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ORIGINAL ARTICLE

An imagined future community: Taiwan Biobank, Taiwanese genome, and nation-building

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Abstract Based on the concept of an imagined future community, this article analyzes the relationship between the establishment of a national biobank (Taiwan Biobank) and nation-building. This article examines (1) the shift in state policy from pursuing a Sci-Tech Island to an Island of Biomedical Technology for the purpose of strengthening the national economy and Taiwan's global competitiveness in biomedicine, (2) the discourses about the uniqueness of the Taiwanese genome as a niche in the competitive global biomedical market, and (3) scientists' imaginary of the necessity of a national genetic project for the health of Taiwan's future generations. By exploring how the discourse of the Taiwanese genome as a niche has been constructed, this article reveals that life science and scientists' imaginary of the futurity who have played important roles in Taiwan's nation-building. We argue that the future imaginaries contained in the scientific discourse regarding Taiwan Biobank reflect the ideas of global scientific competition, connections between genetic distinctness and nationality, and the health of future generations in Taiwan.

Keywords National Biobank · Genetic technology · Futurity · Imaginary · Identity politics

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Introduction

In 2000, the mapping of the human genome for the first time revealed to the world that human beings are 99.9% the same. Yet, in the years since the completion of the Human Genome Project (HGP), the rapid increase in biobanks established along regional, national, and racial/ethnic lines has focused mainly on the genetic variations between human populations rather than on their similarities. In particular, national biobanks supported by the state have been portrayed as the repository of biological markers of a nation. Many countries have launched national biobanks, such as the Icelandic Health Sector Database, the UK Biobank, the Estonian Genome Project, Biobank Japan, the Korean Biobank, and so on.

On July 3, 2000, Academia Sinica, Taiwan's leading research institute, convened its 24th academicians' meeting, and the Academician Ming T. Tsuang proposed the establishment of a genetic database in Taiwan.[1] On October 24, 2012, Taiwan Biobank (hereafter TBB) was officially approved by the Ministry of Health and Welfare. The aim of TBB is to recruit citizens from the "four great ethnic groups" of Taiwan in order to build a national biobank. Focusing on TBB, this article aims to investigate the relationship between the establishment of TBB and the development of identity politics in Taiwan. We will address the following questions: What global and local historical contexts, social conditions, and political factors led to the emergence of the TBB project? Specifically, why do elite scientists claim the need for building a national-scale population biobank? What kinds of new imaginaries of Taiwanese identity have elite scientists enacted to advocate for the TBB project? Eventually, how does the scientific discourse on TBB shape the uniqueness of the Taiwanese genome and influence the formation of national identity?

In this article, building on literatures about nationalism and scientific imaginaries of futurity, we develop the concept of "imagined future community" to analyze the ways in which the national genetic project, TBB, has contributed to Taiwan's nation-building. This article examines (1) state policy shifts from pursuing a Sci-Tech Island to an Island of Biomedical Technology for the purpose of strengthening the national economy and Taiwan's global competitiveness in biomedicine, (2) the discourses about the uniqueness of the Taiwanese genome as a niche in the competitive global biomedical market, and (3) scientists' imaginary of the necessity of a national genetic project for the health of Taiwan's future generations. By exploring how the discourse of the Taiwanese genome as a niche has been constructed, this article reveals that life science and imaginaries of the futurity of scientists who

[1] The proposed work included the following: (1) to convene a conference of Taiwanese scientists, physicians, and ethicists to set up a plan for establishing a population genetic database in Taiwan; (2) to establish a population genetic database in Taiwan, which includes permanent DNA samples from all Taiwanese who agree to participate; (3) to make the population genetic database available to qualified researchers to study (a) the effects of gene variants on Taiwanese health and well-being, (b) the effects of gene variants on medication response, and (c) the genetic relationship of Taiwanese with other population groups; (4) to educate the Taiwanese about the genetic contribution to health and well- being, and (5) to study ethical issues raised by a population genetic database and its impact on the Taiwanese (Tsuang 2000).

have played important roles in Taiwan's nation-building. We argue that the futuristic imaginaries contained in the scientific discourse regarding the TBB reflect the ideas of global scientific competition, connections between genetic distinctness and nationality, and the health of future generations in Taiwan.

An imagined future community: national biobanks and nation-building

The development of national biobanks in the twenty-first century has important implications for the construction of national identity (Simpson 2000; Fletcher 2004; Busby and Martin 2006; Tsai 2010; Kuo 2011). After the HGP disclosed the draft genomic sequence and concomitant with the development of national biobanks around the world, biomedicine, with a renewed sense of scientific authority, has participated in the classification of populations. Rogers Brubaker (2015, pp. 48–84) uses the concept of "the return of biology" to describe this trend. Steven Epstein (2007) also demonstrates how the development of biomedicine has facilitated new understandings of social identity and difference based on the concept of "biopolitical paradigm."

This article will develop the concept of an imagined future community to analyze TBB, its related discourses, and the construction of national identity in Taiwan. We review the relevant literature addressing (1) the role of scientists and the notion of futurity in nation-building in the context of nationalism and (2) the role of imaginary in the field of science and technology studies (STS). Building on these perspectives, we will shed light on the complicated and intriguing relationship between national biobanks and national identity in particular, and science and politics in general, by taking up the case of TBB.

From imagined communities to imagined genetic communities

Benedict Anderson (1983), in his book *Imagined Community*, stressed the centrality of print technology and newspapers to the formation of the idea of nations. People speaking different local dialects became united through reading books and newspapers in a standardized ethnic language, thus creating an imagined community conveyed by the emergence of print capitalism. Bob Simpson (2000) introduced the idea of "imagined genetic community" to highlight the tremendous influence of genetic technology, which informs the imaginings of human sameness and difference and consequently the construction of collective identity. When national biobanks have flourished since 2000, well-established nation-states began to employ genetic technology to further strengthen their collective identity by re-asserting their genetic differences with other countries (Harrison and Johnson 2009, pp. 1–14; Arnason and Simpson 2003; Sleeboom-Faulkner 2006; Tupasela 2016). Some STS scholars have pointed out that new genetic technology creates new possibilities, facilitating the development not only of new knowledge, but also of new identities (Epstein 2007; Atkinson et al. 2007). Especially in the making of national biobanks, DNA markers

are used to construct imagined genetic communities in which nationality is continually being (re)made.

From the concept of imagined community to the concept of imagined genetic communities, STS research highlights two underdeveloped aspects in studies of nationalism, namely, futurity and scientists' role in nation-building.

First, the majority of the existing literature on nationalism places a great emphasis on the past, such as historical trauma or memories, in the discourse on nation and nationalism (Hobsbawm and Ranger 1983; Hroch 1996). When building imagined communities, many such studies have relied heavily on collective memory of the past. By contrast, the relationship of futurity to nation-building has been underdeveloped in nationalism studies. Many STS scholars have emphasized the essential role of futurity[2] in scientific development and knowledge-making, especially in the life sciences and genetic technologies, which is also manifested in the development of national biobanks (Martin et al. 2008; Adams et al. 2009; Fortun 2008; Sunder Rajan 2008; Tarkkala and Tupasela 2018). In this sense, while the construction of nationalism conventionally relied on political and cultural elites initiated through the reinvention of the history, in the post-genomic age, it is scientists who play an important role in constructing the nation through imagining the unique genetic profile of the national population for promoting national health and knowledge economy of the future.

On the one hand, in many national biobanks, national health of future generations has been imagined by scientists through a future-oriented scientific method (the so-called prospective cohort study).[3] On the other hand, branding the uniqueness of a national population for national biobanks is also often connected with nation-building and historical/cultural heritage to build a better future (Busby and Martin 2006; Fletcher 2004; Tarkkala 2019). For example, biobanks in Finland play an important role in activating the imaginary of future success in personalized medicine based on national population as a homogeneous isolate against its settlement history (Tarkkala 2019, pp. 62–86). By contrast, the UK Biobank employed population diversity, historical narrative, and cultural heritage of the British Isles to create the British vision of a shared future (Busby and Martin 2006, pp. 237–251). Similarly, the Estonia Genome Project (EGP) celebrated its heterogeneous population as representative of European populations, which is a niche to bring into being a prosperous future of the nation and helping Estonia's return to Europe (Fletcher 2004).

Second, studies of nationalism have depended heavily on language, history, culture, and ideology (Gellner 1983; Smith 1989; Hroch 1996; Chatterjee 1986) to build an "imagined community" (Anderson 1983), and they have been less focused

[2] Inspired by the literature, we use the term futurity instead of future to capture the interactions between past, present, and future. In other words, futurity does not just mean a particular moment in the future but also refers to dynamics and performativity that shapes the present in multiple ways. See more discussion in the Science, Imaginary, and Futurity section.

[3] Through the scientific method of prospective cohort study, TBB aims to record participants' health, disease, and lifestyle information for the long term as part of the infrastructure for medical and pharmaceutical research that could benefit future generations of national population. See more discussion in the section on Taiwan must have its own lab.

on the relationship between science, technology and nation-building, particularly the role of scientists in nation-building. In STS studies, by contrast, Warwick Anderson (2003) showed how ideas of whiteness in Australia were cultivated in medical discourse and emphasized the coproduction of racial science and imagined white Australian nation. He argued that the lab should be studied as a site where a nation could be imagined. In addition, Gottweis and Kim (2010) used the term "bionationalism" to illustrate the unreserved support of the Korean state towards Woo-Suk Hwang's lab, in which the idea of Koreans is scientifically redefined through the lens of stem cell research.[4]

As states collect biological samples from citizens through national biobanks, DNA markers become the foundation for imaging the contemporary nation-state (Simpson 2000; Hinterberger 2010). Facing the rise of "imagined genetic communities," the research has emphasized that we need new theoretical perspectives to investigate the affinity between the development of national biobanks and identity politics (Simpson 2000). However, neither genetic determinism nor social constructivism alone can sufficiently explain the trend. Brubaker addressed the approach of a "biosocial constructivism" to emphasize the social shaping of biological processes and, simultaneously, the biological shaping of social processes (2015, p. 84). Many STS studies have also suggested moving from extreme genetic determinism and social constructivism to a more systemic examination of how biology and society are coproduced (Jasanoff 2004; Epstein 2007; Fujimura et al. 2008; Ong 2016).

In fact, the increasing significance of national biobanks has formed a new basis for shaping the imagined future of the nation in the post-genomic era. In this article, we want to overcome these two major drawbacks in the existing research on nationalism by focusing on the notion of futurity rather than the past, and by highlighting the role of life science and genetic technology in nation-building rather than history, culture, language, and ideology, in order to bring attention to what we call an imagined future community. We attempt to develop the concept of imagined future community to point out the importance of the imaginaries of the future and the role of scientists in the construction of national identity through national biobanks such as TBB.

Science, imaginaries, and futurity

Since the mid-1990s, STS research has highlighted the influence of the imaginary on the development of scientific knowledge and new technologies, arguing that collective imaginaries play a large part in determining the trajectory of science and technological development (Fujimura 2003; Jasanoff and Kim 2009; Verran 1998;

[4] This bionationalistic support for Hwang was halted after Hwang's lab was embroiled in a scientific misconduct scandal in 2015. The scandal brought the Korean scientific community into worldwide discredit and also damaged the entire Korean biotechnology sector. In contrast to the previously unreserved support from the political and institutional realms, including public funding, loose legal and ethical governance, and the mobilization of female oocyte from the Korean society, this scandal shocked the political system, national self-esteem, and Korean identity (Gottweis and Kim 2010).

Fortun and Fortun 2005) .[5] In STS scholarship, discussions of imaginaries contain three noteworthy features:

First, the concept of imaginaries originates from the tradition of interpretative sociology. Scientific knowledge-making and practices are always imbued with implicit understandings of collective visions of a good society. Building on this tradition, Sheila Jasanoff and Sang-Hyun Kim developed the concept of "sociotechnical imaginaries," which refers to "collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects" (Jasanoff and Kim 2009, p. 120). Sociotechnical imaginaries direct visions of the normative, valuable, and desirable future for a political community, which can be achieved through scientific, technological, and political practices. Through these practices, the nation state is accordingly reimagined and reperformed (Jasanoff and Kim 2009).

Second, the concept of imaginary challenges the assumption of value-neutrality and the rationality of science. In particular, the development of biomedicine and genetic technology has involved continual debates and speculations on the value of life in the future. Through the concept of the political economy of hope, Carlos Novas (2006) argued that the hopes of patients' organizations about future possibilities inherent in science of the present drive the real investment in developing therapies of diseases. Nick Brown (2005) illustrated the reconnection of the regime of truth and the regime of hope. Although the outcomes of stem cell research remain unclear, through banking umbilical cord blood, future hopes for medical therapies could be imagined. In other words, biomedical research no longer depends solely on present-day evidence, proofs, or truths, but is involved in value-guided futurity. The abstraction of future hope has become an important pillar that sustains the debates of value and future imaginaries of life itself.

Third, the concept of imaginary challenges the dichotomy of actions and structure. Imaginaries are not just thoughts in someone's mind but reflect the worldview of specific actors (states/scientists) who are capable of performing imaginaries. Namely, imaginaries are future-oriented, but performative, and embedded within the political and cultural structure of specific societies. As Fujimura (2003) argued, crafting and imagining the future is a constitutive part of scientific work. In her research about how genomics and system biology were intertwined with scientists' imaginations of the Japanese nation and technology, Fujimura suggested that scientists' imaginations are not simply individual dreams but collective enterprises that engage many people, funds, governmental agencies, and researchers. Moreover, the concept of imaginary is defined as "a particular, often complex view of the world that shapes agendas, research trajectories, projects, and policies" (Smith 2009, p.

[5] There has also been growing literature on futurity in relation to technoscientific innovation in the past two decades, such as the sociology of expectations (Borup et al. 2006; Brown and Michael 2003), and studies about promise, anticipation or hope (Brown and Michael 2003; Hedgecoe and Martin 2003; Adams et al. 2009). Compared to the other future-oriented notions, the concept of imaginaries pays particular attention to how technoscientific futures are interconnected with political and cultural practices.

462). Scientists' position, network, and authority enact and further institutionalize particular sociotechnical imaginaries (Marcus 1995, pp. 1–10).

Our discussion above elaborates three significant dynamics contained in the concept of imaginary, which are imaginaries of social world (i.e., collectively imagined forms of social life and social order), value- guided futurity (i.e., debates on the values of life in the future), and institutionalization of scientists' imaginaries (i.e., within specific political structure that enables specific actors to perform and institutionalize sociotechnical imaginaries). In this article, we develop the concept of imagined future community, which is informed by these three interrelated dynamics, to analyze the future imaginaries of scientists contained in the scientific discourse about the TBB. We argue that the future-oriented values enacted by genetic technologies are equally significant, allowing scientists and relevant actors to promise a healthy population, economic prosperity, and national imaginaries, all of which constructs Taiwan as an imagined genetic community that shares a future collective fate in the post-genomic era.

Research method

This article is based on a qualitative multi-methods fieldwork approach (in-depth interviews and field observations) and discourse analysis. Firstly, the development and establishment of TBB were mainly initiated and put into practice by elite scientists. Hence, we interviewed the elite scientists who planned and promoted the establishment of TBB. Some of the scientists were interviewed several times in order to track how their visions evolved and were put into practiced as each stage developed (Stage 1 the pre-feasibility project, Stage 2 the feasibility project, Stage 3 the pilot study project, and Stage 4 the extension project of the pilot study). Furthermore, we also interviewed a few representatives from industry (e.g., Vita Genomics Inc., the Institute for Information Industry, and the Development Center for Biotechnology) who took part in the early evaluation of TBB's economic and industrial potential during the feasibility project of TBB. In addition, we had conducted participant-observation at recruitment orientations of TBB in cities such as Tainan, Chaiyi and Taichung to explore how TBB recruiters conveyed the benefits of TBB to the general public and we took this opportunity to contact and interview public participants.[6] During the course of the fieldwork between 2010 and 2018, we conducted over 50 tape-recorded interviews.

Secondly, this research also drew on archival research of primary and secondary documents. We collected (1) the original proposals of TBB and all the official reports on each stage of TBB which were kept by the Ministry of Science and

[6] We also interviewed social scientists who help establish the ethical and governance framework, and those who challenge the ELSI problems of TBB. However, scientists regarded the social scientists who critically debate on TBB as anti-science and irrational, resulting in the neglect of diverse values underlying public controversy, and in restrictions on innovative governance practices. In considering the main research questions and arguments of this article, we did not include the interviews with social scientists. More discussion can be seen in Lee and Tsai (2018).

Technology and the Ministry of Health and Welfare; (2) TBB's official websites of different stages; (3) videos and brochures texts used for recruitment, some of which were collected at the field site of recruitment orientations; and (4) the minutes of Academician meetings at Academia Sinica. We also relied on secondary documents as newspapers, magazines, media reports, and journal articles about TBB.

Imagining Taiwanese genome

In what follows, this article will analyze how scientists have gradually played a leading role in promoting biotechnological policies and legitimating the establishment of a national biobank through discourses of the economic transformation from the a Sci-Tech Island to an Island of Biomedical Technology, Taiwanese genome as a niche, and the vision of a healthy future generation in Taiwan.

Upgrading national economy from a Sci-Tech Island to an Island of Biomedical Technology

The changing role of scientists in the policy-making of biomedicine

The development of scientific technology in Taiwan can be divided into two stages: labor-intensive industry from 1952 to 1985 and technology-intensive industry thereafter. (Council for Economic Planning and Development 2002). The production of electronics and computer components has driven the Taiwan miracle over the past two decades. Since the mid-1980s, biotechnology and biomedicine have been regarded as the next engine of Taiwanese economic growth. As soon as the industries based on OEM could no longer be substantively developed, innovation-based biotechnologies would bring Taiwan's next economic miracle (Ministry of Science and Technology, Taiwan 2012). In 1982, the revised version of the Science and Technology Development Plan listed biotechnology as one of Eight Key Technologies in Taiwan.

Since the mid-1990s, the government of Taiwan has taken a more active stance on biotechnology in order to upgrade the economy. Several national programs to develop biomedical industry have been launched. The executive Yuan endorsed the Action Plan for Biotech Industry Development in 1995. In 1998, the Advanced Research in Genetic Medicine and Sanitation Plan (ARGMPS) was carried out. In 2000 and 2002, respectively, the National Research Program for Biopharmaceuticals and the National Research Program for Genomic Medicine (NRPGM) were initiated. Although the implementation of these national programs has not directly enhanced the development of the biomedical industry, these programs have built up the research capacity and infrastructure of biomedicine.

Taiwan was a developmental state during the Martial Law period from 1949 to 1987. At that time, the state apparatus and leading technocrats played a dominant role in directing the priorities of science and technology (Wang 2010). Accompanying the democratization of Taiwan in the 1990s, the developmental state gradually

lost its overwhelming power over economic and scientific development and gave way to a greater role for scientists. This is particularly true in the area of biomedicine involving frontier innovation and knowledge. Since the 1990s, several interdepartmental/interministerial dialogue platforms were organized by the government, such as The Science and Technology Advisory Group (STAG), the Strategy Review Board on Biotechnology (SRB), and the Bio Taiwan Committee (BTC), which form an important institutional condition for policy-making of biomedicine.

The Science and Technology Advisory Group (STAG), established in 1979, used to invite internationally reputed scientists to assess and give advice on technological policies to Taiwanese government. More discussion about biomedicine at STAG was only initiated after the 1990s.[7] Several leading scientists have played key roles in STAG in directing biomedical policies. For example, Yuan-Tseh Lee, the Nobel Laureate in Chemistry, who actively promoted biomedicine in Taiwan, was the head of STAG from 1999 until 2007.[8] Academicians in Life Sciences at Academia Sinica, such as Ding-Shinn Chen, Michael M. C. Lai, and Kenneth Kun-Yu Wu, were the members of the advisory board. Through their biomedical policy advice to the Executive Yuan, the proposal to establish TBB was decided to implement. A former Minister mentioned:

> In the STAG meetings, the invited scientists offer advice on technological policies…President Yuan-Tseh Lee brought up the idea of Taiwan Biobank… other STAG members also agreed that Taiwan needs a national biobank to facilitate biomedical research and the pharmaceutical industry. (Sep 2015 J2)[9]

To promote the biomedical industry, the government relies on the expertise and knowledge of scientists in the policy-making process. In order to coordinate policy recommendations of public sector officials and industry, the Executive Yuan convened the Strategy Review Board on Biotechnology (SRB) from 1997 to 2001.[10] The recommendations from the SRB were the major basis to promote and implement biomedical policies. Following the advice of the SRB, the Bio Taiwan Committee (BTC) has held annual meetings since 2004, which further institutionalized the consultation of experts and scientists on biomedical policy at the national level.[11] A scientist responsible for the establishment of TBB made the following statement:

[7] There were only a few subjects discussed in STAG relevant to biomedicine such as the prevention of Hepatitis B and biopharmaceutical industry.

[8] Lee participated the meetings of STAG in 1994, 1995, 1998, 1999, 2000, 2001, 2002, 2003, 2005, and 2007. The meeting was held annually with an exception of 2007. He was the head of STAG from 1999 to 2007 and Chi-Huey Wong was his successor, serving from 2008 to 2011. http://www.bost.ey.gov.tw/Content_List.aspx?n=F0558A90D837D63E (cited on October 28, 2015).

[9] "Sep 2015 J2" denotes that the interview with J2 in September 2015. See the interview list in the Appendix.

[10] In the SRB on biotechnology, 5 out of the 14 specialists who participated in the first SRB meeting in 1997 were Academicians of Academia Sinica.

[11] Please visit the official website of BOST. http://www.bost.ey.gov.tw/news.aspx?n=BBF2DDAD69A41B16&sms=E1CE7A91363ABB7D (cited on October 28, 2015).

> There has been a wider variety of interorganizational dialogue platforms to discuss the development of biotechnologies since the 1990s. It's been more democratic… Decisions are no longer made by a few elite technocrats. The government would listen to scientists in the kind of dialogue platforms. Taiwan Biobank was born in such an era. (Oct 2015 A)

With these dialogue platforms, the STAG, SRB and BTC consequently connected elite scientists as a network for policy-making in biomedicine. Scientists have had opportunities to persuade the government to invest in basic research. In 2005, the government announced the goal of transforming Taiwan into an Island of Biomedical Technology. The Island of Biomedical Technology Project was comprised of three elements: National Health Information Infrastructure, TBB, and Clinical Trial and Research System. This project could be seen as an effort of the state to construct an infrastructure for future biomedical innovation in Taiwan. As a scientist argued:

> We had a vision when we planned the Island of Biomedical Technology Project: Taiwan cannot rely solely on one industry. Many assembly companies have now moved to China…. Unlike Middle Eastern countries which have petrol, we don't have many natural resources. We need to use human brains to make the country develop. The biomedical industry is a knowledge intensive industry. We believe Taiwan can make it. (Oct 2015 A)

The development of TBB illustrates the cooperation of leading scientists and the state to develop the Island of Biomedical Technology Project. After the democratization in the 1990s, scientists started exercising considerable influence on biomedical policy-making by joining dialogue platforms responsible for the priority of development, distribution of funds, and investment infrastructure in Taiwan. Dialogue platforms such as STAG, SRB, and BTC formed the institutional conditions whereby scientists' imaginaries were able to be performed.

At the starting line, we shouldn't be left behind: the global race of national science

In the 1990s, the Taiwanese government recruited elite scientists from overseas, including Yuan-Tseh Lee, Cheng-wen Wu, and Michael M. C. Lai, to develop biomedicine in Taiwan using their international networks and expertise. Most significantly, Yuan-Tseh Lee returned to Taiwan in 1994 to work as the President of Academia Sinica from 1994 to 2006; he had a profound influence on the advancement of biomedical research. He made his vision clear at a conference in 1997: "Today (in Taiwan) we have information technology and electronic industries. I don't know how these industries are going to be in 100 years, but I know biotechnology will be there" (Lin 1997). In fact, most of the biomedicine-oriented research institutes at Academia Sinica, including the Institute of Biomedical Sciences, the Institute of Molecular Biology, and the Genomics Research Center, have developed since the early 1990s. The government positioned Academia Sinica as an important hub for facilitating knowledge innovation that could be channeled into the development of biomedicine.

The proposal to establish a Taiwanese genetic database was first raised by Academician Ming T. Tsuang at the 24th Academician' meeting in 2000. The development of a government-funded TBB went through four subsequent stages[12] before its official establishment in 2012. Since TBB's official launch, it has mainly been carried out by elite scientists at Academia Sinica. Two key aspects of scientists' imaginaries that legitimated the establishment of TBB are as follows:

First, scientists emphasized that Taiwan needs to catch up to the global competition of national biobanks in order to enhance both its international status and its international cooperation in science. As the report on the pilot study of TBB suggested, "many countries in America and Europe have started building large national biobanks… Taiwan needs to create a database for its own population. This database will not only facilitate research of its own but improve Taiwan's research on the international stage" (Taiwan Biobank 2011). The reports on the pilot study projects constantly argued that Taiwan should follow Iceland, the UK, Singapore, Japan, Latvia, and Germany to establish a national biobank with an emphasis on enhancing "international collaborations" and "Taiwan's national standing" (Chen 2006a, b, 2009, 2010). A noted medical researcher, for instance, argued:

> Establishing a national biobank is popular internationally. Taiwan made a rather late start. China is a large country; however, Taiwan is small. If we don't establish a national biobank now, we will never be competitive. We don't have our own (Taiwanese) genetic data. Without having our own genetic database, even if we have our original ideas, we can only do OEM in the future. (Dec 2012 H1)

As Yuan-Tseh Lee similarly argued, "If we don't work hard, we will be over in a few years. When functional genomics is fully explored by other countries, Taiwanese will become Filipino domestic workers" (Lee 2001). In the post-genomic period, Taiwan does not want to lag behind in the global race of biomedicine. A scientist made this remark: "Taiwan Biobank is the ticket to enter the global competition. If we don't build up the national biobank to collect Taiwanese data, we will definitely lose" (Oct 2016 G).

After Taiwan's expulsion from the United Nations in 1971, the problem of statehood has become an exceedingly thorny issue for Taiwan. Taiwan lost its membership in the World Health Organization (WHO), which has excluded Taiwan from having a voice in matters of global health and disease.[13] Taiwan has only

[12] Stage 1: the pre-feasibility project (from September to December 2003); Stage 2: the feasibility project (from August 2005 to July 2007); Stage 3: the preparatory phase of the establishment of Taiwan Biobank (the pilot study project, December 2005 to October 2010); and Stage 4: the extension project of the pilot study (from December 2010 to December 2011).

[13] Before 1971, China's representation by either the Republic of China and the Peoples Republic of China had been disputed in the UN. The UN once suggested that Chiang Kai-shek, the Kuomintang government (KMT) of the Republic of China, should change the name of the nation from China to Taiwan, which would allow the ROC using the name of Taiwan to stay in the UN. However, the KMT government refused to accept the concept of dual representation under a two Chinas option in the UN because it insisted on declaring itself the sole legitimate government of China. By contrast, the KMT government proposed that the UN should exclude the participation of Communist China. The Beijing government (the People's Republic of China) took over the seat of Taiwan on the UN Security Council.

been granted observer status at the annual WHO conference since 2009. A scientist lamented, "because of China's strong opposition, Taiwan can never join WHO. Even though Taiwanese research is constantly cited by WHO, we just cannot join it." (Nov 2016 H).

Due to diplomatic difficulties, the medical achievements of Taiwan are not fully recognized by WHO. However, scientists in Taiwan take the competitiveness in medical research, including that with TBB, as a means of opening up opportunities to join the global network of science and enhance international collaborations. On October 12, 2016, the Strategic Forum for Taiwan iPSC Research and Industrial Development: Current Progress and Future Directions[14] was held at Academia Sinica. Chen-Yang Shen, one of the leading TBB scientists, pointed out in that conference that Taiwan has been invited to become a member of Cancer MoonShot 2020. He said:

> Vice President Joe Biden officially announced that the Apollo consortium[15] in Cancer Moonshot will include Canada, China, Germany, Switzerland, Japan, and South Korea. Taiwan, without having official diplomatic relations with the United States, is also invited…Because the Republic of China establishes Taiwan Biobank which lays a great foundation, we are able to be invited to take part in Cancer MoonShot.[16]

The scientists' remarks above not only reflect the anxiety over Taiwan being left behind in the global competition of science and Taiwan being marginalized in the global community. Their comments also illustrate a vision of Taiwan's future in which the scientific reputation of biomedicine built from TBB elevates the scientific and diplomatic status of Taiwan

Second, TBB was regarded as the foundation for basic research and advancing the alignment from upstream to downstream of the biomedical industry in Taiwan. This kind of discourse could be seen in the projects of TBB which convinced the government to fund upstream basic research for biomedical innovation. A TBB scientist emphasized:

> If we want to develop biomedicine, we need basic research in order to stay innovative and creative. We should not copy others if we want to have the leading position in the field. I see Taiwan Biobank as an infrastructure with much potential. (Nov 2016 H)

Biomedical development which is knowledge intensive has to rely on national research institutes like Academia Sinica to lead the innovation. Thus, imaginaries of scientists at Academia Sinica have made TBB lean towards basic research. Elite scientists convinced the government to invest in basic research that could be converted into the knowledge economy in the future. Therefore, TBB is not purely a

[14] iPSC stands for induced pluripotent stem cells.

[15] APOLLO stands for Applied Proteogenomics Organizational Learning and Outcomes.

[16] Now the project is named Cancer Breakthroughs 2020. For more detail see http://www.cancermoonshot2020.org/home/ (accessed 29 October 2016).

scientific project, rather it is imagined with the hope of upgrading national economy and transforming Taiwan from its past of focusing on manufacturing (OEM) towards the future of knowledge economy. TBB was also envisioned with the purpose of boosting the development of biomedical knowledge and technology. In the background was elite scientists' fears that Taiwan would lag behind in global competition, all of which legitimated the government's support in basic research. The elite scientists' imaginaries in making and performing the desirable and attainable future are significant.

The identity politics of genetic uniqueness: Taiwanese genome and nation-building

In the post-war period until the 1980s, the concept of Taiwan was suppressed in education, culture, and even in academia. In the 1980s, the Taiwanese opposition movement cooperated with the aboriginal movement and began to challenge KMT's Chinese nationalism to rewrite the history of Taiwan. After a decade of indigenization and democratization in the 1990s, the notion of Taiwanese subjectivity[17] in politics has influenced the humanities and social sciences. For instance, the medical samples gathered in Taiwan were categorized as Chinese rather than Taiwanese in medical journals during the martial law period (1949–1987), but after the 1990s, the samples were classified as Taiwanese (Tsai 2014).[18] In this regard, the inclusion of Taiwan in the title of a national biobank (Taiwan Biobank) also shows new imaginaries of Taiwanese. In order to examine how recent trends in identity politics have shaped the TBB project, it is essential to understand scientists' imaginaries in the discourse of TBB, such as Taiwan must have its own lab, the four great ethnic groups are representative of Taiwanese unique genetic composition, and Taiwanese genetic attributes must enter the global arena.

Taiwan must have its own lab

In 1999, Cheng-Wen Wu, then President of Taiwan National Health Research Institutes, contended that Taiwan must have its own lab. He said:

> We need our own national biobank for our people. What is the genetic makeup of our aborigines? We do not even know. Also, we don't know very much

[17] Taiwanese subjectivity is based on a political and cultural discourse of Taiwan-centeredness through multiculturalism and Taiwanese nationalism to challenge Chinese nationalism and to establish the Taiwanese identity as an independent country.

[18] Tsai's research (2014) also points out that the scientific research regarding the rediscovery of Taiwanese ancestry and the genetic attributes of the Taiwanese appeared since the late 1990s after the martial law ended. She argues that the scientific knowledge produced in the lab has spilled over into the Taiwanese society in general through conferences, journals, media, and the like since the 1990s and brought about significant social impacts as part of the phenomena of the ethnicization of biomedicine and the biomedicalization of ethnicity. Furthermore, Liu (2010) also explored the construction of Taiwanese identity based on aboriginal genetic research to illustrate how the production of scientific knowledge is taken up in identity making and nation-building.

> about the association between genetic markers and the common diseases in Taiwan. We have to research it by ourselves […] we cannot expect the Americans to do it for us. (Lee and Yang 1999)

In his proposal of TBB, the Academician Ming T. Tsuang made the following statement in the Academicians Meeting in 2000. He emphasized:

> The complex history of migration to Taiwan has created a population with a gene pool that likely differs in some ways from that of other Asian countries… It (Taiwanese Human Genetic Database) would help us learn more about the population genetic structure, migration history of Taiwan, and the degree to which Taiwanese are genetically similar and different to other Asian populations. (Tsuang 2000)

Both Wu and Tsuang accentuated the genetic uniqueness of the Taiwanese population and the necessity of a Taiwanese lab. Their statements, in fact, resonated with the movement of indigenization or Taiwanization of politics and culture started in the 1990s (Makeham and Hsiau 2005). Over time, more people in Taiwan have come to identify themselves as Taiwanese rather than Chinese.[19] The imaginary of Taiwanese subjectivity accordingly has influenced the emergence of TBB in the 2000s.

On the basis of a prospective cohort study, TBB would identify participants' level of risk at the beginning of the study and follow them for 20 or 30 years. By recording the health information in sequence before diseases occur, rather than asking participants to remember events in the past, potential causes of diseases could be precisely identified. The Preliminary Feasibility Report on the Establishment of TBB highlights how prospective cohort methods can further overcome the problems inherent in traditional methods of conducting biomedical research, such as recall bias. As two TBB scientists argued:

> There are many ways of finding the etiology of diseases. One is to find a group of patients and look into their medical history. However, medical history is difficult to completely reconstruct. It is better to conduct longitudinal studies on a group of healthy people. This method cannot be made possible by any individual lab.…. (Feb 2011 C)
>
> A good national biobank needs to look at samples over time and keep samples from each clinical stage. For example, we have to collect samples from Stage 1, Stage 2, and Stage 3 of cancer. Taiwan also has high-quality medicine and national medical records. I believe Taiwan can do it. (Sep 2015 A)

In Taiwan, the household registration system was established in 1906 under Japanese rule and the system was computerized in 1997. The cancer registry and the collection of causes of death data were introduced in the 1990s. The National Health Insurance system was instituted in 1995 in which nationwide medical

[19] See the research conducted by the Election Study Center of National Chengchi University. (accessed on October 28, 2015).

records and the catastrophic illness registry were also established. These various records on health, disease, migration, and mobility of the Taiwanese population are regarded as an important infrastructure for TBB-related research. A TBB scientist made the following comment:

> Taiwan has the cancer registry, the stroke registry, and so on. Moreover, we issue catastrophic illness cards with a single criterion used nationwide…… Compared to other countries, our national biobank is competitive. (Oct 2015 A)

The ultimate goal of TBB is to collect blood samples and personal lifestyle information from 200,000 healthy participants and 100,000 participants with specific diseases, among people in Taiwan aged 30-70 and from the four great ethnic groups (Hoklo, Hakka, the Mainlanders, and aboriginal peoples) in Taiwan. As the proposal for the TBB shows, Taiwan's unique genetic ancestry as well as Taiwanese lifestyle and risk factors differ from other countries (Tsuang 2000). Two TBB scientists commented:

> If we simply apply the outcome of research based on foreign populations onto the Taiwanese, it is probably not going to work. For example, nasopharyngeal cancer is rare in Europe and North America, but it is common among the Han population in Southern China and Southeastern Asia. If European and North American countries want to work on nasopharyngeal cancer to find out its cause and prevention, they will definitely fail. So, we need our national biobank. (Oct 2015 A)
>
> The genetic inheritance of Taiwanese is unique. We are Han Chinese, but the genetic makeup of Taiwanese is different from that of Chinese in China. Taiwanese differ from other Asian people too. Taiwanese are rather of a unique ethnic group. We have the genetic mixture of Dutch and Spaniards. We are close to Austronesian people. We need our genetic databases. It will help us understand the biological markers of our own people more thoroughly. (Dec 2012 H1)

Ruha Benjamin (2009) pointed out that it has become an important mission for postcolonial countries to assert their genomic sovereignty and to create "a lab of our own." Those postcolonial states brand their national populations as biologically distinct from other nations. They promise public health, scientific progress, and an economic niche by supporting their own genomic sovereignty. The TBB as a national project likewise promises a lab of its own and validation of its genetic distinctiveness, which is connected to a broad set of political and cultural transformations, particularly the emergence of Taiwanese subjectivity over the last three decades or so. It is not difficult to find such postcolonial inclinations in the arguments of TBB scientists, such as "Taiwanese study Taiwanese genes," "Taiwanese explore Taiwanese illness," and "Taiwanese work on the health of Taiwan's next generation." TBB as a scientific project has thus also created a collective future imaginary and a sense of identity for Taiwanese.

The four great ethnic groups are representative of the Taiwanese genome

The aim of TBB is to recruit Taiwanese people from the four great ethnic groups. In fact, the concepts of race and ethnicity were discussed in the initial stages of building TBB. At the 24th Academicians Meeting in 2000, Academician Ming T. Tsuang stressed, the DNA donations should be selected in proportion to the number of each of the four great ethnic groups, namely, Hoklo, Hakka, the Mainlanders, and aboriginal peoples (Yang 2000).

This announcement provoked different reactions. Some academicians pointed out that genetic data might be used to argue that one racial group had a biological edge over another. The potential abuse of genetic data and consequent discrimination were also of concerns to many Academicians in that meeting. Chen-Ning Yang, Nobel Prize Laureate in Physics, suggested that researchers in Life Sciences should be more sensitive in dealing with genetic differences. He asked academicians in life sciences to explain how large the genetic differences among human populations were. Academician Jacqueline Whang-Peng argued that the term "race" was itself contentious, so race could be replaced by individual difference (Chang 2000a). In response, Kun-Yu Wu, the chief of the ARGMSP, seconded Whang-Peng's contention that the genetic database should be used only for disease research, not for ethnic studies, in order to steer away from the thorny issue of race-related political disputes. (Chang 2000b). The Academician Chien-Jen Chen contended that, since ethnic composition of Taiwan is complicated in Taiwan, the differences found in genetic databases may help linguistic, cultural, and ethnic studies (Yang 2000). The day after the Academicians' Meeting, mainstream newspapers in Taiwan similarly questioned the validity of ethnic categorization. The headline in the China Times read, "Whose Genes Are Representative of Taiwanese?" Some journalists had evidently sensed the danger of applying four great ethnic groups to the study of Taiwan's genetic profile. In spite of some concerns, the proposed TBB was soon approved in the subsequent meetings.

In fact, the concept of the four great ethnic groups had already become widely accepted in Taiwan after the change of identity politics in the 1990s.[20] Since TBB began recruiting citizens from the four great ethnic groups in Taiwan, scientists have argued that the concept of ethnicity in TBB can serve as a surrogate concept for the development of personalized medicine in the future. Two leading scientists of TBB, Yuan-Tsong Chen and the aforementioned Chen-Yang Shen, published a statement in *China Times* calling for public support of the TBB project, mentioning that:

> If we want to understand how genes influence genetic attributes and gene-related diseases in Taiwan, the most important factor is the ethnic group, that is, the Hoklo, the Hakka, the Mainlanders, and the aboriginal people. Different ethnic groups probably have different genes…. representative of each of the great ethnic groups that can be collected in three different areas in Taiwan. (Chen and Shen 2006)

[20] See the related discussion of Hsiau (2000) and Wang (2005) for more details.

TBB only recruits the Republic of China (ROC) citizens based on the four great ethnic groups. Residents in Taiwan with foreign ancestry or without ROC citizenship have been excluded. In July 2016, scientists working for TBB mentioned to us that, "TBB will recruit new immigrants, that is, foreign brides,[21] who possess an ROC citizenship ID …when [our plan to do so] passes IRB in the future." In other words, the recruiting strategy mentioned above represents the central aim of TBB, which was to benefit the health of the next generation in Taiwan, including the descents of new immigrants. So far, TBB has only recruited new immigrants from China possessing an ROC citizenship ID.

Taiwan is an immigrant and multi-ethnic society. The original domicile system was introduced by the Kuomintang (KMT, also named as the Chinese Nationalist Party) in the late 1940s. Under this system, every resident in Taiwan had his/her geographic origins in China. Taiwan Province was only one of 35 provinces in China. In the early 1990s, anti-KMT activists began to create the concept of four great ethnic groups under the framework of Taiwanese nationalism. In 1993, the concept first appeared in a proposal made by Ju-Lan Ye, a legislator from the Democratic Progressive Party. The change of identity politics in Taiwan since the 1990s, including the emergence of the concept of four great ethnic groups, multiculturalism, and Taiwanese nationalism, has led the Chinese original provincial background" (1945-1994) to be changed to the classification of citizens' background based on Taiwanese four great ethnic groups" (1994- present) under the framework of Taiwanese nationalism. Thus, the current classification of four great ethnic groups is a social construction instituted since the 1990s in Taiwan. The new classification was intended to build a new national identity.

As one of the new imaginaries of Taiwanese implicated in the development of TBB, scientific research regarding human classification of biological samples also shifted from the category of Chinese to Taiwanese in the 1990s. The examination of TBB's scientific discourse shows that imaginaries such as Taiwan must have its own lab, the four great ethnic groups are representative of the Taiwanese unique genetic composition, and Taiwanese genetics must enter the global arena (see details below) are deeply embedded in the context of identity politics characterized by advocacy of Taiwanese subjectivity, multiculturalism, and Taiwanese nationalism since the 1990s.

The imaginary of the Taiwanese genome must enter the global arena: Taiwanese, Han Chinese, or Asian?

The development of national biobanks is not just intertwined with national histories and ethnic politics but is also involved in the regional and global competition of

[21] The new immigrants refers to a group of new residents who have either migrated to Taiwan or intermarried with local Taiwanese. Foreign brides means those who originated mainly from certain countries in Asia, such as China, Indonesia, Thailand, Vietnam, Thailand, and Philippines since the 1990s, which form the majority of new immigrants. From foreign brides to new immigrants, this illustrates social and political attempts to conceal the potential stigma inherent in the term foreign brides and to recognize them as part of Taiwan.

science and economy. As analyzed above, TBB is closely connected with identity politics and Taiwanese subjectivity. However, when considering the niche of Taiwan's genome in the global pharmaceutical market, the argument that it could represent Han Chinese and even Asian populations was emphasized. The establishment of TBB was then expected to serve as the supply hub of Han Chinese or greater Asian genomic data (Academia Sinica 2007). In this regard, we can see scientists' imaginary to identify the niche of Taiwanese genome in the global pharmaceutical market.

When the initial draft of the HGP was completed, many biomedical companies with interest in Asian populations, for example, Vita Genomics, established in Taiwan in 2001, collaborated with Celera Genomics, a US company, to focus on single-nucleotide polymorphisms (SNPs) of Asian populations in order to explore the populations' susceptibility to specific diseases and responses to certain drugs. Its director, Ellson Chen, argued that: "western drug companies mostly concentrate on diseases common in the West … this has left a gap … even diseases common around the world could have different relevant SNPs in Asian populations" (Cyranoski 2002, p. 27).

In his imaginaries of "mining the genetic gold in Asia" (Biotech East 2001), Ellson Chen argued that the Taiwanese population is the key for imagining a greater Han Chinese market. In our interview, he pointed out: "When Chiang Kia-Shek and his two-million strong Nationalist (KMT) army lost China's civil war in 1949, they retreated to Taiwan, unwittingly creating the perfect environment for genetic research… Han Chinese is the single biggest ethnic group in the world. If there is any research coming out with particular results representative of Han Chinese, it would create tremendous opportunities for well-being and business." Taking up the uniqueness of the Taiwanese genome, Vita Genomics envisioned Taiwan surpassing China by taking advantage of being representative of the whole Han Chinese population. Chen also sees the collaboration with Celera Genomics as a chance for Taiwan to be a hub of biomedical research in Asia and eventually a great opportunity for Taiwan to go global. He was thus described by Biotech East (2001) as someone who "dreams of building a company that will secure Taiwan's place in the worldwide biotech science."

A former administrator of the Biotechnology and Pharmaceutical Industries Promotion Office of the Ministry of Economic Affairs argued that:

> The original project of TBB contained an ideology of Taiwanese provincialism. However, it is impossible to develop biopharmaceutical industries simply for only twenty million Taiwanese… that's why I said that Vita Genomics is not going to work solely on the Taiwanese but instead on Asian populations. (Mar 2011 K2)

Indeed, most discourse on TBB maintained the importance of making Taiwan into a genomic lab of and for Taiwanese, but assertions of the close relationship between the Taiwanese and Chinese populations could also be heard throughout the organizing period of TBB. For instance, the official report on the pilot study pointed out: "the population in Taiwan is representative of the Han Chinese people around the world. It would attract investments from international pharmaceutical companies

and serve as a convenient path for those companies to enter the Chinese market. TBB will overall ensure the leading position of Taiwan in the regional and even global market (Chen et al. 2006, pp. 17–18)." A leading TBB scientist shared with us his vision of making Taiwan a Han Chinese genomic hub:

> With the massive migration in 1949, we can find many Chinese ethnic groups in Taiwan … we started the project with an idea to apply the information of our samples (collected in Taiwan) onto China. Biomedical industries of many countries are interested in expanding their business in China, the biggest market in the world. However, China is not fully developed yet (when it comes to biotechnological research). Investors will definitely look towards the information of Taiwan before they enter the Han Chinese market. (Oct 2012 C)

As Joseph Wong (2005) argued, the political economic rise of China is both a threat to and an opportunity for Taiwan. On the one hand, Taiwan is concerned about its growing dependence on the Chinese economy, which could weaken its political independence. On the other hand, its close relationship with China could offer a strategic gateway into the Chinese biotech market, offering advantages over other emerging competitors, such as Singapore, Japan, and South Korea (Wong 2005). Regarding this dilemma, scientists positioned TBB as a biorepository of Han Chinese or Asian populations to target the global market. Simultaneously, they also regarded various robust health record systems as the infrastructure on which Taiwan could develop a national biobank that is more competitive than China's. Two TBB scientists argued:

> Taiwan is very competitive. We have the best epidemiologists. When it comes to environmental detection, we are far ahead. We have the best national health records. It is not easy for China to follow up their population and come up with decent health outcomes. (Oct 2015 A)
>
> Taiwan has a more manageable population, 23 million. The population in China is too huge to track, while that of Singapore is too small. In comparison with China, Taiwan has lower rates of migration. We also have excellent systems of household registration and records of the NHI which allow us to track the population. I believe our quality [sic] is much better than China. Taiwan needs innovation in order to stand out. We need to generate knowledge-based technology or products. If we don't have them, we are done. (Nov 2016 H)

At the international Biotechnology and Pharmaceutical Conference in 2001, Yuan-Tseh Lee announced the plan to establish the Genomics Research Center to research diseases common in Asia (Gong 2001). Furthermore, the Report of the Establishment of TBB emphasized the TBB's potential to become the leading biorepository of the Chinese population worldwide and the center of biomedical development in Asia.[22] Numerous claims were made that the population of Taiwan is largely

[22] To illustrate the promising nature of the Taiwanese population at the global level of bioeconomy, the example of Stevens-Johnson Syndrome (SJS) was often invoked. Yuan-Tsong Chen, the leading scientist of TBB, published an article, "Medical genetics: a marker for Stevens-Johnson syndrome" in Nature with his colleagues in 2004 (Chung et al. 2004). That article shows there is a strong association in Han Chinese between a genetic marker, HLA-B*1502, and SJS induced by carbamazepine, a drug commonly

representative of the much greater Han Chinese population, thus providing Taiwanese scientists with an entry point into Asia and even global pharmaceutical markets.

What we examined above shows how contemporary narratives of Taiwanese history shape scientists' imaginaries. On the one hand, TBB scientists believe that Taiwan has a rich diversity of Chinese ethnic groups, representing a whole spectrum of Chinese genetic attributes, with one million Chinese migrating to Taiwan after 1949. Therefore, research about Taiwanese genetic makeup can apply to Han Chinese. On the other hand, Taiwan has a complicated colonial history with the Netherlands, Qing Dynasty, and Japan, and it has started recognizing the existence of foreign brides who arrived from Southeastern Asia after the 1990s. This demographic complexity makes TBB scientists argue that Taiwan could become a pivotal center for biomedical research in Asia.

From Taiwanese to Han Chinese or Asians, a shared market in which Taiwan wants to have a lead has been imagined. For TBB scientists, it remains their concern to find out the genetic similarities and differences between Taiwanese and other populations, such as Han Chinese, Asians, and Caucasians. The uniqueness of the Taiwanese Genome claimed by TBB scientists is not fixed, but strategically yoked with scientific, political, economic, and sociocultural imaginaries. The niche of the Taiwanese genome involved in the scientific discourse of TBB intricately interacts with Taiwanese subjectivity, national competition, and the regional and global race, for scientific and economic success.[23] The imaginary of futurity of TBB scientists not only shapes scientific development, but also echoes the changing narrative of Taiwanese history in Taiwan since the 1990s.

Scientists recruit Taiwanese with the discourse for a healthier future generation

The qualities of national populations have been the primary concern of the biopolitical governance of modern states. In the post-war period, the Taiwanese government introduced family planning in the 1960s and the Eugenic Health Law in 1984. The emergence of TBB, in turn, brings Taiwan novel prospects for the future governance of the national population. Scientists have promoted the perspective that TBB-driven preventive medicine would bring well-being to the next generation of Taiwanese.

Footnote 22 (continued)
prescribed for the treatment of seizure disorders. The biological samples used in the research were collected in Taiwan, but the conclusion of that article refers to the Chinese population around the world. Accordingly, the FDA of the United States, based on the conclusion of this article, recommended genotyping all Asians before the prescription of carbamazepine, to avoid medical risk (Ferrell and Mcleod 2008). It constitutes distinct Han Chinese bodies or Asian bodies through Taiwanese ones and mobilizes the Taiwanese into both global and local domains as a good population and a valuable resource.

[23] We are not going to examine the human classification in biomedical research. However, many STS studies have pointed out that human classification, in terms of race, ethnicity, and nationality in science is not pure science but is deeply rooted in the social, cultural, and political context (Duster 2005; Epstein 2007; Fujimura et al. 2008; Goodman 2000). The human classification in biomedical research is always politically referential (Bliss 2012, p. 204).

As TBB scientist Chen-Yang Shen argued in his article, "Taiwan Biobank and its Purposes," the establishment of TBB is not for the contemporary generation, but aims to enhance the health of future generations and to build up the research resources for scientists of the next generation (Shen 2010). This rhetoric manifests how scientists imagine the desirable and attainable future of Taiwan. However, to carry out the envisioned future relies on the participation of Taiwanese, namely, the successful recruitment of the prospective amount of the national population.

For most national biobanks, participants should be healthy volunteers and future research conducted with participants' samples will not have direct effects on them. Hence, this poses new challenges for scientists in terms of how to invite the public to participate in national biobanks. Busby and Martin (2006) argued that the imagination and emotion of nationalism brought out in Anderson's concept "imagined communities" would be crucial to the success of recruitment efforts by national biobanks. Going beyond the traditional references to illness, risk, and relationships with clinicians, the recruitment of the UK Biobank appeals to a common history and culture that encompass notions of citizenship and nationhood (Busby and Martin 2006, p. 247).

In a similar vein, the core theme of TBB's recruitment is "to invite Taiwanese to make a healthy future generation," which makes the establishment of TBB a collective effort of the nation. For example, the official website of TBB shows that "building a new and healthy generation needs all of our contribution."[24] Printed brochures also state that "through the efforts of TBB, we can make a key to health that only belongs to Taiwanese." TBB invites the public to promote a healthier future for the next generation, as long as you are a Taiwanese citizen. A national biobank, therefore, provides a way for citizens to become involved in making a shared future.

Since its establishment in February 2019, TBB has recruited 109,059 participants. As the personnel responsible for recruitment described in interviews with us, there are still a lot of people who have voluntarily registered on the list and are waiting to join TBB. A scientist also mentioned the high willingness of Taiwanese to participate: "My American colleagues wanted to visit Taiwan to see how we persuade so many volunteers. But it's not to my credit. We have informed the participants that they will not get any immediate benefits … It is Taiwanese who are willing to participate due to the spirit of altruism. (Oct 2015 A)"

As Prainsack and Buyx (2011, p. 59) suggested, a recruitment approach based on solidarity reflects a collective commitment or shared goals that encourage the public to make voluntary contributions, even if participation does not produce immediate benefits and contains potential risks. Appeals of altruism and social responsibility were manifest in the recruitment rhetoric of TBB. For example, a TBB recruitment video was released in 2013 with the slogan: "The best things should be kept for children. Let us work together for a healthier Taiwan."[25] Videos for recruitment usually

[24] Taiwan Biobank, Latest News. http://www.twBiobank.org.tw/new_web/news.php?article_option=news&article_add= (accessed on October 26, 2015).

[25] Taiwan Biobank, Recruiting Videos: the Seeds and the Best https://www.youtube.com/watch?v=Xkg_hXJrlhk (accessed on October 26, 2015) (Taiwan Biobank 2013).

end with phrases such as "[in] taking only 2 h, the health of the next generation in Taiwan will be changed because of you."[26] The imagery of the family or appealing to emotions—"for the next generations"—are both aimed at evoking a sense of perpetuating social values in Taiwan.

In other words, the recruitment strategies used by national biobanks usually reflect the cultural values of a given nation. For recruitment, UK Biobank has taken advantage of the solidarity and reciprocity traditions of Great Britain, built up through the system of blood donation and the National Health Service, which celebrates the cultural diversity of Britain to consolidate the national identity (Busby and Martin 2006). When it comes to Taiwan, participants are constituted as altruistic subjects with the prevailing social value of Zuo Gong De which is a religious term from Buddhism that means Do Good Deeds. As one leading TBB scientist pointed out to us, "the public has been very supportive, and for this we are extremely thankful; every sample donated is an act of altruism, or, in the local language, it's Zuo Gong De … they do good deeds to help with the establishment of a national biobank for the next generation. The public support makes our recruitment go very smoothly" (Mar 2011 J2)

According to our fieldwork, the imaginary of "contributing to the next generation" and the cultural metaphor Zuo Gong De are actually perceived by participants as the main reason to join TBB. An official survey of TBB participants revealed that about 70% joined TBB due to "recognizing the research purpose of TBB" with altruistic phrases like "to help Taiwan's medical research," "it's Zuo Gong De," "benefit other people as well as oneself" and "to understand the causes of disease to benefit future generations."[27] TBB participants, who we talked to during TBB recruitment orientations, also reported to us:

> The set-up of Taiwan Biobank is meaningful. I believe that eventually this could help Taiwanese to know better about their genetic makeup. I have children. I think to have longitudinal health information could help Taiwan's future generation. (Oct 2016 R3)
>
> I think this will benefit our next generation. They (TBB) will follow up on us for a lifetime. Based on this data, there will be drugs innovated for particular diseases. We are ordinary people. We don't have anything to contribute to our society. I'm happy to take part in the national biobank. (Feb 2016 R1)
>
> My wife and I are community volunteers. When they (TBB) came to introduce us this project and talked about health and diseases, we felt that maybe we could Zuo Gong De for the next generation. We asked our son and daughter-in-law, and they are also willing to participate. (Feb 2016 R2)

The participants' motivations to join TBB are closely related to the recruitment strategy which calls on Taiwanese to work together for a healthy generation. Taiwanese

[26] Taiwan Biobank, Latest News, http://www.twBiobank.org.tw/new_web/news.php?article_option=news&article_add= (accessed on October 26, 2015).

[27] See the unpublished results of the participant satisfaction survey administered by TBB in September 2016.

are thus enrolled in the shared future enacted by TBB. This discourse has the potential to build common imaginaries and emotions of Taiwanese as an imagined future community.

In the post-genomic era, the emergence of national biobanks illustrates how science takes part in the attempt of contemporary states to govern the quality of national populations. In order to recruit the national population, an imaginary of for-a healthier-future-generation envisaged in TBB has been constructed where scientists, the nation, and recruited citizens work together to take responsibility for this shared future. The imaginary is situated within specific political and geographic boundaries, as Benedict Anderson's imagined communities suggests, referring to citizens who live in Taiwan with similar diets, environments, a shared genetic heritage, and a common future. Through the development of a national biobank, Taiwanese is constructed as an imagined genetic community with shared fate and future.

Conclusion

Based on the concept of an imagined future community, this article analyzes the relationship between the establishment of a national biobank and nation-building in Taiwan. We have argued that the imaginaries of scientists have played an increasingly important role in nation-building in the post-genomic era.

First, we examined the institutional conditions under which scientists' imaginaries were able to be practiced. Since the democratizing decade of the 1990s, the Taiwanese government has established interministerial dialogue platforms, where internationally reputed scientists could join in decision-making processes regarding science and technology policy and exercise their influence by promoting innovative basic biomedical research, with a view to upgrading the national economy amid the globalizing competition in the knowledge economy. By promoting TBB, scientists' imaginaries have brought home the importance of basic research to the government and shaped directions and priorities of policy-making in science and technological development.

Second, advocacy of the notion of Taiwanese subjectivity in politics since the late 1980s has influenced the humanities, social sciences, and natural sciences. The human classification emphasizing Taiwanese identity (rather than Chinese identity) has shaped the knowledge-making of such scientific projects as TBB.

Such imaginaries in TBB as Taiwan must have its own lab, the four great ethnic groups are representative of Taiwan's unique genetic composition, and Taiwanese genetic attributes must enter the global arena and the like are deeply embedded in the context of identity politics, characterized by the advocacy of Taiwanese subjectivity, multiculturalism, and inclusive treatment of new immigrants since the 1990s.

Third, an imaginary of for a healthier future-generation in scientific discourse has been constructed. In this imaginary, scientists and the nation work together to bear the responsibility of creating a healthier future generation and developing a vision for the future shared by the Taiwanese people. TBB, in the recruitment of participants, focuses on the unreserved dedication of the Taiwanese people to the next generation in Taiwan. It uses the well-known cultural metaphor Do Good Deeds

to encourage the public to participate in the project. The idea that Taiwanese must work together to face future threats to their health and well-being, because they share common genes and a unique island environment, contributes much to calls for a collective sense of imagined community and its common destiny in terms of responsibilities and obligations to future generations of Taiwanese.

The idea of imagined communities, associated with the rise of nation-states in the eighteenth century, was the co-work of political and cultural elites. The emergence of imagined genetic communities could be seen as a collaboration between scientific elites and nation-states in the twenty-first century. The imagined genetic communities that have emerged with the rise of national biobanks are a construct of the uniqueness of biological markers linked to national populations, which manifests the biopolitics of genetic uniqueness in the development of biomedicine. Our analysis of TBB overturns the dichotomy of genetic essentialism and sociocultural constructivism. The imaginaries of scientists are not purely scientific. The emergence of an imagined future community represents the coproduction of science, technology, and society, the Taiwanese genome, and identity politics of nation-building in Taiwan.

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Appendix: The interview list

Interviewee	Background	Interview date
Scientist A	Genetics, Epidemiology	November 2012 October 2015
Scientist B	Biomedicine, Immunology	October 2015 August 2016
Scientist C	Genomic Medicine, Epidemiology	February 2011 October 2012 September 2015 August 2016
Scientist D	Genomic Medicine, Epidemiology	March 2011
Scientist E	Genomic Medicine, Immunology	September 2012
Scientist F	Genomic Medicine, Epidemiology	January 2013
Scientist G	Statistical Genetics, Epidemiology	October 2016
Scientist H	Biomedicine, Internal medicine	November 2016
Clinician H1	TBB Advisory Committee Member, Public Health, Epidemiology	December 2012
Clinician H2	TBB Advisory Committee Member, Public Health, Epidemiology	November 2012

Interviewee	Background	Interview date
Clinician H1	EGC member, Genetics	January 2011
Clinician H2	EGC member, Community Medicine Practitioner	March 2011 December 2012
Administrator J1	Former Ministry of Health, Hospital Director	January 2013 October 2015
Administrator J2	Former Official of the Ministry of Health, Researcher of National Research Program for Biopharmaceuticals	March 2011 September 2015 January 2016 November 2016
Administrator J3	Researcher of the Department of Technology and Development, the Ministry of Health	November 2016
Administrator J4	Former Official of the Biotechnology, Health, Medicine and Agriculture Division of the BOST, Executive Yuan	October 2016
Industry Representative K1	Industry Representative in TBB, Former Official of the Ministry of Economic Affairs, Microbiology	March 2011 September 2015
Industry Representative K2	Industry Representative in TBB. President of a Genomic Medicine	March 2011 October 2012 August 2016
Industry Representative K3	Principal Engineer of the TBB Information Platform, Former Researcher of the Institute for Information Industry	March 2011 July 2016
Public Participant R1	From Chaiyi	February 2016
Public Participant R2	From Chaiyi	February 2016
Public Participant R3	From HsinChu	October 2016

References

Academia Sinica. 2007. The Taiwan Biobank Project: For the Health of Future Generations. *Academia Sinica E-news*, April 19. http://newsletter.sinica.edu.tw/en/file/file/1/125.pdf. Accessed Oct 2017. (in Chinese).

Adams, V., M. Murphy, and A. Clarke. 2009. Anticipation: Technoscience, Life, Affect, Temporality. *Subjectivity* 28: 246–265.

Anderson, B. 1983. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. London: Verso.

Anderson, W. 2003. *The Cultivation of Whiteness: Science, Health, and Racial Destiny in Australia*. New York: Basic Book.

Arnason, A., and B. Simpson. 2003. Refractions Through Culture: The New Genomics in Iceland. *Ethnos* 68 (4): 533–553.

Atkinson, P., P. Glasber, and H. Greenslade. 2007. *New Genetics, New Identites*. New York: Routledge.

Benjamin, R. 2009. A Lab of Their Own: Genomic Sovereignty as Post Colonial Science Policy. *Policy and Society* 28: 341–355.

Biotech East. 2001. Vita Genomics Ready to Mind the Genetic Gold in Asia. August 10, http://www.biotecheast.com/modules.php?op=modload&name=News&file=article&sid=785&mode=thread&order=0&thold=0&topic=3. Accessed 23 Mar 2015.

Bliss, C. 2012. *Race Decoded: The Genomic Fight for Social Justice*. CA: Stanford University Press.

Board of Science and Technology, Executive Yuan. The Minutes of BioTaiwan Committee (BTC), http://www.bost.ey.gov.tw/news.aspx?n=BBF2DDAD69A41B16&sms=E1CE7A91363ABB7D. Accessed 28 Oct 2015. (in Chinese).

Board of Science and Technology, Executive Yuan. http://www.bost.ey.gov.tw/Content_List.aspx?n=F0558A90D837D63E. Accessed 28 Oct 2016. (in Chinese).
Brown, N. 2005. Shifting Tenses: Reconnecting Regimes of Truth and Hope. *Configurations* 13 (3): 331–355.
Borup, M., N. Brown, K. Konrad, and H. Van Lente. 2006. The Sociology of Expectations in Science and Technology. *Technology Analysis & Strategic Management* 18 (3–4): 285–298.
Brown, N., and M. Michael. 2003. A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects. *Technology Analysis & Strategic Management* 15 (1): 3–18.
Brubaker, R. 2015. *Grounds for Differences*. MA: Harvard University Press.
Busby, H., and P. Martin. 2006. Taiwan Biobanks, National Identity and Imagined Communities: The Case of UK Biobank. *Science as Culture* 15 (3): 237–251.
Cancer Breakthroughs 2020. 2016. *Cancer Breakthroughs 2020*, http://www.cancermoonshot2020.org/home/. Accessed 29 Oct 2016.
Chang, L.W. 2000a. Academia Sinica Initiates National Genetic Bank. *China Times*, July 5: 5. (in Chinese).
Chang, L.W. (2000b) Whose Genes are Representative of the Taiwanese People? *China Times*, July 5: 5. (in Chinese).
Chatterjee, P. 1986. *Nationalist Thought and the Colonial World: A Derivative Discourse?*. London: Zed Books.
Chen, Y.T., and Shen, C.Y. 2006. Planning Taiwan Biobank carefully. *China Times*, April 2: 5. (in Chinese).
Chen, Y.T., Shen, C.Y., Wu, S.M., Gong, R.W., and Huang, J.L. 2006. *The Preparatory Phase of the Establishment of Taiwan Biobank* (the Second Year). Taipei: Ministry of Health, The Project Report of the Ministry of Health. Executive Yuan: DOH95-TD-M-113-B001. (in Chinese).
Chen, Y.T., Shen C.Y, Wu, S.M., Chen, K.L. and Chen, C.S. 2009. *The Preparatory Phase of the Establishment of Taiwan Biobank* (the Third Year). Taipei: Ministry of Health, Project Report of the Ministry of Health, Executive Yuan: DOH96-TD-M-113-B001. (in Chinese).
Chen, Y.T., Shen, C.Y., Chen, K.L., and Chen, C.S. 2010. *The Preparatory Phase of the Establishment of Taiwan Biobank* (the Fourth year). Taipei: Ministry of Health, Project Report of the Ministry of Health, Executive Yuan: DOH98-TD-M-113-B001. (in Chinese).
Chung, W.H., S.I. Hung, H.S. Hong, M.S. Hsih, L.C. Yang, H.C. Ho, J.Y. Wu, and Y.T. Chen. 2004. Medical Genetics: A Marker for Stevens-Johnson Syndrome. *Nature* 428 (6982): 486.
Council for Economic Planning and Development. 2002. *Challenge 2008: National Development Plan*. Taipei: Council for Economic Planning and Development. (in Chinese).
Cyranoski, D. 2002. Genomics Firm Aims to Fill Asian Gene Gap. *Nature* 416: 115.
Duster, T. 2005. Race and Reification in Science. *Science* 307 (5712): 1050–1051.
Epstein, S. 2007. *Inclusion: The Politics of Difference in Medical Research*. Chicago: University of Chicago Press.
Ferrell, B.P., and H.L. McLeod. 2008. Carbamazepine, HLA-B* 1502 and Risk of Stevens-Johnson Syndrome and Toxic Epidermal Necrolysis: US FDA Recommendations. *Pharmacogenomics* 9 (10): 1543–1546.
Fletcher, A. 2004. Field of Genes: the Politics of Science and Identity in the Estonian Genome Project. *New Genetics and Society* 23 (3): 3–14.
Fortun, M. 2008. *Promising Genomics: Iceland and deCODE Genetics in a World of Speculation*. Berkeley: University of California Press.
Fortun, K., and M. Fortun. 2005. Scientific Imaginaries and Ethical Plateaus in Contemporary US Toxicology. *American Anthropologist* 107 (1): 43–54.
Fujimura, J. 2003. Future Imaginaries: Genome Scientists as Sociocultural Entrepreneurs. In *Genetic Nature/Culture: Anthropology and Science Beyond the Two Culture Divide*, ed. A.H. Goodman, D. Heath, and S.M. Lindee, 176–199. Berkeley: University of California Press.
Fujimura, J.H., T. Duster, and R. Rajagopalan. 2008. Race, Genetics and Disease: Questions of Evidence, Matters of Consequence. *Social Studies of Science* 38 (5): 643–656.
Gellner, E. 1983. *Nations and Nationalism*. Ithaca, New York: Cornell University Press.
Gong, J.R. 2001. Academia Sinica to Establish Genomic Research Center on Asian Illness. *China Times*, February 13: 13. (in Chinese).
Goodman, A.H. 2000. Why Genes Don't Count for Racial Differences in Health. *American Journal of Public Health* 90 (11): 1699–1702.

Gottweis, H., and B. Kim. 2010. Explaining Hwang-Gate: South Korean Identity Politics between Bionationalism and Globalization. *Science Technology Human Values* 35 (4): 501–524.
Harrison, C.E., and A. Johnson. 2009. *National Identity: The Role of Science and Technology*. Chicago: University of Chicago Press.
Hedgecoe, A., and P. Martin. 2003. The Drugs Don't Work: Expectations and the Shaping of Pharmacogenetics. *Social Studies of Science* 33 (3): 327–364.
Hinterberger, A. 2010. The Genomics of Difference and the Politics of Race in Canada. In *What's the Use of Race? Modern Governance and the Biology of Difference*, ed. I. Whitmarsh and D.S. Jones, 147–168. Cambridge: MIT University Press.
Hobsbawm, E., and T. Ranger (eds.). 1983. *The Invention of Tradition*. Cambridge: Cambridge University Press.
Hroch, M. 1996. From National Movement to the Fully-Formed Nation: The Nation-Building Process in Europe. In *Becoming National: a Reader*, ed. G. Eley and R.G. Suny, 60–78. New York and London: Oxford University Press.
Hsiau, A.C. 2000. *Contemporary Taiwanese Cultural Nationalism*. London/New York: Routledge.
Jasanoff, S. 2004. The Idiom of Co-production. In *State of Knowledge: the Co-production of Science and Social Order*, ed. S. Jasanoff, 1–12. London: Routledge.
Jasanoff, S., and S.H. Kim. 2009. Containing the Atom, Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva* 47 (2): 119–146.
Kuo, W.H. 2011. Techno-Politics of Genomic Nationalism: Tracing Genomics and Its Use in Drug Regulation in Japan and Taiwan. *Social Science and Medicine* 73: 1200–1207.
Lee, M.Y. 2001. Yuan-Tseh Lee's Message to the Government: More Investment in Biotech. Taiwan to Become Filipino Domestic Worker of Genetic Studies if It Does Not Work Hard. *United Daily News*, July 5: 3. (in Chinese).
Lee, W.J., and Y.Y. Tsai. 2018. Absent Publics: Taiwan Biobank, Controversy, and Scientific Governance. *Taiwanese Journal of Socology* 64: 49–110. (in Chinese).
Lee, S., and Yang, Y.L. 1999. From Economic Superpower to Health Superpower. *Common Health Magazine*, May 1, 8:22–29. (in Chinese).
Lin, Y.C. 1997. Taiwan has a Beachhead-Strategy for Biotech. *Common Wealth Magazin*e, April 1, 191:100–106. (in Chinese).
Liu, A.J. 2010. Making Taiwanese (Stem Cells): Identity, Genetics, and Hybridity. In *Asian Biotech: Ethics and Communities of Fate*, ed. O. Aihwa and N.N. Chen. Durham and London: Duke University Press.
Makeham, J., and A.C. Hsiau. 2005. *Cultural, Ethnic, and Political Nationalism in Contemporary Taiwan*. New York: Palgrave Macmillan.
Marcus, G.E. (ed.). 1995. *Technoscientific Imaginaries: Conventions, Profiles, and Memoirs*. Chicago: University of Chicago Press.
Martin, P., N. Brown, and A. Kraft. 2008. From Bedside to Bench? Communities of Promise, Translational Research and the Making of Blood Stem Cells. *Science as Culture* 17 (1): 29–41.
Ministry of Science and Technology, Taiwan. 2012. The Full Proposal of National Research Program for Biopharmaceuticals, http://117.56.91.94/KMPublic/readdocument.aspx?documentId=208032. Accessed 26 Oct 2015. (in Chinese).
Novas, C. 2006. The Political Economy of Hope: Patients' Organizations, Science, and Biovalue. *Biosocieties* 1: 289–305.
Ong, A. 2016. *Fungible Life: Experiment in the Asian City of Life*. Durham: Duke University Press.
Prainsack, B., and A. Buyx. 2011. *Solidarity: Reflections on an Emerging Concept in Bioethics*. London: Nuffield Council on Bioethics.
Shen, C.Y. 2010. Taiwan *Biobank* and its Purposes. *Law and Life Science* 4 (4): 1–6. (in Chinese).
Sleeboom-Faulkner, M. 2006. How to Define a Population: Cultural Politics and Population Genetics in the People's Republic of China and the Republic of China. *BioSocieties* 1 (4): 399–419.
Simpson, B. 2000. Imagined Genetic Communities: Ethnicity and Essentialism in the Twenty-First Century. *Anthropology Today* 16 (3): 3–6.
Smith, A.D. 1989. The Origins of Nations. *Ethnic and Racial Studies* 12 (3): 340–367.
Smith, E. 2009. Imaginaries of Development: The Rockefeller Foundation and Rice Research. *Science as Culture* 18 (4): 461–482.
Sunder Rajan, K. 2008. *The Constitution of Postgenomic Life*. USA: Duke University Press Books.
Taiwan Biobank. 2011. Strategic Plan and its Execution for the Taiwan Biobank. (in Chinese).

Taiwan Biobank. 2013. Recruiting Video: the Seeds and the Best. https://www.youtube.com/watch?v=Xkg_hXJrlhk. Accessed 26 Oct 2015. (in Chinese).
Taiwan Biobank. Latest News. http://www.twBiobank.org.tw/new_web/news.php?article_option=news&article_add=1. Accessed 26 Oct 2015. (in Chinese).
Tarkkala, H. 2019. *Reorganizing Biomedical Research: Biobanks as Conditions of Possibility for Personalized Medicine*. Doctoral Dissertation, University of Helsinki, Helsinki.
Tarkkala, H., and A. Tupasela. 2018. Shortcut to Success? Negotiating Genetic Uniqueness in Global Biomedicine. *Social Studies of Science* 48 (5): 740–761.
The Election Study Center of National Chengchi University. 2015. *Changes in the Taiwanese/Chinese Identity of Taiwanese*. http://esc.nccu.edu.tw. Accessed 28 Oct 2015. (in Chinese).
Tsai, Y.Y. 2010. Geneticizing Ethnicity: A Study on the "Taiwan Bio-Bank". *East Asian Science, Technology and Society: An International Journal* (EASTS) 4(3): 433–455. (in Chinese).
Tsai, Y.Y. 2014. Genetic Science and Identity Politics: Indigenous DNA, the Origin of the Taiwanese, and the Emergence of Bio-multiculturalism. *Taiwanese Sociology* 28: 1–58. (in Chinese).
Tsuang, M.T. 2000. Research Proposal: A Population Genetic Data Base for Taiwan. In *Proceeding of the Minutes of the 24th Academicians Meeting*, July 3. Taipei: Academia Sinica. (in Chinese).
Tupasela, A. 2016. Genetic Romanticism—Constructing the Corpus in Finnish Folklore and Rare Diseases. *Configurations* 24 (2): 121–143.
Verran, H. 1998. Re-imagining Land Ownership in Australia. *Postcolonial Studies* 1 (2): 237–254.
Wang, F.C. 2005. From Chinese Original Domicile to Taiwanese Ethnicity: An Analysis of Census Category Transformation in Taiwan. *Taiwanese Sociology* 9: 59–117. (in Chinese).
Wang, C.H. 2010. *The Limits of Fast Follower: Taiwan's Economic Transition and Innovation*. Taipei: Chuliu Book Company. (in Chinese).
Wong, J. 2005. Re-Mak the Developmental State in Taiwan: The Challenges of Biotechnology. *International Political Science Review* 26 (2): 169–191.
Yang, Z.M. 2000. A Taiwanese Genetic Database, Great Initial Controversy. *United Daily News,* July 5: 6. (in Chinese).

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