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Research Productivity of East Asian Scientists: Does Cosmopolitanism in Professional Networking, Research Collaboration, and Scientific Conference Attendance Matter?

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Our study (in the area of sociology of science) examines how cosmopolitanism in three spheres of scientific engagement — networking, collaborating, and conferencing — influences total journal productivity (TOTAL) and productivity in high impact journals (HIJ; impact factor $\geq$ 4). We hypothesize that scientists who exhibit cosmopolitanism in these spheres of scientific engagement have higher HIJ and TOTAL publication counts. To test this hypothesis, we conducted face-to-face interviews with a sample of n=84 life scientists in doctoral granting institutions in Japan, Singapore, and Taiwan. We analyzed our data using a set of generalized linear models (i.e., an over-dispersed Poisson regression for HIJ and a negative binomial regression for TOTAL) with publication counts as the outcome variables, and measures of professional networking, research collaboration, and scientific conferencing as our main predictor variables. To increase the precision of our regression estimates, we incorporated variables pertaining to contextual and personal attributes as multivariate statistical controls. Our results indicate a positive association between HIJ productivity and proportion of foreign contacts, and no association between productivity and collaborations involving foreign participants. Although conference attendance in general is linked with increased productivity (HIJ and TOTAL), conference attendance abroad is not. These findings appear to suggest that the formal collaborative research group with its instrumental ties may not be conducive to productivity, but the informal professional network with its affective ties may be conducive; and having a cosmopolitan professional network is a strong predictor of productivity in high quality outlets.

Keywords: cosmopolitanism, professional networks, publication productivity, scientific conferences, research collaboration, East Asian scientists

BACKGROUND

What does *cosmopolitanism* have to do with scientific processes? We begin with a background on the concept as developed by Robert K. Merton (Merton 1948/1968). When a study that originally began as research on magazine readership produced a curious and serendipitous pattern (in terms of reading and social activities), it was considered so provocative that Merton and his colleagues changed the course of their study toward a better understanding of these "influentials." What started with an insight into two very different ways of responding to the Second World War's impact on a town's economy, progressed toward the unearthing of a pattern of differences in span of geographical orientation, history of travel, reading and friendship, and community involvement. Namely, this had to do with readers, who were considered influential in society, following two distinct patterns of orientation: *local* and *cosmopolitan*.[1]

RESEARCH QUESTION

It was with this epiphany that Merton applied the term, "cosmopolitan," to the growing phenomenon in citizenry whose thinking was evolving toward a broader world view as influenced by mass media, education, and increasing availability of affordable travel; and, as it was juxtaposed with the "local," the citizen whose thoughts, loyalties, regards, and sentiments resided largely nearby. This was an innovative leap from previous understandings of cosmopolitanism. In this study—in the sociology of science —we apply the concept of cosmopolitanism to a population of contemporary elites involved in the production of knowledge—the population of scientists—and examine how cosmopolitanism in three spheres of scientific engagement (i.e., professional networking, research collaboration, and scientific conferencing) influence publication productivity. Specifically, we seek answer to the question: *Does a cosmopolitan orientation in professional networks, in research collaborations, and in scientific conferencing influence total publication productivity (TOTAL) and productivity in high impact journals (HIJ)?* [2]

SIGNIFICANCE OF THE STUDY

Why is it important to seek answer to this question? First, we are not clear whether it is the articulation of cosmopolitanism in collaborations and in networks, or collaborations and networks themselves that influence publication productivity in science. Second, the link between collaboration and productivity is well documented in the case of Western developed countries, but it is not clear whether the same pattern holds true in the case of developed countries of the non-West (Ynalvez & Shrum, 2009; 2011). Third, professional networks have been documented to play an enhancing role in the productivity of scientists in the West, but again have not yet been fully studied in the developed countries of the non-West. Fourth, with the few studies on cosmopolitanism pointing to its potential in enhancing performance (Lee & Bozeman, 2005), we have yet to discover which sphere of scientific activities we should develop a cosmopolitan orientation (Glasser, 1963) to have maximal impact on scientific output. And fifth, the advent of information and communication technologies (ICTs) has ushered intense debate as to whether scientists should interact more through cyberspace rather than spend scare financial resources and taxpayers' money on attending conferences abroad.

Indeed, increased understanding of factors relating to publication productivity is universally beneficial as scientific communities at the local, national, and international levels seek to advance fundamental knowledge, and address issues such as climate change, pandemics, environmental degradation, food security, clean water, and renewable energy—all of which are occurring at a global scale. Examining scientific processes in the non-West—in this case, East Asia, site of a productive cluster of scientific communities—will enrich both Western and Non-Western understanding of how identities, relationships, interactions, and non-cognitive factors shape science.

RELEVANT LITERATURE

Cosmopolitanism

Cosmopolitanism is a rich concept, evolving over time and usage, and increasing in relevance as the world continues toward globalization (Lee & Bozeman, 2005; Theilbar, 1970). "A cosmopolitan is one who is oriented toward the larger social world, beyond his immediate organization or community, with extended interests, concerns, and values" (Merton, 1976, p. 86). Merton's cosmopolitan has lived in other communities, has traveled, and has a higher education in general. This profile is also associated with a heavier intake of media, an interest in world events, a small but diverse set of personal network, and membership in professional associations (Merton, 1948/1968).

Gouldner (1957) built on the work of Merton (1948/1968), revealing that in a college environment, cosmopolitans were more likely to be working on their doctorates while locals were working on their master's degrees, and that cosmopolitans were publishing more. Glaser (1963) added that there might be a dual identity of local and cosmopolitan tendencies, specifically with high performing scientists when similarities in organizational and institutional goals reinforce this multiple orientation. Kantian philosophy (Fine & Cohen, 2002) promotes a cosmopolitanism of a mature society that is able to learn from its mistakes and join together in the interests of common humanity and its larger goals toward a world society. Similarly, Beck (2002), and Beck and Sznaider (2010) espoused a cosmopolitan world view, a new sociological paradigm in which the larger goals of global society might transcend the national. From this body of work, we argue that cosmopolitanism in science is morphed by ICTs and which essentially impacts scientific output.

Professional Networks

The analysis of professional networks is a viable methodological approach to understand the social dynamics that take place in the production of scientific knowledge. According to Ynalvez and Shrum (2011), larger networks are indicative of diversity, access to resources, opportunities, and the channels of information that might lend to professional success. Bozeman and Corley (2004) found that most scientists tend to collaborate within their networks, not necessarily seeking out scientists from other institutions, sectors, or countries. However, the highly specialized nature of the scientific knowledge production process increasingly requires a national or international network of informal ties that can provide dedicated and systematic help to a scientist (Baker & Zey-Ferrell, 1984).

Interestingly, in a study by Ynalvez and Shrum (2009; 2011) among Filipino scientists, place of graduate training had a significant impact on future networking and subsequent productivity. Of the scientists that attended graduate school in Australia, Japan, and the U.S. and then returned to the Philippines, those that attended Japanese graduate schools had greater scientific productivity, and had closer ties with their mentors than those trained elsewhere (Ynalvez & Shrum, 2011). In these situations, perhaps Filipino graduate students had access to human capital and skills that were valuable also to their Japanese mentors, such that these situations would result in a more complimentary and mutually beneficial relationship.

Additionally, Ynalvez and Shrum (2011) reported that while attending graduate school in a foreign country did not significantly enlarge network size, it did diversify it such that the ratio of local to foreign contacts was morphed. More contacts in developed countries translated to increased research collaboration and importantly, to more articles in international journals. Conversely, more contacts in developed countries were also correlated with fewer publications in local journals. Might this positive relationship between cosmopolitanism in professional network among scientists' in resource-constrained research system like those located in the Philippines hold true for scientists in resource-rich research systems in the non-West?

Research Collaboration

Bozeman and Corley (2004) suggested that collaboration often begins with informal relationships and communications, and can greatly enhance access to resources, expertise, and equipment. They continued that it is known to increase "cross fertilization across disciplines," improve chance of funding, and increase visibility and prestige; and, that collaboration is a tool for peer mentoring, increased specialization, and socialization to the profession. Shrum, Genuth, & Chompalov (2007) added that formation of collaboration occurs when it is the most efficient way to achieve objectives maximizing on finances, facilities, and technical knowledge. Increasingly, they reported, it is even formed as a result of advertisement, perhaps because a scientist has more ideas than resources. Katz and Martin (1997), in exploring motivations to collaborate, extol the benefits of cutting costs on equipment, pooling resources, maintaining social connections, and reaping the benefits of another's specialization. These motives offer some explanation as to why international collaborations are also on the rise (National Science Board [NSF], 2010).

Cummings and Kiesler's (2005) evaluation of NSF-funded projects involving multiple disciplines and multiple organizations, presented not only the benefits of collaboration but the difficulties. This is a growing edge in science as the awareness of the need for collaboration and its potential benefit is growing. It is also a growing edge in that there is no single way in which this might be best accomplished. Coordination and issues inherent to relationship development (e.g. conflicts and competing priorities) are inevitable and can be complicated. Nearly all of the projects in their study had significant obstacles; these were generally related to conflicting schedules, differences in vision, budget negotiations across universities, contract negotiations, intellectual property, additional costs, procedures for human subject research across universities (perhaps countries), and different versions of statistical software.

Hara, Solomon, Kim and Sonnenwald (2003) examined four research groups, but focused mainly on the one that experienced the most difficulty in productivity and collaboration. By doing this, they were able to see both sides of the collaboration issue more clearly, and to highlight some difficulties and costs inherent to collaborations among diverse groups. Katz and Martin (1997) mentioned time might be lost to communication, jet lag, travel, the energy expended in adapting to a new environment, and the costs of administration and bureaucracy. Other problems listed by Hara et al. (2003), Cummings and Kiesler (2005), and Walsh and Maloney (2007) include conflict, competition, communication difficulties, expense, time, differences in perspective, and scientific approach. Often, large amounts of funding are attached to collaboration as an ideal and often that funding is exceeded by the unexpected costs associated with the collaboration (Katz & Martin, 1997).

From a methodological view point, Lee and Bozeman (2005) created a range score for cosmopolitanism in collaboration, with 0 being the least, and 5 being the most. This score incorporated foreign country involvement, as well as other distance levels, and the amount of time spent with that element. Between the disciplines observed, physicists had the highest score in cosmopolitanism as they were most likely to collaborate internationally. Also, men, tenured faculty, principal investigators, and those with larger grants had greater association with high cosmopolitan scores.

Scientific Conferences

The very purpose of scientific conferences is to disseminate new knowledge, facilitate discussions, address issues, challenges, and solutions, and provide opportunities for networking within a discipline. Conferences might serve as a launching ground for new ideas for graduate students, professors, and professionals in the discipline. Travel experience, exposure to notable persons within one's discipline, and an enhanced understanding of expectations and standards in one's professional community is an invaluable experience for a student.

> Prpić (2002) considered conferencing a "structural variable" in scientific life that facilitates professional success. She recorded that publication productivity is "strongly influenced" by a scientist's "position in the social organization of science" (p. 27). Prpić's study of young scientists in Croatia emphasized the importance of international contacts, and that it was the most important determinant for productivity levels of female scientists. Conference attendance is an excellent opportunity for these types of introductions, and what is more, international conference attendance was the "most powerful predictor of male productivity" as well (p. 27). When it came to total career productivity, international scientific conferences accounted for 51% of the variance for women, whereas for men, the strongest variance simply had to do with academic degree.

Additionally, participation in international conferences affected women's productivity in international publications, accounting for 70.8% of the variability. For men, it was more complex and conference attendance carried less than half the impact than it did for women, though it was still the strongest predictor. Though Prpić's study was conducted in Croatia, a developing country, it has universal value not only along the gender gap continuum, but in the advantage of scientific conferencing to facilitating one's way into scientific social structures. Babu and Singh (1998) were in consensus with Prpić, affirming that the professional exposure of interactions with top ranked scientists at conferences is conducive to inspiration of new ideas, and subsequent productivity. However, with the advent of Internet-based communications and networking facilities, important questions emerge. For example, does attendance and participation to international scientific conferences associate with scientific productivity despite scientists' utilization of Internet-based conferencing and networking facilities?

Publication Productivity

Journal publication count is a universally accepted measure of scientific productivity (Keith, Layne, Babchuk & Johnson, 2002; Fox, 2005; Fox & Mohapatra, 2007; Prpić, 2007; Hunter & Leahey, 2010). Cole (2000) described journal publication as a check and balance system in which journals are not only a medium for knowledge dissemination, but the peer review process provides a filter to encourage quality. Cole further contended that high ranking journals tend to have higher quality articles by citation count. Interestingly, the reasons why these top journals have articles with higher selection rates is due to a combination of the journal's selection process, via the editor and staff; the referee evaluation; and, the fact that many authors seem to know when their work is worthy of a particular top journal and will direct it accordingly as opposed to a lower tier journal.

> We address this issue and acknowledge other discrepancies that are more difficult to control in productivity measures. In this study, we control the variation in journal acceptance rates by limiting our respondents to the life sciences. Also, both top and non-top ranking journals are taken into consideration in the productivity variables. And, it is important to note that the English language is generally essential to international publishing and this can be a hindrance to publishing for scholars and scientists the world over if they do not have access to dependable and accurate translation (Lee & Bozeman, 2005; Huang, Chang, & Chen, 2006) .

DATA AND METHODS

Study Locations

We conducted on-site face-to-face surveys and in-depth interviews with life scientists in selected doctoral training institutions in Japan, Singapore, and Taiwan.[3] Japan is a leading contributor to contemporary science, has invented a technology-based economy, and maintains a heavy focus on innovation and quality (Wallerstein, 2005; Adams, King, Miyairi & Pendlebury, 2010). Yet, despite these fine attributes of Japanese science, global visibility is a struggle for Japan's research institutes and universities (Normile, 2007). Many insiders attribute this to the hierarchical, insular, rigid, and patriarchal orientation of its scientific system (Kurokawa, 2008; The Economist, 2011). Indeed, many Japanese research universities and institutes are hitherto not open to foreign talents. For example, offering tenured-positions to international professors is still not a popular move. Although open to foreign students, many universities conduct their courses and programs in Japanese, and are not typically ready to offer talented foreign students permanent jobs or positions (Kurokawa, 2008).

Compared to those in the U.S., Japanese doctoral training laboratories are less diverse in terms of the international mix of faculty, post-, and pre-doctoral students. Some insiders contend that Japan should encourage the influx of international talents to enhance innovation and boost creativity (Kurokawa, 2008; Normile, 2007). It is also evident that while other non-English speaking countries (e.g. China and South Korea) are working toward using English as one of the modes of scientific instruction, Japanese doctoral science training is conducted in the Japanese language. Japanese training institutions require foreign graduate students to take Japanese language courses. Based on our observations, another attribute of Japanese research system is the priority accorded to male scientists, and the challenges that face married women who aspire to do scientific work. The predicament of married female Japanese scientists is very exacting, given that domestic expectations are added to the professional demands of being a scientist. Hence, the typical response of junior female scientists is to either remain single, childless, or give up their professional careers upon marriage/becoming a mother.

Singapore is aiming to be world class in its biotechnology industry, which is the fourth pillar of its new economy, and which warrants major government investments (Cooke, 2004; Finegold, Wong, & Cheah, 2004). Compared to Japan over the period 2000-2010, Singapore has drawn much attention by attracting top-caliber scientists from around the world to its life science research facilities (Normile, 2011). Scientists and professors in Singapore's top research universities (e.g. National University of Singapore [NUS], and Nanyang Technological University [NTU]); and in high-technology research institutions (e.g. Agency for Science, Technology, and Research) are high-profile scientists recruited from Australia, Asia (China, India, and Japan), western Europe, and the United States. Amidst this aggressive recruitment of international talents, Singapore is also encouraging young professional returnees to take on scientific leadership roles (Huang & Tan, 2010).

In Singapore, professors and scientists are typically offered large amounts of start-up money, and most do not have to compete for grants to fund their research (Huang & Tan, 2010; Normile, 2011). Graduate students—male and female—come from different countries in the region. And, in contrast to Japan where students have to learn and to be trained using the Japanese language, students in Singaporean universities are mentored and trained in English. Furthermore, Singapore's universities also boast of the on-going and continued growth of joint-programs with top Research I universities in the U.S. like Duke University, University of California Los Angeles, and Yale University. All these efforts are essentially the consequence of Singapore's aspiration and earnest attempt to have its research universities and institutions evolve and transform to strong powerhouses and central players in global science (Normile, 2011).

In terms of science activities, budget, infrastructure, and workforce Japan and Singapore are two of Taiwan's closest comparators in the region. The ranking among the three countries in terms of science budget is in the following order: Japan (1st), Singapore (2nd), and Taiwan (3rd) (Normile, 2005). In the last five years, Taiwan had allocated over ~US$300 million per annum to further strengthen and upgrade its scientific research infrastructure and workforce (Normile, 2005). Funds had been channeled to top research universities (e.g. National Taiwan University) and institutions (e.g. Academia Sinica) to remain competitive with counterpart institutions in Japan (e.g. University of Tokyo, and Tokyo Institute of Technology) and in Singapore (e.g. NUS and NTU).

Taiwan has a rapidly growing population of scientists and researchers (Kirp, 2010). It has recently ranked among the top one percent of research universities in the world (Thomson Reuters, 2009). Unlike Singapore but similar to Japan, scientists in Taiwan's research training institutions are predominantly locals, who have either earned their doctorates in the U.S. or in universities locally. Like their professors, doctoral students are also predominantly locals with a few coming from China, Indonesia, and the Philippines. While Singaporean and Japanese universities train their students in English and in Japanese, respectively; Taiwanese universities adopt a middle ground by using both Mandarin Chinese and English.

Sampling and Data Collection

Most studies that focus on publication productivity use bibliometric data downloaded from on-line databases. While commendable in terms of sample size and country coverage, this strategy provides a picture of knowledge production that is far removed from the context of action and interaction. To come up with a picture from the front-line, we collected data from the actual sites of knowledge production (i.e., research laboratories in doctoral training institutions). Although adducing evidence this way is exacting and tedious—and often times stressful—, we contend that we gain better and up-close understanding of the context, identities, relationships, and phenomena that we are studying (Morrissey, 2011).

We conducted face-to-face surveys and in-depth semi-structured interviews with a sample of life scientists—mainly, biochemists, geneticists, and molecular biologists—in Japan, Singapore, and Taiwan. In Japan, interviews were conducted in either Japanese or English depending on respondent's choice. In addition to recording responses in our questionnaires, we also recorded each interview using a digital voice recorder. Due to budgetary demands associated with conducting international research, we capped sample size at 30 scientists per country.

In each country, sampling was carried out by our local coordinator, who drew a random sample of scientists from lists generated from departmental websites of target institutions. Essentially, country and institution served as stratification variables. We were six respondents short of our target in Singapore due to coordination issues. Hence, our final sample size was at n=84. Our IRB-approved quantitative survey questionnaire and qualitative interview schedule included questions about socio-demographic attributes, time-use, laboratory practices, mentoring practices, research involvement, collaborative projects, professional networks, and research productivity.

Multivariate Statistical Controls

We employed a set of multivariate controls pertaining to locational, personal, and professional characteristics; and email- and web-use behavior of respondents. For locational attributes, we created two dummy variables: Japan (yes=1; no=0) and Singapore (yes=1; no=0). Taiwan served as reference category. For personal attributes, we used marital status (married=1; not married =0), gender (male=1; female=0), and the linear and the quadratic terms of age. Both of these terms were centered.[4] For professional characteristics, we used time devoted to research (%), number of days on vacation per year, number of years spent outside of home country for graduate training, and membership in professional organizations (yes=1; no=0). With regard to web- and email-use behavior, we used the following variables: number of hours in a typical week surfing the World Wide Web for research, emails sent in a typical week that were related to research, and emails received in a typical week that were related to research. Items pertaining to emails sent and received were measured on an ordinal scale (1=less than once a week, 2=less than two per day, 3=three to ten per day, and 4=more than 10 daily).

Core Predictors

Our core predictors comprised six variables: Two relating to professional networks, two pertaining to research collaborations, and yet another two relating to scientific conferencing. For our professional network variables, we used network size (0-10) and proportion of foreign contacts or alters (0.00-1.00).[5] Following the lead of Thielbar (1970) in casting cosmopolitanism along different dimensions such as political cosmopolitanism, we treated the proportion of foreign alters as an indicator of cosmopolitanism in professional networks. Both these professional network variables were derived from responses to our egocentric name-generator (McPherson, Smith-Lovin & Brashears, 2006) from which we solicited the names and attributes of up to 10 individuals whom respondents talk to, go to for advice, or anyone who comes to [them] for advice…those that are the most important for [their] own research work. Information obtained through the name-generator included contacts' gender, citizenship, and location.

For our measure of involvement in research collaborations, we used the total number of main projects with collaborators. Cognizant of the heavy administrative demands associated with large research projects, we capped responses to a maximum of three. As a measure of cosmopolitanism in research collaborations, we used the proportion of main collaborative projects which had foreign collaborators (0.00-1.00). Our definition of a collaborative research project is consistent with that of Ynalvez and Shrum (2011) which is: doing research activities with someone outside respondent's department with the aim of generating output. By this definition, a scientist working closely with his/her doctoral student would not count as collaboration. However, a scientist at, say, the department of sociology, who works closely with a professor at, say, the department of biology within the same university, would be considered a collaboration.

With regard to scientific conferencing, we used the total number of professional meetings attended in the last two and half years, and the proportion of professional meetings attended abroad (0.00-1.00). We used the latter as our indicator of cosmopolitanism in scientific conferencing. Hence, we have three indicators relating to cosmopolitanism: proportion of contacts that are foreign, proportion of main projects that have foreign collaborators, and proportion of scientific conferences abroad that respondent had attended in the last 2.5 years.

Outcome Variables

Following Duque et al. (2005), we employed a self-report method of publication productivity. Self-reported publication counts have been shown to correlate highly with those listed in abstracts and indices (Fox, 2005). Also, for our purposes of understanding knowledge production in the actual sites of action and interaction, these have been shown to be more reliable than bibliometric approaches (Ynalvez & Shrum, 2011). In this study, we measured publication productivity by the number of articles in high impact journals (*HIJ*) and by the total number of articles in both HIJ and non-HIJ (*TOTAL*). We define HIJs as those journals with an impact factor ≥ 4. These productivity measures covered a period of 2.5 years prior to our survey interviews. We employed a short period in order to allow for ease of recall (Fox, 2005).

Analytical Method

Using Statistical Packages for the Social Sciences 20.0 (IBM SPSS, Chicago, IL), we calculated descriptive statistics for all variables in this study. We performed mean comparisons among the three countries by way of an analysis of variance and a Games-Howell post-hoc test, [6] and used a set of generalized linear regression models (over-dispersed Poisson and negative binomial regression) to examine the relationship between our outcomes and predictor variables. With HIJ having a heavily positive skewed distribution, our analytical approach took the form of an over-dispersed Poisson regression model (Coxe, West, & Aiken, 2009; Hilbe, 2007). We used a negative binomial regression model for TOTAL productivity because the severe positive skewness of its distribution could not be corrected by an over-dispersed Poisson regression model (Coxe *et al.,* 2009; Hilbe, 2007). [7]

A normal error regression model with the outcome variable log-transformed was not used because this technique failed to correct for positive skewness for both TOTAL and HIJ productivity, which made it—the normal error regression—an untenable modeling technique to use (Field, 2009). The standard Poisson regression model was also not feasible because both of our outcome variables violated the equi-dispersion assumption (Coxe *et al.,* 2009; Hilbe, 2007). And, because regression coefficients estimated from a small sample run the risk of being unstable, we used robust standard errors to test for statistical significance (Hilbe, 2007). Diagnostic tests for multicollinearity among the predictor variables revealed no serious problem (Field, 2009).

FINDINGS

Respondents' Profile

Table 1 shows descriptive statistics for our sample. With regard to respondents' personal characteristics, nearly four-fifths (79%) were married, about three-fourths were male (76%), average age was 48 years with the youngest and the oldest at 31 and 68 years, respectively. As to their professional attributes, the average respondent spent about three-fifths (57%) of his/her time on research, was on vacation for about 11.5 days/year, had spent a little over four years for international graduate training, and 93% were members of a professional organization.

In terms of email- and web-use relating to research, the typical scientist sent three to ten emails and received three to ten emails daily, and spent ~15 hours a week surfing the Internet. Network size averaged five contacts and ranged from zero to ten, while the average percentage of foreign alters in a network was at 18%. As far as research collaboration was concerned, the average number of collaborative projects and the average percentage of projects with a foreign collaborator were at 1.70 and 43%, respectively. On the matter of scientific conferencing, the average scientist

Table 1
Descriptive Statistics

Variables	Mean	SD	Min	Max
Japan (yes=1;no=0)[1]	0.36	0.48	0.00	1.00
Singapore (yes=1;no=0)[1]	0.26	0.44	0.00	1.00
Marital status (married=1;not married=0)	0.79	0.41	0.00	1.00
Gender (male=1; female=0)	0.76	0.43	0.00	1.00
Age (yrs)	48.38	9.18	31.00	68.00
Professional time devoted to research (%)	57.10	17.03	10.00	90.00
No. of days on vacation per year	11.38	8.74	0.00	50.00
No. of years out of home country for graduate training	4.36	3.62	0.00	10.00
Member of a professional organization (yes=1;0=no)	0.92	0.27	0.00	1.00
Email sent related to research[2]	3.13	0.81	1.00	4.00
Email received related to research[2]	3.24	0.81	1.00	4.00
Web use (hours per week)	14.74	12.82	1.00	70.00
Total network size (0-10)	4.99	2.60	0.00	10.00
Proportion of alters who are foreign	0.18	0.26	0.00	1.00
Total number of main projects with collaborators	1.70	1.10	0.00	3.00
Proportion of main projects with international collaborators	0.43	0.40	0.00	1.00
No. of professional meetings attended[3]	9.00	8.48	0.00	53.00
Proportion of prof. meeting attended abroad[3]	0.47	0.29	0.00	1.00
No. of articles in high impact journals (HIJ)[3]	3.50	3.60	0.00	15.00
Total no. of publications (TOTAL)[3,4]	10.24	8.23	0.00	30.00

[1] Taiwan is the reference category.

[2] This item is measured on an ordinal scale ranging from 1 to 4 (1=less than once a week, 2=less than two per week, 3=three to ten per day, 4=more than ten daily).

[3] Period covers the last 2.5 years prior to the survey.

[4] Total includes both HIJ and non-HIJ publications over the last 2.5 years prior to the survey.

Table 2
Three-Country Comparison of Means[1]

Variables	Japan (n=30)	Singapore (n=24)	Taiwan (n=30)	Full Sample (n=84)	Remark
Marital status (married=1;not married=0)	0.97	0.76	0.63	0.79	JS ST
Gender (male=1; female=0)	0.93	0.86	0.53	0.76	JS T
Age (yrs)	51.48	44.38	48.17	48.38	JT ST
Professional time devoted to research (%)	55.00	61.57	56.00	57.10	JST
No. of days on vacation per year	7.00	14.88	13.17	11.38	J ST
No. of years out of home country for graduate training	2.22	7.71	4.07	4.36	JT S
Member of a professional organization (yes=1;0=no)	1.00	0.86	0.90	0.93	JST
Email sent related to research[3]	3.48	3.33	2.67	3.13	JS T
Email received related to research[3]	3.56	3.43	2.83	3.24	JS T
Web use (hours per week)	8.09	16.58	11.65	11.75	JST
Total network size (0-10)	6.62	3.62	4.37	4.99	J ST
Proportion of alters who are foreign	0.11	0.30	0.17	0.18	JT ST
Total number of main projects with collaborators	1.69	2.38	1.23	1.70	JT S
Proportion of main projects with international collaborators	0.49	0.64	0.17	0.43	JS T
No. of professional meetings attended[4]	14.95	5.64	5.60	9.00	J ST
Proportion of professional meetings attended abroad[4]	0.41	0.65	0.40	0.47	JT S
No. of articles in high impact factor journals (HIJ)4	4.21	5.37	1.50	3.50	JS T
Total no. of publications (TOTAL = HIJ and non-HIJ combined)[4]	13.87	11.11	6.27	10.24	JS ST

[1] Comparison of means is based on a Games-Howell test with the type-I error rate set at 0.05 (Field 2009).

[2] The column labeled 'remark' shows the results of a multiple comparison of means tests for the three study locations at a 5% Type-I error rate. An entry that reads JST indicates no significant differences among the three locations. An entry that reads J S T indicates that all three means are significantly different from each other. An entry that reads JS ST indicates that Japan and Singapore are not significantly different from each other, and Singapore and Taiwan are also not significantly different from each other, but Japan and Taiwan are significantly different.

[3] This item is measured on an ordinal scale ranging from 1 to 4 (1=less than once a week, 2=less than two per week, 3=three to ten per day, 4=more than ten daily).

[4] The time period covers the last 2.5 years prior to the survey.

attended about nine conferences in the past 2.5 years with 47% of those conferences abroad. As for HIJ and TOTAL productivity, the average scientist had about 3.5 and 10.24 articles in the last 2.5 years, respectively.

Mean Comparisons among Countries

Although the sample of scientists we surveyed were predominantly married and male, it is clear from Table 2 that scientists in Japan (married, 97%; male, 93%) had higher rates than those in Taiwan (married,63%; male, 53%). The Singapore group was not significantly different from both the Japan and the Taiwan group. Indeed, the life sciences community in this region is still largely male-dominated, with these males also predominantly married. With regards to age, scientists in Japan were about 50 with those from Singapore about 45. Taiwan scientists were about 48 years of age.

With respect to professional attributes, there were no significant differences in terms of the percentage of professional time devoted to research. Descriptive statistics indicated that 57% of professional time was devoted to research, with the remainder devoted to administrative work and teaching. In a year, scientists in Japan had significantly shorter vacation time (~7 days) compared to counterparts in Singapore and in Taiwan (~14 days). While Japan-based scientists would typically take vacation around New Year, those in Singapore and in Taiwan would have their vacation split between the traditional (Roman) New Year and the Chinese New Year.

In terms of years spent for international graduate training, Japan-, Singapore-, and Taiwan-based scientists spent 2.2, 7.7, and 4.1 years, respectively; with Japan and Taiwan not statistically different. Almost all scientists in each of the three countries reported membership in a professional organization, with no significant differences in membership detected. Ninety-three percent of respondents were members. On the matter of email- and web-use, scientists in Japan and in Singapore sent and received significantly more research-related emails (three to ten daily) than counterparts in Taiwan (less than two daily). Research-related web-use, however, was not a source of differences among the three groups. The average was at ~12 hours per week surfing the World Wide Web.

Japan-based scientists reported larger professional networks (6.62) than either Singapore- (3.62) or Taiwan-based scientists (4.37), with the latter two exhibiting no significant difference between them. Despite the larger network size for Japan-based scientists, they had the lowest (11%) proportion of foreign contacts while Singapore-based scientists had the most (30%). This pattern is consistent with the extant literature, which indicates the greater local orientation (lesser cosmopolitanism) of scientists in Japan compared to those in Singapore. In terms of number of projects with a foreign collaborator, scientists in Japan and in Singapore report significantly more projects than colleagues in Taiwan. As far as attendance to conferences was concerned, Japan-based scientists were more visible than scientists in Singapore and in Taiwan. Our results showed that the average scientist in Japan attended ~15 meetings over the last 2.5 years compared to those in Singapore and in Taiwan, who attended ~6 meetings. However, Singapore-based scientists had the highest percentage (65%) of conference attendance abroad. In terms of HIJ publications, Japan- and Singapore-based scientists had significantly higher HIJ publications than their Taiwan-based counterparts. As for TOTAL productivity, Japan-based scientists had significantly higher output compared to Taiwan-based scientists. TOTAL productivity for Singapore-based scientist, however, was not significantly different from either Japan- or Taiwan-based scientists.

Predictors of Productivity

In this section, we address whether these observed differences in productivity are robust even after incorporating multivariate controls in our analyses. The regression analyses for productivity revealed interesting results (Table 3). Several of our control variables, and a couple of our core predictors turned out to be significantly associated with HIJ and TOTAL productivity. With regard to location, Singapore-based scientists had significantly higher HIJ productivity counts (B=2.017, $p<.001$) than either Japan- or Taiwan-based scientists. Put another way, Singapore-based scientists published, on average, 7.52 times more than either Japan- or Taiwan based scientists.[8]

One possible reason for this may have to do with the higher level of English language proficiency among Singapore-based scientists compared to those based in Japan and in Taiwan. Such proficiency may have proven to be an advantage in getting published given that high-impact factor scientific journals are typically in English. Another plausible reason may have to do with Singapore-based scientists not having to compete for and write grants to fund their research. This allows them to focus their energy, talent, and time on research which includes writing manuscripts. Such focus is especially needed to publish in HIJ. In contrast, Japan-based and Taiwan-based scientists need to worry about writing and competing for grants. Not only do these translate to additional work load and responsibility; but once these grants are won and awarded, directing and managing them add to the already heavy load of Japan- and Taiwan-based scientists.

We also observed that being married was associated with higher HIJ (B=0.929, $p<.05$) and TOTAL (B=0.647, $p<.05$) productivity. In other words, married scientists published, on average, 2.53 times more in HIJ and 1.91 times more in TOTAL than scientists who were not married. A possible explanation is the instrumental (e.g. help in household duties) and the affective (e.g. caring, encouragement, and having someone to talk to) support afforded by a marriage partner. For example, having a spouse (i.e., the wife in most cases given the patriarchal orientation in the institutions/locations we surveyed) may have freed our respondents from assuming the role of primary care-givers to children, aging parents and parents-in-law, or all at the same time.

With regards to gender, being male had no significant association with either HIJ or TOTAL productivity despite the privilege given to and the greater number of male scientists in these countries. This result was unexpected yet not really surprising. It was unexpected because males are more likely to be productive than females in a culture that harbors a patriarchal orientation. It was not surprising because recent studies in Western developed countries had already observed a decreasing trend in the productivity gap between male and female scientists. Such a trend may have already gained momentum in the research systems of the developed non-West.

The linear (B=0.056, $p<.01$) and the quadratic (B=-0.003, $p<.05$) terms of age are suggestive of a curvilinear relationship between age and HIJ. With respondents' age ranging from 31 to 68, we observed that, initially, increasing age was associated with increasing HIJ productivity, then productivity peaked at about age 58 and then declined.

In terms of professional attributes, professional time devoted to research, days on vacation per year, years out of home country for graduate training, and the email-use variables had no significant associations with either HIJ or TOTAL productivity. Although there were no significant associations with HIJ productivity, we observed that membership in professional organizations was positively associated (B=0.818, $p<.05$) and web-use negatively associated (B=-0.021, $p<.05$) with TOTAL productivity.

In terms of professional networking, network size appeared not to be significant and important as the proportion of foreign contacts (B=1.372, $p<.001$) for HIJ productivity. In other words, a one unit increase in the proportion of foreign contacts translates to 3.95 times more HIJ publications. This highlights the importance of international ties in getting published in high-quality scientific outlets. With respect to scientific conferencing, however, number of conferences attended seemed to be more

Table 3

Generalized Linear Regression Results for HIJ and for TOTAL Productivity

PREDICTORS	HIJ[1]		TOTAL[1]	
	B	RSE	B	RSE
(Intercept)	-0.472	0.915	0.718	0.782
Japan (yes=1;no=0)	0.563	0.352	-0.138	0.332
Singapore (yes=1;no=0)	2.017 ***	0.491	0.340	0.317
Marital status (married=1;not married=0)	0.929 *	0.410	0.647 *	0.286
Gender (male=1; female=0)	-0.267	0.275	0.055	0.275
Age (yrs) centered linear	0.056 **	0.020	-0.002	0.015
Age (yrs squared) centered quadratic	-0.003 *	0.002	-0.001	0.001
Professional time devoted to research (%)	0.008	0.006	-0.002	0.005
No. of days on vacation per year	-0.012	0.015	-0.005	0.010
No. of years out of home country for graduate training	-0.055	0.040	-0.013	0.041
Member of a professional organization (yes=1;0=no)	0.019	0.440	0.818 *	0.240
Email sent related to research[3]	-0.137	0.263	-0.074	0.155
Email received related to research[3]	0.145	0.287	0.106	0.179
Web use (hours per week)	-0.011	0.011	-0.021 *	0.008
Total network size (0-10)	0.054	0.045	0.017	0.046
Proportion of alters who are foreign	1.372 ***	0.325	-0.079	0.386
Total number of main projects with collaborators (0-3)	-0.267	0.194	0.076	0.122
Proportion of main projects with international collaborators	-0.268	0.277	0.572	0.321
No. of professional meetings attended	0.022 **	0.010	0.034 *	0.014
Proportion of professional meetings attended abroad	0.520	0.388	-0.432	0.363
Deviance[4]	84.462		61.027	
Scale	2.223		0.223	

[1] HIJ and TOTAL (HIJ and non-HIJ combined) cover the last 2.5 years from the survey period.

[2] *, **, *** denote significance at the .05, .01, and .001 levels, respectively.

[3] Item is ordinal in scale ranging from 1 to 4 (1=less than once a week, 2=less than two per week, 3=three to ten per day, 4=more than ten daily).

[4] HIJ was anlayzed using an over-dispersed Poisson regression, while TOTAL was analyzed using a negative binomial regression.

important to both HIJ (B=0.022, p<.01) and TOTAL (B=0.034, p<.05) productivity than the proportion of conferences attended abroad.

This regression coefficient implies that one additional scientific conference attended translates, on average, to 1.02 times more HIJ publications and to 1.03 times more TOTAL publications. Unexpectedly and yet largely consistent with the finding of Ynalvez and Shrum (2011) in a developing country, research collaboration and cosmopolitanism in research collaboration were not significantly associated with productivity. We further discuss these results in our discussion section.

Research Problems

The non-significance of our research collaboration variables made us wonder what challenges and problems our respondents encountered that made these results as they were. To shed light on this unexpected result, we performed a one-tailed Spearman rank-correlation analysis between our productivity, collaboration, and network variables on the one hand; and the 10 ordinal variables pertaining to research problems on the other hand (Table 4) (Field, 2009).[9]

Clearly, involvement in research collaborations was positively correlated with problems about heavy administrative demands (r_s = +0.40, p<.01), while engagement in international research collaborations was positively correlated with problems contacting people when they were needed (r_s = +0.25, p<.05), coordinating schedules (r_s = +0.34, p<.01), and heavy administrative demands (r_s = +0.42, p<.01). We also observed that having a large professional network and a high proportion of foreign contacts were positively correlated with problems coordinating schedules (r_s = +0.21, p<.05) and heavy administrative demands (r_s = +0.19, p<.05), respectively. However, it is worth noting that research problems were linked more (in terms of the magnitude and the significance of the correlation

Table 4

Correlation Analysis for Productivity, Collaboration, Network, and Research Problems[1]

PROBLEMS[2]	HIJ[3,4]	TOTAL[3,4]	PN[5]	PNf[6]	RC[7]	RCf[8]
Problem contacting people when they are needed	0.09	0.00	0.01	0.18	0.15	0.25 *
Problem coordinating schedules	0.23 *	-0.09	0.21 *	0.01	0.18	0.34 **
Problem about length of time to get things done	0.19 *	-0.13 *	0.00	0.03	0.15	0.11
Problem of transmitting information	0.10	-0.03	-0.07	0.02	-0.13	-0.15
Problem of getting others to see your point	0.08	-0.08	-0.10	-0.04	-0.06	0.06
Problem about data management	-0.02	-0.04	-0.02	-0.06	-0.05	0.09
Problem about resolving conflicts	0.14	-0.06	0.16	-0.18	0.06	0.04
Problem about decisions on a division of work	0.13	0.04	0.01	0.06	0.04	0.05
Problem about heavy administrative demands	0.28 **	0.06	0.13	0.19 *	0.40 **	0.42 **
Problem about heavy teaching load	-0.04	0.00	-0.14	0.07	0.03	0.02

[1] Results are based on a set of one-tailed Spearman rank correlation analyses.

[2] Each of the research problem statements is measured on an ordinal scale ranging from 1-3 (1=no problem, 2=minor problem, 3=major problem)

[3] An asterisk (*) and a double asterisks (**) denote significance at the 5% and 1% level, respectively

[4] HIJ denotes no. of articles in high impact journals; TOTAL denotes no. of articles in HIJs and non-HIJs combined.

[5] Total network size (0-10)

[6] Proportion of alters who are foreign

[7] Total number of main projects with collaborators (0-3)

[8] Proportion of main projects with international collaborators

coefficients) with research collaborations than with professional networks. Also noteworthy is the positive correlation of problems coordinating schedules (r_s = +0.23, p<.05), about the length of time to get things done (r_s = +0.19 p<.05), and again heavy administrative demands (r_s = +0.28, p<.01) with HIJ productivity. In comparison to that of HIJ, TOTAL productivity was negatively correlated with problem about length of time to get things done (r_s = -0.13, p<.05), and was not significantly correlated with the remaining nine problem areas (Table 4). This implies that much of TOTAL productivity comprises publications in non-HIJs, which are not as demanding as HIJs in terms of scientists' attention, time, and resources. In our discussion section, we link all these findings together to come up with an understanding of how collaborations, networks, and conferencing relate with HIJ and TOTAL productivity.

DISCUSSION

Scientific Conferencing and Productivity

Attendance in scientific conferences appears to matter in publication productivity. This finding is consistent with that of Prpić (2000; 2002), who found this to be the case among young scientists in Croatia and who saw conference attendance as a potential productivity-leveler for female scientists as it was with women that conference attendance had the greatest impact. There is perhaps, a tacit element to conference attendance that brings studies of science to life, complete within the dimensions of their socio-cultural context. Thus, these studies become more fathomable, more situated in reality, and more comprehensible to emulate. However, our own results indicate no significant influence of conference attendance abroad on publication productivity. This runs contrary to our expectation that cosmopolitanism in scientific conferencing would lead to increased publications as a result of comments, critiques, feedback from; and interactions with prominent scholars who typically attend and grace such occasions by way of being discussants, moderators, presenters, and speakers.

So why was conference attendance abroad—our measure of cosmopolitanism in scientific conferencing—not a significant predictor of TOTAL and of HIJ productivity when the experience of traveling, of broadening one's perspective, and of meeting prominent scientists within one's discipline in a larger playing field might be many things at once, including inspirational and motivational (Babu & Singh, 1998; Prpić, 2002)? When such conference attendance abroad might even be an excellent opportunity to pool or gather resources? And when such conference attendance might provide the best opportunity of staying current on the hot topics in one's discipline, as well as the opportunity to be exposed to new techniques, and the latest developments?

In our earnest attempt to answer these questions, we provide four possible answers: (1) since most of the international conferences our respondents attended were either in Western Europe or in North America, it is possible that the amount of time and energy that go with such trips take away from the concentration and focus needed to come up with well-written manuscripts; (2) because majority of our respondents come from conservative cultures, interactions with international colleagues may not have been easier and more spontaneous compared to exchanges with local colleagues, who are the typical audience in local and domestic conferences; (3) yet another reason could be that the time involved preparing for international travels (e.g. visa application and processing) might have proven counterproductive. In other words, though there maybe advantages in meeting and exchanging ideas face-to-face with leading scholars at conferences abroad, these advantages may be actually less impacting compared with simply staying home and working in one's laboratory; and (4) still another reason derives from Merton's (1948/1968) assertion that a cosmopolitan outlook is the result of having traveled internationally. This implies that the influence of international scientific conferencing on productivity might be indirectly impacting—rather than directly which a regression analysis is fit to capture—publication productivity through international research collaborations, international professional networking, or both. However, the cross-sectional nature of our survey precludes us from pursuing and investigating this possibility. While previous studies point to the 'publication productivity enhancing effect' of international conference attendance, our findings suggest this result cannot be generalized across knowledge production sites and populations of knowledge producers.

Professional Networks and Productivity

Our investigation on the relationship between professional networks and publication productivity revealed the following: (1) TOTAL and HIJ productivity were not related to network size, and (2) high proportion of foreign contacts was strongly and positively associated with HIJ productivity, but not with TOTAL productivity. These results suggest that network diversity takes precedence over network size. While number of contacts is important, the diversity of contacts makes a significant contribution in the production of high quality output. Specifically, our findings indicate that the diversity of a network in the form of having more foreign (or international) contacts—our measure of cosmopolitanism in professional networks—may have meant having access to expertise, equipment, and resources. These are factors that are critical to the production of high-quality output (Baker & Zey-Ferrell, 1984). It is worthy to note that these constellations of contacts not only comprised experts and talented individuals, but were—at the same time—those whom our respondents considered and described as very close and well trusted confidants, equals, and friends; those who harbored affective and supportive sentiments toward our respondents.

When Merton (1968) examined the networks of cosmopolites, he noted that those were "wider," but smaller in number. In other words, this diversity implied that quality took precedent over quantity of relationships. In our respondents' case, these were the sets of informal professional relationships (e.g. contacts whose relationships with our respondents were described by the terms "buddies," "confidants," and "close friends" instead of "bosses," "managers," and "supervisors"). Indeed, Merton's cosmopolitan-influentials chose their friends as individuals with whom they could talk freely, and people with whom they had shared experiences (Baker & Zey-Ferrell, 1984; Merton, 1968). In our survey, we narrowed one's professional network down to the people (contacts) with whom our respondents could talk with about their research and matters important to their work, and whom they considered close friends and trusted confidants. Hence, our measure is similar to Merton's consideration of cosmopolitan networks in that it sought to encompass the community supportive of our respondents' research.

Although our measure only included the particularly cosmopolitan network variable, *proportion of foreign contacts*, our results alludes to the hypothesis that a cosmopolitan professional network characterized by affective and supportive ties provides a social support system that is conducive to the production of high-quality output. As one respondent in our qualitative interviews stated: "in doing cutting-edge research, you need someone to discuss with, to argue, to debate, and to bounce around ideas with. However, that individual cannot just be anyone. That individual should be someone whom you trust, and someone who will give you genuine and honest advice and feedback. Someone who is not afraid to let you know that your ideas, drafts, concepts, models have serious faults or are not well thought of; someone who sees you not as a competitor, but as a friend; and someone who is your staunch supporter and loyal advocate." Indeed, our results point to the importance of having close and strong ties far beyond the local—in our case, the international—in the production of high quality output.

Research Collaboration and Productivity

In the context of resource-constrained research system in a developing country, Ynalvez and Shrum (2011, p. 213) reported that "informal and non-structured professional network ties, and not the formal and structured collaborative groups, matter for publication productivity." While not a direct replication of that study, our findings—based on data collected in resource-rich research systems in three developed countries—revealed a strikingly similar pattern: that affective, informal, and non-structured relationships embedded in professional networks enhances productivity, more specifically HIJ productivity. In contrast, the instrumental, formal, and structured arrangement and interaction that characterize collaborative research groups appear not to be conducive to productivity, whether in terms of HIJ or TOTAL productivity.

Hence, the intriguing question is: what explains this relational pattern, which had been previously observed in *resource-constrained* research systems (Ynalvez & Shrum, 2011) and now in *resource-rich research systems*? Based on our correlation analysis, a possible explanation is the *productivity suppressing effect* (Lee & Bozeman, 2005) of research problems inherent in international collaborations such as contacting people when they are needed, coordinating schedules given different time zones, and heavy administrative demands. Although advances in information and communication technologies and social networking facilities (Lee & Bozeman, 2005; Ynalvez & Shrum, 2006) in tandem with the capacity of resource-rich research systems to acquire, to maintain, and to update these technologies may have made collaborating at a distance easier; it may not yet have made it that convenient and efficient.

Other challenges mentioned in the extant literature take the form of differences in culture, in disciplinary expectations and practices, and in proficiencies and skills (Katz & Martin, 1997; Cummings & Kiesler, 2005; Walsh & Maloney, 2007). Katz and Martin (1997) revealed a host of other difficulties made apparent by international collaborations including, but not limited to, financial costs, unpredictable costs in time, and increased cost of and need for administration. They also included differences in the perceptions of ethics, rewards, timelines, and values, and the fact that the formality and structure involved in these intercultural efforts sometimes limit the very creativity they are supposed to cultivate.

Cummings and Kiesler (2005), in their evaluation of research collaborations, found that multi-university efforts were problematic due to, not only a lower than typical use of coordination mechanisms, but to difficulties in aligning budgets, cultures, language, priorities, and rewards. These difficulties may have taken away from scientists the focus, dedication, and motivation needed to produce manuscripts that would make it to high quality outlets, or would be accepted for publication in a non-HIJ. Indeed, the challenges our respondents faced in collaborating with international and/or internationally-based colleagues, and the time-demand and workload involved in producing quality manuscripts may have combined to create a situation not conducive to publication productivity. For HIJ productivity, it could also be the case that since competition among scientists (e.g. laboratory to laboratory competition; or even Japanese versus U.S. scientists striving to get ahead of each other in publishing a 'breakthrough' finding in a prestigious journal such as *Nature* or *Science*) is very much a part of the knowledge production process, scientists might be more willing to share authorship and work with collaborators when it comes to publishing more mundane research findings, and might be more hesitant to work jointly and share authorship with collaborators when it comes to publishing potentially groundbreaking and transformative research findings. Hence, for innately competitive reasons (at the individual-, laboratory-, institutional, or even country level), scientists might prefer working closely with their professional networks than with their research collaborators.[10]

CONCLUSIONS

In this essay, we focused on how the articulation of cosmopolitanism in three spheres of scientific life (i.e., networking, collaborating, and conferencing) shape publication productivity among life scientists in Japan, Singapore, and Taiwan—countries in the non-West that are home to a cluster of economically strong, resource-rich, and scientifically productive knowledge generation sites. We observed that cosmopolitanism in one of the three spheres of scientific life we examined influenced the groundwork for high quality scientific output. Specifically, we found that cosmopolitanism in professional networks significantly enhanced HIJ productivity, while cosmopolitanism in collaboration and in conferencing did not. This finding is highly consistent with that reported by Ynalvez and Shrum (2011) wherein research collaboration and publication productivity among scientists in resource-constrained research systems were not linked.

The non-relationship between cosmopolitanism in scientific conferencing and HIJ productivity was unexpected. However, this is not to claim that conferencing in general and cosmopolitanism in conferencing in particular are not meaningful activities in scientific life and in publication productivity. Rather, we forward the hypothesis that scientific conferencing activities contribute indirectly to publication productivity by providing both the occasion and the opportunity for scientists to build, diversify, and strengthen their professional networks; and to be invited and involved in research collaborations. As reported by our respondents, getting to meet and being introduced face-to-face with other scientists come first in any collaborative or networking relationship. Indeed, initial face-to-face introduction and interaction are still important even in a time pervaded by digital communication technologies (e.g. *Adobe Connect, Facetime,* and *Skype*) and Internet-based social networking sites (e.g. *Facebook* and *MySpace*). Whether the importance of initial face-to-face meeting prior to any form of collaboration or networking has to do with the conservatism of the institutions we studied is yet to be examined by way of cross-cultural comparative studies.

Our findings further suggest that cosmopolitan scientific relationships—in terms the informal professional network ties—may be an important social support system in stimulating HIJ productivity. Specifically, a cosmopolitan orientation within the context of the informal and affective professional networks appears conducive to generating HIJ publications. This empirical finding derived from the front-line of knowledge production—the scientific research laboratory—carry implications on the importance of improving relationships among actors within scientific research systems. That is, scientists' informal support systems have the capacity to shape the production of quality scientific output. However, due to the nature of our data collection method and the size of our sample, we caution readers from deriving causal linkages among the activities and the outcomes we examined. At best, our findings point to new hypotheses that future researchers might pursue in greater depth and detail.

ENDNOTES

[1]Demarcation between 'localites' and 'cosmopolites' lies in their orientation. Localites mainly confine their interests to their community or organization, while the cosmopolites are significantly oriented toward the world outside their community or organization (Merton, 1968, Thompson & Tambyah, 1999).

[2]We define "HIJ" as journals in the life sciences with impact factor of at least 4.00. Although a subjective cut-off level, we argue, on the basis of our quantitative and qualitative interviews, that this cut-off value reasonably demarcates high-impact journals from low-impact journals in the life sciences. In addition, we define "TOTAL" as the total of HIJ and non-HIJ publications.

[3]Although there are other scientifically strong countries in the region such as China and South Korea, our choice of locations are mainly guided by the practical consideration of our having strong formal and informal ties in these countries with a long history of cooperation and trust. In our experience doing international social research, having strong and durable ties with individuals, who would act as local coordinators and dependable collaborators, is one

of the most important factors that determine the make or break of this type of research endeavor given the prevailing culture of conservatism and misgiving for strangers in the locations we studied.

[4]The linear and the quadratic terms of age were *mean-centered* (Field, 2009) to ensure that there was no correlation between these terms. No correlation between the linear and the quadratic terms is important because both were predictors in our regression models.

[5]The terms 'foreign contact/s' and 'foreign collaborator/s' mean contacts and collaborators who is/are based in a country different from where a particular respondent was based at the time of survey. And in this essay, the terms 'foreign contact/s' and 'foreign collaborator/s' mean the same thing as 'international contact/s' and 'international collaborator/s', respectively.

[6]The Games-Howell test accounts for unequal variances among populations being compared (Field, 2009).

[7]A competing alternative to the over-dispersed Poisson regression (OPR) is the negative binomial regression (NBR) approach (Coxe et al., 2009). In our case, the OPR was better at explaining variability of HIJ productivity. In addition, the magnitude of the over-dispersion was not at a level of severity that would warrant an NBR approach. In the case of TOTAL productivity, because the magnitude of over-dispersion was so severe that it could not be corrected by an OPR approach, we employed an NBR approach.

[8]The value 7.52 is calculated by way of the following expression: exp(B) = exp(2.017) = 7.520 (Coxe et al., 2009).

[9]Each of the 10 research problem items is measured on an ordinal scale ranging from 1-3 (1=no problem, 2=minor problem, 3=major problem).

[10]The history of science is rife with episodes of such competitions and conflicts (Lightman, 2005).

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