oil, while the spindle noise, vibration velocity RMS and temperature rise are reduced. Jiao Da<sup>[3]</sup> made the  $Al_2O_3$  /  $SiO_2$  composite nanoparticles were prepared by hydrothermal method. The composite nano-particles were modified and added to the base oil, and the friction test was carried out. It was found that the friction coefficient was the smallest when adding 0.5wt% composite particles; the composite nano-particles get the best anti-friction effect when adding 0.5wt% concentration of nano-particles,  $Al_2O_3$  less friction effect than  $SiO_2$ . Yu Xuguang<sup>[4]</sup> prepared by thermal decomposition of different forms of  $MoS_2$  nano-particles, with a dispersant is added to the test 350SN base oil, we found that addition of 1.5wt%  $MoS_2$  nano-particles and base oil wear scar diameter fibers  $MoS_2$  nano were less than the pure base oil, the maximum bite load is

improved, and the  $MoS_2$  particles are better than the nano  $MoS_2$  fiber. Xiong Kun<sup>[5]</sup> prepared the nanocomposite particles of boron nitride / calcium borate. After adding 1wt% nanocomposite particles, the friction coefficient and the wear spot of the base oil were significantly reduced and the maximum bite load increased obviously. Zhang Lin<sup>[6]</sup> modified stearic acid and methyl acrylate nano-yttrium oxide particles; found that liquid paraffin added 0.25wt% stearic acid modified nano-yttrium oxide PB value than the base oil increased by 37.5%, friction reduction of 39.6 %. Lin<sup>[7]</sup> and others to oleic acid and stearic acid on the surface modification of graphene to enhance its lipophilicity, in the four ball verification machine compared with the modified flaky graphite tribological properties, It was found that the modified graphene could be stably present in the base oil without precipitation, and the base oil to which the modified graphene was added was better than the base oil without the addition of the base oil and the modified flaky graphite got better Anti-wear and anti-friction effect. Zhang Wei<sup>[8]</sup> and others in the graphene preparation process with oleic acid on the graphene modified and found that the addition of 0.06wt% modified graphene base oil grinding spot is more smooth than the base oil, roughness decreased, while adding 5wt% gravel of the modified base oil of the modified graphene surface is undulating and the roughness is significantly higher than that of the base oil. The reason may be that the excess graphene is accumulated on the friction surface and becomes the abrasive, causing more wear. QiaoYulin<sup>[9]</sup> and other grapheme directly into the liquid paraffin, in the multi-functional reciprocating testing machine to study the different load and frequency of the two kinds of oil lubrication

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characteristics, found that the liquid paraffin and add 0.025wt% graphene friction coefficient and the wear volume of the liquid paraffin increased with the increase of the load. However, the friction coefficient and the wear volume of the paraffin wax were relatively small. The friction coefficient of the two kinds of oil samples decreased with the increase of the frequency, but the graphite liquid paraffin of olefins is not affected by frequency. Sandoz-Rosado EJ<sup>[10]</sup> studied the properties of graphene as a solid lubricant, and that the graphene has a high bearing capacity because the larger van der Waals force between the graphene layers makes the stress dispersal, and many studies have shown that the lubricating oil Add the right amount of graphene can effectively reduce the wear and tear.

In summary, graphene lubricants not only have high efficiency lubrication characteristics, but also contribute to energy-saving emission reduction, predecessors on the graphene launched all aspects of research and achieved some results, but the paper graphene and dioxane (T203) is very rare, and it is very important to study the application of graphene in lubricating oil additive.

### 1. Characterization of graphene

In order to reveal the high efficiency lubricating properties of graphene, it is necessary to characterize graphene. In this study, graphene was characterized by scanning electron microscopy (SEM). The microstructure of graphene was observed by JSM-7500F made by Japan JEOL company field emission scanning electron microscopy (SEM), and the maximum voltage was 100 million times. The scanning electron microscopy of graphene was shown in Fig. 1. It can be seen from Figure 1 that the graphene has a regular lamellar structure with an average particle size of 10um or less and a certain wrinkle and curl on the surface of the lamellae. The multilayered graphene is deposited by the van der Waals forces; Electron

microscopy can only see the selected graphene for multi-layer graphene.

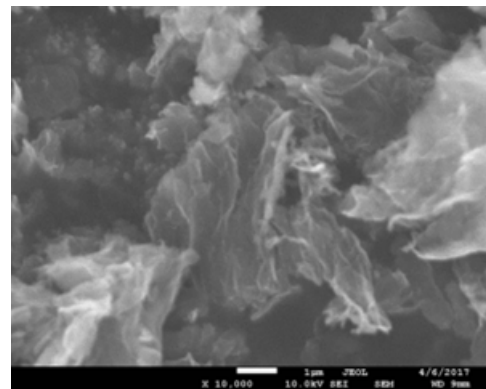


Fig.1 SEM image of numerous multi-layers Graphene

## 2. Gritene and T203 complex test

### 2.1 Compound test oil sample configuration

Base oil and additives mixed with magnetic stirring and ultrasonic oscillation for 30min each.

(1) 1 wt% T203 was added to the base oil and stirred to prepare an oil sample.

(2) 1 wt% T203 and 3 wt% graphene oil additive treated with dispersant span-80 were added to the base oil, stirred to prepare an oil sample, and the final mass fraction of graphene was 0.03 wt%.

### 2.2 Effect of graphene and T203 on the diameter of abrasive

Zinc dithiophosphate (T203) is a very common type of anti-oxidation anti-wear additives, the current market, most of the lubricants contain such ingredients, T203 is thiophosphoric acid, The grain diameter (WSD) values obtained from the combination of graphene and T203 are shown in Table 1, where G is graphene.

Table.1 the diameter of each oil-sample grinding under the test of graphene and T203 complex

Material	Base oil	Base oil +0.03wt%G	Base oil +1wt%T203	Base oil+0.03wt%G +1wt%T203
Diameter (mm)	0.559	0.471	0.458	0.434

Table 1 can be seen in the base oil to add graphene and T203 after the wear spot diameter are reduced, add 1wt% T203 than the addition of 0.03wt% graphene better, graphene and T203 after the combination of wear diameter the amount of a single additive is smaller, indicating that the two complex can play a synergistic effect.

### 2.3 Effect of graphene and T203 on the friction coefficient

The coefficient of friction (COF) of the graphene and T203

complex test is shown in Table 2. The friction coefficient of the base oil was 0.116, the coefficient of friction of the graphene oil was 0.096, 17.2% lower than that of the base oil, the coefficient of friction after adding 1wt% T203 of base oil was lower than that of the addition of 0.03wt% graphene alone, The friction coefficient of the two kinds of additives is the smallest, which is about 31.9% lower than that of the base oil, and the friction coefficient of the oil is close to that of the 1 wt% T203 alone.

Table.2 the friction coefficient of the oil samples of graphene and T203 complex test

Material	Base oil	Base oil +0.03wt%G	Base oil +1wt%T203	Base oil+0.03wt%G +1wt%T203
COF	0.116	0.096	0.081	0.079



**2.4 Effect of graphene and T203 on PB value**

The maximum card bite load (PB) values obtained from the graphene and T203 complex test are shown in Table 3. It can be seen from Table 3 that the maximal bite load of the graphene oil sample and the T203 oil sample is larger than that of the base oil,

and the oil sample with 1 wt% T203 added more than 0.03 wt% graphene oil large, the combination of the two after the largest card bite load than a single addition of a single amount of graphene and T203 are greater, it should be the effect of the two together.

**Table.3 PB value of the oil samples of graphene and T203 complex test**

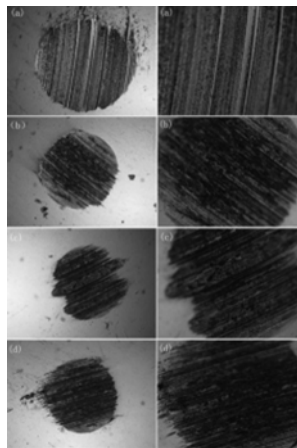
Material	Base oil	Base oil +0.03wt%G	Base oil +1wt%T203	Base oil+0.03wt%G +1wt%T203
PB value (N)	686	853	990	1009

**2.5 Study on the Synergistic Mechanism of Grain and T203**

Figure 2 for the graphene and T203 complex test corresponding to different oil-like steel ball wear surface morphology map. Figure 2 on the left side of the optical microscope under the magnification of 100 times after the ball

surface morphology, the right side of the magnification of 200 times. It can be clearly seen that the surface of the oil sample is much smoother than the base oil, and the base oil exhibits more abrasive abrasive wear. Although the oil sample has a certain number of microkits, it is much flat relative to other oil samples.

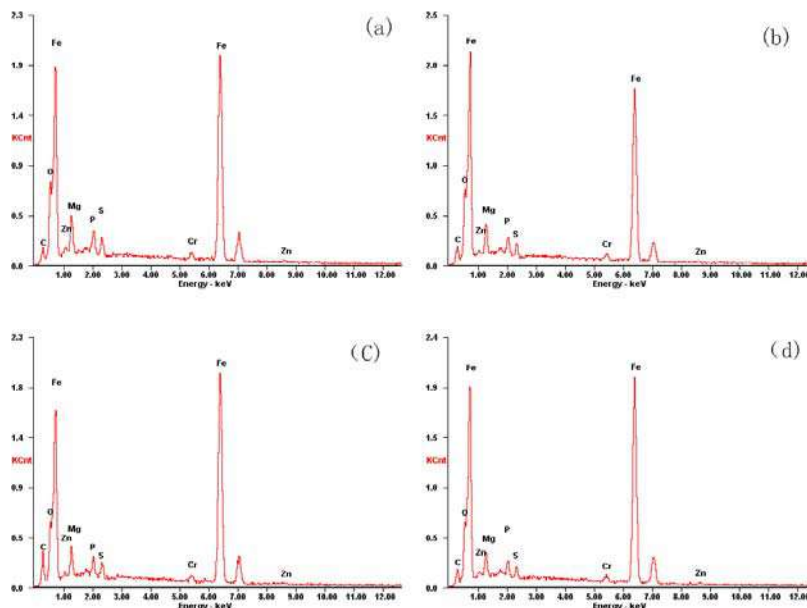
**Fig.2 Surface topography of steel beads of graphene and T203 complex test**



- (a) base oil
- (b) base oil+0.03wt%G
- (c) base oil+1.5wt%T203
- (d) base oil+0.03wt%G+1.5wt%T203

Figure.3 shows EDS energy spectra of the steel bead surface with oil sample and graphene and T203 complex oil-sample lubrication.

**Fig. 3 EDS spectra of four different oil samples**



- (a) base oil  
 (b) base oil+0.03wt%G  
 (c) base oil+1.5wt%T203  
 (d) base oil+0.03wt%G+1.5wt%T203

The content of ESD energy spectrum elements in the surface of steel ball ground surface under four kinds of lubrication conditions is shown in table 4.

**Table.4 content of the surface element of four oil - sample steel beads with graphene and T203 complex test**

Oil sample	C	O	Mg	P	S	Cr	Fe	Zn
Base oil	7.16	9.04	5.18	1.78	0.98	1.56	74.06	0.24
Base oil+G	9.44	9.25	5.08	1.74	1.14	1.40	71.66	0.3
Base oil+T203	14.50	7.68	3.41	1.24	1.07	1.22	70.56	0.33
Base oil+G+T203	8.64	7.66	3.67	1.15	0.84	1.32	76.42	0.30

According to the related literature on the mechanism of T203 study, after T203 added to the base oil, the low temperature will be adsorbed on the surface of the friction to form a physical adsorption film, when the temperature increases, T203 decomposition, and chemical reaction in the surface of the friction, generate phosphate, sulfate, iron sulfide, iron oxide and other complex components of the lubricating oil film. Graphene and T203 together with the base oil added to the lubricating effect is better, which may be T203 and graphene interaction results.

### 3. Conclusions

In this paper, the effect of graphene and T203 oil additive is studied. The synergistic effect of grapheme and zinc dialkyldithiophosphate (T203) was studied by four-ball machine long grinding. The surface morphology of different oil samples was observed by scanning electron microscopy and EDS equipment. The synergetic mechanism of graphene and zinc dialkylthiophosphate (T203) additives. The results show that the combination of graphene and zinc dialkyldithiophosphate (T203) has a certain synergistic effect. The friction coefficient, the wear spot diameter and the maximum bite load of the oil sample are improved with the addition of the equivalent T203 alone, Which may be due to the combination of graphene and T203 in the joint effect.

## References

- [1] Huang Haidong, TuJiangping, GanLuping, Zou Tongzheng, Li Chunzhong, Zhao Xinbing. The preparation of flake nano-graphite and the friction and wear properties of its lubricating oil additives [J]. Journal of tribology, 2005(04):312-316.
- [2] He Qiang, Liu Hongzhao, Ye Jun. Research on tribological properties of nano-copper as an N32 lubricant additive [J]. Journal of tribology, 2010(02): 145-149
- [3] Jiao Da. Study on the performance of Al<sub>2</sub>O<sub>3</sub> / SiO<sub>2</sub> composite nanoparticles as anti-wear agents [D]. Jinan University, 2011
- [4] Yu Xuguang. The tribological properties of nanoMos<sub>2</sub> [J]. Nonferrous metals, 2006(04): 5-8
- [5] Xiong Kun. Study on the synthesis and frictional properties of composite nanospheres with boron nitride core [D]. Hebei Industry University, 2014
- [6] Zhang Lin. Study on modification of yttrium oxide and its lubricating oil additives [D]. Guangdong Industry University, 2011
- [7] Lin J S, Wang L W, Chen G H. Modification of Graphene Platelets and their Tribological Properties as a Lubricant Additive [J]. Tribol Lett, 2011,4(1):209-215.
- [8] Zhang W, Zhou M, Zhu H W, et al. Tribological properties of oleic acid-modified graphene as lubricant oil additives [J]. Journal of Physics D (Applied Physics), 2011, 44:205-303.
- [9] Qiao yulin, Cui qingsheng, Zangyan, Zhang qing. Anti-wear and anti-friction properties of graphene oil lubricant additives. Journal of the ironclad university of engineering, 2014(6): 97-100
- [10] Sandoz-Rosado E J, Tertuliano OA, Terrelle J. Anatomistic study of the abrasive wear and failure of graphene sheets when used as a solid lubricant and a comparison to diamond-like-carbon coatings [J]. Carbon, 2012, 50:4078-4084.

# Analysis on Misdiagnosis Reasons of Ultrasonic Elastography in Superficial Soft Tissue Tumors

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**Abstract:** Objective To investigate the misdiagnosis reasons of ultrasound elastography in superficial soft tissue tumors. Method Confirmed by pathology were retrospectively analyzed in 89 patients with superficial soft tissue tumors were 19 cases ultrasound elasticity imaging misdiagnosis reason. Results 14 cases were misdiagnosed as benign tumors, 5 cases of malignant tumor as benign. Conclusion Tumor size, tumor location, tumor pathological features, operation technique ultrasound elasticity imaging is a common cause of misdiagnosis. Mastering the ultrasound elasticity imaging techniques, mass characteristics, combined with two-dimensional ultrasonic ultrasonographic features help improve the correct diagnostic rate of superficial soft tissue tumors, reduce the clinical misdiagnosis.

**Key words:** superficial soft tissue tumors, ultrasonic elasticity imaging, misdiagnosis

## Introduction

In recent years, ultrasonic elastography has been applied to the clinical diagnosis of the tumor in superficial soft tissues and superficial organs. But there still exist some limitations for the examination method, which may cause misdiagnosis. During January 2013 to March 2015, there were 19 cases of ultrasonic elastography diagnosis among 89 cases of soft tissue tumors in our hospital; the misdiagnosis rate reached 21. 3%. The paper retrospectively analyzes misdiagnosis causes of ultrasound elastography to improve clinical diagnosis rate.

## 1. Information and Methods

### 1.1 General Information

During January 2013 to March 2015, 89 cases of soft tissue tumors were treated in our hospital, among which 31 cases were male and 58 cases female, aged from 13 to 80 years, and the average age was 51 years. All patients accepted ultrasonic examination before operation and they were affirmed by pathological examination after surgical resection or puncture biopsy.

### 1.2 Instruments and Methods

Hitachi Company's HI Vision Preirus Colour Ultrasonic Scanner is adopted, which equips the linear array probe with frequency of 6.0~13.0MHz. Routine ultrasound examination in the supine position is accepted to record the two-dimensional ultrasonographic features of tumors (including position, morphology, size, rim, envelope, internal echo characteristics, relationship with surrounding soft tissues and blood vessels).

Besides, the Color Doppler Flow Imaging is adopted to observe the blood supply of the tumor and judge whether it is benign or malignant. Then real-time ultrasonic elastography is initiated and the region of interest (ROI) is generally 2 to 3 times larger than that of the lesions. For larger nodules, 2/3 of the sampling frame is chosen as a part of the nodule, and 1/3 is the surrounding tissue. The probe is held by hand to slightly press vertically on the surface of the body, making the pressure index reach 3 to 4, storing and analyzing the elastic image with good stability and repeatability<sup>[1]</sup>. When pressing, the two-dimensional image and the elastic image are simultaneously displayed on the left and right sides of the screen to help identify the hardness of the lesion tissue. In the elastic image, the color codes represent the elasticity of the different tissues, the red codes represent the soft tissues, the green codes represent the tissues with the average hardness, and the blue codes represents the hard tissues which are not easy to deform. This research is combined with domestic and international studies on the breast and grades the cases based on the five-point method proposed by Itoh<sup>[2]</sup> and the modified five-point method proposed by Luo Baoming<sup>[3]</sup>. 1 point: the lesion area and surrounding tissues are completely covered with green; 2 point: the blue and green are mixed in the lesion area, mainly with green color; 3 points: the lesion area is mainly blue, and the surrounding area is partly green; 4 points: the lesion area is completely covered with blue; 5 points: the lesion area is completely covered with blue, and the small part of tissues around the lesion is also blue. 1~3 points are divided into benign, 4~5 points are malignant. The ratio of elastic

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strain rate for the lesion area and the surrounding tissues is measured. 3.08 is a bounded point,  $\geq 3.08$  is malignant,  $< 3.08$  is benign<sup>[4]</sup>.

### 1.3 Statistical Methods

Apply the statistical software SPSS13.0 to analyze the data; take pathology results as the criterion and calculate the sensitivity, specificity, accuracy, positive predictive value and negative predictive value of ultrasound elastography on the diagnosis of soft tissue tumor.

## 2. Results

### 2.1 Pathological Results

Of the 89 cases of soft tissue tumors, 75 cases are benign, among which there are 38 cases of lipomyoma, 8 cases of fibroma, 9 cases of hemangioma, 12 cases of neurilemmoma, 2 cases of osteochondroma, 3 cases of osteoma, 3 cases of cyst; 14 cases are malignant, among which there are 5 cases of liposarcoma, 4 cases of fibrosarcoma, 2 cases of chondrosteoma, 2 cases of synovial sarcoma and 1 case of malignant neurinoma.

### 2.2 Ultrasonic Elastography Examination Results

61 cases of benign tumors are diagnosed by ultrasonic elastography and 14 cases are false positive. 9 cases are malignant tumor, among which 5 cases are false negative. Sensitivity is 64.3%, specificity 81.3%, accuracy 78.7%.

### 2.3 Comparison of Misdiagnosed Cases and Pathological Results

In this group 14 cases of benign tumors are misdiagnosed as malignant; the pathological results are 4 cases of fibroma, 1 case of cyst, 4 cases of neurilemmoma, 2 cases of chondrosteoma, 3 cases of osteoma. 5 cases of malignant tumors are misdiagnosed as benign; the pathological results are 4 cases of liposarcoma and 1 case of synovial sarcoma.

## 3. Discussion

With the wide application of ultrasound elastography in clinical practice, it has achieved great clinical application values in the differential diagnosis of thyroid and breast diseases, but it is rarely applied in soft tissue tumors. Ultrasound elastography has opened up a new field for ultrasonic diagnosis of soft tissue tumors, but it has its limitations. To analyze the misdiagnosis reasons of ultrasound elastography should be analyzed to minimize the misdiagnosis and improve the accuracy of diagnosis.

### 3.1 Analysis on Reasons of Misdiagnosing Benign Tumors as Malignant Tumors

(1) In this group there are 2 cases of fibroma and 4 cases of neurilemmoma, whose volumes are large and whose elasticity score is 4 points; they are misdiagnosed as malignant tumors. When the volumes of tumors are large, it is difficult to apply uniform pressure, resulting in distortion of elastic

imaging results in different parts of the tumors. The absence of adequate normal tissues around the lesion area may also affect the result of elastic imaging. Improper setting of ROI also affects the score result of the ultrasonic elastic, so ROI should be adjusted to more than 23 times than the range of the lesion tissue area, at least not less than 1.5 times.

(2) The elasticity score of 2 cases of fibroma is 5 points, mainly because the fibrosis and calcification inside the tumor increase the hardness of the tumor. At the same time, the acoustic attenuation caused by calcification can also affect the elasticity score, which makes the elasticity score higher and causes the misdiagnosis. Most studies show that the combination of motorization or calcification in the lesion area can increase the hardness of the lesion area and the score of UE becomes higher<sup>[5-6]</sup>.

### 3.2 Analysis on Reasons of Misdiagnosing Malignant Tumors as Benign Tumors

In 5 cases of liposarcoma, the ultrasonic elasticity score of 4 cases is 3 points, the elasticity score of 1 case with synovial sarcoma is 3 point and is misdiagnosed as benign tumor. The reason is that the tumor is soft and the elasticity score is low, which is easy to be misdiagnosed as benign tumor. When the tumor is combined with a small amount of accumulated blood, the tumor may become soft and the elastic imaging score may be reduced, resulting in misdiagnosis.

### 3.3 Other Reasons

(1) The pathological components of soft tissue tumors are complicated, and there are many kinds of tumors; there is a certain cross between the hardness of benign and malignant lesions, which is easy to cause misdiagnosis.

(2) Human factors: the deficiency of operators' skills and techniques can cause the uneven force of the tumors and the unstable elastic image.

### 3.4 Measures of Avoiding Misdiagnosis

(1) Master and fully understand the factors influencing the results of ultrasonic elastography, and then analyze comprehensively them. Combining two-dimensional ultrasound and color Doppler ultrasound can reduce the misdiagnosis rate of soft tissue tumors by ultrasonic elastography. The shape, edge, internal echo and blood supply of the tumor are observed carefully, and the ultrasonic elasticity imaging score is combined to analyze the benign and malignant tumors.

(2) Enhance the professional skill training of the doctors in ultrasound department, and master the correct examination method and operation skill of elastic imaging to avoid misdiagnosis caused by improper operation.

With the improvement of the resolution of ultrasonic instruments, more and more soft tissue tumors are found, and the judgment of benign and malignant tumors is helpful to clinicians. It is found that the diagnostic accuracy of

ultrasound elastography on soft tissue tumors is lower than that on thyroid nodules and breast nodules. Some references show that the diagnostic accuracy of ultrasound elastography in malignant thyroid nodules is 89.4%<sup>[7]</sup> and the diagnostic accuracy of ultrasound elastography in malignant breast nodules is 89.4%<sup>[8]</sup>. The ultrasonic elastic imaging in the research adopts the method of scoring and the compliance ratio of the lesions to the surrounding tissues, which are the semi-quantitative method, which is greatly influenced by the technique and technique of the operator. The shear wave elasticity imaging has been developed rapidly in recent years, whose operation is stable and repeatability is high; it can be made quantitative analysis; the value in diagnosis of soft tissue tumors can be further studied. Single elastic imaging value is not high and cannot serve as the sole or primary diagnostic indicator.

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## References

- [1] Luo Baoming, Zeng Jie, Ou Bing, et al. The Influence of the Examination Region Size of Breast Ultrasound Elastography on the Results of Diagnosis [J].China JMIT, 2007,23(9): 213.
- [2] Itoh A, Ueno E, Tohno E, et al. Breast Disease: Clinical Application of US Elastography for Diagnosis[J]. Radiology, 2006, 239(2): 341-350.
- [3] Luo Baoming, Ou Bing, Zhi Hui, et al. Value of Modified Ultrasonic Elastic Imaging Scoring Standard in Diagnosis of Breast Tumors[J]. Journal of Modern Clinical Biomedical Engineering, 2006, 12(5): 396-398.
- [4] Zhi Hui, Xiao Xiaoyun, Yang Haiyun, et al. Comparison of Diagnostic Value of Ratio Method and Score Method in Elastic Imaging of Breast Tumors with Different Sizes[J]. Chinese Journal of Ultrasound in Medicine, 2011, 26(11): 991-994.
- [5] Luo Baoming, Ou Bing, Zhi Hui, et al. Analysis and Countermeasure of Misdiagnosis of Ultrasound Elastography in Breast Tumors[J]. Chinese Journal of Ultrasound in Medicine, 2007, 23(4): 259-261.
- [6] Ye Lei, Wang Liping, Huang Yuan. Analysis and Countermeasures of Misdiagnosis of Shear Wave Elastic Imaging[J].World Health Digest, 2013, 10(15): 248-249.
- [7] Xu Fang. Application of Elastic Imaging in Thyroid Nodule Diagnosis[J].Jilin Medical Journal, 2012, 33(9): 1826-1827.
- [8] Wen Jing. Research on Combining Ultrasound Elastography With Color Doppler Ultrasound in Diagnosis of Breast Tumors[J]. Journal of Practical Medicine, 2012, 28(10): 1669-1670.

# Possibility for New Drug Inhibiting Immediate Early Gene of HCMV

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**Abstract:** HCMV is a pathogen worth our attention because it's highly prevalent in the world, and threatens the health of immunocompromised people. However, the existing drugs have many disadvantages including toxicity and viral drug resistance. Therefore, we need to find a new effective drug for this pathogen. One such possibility comes from ESE drugs extracted from plant and is shown to be effective against herpesvirus.

**Key words:** immunocompromised, new drug, gene

## 1. Introduction

Human cytomegalovirus (HCMV) is a DNA virus that causes chronic infection in over 80% of people in the world. Normally, HCMV can be transmitted by sexual contact or body fluid such as saliva and urine; however, HCMV can also infect infants through breast milk, or adults through solid organ transplantation or blood transfusion. In immunocompetent people, HCMV primary infection usually causes mild flu-like symptoms and lead to an asymptomatic chronic infection. In rare circumstances, chronic HCMV infection in immunocompetent individuals can develop complications such as pneumonia, hepatitis and meningitis, however the worst diseases can occur in immunocompromised populations including people with HIV, transplant recipients and infants. In HIV-infected individuals, HCMV can causes severe symptoms by opportunistic infection. Transmission of HCMV to babies can also have severe consequences. HCMV primary-infected mothers have a 30% possibility of infecting their infants through placental transmission (Revello M G, et al., 2002; Revello M G, et al., 2002; Stagno S, et al., 1986) and congenital HCMV infection rate is estimated to be 0.6%~0.7% of births worldwide (Kim Phuong, et al., 2013). HCMV Infection during pregnancy can result in severe consequences, with approximately 12% of symptomatic babies die from the infection. In addition, 50% of the surviving infants can have permanent sequelae including developmental retardation, vision loss, sensorial deafness, or a combination of these effects (Ramsay M E, et al., 1991). HCMV also presents a big threat to transplant recipients. Approximately 75% of transplant patients are infected with HCMV during the first year after solid organ transplant. In this population, HCMV

infection can also cause allograft rejection directly or indirectly, and make patients susceptible to opportunistic infections and malignancies. (Fishman JA, et al., 2007; Pereyra F, et al., 2004) Therefore, effective treatments for HCMV are critical to limit viral infection in these susceptible populations.

Although HCMV can infect tissues all over the body, salivary glands, which are responsible for saliva transmission, are key tissue targets for HCMV infection (Koichi, et al., 2007). HCMV disrupts the cytoskeleton in cells, causing infected cells to be uncommonly enlarged, which is a key attribute for pathology diagnosis whereas the symptoms of HCMV infection are similar with infectious mononucleosis or other glandular fevers. Among all host cell targets, fibroblasts are the most well studied in HCMV research. Fibroblasts are essential connective cells crucial for wound healing and play an important role in tumor cell mediation, as in the cases of tumor-associated host fibroblasts (TAF). TAF can induce extracellular matrix (ECM) remodeling to control tumor cell proliferation among epithelial cells (Silzle, et al., 2004). Infection of HCMV in fibroblast cells can interfere with their production of anti-tumor cytokines – ECM chemokines including Tenascin and Thrombospondin-1. Therefore, HCMV may eventually cause mucoepidermoid carcinoma. (Melnick M, et al., 2011)

HCMV can lead to a persistent infection in a host because it can evade the immune system using many different mechanisms. This means that a person once infected can be a potential carrier of this virus for the rest of their life. As a DNA virus, HCMV has a large genome of ~230kb. The HCMV genes can be classified into two types: unique long (UL) or unique short (US) genes. Various immune evasion mechanisms are controlled by multiple UL or US proteins. (Mocarski ES, et

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al., 2007) One evasion mechanism used by HCMV is to mimic the human Class I MHC using the UL18 viral protein. UL18 is expressed on the infected host cell's plasma membrane and has a better capacity than human Class I MHC for binding to the T cell and NK cell receptors to inhibit their activation (Chapman et al., 1999; Cosman et al., 1997). Even more complicated mechanisms for blocking the presentation of antigens are inside the cell, including US6 protein blocking

peptide translocation by inhibiting ATP binding to TAP proteins. TAP proteins are structures responsible for pumping peptides into the ER to bind with MHC class 1. Additionally, US3 protein can inhibit functions of tapasin, an MHC class 1 antigen-processing molecule, and US2 and US11 can induce ER-associated degradation. (Ted H. Hansen., Marlene Bouvier. 2009)

**Table.1 List of IE1 and IE2 functions**

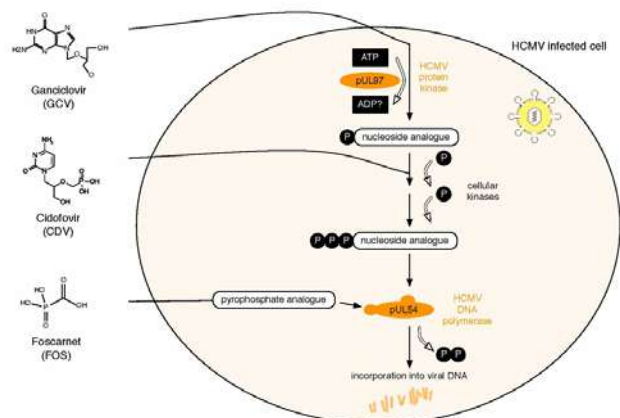
IE 1	IE 2
productive viral replication (under low MOI)	productive viral replication (main factor)
promote transcriptional activation with IE2	principal transcriptional activator of early gene
---	block host cell DNA replication
associates with mitotic host cell chromatin (protein-protein function)	binds to DNA
block extrinsic apoptosis	block extrinsic apoptosis
Antagonist of ND10-Related Intrinsic Defenses (counteracting PML)	---
antagonize the type I IFN response interfering with Jak-STAT signaling	Direct suppression of chemokine production
Summary on evasion strategies	
IE1--antagonization <i>apoptosis</i>	IE2--inhibition <i>apoptosis</i>
<i>ND10-related transcription silencing</i>	<i>inflammatory cytokine/chemokine induction</i>
<i>type I IFN signaling</i>	---

However, the earliest and most important immune evasion strategy for HCMV is the expression of proteins called immediate early protein (IE1 and IE2) which play an important role in the early infection of HCMV and several types of immune evasion. Both IE1 and IE2 are able to promote viral replication and transcription, but their exact functions are different (see Table 1). IE1 can interact with human signal transducer and activator of transcription (STAT) proteins to block host anti-viral gene expression. In addition, transcriptional regulation by IE1 and IE2 appears to interact with cellular transcription factors including histone-modifying enzymes to block their function. (Christina, et al., 2009; Fang, et al., 2016) IE1 can bind to host cell chromatin inside the nucleus to prevent limitations on viral gene transcription, whereas IE2 can bind to host cell DNA and directly inhibit antiviral responses by cooperating with cellular transcription factors. As a mechanism to block extrinsic apoptosis, IE1 can target the tumor suppressor protein PML; and IE2 binds to tumor suppressor p53 interfering with its transcriptional activator function (Christina, et al., 2009; Fang, et al., 2016).

Because HCMV can inhibit tumor suppressor proteins, it can protect tumor cells from apoptosis and create a microenvironment which promotes the development of tumor cells (Soroceanu and Cobbs., 2011). For example,

HCMV-infected fibroblast cells persistently secrete factors including the glial cell derived neurotrophic factor (GDNF) which can promote tumor cell activities (Esseghir et al., 2007; Ng et al., 2009). In such circumstances, even immunocompetent people can suffer from latent HCMV infection.

**2. Current drugs**



**Fig.1 drug targets. (pic from Wikipedia). This picture briefly explained how three most prevalent anti-HCMV drugs function with viral replicating process**

There are many drugs developed for HCMV including ganciclovir, acyclovir, foscarnet, and cidofovir. Ganciclovir and acyclovir are guanine analogues that can inhibit viral replication by targeting viral DNA polymerase. Cidofovir is a phosphorylated nucleotide analogue similar to ganciclovir and acyclovir that works by blocking DNA polymerase. Foscarnet is a pyrophosphate analogue that functions by blocking the pyrophosphate binding site of pUL54. Ganciclovir is used as a first-line treatment, but it needs phosphorylation by viral protein kinase, pUL97, to be activated, and as such the mutations reducing phosphorylation activity of pUL97 can lead to drug resistance. (Biron KK, et al., 1986). Due to toxicity, cidofovir and foscarnet are only given after ganciclovir resistance develops in an infected individual. Still, HCMV can mutate to develop resistance to these two drugs. As nucleic acid analogues, ganciclovir, acyclovir and cidofovir drugs may cause severe side effects by interfering with human DNA replication. Although these drugs can be used to treat infections in immunocompromised population, their usage still involves questions of toxicity, poor oral bioavailability, modest efficacy, and development of drug resistance (Andrei G et al., 2009). In addition, there is no drug approved for treating congenital infections and new trial drugs have failed to meet the expectations. (Christina, et al., 2009) Therefore, there is a need to develop new drugs to treat HCMV infection and evidence suggests IE1 and IE2 are ideal candidate drug targets.

Since the IE genes are so important for HCMV replication, there are many possibilities for finding drugs to inhibit IE gene expression. Current research has discovered potential drug activity of extract prepared from leaves of the *Elaeocarpus sylvestris* plant. *Elaeocarpus sylvestris* extract (ESE) was shown to inhibit IE gene expression and interfere with HCMV infection (Kim Phuong, et al., 2013). This research showed that ESE inhibited HCMV replication at a MOI of 1.0. ESE treatment reduced HCMV replication in HFF cells by 99.6% which is notably higher than the DMSO control. In this study, researchers found that ESE can interfere with the expression of viral lytic gene expression. Three types of lytic genes -IE, E, L – were significantly inhibited. More importantly, the ESE treatment did not seem to severely affect the viability of infected fibroblast cells. Treatment of fibroblasts with 10 µg/ml of ESE only slightly lowered the viability of these cells compared to the control group (Kim Phuong, et al., 2013)

*Elaeocarpus sylvestris* is a kind of tree which mainly grows in eastern Asian countries including China, Japan, and Korea. *Elaeocarpus sylvestris* is easily grown and can even be used as shade trees. Raw plant material would be abundant if needed to produce drugs, so the drug cost may be much cheaper than any exist drugs for HCMV. This species contains a potential active chemical called the gallotannin 1,2,3,4,6-penta-O-galloyl- beta-D-glucose, a compound that

has previously suggested to be radioprotective and used in traditional Chinese medicine. Also, there is a research about effectiveness of this key compound on inhibiting replication of varicella-zoster virus (VZV) which is in the same family-herpesviruses- with HCMV (Bae S, et al., 2017). Therefore, ESE may be an effective and cheap drug with minimum adverse effects. We propose to test the efficacy of ESE and evaluate how this compound can be formulated into a drug.

### 3. Research

Although ESE has been discovered that it may help with HCMV therapy, there is still a long way for us to produce it as a drug.

#### 3.1 Optimize effective dose of ESE

We need to test ESE's toxicity and effect further. In Kim's ESE research, the viability of fibroblasts treated with ESE was only slightly different from DMSO control, but the viability was still reduced by 32%. ESE would cause severe side effects if it were to kill 32% of the fibroblasts in our body. However, this outcome is only tested under one specific density of ESE. Therefore, we need to try different doses of ESE and observe its toxicity on fibroblasts versus the optimal dose for an effect on HCMV. Previous research tested the effect and toxicity of 10 µg/ml ESE on fibroblasts, and it can reduce almost all HCMV replication. We will be sure to test for lower doses to minimize toxicity. We will incubate the fibroblasts with the following ESE concentrations, 0.1, 0.5, 1, 5, 10, 20 µg/ml, and then use PCR to measure HCMV viral DNA. We will also use the CellTiter-Glo – an assay which uses fluorescently-labeled ATP added to cells - to determine the active metabolism of the fibroblasts. We will create a histogram of the results to find the best dose for treating HCMV and with least influence on viability of fibroblasts.

#### 3.2 Test active compound of ESE

Previous research proposed that ESE extract can inhibit expression of IE genes, but how exactly the ESE can interact with HCMV infection is still unknown. In order to understand our new drug better, we can measure the levels of different viral proteins using Western Blot of HCMV-infected cells with and without ESE treatment to find out which proteins might be suppressed after ESE treatment. At the same time, we can use PCR to detect the level of IE gene RNA to determine if the drug inhibits the translation or transcription of certain IE genes/proteins. We will also test whether gallotannin 1,2,3,4,6-penta-O-galloyl-beta-D-glucose is the effective compound inhibiting HCMV replication by purifying the extract. We will titer the amount of gallotannin glycerin needed to inhibit HCMV infection in fibroblasts and add same volume of glycerin in control group. Then we will use western blot to evaluate changes in viral proteins. If the amount of viral protein is significantly lowered compare to the control, this



compound is proved to be effective on treating HCMV.

### 3.3 Design efficient extraction of ESE

We need to design an efficient method to extract effective compounds and condense them into an effective concentration that would be easy to take. In Kim's research, researchers used 70% ethanol to extract this drug. However, this extraction may not yield sufficient compounds because of the variation in plants and solubility of alcohol. Therefore, we need to find a method that can extract the maximum amounts of active compounds and retain their solubility and structure. At first, we can test what temperature the valid compound can bear, so we can determine whether it will survive the direct distilling from ethanol. If not, we can try extraction using other liquid with low boiling point such as benzene, then we can distill and condense the ESE drug. We can also tell which temperature is best for storage by doing this.

### 3.4 Test toxicity in uninfected mice

Third, we will begin to test the performance of ESE and gallotannin glycerinum in animals. Although the previous test on ESE shows that there are little side effects on fibroblasts, we can't determine what side effects ESE will cause on all kinds of cells and how the metabolism of the drug inside the body if we don't test it in a living subject. We will test the toxicity of these compounds in vivo by injecting 5 different concentrations of each compound into groups of uninfected 6 mice and then monitoring for symptoms of morbidity.

### 3.5 Test efficacy in animal models of HCMV

Because HCMV is a human only virus, there has no direct animal model for this virus. However, in the past several years, scientists designed humanized mice— immunocompromised mice engrafted with regenerating human tissue – to investigate this virus. We can use this method to prepare our mice models. We would then give mice different doses of our primary ESE drug to determine the lowest effective dose and the highest tolerable dose in vivo. The drug resistance of HCMV can be tested by persistent treatment in mice models. We can constantly give different effective dose of ESE to mice and measure density of viral particles in serum during a long period using PCR to discover how difficult and how long HCMV can develop resistance to this drug. If it shows that the drug can effectively control the HCMV replication without severe side effects, we can further test it in volunteers and patients with HCMV.

## 4. Summary

HCMV is a pathogen worth our attention because it's highly prevalent in the world, and threatens the health of immunocompromised people. However, the existing drugs have many disadvantages including toxicity and viral drug resistance. Therefore, we need to find a new effective drug for this pathogen. One such possibility comes from ESE drugs

extracted from plant and is shown to be effective against herpesvirus. Consequently, I illustrated my idea and general design of my research in this proposal.

## References

- Andrei G, De Clercq E, Snoeck R. 2009. Drug targets in cytomegalovirus infection. *Infect. Disord. Drug Targets* 9:201–222. <http://dx.doi.org/10.2174/187152609787847758>
- Bae S, Kim SY, Do MH, Lee CH, Song YJ. 1,2,3,4,6-Penta-O-galloyl-β-D-glucose, a bioactive compound in *Elaeocarpus sylvestris* extract, inhibits varicella-zoster virus replication. *Antiviral Res.* 2017 Aug;144:266-272. doi: 10.1016/j.antiviral.2017.06.018. Epub 2017 Jun 29.
- Biron KK, Fyfe JA, Stanat SC, Leslie LK, Sorrell JB, Lambe CU, Coen DM; Fyfe; Stanat; Leslie; Sorrell; Lambe; Coen (1986). "A human cytomegalovirus mutant resistant to the nucleoside analog 9-([2-hydroxy-1-(hydroxymethyl)ethoxy]methyl)guanine (BW B759U) induces reduced levels of BW B759U triphosphate". *Proc. Natl. Acad. Sci. U.S.A.* 83 (22): 8769–8773. PMID 387013 Freely accessible. PMID 3022304. doi:10.1073/pnas.83.22.8769
- Chapman, T.L., Heikeman, A.P., Bjorkman, P.J., 1999. The inhibitory receptor LIR-1 uses a common binding interaction to recognize class I MHC molecules and the viral homolog UL18. *Immunity* 11 (5), 603–613
- Christina Paulus., Michael Nevels., 2009 The Human Cytomegalovirus Major Immediate-Early Proteins as Antagonists of Intrinsic and Innate Antiviral Host Responses. *Viruses* 2009, 1, 760-779; doi:10.3390/v1030760
- Cosman, D., Fanger, N., Borges, L., Kubin, M., Chin, W., Peterson, L., Hsu, M.L., 1997. A novel immunoglobulin superfamily receptor for cellular and viral MHC class I molecules. *Immunity* 7 (2), 273–282.
- Daniele Lilleri , Anna Kabanova , Maria Grazia Revello , Elena Percivalle , Antonella Sarasini, Emilia Genini , Federica Sallusto , Antonio Lanzavecchia , Davide Corti , Giuseppe Gerna. Fetal Human Cytomegalovirus Transmission Correlates with Delayed Maternal Antibodies to gH/gL/pUL128-130-131 Complex during Primary Infection. *PLOS ONE* March 2013 | Volume 8 | Issue 3 | e59863
- Esseghir S, Todd SK, Hunt T, Poulosom R, Plaza-Menacho I, Reis-Filho JS, Isacke CM. A role for glial cell derived neurotrophic factor induced expression by inflammatory cytokines and RET/GFR alpha I receptor up-regulation in breast cancer. *Cancer Res.* 2007; 67(24):11732–41. [PubMed: 18089803]
- Fishman JA, Emery V, Freeman R, Pascual M, Rostaing L, Schlitt HJ, Sgarabotto D, Torre-Cisneros J, Uknis ME, Cytomegalovirus in transplantation - challenging the status quo, *Clinical Transplantation* 21:149–158, 2007.
- Kim Phuong To, Se Chan Kang and Yoon-Jae Song. The extract of *Elaeocarpus sylvestris* inhibits human cytomegalovirus immediate early gene expression and replication in vitro. *MOLECULAR*

- MEDICINE REPORTS 9: 744-748, 2014 DOI: 10.3892/mmr.2013.1824
- Koichi Yamanishi; Arvin, Ann M.; Gabriella Campadelli-Fiume; Edward Mocarski; Moore, Patrick; Roizman, Bernard; Whitley, Richard (2007). Human herpesviruses: biology, therapy, and immunoprophylaxis. Cambridge, UK: Cambridge University Press. ISBN 0-521-82714-0.
- Liliana Soroceanu., Charles S. Cobbs., 2011 Is HCMV a Tumor Promoter? *Virus Res* . 2011 May ; 157(2): 193–203. doi:10.1016/j.virusres.2010.10.026.
- Melnick M, Sedghizadeh PP, Allen CM, Jaskoll T, Sedghizadeh; Allen; Jaskoll (10 November 2011). "Human cytomegalovirus and mucoepidermoid carcinoma of salivary glands: cell-specific localization of active viral and oncogenic signaling proteins is confirmatory of a causal relationship". *Experimental and Molecular Pathology*. 92 (1): 118–25. PMID 22101257. doi:10.1016/j.yexmp.2011.10.011
- Mocarski ES, Shenk T and Pass RF: Cytomegaloviruses. In: *Fields Virology*. Knipe DM and Howley PM (eds). Vol. 2. 5th edition. Lippincott Williams & Wilkins, Philadelphia, pp 2701-2772, 2007.
- Ng WH, Wan GQ, Peng ZN, Too HP. Glial cell-line derived neurotrophic factor (GDNF) family of ligands confer chemoresistance in a ligand-specific fashion in malignant gliomas. *J Clin Neurosci*. 2009; 16(3):427–36. [PubMed: 19138852]
- Pereyra F, Rubin RH, Prevention and treatment of cytomegalovirus infection in solid organ transplant recipients, *Current Opinions in Infectious Diseases* 17:357–361, 2004.
- Qianglin Fang , Ping Chen, Mingzhu Wang , Junnan Fang , Na Yang , Guohong Li , Rui-Ming Xu. 2016 Human cytomegalovirus IE1 protein alters the higher-order chromatin structure by targeting the acidic patch of the nucleosome DOI: 10.7554/eLife.11911
- Ramsay ME, Miller E, Peckham CS. Outcome of confirmed symptomatic congenital cytomegalovirus infection. *Arch Dis Child*. 1991; 66:1068–1069. [PubMed: 1656894]
- Revello MG, Gerna G. Diagnosis and management of human cytomegalovirus infection in the mother, fetus, and newborn infant. *Clin Microbiol Rev*. 2002; 15:680–715. [PubMed: 12364375]
- Revello MG, Zavattoni M, Furione M, Lilleri D, Gorini G, Gerna G. Diagnosis and outcome of pre-conceptional and peri-conceptional primary human cytomegalovirus infections. *J Infect Dis*. 2002; 186:553–557. [PubMed: 12195384]
- Silzle, Tobias; Randolph, Gwendalyn J.; Kreutz, Marina; Kunz-Schughart, Leoni A. (2004-01-10). "The fibroblast: Sentinel cell and local immune modulator in tumor tissue". *International Journal of Cancer*. 108 (2): 173–180. ISSN 1097-0215. doi:10.1002/ijc.11542.
- Stagno S, Pass RF, Cloud G, Britt WJ, Henderson RE, Walton PD, Veren DA, Page F, Alford CA. Primary cytomegalovirus infection in pregnancy. Incidence, transmission to fetus, and clinical outcome. *Jama*. 1986; 256:1904–1908. [PubMed: 3020264]
- Ted H. Hansen., Marlene Bouvier. 2009. MHC class I antigen presentation: learning from viral evasion strategies. *Nature reviews, Immunology*, volume 9, July 2009 ,503 doi:10.1038/nri2575

# Observation on the Effect of Alprostadil Combined with Dredging Collaterals of Tonifying Qi, Activating Blood and Resolving Sputum in Traditional Chinese Medicine on Lower Extremity Arteriosclerosis Occlusive Disease

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**Abstract:** *purpose:* To investigate the clinical effect of alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine on lower extremity arteriosclerosis occlusive disease. *Methods:* Ninety-six patients with lower extremity arteriosclerosis occlusive disease treated in Linyi Central Hospital are selected as the study samples which are divided into the control group (n = 48) and the combined group (n = 48) with the sampling method; the control group is treated with alprostadil while the combined group is treated with alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine. The clinical curative effects of the two groups of patients are compared. *Results:* The TC, TG, LDL-C, whole blood viscosity (high-cut, low-cut), fibrinogen, CRP and TCM score in the combined group are lower than those in the control group while the ABI, inner diameter of ADP, PSV, blood flow volume and total effective rate in the combined group are higher than those in the control group,  $P < 0.05$ . *Conclusion:* Alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine can effectively improve the clinical symptoms and the blood rheology status of the lower extremity arteriosclerosis occlusive disease, has remarkable curative effect and is worth clinical application.

**Key words:** Alprostadil, dredging collaterals of tonifying Qi, activating blood and resolving sputum; lower extremity arteriosclerosis occlusive disease; observation of curative effect

## Introduction

The lower extremity arteriosclerosis occlusive disease (LEAOD) is a common frequently-occurring disease in clinical vascular department. The incidence rate of LEAOD in our country has been increasing in recent years. There are 20 percent of patients belonging to the elderly group aged 60 to 75 years old. The incidence of systemic arterial and cardiovascular diseases in the elderly is greater, and thus LEAOD along with coronary sclerosis and cerebral arteriosclerosis diseases belongs to the local lesions of systemic arteriosclerosis. The incidence of the combination of these three diseases is greater; advanced age, hyperlipidemia, hypertension, long-term smoking history and diabetes mellitus are high risk factors of LEAOD. The clinical manifestation of patients with LEAOD is characterized by intermittent claudication, followed by gangrene, limb ulcer and resting pain; with the worsening of the disease, these patients can eventually suffer the paraplegia. Although the current medical technology

has developed rapidly, there is still a lack of effective therapy for the treatment of LEAOD; researches show that the combination therapy of TCM and WM for treating LEAOD can be regarded as a new target and research direction<sup>[1]</sup>. Based on the above background, the clinical effects of alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine in the treatment of LEAOD are observed, and it is hoped that it can provide reference for clinical treatment.

## 1. Information and Methods

### 1.1 General Information

From May 2015 to June 2016, 96 patients with lower extremity arteriosclerosis occlusive disease were selected as the study samples which were divided into the control group (n = 48) and the combined group (n = 48) with the sampling method. The proportion of male and female in the control group was 28: 20, aging from 48 to 79 years old; the median age was 62.47 years old; the course of the disease was 3 to 15

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### 2.2 Blood Vessel Function Index and TCM Score

The ABI, the inner diameter of ADP, PSV and blood

flow volume in the combined group are higher than those in the control group ( $P \leq 0.05$ ), as shown in table 2.

Table.2 Comparison of Blood Vessel Function and TCM score ( $\bar{x} \pm s$ , n=48)

Group	ABI	Inner Diameter of ADP (cm)	PSV (cm·L <sup>-1</sup> )	Blood Flow Volume (m/s·mm <sup>2</sup> )
Control Group	1.07±0.03	2.62±0.68	22.30±0.07	0.73±0.20
Combined Group	1.01±0.02	2.34±0.66	21.04±0.06	0.53±0.17
<i>t</i>	11.529	2.047	94.685	5.279
<i>P</i>	0.000	0.043	0.000	0.000

### 2.3 Total Effective Rate

The total effective rate of the combined group is higher than that of the control group ( $P < 0.05$ ), as shown in table 3.

Table.3 Comparison of Total Effective Rates for Clinical Treatment [n (%); n=48]

Group	Cure	Obvious Effect	Effective	Ineffective	Total effective rate
Control Group	4 (8.33)	20 (41.67)	9 (18.75)	15 (31.25)	33 (68.75)
Combined Grou	8 (16.67)	25 (52.08)	11 (22.92)	4 (8.33)	44 (91.67)
$\bar{x} \pm s$	/	/	/	/	7.940
<i>P</i>	/	/	/	/	0.005

## 3. Discussion

The pathological basis of LEAOD is that the narrowing of the lumen of the middle cerebral artery of the lower limb leads to occlusion and thrombosis, and it clinically belongs to the chronic occlusive disease caused by atherosclerosis diffusion to the peripheral artery, which can lead to an increase in blood viscosity of the patients, a rise in blood lipid and impaired vascular function, and even severe complications such as tissue infection necrosis<sup>[3]</sup>. At present, there is no specific cure method for LEAOD in clinical treatment, but it can be treated by lower limb artery reconstruction, lower limb artery bypass, percutaneous transluminal angioplasty and other surgical treatment, and the conservative treatment should be recommended for patients according with conservative treatment. Alprostadil is a commonly used medicine in conservative treatment, which helps to improve ABI, maintain the balance of blood lipid metabolism and blood rheology index of patients, has certain help in relieving the pathological process of LEAOD and improving the resting pain of the patient. However, the single use of the drug could not have the effect of treating the focus, but the short-term curative effect is still available, but with the extension of the medication time, the sensitivity to ABI will be gradually lost<sup>[4]</sup>. According to the theory of traditional Chinese medicine, LEAOD belongs to the category of “evil pulse”, “arthralgia syndrome” and “gangrene of finger or toe”<sup>[5]</sup>; the pathogenesis is characterized by deficiency of qi and blood, stagnation of endogenous retention of phlegm, and thus disharmony of yin and yang; it belongs to the syndrome of asthenia in origin and asthenia in superficiality as well as deficiency and excess, and is suitable

for the treatment of qi and blood, promoting blood circulation, eliminating phlegm and dredging collaterals. The Tongluo Zhibi Decoction used by the research belongs to the field of traditional Chinese medicine for invigorating qi, promoting blood circulation, eliminating phlegm and dredging collaterals; In the recipe, radix astragali is taken as monarch drugs, and is effective in promoting granulation, removing toxic substance, invigorating qi and promoting blood circulation. The root of red-rooted salvia, angelica sinensis and ligusticum wallichii are taken as ministerial drugs; it is effective to regulate ying and wei and defense-qi-construction if both monarch drugs and ministerial drugs are taken. Succus bambusae and loofah sponge can be used for dredging collaterals and eliminating phlegm; radices trichosanthis has effects in clearing away heat and toxic materials; raw semen coicis and medicinal cyathula root have effects in dispersing blood stasis and relieving pain; cordyceps sinensis can be used for dredging collaterals and removing blood stasis; the above drugs are adjuvants. Root of common peony, peach kernel and red flowers are conductant drugs, which can promote blood circulation, relieve pain, eliminate phlegm and dredge collaterals; when the pesticide effects reach the focus, the effects of invigorating qi, promoting blood circulation, eliminating phlegm and dredging collaterals are produced<sup>[6]</sup>. Modern pharmacology studies have shown that<sup>[7]</sup> the traditional Chinese medicine for promoting blood circulation and removing blood stasis such as angelica sinensis, the root of red-rooted salvia, ligusticum wallichii and root of common peony can accelerate the blood flow rate, promote blood circulation of lower limbs and collateral circulation, eliminate local microcirculation blood stasis, and simultaneously reduce the synthesis of cholesterol in the cells

and the inflammatory injury of endothelial cells; the anti-thrombosis and anti-arteriosclerosis effects are obvious; the medicinal cyathula root can reduce the whole blood viscosity; the earthworm anticoagulation effect is remarkable, and the stability of the erythrocyte membrane can be enhanced, so that the blood vessel function and the blood rheology index of the lower limb can be improved.

In conclusion, alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine can effectively improve the clinical symptoms and the blood rheology status of the patients with the lower extremity atherosclerotic occlusive disease, has remarkable curative effect and is worthy of clinical application.

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## References

- [1] Wu Haokun, Zhao Yiqiao. Observation of curative effect of alprostadil combined with dredging collaterals of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine in the treatment of the lower extremity atherosclerotic occlusive disease[J]. *Journal of Modern Chinese and Western Medicine*, 2016, 25(19): 2091-2093.
- [2] Vascular Surgery Division, Surgery Department, Chinese Medical Association. Guidelines for diagnosis and treatment of the lower extremity atherosclerotic occlusive disease[J]. *Chinese Journal of Medicine*, 2015, 95(24): 145-151.
- [3] Gong Weiqiang, Xu XiaoPing. Clinical observation of alprostadil combined with Tongluo Decoction of tonifying Qi, activating blood and resolving sputum in traditional Chinese medicine in the treatment of the lower extremity atherosclerotic occlusive disease[J]. *Chinese Journal of Biochemical Drugs*, 2015, 35(7): 63-65.
- [4] Li Jianpeng, Wang Zheng. The efficacy and influence of thrombectomy combined with alprostadil in the treatment of the lower extremity arteriosclerosis occlusive disease. *Chinese Journal of Experimental Studies*, 2016, 22(6): 159-162.
- [5] Yan Shan Shan, Wang Zhuanyun. Clinical Study of Blood-Activating and Tongbi Decoction Combined with Alprostadil in the Treatment of Diabetic Lower Extremity Arteriosclerosis Occlusive Disease[J]. *Clinical Study of Traditional Chinese Medicine*, 2015, 7(36): 59-60.
- [6] Yuan Bing, Yi Weidong, Wu Weihai, etc. Analysis of curative effect of Yiqi , activating blood Tongmai prescription on the treatment of diabetic lower extremity arteriosclerosis occlusive disease and its influence on CD62p. *Sichuan Traditional Chinese Medicine*, 2015, 33(8): 55-58.
- [7] Liu Yang, Yu Shijia. Clinical observation of tonifying qi and dispersing blood stasis prescription combined with alprostadil fat emulsiom injection in the treatment of diabetic lower extremity arteriosclerosis occlusive disease. *Journal of Liaoning University of Traditional Chinese Medicine*, 2015, 17(6): 172-174.

# Experience on Treatment of Intracranial Infection after Ventricular Hemorrhage Treated with External Ventricular Drainage

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**Abstract:** *Objective:* To explore the treatment and experience of intracranial infection after ventricular hemorrhage is treated with external ventricular drainage. *Methods:* A total of 30 patients with intracranial infection were enrolled in our hospital from August 2011 to September 2016. The patients were treated with intravenous, lumbar drainage, intrathecal injection and treatment for all patients. Before and after the clinical indicators, cerebrospinal fluid traits were observed and compared. *Results:* The mean extubation time was 6.43 days ( $s = 1.12$ ) for all patients. At the end of treatment all the symptoms of infection in patients disappeared, no deaths. After treatment, body temperature, intracranial pressure, cerebrospinal fluid white blood cell count, protein content was significantly lower than before treatment, and chloride and sugar indicators were significantly higher than before treatment,  $P < 0.05$ . *Conclusion:* Intracranial drainage after intraventricular hemorrhage is effective in the treatment of intracranial infection, intravenous administration, combined treatment of lumbar pond drainage and intrathecal antibiotics, and the prognosis is good and worthy of clinical promotion.

**Key words:** external ventricular drainage, ventricular hemorrhage, intracranial infection, treatment experience

## Introduction

Ventricular hemorrhage is a common acute severe hemorrhagic cerebrovascular disease. The mortality of patients can reach more than 50%. Common causes include vascular malformation, hypertension and cerebral ventricle obstruction which can cause increase of intracranial pressure and form cerebral hernia, and ultimately result in ventricular hemorrhage. In the clinic treatment, the external ventricular drainage is usually adopted to treat patients' symptom of bleeding. The longer the drainage time is, the easier the intracranial infection is to get; researches show that<sup>[1]</sup> after the ventricular hemorrhage is treated with the external ventricular drainage, the intracranial infection rate is 8%~40%, which has serious effect on the prognosis of patients. Therefore, effective treatment measures are of great significance for improvement of the patients' prognosis. Based on the above background, the treatment measures for the treatment of external ventricular drainage, ventricular hemorrhage or intracranial infection are discussed, and it is hoped that it can provide reference for clinical practice.

## 1. Information and Methods

### 1.1 General Information

30 patients with intracranial infection selected in our

hospital after their ventricular hemorrhage was treated with external ventricular drainage during August 2011 to September 2016 were studied. The proportion of male and female was 16:14, aging from 42 to 76 years old, and the average age was 55.79 years old( $s=4.38$ ); the catheter drainage time was 6 to 15 days, and the average time was 9.85 days ( $s=1.24$ ). Specific symptoms included 71 cases of hypertensive cerebral hemorrhage and breaking into ventricle and 9 cases of primary intraventricular hemorrhage; the bleeding parts included 23 cases of unilateral hemorrhage and 57 cases of bilateral hemorrhage. There was no significant difference in the baseline information of the two groups after independent sample detection comparison ( $P>0.05$ ), and thus the two groups were comparable.

Diagnostic criteria for intracranial infection<sup>[2]</sup>: ①After operation, the fever is continued and accompanied with severe headache; the body temperature is more than 38.5℃; the duration of fever is more than 7 days; ②there is obvious meningeal irritation syndrome; ③white blood cell count in blood routine examination is more than  $150 \times 10^6/L$ ; ④the pressure of cerebrospinal fluid and protein content increase, and the number of cells with turbid appearance increases; the cells are mainly white blood cells with polymorphic nucleus; the chloride and sugar index decrease.

### 1.2 Method

After the patients were admitted into the hospital,

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unilateral or bilateral external ventricular drainage was adopted according to the results of the skull CT examination; the ventricular drainage tube with a 4mm diameter was adopted in the operation; all patients' operations were finished successfully.

After diagnosis of intracranial infection, vancomycin needle (Xinchang Pharmaceutical Factory of Zhejiang Pharmaceutical Co., Ltd., SFDA No. : H20033366, 20,000 U/time, Bid) is used for veins, and the patient's head drainage tube is removed and the continuous lumbar cisterna drainage is adopted; the lumbar puncture is inserted into the silicone rubber drainage tube through the guide needle between the 4th and 5th gap of the lumbar spine, and connected with the extracranial drainage device (the main components include a signal interrupter, a flow regulating switch, an air filter, a effusion bag and a cranial pressure regulating bottle, provided by WeiHai Weichuang Medical Device Co., Ltd.). When the cranial pressure regulating bottle is hung on the head of the bed, if a frequent blockage occurs during drainage, the treatment effect cannot be achieved after re-opening or continuous puncture for 14 days, the extraction of the tube is taken into account, and the tube should be placed between the 2nd and 3rd gap of lumbar vertebra for drainage. Adjust the flow rate according to the patient's specific condition, usually with 2~8 drops/min and 4~16mL/h as the criterion. 10 mg of gentamicin needle (Hubei Qianjiang Pharmaceutical Co., Ltd., SFDA No. : H42020771) and 10 mL normal saline are injected daily according to the condition of the lumbar cistern drainage tube, and the drainage is opened after 2 hours of clipping; the drainage is gradually reduced after the patients recover with a

decrease of half or 100ml the next day; 5 mL of cerebrospinal fluid is collected for test every day until the drainage is less than 100 mL; when the body temperature, cerebrospinal fluid indication, CT and blood picture are normal, the intrathecal drug administration is stopped and the tube is pulled out; the intravenous drug is administered for 3 days.

### 1.3 Observational Index

After 15 days of continuous observation, the clinical indexes and cerebrospinal fluid traits were compared before and after treatment.

### 1.4 Statistical Analysis

The data are statistically analyzed by SPSS19.0. The measurement data are expressed as ( $\bar{x} \pm s$ ), and have a t-test. Refer to  $P \leq 0.05$  for the determination standard with statistical difference between statistical values

## 2. Results

In all patients, the tube extraction time of 17 cases was less than 5 days; the tube extraction time of 9 cases was 6 to 9 days, and the the tube extraction time of 4 cases was more than 10 days; the average extraction time was 6.43 days ( $s=1.12$ ). At the end of the treatment, all patients' infection symptoms disappeared and there was no case of death.

The body temperature, intracranial pressure, white blood cell count in cerebrospinal fluid and protein content after the treatment were significantly lower than those before treatment, and the chloride and sugar index was significantly higher than that before treatment ( $P < 0.05$ ), as shown in table 1.

Table.1 Comparison of clinical indications and cerebrospinal fluid traits before and after treatment ( $\bar{x} \pm s$ ; n=30)

Time quantum	Body temperature ( $^{\circ}\text{C}$ )	Intracranial pressure (mmHg)	White blood cell count ( $\times 10^6/\text{L}$ )	Protein content (mg/L)	Chloride (mmol/L)	Sugar (mmol/L)
Before treatment	38.50 $\pm$ 0.02	35.24 $\pm$ 1.96	150.34 $\pm$ 5.68	1034.25 $\pm$ 12.53	109.34 $\pm$ 2.12	0.76 $\pm$ 0.24
After treatment	37.42 $\pm$ 0.04	12.03 $\pm$ 1.37	80.96 $\pm$ 5.32	272.92 $\pm$ 12.79	123.51 $\pm$ 2.09	3.25 $\pm$ 0.35
<i>t</i>	132.272	53.161	48.830	232.896	26.071	32.137
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

## 3. Discussion

Although the intracranial pressure can be rapidly decreased and the obstruction status of the ventricular system can be relieved through external ventricular drainage, the drainage after the operation can lead to the increase of incidence rate of intracranial infection; the research of Zheng Jiadi<sup>[3]</sup> shows that the incidence rate of intracranial infection after the external ventricular drainage is 8.9 times higher than that without the external ventricular drainage. The factors that result in the intracranial infection after the external ventricular

drainage are as follows: ①the cerebral hemorrhage disease itself can cause the patients staying in stringent state, and the decrease of organism immunity leads to the infection; ②the defense function of the ventricular system is relatively weak; there isn't any phagocyte in the cerebrospinal fluid; after the pathogen invades into the ventricular chamber due to a lack of alexin and IgM, the infection is more likely to occur, and the control is difficult; ③ long-term placement and multiple injections of urokinase into the brain chamber increase the risk of infection; ④ the cerebrospinal fluid in the process of replacing the drainage bag can flow backwards, thereby



causing the intracerebroventricular infection.

In this study, the intracranial infection is treated with the combining therapy of intravenous injection, lumbar cistern drainage combined with intrathecal injection antibiotics; the experience is as follows: ① The pathogenic bacteria of intracranial infection after the external ventricular drainage is mainly gram positive bacteria; for the choice of the intravenous antibiotics, if the bacterial culture of the cerebrospinal fluid is positive, the antibiotics with good bacterial inactivation effect that is easy to pass through the blood brain barrier can be selected according to the result of the drug sensitivity of patients; but considering the antibiotic resistance of the bacteria, the antibiotics can be adjusted after the treatment for a period of time according to the results of bacterial culture. In this study, vancomycin is recommended; drug resistance is not detected in all cases during the continuous treatment; the vancomycin belongs to glycopeptides antibiotics, can penetrate the blood brain barrier better, and can play a significant role in G+ bacteria infection. ② In the circulation course of the antibiotics successfully entering into the absorption mechanism of the cerebrospinal fluid, the intrathecal drug administration can rapidly reach the concentration of the blood drug peak and effectively control the infection. The intrathecal injection drug selected in this study is gentamicin with mild toxic and side effects, and has little irritation to nerve causticity and nerve root irritation, and the sensitivity of pathogenic bacteria is high, and the defect of increasing nerve injury can be effectively avoided<sup>[4]</sup>. ③ Whether the lateral external ventricular drainage tube needs to be removed immediately after the intracranial infection occurs, there is still a dispute in the present clinic, but the study hold the views that the drainage tube is the root cause of infection, so the infection can be controlled more thoroughly after extraction. Jiang Qijun<sup>[5]</sup> thinks that the method of repeated lumbar puncture and releasing cerebrospinal fluid inflammatory factor can be adopted, but the method has the defect of repeated invasive operation, which can cause additional pain to the patients; the disposable lumbar cistern drainage used in the study can not only draw out intracranial bacterial, hemoglobin and inflammatory cerebrospinal fluid released by inflammatory cells continuously, reduce bacterial

count, improve symptoms of intracranial infection, but also recover the absorption metabolic mechanism of cerebrospinal fluid, promote the production of new cerebrospinal fluid, and rapidly reduce irritation of inflammatory mediators to meninges. In addition, the continuous drainage can reduce the visible component of blood, the arachnoid adhesion caused by the aggregation of inflammatory substances and the stenosis of the midbrain aqueduct, reduce the intracranial pressure, avoid the backflow and infection of cerebrospinal fluid and facilitate the prognosis of the patient.

In conclusion, if intracranial infection occurs after the treatment of ventricular hemorrhage by external ventricular drainage, the combining therapy of intravenous injection, lumbar cistern drainage combined with intrathecal injection antibiotics is adopted, which can achieve remarkable effect; the prognosis of the patient is good, and it is worthy of clinical popularization.

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## References

- [1] Shen Yunlong, Liu Jialing, Qi Songtao, etc. Analysis of risk factors of secondary intracranial infection after ventricular hemorrhage by external ventricular drainage[J]. Chinese Journal of Neurologic Diseases, 2015, 41(12):705-709.
- [2] Zhou Liangfu. Modern Neurosurgery (the2nd Version)[M]. Fudan University Press, 2015:89-90
- [3] Zheng Jiadi. Application of ventricular external drainage in patients with small cerebral hemorrhage[J]. Chongqing Medical, 2016,45(21):2998-3000.
- [4] Wang Sengang, Zhao Jianqi, Jing Xiepan, etc. Treatment and analysis of intracranial infection vancomycin and lumbar cistern drainage for intracranial infection of patients with hypertensive intracerebral hemorrhage[J]. Chinese Journal of Nosocomiology, 2015,25(9):1999-2001.
- [5] Jiang Qijun, Gan Zhengkai, Luo Xue, etc. Research on application effect of antibacterial drugs and mannitol on patients with intracranial infection after intracerebral hemorrhage[J]. Chinese Journal of Nosocomiology, 2015(20): 4682-4684.

# Research for the Effect of Different Mass Fraction of $\gamma$ -Al<sub>2</sub>O<sub>3</sub> on the Thermal Stability of Mesoporous Rare-earth Oxides

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**Abstract:** A mesoporous La/Ce/Zr composite oxide catalyst is prepared, in which  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> works as the main modification component to replace different mass percent of Ce/Zr solid solution matrix. The structures and performances of the composite oxide catalyst powder are characterized by ICP analyzer, scanning electron micro-scope (SEM), specific surface analyzer, laser particle size analyzer, thermal gravimetric analyzer (TGA) and other characterization techniques. The results show that  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> adjunction significantly improves the sintering degree of the surface of the catalyst powder under high service temperature, increases the thermal stability and anti-aging performance of the catalyst, and simultaneously helps to improve NO<sub>x</sub> reduction rate and CO<sub>2</sub> generation rate of the catalyst. The results of this study have an important value in an engineering application for the simultaneous removal of marine diesel engine exhaust pollutants of PM and NO<sub>x</sub>.

**Key words:**  $\gamma$ -Al<sub>2</sub>O<sub>3</sub>, Mesoporous material, rare-earth metal, thermal stability

## Introduction

Under normal conditions, the ignition temperature of carbon particles (PM) of marine diesel engine is high and NO<sub>x</sub> is difficult to be reduced, so the simultaneous catalytic removal of PM and NO<sub>x</sub> for diesel engine has become one of the hot topics in the research field<sup>[4][5][6]</sup>. At present, the previous use of rare earth catalyst has effectively reduced PM ignition temperature and improved the reduction rate of NO<sub>x</sub><sup>[1]</sup>. However, because of its poor thermal stability and anti-aging performance, the technology of the simultaneous catalytic removal of diesel engine PM and NO<sub>x</sub> is not widely used in marine engineering practice, and should be studied further later.

The catalytic property is mainly influenced by the microstructure properties of the catalyst<sup>[2]</sup>. The distribution state, powder surface contact state and acid-base properties of loaded carriers of the active components have significant influence on the catalytic properties<sup>[3]</sup>. At the present stage, the research of the catalyst, especially the supported catalyst, in changing the substrate surface coating, substrate surface acidity and morphology is to change the mobility and distribution of the active catalyst component on the substrate surface<sup>[7][8][9]</sup>. In substrate coating material, activated alumina has been more researched and applied.

Activated alumina with certain catalytic redox ability has a

disordered crystal phase like spinel structure, structural flaws and crystal aluminum vacancies, while it has small particle size, large specific surface area, strong adsorption ability to different reactant and large catalytic reaction temperature range. So it can be used as catalyst or catalytic agent. For example, firstly  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> is coated on the surface of the honeycomb ceramic filter, then the catalyst is impregnated in the ceramic filter, for instance, the triple-effect gasoline purification filters.

$\gamma$ -Al<sub>2</sub>O<sub>3</sub> has some characteristics of high melting point and high specific surface area, which are used to modify the lanthanum cerium zirconium composite oxide in order to prepare a mesoporous lanthanum cerium zirconium aluminum composite oxide<sup>[10]</sup>. Then its effect is studied on catalytic performances of engine PM and NO<sub>x</sub><sup>[11]</sup>. Finally, the purpose of this paper is achieved, that is to improve the thermal stability of rare-earth catalyst and aging resistance, to improve the production rate of CO<sub>2</sub> and the reduction rate of NO<sub>x</sub>, and to meet the needs in engineering practice of marine diesel engine.

In this paper, two mass fractions of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> are used to modify lanthanum cerium zirconium composite oxide. There are two kinds of experimental schemes.

The first scheme is to use 60%  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> instead of Ce/Zr to obtain the mesoporous lanthanum cerium zirconium aluminum composite oxide, which is La<sub>0.05</sub>Ce<sub>0.24</sub>Zr<sub>0.11</sub>O<sub>2</sub> / ( $\gamma$ -Al<sub>2</sub>O<sub>3</sub>)<sub>0.6</sub>, hereinafter referred to as LCZA60.

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The second scheme is to use 76% $\gamma$ -Al<sub>2</sub>O<sub>3</sub> instead of Ce/Zr to get the mesoporous lanthanum cerium zirconium aluminum composite oxide, which is La<sub>0.04</sub>Ce<sub>0.15</sub>Zr<sub>0.05</sub>O<sub>2</sub>/(Al<sub>2</sub>O<sub>3</sub>)<sub>0.76</sub>, hereinafter referred to as LCZA76.

### 1. Preparation for the experiment

In the preparation process of the mesoporous lanthanum cerium zirconium aluminum composite oxide powder, the process parameters of the solution concentration, pH, precursor and calcination temperature are the same<sup>[12]</sup>. Only a partial content of component is changed to be able to greatly change the physicochemical properties of the catalyst, such as specific surface area, the formation of the composite crystalline phase and catalytic properties, and so on<sup>[13]</sup>. This experiment still uses rare-earth nitrate as rare-earth source, NH<sub>4</sub>HCO<sub>3</sub> as precipitant, and sixteen alkyl three methyl bromide as a cationic surfactant dispersant<sup>[14]</sup>. The composite powder is prepared by dispersing active suspended Al<sub>2</sub>O<sub>3</sub> nanoparticles in liquid<sup>[15]</sup>.

According to the two experimental schemes, the mass fraction ratio of each component for required catalyst powder is respectively as follows: (La<sub>2</sub>O<sub>3</sub>): (CeO<sub>2</sub>): (ZrO<sub>2</sub>): (Al<sub>2</sub>O<sub>3</sub>) = 5:24:11:60, (La<sub>2</sub>O<sub>3</sub>): (CeO<sub>2</sub>): (ZrO<sub>2</sub>): (Al<sub>2</sub>O<sub>3</sub>) = 4:15:5:76. The needed quantities of La (NO<sub>3</sub>)<sub>3</sub>·6H<sub>2</sub>O, Ce (NO<sub>3</sub>)<sub>3</sub>·6H<sub>2</sub>O, Zr (NO<sub>3</sub>)<sub>4</sub>·5H<sub>2</sub>O, NH<sub>4</sub>HCO<sub>3</sub> and sixteen alkyl three methyl bromide and activated alumina powder are calculated and weighed. Rare-earth nitrate and sixteen-alkyl three-methyl bromide are dissolved in deionized water with the total concentration of rare-earth ions being 0.5 mol/L. NH<sub>4</sub>HCO<sub>3</sub> is dissolved in

deionized water with the concentration of NH<sub>4</sub>HCO<sub>3</sub> solution being 1 mol/L. Two solutions are magnetically stirred to be fully dissolved at room temperature.

Ammonia is used to adjust PH value of NH<sub>4</sub>HCO<sub>3</sub> solution to around 8.5. Alumina nanoparticles of the corresponding quality are put into the rare-earth nitrate solution and are evenly dispersed in the solution by ultrasonic dispersion, then are stirred by magnetic mixer under the constant temperature. Under 70°C constant temperature, the excessive rare-earth ion solution is slowly titrated into NH<sub>4</sub>HCO<sub>3</sub> solution to control pH value between 8-8.5 with continuous magnetic stir. After a period of constant temperature mixing reaction, the reaction production is filtrated and precipitated, and is washed by deionized water two times and then by absolute ethanol. After being dried about one hour at 100°C, the reaction production is put into the high temperature resistance furnace and is roasted for about four hours at 800°C, finally two powder catalysts of La/Ce/Zr/Al composite oxides can be obtained respectively, which are LCZA60 and LCZA76.

### 2. Characterization and analysis of physical performances for catalyst

The characterization and analysis instrument of catalyst physical and chemical properties in this paper are as follows: Coulter LS-230; ASAP2100; JSM-7500F; XPert Powder, Hitachi TG/DTA7200.

#### 2.1 ICP analysis

**Table.1 Quantitative analysis of chemical composition for LCZA60**

Chemical composition	Actual content (%)	Design content (%)	Error (%)
La <sub>2</sub> O <sub>3</sub>	5.08	5	1.6
CeO <sub>2</sub>	23.71	24	-1.2
ZrO <sub>2</sub>	11.13	11	1.2
Al <sub>2</sub> O <sub>3</sub>	59.95	60	-0.001
LCZA60	99.87	100	-0.13

**Table.2 Quantitative analysis table of chemical composition for LCZA76**

Chemical composition	Actual content (%)	Design content (%)	Error (%)
La <sub>2</sub> O <sub>3</sub>	4.08	4	0.08
CeO <sub>2</sub>	14.55	15	-0.45
ZrO <sub>2</sub>	5.05	5	0.5
Al <sub>2</sub> O <sub>3</sub>	75.60	76	-0.4
LCZA76	99.28	100	-0.72

The deviation between the measured value and the design value of the chemical composition in Table 1 and table 2 is less than 2%. Because of small deviation, the chemical composition

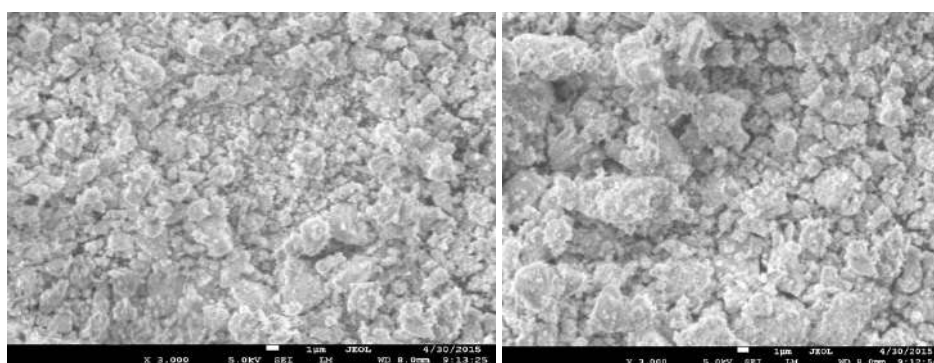
can meet the experimental requirements.

#### 2.2 BET and SEM analysis

**Table.3 Particle size and specific surface area of fresh catalyzer**

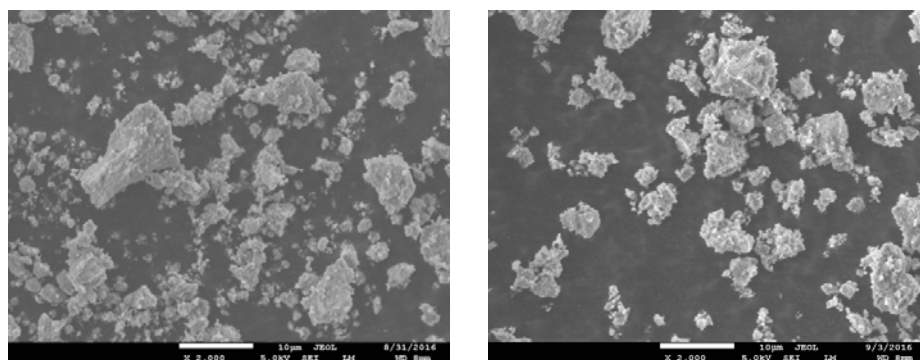
Parameter Catalyzer	D10 ( $\mu\text{m}$ )	D50 ( $\mu\text{m}$ )	D90 ( $\mu\text{m}$ )	Average particle size reduction rate (%)	Specific surface area ( $\text{m}^2/\text{g}$ )	Specific surface area increase rate (%)
$\gamma\text{-Al}_2\text{O}_3$	0.13	0.22	0.45	0	130.3	0
$\text{La}_{0.05}\text{Ce}_{0.65}\text{Zr}_{0.3}\text{O}_2$	0.91	2.96	6.43	0	67.4	0
LCZA60	1.23	2.71	7.60	8.5	120.2	78.4
LCZA76	1.25	2.70	7.61	8.8	125.52	86.3

$\gamma\text{-Al}_2\text{O}_3$  used in the experiment is purchased from the market, with its data provided by the merchant.



(a) Fresh state

(b) Thermal aging state

**Fig.1 SEM image of LCZA60**

(a) Fresh state

(b) Thermal aging state

**Fig.2 SEM image of LCZA76**

Compared with Fig 1 (a), the size of individual particles in Fig 2 (a) is larger, but its distribution is more uniform. The result shows that the addition of  $\gamma\text{-Al}_2\text{O}_3$  promotes the dispersion of La so as to evenly distribute refinement effect of La.

Compared with Fig 1 (b), although sintering agglomeration in Fig 2 (b) occurs in a few areas, the grain size and the adhesion degree are lower, the grain size in other regions is relatively smaller and its distribution is more uniform. The result shows that addition of  $\gamma\text{-Al}_2\text{O}_3$  has the effect of dispersing and isolating

the La/Ce/Zr component so as to reduce the adhesion between the grains and prevent the occurrence of sintering agglomeration.

Although the addition of  $\gamma\text{-Al}_2\text{O}_3$  does not lead to the significant increase of the specific surface area, the thermal stability and anti-aging performance are significantly improved, and the occurrence of agglomeration is decreased.

2.3 Anti-aging performance

Table.4 The specific surface area of thermal aging catalyzer

Parameter	Aging temperature (°C)	Specific surface area (m <sup>2</sup> /g)	Specific surface area change rate after aging (%)
Catalyzer			
La <sub>0.05</sub> Ce <sub>0.65</sub> Zr <sub>0.3</sub> O <sub>2</sub>	1000 (4h)	25.07	0
La <sub>0.05</sub> Ce <sub>0.25</sub> Zr <sub>0.1</sub> O <sub>2</sub> /(Al <sub>2</sub> O <sub>3</sub> ) <sub>60</sub>	1000 (4h)	82.23	-31.6
La <sub>0.04</sub> Ce <sub>0.15</sub> Zr <sub>0.05</sub> O <sub>2</sub> /(Al <sub>2</sub> O <sub>3</sub> ) <sub>76</sub>	1000 (4h)	105.51	-15.9

Data of table 4 fully shows that the sintering degree for the active component on surface of LCZA76 is smaller. The reason is due to the good thermal stability of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub>. Although the grain has a certain degree of growth, because of the effect of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> on the dispersion of the active component, the La/Ce/Zr grains are separated by  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> to prevent the occurrence of sintering. Therefore, the addition of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> can maintain a good surface structure of catalyst powder under high temperature condition, and make the grain size more uniform distribution, then effectively inhibit the sintering of the active component.

2.4 TPR catalytic experiment

3mg PM is fully mixed with 8mg LCZA60 and LCZA76 respectively in the thermogravimetric analyzer. TPR experiment is carried out by passing the mixture gas of NO and O<sub>2</sub>, where the NO concentration is 1000ppm.

It is TPR curves of catalyst LCZA60 under NO and O<sub>2</sub> atmosphere, as shown in figure 3. The results show that the ignition temperature of engine PM is about 305°C and the highest oxidation catalytic activity temperature is about 510°C. The maximum production rate of CO<sub>2</sub> is 77.5% and the maximum reduction rate of NO is 21.8%.

It is TPR curves of catalyst LCZA76 under NO and O<sub>2</sub> atmosphere, as shown in figure 4. The results show that the ignition temperature of engine PM is about 290°C and the highest oxidation catalytic activity temperature is about 480°C. The maximum production rate of CO<sub>2</sub> is 83.3% and the maximum reduction rate of NO is 22.8%. Compared with LCZA60, both the ignition temperature and maximum active

temperature of LCZA76 are reduced and its maximum production rate of CO<sub>2</sub> and maximum reduction rate of NO are increased.

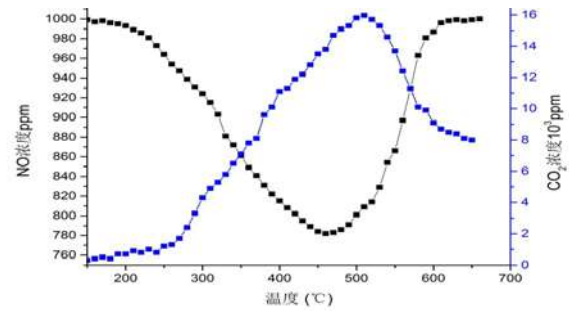


Fig. 3 TPR curves of LCZA60 under

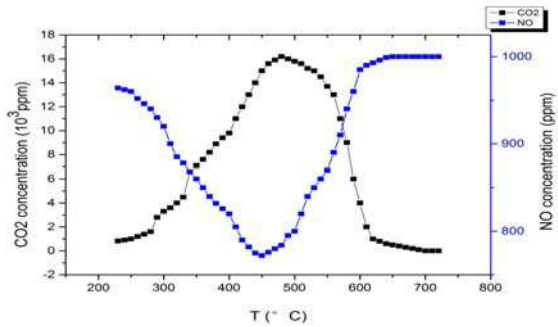


Fig.4 TPR curves of LCZA76 under NO and O<sub>2</sub>

According to Figure 3 and Figure 4, the experimental contrastive results of LCZA60 and LCZA76 under NO and O<sub>2</sub> atmosphere are shown in Table 5.

Table.5 Comparison of experimental results

	Before catalysis	After LCZA 60	After LCZA 76
The ignition temperature of PM (°C)	490	305	290
The highest active temperature of PM (°C)	650	510	480
Maximum production rate of CO <sub>2</sub> (%)	0	77.5	83.3
Maximal reduction rate of NO (%)	0	21.8	22.8

To sum up, addition of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> promotes the dispersion on the surface of La/Ce/Zr composite component, increases surface structure defects, and enhances the activation adsorption capacity of NO catalyst and migration of lattice oxygen, then

improves the catalytic complex on La/Ce/Zr NO removal performance.

3. Concluding remarks

Because activated  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> has active component dispersion effect and heat stable structure. Addition of activity  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> improves the surface sintering degree under high temperature, enhances the thermal stability of the catalyst, and improves the anti-aging performance, meanwhile improves the LCZA76 surface dispersion, the specific surface area and the catalytic performance, and then CO<sub>2</sub> production rate and NO reduction rate. However, it also reduces ignition temperature of PM.

At the present stage, properties of LCZA76 catalyst have basically met some processing requirements of the marine diesel engine exhaust pollutants.

## References

- [1] Yoshida, K., Makino, S., sumiya, S.etc. Simultaneous reduction of NOx and particulate emissions from diesel engine exhaust [J]. SAE Paper No.892046. 1989.
- [2] Shangguan, W. F., Teraoka, Y., Kagawa, S. Promotion effect of potassium on the catalytic property of CuFe<sub>2</sub>O<sub>4</sub> for the simultaneous removal of NOx and diesel soot particulate[J].Applied Catalysis B-Environmental. 1998, 16(2): 149-154.
- [3] Shangguan, W. F., Teraoka, Y., Kagawa, S. Kinetics of soot-O<sub>2</sub>, soot-NO and soot-O<sub>2</sub>-NO reactions over spinel-type CuFe<sub>2</sub>O<sub>4</sub> catalyst[J]. Applied Catalysis B-Environmental. 1997,12(2-3): 237-247.
- [4] Teraoka, Y., Nakano, K., Kagawa, S.etc. Simultaneous Removal of Nitrogen-Oxides and Diesel Soot Particulates Catalyzed by Perovskite-Type Oxides[J]. Applied Catalysis B-Environmental. 1995, 5(3): L181-L185.
- [5] Teraoka, Y., Nakano, K., Shangguan, W.etc. Simultaneous catalytic removal of nitrogen oxides and diesel soot particulate over perovskite-related oxides[J]. Catalysis Today. 1996,27(1-2): 107-113.
- [6] Teraoka, Y., Kanada, K., Kagawa, S. Synthesis of La-K-Mn-O perovskite-type oxides and their catalytic property for simultaneous removal of NOx and diesel soot particulates[J].Applied Catalysis B-Environmental. 2001, 34(1): 73-78.
- [7] Shangguan, W. F., Teraoka, Y., Kagawa, S. Simultaneous catalytic removal of NOx and diesel soot particulates over ternary AB<sub>2</sub>O<sub>4</sub> spinel-type oxides[J]. Applied Catalysis B-Environmental. 1996, 8(2): 217-227.
- [8] Hong, S. S., Lee, G. D. Simultaneous removal of NO and carbon particulates over lanthanoidperovskite-type catalysts[J]. Catalysis Today,2000, 63: 397-404.
- [9] Shibata, K., Oi, T., Otsuka, A.etc. Properties of DPF system using perovskite catalysts supported on ZrO<sub>2</sub>/SiC fibers[J]. Journal of the Ceramic Society of Japan. 2003, 111(11):852-856.
- [10] Liu X, Wei Y., Jin D., et al. Synthesis of mesoporous aluminum oxide with aluminum alkoxide and tartaric acid[J].Materials Letters,2000,42:143-149
- [11] Zhi Liu, Yuan Yang, JunhuaMi, et al. Dual-templating fabrication of three-dimensionally ordered macroporous ceria with hierarchical pores and its use as a support for enhanced catalytic performance of preferential CO oxidation[J]. International Journal of Hydrogen Energy, 2013, 38(11): 4445-4455
- [12] Ying Xiao, Shusen You, Yuan Yao,et al. Generalized Synthesis of Mesoporous Rare Earth Oxide Thin Films through Amphiphilic Ionic Block Copolymer Templating[J]. European Journal of Inorganic Chemistry, 2013(8): 1251-1257
- [13] Kun Wang (Bridgewater, NJ, US), Robert C. Lemon (Easton, PA, US) Robert C. Lemon (Easton, PA, US). MESOPOROUS ALUMINAS STABILIZED WITH RARE EARTH AND PHOSPHOROUS[P].20120088654. US: [2012-04-12]
- [14]Zhang Hairong. Basic research on Simultaneous Catalytic Removal of PM and NOx on the composite metal oxides in diesel exhaust[D]. Shanghai Jiao Tong University. 2007
- [15]Yu Fangli. Preparation of mesoporous CeO<sub>2</sub> and Co<sub>3</sub>O<sub>4</sub> and their application in catalytic oxidation of CO[D]. Dalian University of Technology. 2013

# Bicluster Analysis for Estimating Missing Values in Gene Expression Data

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**Abstract:** Gene expression data are a large-scale matrix produced by DNA microarray experiments and can be used to effectively extract biological information. Gene expression data often have missing values due to experimental conditions, and such values should be filled. The traditional method for filling missing data is based on a single feature of gene expression data and does not consider the correlation among data matrices. Considering that a low bicluster mean square value leads to high correlation of gene expression data, this paper proposes a new method for filling the bicluster data (Trim-SA). The method uses simulated annealing to produce a bicluster that meets the conditions. The bicluster is then effectively corrected through data correlation, and the missing data are filled with local least squares method. Analysis of four groups of real gene expression data shows the high filling accuracy of the developed Trim-SA method.

**Key words:** gene expression data, missing data filling, bicluster, simulated annealing

## Introduction

Gene chip technology<sup>[1]</sup>, also known as DNA microarray technology, is a high throughput molecular biological method used to rapidly quantify a large number of genes and acquire their expression levels under different conditions at the same time. The working principle of gene chip technology is to analyze two complementary DNA hybridization signals and obtain the gene expression level of the biological sample<sup>[2]</sup>. Gene chip technology has been widely applied not only in biological and medical research but also in studies on life science. An incomplete gene expression data matrix with missing values cannot be directly handled. As such, the experiment should be first replicated to determine the missing points or delete the genes with missing values. However, these two methods are impractical. In this regard, 0 value method<sup>[3]</sup> proposed in uses mean line to fill the missing value; this method is simple but requires coarse data processing and yields high error rate and considerable effect on the experimental results.

The missing data problem has been observed in various application fields, and several methods have been used to fill the lacking relevant data. According to the deficiency of the simple filling method, the multiple imputation method<sup>[4, 5]</sup> based on data analysis, filling, and combination and statistically analyze the data is put forward. Scholars have investigated imputation methods, which use hybrid global local filling and bicluster filling, to supply the missing gene expression data.

The combination of global and local methods and statistical

methods is used to determine global and local correlations to overcome the overfitting problem caused by the global fill algorithm and address the abundant nonuniform distribution of expression in the gene expression data. Jornsten et al<sup>[6]</sup> weighted and estimated the value of gene expression data, and Pan et al<sup>[7]</sup> improved the weighted solution on this basis. Wang et al<sup>[8]</sup> obtained the target gene by using the Pearson coefficient, and the missing values were filled by local least squares (LLS) and shrinkage estimation. LLS is the most commonly used method to estimate the missing points of local gene expression matrix; this method uses multiple regression model and has the advantages of low computational complexity and high estimation accuracy. Li et al<sup>[9]</sup> and He et al<sup>[10]</sup> combined LLS method with the global feature of bias in principal component analysis and used the principal axis of the linear combination to estimate the missing values in the gene expression data. Cheng and Church<sup>[11]</sup> applied bicluster to the gene expression data matrix to determine the submatrix with similar expression levels. Ji et al<sup>[12]</sup> combined bicluster and estimation of missing values in the data matrix, obtained the local structure by biclustering, and made full use of the strongest correlation between the submatrix and the missing points to reduce the estimation error rate. The bicluster Bayesian PCA (bi-BPCA) method<sup>[13]</sup> combines the k-nearest neighbor (KNN) algorithm, the bias PCA, and the bicluster method to overcome the defect that the principal component analysis (PCA) cannot deal with the local structure of the data. KNN filling algorithm<sup>[14]</sup> is a popular local method, which can describe the correlation degree between genes by

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calculating the distance between the target gene and other genes with complete value to choose the KNN gene.

Bose et al [15] established a new method of distance calculation, which states that, with smaller square residual value of bicluster, the data correlation is higher and the expression pattern is consistent. The distance is composed of the mean square residual value and Euclidean distance, and then the missing values of the gene expression data are predicted according to the average weights of neighbor genes and columns. Bose et al [15] considered the correlation of the expression of the two clustering data and integrated the mean square residual value into the distance calculation, but they did not take into account bicluster production and correction of the data consistency. This work puts forward a new method to fill the bicluster data. The method uses simulated annealing method to produce bicluster, which meet the conditions. Then, the bicluster is effectively corrected with data correlation by filling the missing data with local least squares method. This method can deal with the correlation of gene expression data and fill the missing values effectively.

**2 Related Work**

**2.1 Bicluster correlation principle**

The gene expression data matrix is  $A$ , and  $a_{ij}$  is the element value of the expression matrix  $A$ , which indicates the expression value of  $i$  rows in the  $j$  columns. In the ideal state, the element value  $a_{ij}$  of the bicluster can be defined as the mean value of the row plus the mean value of the column minus the matrix mean.

$$M = \begin{pmatrix} g_t \\ g_1 \\ g_2 \\ \vdots \\ g_k \end{pmatrix} = \begin{pmatrix} \tilde{g} & \alpha^T \\ G & W \end{pmatrix} = \begin{pmatrix} g_{t1} & g_{t2} & \cdots & g_{tp} & \alpha_1 & \alpha_2 & \cdots & \alpha_{n-p} \\ g_{11} & g_{12} & \cdots & g_{1p} & w_{11} & w_{12} & \cdots & w_{1,n-p} \\ g_{21} & g_{22} & \cdots & g_{2p} & w_{21} & w_{22} & \cdots & w_{2,n-p} \\ \vdots & \vdots & & \vdots & \vdots & \vdots & & \vdots \\ g_{k1} & g_{k2} & \cdots & g_{kp} & w_{k1} & w_{k2} & \cdots & w_{k,n-p} \end{pmatrix} \quad (4)$$

In the formula,  $\tilde{g}$  is the solution, and  $\alpha^T$ ,  $G$ , and  $W$  are known. Among them,  $\tilde{g}$  indicates that the target gene  $g_t$  contains the vector of  $p$  deletion points,  $\alpha^T$  represents the vector of the known points of the target gene  $g_t$ ,  $\tilde{g}$  corresponds to the  $k$  neighbor matrix is  $G$ , and  $\alpha^T$  corresponds to the  $k$  neighbor matrix is  $W$ . In fact, the target gene deletion point is represented by  $k$  linear combination of a neighbor matrix. Using the linear relationship between  $\alpha^T$  and  $W$  to obtain the coefficient vector  $x$ ,  $x$  as follows:

$$x = \min \|W^T x - \alpha\|_2 = (W^T)^\dagger \alpha \quad (5)$$

The formula shows the least squares problem. The pseudo inverse matrix of  $W^T$  is multiplied with vector  $\alpha$  to obtain the coefficient vector  $x$ . In the target gene  $g_t$ , the  $p$

$$a_{ij} = a_{iJ} + a_{Ij} - a_{IJ} \quad (1)$$

Where  $I$  is the subset of gene sets, and  $J$  is the subset of conditional sets. However, in the presence of noise in the genetic data, biclustering is not necessarily ideal, so the residual is defined to quantify the true value of an element and the expectation of the relevant row, column, and matrix. The residual value of element value  $a_{ij}$  in the non-ideal state is defined as

$$RS_{IJ}(i, j) = a_{ij} - a_{iJ} - a_{Ij} + a_{IJ} \quad (2)$$

To evaluate the quality of the bicluster under the influence of noise, Cheng and Church [11] defined the mean square residual  $H(I, J)$  the basis of the residuals.

$$H(I, J) = \begin{cases} \frac{1}{|I||J|} \sum_{i \in I, j \in J} RS_{IJ}(i, j)^2 \\ \frac{1}{|I||J|} \sum_{i \in I, j \in J} (a_{ij} - a_{iJ} - a_{Ij} + a_{IJ})^2 \end{cases} \quad (3)$$

If  $H(I, J) \leq \delta$  and  $\delta \geq 0$  are satisfied, then the submatrix  $A_{IJ}$  is called  $\delta$ -bicluster.

**2.2 LLS method**

Kim et al [16] proposed LLS method to find out the unknown data; the method exhibits the advantages of low computational complexity and high accuracy.

In gene expression matrix  $A$ , the target gene  $g_t$  contains  $p$  deletion points. Calculate the Euclidean distance of the target gene T with other gene lines and find its nearest  $k$  neighbor  $g_1, g_2, \dots, g_k$  to form a  $M$  matrix.

deletion points are multiplied by the corresponding matrix  $G^T$  and the coefficient vector  $x$ . The formula is as follows:

$$g^T = G^T x \quad (6)$$

Although the partial least squares method can be effective to calculate the unknown data, taking into account the gene expression data matrix expression of consistency, it is currently used in data estimation method based on partial correlation most widely.

**2.3 Bicluster pruning**

The traditional data filling methods, such as Euclidean distance and Manhattan distance, select genes that have similar target size, but the lack of consider of bicluster expression model.



In this paper, we introduce a new method of bicluster pruning, modifying the generated biclustering, and selecting the most similar genes.

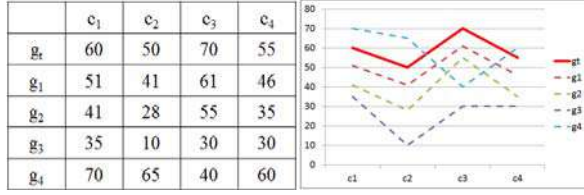


Figure.1 The bicluster

Figure.2 Bicluster expression pattern

$$\tilde{M}[i, j] = \begin{cases} 1 & M'[i, p] < M'[i, q] \\ 0 & M'[i, p] = M'[i, q] \quad p \neq q \text{ and } q \geq p+1 \\ -1 & M'[i, p] > M'[i, q] \end{cases} \quad (7)$$

$$i \in [1 \cdots m], \quad j \in [1 \cdots n(n-1)/2], \quad p \in [1 \cdots n-1], q \in [2 \cdots m]$$

As shown in the figure 3, the bicluster matrix  $\tilde{M}$  is the transformed matrix, and the target gene is the basic expression pattern of  $g_t$ . The ratio of  $\mathcal{E}$  to the target gene, the  $\tilde{M}$  value of matrix  $g_3$  was 33% and  $g_4$  was 66%, must be less than 30%. Therefore,  $g_3$  and  $g_4$  were removed from the bicluster matrix.

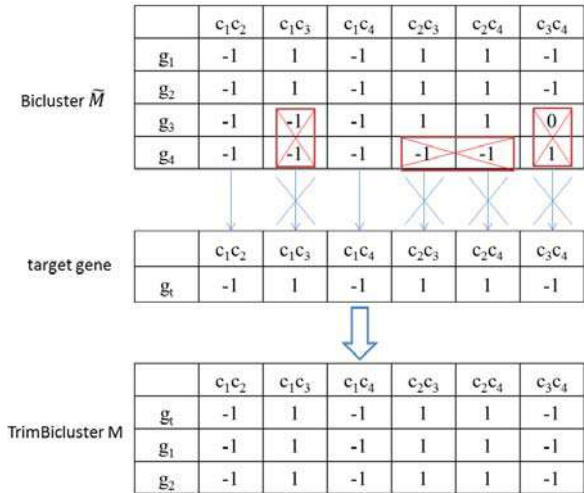


Figure.3 The bicluster pruning

### 3 Bicluster Missing Data Method Based on Simulated Annealing

#### 3.1 K-nearest neighbor method

K-nearest neighbor method is one of most commonly used methods for filling the missing values of gene expression data. To find the target gene and the k-nearest neighbor with full value gene, the method uses Euclidean distance to calculate the distance between the genes, expressed as:

$$Dis(a_t, a_s) = \sqrt{(a_t - a_s) \times (a_t - a_s)^T} \quad (8)$$

As shown in the figure1-2, the target gene  $g_t$ ,  $g_1 - g_4$  is the gene of the bicluster,  $g_4$  and target gene  $g_t$  expression pattern is the largest gap, should be removed from the bicluster,  $g_1, g_2$  and the target gene  $g_t$  expression pattern is the closest. For the bicluster matrix, a model transformation<sup>[17]</sup> is used to generate  $M'$  transformation matrix  $\tilde{M}$ ,  $M'$  gene line unchanged, and  $n$  conditions of the 22 combinations. Therefore, the transformation matrix  $\tilde{M}$  consists of  $m$  rows and  $n(n-1)/2$  columns.

In the formula,  $a_t$  represents the target vector containing missing values and  $a_s$  represents any complete vector outside the target vector. Although the k-nearest neighbor algorithm is widely used, the correlation of gene expression data cannot be used effectively. To make better use of the characteristics of gene expression data, the k-nearest neighbor method is used to obtain the two directions simultaneously in the row and column, and the smaller matrix is used as the initial seed of the bicluster.

#### 3.2 Simulated annealing method

The basic idea of the simulated annealing method<sup>[18]</sup> is to find the global optimal solution of the objective function in the solution space at the beginning of a higher temperature. The simulated annealing method is often used in combinatorial optimization.

In the process of bicluster optimization, a new bicluster seed  $S'(I, J)$  is generated by adding the initial rows and columns of the initial seed  $S(I, J)$ , and the mean square residual value of the initial bicluster is calculated by Formula (3).

$$DE = H(S') - H(S) \quad (9)$$

When  $DE < 0$ , the seed  $S'(I, J)$  is accepted as the current new bicluster; otherwise, the state acceptance function is computed as

$$f = \exp(-DE/T) \quad (10)$$

When the probability value is  $f > rand(0, 1)$ , the seed  $S'(I, J)$  is accepted as the current new bicluster.

#### 3.3 Trim-SA method description

The Trim-SA procedure is described below:

1. Finding out the missing values in the gene expression data and calculate the row mean as the initial value.
2. Using the formula (8) to produce the initial seed of bicluster.
3. Using simulated annealing method to optimize bicluster.

- a) Initializing initial temperature, cooling rate, and termination temperature;
  - b) Using Formula (3) to compute the mean square residual of a bicluster seed;
  - c) Increasing the rows and columns of the bicluster seed, generating new biclusters of seeds, and computing the mean square residuals and the mean square residual increments of a  $DE$ ;
  - d) Judging the increment  $DE$ , and if the increment  $<0$  is accepted, the new solution is accepted as the current solution, otherwise the probabilistic  $\exp(-DE/T)$  is accepted as the new current solution;
  - e) If the termination condition is satisfied, then the output optimal biclustering is obtained;
  - f) Gradually reduce the temperature, and then turn  $b$  steps.
4. Continue to optimize the bicluster and bicluster pruning.

5. LLS method is used to fill missing data.

From the above steps, we can know that the Trim-SA method uses the KNN method to produce the bicluster seeds with missing value and then optimize the target bicluster according to the simulated annealing temperature ratio, and artificial bicluster optimization pruning operation is done. The missing value is obtained by using the partial least squares method. The Trim-SA method makes full use of the local characteristics of the gene expression data and the bicluster, which guarantees the filling quality of missing values when the optimal bicluster is performed.

#### 4 Experimental Results and Analysis

In this article, four sets of data are used based on Infection<sup>[19]</sup>, Ronen<sup>[20]</sup>, Ogawa<sup>[21]</sup>, and Yoshi<sup>[22]</sup>, as shown in Table 1.

Data Set	Original list	Complete list	Download site
Infection	16839×39	6851×39	<a href="http://genome-www.stanford.edu/listeria/gut/">http://genome-www.stanford.edu/listeria/gut/</a>
Ronen	10749×26	5342×26	<a href="http://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE4158">http://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE4158</a>
Ogawa	6529×8	4976×8	<a href="http://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE20">http://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE20</a>
Yoshi	6166×24	4380×24	<a href="http://web.stanford.edu/group/cyert/microarray.html">http://web.stanford.edu/group/cyert/microarray.html</a>

**Table.1 Four experimental data sets**

Based on this table, Infection and Ronen are time series data sets, Ogawa is a non-time-series data set, and Yoshi is a mixed sequence data set. To verify the Trim-SA method and bi-BPCA<sup>[13]</sup>, BPCA<sup>[23]</sup>, LLS<sup>[16]</sup>, and the bicluster method of iterative least squares method (Li-iLS)<sup>[24]</sup> were compared. Algorithm programming using Matlab 2012b was used, with  $\mathcal{E}$  value of 30%. The experiment adopts the method of simulating the missing points according to different proportions in the whole procession. In the experiment, the method of simulating the missing points in different ranks is used in the complete ranks, and the data are randomly deleted as missing values in the complete ranks. The accuracy of the estimation result is evaluated by normalized root-mean-square error, expressed as NRMSE

$$NRMSE = \frac{\sqrt{\sum_{j=1}^N (y_j - \hat{y}_j)^2 / N}}{\sigma_y} \quad (11)$$

In the formula,  $y_j$  is the true value,  $\hat{y}_j$  is the estimated value,  $N$  is the number of the estimated value, and  $\sigma_y$  is the standard deviation of the original value of the  $N$  genes. If the normalized mean square root error is smaller, then the accuracy of the prior estimate will be improved. Table 2 (a)-(d) present the average biclusters volume, average biclusters mean square residuals, and normalized root mean square error obtained by the four data sets under the row  $k$  values where  $row\_k=6$ , the column  $k$  values  $column\_k=3$ , the temperature initial values, and the  $T=100$  parameter values.

**Table.2 (a) Infection results comparing data set T=100**

Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Infection	1%	457	0.0315	0.2185
	5%	211	0.0326	0.1268
	10%	196	0.0481	0.2904
	15%	475	0.0361	0.1739
	20%	531	0.0482	0.1977
	25%	852	0.0386	0.1319
	30%	617	0.0440	0.2982

**Table.2 (b) Ronen results comparing data set T=100**

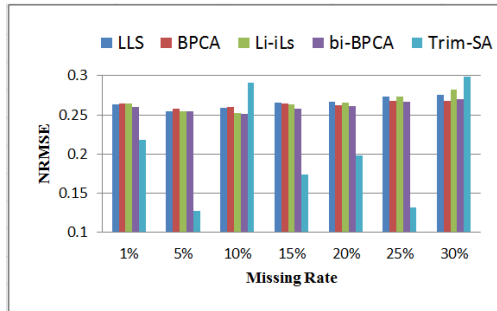
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Ronen	1%	423	0.0271	0.4206
	5%	199	0.0294	0.5153
	10%	322	0.0171	0.4868
	15%	167	0.0233	0.5382
	20%	237	0.0243	0.4609
	25%	341	0.0263	0.4614
	30%	312	0.0243	0.4174

**Table.2 (c) Ogawa results comparing data set T=100**

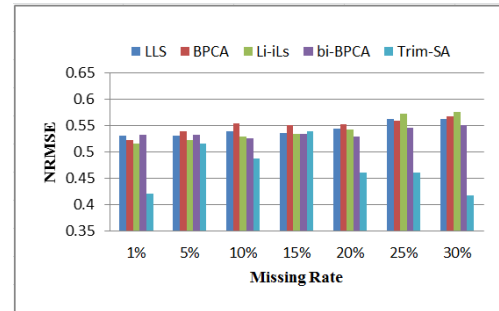
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Ogawa	1%	281	0.0237	0.2492
	5%	403	0.0267	0.5486
	10%	219	0.0250	0.2228
	15%	395	0.0342	0.3763
	20%	303	0.0228	0.4162
	25%	34	0.0321	0.5654
	30%	374	0.0276	0.6814

**Table.2 (d) Yoshi results comparing data set T=100**

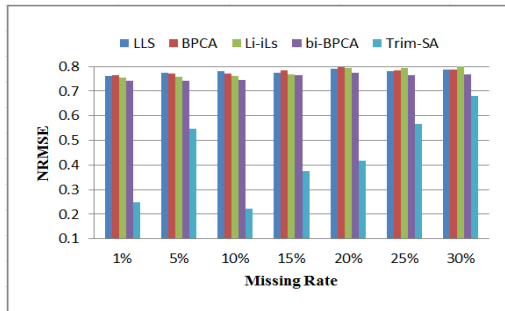
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Yoshi	1%	311	0.0273	0.5667
	5%	324	0.0246	0.2841
	10%	321	0.0311	0.5038
	15%	243	0.0237	0.3622
	20%	241	0.0348	0.3266
	25%	264	0.0221	0.6571
	30%	233	0.0289	0.4048



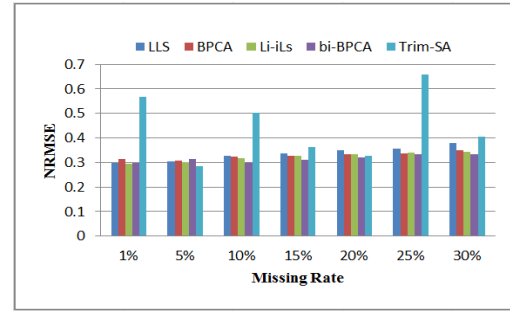
**Figure.4 (a) Infection data set T=100**



**Figure.4 (b) Ronen data set T=100**



**Figure.4 (c) Ogawa data set T=100**



**Figure.4 (d) Yoshi data set T=100**

Figure.4 (a)-(d) show the comparison of Trim-SA method

and the four methods in the four sets of data. The horizontal axis

is the data loss rate, the vertical axis is normalized root mean square error, and the data value is the average of the five experiments. Figure 4 (a) uses the infection data set, when the loss rates are 5% and 25%, the standard Trim-SA method of minimum root mean square error is less than 0.15; When the loss rates are 10% and 30%, the NRMSE has a great fluctuation in the Trim-SA method, and the standard root mean square error is close to 0.3, which is higher than that of the other four methods.

Figure 4 (b) uses the Ronen data set. As shown in the figure, Trim-SA standard with a loss rate of 15% of the NRMSE is slightly higher than that of the three methods. The rest are better than the other four methods, when the loss rate ranges are 1% and 30%, the standard root mean square error is even less than 0.45.

Figure 4 (c) uses the Ogawa data set. The loss rate ranges from 1% to 30%, Trim-SA method is better than the other four methods, and the standard of the four methods of root mean square error is more than 0.7. Compared with the Trim-SA

method with a standardized root mean square error less than 0.7, the loss rate ranges 10%, and the NRMSE is even lower than 0.3. In contrast to the Ogawa data set, Figure 4 (d) uses Yoshi data using Trim-SA method, with the loss rate of 5% standardized RMSE error rate, which is better than that of the other four methods, and the other loss rate is higher and has large fluctuations.

By comparing the four sets of data, the Trim-SA method has the best effect on the Ronen data set and the Ogawa data set, and the results of the experiment using the Infection data set are better. However, the results will lead to abrupt jumps. The Trim-SA method using the KNN method generates bicluster seeds; the simulation of random search for biclustering row and column direction of annealing; the bicluster with probabilistic jumping. At the same time, the capacity of bicluster and mean square residuals will affect the NRMSE. Therefore, the standard root mean square error of each set is different, and the error rate varies greatly, which even doubles or decreases.

**Table.3 (a) Infection results comparing data set T=1000**

Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Infection	1%	510	0.326	0.2597
	5%	302	0.0132	0.1718
	10%	393	0.0163	0.1911
	15%	610	0.0161	0.2139
	20%	608	0.0201	0.1516
	25%	695	0.0137	0.1319
	30%	250	0.0188	0.3885

**Table.3 (b) Ronen results comparing data set T=1000**

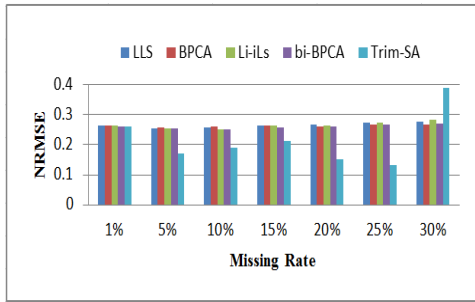
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Ronen	1%	523	0.0429	0.6617
	5%	704	0.0373	0.3584
	10%	156	0.0339	0.3452
	15%	315	0.0324	0.1214
	20%	266	0.0454	0.2561
	25%	462	0.0307	0.4768
	30%	373	0.0307	0.1891

**Table.3 (c) Ogawa results comparing data set T=1000**

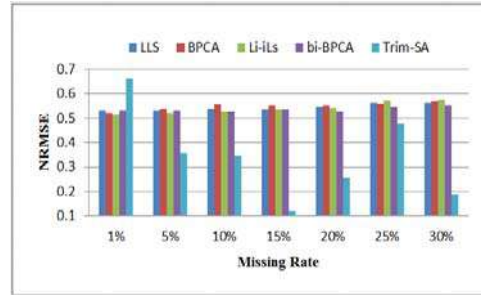
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Ogawa	1%	289	0.0254	0.3370
	5%	703	0.0380	0.5667
	10%	410	0.0303	0.6791
	15%	679	0.0375	0.9808
	20%	437	0.0313	0.8739
	25%	838	0.0502	0.5629
	30%	452	0.0363	0.8729

**Table.3 (d) Yoshi results comparing data set T=1000**

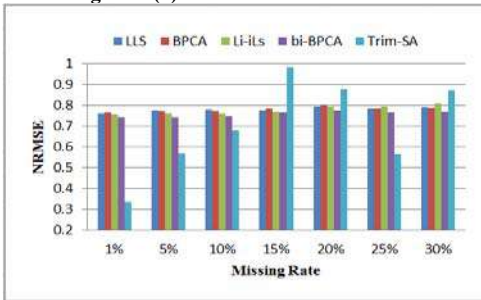
Data set	Loss rate	Average volume	Mean square value	Standardization of root mean square error
Yoshi	1%	196	0.0287	0.3056
	5%	418	0.0272	0.1076
	10%	312	0.0370	0.3581
	15%	620	0.0341	0.4990
	20%	365	0.0510	0.2578
	25%	234	0.0524	0.2519
	30%	180	0.0284	0.4810



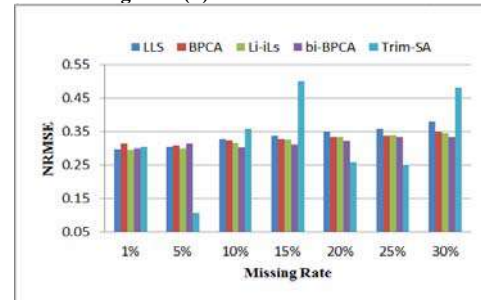
**Figure.5 (a) Infection data set T=1000**



**Figure.5 (b) Ronen data set T=1000**



**Figure.5 (c) Ogawa data set T=1000**



**Figure.5 (d) Yoshi data set T=1000**

Table 3 (a)-(d) show that, when the four data sets at the row  $k$  values of  $row\_k = 10$ , the column  $k$  values  $column\_k = 3$ , the temperature initial values, and the  $T=1000$  parameter values. Figure 5 (a)-(d) show Trim-SA method and comparison of four methods in the four groups of the data and  $T=1000$ . In Figure 5 (a), Trim-SA method in addition to the missing rate of 30% normalized root mean square error is higher than the other four methods, and the loss rate of the other standard root mean square error was lower than the other four methods. In contrast to the Ronen dataset, only 1% standardized root mean square errors are higher than the other four methods, as shown in Figure 4 (b). Compared to the initial value of  $T$  equals to 100 parameter settings of initial temperature, Ogawa data loss rate was 15%, 20%, and 30% of the standard root mean square error, which is higher than the other four methods, and Yoshi data loss rate was 5%, 20%, and 25% of the normalized root mean square error, which is less than the other four methods.

The experimental results show that the Trim-SA method combines the KNN method with simulated annealing method and bicluster method to improve the global optimization ability of data filling. Local characteristics of data are extracted by means of bicluster pruning and LLS. Using the LLS method to fill the bicluster at most of the missing rates, the highest estimation accuracy has been achieved, because the method combines the overall correlation and the local similarity of the gene expression data. Through the experiment of four sets of data sets, we can obtain low standard root mean square error.

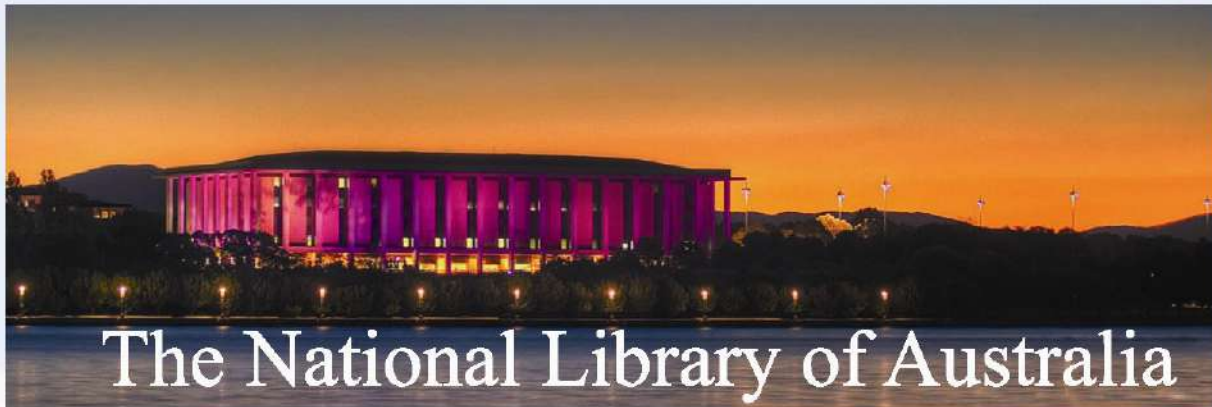
**5 Concluding Remarks**

The Trim-SA method proposed in this work is a combinatorial optimization method. The method is a combination of simulated annealing method and the bicluster combination fill algorithm, which fully considers the characteristics of gene expression data correlation, data clustering using double fill pruning, and partial least squares

method. By comparing the four sets of data with four methods, LLS, BPCA, Li-iLs, and bi-BPCA, we can see that the Trim-SA method is ideal and has high-accuracy filling. However, in the process of experiment, the randomness of the search process, the setting of initial temperature, and the abrupt change of temperature drop caused by simulated annealing method were found to lead to large fluctuations in the experimental results. In the process of generating bicluster seeds by KNN method, the Trim-SA method is sensitive to data size, and it has a great influence on the bicluster volume and the mean square residual value, thus affecting the accuracy of the prediction value. Therefore, the proposed method needs to be studied deeply and deflected step by step, and the solution methods such as experiments need to verify the searchability of solution algorithm and use adaptive simulated annealing method. According to the feedback information of bicluster, search progress adjusts the temperature change and the bicluster adaptive search intensity, among others.

## References

- [1] Dudoit S, Yang Y H, Callow M J, et al. Statistical methods for identifying differentially expressed genes in replicated cDNA microarray experiments[J]. *Statistica Sinica*, 2002, 12(1): 111-139.
- [2] Lockhart D J, Winzler E A. Genomics, gene expression and DNA arrays, [J]. *Nature*, 2000, 405(6): 827-836.
- [3] Alizadeh A A, Eisen M B, Davis R E, et al. Distinct types of diffuse large B-cell lymphoma identified by gene expression profiling[J]. *Nature*, 2000, 403(6769): 503-511.
- [4] Rubin D B. Multiple imputation: a primer[J]. *Statistical Methods in Medical Research*, 1999, 8 (1): 3-15.
- [5] Rubin D B. Inference and missing data[J]. *Biometrika*, 1976, 63 (3): 581-592.
- [6] Jørnsten R, Wang H Y, Welsh W J, et al. DNA microarray data imputation and significance analysis of differential expression[J]. *Bioinformatics*, 2005, 21(22): 4155-4161.
- [7] Pan X Y, Tian Y, Huang Y, et al. Towards better accuracy for missing value estimation of epistatic miniarray profiling data by a novel ensemble approach[J]. *Genomics*, 2011, 97(5): 257-264.
- [8] Wang H, Chiu C C, Wu Y C, et al. Shrinkage regression-based methods for microarray missing value imputation[J]. *BMC Systems Biology*, 2013, 7(S6): 1-12.
- [9] Li H H, Shao F F, Li G Z. Semi-supervised imputation for microarray missing value estimation[J]. *Bioinformatics and Biomedicine*, 2015, 10(1): 297-300.
- [10] He C, Li H H, Zhao C B, et al. Triple imputation for microarray missing value estimation[J]. *Bioinformatics and Biomedicine*, 2015, 280-213.
- [11] Cheng Y, Church G M. Biclustering of Expression Data[J]. *Proceedings of the Eighth International Conference on Intelligent Systems for Molecular Biology (ISMB)*, 2000, 93-103.
- [12] Ji R, Liu D, Zhou Z. A Bicluster-Based Missing Value Imputation Method for Gene Expression Data[J]. *Journal of Computational Information Systems*, 2011, 7(13): 4810-4818.
- [13] Meng F C, Cheng C, Yan H. A bicluster-based bayesian principal component analysis method for microarray missing value estimation[J]. *IEEE journal of biomedical and health informatics*, 2014, 18(3): 863-871.
- [14] Troyanskaya O, Cantor M, Sherlock G, et al. Missing value estimation methods for DNA microarrays[J]. *Bioinformatics*, 2001, 17(6): 520-525.
- [15] Bose S, Das C, Chattopadhyay S. A Novel Biclustering Based Missing Value Prediction Method for Microarray Gene Expression Data[J]. *International Conference on Man and Machine Interfacing (MAMI)*, 2015, 1-6.
- [16] Kim H, Golub G H, Park H. Missing value estimation for DNA microarray gene expression data: Local least squares imputation[J]. *Bioinformatics*, 2005, 21(2) : 187-198.
- [17] Ayadi W, Hao J K. A memetic algorithm for discovering negative correlation biclusters of DNA microarray data[J]. *Neurocomputing*, 2014, 145(18): 14-22.
- [18] Kirkpatrick S, Gelatt C D, Vecchi M P. Optimization by simulated annealing[J]. *Science*, 1983, 220(4598): 671-680.
- [19] Baldwin D N, Vanchinathan V, Brown P O, et al. A gene expression program reflecting the innate immune response of cultured intestinal epithelial cells to infection by *Listeria monocytogenes*[J]. *Genome Biology*, 2003, 4(1): 1-14.
- [20] Ronen M, Botstein D. Transcriptional response of steady-state yeast cultures to transient perturbations in carbon source[J]. *Proceedings of the National Academy of Sciences of the United States of America*, 2006, 103(2): 389-394.
- [21] Ogawa N, Derisi J, Brown P O. New components of a system for phosphate accumulation and polyphosphate metabolism in *Saccharomyces cerevisiae* revealed by genomic expression analysis[J]. *Molecular Biology of the Cell*, 2000, 11(12): 4309-4321.
- [22] Yoshimoto H, Saltsman K, Gasch A P, et al. Genome-wide analysis of gene expression regulated by the calcineurin/Crz1p signaling pathway in *Saccharomyces cerevisiae*[J]. *Journal of Biological Chemistry*, 2002, 277(34): 31079-31088.
- [23] Oba S, Sato M A, Takemasa I, et al. A Bayesian missing value estimation method for gene expression profile data[J]. *Bioinformatics*, 2003, 19(16): 2088-2096.
- [24] Cheng K O, Law N F, Siu W C. Iterative bicluster-based least square framework for estimation of missing values in microarray gene expression data[J]. *Pattern Recognition*, 2012, 45(4): 1281-1289.



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