From Field to Museum
Studies from Melanesia in Honour of Robin Torrence

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Papuan Gulf Spirit Boards and Detecting Social Boundaries: A Preliminary Investigation

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Abstract. This paper is an exploratory investigation of Papuan Gulf spirit boards. These ceremonial items and their designs were owned by clans and other patrilineal groups and comprised an important aspect of traditional ceremonial life. During the early contact period, they were intensively collected by Europeans and now appear among world-wide museum holdings of Papua New Guinea material culture. The Australian Museum has an extensive collection of spirit boards that provide the primary data for this study. Here spirit board design elements are analysed to understand how they are distributed between or only retained within cultural groups living in the east-central Papuan Gulf. The paper also examines ways to analyse spirit board designs.

Prologue. During 1983 I carried out fieldwork in the Orokolo villages, Papuan Gulf, on behalf of the Australian Museum. Most days over almost two months I interviewed village elders who provided me with a wealth of critical information about their cultural heritage. The information I collected about the relationship between their social system and the designs appearing on their traditional ceremonial material culture is significant, especially given more than 50 years had passed since the major ceremonies ceased being performed. The elders were both candid and patient, and I am greatly indebted to them for the trust they showed in me. By mutual agreement, I promised to begin all publications that used the cultural information they passed on to me by recognising these holders of community wisdom with their photographs (Fig. 1).

Introduction

Social identity, social structure, intergroup boundaries and interaction, social networks and migration patterns are key objectives of much current archaeological research (e.g., Chiu, 2015; McDonald and Veth, 2012; Rigaud *et al*., 2018; Stone, 2003; Torrence, 2011). One common interpretative framework relies on social behavioural models, mostly borrowed from critical research in other disciplines such as anthropology, evolutionary biology or behavioural science (e.g., Appadurai, 1986; Barth, 1969; Lave and Wenger, 1991; Lipo and Madsen, 2001; Wobst, 1974). More information comes to hand in the form of direct observations (Graves *et al*., 2016; Wiessner, 1984), comprehensive historic records (McBryde, 2000) or well-documented museum collections (Torrence and Clarke, 2016).

Using ethnographic and historic records, this paper explores the social symbols found on Papuan Gulf spirit boards (Fig. 2). These artefacts were collected in substantial numbers during the early stages of the contact period from the late 19th century to just prior to World War II (Welsch, 2015a: 22–26) and important holdings are in the Australian Museum, as well as other world-wide institutions. Spirit boards are attractive and frequently occur in ethnographic art compilations (e.g., Welsch *et al*., 2006).

F. E. Williams, Papua New Guinea's first Government Anthropologist, documented Papuan Gulf cultures between 1923 and 1937, spending 16 months with the Elema and eight with the Purari, their western neighbours, recording their traditional cultures (Williams, 1924: vii, 2015: xi). He noted (2015: 246–247, fig. 11, plate 28) that some designs carved on *hohao*, Elema spirit boards, as well as those portrayed on other ceremonial items, communicated their ownership by particular social groups—clans (*bira'ipi*) and patrilineal

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Figure 1. Orokolo Elder Informants, 1983 Australian Museum Ethnographic Research Project.

descent groups (*aualari*). Thus, spirit boards should be a valuable resource for investigating traditional social group boundaries in the Papuan Gulf.

Moreover, spirit boards may have utility for archaeological investigations in the region. Almost 50 years of archaeological research into South Papuan coastal trade and exchange (e.g., Allen, 2017; Rhoads, 1982; Skelly and David, 2017; Urwin *et al*., 2021) demonstrates a diverse suite of exotic goods arrived in the Papuan Gulf from distant areas to the east, west and north. However, we have little idea about how these goods were distributed and ferried through the region. An understanding of social identity and social networks among Papuan Gulf peoples is key to revealing local trade and exchange systems. Spirit boards offer one of the few avenues to investigate early historic Papuan Gulf society. This paper examines the viability of a comprehensive research project focused on Papuan Gulf spirit boards.

The paper consists of three parts. The first considers theoretical underpinnings for analysing social boundaries in Papua New Guinea and associated methodological approaches. As well, the ethnography of spirit boards—their role in traditional society and their designs—is examined.

The second section sets out the research methodology—the recording of design elements and analytical techniques. It presents a pilot study of a small collection of Western Elema (Orokolo) *hohao*, mostly from the Australian Museum, that have detailed contextual documentation. It then investigates a more substantial collection of Papuan Gulf spirit boards that are more diverse, both geographically and culturally.

The third section assesses the success of this exploratory investigation. It concludes by considering whether spirit boards can serve as a proxy for social markers capable of detecting intra- and inter-regional sharing of designs.

Design elements research, social boundaries and the Papuan Gulf

New Guinea art typically conveys messages, and these are frequently communicated through ritual and ceremonial behaviour. As a consequence, meaning is conveyed at a system-wide or group level as style. In other words, meaning is contained in a circumscribed regional design system (Forge, 2017: 111, 114–115). Seeking meaning in Abelam art Forge (1965: 23) asked:

> How far is the art of the Sepik a means of communication? … How far does the art form a system *sui generis* or, in other words, to what extent can we take carvings and paintings as things in their own right relating to each other and the beholder, and not as mere manifestations of some other order of cultural fact such as mythology or religion? Does plastic art of a group have its own rules, not just style, but also of meaning and interpretation?

Forge (2017) later provided a lead-in to social boundary analyses by noting:

> Frequently certain sacra are owned by clans or other segments of the group performing the ritual and have segment specific names; these, and sometimes designs, are property whose copyright is to be defended … The clan-owned designs on the hevehe masks of Orokolo are a classic and well-known example of this class of division of property.

Kaitilla (1997: 402) further illustrated the role of art incorporated into traditional Papua New Guinea buildings and how this incorporation integrated social groups and their art:

> Primitive art objects [e.g., men's house posts and carved boards] were displayed prominently both inside and outside of men's spirit houses as a visible sign serving to ensure a feeling of security and survival, as a warning to outsiders about the supernatural forces in them. In this sense social organisation and regulation [are] the primary functions of primitive art.

Moving from theory to methodology, Conkey's (1978) study of Upper Palaeolithic art and group borders argued that art objects contain structural elements, specifically information content, understood by different territorial groups. These identify boundaries separating different groups through distinct graphic designs (Conkey, 1982: 116). Conkey's approach is most relevant to this study since it is well-founded on linguistic (Schapiro, 1969) and anthropological theory (Barth, 1969; Leach, 1976). Conkey's analysis focused on three basic structural elements of art: (i) design—a typological system starting with elements as the basic unit and continuing to analysed motif forms; (ii) design field—properties of the space within which images

Figure 2. Orokolo *hohao*. Reproduced courtesy of the Australian Museum. Pacific Collection reg. no. E000258.

occur; and (iii) design configuration—the positioning of motifs as a whole on an object (Conkey, 1978: 120, 1980: 615–617). Her use of multivariate statistics as a basic analytical tool also serves as a guide for this study. This approach has proved useful in recent studies of cultural identity relevant to Australian Indigenous rock art and shield designs (McDonald, 2009; McDonald and Harper, 2016).

Papuan social groups, material representations and spirit boards

Among Papuan Gulf peoples (Fig. 3), specific symbols and designs belong to different social groups (i.e. the designs associated with clans (*bira'ipi*) and patrilineal descent groups (*aulari*) among the Elema). These were incorporated into the patterning of designs on spirit boards, ceremonial masks, bullroarers and bark belts. Additional information can be assembled from Williams (1940: 246, fig. 11) and Beier and Kiki (1970). Other information is contained in my notes for the 1983 Orokolo fieldwork for the Australian Museum (Rhoads, 1984). Together, these all provide a substantial body of information about Western Elema material culture.

Local names for boards varied between the different major Papuan Gulf groups—*hohao* among the Elema, *kwoi* (*koi*) for the people living in the Purari delta, *gope* among communities along the Era and Wapo Rivers and at Urama Island, and *titi ebiha* for the Kerewo in the Goaribari Island area (Beier and Kiki, 1970; Bell, 2009; Newton, 1961: 15, 19; Welsch, 2015b).

Spirit boards were stored in men's houses—*eravo* (Elema), *ravi* (Purari) and *dubu* (Urama)—along the partitions separating sleeping areas for initiated men belonging to the same clan. Large ceremonial masks were suspended along the central aisle of men's houses. The spirit boards were rarely, if ever, removed from these houses. Elema and Purari men believed the spirit boards embodied the strength of important ancestral/mythological figures, who empowered them in the hunt and at war (Beier and Kiki, 1970: 12; Williams, 1940: 8, 12–13). Once a board deteriorated, a copy—usually an exact replica (Beier and Kiki, 1970: 23)—was made, with the board ownership typically retained by the original social group. Williams (1940: 156) comments that many *hohao* are 'very ancient', an idea supported by Beier's and Kiki's informants who reported the first *hohao* were made following the deaths of clan heroes (1970: 12).

Frankel (2010) described Papuan Gulf spirit board manufacture based on his field observations during a 1978 archaeological fieldwork expedition to Kinomere Village (Urama Island). The boards were traditionally fashioned into an oval shape from planks of light wood or portions of old canoes, typically measuring 120–150 cm long and 20–30 cm wide. Senior men owned these full-sized spirit boards. Smaller versions did occur, and these are said to be neither secret nor sacred (Welsch, 2006: 6), and may belong to young uninitiated males.

Frankel (2010: 51–54, fig. 5) identified as many as 15 different stages involved in manufacturing a spirit board. Eye, cheek and mouth motifs were carved before other designs, so human features formed a central design structure around which other design elements were carved. Primary design motifs (*ovo laea*) included eyes, navel and geometric designs that were symbols for clouds, trees, stars and land or territory, all 'invented' designs of the patrilineal clans (Beier and Kiki 1970: 27). My informants consistently remarked that eye motifs were key social markers, but few commented that mouth and cloud motifs have social meanings as well

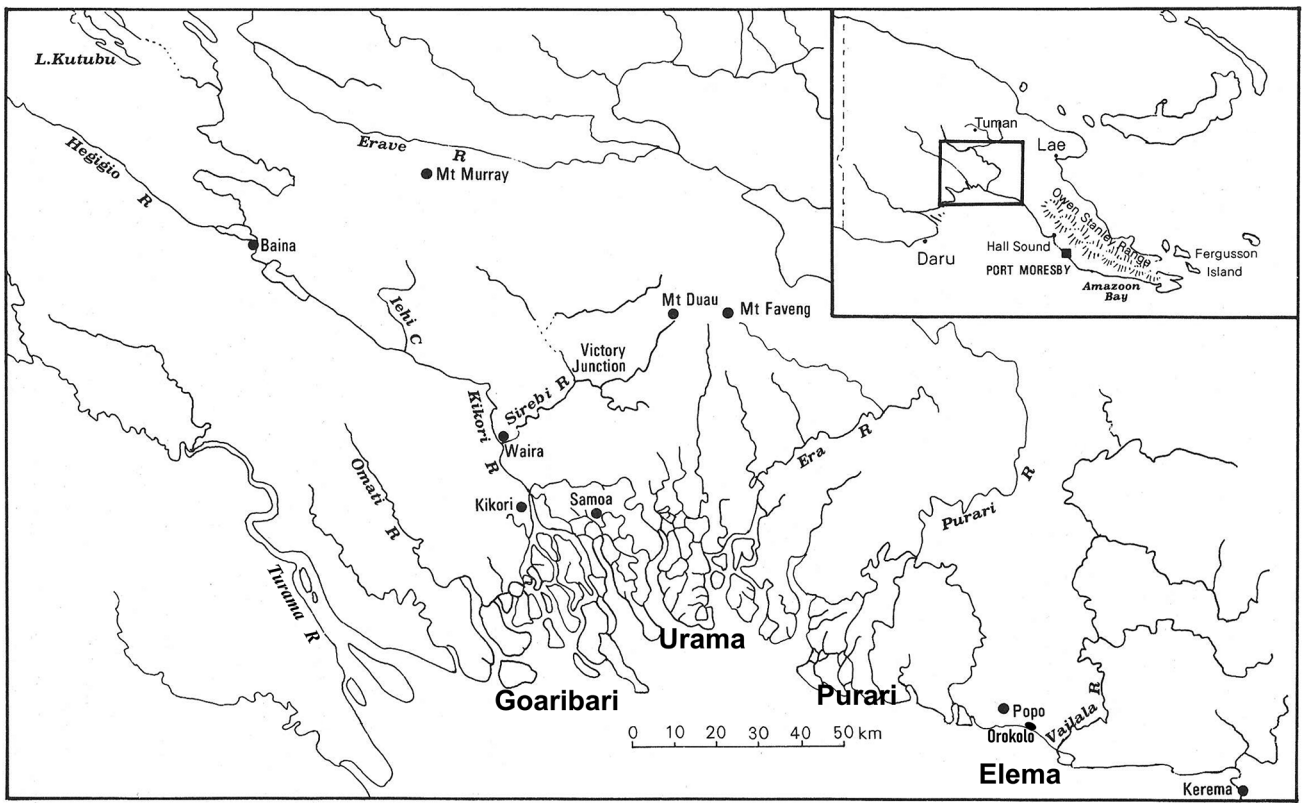

Figure 3. Papuan Gulf study area of Papua New Guinea.

(Rhoads, field notes, 15–16 November 1983). Spirit boards were mostly coloured with charcoal and red or pink ochre (*mou*), which was obtained from either peoples living near the present-day Kikori Station or eastern Elema groups living in the Hall Sound area through trading sago for ochre and stone axes (Beier and Kiki, 1970: 24; Rhoads, field notes 14 November 1983).

Research methods and analyses

I assembled a collection of 39 spirit board images from the Western Elema, Purari and Urama study area held in the Australian Museum, to which I added another 101 published in various indigenous art compilations (Brake *et al*., 1979; Lewis, 1973; Newton, 1961; Friede and Friede, 2005; Webb, 2015a; Welsch *et al*., 2006). Those chosen for analysis from the 140 spirit board images, needed to have good local provenance information and date to or before World War II, with the exception of some items from the Urama area. While Western Elema culture was severely impacted c. 1919 as a result of the Vailala Madness cult, the cessation of traditional Elema ceremonies and the destruction of ritual material culture were not universal (Williams, 1934: 370). Generally speaking, traditional activities in the Papuan Gulf continued in some manner until the late 1940s/early 1950s. Appendix 1 lists the 93 spirit boards selected for this study and provides analysis code numbers and source documentation for each.

Before progressing, it is necessary to clarify how Conkey's three basic structural elements of art—designs, design fields and design configurations—are used in this paper.

1 Designs are described using two terms. First, a design element is the basic unit of analysis and consists of a distinct patterning of geometric marks. When specific design elements are discussed in this paper, they are designated DE, for example DE #25. Second, motifs are the product of analysis and can be either a special design element or a distinctive cluster of design elements. Motifs are often identified as a social group's designs by traditional elders (e.g., Beier and Kiki, 1970; Munn, 1962, 1966; Rhoads, 1984). These may be a particular eye style, a material culture item (e.g., headdress, ornament) or a particular graphic design (e.g., parallel lines indicative of clouds). These social symbols are referred to as social motifs in this paper. In summary, the basic distinction here between 'design elements' and 'motifs' is that design elements are used as a generic term, while motifs are an informed or technical designation.
2 Design fields are the areas of an object within which design elements and motifs occur. These form the spatial units for analysis (see below).
3 Design configuration is the positioning of motifs across an entire object. In some instances (e.g., Beier and Kiki, 1970: 59–60, fig. 5, caption), social symbols and their patterning comprise 'notations of conversations and story-telling', as well as mythological designs (Munn, 1962: 978).

The design elements and social motifs used in the analysis were initially drawn from those identified by the Orokolo elders (Rhoads, 1984) and those noted in *Hohao* (Beier and Kiki, 1970).

New design elements were assigned whenever they were not identical to one already allocated to my sample. A frame consisting of nine, equal-sized rectilinear cells or design fields—designated A–I (Fig. 4)—was closely draped over each spirit board image while recording design elements (Table 1). This approach aligns with Conkey's (1982) analysis of how design space is used, specifically whether or not symmetry is a consistent feature of design configurations. When a design element was repeated in an adjacent or several

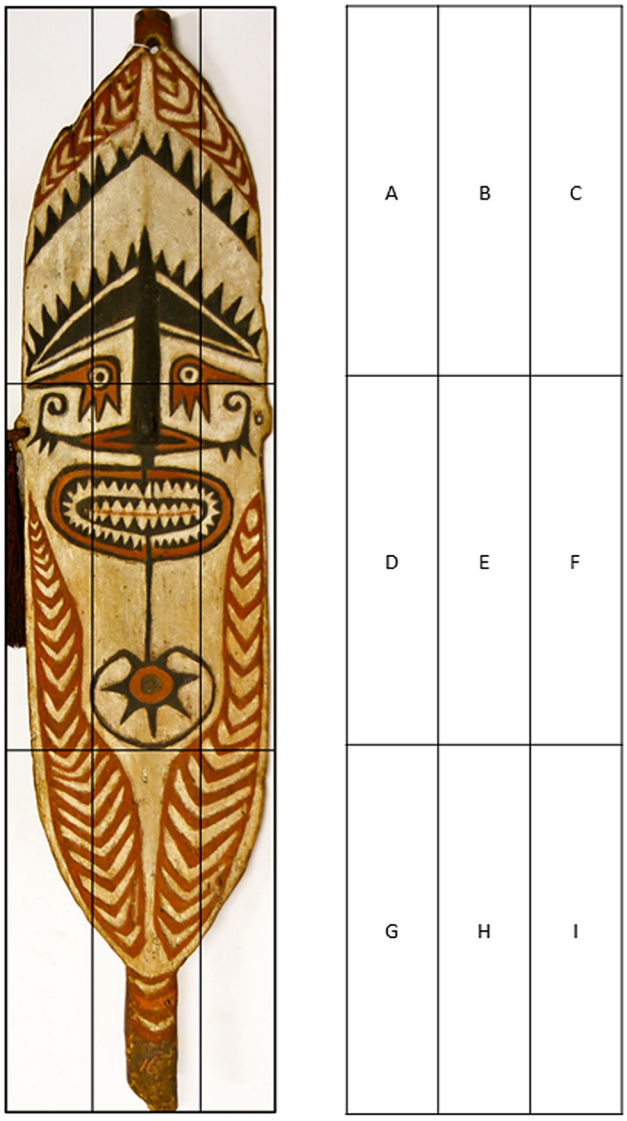

Figure 4. Recording overlay for Papuan Gulf spirit board design elements. Orokolo *hohao* reproduced courtesy of the Australian Museum. Pacific Collection reg. no. E000257.

cells on one board, it was only noted once for the board. The data matrix, *n* rows (boards) and *m* columns (design elements), is thus presented as a table of zeros/ones (0/1).

The analysis employed familiar multivariate routines available in the *PAST* statistics package (PALeontological Statistics) v 3.2 (Hammer *et al*., 2001). The first routine, Correspondence Analysis (CA), is useful for data exploration (Hammer, 2018: 101–102; de Leeuw and Mair, 2006) and its use in Australian Indigenous rock art studies (McDonald and Harper, 2016; McDonald, 2009: 241, 253–256) has demonstrated its utility for comparable studies. Generally, CA is applicable to most types of data and is commonly employed for counted or ratio-scale data expressed as non-negative integers (Bolviken *et al*., 1982; Carlson, 2017: 279–280; Greenacre, 2010; Shennan, 1997: 308–313). This statistic determines those 'hypothetical variables' (components or eigenvalues) that account for the possible variance in the study sample, based on Chi-squared distances. The reduction of a matrix of *n* rows (usually objects) and *m* columns (variables) to a two-dimensional graphic display (map) showing the affinity between objects and attributes is a particularly useful aspect of this multivariate routine.

Two multivariate clustering routines (Hammer, 2018: 110–111, 113) were used to group spirit boards or design elements. Hierarchical cluster analysis produces a dendrogram that shows how the data groups, starting with 'each observation representing a cluster and merging observations and clusters until we have combined everything into a single group' (Carlson, 2017: 334). Ward's method, employing a Euclidean distance coefficient, was used in this study to produce relatively balanced clusters for which in-group variance is minimised (Shennan, 1997: 241). The second clustering method, *k*-means, is a non-hierarchical method that accommodates missing data. It divides a sample into the number of groups specified by the analyst. In this procedure, the cluster assignments, while random at the outset, are reallocated to different groups through an iterative process until reassignment stops. In particular, *k*-means establishes a proposition or model of how observations cluster and this, in turn, may be interrogated by related but separate data (Carlson, 2017: 321).

Orokolo hohao pilot study

A pilot study of the Orokolo *hohao* sample was designed to investigate patterning among the social motifs because the sample size was small and its social context well-documented. As well, the late prehistoric/early historic period archaeology and oral traditions of the area have been comprehensively studied (Rhoads, 1994; Urwin, 2018). The pilot analysis of these *hohao* asked four questions:

1 How do design elements and social motifs vary geographically, particularly as Orokolo is a relatively small, culturally unified region?
2 How are they allocated among the different design fields?
3 How useful are the analytical routines chosen for exploring design patterning?
4 How long have spirit boards been used in the Orokolo region?

The pilot study was thus designed to assess the utility of my methods prior to expanding investigations to include a greater number of Papuan Gulf spirit boards belonging to several cultures.

Orokolo sample characteristics

The Orokolo pilot study sample (Table 2) comprised 30 boards, of which 23 are part of the Australian Museum's Pacific collection. The remaining seven, also well-documented traditional spirit boards, are published in Beier and Kiki (1970). Twenty in the Australian Museum collection have exceptionally good provenance. Three were acquired by T. Bevan, an early Papuan Gulf explorer, in 1883 from coastal Orokolo villages, while S. Macdonell, a trader living in the area during the early 20th century, collected the remaining boards from people inhabiting both coastal and inland areas of Orokolo. Figure 5 illustrates the distribution of localities relevant to the pilot study. These include:

Table 1. Example of the design element record for E000257 (Fig. 4).

reg. no.	locality	A	B	C	D	E	F	G	H	I
E000257	Orokolo	9, 37, 43, 44, 53	3, 9, 37, 43, 44, 53	9, 37, 43, 44, 53	53, 71, 72, 87, 99	53, 71, 72, 87	53, 71, 72, 87, 99	99	87, 99, 117	99

Table 2. Orokolo Pilot Study *hohao*: name, social affiliations and geographical attribution.

board registration number/Beier & Kiki, 1970: plate no.	board's personal name and locality attribution	social group(s) attribution
A0156768	*Ailaka*; Kavava village	Akai clan, Purari aualari
E000256	*Merava*; coastal Orokolo	Milahiru clan
E000257	*Kiki*; Harevavo village	Lavai-ipi clan
E000258	*Korope*; Harevavo village	Hoirahiru clan
E021046	*Marupai*; Kaivukavu village	Milahiru clan*
E022633	*Meakere*, coastal Orokolo	Hururu clan
E022634	*Kaiakere*; Kavakava village	Hururu clan; displayed with *Meakere* in the men's house (*eravo*)
E023104	Muro area	—
E023105	Orokolo area	—
E023108	*Eipepe*; Kaivakavu village	Hururu clan
E023109	*Auaro*; Orokolo area	Kairipopo clan*
E023112	Muro area	—
E023113	Paivea area (inland from Orokolo)	—
E023114	Muro area	—
E024469	Kaivakava village	—
E024471	Orokolo area	—
E026296	Orokolo area	—
E026299	Orokolo area	—
E026300	*Miaikere*; Kavava village	Hururu clan
E026301	Muro area	—
E072964	*Epe*; Muro area	Heh clan
E072965	Marea village	—
H 1	*Ila Klaika*; Hopaiku village; ancestor in clan's origin myth	Maori clan
H 2	*Ila Kalaika*; Harilareva village	Kaivamauka clan (Deep Water section)
H 3	*Maria Ere*; Harilareva village	Kaivamauka clan
H 4	*Hilake*; Harehavo village	Vailala clan (Hilake Pilore section)
H 5	*Eoe*; Harevavo village	Vailala clan
H 7	*Auaro*; Kaiva; Kovu village; board's 'twin hohao' called *Iko*	Kaivamauka clan
H 8	*Lakekavu* (turtle); Harevavo village; mythological story associated with the board	Kaivamauka clan (Deep Water section), Moro aualari
H 9	*Epe*; crocodile motif is Epe's first form after 'descending from the sky'	Epe Havora clan

* Not mentioned in Williams (2015) or Beier and Kiki (1970).

1 The central cluster of Orokolo settlements.
2 Two groupings of villages at the western end of Orokolo Bay.
3 Other smaller villages dispersed eastward toward the government station at Ihu.
4 Inland villages, particularly Muro.

Roughly two-thirds of the Orokolo *hohao* have personal names, mostly attributed to ancestral figures and belonging to recognised clan groups. About half are attributed to named villages (Tables 2 and 3). This social group distribution of spirit boards parallels Williams' early observations about how clans were distributed among the Orokolo settlements and the different named social groupings, as well as the significance of human figures portrayed on *hohao* (Williams, 1940: 35–37, 154). The naming of *hohao* is important here because Williams (1940: 156) argued that named *hohao* are 'obviously very ancient.'

Analyses

The pilot study first assessed the spatial patterning of design elements near the edge of a board (Fig. 4: sample cells A, C, D, F, G and I). Empirical observation indicated a high degree of bilateral symmetry among design elements positioned in these design fields. Fig. 6 presents histograms illustrating the patterning along the left (A, D and G) and right (C, F and I) board margins. Comparisons of cells A vs C and G vs I indicate a high degree of left-right symmetry at the top and at the bottom of boards. The same degree of symmetry is not as apparent when comparing the top and bottom design fields along each side—cells A vs G and C vs I. Also, some design elements overlap in adjacent cells, A vs D and D vs G, where design elements often cross the margin between recorded design fields. Based on these results, I limited my *hohao* analyses to one margin and the areas along a board's centre, in other words cells A, B, D, E, G and H.

A total of 118 design elements were recorded for the 30 boards. On average, nine were noted for each board. Only 270 cells of the resultant data matrix (7.4%) contained a value of one, so I used clustering routines to reduce the size and sparseness of the matrix. I first used hierarchical analysis (Ward's method) to determine how well the data formed distinct groupings. The hierarchical dendrogram (Fig. 7) was a promising result, as it showed only low-level chaining, or sequential joining of attributes. I determined that 10 groups, selected by using an arbitrary cut off of 2.5–3.0 (Euclidean distance), constituted a useful grouping of design elements.

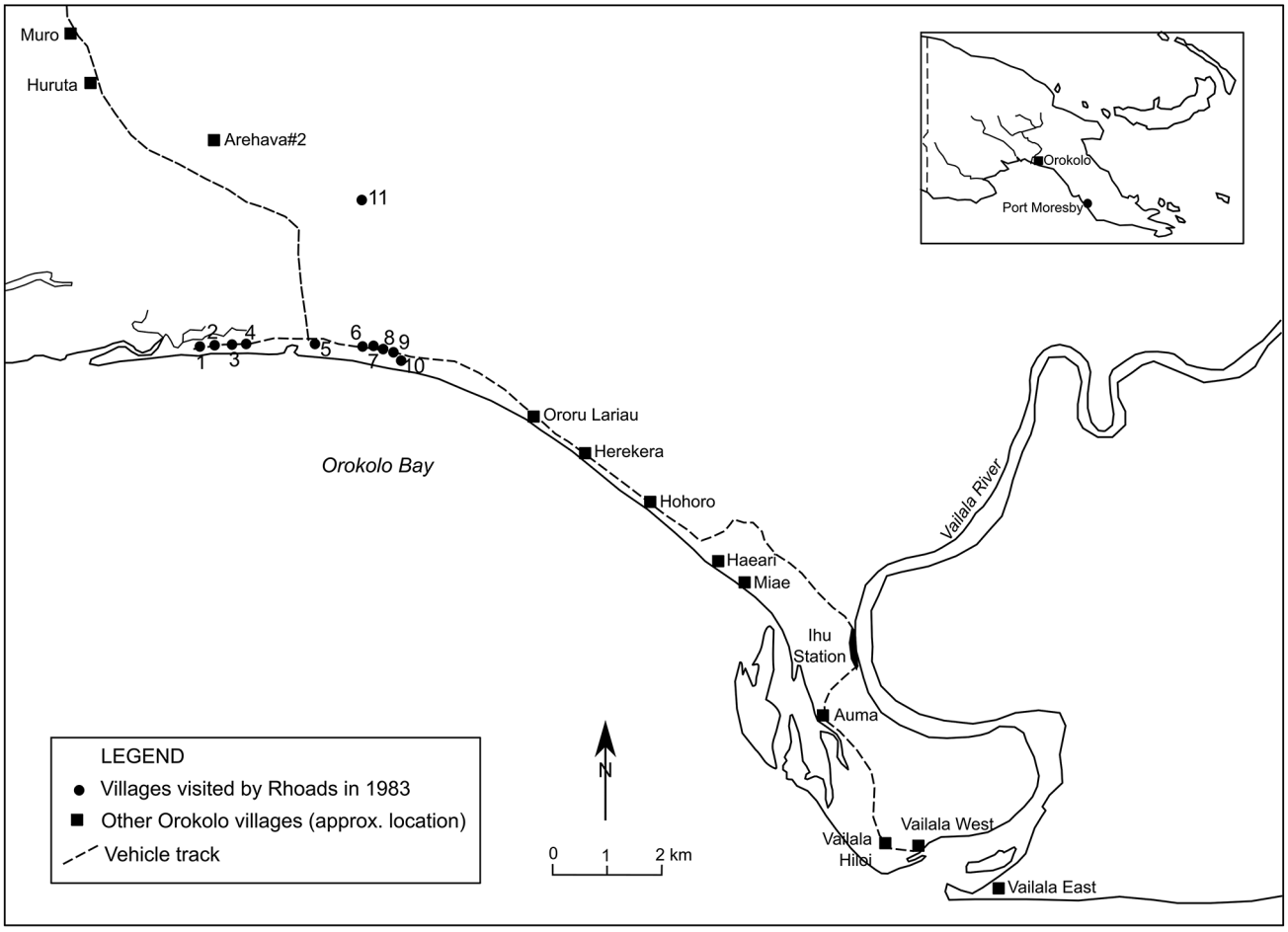

Figure 5. Orokolo locality map. (*1*) Harevavo; (*2*) Marea; (*3*) Kaivakavu; (*4*) Larihairu; (*5*) Ioku; (*6*) Harilareva; (*7*) Hopaiku; (*8*) Mirimaru; (*9*) Kavava; (*10*) Hururu; and (*11*) Paivea.

A *k*-means cluster analysis for 10 groups was undertaken. This produced a pronounced reorganisation of the design elements according to particular design fields (e.g., upper board, upper or lower margin, and central area). No group consisted of homogenous design elements; however, subgroups consisting of similar designs were evident in each group. I reorganised the *k*-means cluster groups into 37 new cluster groups, mostly by subdividing each group into two or three new groupings of comparable designs. Ten of the new groups consisted of rare design elements. The impact of the *k*-means procedure and my reorganising *k*-means groups produced a notable reduction of data matrix 'sparseness'—21% of cells now had values of one. It is important to note that a new numbering system, beginning with 200, was used for the 37 clustered design elements groups (CG); this helped eliminate any confusion with the original system for recording design elements (see Table 3).

The clustered groups highlight some designs that commonly served as social symbols. These include:

1 Centrally positioned human figures: CG #223 (motifs 29, 30, 36)
2 Eye motifs: CG #204 (59, 60), CG #220 (52, 55)
3 'Distinctive' designs: CG #203 (19, 27, 28), CG #213 (114), CG #218 (106), CG #233 (75)

This process also draws attention to two cluster groups said by Orokolo elders to be 'just decoration': upper board design elements CG #225 (40) and CG #226 (8). I next undertook a correspondence analysis using the clustered groups of design elements as attributes for the Orokolo *hohao* sample. Fig. 8 presents separate plots for (A) cluster groups and (B) *hohao*. The area around the plot's centre is shaded because the attributes (CGs) mapped in this area of the CA map are not statistically different from one another. Importantly, the X and Y axes relate to the first and second eigenvalues (component scores), respectively, and together account for only 20% of variation in design elements for the entire Orokolo *hohao* sample. In fact, 11 components were necessary to accommodate 76% of sample variability. This may reflect only that a small group of *hohao* were sourced from a relatively small region.

Examining the CA map further, the clustered groups of design elements strongly aggregate near the plot's centre, and mostly to the right of the origin (Fig. 8A). The map also shows a distribution of motif groups that form a 'string' of outliers near the first axis and streaming away to the left of the origin—CGs #211, #215, #223 and #229. This suggests an underlying structure for *hohao* designs. CG #223 (centrally positioned human figure), given its position, is a significant 'contributor' to sample variation and my informants remarked that central human figure motifs comprise social markers. The remaining clustered groups in this area of the CA map do not have a similar level of importance.

Five clustered groups—CGs #216, #217, #228, #230 and #235—comprise the attributes most influential for the second axis (9% of sample variance). Their significance is difficult to judge because they consist mostly of relatively rare design elements. However, social markers CGs #204, #213 and #230 map at some distance away from the origin and their importance may appear as contributors to sample variance, when mapping other CA components.

Figure 8B shows the village localities associated with

Table 3. Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

Clustered Design Element Groups Code (CG)	Design Element Description	Primary Design Element code	Design Element Illustration	Informant Comments (relevant spirit board analysis codes, see Appendix)
200	navel, sun burst design	91		(26)
		92		(29)
		93		(16, 30)
201	navel, various designs	94		(1)
		95		(4, 6, 10)
		96		(23)
		97		(15)
		98		(18)
202	chevron/triangular design, upper board	14		(4, 10, 12, 15, 18, 22, 23, 24, 25, 27, 28, 29, 30, 31)
		16		motif of Akai clan, Purari aualari (1)
		17		(17)
203	distinctive designs, upper board	18		hands motif—clan Ancestor Epe reaching down from the sky (23, 31)
		19		hair comb motif called *kou*—Hururu clan marker (10)
		20		motif at the top of the board called *hura kaikaia*,—hole in the sand formed by a small crab-like creature (11)
		22		(15, 20)
		23		(16, 18)
		24		(17)
		25		(18)
		26	see Figure 9a	motif associated with Muro area (14)

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Table 3 (continued from previous page). Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

204	eye motif, multiple projections	58		eye motif called *aipa laka* (6)
		59		eye design—orchid motif, "sacred" to Maori clan (24)
		60		eye motif called *rove*—clan marker (7)
205	eye motif, circular surround design	56		(23)
		62		eye motif associated with Muro (13)
		63		(30)
		64		(6, 17, 29)
		65		eye motif used by many clans (9, 10)
		66		(16, 18)
206	unembellished mouth designs	67		(1, 4, 15, 16, 19, 26)
		68		(1, 4, 15, 16, 19, 26)
		69		(29)
207	outlined mouth designs	70		(13, 30)
		71	see Figure 4	(3, 6, 7)
		73		(10, 17, 18, 25)
208	designs connecting face directly to mid-lower board	78	see Figure 2	sawtooth motif around face lower face and belly button called *maure rove*, cockatoo crest (4)
		79		(27)
		80		(29)
		81		(10, 17, 26, 30)
209	finial, no design	3		(2, 3, 8, 10, 12, 13, 15, 16)
210	finial, various design elements	1		(1, 4, 5, 9)
		2		(31)
		4		(7)
		5		(14)
		6		(17)

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Table 3 (continued from previous page). Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

211	different design elements, lower board area	109		nested triangles motif—clouds [**NB** clouds played important role in Elema mythology (*Hohao* p. 23)] (29)
		110		(5)
		111		(11, 16)
		112		(14)
212	undecorated area, lower board	113		(19)
213	face motif, lower board	114		upside down face motif called *Hae,* the ancestor Maria Ere's spirit (26)
214	board's stand	115		undecorated (1, 10, 11, 12, 13, 14, 16, 17, 22, 28, 29, 31)
		116		parallel lines design (2, 4, 23, 26, 27)
		117		chevron design (3, 5, 6, 18, 30)
		118		elaborate designs (15)
215	various designs, along lower board margin	99	see Figure 4	chevron motif called *piku ove,* wood grub (3, 14)
		100		chevron motif called *miave poku*, hornbill beak (8)
216	various geometric designs, lower board	101	see Figure 9b	linear (11, 13, 20)
		102		sawtooth lines (15)
		103		y-shaped (16)
217	back bone designs	104		motif called *uki korari* (7)
		105		(17)

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Table 3 (continued from previous page). Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

218	lower board, human torso and legs, different designs	106		lower torso belongs to Kurua [aka Mila Maipala], a mythological giant (*Hohao* p. 59) (28)
		107		(11, 24)
219	curved eye motif	46	see Figure 9c	(15)
		47		eye motif—pig tusk (1)
		48	see Figure 9d	eye motif called *orae* ("It is just decoration.") (2)
		54		(12)
220	eye motif, pointed designs	49		eye motif called *lavo*, mountain in Owen Stanley Ranges, which has associations with the Kaivamauka and Maori clans (25)
		50		(5)
		51		eye motif called *piku ova*—shadow (or spirit) of the woodworm (26, 27)
		52		eye motif called *miripapu*, river meander; clan marker originating in the Purari area; remainder of the face comprises a single motif called *makoura*, a mushroom found along river meanders—the forehead being the cap, nose the stem and mouth the root. (11)
		53		(3)
221	design, immediately below face	82		beard-like design (12)
		83		curvilinear design (12)
		84	see Figure 9c	hand-like designs (15, 23)
		85		board attributed to Orokolo area (16)

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Table 3 (continued from previous page). Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

222	navel, sawtooth surround	86		(13)
		87	see Figure 4	navel motif called *hekure*, central portion of the *paru* fruit (3)
		88		(24, 25)
		89		sawtooth motif around navel called *merove ari*—cane thorns, clan marker (27, 28)
		90	see Figure 9d	sunburst motif symbolises a turtle shell or bailer shell, which are strongly associated with the Orokolo area (7, 8)
223	centrally positioned human figure	29		crocodile motif - Vailala clan marker. (31)
		30	see Figure 9e	clan ancestor (5)
		31		Muro area (8)
		32	see Figure 9a	Muro area (14)
		34	see Figure 9b	Muro area (20)
		36		clan ancestor *Epe* (22)
224	various designs, top of head	37	see Figure 9d	sawtooth motif above head, cassowary feather headdress (2, 3, 4, 5, 6, 7, 10, 11, 13, 15, 16, 19, 23, 24, 25, 26, 28, 29, 30)
		41		small disc shell ornament motif, curved line along top of forehead (6, 19, 24)
		43	see Figure 9d	half-moon design above eyes—symbolises “unoccupied land,” places where clan wishes to “conquer or farm” (2, 3, 4, 5, 6, 7, 10, 11, 13, 15, 16, 17, 18, 19, 23, 24, 25, 26, 27, 28, 29, 30)
225	designs above forehead	39		motif called *kou*, shark's teeth headband (7, 16)
		40		"just decoration" (5)

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Table 3 (continued from previous page). Orokolo Pilot Study *hohao*: design element analysis codes, key motif illustrations, and descriptions.

226	geometric with chevron infill, upper board margin	8	see Figure 9d	"just decoration" (2, 23)
		9		(3, 4, 6, 7)
		11		(7, 9)
227	geometric with no infill, upper board margin	10		(5, 20)
		13		(19)
228	forehead design	42		headdress motif represents coconut fronds (1, 9)
229	sawtooth line, upper board	44		shark's teeth motif (3, 4, 22)
230	drooping eye motif	55		eye motif called *merove*—palm leaf, clan marker (28)
		57	see Figure 2	eye motif called *ori veo vahae*, hornbill beak (4, 19)
231	downward pointing chevron, lower board margin	15		chevron motif called *mealalau meakaroro*, high clouds (2, 6, 9, 10, 11, 12, 13, 15, 18, 5, 27, 30, 31)
232	nose ornament, very elaborate design	72	see Figure 4	young fern or young cane shoot design (3, 23)
233	nose and nose ornament design	74, 75		nose ornament (2, 3, 16, 25)
234	designs outlining tassel hole	76		(2, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16)
235	lobe outlining lower portion of face	77		black bulge motif either side of lower face called *ikavari* - string or magic vine connecting known and unknown worlds—clan marker (29)
236	headdress motif	38		motif called *lupu* – pig bristle headband (27)

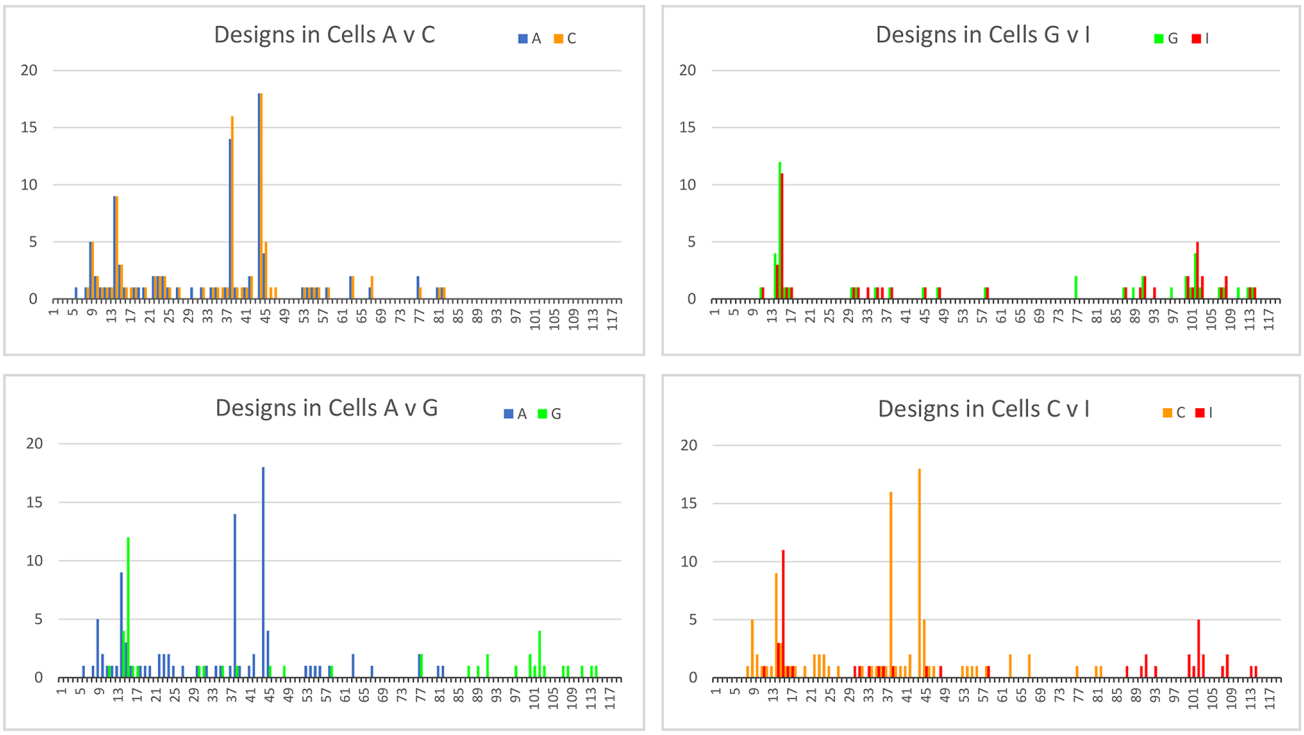


Figure 6. Histograms comparing the frequency distribution of design elements (code numbers) among different design fields (recording cells—see Fig. 4).

the *hohao* on the CA map. Two patterns are apparent. First, *hohao* from coastal areas, where the large Orokolo villages were situated, appear as a large aggregation near the map's centre. Second, more than 80% of boards from the inland areas (E023104, E023114, E026301, and E072964) plot to the map's left, noticeably associated with central human figure motifs (CG #223) (Table 3; Fig. 8B). As explained above, this cluster comprises a strong design feature of the Orokolo area *hohao* sample, and marks differences between inland (Muro area) and coastal design elements. Importantly, this is consistent with informants' reports that clan motifs for inland, as opposed to coastal, areas were quite distinct (Rhoads, field notes 17 November 1983). Figure 9 illustrates this difference in *hohao* design structures.

The results of the pilot study produced some encouraging results. The sample exhibited highly interrelated design elements and motifs among spirit boards. Those sourced to the Muro area form a recognisable and significant geographical assemblage that aligns with Western Elema oral history. Urwin recorded stories relating to the abandonment of Popo, the people's ancestral village. Some groups migrated to the coast, where early historic villages were recorded. Others moved farther inland and to the west, close to present-day Muro (Urwin pers. comm., 4 June 2018). Urwin estimates this event occurred some six generations ago, and his archaeological investigations place this time to c. 140 cal. BP (Urwin, 2018: 277).

Less promisingly, the data does not seem to be well-structured throughout. The CA maps demonstrate that outliers strongly influence sample variance. The need to calculate 11 CA components to accommodate 76% of sample variance further demonstrates this point. At present it is unclear whether there are problems with the analytical routine selected to explore the data, the internal characteristics of the data, or both.

Western Elema to Urama Island social boundaries investigation

This section of the paper concerns spirit boards from three Papuan Gulf cultures—the Elema who mostly live near the coastal strand around Orokolo, the Purari whose villages are situated in and around the mouth of the Purari River, and the Urama who inhabit the swamplands farther west (Fig. 3). While differing linguistically (Franklin, 1973), these cultures share comparable ways of life and ritual. This offers an ideal situation to test the use of spirit boards in marking social boundaries. The questions asked are similar to those outlined for the Orokolo sample, with two differences. First, asking whether spirit boards were in use prior to the contact period is omitted. Second, spirit boards from the three cultural areas are assumed to differ in varying amounts, and this idea is investigated by assessing the degree to which spirit boards share design elements.

Sourcing and sample characteristics

As described above, this sample consists of 93 spirit boards (Appendix 1) that met provenance and collection date criteria. The Orokolo sample, in addition to the *hohao* in the pilot study analysis, now included an additional 11 *hohao* from Orokolo and five from Vailala, all dating to 1912 and collected by A. B. Lewis, an American anthropologist who purchased artefacts for the Field Museum in Chicago while visiting the Papuan Gulf. A small assortment of other *hohao* were also added to the sample, notably the 1891 specimen attributed to the Thursday Island-based missionary the Rev. Savage (Webb, 2015a: plate 1). The sample of Western Elema *hohao* now totalled 50, attributed to four localities (Fig. 10).

The Purari *koi* sample consists of material from seven villages. Lord Moyne likely collected the five Iari Village boards for the British Museum during his 1935 visit to the Papuan Gulf (Webb, 2015b: 35). The eight spirit boards from Kaimari are a part of the Frank Hurley collection held by the Australian Museum. These pertain to his visit to the Purari-

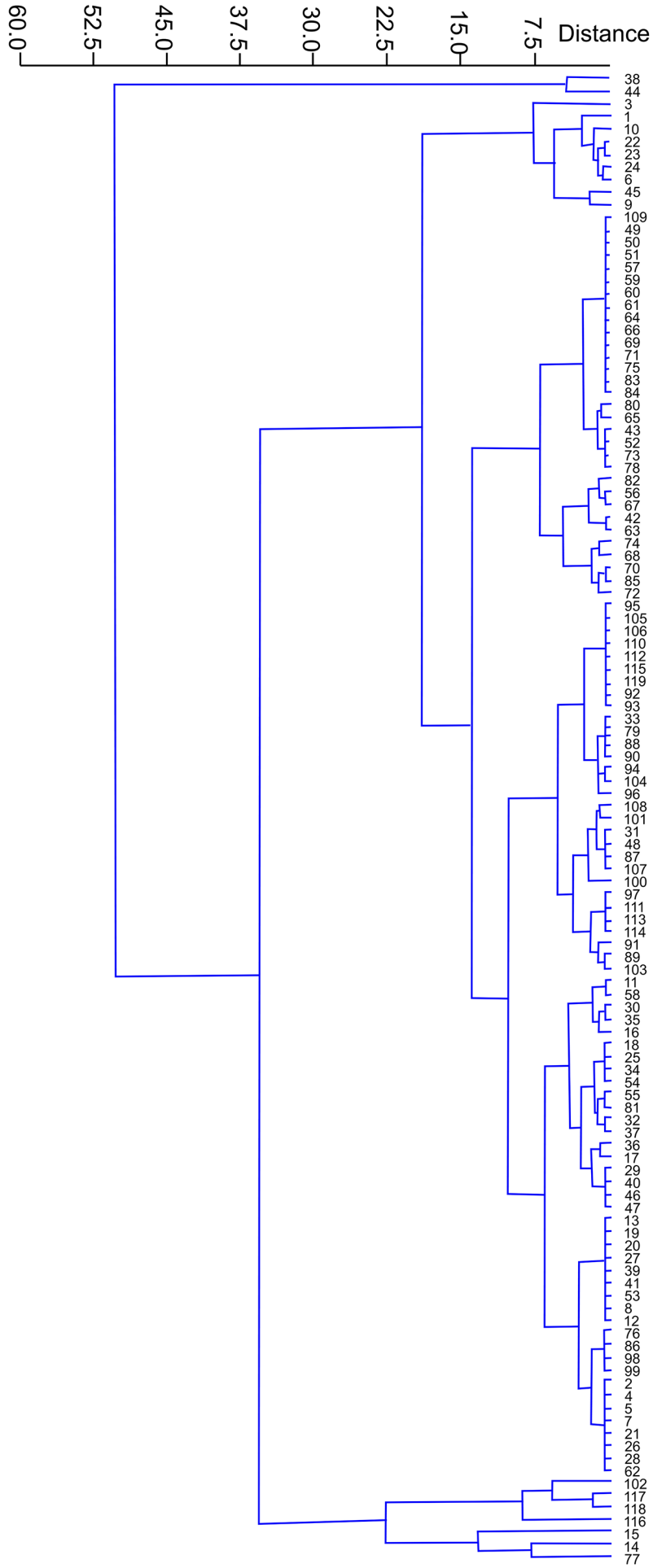


Figure 7. Orokolo *hohao* sample: hierarchical cluster analysis (Ward's method) of design elements (numerical codes).

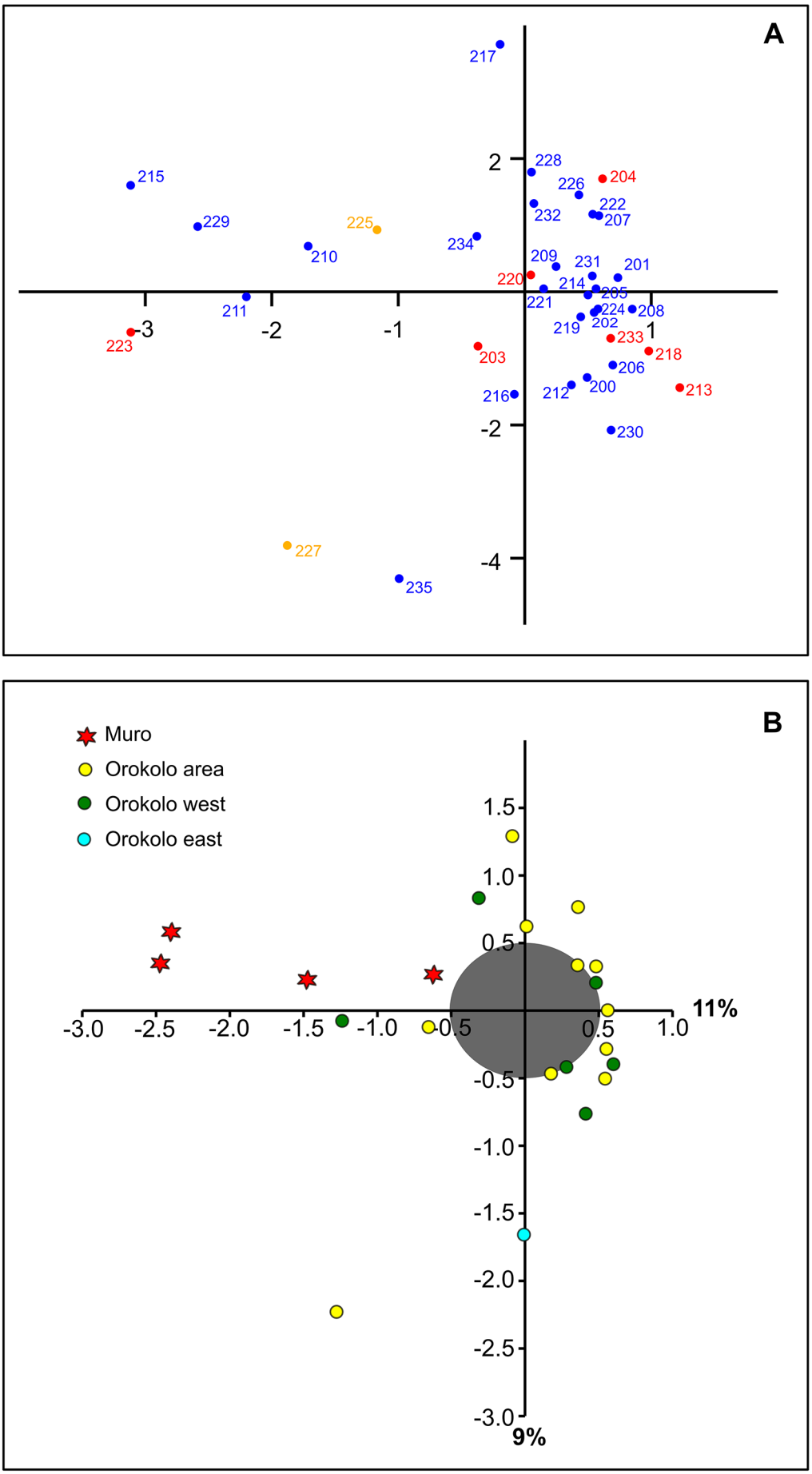


Figure 8. Orokolo pilot study multivariate analysis (CA) map, showing (*A*) distribution of design elements, with social motifs indicated in red, 'just decoration' in orange, and other design elements in blue; (*B*) plotting individual *hohao* showing locality attribution.

Figure 9. Comparison of Muro (*a–c*) and Orokolo (d, e) *hohao*. Reproduced courtesy of the Australian Museum. Pacific Collection reg. nos (from left to right) E023114, E026301, E024469, E000256 and E021046.

Kikori Delta in 1921 and 1922 (Australian Museum accession records). A. B. Lewis collected the two Kaivare boards and three others from Maipua in 1912. The remaining Maipua board, as well as the one from Kairu, were collected by A. C. Haddon, an English anthropologist, in 1914. The Mapaio (? Maipua) spirit board is an item from Schultze-Westrum's 1966 expedition to the Gulf. The boards attributed to Ukiravi and Urika date to 1915 and 1920, respectively. Macdonell is recorded as the collector for the first; the other has no source information. The *koi* sample totals 24 and is attributed to seven localities (Fig. 10). Like the *hohao*, the Purari *koi* incorporated distinctly human features, especially in their facial designs (Bell, 2009). *Koi* were individually owned and inherited patrilineally (Williams, 1924: 66–67, 84, 146).

The earliest of the 19 Urama Island spirit boards, *gope*, date to 1921/1922 and belong to the Australian Museum's Pacific Collection. Although not attributed to a locality, they were likely acquired at Kinomere Village, as is likely the case for three boards collected in 1930 by the Swiss anthropologist P. Wirz. The remainder of the Urama sample, with one exception, was collected by Schultze-Westrum at Kinomere in 1960 and 1966 and at Omaumere in 1966. The addition of recent spirit boards from Urama was a compromise to increase sample size. The last Kinomere board is held by the de Young Museum (San Francisco) as a part of the Jolika Collection (Friede and Friede, 2005: plate 466) and is dated to the late 19th/early 20th century. Urama *gope* boards differ from *hohao* and *koi* by not exhibiting prominent central designs characteristic of human forms (Schultze-Westrum, 2015). Also, they were not given personal names, nor were they associated with a patrilineal ancestor. *Gope* were not long-term family heirlooms or possessions. Schultze-Westrum further claims that Urama spirit boards are primarily related to head-hunting cults and served as the source of power and strength to vanquish one's opponents.

The design elements used for the Orokolo pilot served as the starting point for the analysis of this larger sample.

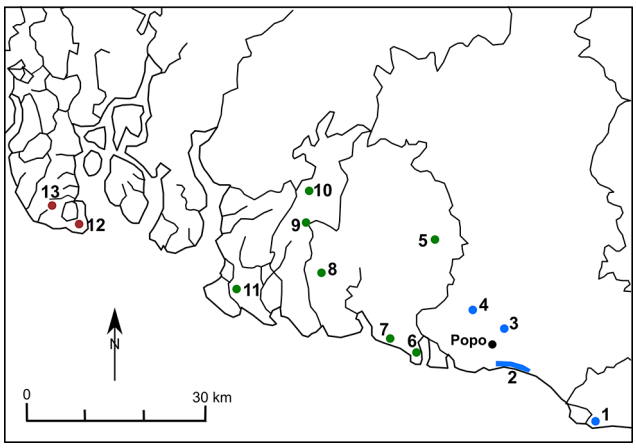


Figure 10. Western Elema-Urama region: historic villages discussed in the analysis—Urama (red), Purari (green) and Orokolo (blue). The numbers in parentheses in the key indicate the number of spirit boards appearing in the sample from each village (mapped from Johnston and Green, 1932; Gullick and Carne, 1913; unknown, 1942; unknown, n.d.; Wirz, 1934: karte 2). Key:

1	Vailala (5)	8	Maipaio/Mapaio (1)
2	Orokolo (40)	9	Kairu (1)
3	Paivera (1)	10	Ukiravi (1)
4	Muro (4)	11	Kaimari/Kaivare (10)
5	Iari (5)	12	Kinomere/Urama Island (17)
6	Maipua (5)	13	Omaumare (2)
7	Urika (1)		

New design elements were added as needed following the procedures outlined above. The analytical routine used, however, differs. Only the central panel (recording cells B, E and I) design fields, excluding design elements on the board's finial and stand, were analysed. This approach concentrated on the area of the spirit boards judged to contain the most definitive social motifs. Moreover, the number of design attributes were substantially minimised, thereby limiting the data matrix's size.

Analyses

The Western Elema-Urama spirit board sample consisted of 93 spirit boards from 13 localities. A total of 292 design elements were recorded for these boards. The resultant data matrix was very sparse with only 3% of the cells having a value of one. Unexpectedly, an exploratory CA using only three eigenvalues accounted for 100% of sample variability. Nevertheless, the attribute map for the first and second components (72% variability) showed an extreme degree of design element clustering around the origin, with one outlier either end of the X axis and two at each end of the Y axis. All but one of these outliers occurred on spirit boards from Purari villages and Urama Island. A Muro *hohao* with a central human figure was the exception. When these boards were removed from the sample and the CA recalculated, more than 40 eigenvalues were required to account for 75% of variability.

Consequently, I began assessing the data employing the same clustering routines used to group the design elements and social motifs in the Orokolo pilot study. The hierarchical cluster dendrogram (Fig. 11) demonstrated an unacceptably high degree of chaining when clustering spirit board design elements. In other words, there are excessive numbers of 'small clusters joining within a large cluster rather than forming new large clusters', and this leads to 'close groups being incorrectly merged' (Flynt and Dean, 2016: 211). This suggested that the clustering routine I had chosen to explore the design element dataset was not suitable.

Both the Orokolo elders and the ethnographic literature agree that eye and mouth motifs comprise principal clan markers. This suggested that creating a subset consisting of facial designs (forehead, eyes, nose and mouth) and any associated design elements (e.g., headdress or nose ornament) offered another avenue to analyse spirit boards. This procedure reduced the dataset to 106 design elements. The sample was reduced from 93 to 90 spirit boards by eliminating three Muro *hohao*, each with a complete human figure motif, which incorporated several facial design elements not recorded separately.

The nine prevalent design elements, those that occur 10 or more times in the facial design sample, are listed in Table 4. Fig. 12 illustrates their distribution in the Orokolo, Purari and Urama areas. Five significant findings emerge. First, the sawtooth headdress (DE #37) is virtually an exclusive characteristic of Orokolo *hohao*. Second, the lower nose motif (DE #75) holds almost the same importance among Urama *gope*. Third, three other motifs—'toothy smile' (DE #69), nose ornament (DE # 74) and solid line bordering face (DE #81)—also comprise important Western Elema design elements. Fourth, the half-moon-shaped forehead (DE #43), the most prevalent motif in the entire Western Elema—Urama sample, occurs across all three regions, although the percentage representations are not particularly high. Finally, the plain eye design (DE #64) and two mouth motifs (DE #67, DE #68) are shared in roughly comparable percentages in the study area, although the small number of occurrences warrants caution.

A hierarchical cluster analysis (Ward's method) of the facial design sample was undertaken to determine how

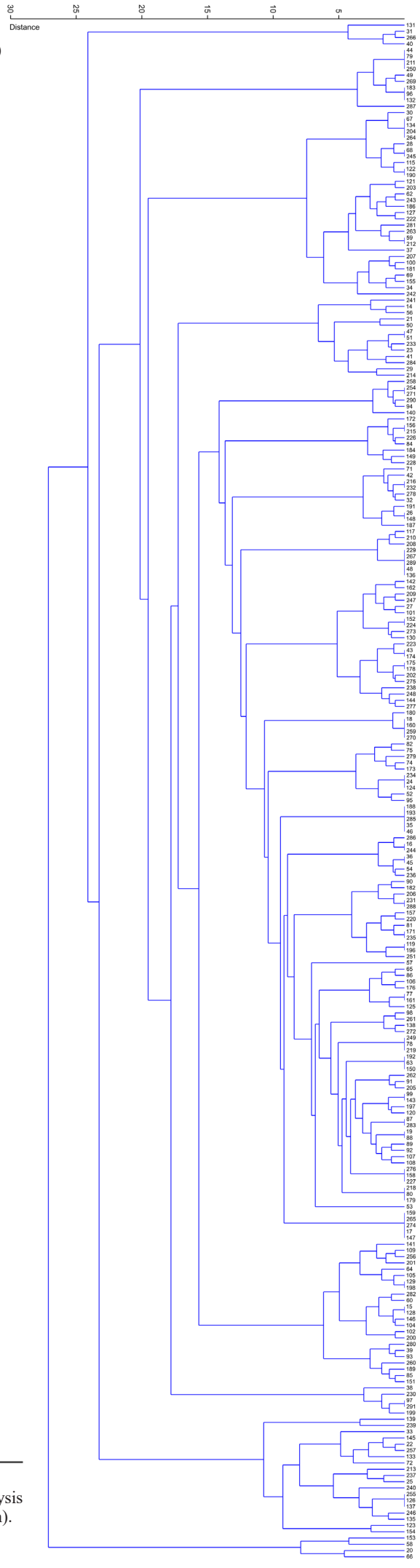


Figure 11. Western Elema-Urama spirit boards: hierarchical cluster analysis (Ward's method) dendrogram of design elements (code numbers shown).

Table 4. Western Elema-Urama facial designs sample: key motifs. These *design element (DE) codes* correspond with those used in Table 3.

Design Element (DE) Code	Description	Image
37	sawtooth headdress	
43	half-moon-shaped forehead	
64	plain eye motif	
67	v-shaped mouth	
68	oblong-shaped mouth	
69	'toothy smile'	
74	nose ornament	
75	lower nose motif	
81	solid line bordering face	

well the spirit boards in the sample formed groups. Fig. 13 presents the results. There were four unambiguous spirit board clusters or groups, each of which is divided into two subgroups for purposes of analysis.

Group 1 is an outlier consisting of 14 boards 'distantly related' (in terms of Euclidean distance) to the other three clusters. Spirit boards from each area occur in Group 1a and they all share the half-moon-shaped forehead, plain eye design and toothy smile motifs in common (Table 4). More than half of the spirit boards in Group 1b are attributed to the Urama Island region. DE #135 (mouth surrounded by red-infilled ellipse) is recorded on three spirit boards, two of which are Kinomere *gope* (Table 5). Group 2 comprises 26 *hohao* and one *koi* and is not closely 'related' to the other groups, perhaps due to the high number of *hohao*. The single *koi* (Kaimari) has a very distinctive cheek hook design (DE #84), but the presence of 'toothy smile' and nose ornament design elements, discussed above, demonstrates that the board has some affinity with Orokolo *hohao*. So far, this analysis indicates a trend towards culturally specific design elements.

Groups 3 and 4 are closely related to one another and comprise 29% and 26%, respectively, of the facial design sample. Group 3a has an even distribution of boards from all three regions. Aside from the occurrence of social motifs among the sample, few design elements appear more than once. Group 3b primarily consists of Orokolo and Urama boards that have rare design elements, demonstrating little overlap. Two design elements—DE #126 (elongated eye) and DE #137 (triangular mouth)—only occur together on

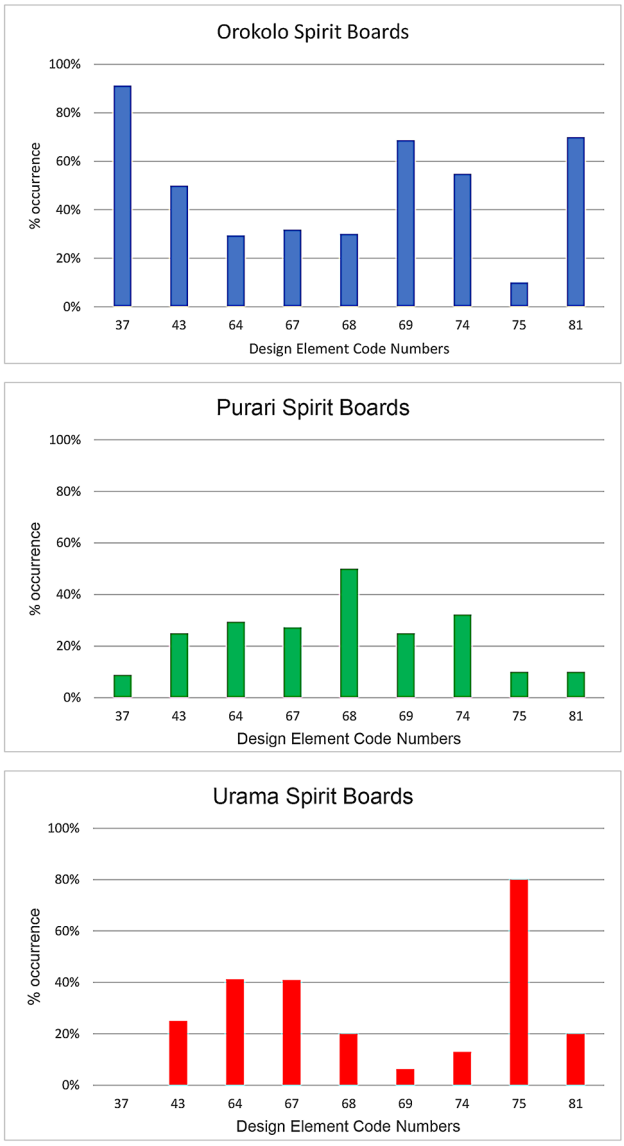


Figure 12. Western Elema-Urama spirit board 'facial designs' sample: histogram illustrating the distributions of the most prevalent design elements occurring on spirit boards from different cultural areas.

two Urama spirit boards, perhaps reflecting a 'classic' *gope* design. Group 4 has notably different subgroups—4a being a relatively even distribution of boards from the three regions, whereas Purari and Orokolo boards comprise the larger 4b subgroup. Here the sharing of common design elements across cultural boundaries is absent. This provides an opportunity to investigate locality-specific design elements. Among 4b spirit boards, there are four examples where the multiple occurrences of village-specific designs occur in the entire Elema-Urama Island sample. These include (see Table 5):

1 DE #94 (two-pronged eyes)—Kaimari
2 DE #117 (elongated curvilinear eyes)—Iari
3 DE #122 (flared eyes bordered by parallel sawtooth lines)—Orokolo
4 DE #155 (parallel lines across bridge of nose)—Orokolo

In summary, general trends begin to emerge when instances of particular design elements occur on more than 10% of the spirit board sample. These instances are rare, so inter-regional motif sharing is not demonstrated. A sample of spirit boards exhibiting fewer design elements is

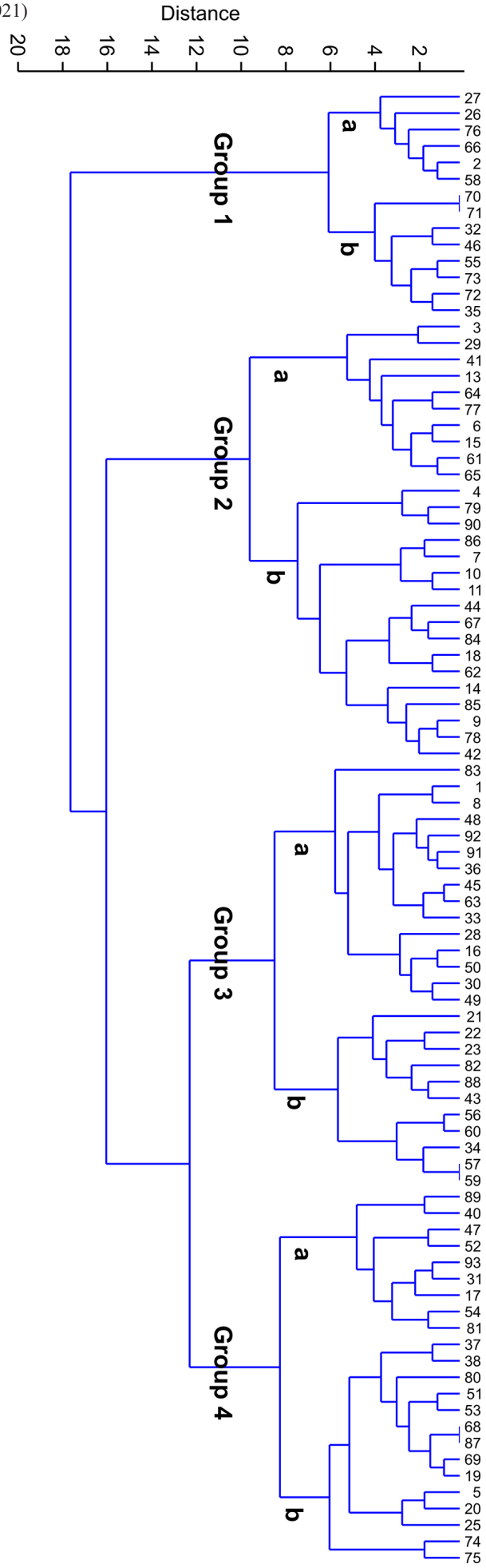
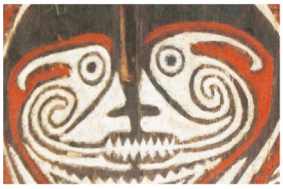
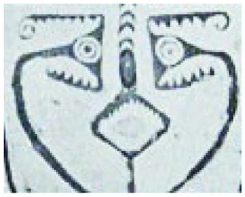


Figure 13. Western Elema-Urama spirit board 'facial designs' sample: hierarchical cluster analysis (Wards method) dendrogram indicating board groupings.

Table 5. Western Elema-Urama facial designs sample: rare motifs. New *design element (DE) codes* were assigned for the Western Elema-Urama Island sample; therefore, they do not correspond with those described in Table 3.

Design Element (DE) Code	Description	Image
84	cheek hook feature	
94	two-pronged eye	
117	elongated curvilinear eye	
122	flared eye bordered by parallel sawtooth lines	
126	elongated eye	
135	mouth surrounded by red-infilled ellipse	
137	triangular mouth?	see 126 above
155	parallel lines across bridge of nose	

required to be more confident of the results. This suggests that minor differences between design elements and social motifs probably occur and these are the product of inexact replication of motifs when a dilapidated spirit board is copied. If correct, future analyses will improve if very similar motifs are combined rather than differentiated. This will, in turn, assist more efficient recording of spirit board designs, identifying 'analytical' motifs and interpreting design elements that are shared across regional cultural boundaries.

Conclusion

This study of Papuan Gulf spirit boards was intended to be speculative and exploratory. The use of design elements as proxies for social systems has not been widely tested in the New Guinea context. The pilot study of Orokolo *hohao* demonstrated how different design fields were used for different designs along board margins, even though they are not as well-documented ethnographically as are the motifs on a board's central panels. The study also showed that spirit boards possess patterns of design elements at a geographical level of differentiation. This supports regional cultural level investigations, but perhaps not the contribution of local variability to social boundaries, unless a large collection of spirit board images is available. An analysis comparable to the Orokolo pilot study might be expanded for *hohao* collected among Elema communities farther to the east. An analysis of spirit boards from across the entire Kikori-Purari Delta region also seems possible. However, a more robust sample will also be required if the degree to which design elements were shared between the different cultural groups is to be detected. For example, Fig. 12 suggests that while the Elema possessed a clear set of design elements, others were shared with the Purari and Urama. However, it is unclear which ones were not shared and this knowledge is essential in order to analyse the social networks in the Papuan Gulf.

This study demonstrated that 'simple' Correspondence Analysis has its limitations. McDonald (2009: 241) observed that variables often need to be aggregated to avoid the impact of rare attributes, which may result in the remaining variables becoming clumped around the centroid in a CA map. Creating clustered variables for the Orokolo pilot study helped alleviate this problem but failed to do the same for the Western Elema-Urama study. Different CA routines (Greenacre, 2010, 2013; de Leeuw, and Mair, 2009) may prove to be more applicable. Regardless, descriptive analysis similar to that undertaken for the facial designs database will likely prove to be a better starting point from which to initiate multivariate analyses.

Finally, the safe answer to the question of the likely age of spirit board use is c. 140 cal. BP. That was the time when the Western Elema's ancestral village Popo was abandoned, probably because the coastline shifted southward from its much earlier position near their settlement. Some people moved south nearer to the new coastline and others settled the areas farther inland in the vicinity of Muro. A less cautious estimate is that *hohao* came into use not long after the Popo area was settled, about 600 BP (Urwin, 2018: 261). At this time, as the oral history tells us, there was major social change among the people and Urwin (2018: 108) surmises that this was when the Western Elema clan system was established.

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Appendix 1. Western Elema-Urama spirit board sample: source information.

spirit board analysis codes[a]		source Information
1		Brake *et al.*, 1979: fig 55
2		Welsch *et al*., 2006: fig. 13
3		Welsch *et al*., 2006: fig. 92
4		Welsch *et al*., 2006: fig. 95
5	(1)	A015768[b]
6	(2)	E000256
7	(3)	E000257
8	(4)	E000258
9	(5)	E021046
10	(6)	E022633
11	(7)	E022634
12	(8)	E023104
13	(9)	E023105
14	(10)	E023108
15	(11)	E023109
16		E023110
17	(12)	E023112
18	(13)	E023113
19	(14)	E023114
20	(15)	E024469
21	(16)	E024471
22	(17)	E026296
23	(18)	E026299
	(19)	E026300[c]
24	(20)	E026301
25		E027126
26		E027129
27		E027136
28		E028092
29		E028094
30		E028096
31		E028102
32		E028104
33		E028106
34		E028107
35		E028108
36		E028109
37		E035104
38		E035106
	(21)[d]	
39	(22)	E072964
40	(23)	E072965
41		Webb, 2015a: plate 1
42		Webb, 2015a: plate 3
43		Webb, 2015a: plate 9
44		Webb, 2015a: plate 17
45		Webb, 2015a: plate 29
46		Webb, 2015a: plate 31
47		Webb, 2015a: plate 33
48		Webb, 2015a: plate 34
49		Webb, 2015a: plate 41
50		Webb, 2015a: plate 45
51		Webb, 2015a: plate 46
52		Webb, 2015a: plate 47
53		Webb, 2015a: plate 48
54		Webb, 2015a: plate 49
55		Webb, 2015a: plate 105
56		Webb, 2015a: plate 108
57		Webb, 2015a: plate 109
58		Webb, 2015a: plate 115
59		Webb, 2015a: plate 116
60		Webb, 2015a: plate 125
61	(24)	Beier & Kiki, 1970: plate 1
62	(25)	Beier & Kiki, 1970: plate 2
63	(26)	Beier & Kiki, 1970: plate 3
64	(27)	Beier & Kiki, 1970: plate 4
65	(28)	Beier & Kiki, 1970: plate 5
66	(29)	Beier & Kiki, 1970: plate 7
67	(30)	Beier & Kiki, 1970: plate 8
68	(31)	Beier & Kiki, 1970: plate 9
69		Beier & Kiki, 1970: plate 10[e]
70		Friede & Friede, 2005: plate 464
71		Friede & Friede, 2005: plate 465
72		Friede & Friede, 2005: plate 466
73		Friede & Friede, 2005: plate 469
74		Lewis, 1973: plate VI.1a
75		Lewis, 1973: plate VI.1b
76		Lewis, 1973: plate VI.2a
77		Lewis, 1973: plate VI.2b
78		Lewis, 1973: plate VIIa
79		Lewis, 1973: plate VIIb
80		Lewis, 1973: plate VIIc
81		Lewis, 1973: plate VIIIa
82		Lewis, 1973: plate VIIIb
83		Lewis, 1973: plate VIIIc
84		Lewis, 1973: plate Xd
85		Lewis, 1973: plate XIIa
86		Lewis, 1973: plate XIIc
87		Lewis, 1973: plate XIVc
88		Lewis, 1973: plate XIVb
89		Newton, 1961: fig. 42
90		Newton, 1961: fig. 43
91		Newton, 1961: fig. 187
92		Newton, 1961: fig. 188
93		Newton, 1961: fig. 189

[a] Spirit board codes for Orokolo pilot study are indicated in parentheses.
[b] Pacific Collection, Australian Museum alphanumeric registration number.
[c] E026300 is exceptionally small when compared with other boards in the Western Elema to Urama sample and was excluded from this sample. It was included in the Orokolo pilot study only to increase sample size.
[d] The provenance for spirit board E057244 (21) is uncertain and was dropped from all analyses before they began.
[e] The design elements for spirit board 69 were quite different from others in the Orokolo pilot study, and predictably this board would have been an outlier in the analysis; therefore, this board was omitted from the pilot. However, given that the overall diversity of design elements in the Western Elema to Urama sample was substantially greater, this board was included in this latter sample.