様式６－３

Topic-Setting Program to Advance Cutting-Edge

Humanities and Social Sciences Research

（Area Cultivation）

Progress Report

（Summary of Final Report）

Synthesizing historical sciences: New perspectives to cultural evolutionary studies

Core-Researcher: Yasuo Ihara

Institution: The University of Tokyo

Academic Unit: Graduate School of Science

Position: Lecturer

Research Period： FY2014 - FY2017

1. Basic information of research project

Research Area	New advances in humanities and social sciences using analytical methods incorporating praxeology, cognitive science, and neural science
Project Title	Synthesizing historical sciences: New perspectives to cultural evolutionary studies
Institution	The University of Tokyo
Core-Researcher (Name, Academic Unit & Position)	Yasuo Ihara, Graduate School of Science, Lecturer
Project Period	FY2014 - FY2017
Appropriations Plan (¥)	FY2014 2,000,000 JPY
	FY2015 3,450,000 JPY
	FY2016 3,200,000 JPY
	FY2017 2,700,000 JPY

2. Purpose of research

Following the objective of Research Area D, this research project aimed at establishing a new study of cultural evolution by synthesizing neighboring disciplines across historical science. A substantial understanding of a phenomenon necessitates understanding of its history. However, historical science is subdivided into smaller subfields and there have been very limited attempts to synthesize neighboring fields. In other words, while each of neighboring fields has been deepened significantly, extreme fragmentation of research subjects is commonplace in historical science. To understand cultural phenomena (from ornaments and potteries to habits, conventions, norms, and institutions), which are our target in this research project, it is essential to take various kinds of approach from biological basis, social transmission, acculturation process, how emergence of symbols and meanings enhance human evolution, etc. The present situation is, however, each field takes a different approach and accumulates fragmental studies, and almost none has been done to synthesize them. In this project, researchers from evolution, archaeology, cognitive science, and philosophy of science collaborate to study history of culture by using methodology and knowledge in humanity, social science, and natural science.

3. Outline of research (Including study member)

Members

Yasuo Ihara

Head investigator, Group leader (evolutionary anthropology group)

Lecturer, Graduate School of Science, the University of Tokyo

Research management

Kohei Tamura

Researcher (evolutionary anthropology group)

Assistant Professor, Frontier Research Institute for Interdisciplinary Sciences, Tohoku University

Mathematical analysis

Takehiko Matsugi

Group leader (archaeology group)

Professor, National Museum of Japanese History
Archaeological analysis

Nobuhiro Minaka
Group leader (phylogenetics group)
Unit leader, National Agriculture and Food Research Organization
Phylogenetic analysis

Sean Sangheon Lee
Collaborator (phylogenetics group)
Assistant Professor, Graduate School of Asia-Pacific Studies, Waseda University
Phylogenetic analysis

Hisashi Nakao
Group leader (philosophy group)
Assistant Professor, Faculty of Global and Science Studies, Yamaguchi University
Philosophical analysis

In this project, we examined data on material culture obtained by archaeological method from the viewpoint of various fields and aimed at understanding the comprehensive cultural history not biased to specific fields. Initially, our plan was to collect data in West Asia (especially Iran). However, since negotiations with the Iranian government did not proceed well, excavations could not be conducted. Instead, with the help of Dr. Naoko Matsumoto and Dr. Yuji Yamaguchi (Okayama University), we mainly gathered data of the Japanese archaeology. Collected data are as follows.

(1) Ongagawa style pottery

This is a style of potteries characteristic of the time around the transition from the Jomon period to the Yayoi period. This style of potteries is thought to have developed mainly in the northern Kyushu, and then propagated from there to various parts of Japan. It is morphologically very simple and appropriate as an object of elliptic Fourier analysis as will be described later. In this research, by extracting two-dimensional actual maps from excavation reports and applying to them elliptic Fourier and principal component analyses, transmission and diffusion process of the Ongagawa type pottery was investigated.

(2) Japanese ancient bone data

For the Jomon period and the Yayoi period in Japan, we collected data of fossils excavated from various archaeological sites included in excavation reports. We used these data to examine the controversy about the evolution of war (or the influence war gave to human evolution) in recent years.

(3) Keyhole-shaped tumulus

Keyhole-shaped tumulus is a form of ancient tomb made from the third to sixth century, which is often adopted as the tomb type of the ruling class. From above, a rectangular or trapezoidal protruding portion is attached to a circular main portion, sometimes called "keyhole shape". It is usual for a mound to have a structure called "danchiku" in which slope and flat part (terrace) are overlapped in two or three tiers. With respect to such keyhole-shaped tumuli, we obtained a two-dimensional survey map and analyzed the historical dynamics of the form of the keyhole-shaped tumuli using a geometric morphometric method called the landmark method.

(4) Spread of the Hinoeuma superstition

Research on cultural evolution at the group level has not been dealt with the distinction between long-term and short-term effects of cultural transmission because much of the available data is a snapshot. In this research, using the fact that the Hinoeuma fertity drop is a demographic phenomenon occurring periodically, we explored a model that considers the above factors to study the role of culture transmission played in the decline of births in 1966.

Regarding the above data, especially (1) and (3), Tamura, Matsugi, Nakao, Minaka (and collaborators Matsumoto, Yamaguchi) worked together to examine the data using such methods as elliptic Fourier analysis and geometric morphometrics. Regarding (2), since this is also a matter related to the philosophical hypothesis, Nakao, Matsugi (and collaborator Matsumoto) collaborated to examine the data. For (4), Ihara and Tamura cooperated to collect relevant demographic, linguistic, and geographic data.

With respect to (1) and (3) in particular, we analyzed archeological datasets using evolutionary and mathematical methods such as elliptic Fourier analysis and geometrical morphometry, as mentioned earlier. Regarding the application of such an evolutionary method, we continued discussion while also considering validity from a philosophical point of view. For (2), using statistical methods such as chi-square test, we examined differences in the frequency of war between the Jomon period and the Yayoi period. Interpretation of results obtained from such mathematical analysis was examined by all members. In the process, feedback was given to each assumed assumption and data to be analyzed, and analysis and interpretation were repeated.

4. Research results and outcomes produced

All studies have been able to make some achievements. Particularly, research on ancient human bones has been published in prominent journals such as Biology Letters, Letters on Evolutionary and Behavioral Sciences. The research of Hinoeuma has been published in Evolution & Human Behavior, the best-known journal in human behavioral evolution. We also made presentations at international conferences such as Human Behavior and Evolution Society, World Archaeology Congress, Human Behavior and Evolution Society Japan, Society of Evolutionary Studies Japan, Japanese Archeological Association, and other domestic conferences. Finally, we have published a book "Cultural Evolution and Archeology" (Keiso Shobo) and organized a related international symposium entitled "Perspectives on Prehistoric Cultural Evolution (From Archaeology to Behavioral Experiment)." For the symposium, we invited three researchers from the UK (Enrico R. Crema, Thomas E. Currie, and Alex Mesoudi) and two from within Japan (Masanori Takezawa and Naoko Matsumoto). In addition, we were able to publish outcomes on other relevant research in the form of various papers, writings, and presentations.

Regarding the effect of the current project on related academic fields, first of all, it can be considered that this study has made considerable progress in cultural evolution research in Japan. Cultural evolution research has been recognized gradually not only in various fields but also generally, partially owing to the above-mentioned book by Alex Mesoudi, which has been translated into Japanese. In fact, studies focusing on cultural evolution at various related academic conferences are on the rise, and there are also a few influences that this research had on such spread.

One more specific effect is that the framework of this research is gradually expanding while involving related researchers. Regarding the evolution of violence and war based on ancient human fossil data, as mentioned earlier, we have collaborated with Naoko Matsumoto of Okayama University and graduate students of Okayama University. They have also obtained research grants on related topics ("Evolutionary archaeological research on the nature of war and human beings" granted by Suntory Foundation to Naoko Matsumoto, and "Mathematical analysis on change and regionality of the Kofun era iron arrow-head", Kakenhi C to Takeshiko Matsugi). Mathematical analysis of archaeological remainas is also being carried out jointly with Koji Noshita of the University of Tokyo, who is a researcher of mathematical morphology, and Yuji Yamaguchi of Okayama University. As mentioned earlier, we have also obtained the Grants-in-Aid for Mathematical Analysis of archeological remains of the Kofun period.

Furthermore, we have established closely cooperative relationships between related fields in a quite natural way. In addition to acquiring research funds, we have some research projects that are already in progress. We believe that we have established in Japan a new study of cultural evolution, in which researchers from archeology, evolution, cognitive science, scientific philosophy, and others collaborate to achieve comprehensive understanding of history of culture. A future task is to expand various research on more diverse themes and expand the study of cultural evolution. This will allow interdisciplinary/comprehensive fields to examine the historical dynamics of culture to exist and to play a role of alleviating fragmentation of historical science.

As future developments, we have started collecting and analyzing preliminary data on the following themes. We will make the themes more concrete and proceed to understand the process. By applying the methodology developed in this research project, it is possible to lead to more detailed understanding and to further expand cultural evolutionary science.

(1) Study on iron arrowheads of Kofun period

Although iron arrowhead was a weapon that appeared in the Yayoi era, it was widely seen during the Kofun period, and it is considered to be a general weapon at that time. It is also distributed not only in the Japanese archipelago but also on the Korean Peninsula, and it is believed that the change is related to the formation of nations of both the Japanese archipelago and the Korean peninsula. It is thought that various factors such as the cultural influence from the Korean peninsula, the killing ability, the manufacturing technique, and the design with the psychological effect are involved in the formation of iron arrowhead. The use of the elliptic Fourier analysis method established in this research project is considered to help clarify the process of national formation of the Japanese archipelago and the Korean Peninsula by quantifying the spatiotemporal variation in the form of iron arrowhead.

(2) Study on human fossil data and war

In this research project, we collected fossil data excavated in the Jomon period and the Yayoi period, revealed that the proportion of injured human bones is much less than in previous studies conducted in other regions/times. This is a powerful counter example to the allegation of previous research that intergroup fighting was universal for prehistoric hunter gatherers. On the other hand, the factors that cause intergroup conflict (especially large scale) has not been clarified. Therefore, in order to investigate the correlation

between inter population conflict and population size (which can be estimated from the number of burial urns) as one of influential hypotheses, we can further deepen this issue by using GIS and statistical analysis together. Moreover, by analyzing the change of the form of the weapon of killing and the ability of the killing, as in the study of the iron arrowhead, it will be possible to investigate social psychological changes accompanying intergroup conflict.

(3) Transmission and diffusion process of the Ongagawa potteries

In this research project, we quantified the spatial variation of the form of the Ongagawa type pottery, which is formed within a relatively short period of time. In order to understand in detail problems such as acceptance and diffusion of new cultural elements and formation of regional differences, it is important to clarify what type of cultural transmission have formed the regional differences. For example, mathematical analysis on cultural evolution of potteries created by early European farmers has pointed out that there has been a tendency to prefer novel cultural elements. By using the same method, it is possible to clarify the actual condition of agricultural diffusion in Japan and to bring important case about acceptance of new technology.

(4) Study on morphology of burial urns

Burial urn is a large pottery used for burial. For example, by combining quantitative analysis methods such as those used for ancient tombs and earthenware with machine learning, it is possible to automate classification of burial urns. If such a classification method is established, it is possible to save labor in various work such as preparation of an excavation report, and it also leads to clarification of classification assumptions that are currently implicit. Moreover, from the physicochemical analysis, it has been shown that burial urns were made in each village. Therefore, analysis of burial urns can be a starting point of tackling issues of regional differences and formation and retention of tradition.

(5) Collective identity and evolution of cooperation and confrontation

How can we apply the methods developed in this research project to solve contemporary issues? One possible theme is collective identity (sense of belonging to a group). Sometimes humans have sense of belonging to a group to which they belong. It is known that people divide a society into in-group and out-group and behave cooperatively toward in-group members and hostilely toward out-group. Such collective identity may have become a basis of, for example, recent US presidential election and immigration problems, which can be said to be an urgent task of modern society. There is a long accumulation of research in archeology about the interaction between objects and social identity, such as the collective identity that appears in material culture and the material culture that contributes to the formation of collective identity. For quantitative analysis of such things, the methodology developed in this research subject should be effective. By collaborating with a research field targeting contemporary society, such as sociology, we can capture the cultural evolution, formation and collapse of collective identity on various time scales and related to collective identity It gives a basis for understanding various problems in a unified way.