Cultural Identity and Intergroup Conflicts:

Testing Parochial Altruism Model via Archaeological Data

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Abstract

The present research used archaeological data, i.e., the data obtained from *kamekan* jar burials in the Mikuni Hills of the northern Kyushu area in the Middle Yayoi period, to test the parochial altruism model. This model argued that out-group hate and in-group favor coevolved via prehistoric intergroup conflicts. If this model is accurate, such an out-group hate and in-group favor could be reflected in the archaeological remains, such as pottery making; the more frequent intergroup conflicts are and the more each group is opposed, the more independent and coherent each group will be and more evident cultural identity could be established within each group. We employed an elliptic Fourier analysis for the shapes of *kamekan* jar burials. We examined whether frequent intergroup conflicts in the period influenced *kamekan* jar pottery between subareas of the Mikuni Hills. The results suggested that the shapes of *kamekan* jar burials after the KIIIa type are slightly different between subareas, which is partially consistent with the model. However, the results do not support the model directly.

Key words: elliptic Fourier analysis; Yayoi period; evolution of morality; *kamekan* jar burials

1. Introduction

The evolution of morality is a multidisciplinary topic; various disciplines, such as an-

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thropology, economics, history, primatology, psychology, and philosophy, have been significant contributors (e.g., Boehm, 2013; de Waal, 2006; Gintis & Bowles, 2011; Joyce, 2005; Scheidel, 2017; Sober & Wilson, 1998; Sterelny, 2021; Tomasello, 2014; Wrangham, 2019). This is because morality and human evolution need to be examined multi-disciplinarily; however, such examinations still need to include some fields relevant to the evolutionary dynamics of human morality. Archaeology focuses mainly on material aspects of the phylogeny of Homo and their interpretations are not sometimes easy though archaeological remains are highly useful for investigating the past because they most directly reflect our past behaviors and they could offer deep insights into the human evolutionary changes over one million years. For instance, many would acknowledge that cognitive archaeology has contributed to the evolution of the mind (e.g., de Beaune, Coolidge, & Wynn, 2009; Mithen, 1996; Spikins, 2005; Sterelny, 2021).

The present research depends on archaeological data to examine a model relevant to the evolution of morality, i.e., the parochial altruism model (e.g., Bowles, 2009; Choi & Bowles, 2007; Gintis & Bowles, 2011). The model argued that outgroup hate and ingroup favor coevolved via group selection. It has often been discussed whether morality or altruism evolved by group selection or not among not only evolutionary biologists but also philosophers (e.g., Joyce, 2005; Sober & Wilson, 1998; Sterelny, 2021). Bowles (2009) and Gintis & Bowles (2011) claimed that intergroup conflicts or warfare in prehistoric hunter-gatherer societies was an essential selective pressure for group selection of the out-/in- group biases. These claims have been challenged in many ways (e.g., Ferguson, 2013; Fry & Söderberg, 2013; Nakagawa & Nakao, 2017; Nakao et al., 2016, 2020; Nakao, Tamura, & Nakagawa, 2022) though controversies remain.

The present study examined the model based on archaeological data when prehistoric intergroup conflicts or warfare plausibly occurred. Specifically, we focus on the data of jar burials in the northern Kyushu area of the Middle Yayoi period (250 BC to AD 30). The model would expect that people show more out-group hate and in-group favor when warfare occurs than when it does not. The northern Kyushu area, especially the Mikuni Hills of the Middle Yayoi period, found clearer and richer evidence of warfare (i.e., injured skeletal remains) than other areas and periods (e.g., Nakagawa et al., 2021; Nakao et al., 2016, 2020). If the model is accurate, out-group hate and in-group favor could be reflected in the archaeological remains, such as pottery making; the more frequent intergroup conflicts are, and the more opposed each group is (related to higher out-group hate), the more independent and coherent each group is and the more evident and more distinctive cultural identity (related to higher ingroup favor) could be established within each group (e.g., Nakao, Tamura, & Nakagawa, 2022). We examined pottery specially used for burials in the targeted area of the period, i.e., *kamekan* jar burials because burials could directly reflect cul-

tural identity than other daily pottery, which is more functionally constrained. The present article investigated the shapes of *kamekan* jar burials quantitatively, and the results were partially consistent with the model.

2. Materials and Methods

2.1. Materials

We examined the shape of *kamekan* jar burials in the Mikuni area of the northern Kyushu of the Middle Yayoi period (Figure 1). It has been traditionally assumed that the Mikuni Hills are culturally and geographically distinct to a certain degree; the people in the area engaged with rice farming using water from the Homan River (e.g., Nakagawa et al., 2021; Ozawa, 2002). The Yayoi period found that rice farming spread from the Korean peninsula and established in the Japanese archipelago, causing an increase in population, the degree of social hierarchy, and the frequency of intergroup conflicts (e.g., Hashiguchi, 2005; Matsugi, 2007; Mizoguchi, 2013; Nakagawa et al., 2021). *Kamekan* jar burials were widely used in the northern Kyushu area

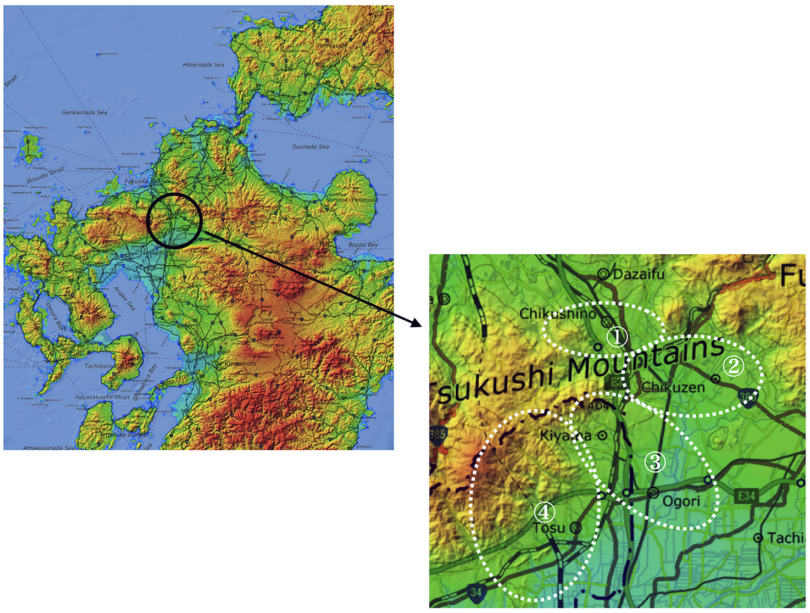


Figure 1 The areas investigated in this study. Four districts were divided according to the current administrative division. 1. Chikushino city, 2. Chikuzen town, 3. Ogori city, 4. Tosu city. The map is based on the color altitude map published the Japan Geospatial Information Authority with information on the sea area from the Hydrographic and Oceanographic Department, Japan Coast Guard, and modified by HN.

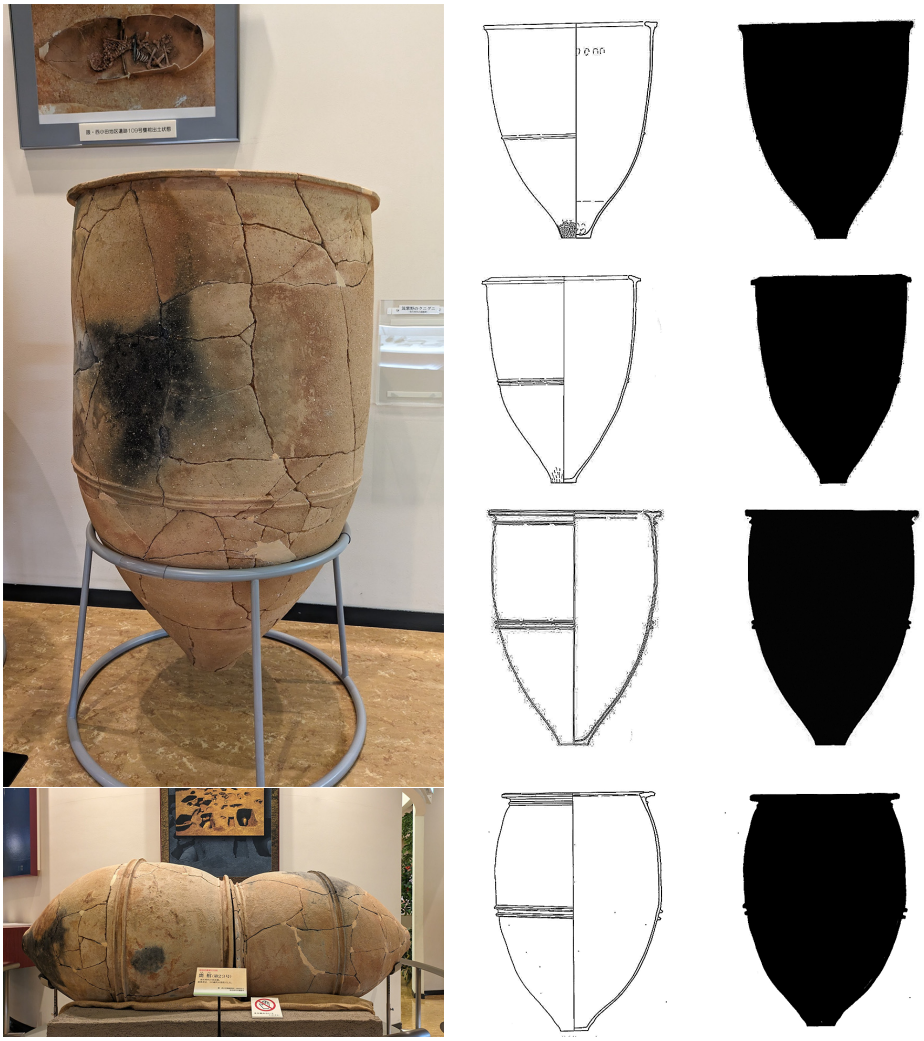


Figure 2 Examples of *kamekan* and the two-dimensional data of *kamekan* jar burials. Photos are KIIIb and KIIc types (K23 at the 13 location and K109 at the 3 location of the Kuma-nishioda site owned by Chikushino City Historical Museum). Drawings are KIIb (SJ9220 from the Yatsunamikanamaru site), KIIc (SJ1131 from the Yubiumesaka site), KIIIa (K522 from the Okubo site), and KIIIb types (K33 from the Dojoyama site) from top to bottom. The scale is ignored, although they are around 80–120 cm, and the largest is over 130 cm. The black-painted data is used for elliptic Fourier analysis.

during the late-Early to the early-Late Yayoi period (Hashiguchi, 2005; Nakagawa et al., 2021) while they were the most common in the Middle Yayoi period.

The types of *kamekan* jar burials from the Middle Yayoi period were divided into

six, i.e., KIIa, KIIb, KIIc, KIIIa, KIIIb, and KIIIc types (see Figure 2 and Nakagawa et al., 2021 for some examples). The typology and chronology depended mainly on the shapes of their rims and whole bodies (e.g., Hashiguchi, 2005; Nakagawa et al., 2021). We focused on larger *kamekan* jar burials, especially from KIIb to KIIIb, to investigate whether or not their shapes are regionally more different in KIIIa (when the frequency of intergroup conflicts was the highest) if compared to the back-and-forth periods (Nakagawa et al., 2021). The two-dimensional data obtained from the *kamekan* jar burials were collected from relevant excavation reports published in cities and towns of the Mikuni Hills, i.e., Chikushino city, Chikuzen town (and the Yasu town, which was annexed to the Chikuzen town), Ogori city, and Tosu city. The number of *kamekan* jar burials examined in this paper is summarized in Table 1; the sites with *kamekan* jar burials examined in the present research are in Figure 3.

Table 1 The number of of *kamekan* jar burials examined in the present research

Subareas/Types	KIIb	KIIc	KIIIa	KIIIb	Total
Chikushino	34	18	36	22	110
Chikuzen	36	61	26	1	124
Ogori	114	165	27	35	341
Tosu	216	438	91	29	774
Total	400	682	180	87	1394

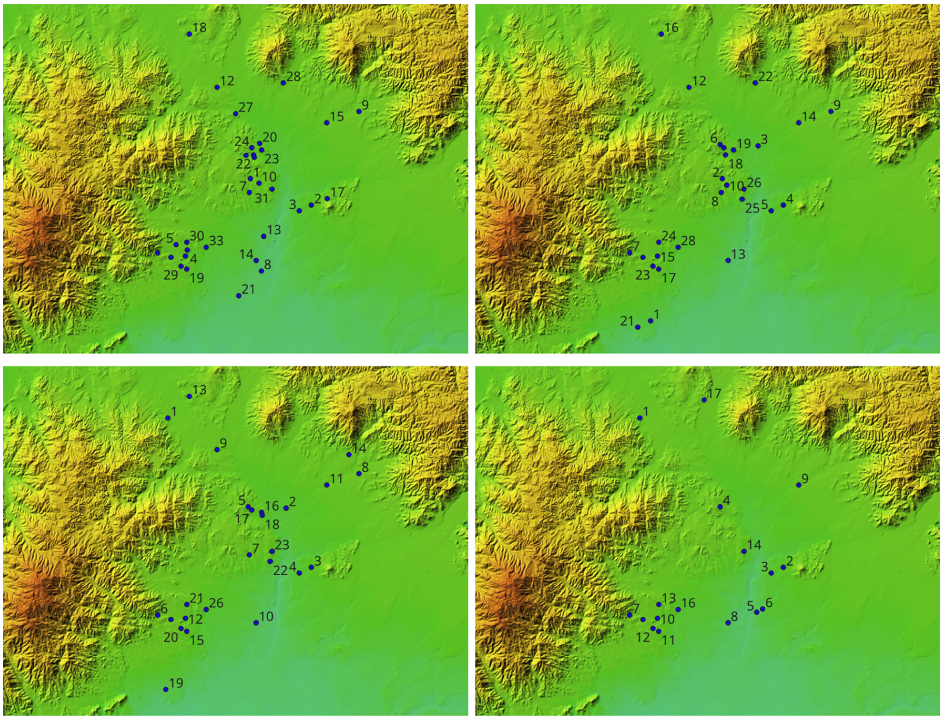
2.2. Methods

The data was analyzed by the elliptic Fourier analysis and principal component analysis (PCA). PCA is a multivariate analysis method for reducing the dimensions of large data set and exploring new variables (i.e., principal components) to visualize the most variable aspects of the original data set. Elliptic Fourier analysis quantifies the outline of the objects by the sum of a function of *sin* and *cos* (e.g., Kuhl & Giardina, 1982) as follows:

$$x(t) = \frac{a_o}{2} + \sum_{t=1}^{\infty} a_i cos(i\omega t) + \sum_{t=1}^{\infty} b_i sin(i\omega t) \quad (1)$$

$$y(t) = \frac{c_o}{2} + \sum_{t=1}^{\infty} c_i cos(i\omega t) + \sum_{t=1}^{\infty} d_i sin(i\omega t) \quad (2)$$

If the object function is function of x(t) = (*x(t)*, *y(t)*), it is a vector 4n dimensional vector like $(a_1, a_2, \cdots a_n, b_1, b_2, \cdots b_n, c_1, c_2, \cdots c_n, d_1, d_2, \cdots d_n)$. The vectors mean quantitative description of pottery outline. The present study sets the number of parameters as twenty because it reflects the actual outline to a certain extent and does not influence the analysis itself (e.g., Noshita & Tamura, 2017).



KIIb: 1.Hasakonomiya, 2.Hikata, 3.Hikatashimoyashiki, 4.Hirabaru, 5.Imamachiumesaka, 6.Kamiyama, 7.Kitamuta, 8.Koitaigutensan, 9.Kotonomiya, 10.Mitsusawafutsugaura, 11.Murata-sanbonmatsu, 12.Nagaoka, 13.Oboyokomakura, 14.Oitai, 15.Oki, 16.Okubo, 17.Shiroyama, 18.Shurita, 19.Tashirotenmangu, 20.Tenjin, 21.Terafukudo, 22.Tsuko-higashimiyahara, 23.Tsuko-soramae, 24.Tsukomuta, 25.Tsukoobayashi, 26.Tsukotanukihara, 27.Yakura, 28.Yamae3, 29.Yasunagata, 30.Yatsunamikanamaru, 31.Yokogumakitsunezuka7, 32.Yubihonmura, 33.Yubiumesaka
KIIc: 1.Fujiki, 2.Hasakonomiya, 3.Higashiodamine, 4.Hikata, 5.Hikatashimoyashiki, 6.Ikenoue, 7.Kamiyama, 8.Kitamuta, 9.Kotonomiya, 10.Mitsusawakitanakao, 11.Murata-sanbonmatsu, 12.Nagaoka, 13.Oitai, 14.Oki, 15.Okubo, 16.Shurita, 17.Tashirotenmangu, 18.Tsuko-higashimiyahara, 19.Tsuko-soramae, 20.Tsukomuta, 21.Uchihata, 22.Yamae3, 23.Yasunagata, 24.Yatsunamikanamaru, 25.Yokogumakamiuchihata, 26.Yokogumakitsunezuka7, 27.Yubihonmura, 28.Yubiumesaka
KIIIa: 1.Dojoyama, 2.Higashiodamine, 3.Hikata, 4.Hikatashimoyashiki, 5.Ikenoue, 6.Kamiyama, 7.Kitamuta, 8.Kotonomiya, 9.Nagaoka, 10.Oitai, 11.Oki, 12.Okubo, 13.Shurita, 14.Takoshi, 15.Tashirotenmangu, 16.Tsuko-soramae, 17.Tsukomuta, 18.Tsukouchihata, 19.Uchihata, 20.Yasunagata, 21.Yatsunamikanamaru, 22.Yokogumakamiuchihata, 23.Yokogumakitsunezuka7, 24.Yokogumakitsunezuka, 25.Yubihomura, 26.Yubiumesaka
KIIIb: 1.Dojoyama, 2.Hikata, 3.Hikatashimoyashiki, 4.Ikenoue, 5.Inouehaiji, 6.Inouekitauchihara, 7.Kamiyama, 8.Oitai, 9.Oki, 10.Okubo, 11.Tashirotenmangu, 12.Yasunagata, 13.Yatsunamikanamaru, 14.Yokogumakitsunezuka, 15.Yubihonmura, 16.Yubiumesaka, 17.Yunoki

Figure 3 The site locations with *kamekan* jar burials examined in the present research. The map is based on the color altitude map published by the Geospatial Information Authority of Japan with information on the sea area from the Hydrographic and Oceanographic Department, Japan Coast Guard, and modified by the author using QGIS (3.20.3).

We used R4.02 (R Core Team, 2020) and R Studio RStudio 1.3.1093 (R Studio Team, 2020) for analyses, and Momocs package for elliptic Fourier analysis (Bonhomme et al., 2014), and ggplot2 (Wickham, 2016) for visualizing the results.

3. Results

The contribution rates of the PCA analyses are summarized in Table 2, and the shapes each principal component (PC) captures are mentioned in Figure 4. In all the results, PC1 and PC4 captured the bilateral difference in the data and should be ignored because such differences are plausibly not intentional but accidental or due to immature techniques. PC2 grasps the whole width, PC3 roundedness of the lower half, and PC5 shapes of the rims.

Table 2 The contribution rates of the PCA analyses

PCs/Types	KIIb	KIIc	KIIIa	KIIIb
PC1	66.5	63.2	57.2	70.8
PC2	21	25.7	27.1	13.2
PC3	4.4	3.3	5.8	5.8
PC4	2.7	2.4	3	2.5
PC5	1.5	1.3	1.8	2.1
PC6	0.8	0.8	0.8	1.1

The results of PCA are plotted in Figure 5 (all of the principal component scores are available on OSF: https://osf.io/3e8p5/). The subareas selected for the analyses are based on current administrative distinctions, such as cities or towns (See Nakao (submitted) for more detailed results for each site in each city or town). In the KIIIa and KIIIb types (especially PC2), *kamekan* jar burials from Tosu city showed slightly different distributions. We conducted SteelDwass test on PC2 scores and found significant differences between Chikushino and Tosu city ($t = 2.8101$, $p = .0255$) in KIIb type, Chikushino city and Chikuzen town ($t = 3.4670$, $p = .0030$), Chikushino and Ogori city ($t = 3.8495$, $p = .0001$), and Chikushino and Tosu city ($t = 3.9956$, $p = .0003$) in KIIc type, Chikushino and Tosu city ($t = 3.0741$, $p = .0113$) and Ogori and Tosu city ($t = 2.6875$, $p = .0362$) in KIIIa type, and Ogori and Tosu city ($t = 3.6481$, $p = .0015$) in KIIIb. Despite these statistically significant differences suggesting that the degree of variations depends on each subarea, it still overlapped considerably in all periods, and slightly more wider differences might be found after the KIIIa period.

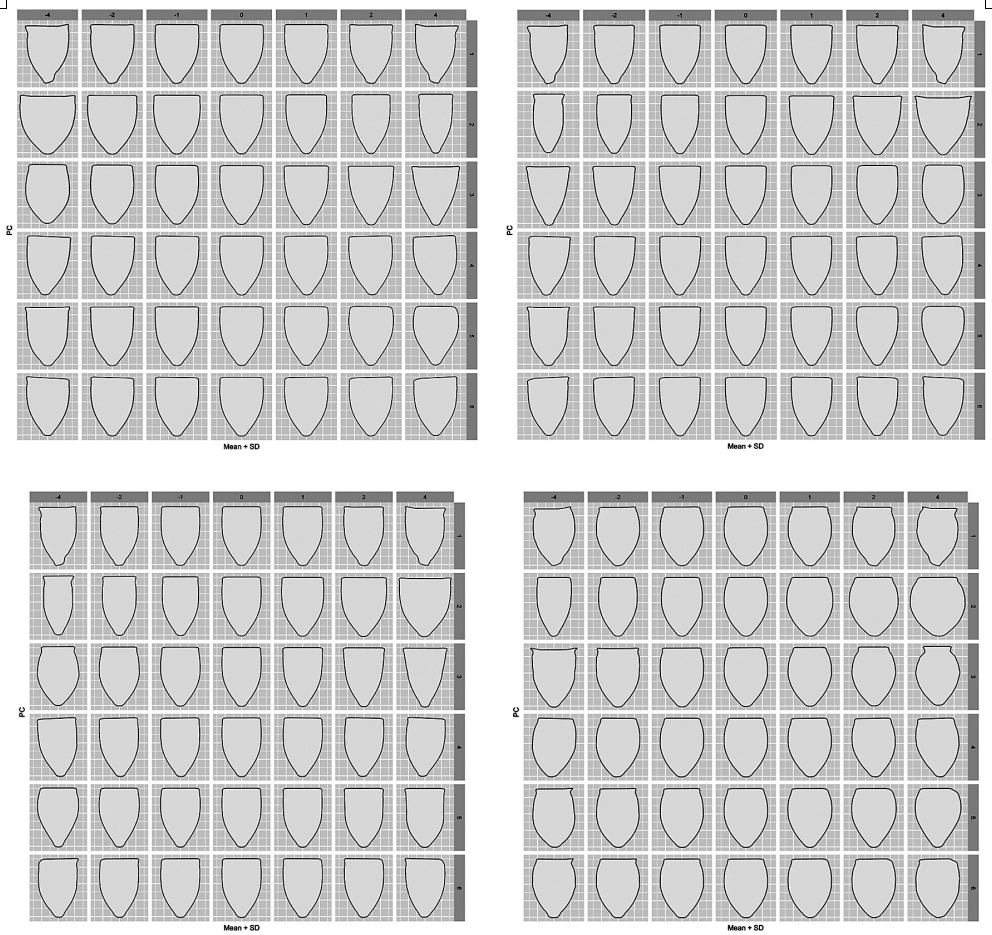


Figure 4 The shapes of each PCs captured in KIIb, KIIc, KIIIa, and KIIIb types in a clockwise direction.

4. Discussion

Nakagawa et al. (2021) showed that the frequency of violence was estimated based on the number of injured skeletal remains, which was highest in the Mikuni Hills of the KIIIa period, suggesting that intergroup conflicts or some warfare were intense in that area. As argued in the introduction section, if the parochial altruism model is accurate, it should be expected that out-group hate and in-group favor could be reflected in *kamekan* jar burials; the more frequent intergroup conflicts are and the more opposed each group is, the more independent and coherent each group is and the more evident and more distinctive cultural identity could be established within each group. The present results were partially consistent with the model: The shapes

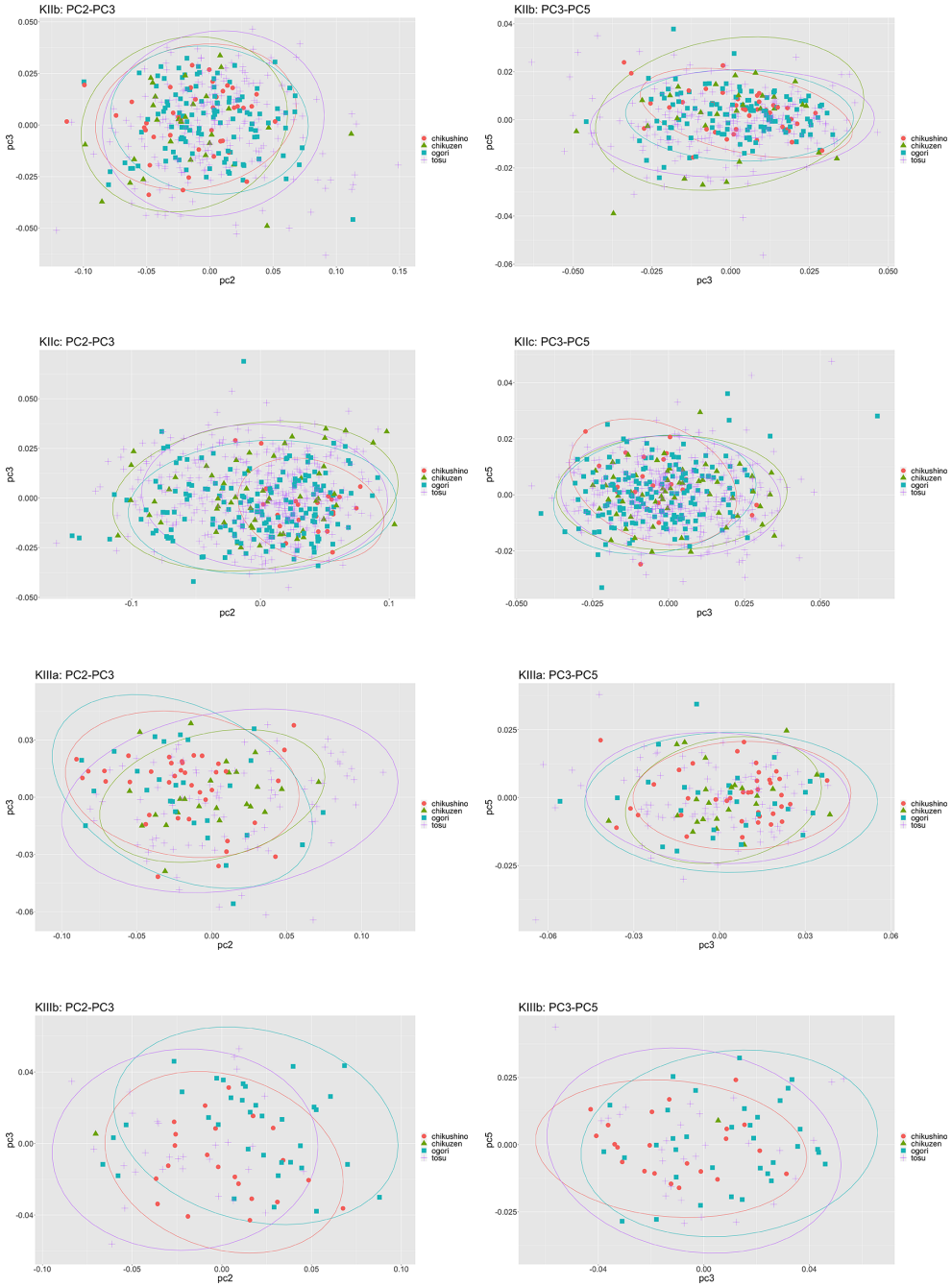


Figure 5 The results of the principal component analyses were plotted.

of *kamekan* jar burials were slightly more varied between subareas after the KIIIa period. The subtly different distributions after the KIIIa period were not plausibly regional because any geographical clines were not found.

It should be noted that the results do not directly support the model. The model argued that intergroup conflicts or warfare in the prehistoric hunter-gatherers are essential selective pressures (e.g., Bowles, 2009; Gintis & Bowles, 2011). The data investigated in the present article is from the Yayoi period, when people mainly engaged in rice farming. Some are skeptical about the evolutionary scenario in the parochial altruism model based on the data obtained from the intergroup conflicts the prehistoric hunter-gatherers (e.g., Ferguson, 2013; Fry & Söderberg, 2013; Nakagawa & Nakao, 2017; Nakao et al., 2016, 2020; Nakao, Tamura, & Nakagawa, 2022). Although the question of how and when the outgroup hate and ingroup favor evolved remains unsolved, the present results suggested that the model is possibly applied to intergroup conflicts or warfare after the introduction of agriculture.

Furthermore, after the KIIIa period, although the shapes of *kamekan* jar burials might be slightly more varied between subareas, the shapes are also similarly varied within each subarea. The results were inconsistent with the expectation from the model that the more frequent intergroup conflicts are and the more opposed each group is, and the more independent and coherent each group is.

It is possible that *kamekan* jar burials were too common to show significant areal differences in cultural identity. However, Nakazono (2004) and Nakao et al. (in preparation) argued that the sizes of *kamekan* jar burials correlate with the number of grave goods and that the sizes differ in each area. The results suggested that social or cultural implications could be reflected in *kamekan* jar burials even though they were prevalent in the northern Kyushu of the Middle Yayoi period. Thus, it is plausible that non-significant differences in the shapes of *kamekan* jar burials of the Mikuni Hills are interpreted socially or culturally.

Nakao, Tamura, & Nakagawa (2022) and Nakao (submitted) suggested that intergroup conflicts in those areas of the period were not so intense because we could not find any sites ceasing to exist directly because of intergroup conflicts and the variations of the *kamekan* shapes of many other regions in the northern Kyushu area still overlap considerably after the KIIIa period. The results of the present research also supported the interpretation. The results indicated that although slightly more significant differences were found after the KIIIa period, each subarea significantly overlapped.

To sum up, the present results were partially consistent with the expectation from the parochial altruism model. However, they did not support the model directly. The model is intuitively plausible, while further examinations are required.

5. Conclusion

The present article quantitatively and mathematically analyzed archaeological data, i.e., *kamekan* jar burials, to examine whether the results could support a model relevant to the evolution of morality, i.e., the parochial altruism model. We concluded that archaeological material data after the introduction of agriculture (not initially the intended era in the model) is partially consistent with the model. However, the data does not advocate the model directly. Our discussion implied that although archaeological data tends to be ignored in the discussions on the evolution of morality, it could significantly contribute to the topic.

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