11. Science Popularization of Grass-root NPO

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Abstract. Research on science popularization organization mostly focuses on social organization and NPO with apparent government background, however, discussion on science popularization of grass-root NPO is rare. This paper briefly analyzed the shortcomings of grass-root NPO in the field of science popularization and the reason of being ignored, and proposed some suggestions.

Keywords: Grass-root NPO, science popularization.

Introduction

With the human society entered high-tech period in the 21st century, the rapid development of science and technology not only provides prerequisite for promoting human welfare, but also makes human beings facing severe challenges. Global warming, resources exhaustion, energy crisis and population boom still are obstacles that crossing in the further development of human beings, a single scientist or any country could not cope with them in way of dealing with these comprehensive problems, which needs globally public engagement. However, the prerequisite of public engagement is to promote the scientific literacy of the public, and to make the public fully understand and recognize these problems. How to let them fully understand the urgent problems and at the same time making the public enjoy the benefit of science and technology achievements? The author thought that the broad science and technology practitioners should throw themselves into science popularization to promote the science literacy of the public.

Just as the name implies, science popularization is the activity which takes promotion the scientific literacy of the public as its purpose, is the process of disseminating scientific and technological knowledge and skills which has already being mastered by human beings and science thoughts, science method, science spirit which evolves from scientific practice to every aspects of the society by various ways and channels. From this perspective, science popularization is a social public welfare and also is the system engineering. During the process of promoting the cause of science popularization, association of science and technology, which is the mass organization of China science and technology practitioners, is the important social sectors of promoting science and technology cause by the government. The broad science and technology practitioners who affiliate to the association of science and technology exert great functions in promoting China science popularization causes. However, science popularization is a systematic work involving every sector of the society. To enhance the science popularization work and promote the scientific literacy of the public is an important and basic social engineering, is the necessary content of socialist material civilization, socialist spiritual civilization and socialist political civilization, which is the collective responsibility of our society. Therefore, the overall engagement is the important component part of science popularization work.

The relevant provision of Law of the Peoples Republic of China on Popularization of Science and Technology regulates that State organ, armed forces, public organizations, enterprises and institutions, rural grassroots organizations and other organizations shall work for PST(Popularization of Science and Technology—note by the author). In order to achieve the working mode of Great Mass Organization-Great Coordination-Great Publicity-Great Science Popularization under the guideline of great unity and coordination requires us to integrate various social resources; thus, we should discuss the function of the grass-root non-profit organization, as a sector of other social organization, in the cause of science popularization.

According to different research perspective, different scholars and researchers give non-profit organization (NPO) different definitions. The author believed that NPO is the social organization between government and enterprises that founded according to voluntary principles but not be founded by business purpose to provide various services to the public or exceptive clients. However, NPO in China has its own features due to its dual-management system; the classification of NPO in China also is extraordinary. This paper will not focus on its classification, but pays much attention to the function and strategies of NPO in developing the science popularization and how to enhance NPOs' effectiveness during the cause of science popularization. Wu Zhongze believed that scientific and technological NPOs are mainly formed by scholarly communities of a specific subject, such as various societies. The practical situation is that these societies belong to the scope of social organization, but not including the grass-root NPO.

The Status Quo of Grass-root NPO in Science Popularization

Recent years, national innovation system has already on the agenda of our government, yet as the important component part of this system, the science and technology popularization system bears the important mission of transforming science and technology into practical productivity. In order to reflect the situation of China science popularization and propose suggestions to China science popularization development, since Oct, 2010, China Research Institute for Science Popularization has already being compiled China Science Popularization Report. The relevant charters of the report would introduce the organizations that carried out science population, these organizations in nature belonged to the scope of NPOs, but which had far more government background. This situation reflects that the grass-root NPOs do not attract enough attention in the process of science popularization. The deficiency of grass-root NPOs in science popularization and their lagging research have its intrinsic reason, but also have extrinsic obstacles. Capital scarcity is the first obstacle of science popularization. According to statistics, there are 191 national societies affiliated to China Association of Science and Technology (CAST), 167 of them are collective membership, which including 41 science societies, 64 engineering science societies, 14 agricultural societies, 22 medical societies, 26 science popularization and interdisciplinary societies. The capital of these societies has a certain guarantee, if we look at to grass-root NPO, their resources of capital is single, most of their capital comes from solicit contributions, donation and foundations. China does not have perfective taxation incentive policy which makes enterprises and individuals would not like to donate, and this further results in a vicious circle of capital deficiency. Taking Beijing Huiling as an example, its capital mostly comes from the grant of foreign foundations. At the same time, its daily maintenance expenditure is very strained.

Shortage of talents results in the inability to make further advances of grass-root NPOs in science popularization. The characteristic of pure public welfare and non-profit making leads them could not attract and retain outstanding human resource through high compensation. The scientific and technological talents with high academic background are inclined to enter enterprises or government departments, which bring about the human resources of grass-root NPOs are marginalized, therefore, they are very difficult to find excellent talents from the personal market. Voluntary group is the indispensable part of providing service of science popularization by grass-root NPOs, however, after careful research, we could find this group could fall into two parts, the first part is students, most of them are being organized by school mass organizations, which brings some difficulties in training and talents cultivation because of their great fluidity; the second part is the successful individuals in other aspects, they get involved in NPOs cause without any expectation of money, but they only could help grass-root NPOs during their leisure time, which means they could not fully take part in the cause. Personnel problem is another obstacle of the development of grass-root NPOs in science popularization.

The narrow scope of grass-root NPOs in science popularization also limits their function. Science popularization system is a comprehensive one, and different science and technology needs different technical talents, however, NPOs could not get the fully human resources that they needs, which results in their limited filed and narrow scope of carrying out science popularization. Most grass-root NPOs have to confine their activities to the much comprehensive but less sophisticated field, for example, they focus their filed on the environmental protection, agricultural industry and sustainable development.

The dual-management system also confines the grass-root NPOs' engagement of science popularization activities. The dual-management system was established by the State Council in 1989, in order to manage the civil organizations. According to this system, any civil organization which wants to take form must find a administrated departments, only after being approved by the administrated departments, can it registers in the civil administration department. This system gives us two hints. The first one is that there are two departments in charging of the registration process, and the approval of the first department is the prerequisite of the second department's approval; the second one is even an organization get approval by the two departments, they still are responsible for different aspects of the organization operation. Therefore, many grass-root NPOs could not find the registration department and subordinated departments, they have to fluctuate between legal and illegal. This also becomes the barrier.

However, the increasing grown number of grass-root NPOs in China like mushrooms after rain shows extraordinary performance in the aspect of science popularization, especially after the Wenchuan Earthquake, a batch of grass-roots NPOs initiatively left for disaster areas, they providing excellent service in assisting the local government in the field of healing the wounded and rescuing the dying. The international society had named the 2008 as China's First Year of Volunteer, which illustrated that the great number of grass-root NPOs had already become an indispensable part of science popularization in China.

When analyzing the science popularization (communication) experience of NPO in developed countries, we could find that purely relying on government could not reach the anticipated results, only giving play to the large-scope characteristic of NPO and carrying out directive science and technology services, could science popularization attract the public engagement and achieve the aim of enhance scientific literacy.

Conclusion

The optimum operation of society needs the well-organized coordination of government, enterprise and NPO, and the construction of science popularization system also needs the cooperation of government, enterprise and NPO. As the important supplement of government and traditional social organizations, the grass-root NPO could further recognize the needs of grass roots, meet the multiple requirements of society, how to exert its function in science popularization is a considerable subject.

First, a benign environment for grass-root NPO is necessary when it carries out science popularization work. Whether the public is fond of science and technology and could engage in it to some extent depends on whether their requirements are fully met. The science popularization activities carrying out by NPO with official background only could meet the middle-level citizens' requirements. So the current dual-management system should be revised in order to extend grass-root NPOs developing space, they should be endowed the official legitimacy, social legitimacy, political legitimacy and legal legitimacy.

Second, grass-root NPO should be encouraged to engage in science popularization activities. Due to various limitation and barriers, entering the field of science popularization for grass-root NPOs is difficult, especially for the activities with strong specialty. Which needs the government support and encourage them to take part in. This kind of encouragement should include cultivate talents, provide capital etc. science and technology talents should be encouraged to find jobs or take part-time jobs at grass-root NPOs, the financing channel should be extended, and at the same time encourage the enterprise and individual to donate through perfecting the taxation policy should be implemented.

Finally, the social climate of absorbing grass-root NPO should be cultivated. The traditional convention of China makes the public form a mind of resistance towards NPO. For them, non-profit organization is non-government organization, so non-government equals to anti-government. This public opinion results in the dilemma of NPO, especial for the grass-root NPO. To create a benign social climate for grass-root NPO during their development and engagement in science popularization is significant, which could give them much time and energy to carry out science popularization activities.

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Table1. Question classification

Scientific Knowledge decide whether the	Biology	C1-3. It is the mother's genes that
		baby is a boy or a girl. (d) C2-5. Human beings, as we know them today,
		developed from earlier species of animals. (a) C4. "DNA"
	Geography	C1-1. The centre of the earth is very hot. (b)
		C1-5. The continents on which we live have been moving for millions of years and will continue to move in the future. (c)

		C2-9. It takes one day for the earth to go around the sun. (f)
	Engineering	
	C5. "Internet"	
	Physics	C2-6. All radioactivities are man-made. (e)
		C2-7. Lasers work by focusing sound waves. (h)
		C2-8. Electrons are smaller than atoms. (g)
	Medical Science	C1-4. Antibiotics kill viruses as well as bacteria. (i)
C3. "Molecule " Scientific	Chemistry Methods research"(C7), "Comparative experiment"(C8), "Probability"(C9)	"scientifically
Scientific Spirit "Science and	Superstition"(C10), "Science and Personal Behavior"(C11)	

Since data could only be analyzed in terms of bi-variate response variable with culture distance model (Raza G, S. Singh, 2007, 2009) and question types of the four categories were different from each other, standardization was carried out in the dataset before analyzing. The nine questions on science view were mainly simple statements of scientific information and the responses were solicited in terms of 'True', 'False' and 'Don't know'. 'True' indicated that the respondent knew the correct answer and 'False' meant s/he did not know the correct scientific explanation. 'Don't know' was recorded as incorrect response. The three questions on science terminology were closed questions. Two options of each question were considered to be the correct answers, which indicated that the respondents understood the terminology, and the other two were recorded as incorrect response. The three questions on scientific method were also closed questions. Only one option of each question was considered to be correct, which indicated that respondents fully understand the method, and the other three were recorded as incorrect response. The response 'do not believe' to the five questions under C10 and the response except 'pray to god bless' to C11 were considered to be correct answers, and the rest responses were recorded to be incorrect.

During the survey all the respondents were instructed to record their education attainment to relevant level. The education level was converted into years of schooling at the time of analyzing the dataset as continuous control variable. For example a response 'primary school' was recorded at the time of interview and converted into 6 years prepared for data analyzing (see Table 2).

Table2. Education scale in China

Education		Illiterate	Middle school	High School	College University	
		Primary school				

Number of Years of Schooling 0,1,2 3,4,5,6 7,8,9 10,11,12
13,14,15 16,17

With the standardized dataset, dichotomous curves could be plotted for each question in Table 1 and values of cultural distance for each question could be computed. In order to get the values of cultural distance of six scientific disciplines listed in Table 1, values of questions under each discipline should be weighted mean using the following equation.

$$V_i \Rightarrow \leftarrow \supseteq V_j \leftarrow \frac{k}{n_j}$$

Where,

(1)

14

Vi is the culture distance value of each scientific discipline

Vj is the culture distance value of each question
kj is the number of respondents who gave the right answers to the question*
nj is the number of respondents who were interviewed in the survey*
*For different group, kj and nj are different.

It should be noted that kj/nj is the coefficient of each question for different groups of respondents. It could reflect the degree of complexity of each question for different groups of people. For each scientific discipline, the coefficient indicated the weight of related scientific knowledge or information implied in each question under this discipline for certain specified cultural group or a subgroup. With this equation, culture distance values of different scientific concepts of different groups of people could be computed.

Contrastive Analysis on culture distance based on 2010 survey in China

With the adjusted model described before, based on the dataset of 2010 survey in China, the culture distance values of general respondents and different groups were obtained. Contrastive analysis among the four surveys that had been conducted in China in year 2003 (China S&T Indicators, 2004), 2005 (China S&T Indicators, 2006), 2007 (China S&T Indicators, 2008) and 2010 and between various groups, such as male and female respondents, and respondents in different regions, were carried out in the following part.

Culture distances in general

Cultural distances of science-view: As shown in Fig. 1, the culture distance values differed greatly among the nine questions. ‘The theory of evolution’ (a) was placed closest to the quotidian life of Chinese citizens with the values being 3.7 (2003), 3.6 (2005), 4.2 (2007).and 5.3 (2010). ‘Antibiotics kill viruses as well as bacteria’ occupied the farthest end of culture distance scale. The values of cultural distance were 18.2 (2003), 19.2 (2005), 16.7 (2007) and 17.9 (2010). Here we can notice a sharp rise in culture distance values of ‘earth revolution’ (f) between 2007 and 2010. The reason for this increase may be located in the expression of the question which might have easily confused respondents between rotation and revolution of the earth. The culture distance values of other questions remained almost the same over the years with minor fluctuations.

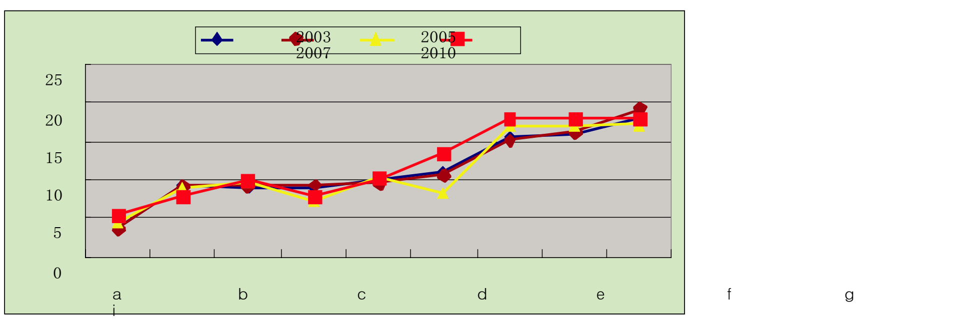

Figure 1. Culture distances on science view of the four surveys in China

Culture distances of scientific terms: The culture distance values of ‘DNA’ and ‘Internet’ decreased on the whole, whereas the culture distance value of ‘Molecule’ visibly increased over the years (see Fig. 2).

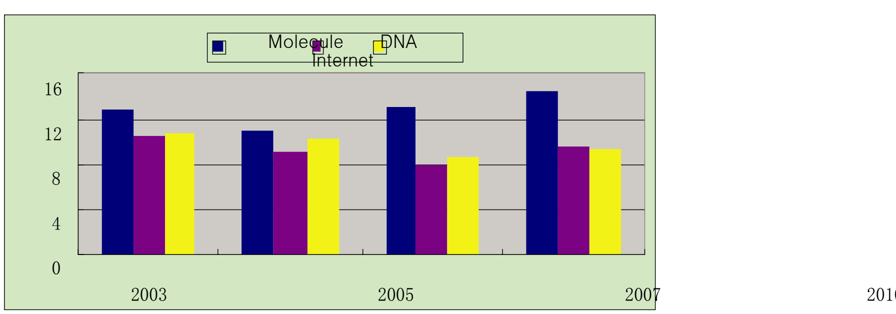

Figure 2. Culture distances of scientific terms of the four surveys in China

The results reflected that compared to ‘Molecule’, ‘DNA’ and ‘Internet’ stayed closer to Chinese citizens’
quotidian life. People intended to seek more information about ‘DNA’ and ‘Internet’ use in daily life and work.

Culture distances on scientific methods: From Fig. 3, we can see that the culture distance values of ‘comparative experiment’ and ‘probability’ stayed at a certain level over the years with minor fluctuations. But an obvious raise could be noticed on the culture distance value of ‘understanding of ‘scientifically research’’ from Fig. 3. Science communicators in China should pay attention to this phenomenon.

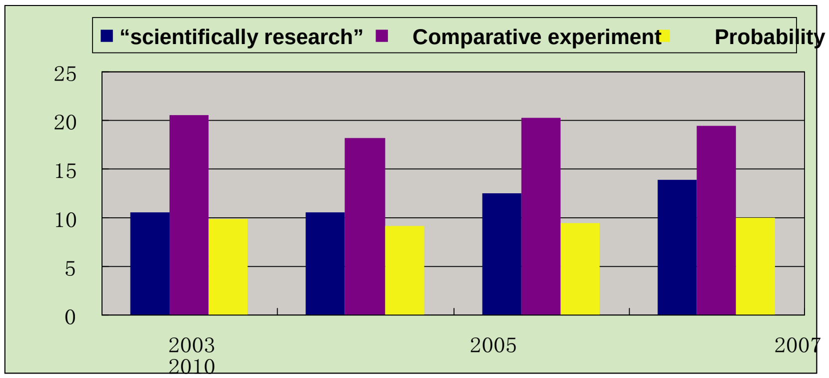

Figure 3. Culture distances on scientific methods

The culture distance values of the two parts on scientific spirit decreased over the years (see Fig. 4). ‘Science and personal behavior’ stayed much closer to the quotidian life of Chinese citizens than ‘science and superstition’. It showed that Chinese citizens’ personal behavior in their daily life became more scientific. Promoting science over superstition through science popularization needs to intensified in China.

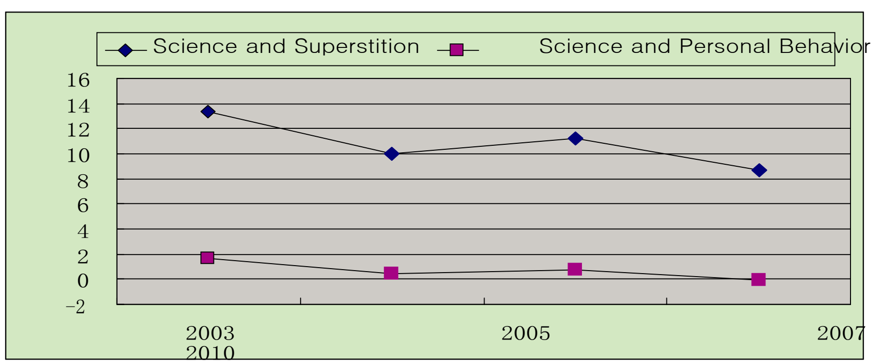

Figure 4. Culture distances on scientific spirit

Culture distance of gender groups

The culture distance values of the six scientific knowledge disciplines of male and female respondents were computed with adjusted cultural model stated above. The results showed that scientific knowledge and information about biology stayed closest to the quotidian life of both genders with the scores being 7.3 (male) and 7.7 (female) (see Fig. 5). Information and knowledge about medical science placed at the longest culture distance scale. For male and female respondents the distances were 18.6 (male) and 17.5 (female). The other four disciplines occupied the places between these two extremes along the culture distance scale, which were geography (9.9 for male, 11.3 for female), engineering (9.1 for male, 9.5 for female), chemistry (14.0 for male, 14.9 for female) and physics (14.3 for male, 16.9 for female) in ascending order according to their culture distance values. It could be noticed that the culture distance values of all the scientific knowledge disciplines of male respondents were lower than that of female, except that the culture distance value of medical science of female respondents was lower than that of male and universal sample. We can also see that the gaps of culture distance values between male and female on geography and physics were obviously bigger than the other four. The reason to these two phenomenons might be the difference in structure of mind of these two gender groups. Men were more likely to absorb and accept knowledge and information with strong logic like physics and geography, but women prefered to get information and grasp knowledge related to health and personal care. So in order to make science communication effectual for different gender groups, different transmission methodologies with a focus on specific content should be formulated according to knowledge structure needs of male and female.

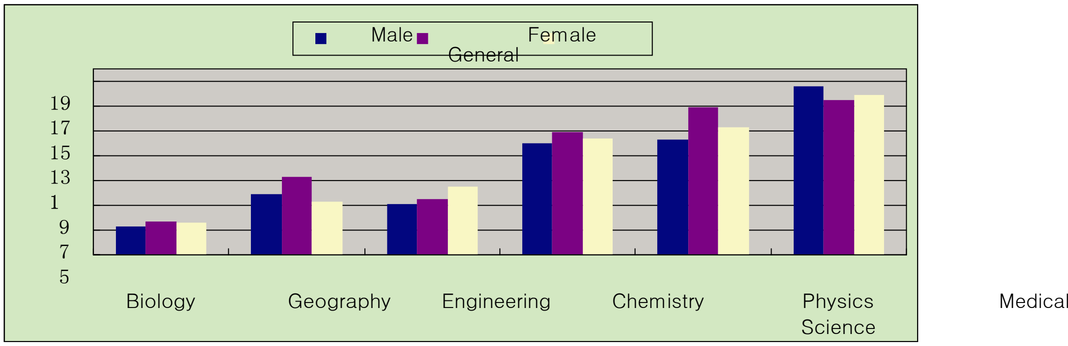

Figure 5. Gender difference on scientific knowledge

The culture distance values of ‘scientific knowledge’, ‘scientific methods’ and ‘scientific spirits’ of male and female respondents were also computed with the adjusted model. It could be seen in Fig. 6 that the culture distance value of female on scientific methods was lower than that of the male and general. The culture distance values of male-scientific-knowledge and spirits were lower than that of female and the latter one was much lower. The reason could be attributed to low level of exposure to scientific method which women get in traditional societies. Special effort should be made in promoting scientific spirits among female group.

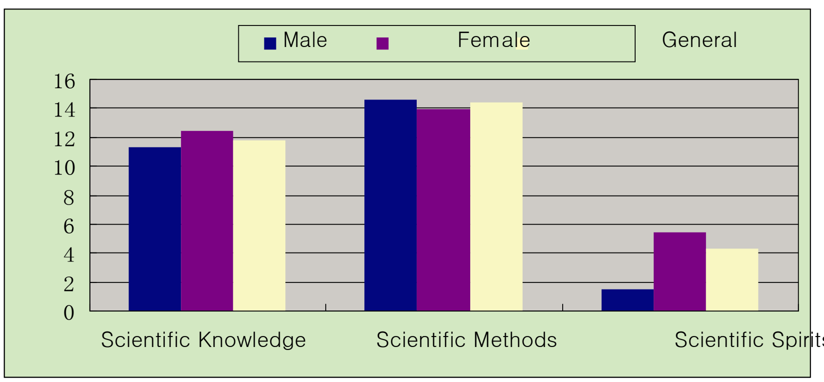

Figure 6. Gender difference on understanding of science

Culture distance of various provinces

Using the national representative data collected in 2010 survey, culture distance values of questions in Table 1 could be computed for all the thirty-two provincial units in mainland China. According to RCDI (National Survey Research Center at Renmin University of China, 2008), thirtyone provinces in China were divided into four categories. For the present discussion two provinces from each category were selected (see Table 3). Beijing and Shanghai represented the region which had the highest comprehensive development level across China. Jiangsu and Jilin were located in the coastal area, which were less developed than the first category. Shanxi and Chongqing represented the region which had the middle comprehensive development level and were also located in central China. Yunnan and Qinghai belonged to the least developed category which were located in western China. Values of different scientific disciplines for each of these provinces were computed with adjusted model. Values of scientific knowledge for each selected province were also computed (see Table 4). Subsequently, all the eight provinces were ranked on the basis of their cultural distance from each of the six scientific disciplines. Value 1 was assigned for the lowest cultural distance and 8 occupied the outermost end (see Table 5). In the following paragraphs an effort has been made to present the salient features of the rank distribution.

Table3. Eight provinces selected according to RCDI

Categories	Provinces
¢ñ	Beijing, Shanghai
Ⅱ	Jiangsu, Jilin
Ⅱ	Shanxi, Chongqing
Ⅱ	Yunnan, Qinghai

The relative position of cultural distance for all the disciplines remained nearly the same across each province. For all the eight provinces, ‘biology’ could be placed at the shortest cultural distance and ‘medical science’ could be placed at the farthest end. In between, the value of cultural distance for the other four disciplines i.e. ‘enginnering’, ‘geography’, ‘chemistry’ and ‘physics’ increased progressively. For example, Shanghai, which belonged to category Ⅱ, ranked the first place in scientific knowledge with the value of 10.0, the computed values of biology, engineering, geography, chemistry, physics and medical science for Shanghai were 5.9, 8.5, 8.8, 12.3, 13.6, 13.9, respectively. Correspondingly, for Yunnan which was much less developed than Shanghai, scored the third place in scientific knowledge, and the respective values of the six disciplines were 6.9, 8.4, 9.8, 12.9, 14.5 and 15.9. Though there was a big gap in comprehensive development level between Shanghai and Yunnan, the differences of cultural distance values of scientific knowledge and six scientific disciplines were small (less than 2) between these two provinces. Another example, still comparing with Shanghai, Beijing which was on close level of comprehensive development with Shanghai, ranked the sixth in scientific knowledge with the value of 11.7. And the corresponding values of the six disciplines for Beijing were 6.6, 8.3, 9.7, 15.4, 16.4 and 23.5. Big gaps could be seen in cultural distance of certain disciplines such as medical science (almost 10) between Beijing and Shanghai. These showed that the culture distance of different area was not directly related to its comprehensive development level. It also showed that people’s level of understanding for each scientific discipline varied greatly among provinces.

It should also be noted that absolute values of cultural distance for various scientific disciplines varied a great deal across provinces. Jiangsu scored the lowest on cultural distance scale for physics with the value of 13.3, and Chongqing scored 19.2 for the same scientific discipline. Jilin was placed at the largest cultural distance for chemistry with the value of 20.4, where as, for Shanghai the score of chemistry was quite low, i.e. 12.3. It is evident that using this adjusted model, if a province was taken as the reference point, the cultural distance of each scientific discipline could be mapped and strategies to bridge the cultural distance for each category of scientific knowledge could be devised.

Table4. Relative cultural distance of the selected Chinese provinces

	Biology	Engineering	Geography	Chemistry	Physics	Medical science	Scientific knowledge
Beijing	6.6	8.3	9.7	15.4	16.4	23.5	11.7
Shanghai	5.9	8.5	8.8	12.3	13.6	13.9	10.0
Jiangsu	6.2	9.0	9.1	13.8	13.3	17.3	10.5
Jilin	8.2	9.1	10.9	20.4	16.1	>25	11.3
Shanxi	7.5	9.3	9.1	15.0	15.1	18.2	11.5
Chongqing	9.1	10.2	12.6	16.0	19.2	18.4	13.9
Yunnan	6.9	8.4	9.8	12.9	14.5	15.9	10.9

Qinghai	7.9	9.7	11.0	16.6	16.6	18.1	12.6

Table5. Ranking of provinces based on cultural distance

	Biology Physics	Engineering Medical	Geography		Chemistry		Scientific knowledge
						science	
Beijing	3		4		1		5
6	7		6				
Shanghai	1		1		3		1
2	1		1				
Jiangsu	2		2		4		3
1	3		2				
Jilin		7	6		5		8
5	8		4				
Shanxi	5		3		6		4
4	5		5				
Chongqing	8		8		8		6
8	6		8				
Yunnan	4		5		2		2
3	2		3				
Qinghai	6		7		7		7
7	4		7				

Conversely, if we take a scientific discipline as the reference point, then various provinces could be placed at varying degree of cultural distance. For example, in order to democratise the knowledge of biology, Shanxi will have to travel a longer cultural distance compared to the population of Yunnan, Beijing and Jiangsu. Thus, it could be concluded that the strategy to communicate knowledge of biology to the people in Jiangsu may not work in Yunnan or Shanxi. In other words, if a scientific notion was to be democratised among a province, specificities of their cultural-cognitive-structure would have to be taken into account. It could also be pointed out that with the adjusted cultural distance model, differences in structures of people's cultural mind in different areas could be probed. Scientific notions placed at large cultural distances were not expected to become a part of the people's cultural thought through short term solutions. Thereby, suited and effective measures could be adopted by local science communicators referring to the analytical results presented here.

Conclusions

The adjusted model well described the status of public understanding of science in China in a different perspective. It is evident that based on this model index for measuring level of public understanding of science could be constructed without declaring sections of society as 'scientifically literate' and 'scientifically illiterate'. It also evidently reflected the scientific awareness level of different gender groups and areas for different scientific concepts. As the level of complexity increases the relative cultural distance, of scientific phenomenon, tenet or information, from the quotidian life of populace also increases. Using the model relative culture distance between various scientific notions and people's structure of thought in quotidian life were mapped among genders and areas. Based on these maps, strategies for effective communication of science, specific to various cultural groups and different areas, can be formulated.

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