

“Cultural Bonds” in High Technology: Collaborations between Chinese Researchers in Nanotechnology

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ABSTRACT

Socio-cultural issues have attracted increasing attention from policy makers in high technology. For example, a certain “culture” of high-tech fear, exemplified by Michael Crichton’s best-selling novel *Prey*, seems to have emerged in U.S. In this paper, we examine the cultural dimension of nanotechnology in an alternative way. Specifically, we look at how “cultural bonds” enter into scientific collaborations between ethnic Chinese researchers residing in U.S. and China. In U.S., ethnic Chinese researchers have constituted a large and important workforce. Although collaborations with researchers in China are not geographically convenient, professional journals have published a high number of collaborative studies that involve ethnic Chinese scientists residing in U.S. and China. We analyze the motivations behind such “culturally-based” collaborations. Among other things, new economic benefits are significant incentives for Chinese researchers in the two countries to collaborate with each other. We also discuss the implications of such collaborations in the context of China’s modernization and US-China relations.

Keywords: scientific collaboration, modernization, globalization, US-China relations

1 INTRODUCTION

In recent years, nanotechnology has entered into less industrialized countries such as China, India and those in Latin America. As the national governments of these countries have provided an enormous amount of funding in nanotechnology research, scientists and venture capitalists now have great interests to understand nanotechnology development in these countries.

Although more and more high-quality scientific research now comes from research groups in the less industrialized worlds [1, 2, 3], the scientific infrastructures of these countries are still underdeveloped. Science commentators and analysts remain skeptical if high-tech research can be conducted in the same capacity as it is in the more industrialized worlds [3].

Nanotechnology development in China has attracted widespread attention for two reasons. First, Chinese research groups have published ground-breaking results in such prestigious journals as *Science* and *Nature* [1, 2]. Moreover, China offers a huge potential market for future nano-products. Taken together, Chinese scientists do seem

to possess the capacity to conduct nanotechnology research, while the huge population in that country carries promising potentials to capitalize nanotechnology findings and products. For scientists, social scientists, analysts and skeptics, a major question to ask is: What enables scientists to develop high-tech research even though the infrastructures in those countries are far from developed?

To approach this question, we look at a particular form of academic collaborations - those between Chinese scientists resided in U.S. and China. On the surface, these collaborations appear to be “culturally-based”. By interviewing scientists in both countries, we attempt to reveal the economic and scientific motivations behind such “cultural bonds”. Through collaborative activities, our respondents also develop perceptions about the pros and cons of doing nanotechnology in China vis-à-vis U.S. Because of space limitations, we can only report selected findings in this paper.

2 METHODS

Our primary aim is to generate new social theories and perspectives, and we follow the grounded theory tradition [4]. Grounded theory is an ethnographic method, which emphasizes careful comparisons between contexts and actors. It is quite suitable for understanding scientists from two different socio-economic entities. In terms of theoretical orientations, we follow an emerging group of researchers from social studies of science, whose interests lie primarily on theorizing “scientific practice” [5, 6].

To serve our empirical and theoretical purposes, we conduct in-depth interviews with Chinese scientists in both U.S. and China. Covering both countries should allow us to obtain a “two-sided” perspective. This perspective enables us to more easily detect scientific and economic considerations that may, or may not, be country-specific.

For all interviews, we make use of an interview protocol. We follow standard procedures in social science to handle in situ contingencies in interview research and allow for ad hoc changes that arise during the interviews [4]. For example, a respondent might provide an answer that is relevant to later questions. In all interviews, we attempt to cover a set of basic questions.

2.1 Ethnography and Guiding Assumptions

Ethnographic research pays attention to the emergent qualities and findings that arise and evolve during the actual

research process [4]. At one extreme, researchers do not make any assumptions before going to their research “field”. Other researchers make weak assumptions and are ready to modify their pre-conceptions after data collection.

Our research is closer to the latter type. Thus, we make several weak assumptions based on previous findings before going to the field. First, we notice that scientists in China are now very eager to publish in English journals. In fact, top journals issued in Euro-American countries have now become a standard for tenure promotion in many elite Chinese universities. In U.S., the “publish or perish” culture definitely persists, but the eagerness to publish in journals issued in China or other Chinese-speaking countries is relatively low. However, it is possible that American-Chinese scientists would benefit from collaboration with local Chinese scientists. In that sense, American Chinese scientists may also have publication-related motivations to collaborate with Chinese scientists in China.

Economically speaking, U.S. continues to be the leading country in terms of funding level for nanotechnology research [8]. Thus, Chinese scientists in China may have economic interests when collaborating with scientists American Chinese scientists. However, the cost of doing research in China may be lower in China than U.S. Thus, Chinese scientists from U.S. may be interested to cut costs by conducting research in China.

There can be motivations other than economic and scientific for Chinese scientists in the two countries to collaborate. In our interviews, we pay attention to indications of other possible motivations. For example, would American-Chinese scientists think that collaboration with local Chinese scientists is “culturally-oriented”? Or does collaboration with local scientists in China provide a way to fulfill nationalistic feelings? Finally, through understanding their collaborative experiences, we can also identify what Chinese scientists perceive as opportunities and constraints regarding nanotechnology research in China.

2.2 Key Questions and Respondents

Although we assume that each interview may proceed differently, we have covered several key questions during all interviews:

1. What is the most important reason for you to collaborate with Chinese scientists in U.S./China?
2. How do you think collaborations with Chinese scientists in U.S./China will benefit your scientific research?
3. What kind of opportunities and difficulties are there for you to collaborate with Chinese scientists in U.S./China?
4. Based on your collaborative experiences, what do you think about nanotechnology development in China?

This paper is based on interviews with ten scientists in U.S. and China. The academic disciplines of our respondents include electronic engineering, physics, chemistry, bio-medicine and material science. They all have a permanent position in either a U.S. or Chinese university, and all have done collaborative research with researchers in U.S. or China.

3 RESULTS

3.1 Scientific and Economic Motivations, Constraints and Opportunities

In terms of collaboration for nanotechnology research, Chinese scientists in both countries have some very similar motivations. First, both groups recognize the multidisciplinary (and often under-defined) character of nanotechnology, and find it important to adopt an interdisciplinary attitude:

“Am I doing nanotechnology? Well, as I said, it depends. Definitions of nanotechnology depend on who you ask. My research (IC chip) is (in) nanotech transistor size.” (Respondent 8 – from U.S.)

“Nanotech is a boundary profession. There are different branches of knowledge that may be of use. My undergrad degree is chemistry, then my grad degree is in physics and my postdoc is about material science. When a particular nanotech product is used in human body, then you probably need some knowledge in biology.” (Respondent 2 – from China)

“I do physical chemistry, but I now study nucleotide. That means I need to learn about cells and biology. I didn’t know the technology regarding how to grow cells.” (Respondent 1 – from China)

Chinese scientists in both U.S. and China recognize that high technology research is more developed in U.S. than in China. In fact, government agencies in China have set up international advisory panels, of which ethnic Chinese scientists that have migrated to Euro-American countries constitute a major group. In this sense, an important kind of collaboration between Chinese scientists in U.S. and China is that the latter would invite the former to serve in experts’ panels. Why would overseas Chinese scientists serve as “international experts”?

“We serve as ‘international experts’ because we can read Chinese. Proposals in China are still written in Chinese.” (Respondent 6 – from U.S.)

Yet, for both Chinese scientists in U.S. and China, undeveloped scientific infrastructure remains an obstacle of doing research in China:

“Compared with other countries, China has started a bit late. But it's rising fast. We still lack the technology to catch up. More advanced countries are doing mass production for high- and intermediate-level products. We are doing intermediate and low. As I said (earlier during the interview), equipment is very expensive.” (Respondent 3 – from China)

As some Chinese scientists have resided in U.S. for a long time, they even express “unfamiliarity” with the science culture in China:

“I have been in U.S. for twelve years. I think there are administrative duties to take care of in both countries (China and U.S.). But it's much easier to handle them here (in U.S.). Not as much politics!” (Respondent 7 from U.S.)

In science studies, some researchers have shown that different disciplines have developed their own “cultures” [6]. How do our respondents think about disciplinary conflicts? Our respondents in China believe that collaborations do not necessarily lead to conflicts:

“We have collaborations, but most are *general* collaborations (*italics is my emphasis*). That is, we chat. You need help from experts in other fields.” (Respondent 1 – from China)

“Well, collaboration operates under the principle of “doing for each party's own good”. And our collaboration is mostly *academic kind* (*italics is my emphasis*).” (Respondent 3 - from China)

So, why do scientists in U.S. want to do research in China? Supply of materials and low costs are two major reasons. For those who are currently developing nano-materials, they can find plenty of raw materials, which cost much less than they would be in U.S., in China.

“You know, more than 50% of this material comes from China.” (Respondent 5 – from China)

Low costs for conducting tests and experiments in China can also save scientists a lot of money. For example, scientists can construct physical models in China at a much lower costs:

“When we want to test something like this (a physical model for surgery), we need to produce a lot of actual models. In China, we spend very little money and we can produce enough.” (Respondent 6 – from U.S.)

3.2 Transnational-Local Awareness and Other Motivations

As in other high-tech research, collaborations in nanotechnology can help scientists link their research to industrial application or other practical uses. In this regard, many Chinese scientists have become highly transnational. In fact, being aware of the transnational nature of their research seems to carry important economic implications:

“... And the market is certainly big. For example, in catastrophe like 911, you run out of energy all of a sudden. If your building is equipped with something that can illuminate, it's very helpful. Something (bright) that circulates within the building (will be useful).” (Respondent 2 – from China)

“We have collaborators mostly from Shanghai, but also other cities like Beijing. We also have a long-term international collaborator: (He is currently at) XXX University's, Professor XXX.

This project is competitive in two ways: First, it is a very special product. Second, it has reached *international* standards (*italics is my emphasis*). That's why the government is so supportive. Actually we are quite ready to engage in mass production.” (Respondent 3 – from China)

Collaborative research also allows scientists to cultivate the resources and talents in different localities. In both U.S. and China, Chinese scientists are particularly aware of the distinctive advantages of doing research in certain metropolitan cities in China, most notably Shanghai and Beijing:

“Shanghai is the best city to do nanotech, actually high-tech in general, because they have the right policy - “Ke Jiao Xing Shi” (meaning roughly “prospering the city with science”).

So, how about Beijing?) (Interviewer)

Well, that's just because it's Beijing, and then it's easier to get funds.” (Respondent 3 – from China)

Other than the “right policy”, these cities also supply talented people:

“This university is definitely good, but do not receive as much attention as in those ‘key universities’ in Beijing and Shanghai. ... I talked to graduates from this university (in Zhejiang). All of them want to get a job in Shanghai. They said: ‘Definitely’. Why? Because they can get a much higher salary”. (Respondent 8 – from U.S.)

Interestingly, our respondents do not necessarily see doing nanotechnology research in China as being patriotic. A more inclusive outlook seems to be at work:

“We are doing scientific research. So, our contribution is to the whole world. My research will contribute to people in China, just like my friends’ research in China will contribute to people in U.S.” (Respondent 6 – from U.S.)

“In scientific research, our primary concern is whether a specific collaboration will serve each other’s scientific purposes. ... Nationalistic motivation is secondary. (Respondent 8 – from U.S.)

In addition to scientific and economic motivations, do Chinese scientists collaborate for other reasons? Yes! Some of them do it for “personal reasons”:

“Some people call mine ‘fake collaborations’. I go back to see families, friends and old colleagues. Other than doing research, I enjoy eating Chinese food a lot.” (Respondent 6 – from U.S.)

4 DISCUSSION / FURTHER RESEARCH

In this paper, we highlight several observations, which are worthy of attention and further research. First, we notice that the “cultural bonds” between Chinese scientists in US and China are supported by scientific and economic considerations. Thus, collaboration between Chinese scientists in both countries may not be purely “cultural”. More likely, the “cultural aspect” of this kind of collaboration facilitates researchers to align various concerns [5].

We do, however, recognize that the process in which scientists’ multiple concerns translate into actual nanotechnology research can be very complex. We believe

that, in such a multidisciplinary scientific enterprise as nanotechnology, scientific, economic, political and even personal concerns are intermingled. Accordingly, the final product generated by a collaborative research is likely to be a combined result of scientific, economic and institutional – both intended and unintended [5].

Hopefully, our research also opens up an interesting point to reconsider modernization and globalization theories. Older social theories believe that importation of Euro-American culture is necessary for developing countries to modernize [7]. As advances in modern transportation and communication have made academic exchanges increasingly convenient, it is likely that scientists from different countries – more or less industrialized – would like to benefit from more academic exchanges. For scientists that share the same language and cultural backgrounds, such exchanges do not necessarily entail “cultural adjustment”, which, if at all, may take a long time to actualize. According to our observations, collaborative research seems to provide better understanding about local resources and international applications. In this sense, policy makers have a good reason to cultivate institutional mechanisms and encourage collaborative work. More academic exchanges between scientists in U.S. and China can also strengthen US-China relations.

We recognize that further research is necessary. For examples, we can examine variations among scientists from different scientific disciplines and localities at greater depth. In this paper, we do not claim representativeness regarding the data we collected in this research. Our small number of respondents does not represent all Chinese scientists in either China or U.S. To obtain representativeness, several quantitative approaches may be applied. Other than large-scale survey methods, one may also consider Bayesian Method [9], Social Network Analysis [10], and Respondent-driven Sampling Technique [11].

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