

# Chapter 3

## Telling Stories Through R: Geo-Temporal Mappings of Epigraphic Practices on Penghu



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### 3.1 It Takes a Story to Catch a Fish

Fishermen on Penghu, like all over the world, sit endless hours at the pier to chat and mend their nets. Stitching together piece by piece, they shape the tool that allows them to engage with their environment beyond the limits of their eyes and hands. Their stories and languages, woven centuries ago by their ancestors, are spun from the same yarn. These linguistic structures help to catch an environment in categories and causal relations based on the experience of generations and not accessible to immediate perception (Harrison 2007).

Scientists likewise have to acquire and culture a craftsmanship, which involves skills, tools, and a language. Skills are needed to operate tools and languages translate the outcome of the operation into meaningful stories that offer new perspectives on the world. Scientific endeavors thus frequently involved quests for new tools. Once developed, tools such as the telescope of Galileo (Brown 1985) or the British National Corpus (Leech 1993), have pushed scientists to perceive the old world in unpronounceable forms and shades, which then had to be cast into new languages, terms, and stories, such as *earth orbit* or *collocate* to explain, consolidate, classify, trigger, and transmit perceptions and insights.

The research presented here has been conducted in the framework of the the *ThakBong* project, a project in the Digital Humanities, which was started in April 2007 with the general intention to document and research funerary and epigraphic

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practices on Taiwan (Streiter et al. 2011), combining ideas and theories from different disciplines in the humanities and social sciences, such as linguistics, anthropology, sociology, and archaeology.

In the course of this long-term effort, 618 gravesites have been documented on the Taiwan archipelago, capturing and annotating 279,423 photos of 61,351 tombs.

Our craftsmanship is based on easy knitting patterns. Setting out on field trips in rhythms that follow the climate and local calendars, we visit burial grounds, clean tombstones, and harvest digital, geo-tagged photographic images. At home in our lab, our primary data are post-processed, annotated, and transcribed. Then, our catch, like processed fish, is frozen on mirrored hard drives to be preserved for the decades to come. Continuing this lossless accumulation of data, we weave a net that continues to capture unexpected phenomena whenever the size of the net increases or its meshes get smaller. New catch may include historical events like flooding, epidemics, or waves of migration.

The catch we get by casting our net over local graveyards can be read as a newspaper of regions where no reporter showed up, as a population census where no official kept records, as a *who is who* of a village where now buildings scrape the sky and as a map of a deadly battle field where people struggle over ethnicity, nationality, religion, space, symbols, and the meaning of life. Having these unwritten documents in one's hand is a truly exciting, awe-inspiring, and humbling experience. It is worth for us to get dirty hands during fieldwork and for the reader to get sweaty hands on a keyboard, exploring data and tools.

The tool we use to explore our data is the *R programming language* (R Development Core Team 2008). *R* is one of the Swiss army knives that is popular with digital humanists. As a programming language, *R* is slightly different from some of its competitors, such as Python, and might thus provide an alternative gateway into the world of coding.<sup>1</sup> *R* is free and rich in its features. Its graphics are awesome and yet it is easy to start with. To install *R* on your computer, visit the Comprehensive R Archive Network web pages at <https://cran.r-project.org/> and to follow instructions given there.

A second tool we introduce implicitly is *KnitR*. Through *KnitR*, one can include *R* commands in one's *latex* or *markdown* text to produce tables and graphics on the fly, tapping dynamically into data stored in a spreadsheet file or a database. This is what we will attempt in this paper. Graphics and tables are produced by the commands that you see within this text.

All the catch we managed to freeze in digital format has been prepared and packaged to be loaded onto your computer. A first package, small and easy to handle, contains the data: index numbers, transcriptions, and classifications. A second package, huge in size, contains hundreds of thousands media files and can be downloaded for browsing tombs and tombstones in search for inspiration, a confirmation, an example, or an explanation, in other words, something you assume

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<sup>1</sup>Loops can frequently be avoided in *R* and a programming code consists of a sequence of function calls, the outcome of which is assigned to variables with meaningful names.

you cannot find in the bare data. Data and media files have been archived and can be accessed at *DANS*,<sup>2</sup> at <http://dx.doi.org/10.17026/dans-zvy-rtju> and <http://dx.doi.org/10.17026/>, respectively. In addition to these packages, a third package has been put at your disposal, containing programming code that has been written with the intention of facilitating the access to these funerary and epigraphic data, preparing them to be fed into standard analysis modules. The first and the third package can be downloaded from <http://thakbong.dyndns.tv/R>.

As a first exercise on *R*, we will download the first and third package, into an existing folder on your computer.<sup>3</sup> R-code like the code above reads usually from right to left. A value is created on the right side and assigned, through the assignment operator `<-`, to a variable on the left side of the operator `<-`, e.g., `source.dir`.<sup>4</sup>

```
source.dir <- '/home/oliver/R'
source('http://thakbong.dyndns.tv/R/ThakBongRHTTP.R')
```

After running these commands in *R*, you will notice that the folder you have specified has been populated with numerous files. The `.R` files are the functions, the `.gz` files are the data in a compressed format.

The data package is subdivided into different cans, each of them formatted as compressed comma separated value (CSV) file, uncompressed by *R* the moment they are read in. Each file contains one data frame, representing each one entity type, such as *tombstone*, *tomb*, *graveyard*, etc. To read them into *R* and connect them in the right way, you best use some functions we prepared in the third package of *R* code.

After downloading helper functions and data onto your computer, you can load them into your *R*-session as shown in the following code snippet.<sup>5</sup>

<sup>2</sup>The *Data Archiving and Networked Services* is an institute of the *Royal Netherlands Academy of Arts and Sciences (KNAW)* and *Netherlands Organization for Scientific Research (NWO)*.

<sup>3</sup>In Line 1, you specify a folder on your computer that should contain the data and functions. If not existing, you have to create that folder before. In Line 2, you start the download into this folder.

<sup>4</sup>*R* knows also a right assignment `->`, allowing to write lines from left to right. As most and earliest programming languages used the left assignment, most people are used to read and write code from right to left. With the right-assignment however, one has in *R* the opportunity to write highly readable code in the style of UNIX pipes using the `magrittr` package.

<sup>5</sup>Line 1: You specify the folder into which you downloaded the *ThakBong* data. Line 2: All functions and commonly used data are loaded. You can always start your analysis of *ThakBong* data in *R* with these two lines, unless you want to update functions and data from the online repository.

```
source.dir <- '/home/oliver/R'
source(file.path(source.dir, 'ThakBongRLocal.R'))
```

Once the material loaded from the local folder into your *R*-session, variables and functions become available to you. A central variable is `df.thakbong`, a variable that contains all information on all graveyards, tombs, tombstones, and tombstone inscriptions, merged into one big dataframe.<sup>6</sup> Function you might apply to this dataframe are `get.stone.form`, `get.stone.height`, `get.stone.width`, `get.stone.material`, `get.tomb.altitude`, or `get.tomb.direction` which, as you might expect, extract the requested values from a dataframe you feed into that function as parameter.

Filtering the data frame is a central procedure that prepares every analysis. Helper functions of the type `has` or `is` operate as filters that retain relevant rows. In the example code below, we retain only graveyards located in Asia, the region we are going to focus on.

```
df.asia <- is.asia(df.thakbong)
df.penghu <- is.penghu(df.asia)
df.penghu.year <- stone.has.creation.year(df.penghu)
remove(df.thakbong)
```

Much of the success of your analysis will rely on how you segment the data. If you compare groups that have nothing in common, little follows from your comparison. Likewise, if you compare groups that are internally very diverse, you do not know which attribute of the group is responsible for the difference between groups. In the ideal case, you create a homogeneous group that distinguishes itself through well-defined features from the comparison groups. Groups may differ according to time, space, surname, or position in a social network. To create these groups, *R* puts at your disposal two important techniques. The first allows

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<sup>6</sup>A data frame stores data tables, similar to data tables in a relational database. `df.thakbong[1,]` returns the first row, `df.thakbong[,1]` the first column, and `df.thakbong[1,1]` the first element in the first column. The values of one column are stored in a vector. A vector is a sequence of data elements of the same type, e.g., all elements must be numerical or textual. A vector can be created by combining different elements, as in `kids <- c('Mary', 'Bill')`. The data in this vector can be accessed, e.g., as in `kids[1]`, which would yield “Mary.”

to split any dataframe into a list of smaller dataframes.<sup>7</sup> The second technique works on the output of the first and facilitates the run through all smaller dataframes, processing them one by one.

The splitting of a dataframe is done with the help of the `split()` command. The dataframe `graveyards`, for example, can be split into different sorts of `graveyards`, specified by any combination of names of columns by which you want to split. The following command splits `graveyards` according to the archipelago the graveyard resides on and the country code. The output is a list of dataframes. Adding `drop=TRUE` removes graveyards without reference to an archipelago or a country code.

```
df.archipelago <- is.archipelago(df.asia)
list.df.archipelago <- split(df.archipelago, list
  (df.archipelago$graveyard.archipelago,
  df.archipelago$graveyard.country.code), drop=TRUE)
```

To run through such a list of dataframes, to extract or calculate some values, or to draw a graph or map for each of these dataframes, we use functions of the `apply` family.<sup>8</sup> Functions of the `apply` family achieve in R what other programming languages achieve through loops.<sup>9</sup> What would be the body of the loop can be expressed in a function which can then be repeatedly applied to a split dataframe.<sup>10</sup> Using this technique, we can, for example, count for each archipelago the number of tombs sampled in the ThakBong project (`sum(x$number.of.tombs)`), as exemplified in Fig. 3.1. For simple task, you can combine `split` and `apply` in the aggregate function which splits and applies a function with one command.

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<sup>7</sup>A list is more flexible than a vector as it may contain any combination of simple and complex values. A list is created through the operator `list` as in `age<-list(kids,c=(12,11))`. The second (complex) element of this list can be accessed as `age[[2]]`. As `age[[2]]` is a vector, we can access the age of the first kid directly as `age[[2]][1]`.

<sup>8</sup>The function `lapply` returns a list and `sapply` simplifies the output and returns a vector if possible. The `mapply` function applies a function repeatedly with different parameters for each application.

<sup>9</sup>Loops are a much debated design feature of computer languages. Hated by some and beloved by others, they are frequently believed to be hard to read and hard to be maintained. Although R offers the possibility to avoid loops in many cases, one is free to use loops of functions of the `apply` family.

<sup>10</sup>You can use an existing function in `mapply` or construct an unnamed function in `sapply` and `lapply`. This function is then applied to each of the split data frames. If you have to use an unnamed function but the functionality is given in available functions, you can call the existing function from within the unnamed function, as in `function(x,y) YOURFUNCTION(x,y)`.

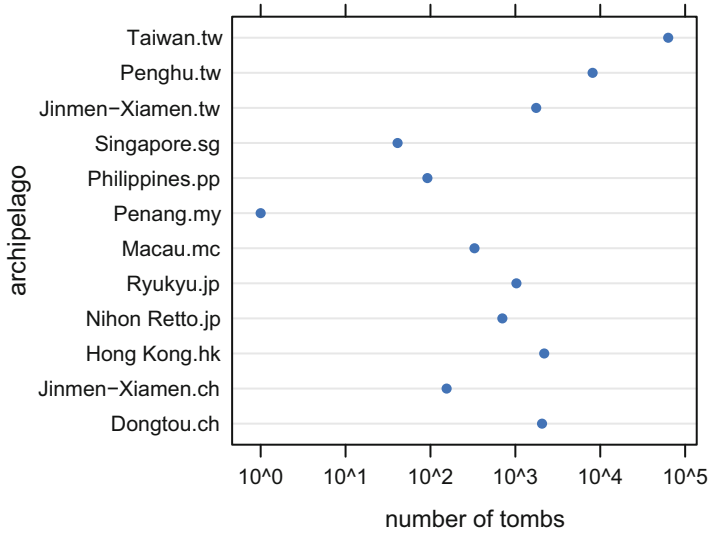


Fig. 3.1 The number of tombs per archipelago surveyed within the ThakBong project

```
dotplot(sapply(list.df.archipelago, function(x)
  nrow(x)), ylab='archipelago',
  xlab='number of tombs', scales=list(x=list(log=TRUE)))
```

### 3.2 From History to Code

Funerary and epigraphic practices vary from place to place and from time to time. When mapping these variations through space and time, we seldom see a random distribution. The variations that can be attested on Taiwan and Penghu burial grounds frequently relate to turning points in local political and social histories. These turning points, experienced by local people as states of crisis, caused funerary and epigraphic practices to be adjusted directly or indirectly, sometimes overnight, sometimes after one or two generations. In different regions, transformations may yield different forms, or we might say, find different solutions, even if driven by the same cause, depending on how local agents harmonize locally established practices with new political and social contexts. Either the local conditions before the crisis might have been different or local agents come up with new and creative ideas. Unfortunately, turning points in Taiwan's and Penghu's political history relate frequently to the rise of nationalism and colonialism in East Asia.

Back in the fifteenth and sixteenth century, sign boards like “Welcome to Taiwan” were certainly not installed along Taiwan’s coastline to tell early explorers, pirates, and shipwrecked sailors where they had stepped ashore. Long time after Penghu had appeared in Chinese travel accounts<sup>11</sup> and on Chinese maps, Taiwan and its neighboring islands were still terra incognita to China and contemporary names used were of uncertain reference within a region that stretches from Okinawa to the Philippines. For this reason even today, after extensive research on wind directions, currents, vegetation, and landscape, one frequently cannot tell which islands travellers have actually set their foot on, basically because these travellers could not know themselves (Ptak 2015). Therefore, Ptak hypothesizes that commanders of expeditions might have systematically reported to have visited the islands they were supposed to visit to avoid any backlash.

Among the first written histories that can reliably be associated with the island that we call Taiwan today are those that come from Dutch and Spanish accounts of their patchwork colonization of the island in 1624 and 1626. The name *Taiwan* as used by the *Dutch Verenigde Oostindische Compagnie* (VOC) in the seventeenth century derives from a native Austronesian group’s self-name. After 16 years of sharing the island, the Spaniards were ousted by the VOC, who in turn were besieged in 1662 by Koxinga (鄭成功 Zhèng Chénggōng), a merchant and swashbuckler loyal to the Chinese Ming Dynasty (明朝 Míngcháo). At that time, the Chinese government was under military pressure from its northern Jurchen neighbor, the Qing State (Manchurian: Daicing Gurun, Mandarin: 清朝 Qīngcháo), established in 1616 in Manchuria.

Many highly ranked Ming militaries recognized the weakness of the Chinese state and joined the new emerging colonial power. Not so Koxinga. After the Manchurian invasion of China and the suicide of the last Chinese emperor Chongzhen (崇禎 Chóngzhēn) in 1644, Koxinga and his family, surnamed Zheng (鄭 Zhèng), conquered Penghu and Taiwan in 1661 and maintained a Ming-loyal state for 20 years, until, in 1682, these islands also succumbed to the Manchu forces. The social transformation during the Zheng period were highly significant for Taiwan’s social structure: The Chinese population on the island, under the Dutch at the bottom end of the social pyramid, obtained under the Zheng regime a social position that was higher than that of the Indigenous population, see Brown (2004), receiving material and legal benefits in an evolving Han-state that was threatened internally and externally by non-Han ethnicities.

Modernity started abruptly in 1895 with a Japanese surprise attack and the occupation of the Penghu archipelago, while still negotiating with Qing representatives in Shimonoseki. In the treaty of Shimonoseki, signed the same year after the occupation of Penghu, the Qing ceded both Penghu and Taiwan to the Japanese Empire, marking the beginning of a 51-year-long Japanese period during which Taiwan and Penghu were developed into a lucrative colony and a military outpost

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<sup>11</sup>An early travel account on Penghu can be found in 汪大淵 Wáng Dàyuán (Wang Dayuan) (1339/1981).

for later attacks of the Imperial Army on Southeast Asia. As part of their critical role in the Japanese war machine, Taiwan and Penghu were bombed, similar to Okinawa, towards the end of World War II by the US military.

Unlike Okinawa however, the US military did not occupy Penghu and Taiwan after WWII and allowed instead Chiang Kai-shek (蔣介石), who had followed Sun Yat-sen as the head of the Chinese Nationalist Government, to install on Taiwan and Penghu the Republic of China, a one-party-state under the Kuomintang.

Although Taiwan has only a surface that corresponds to Switzerland, not all colonial regimes managed to rule over the entire territory of Taiwan, as Taiwan's Indigenous population fiercely defended their native lands. This limited control is especially true for the Dutch and the Spaniards, but also for the Zheng and Manchurian regimes. Would this extension of the regimes reflect in the distribution of tombs on Taiwan, which are essentially Han-tombs, in different time periods? An easy way to answer such a question is to draw with R a digital map.

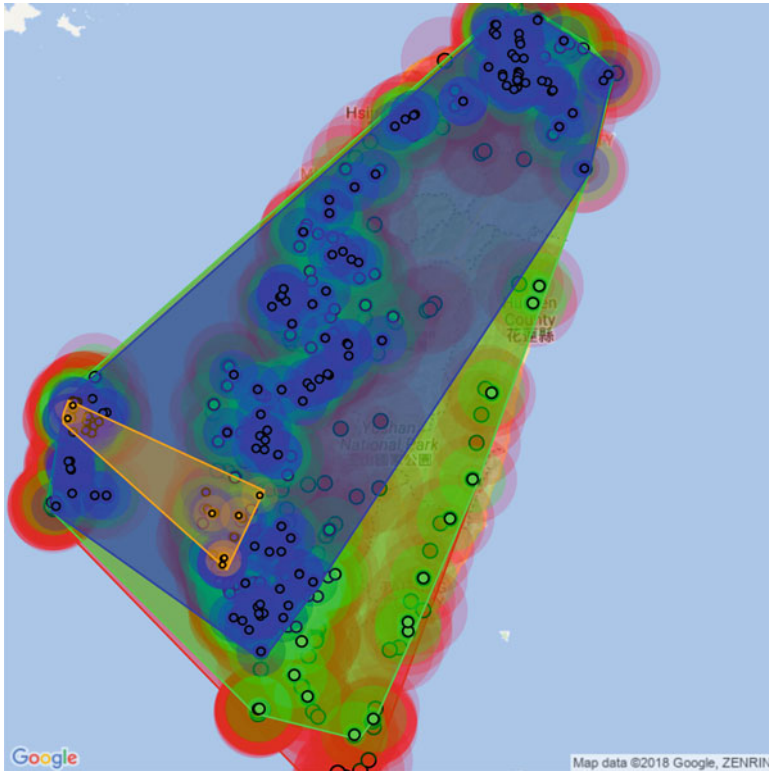
The first step in drawing a map is to create a canvas. A canvas is a background map, which we can be repeatedly loaded as unpainted geo-referenced background for drawing geo-referenced lines and dots. Using maps provided by Google, we create and store two canvases for Penghu and Taiwan. Parameters to create these maps are the map type, the zoom level and the geo-references of the center of the map.<sup>12</sup> As long as we do not call a plot command, e.g., through `PlotOnStaticMap(canvas.penghu)` nothing visible happens to a canvas at this stage.

```
NEW=TRUE; if(file.exists('PenghuCanvas.png'))
  { NEW <- FALSE }
geo.penghu <- c(23.5,119.583333)
geo.taiwan <- c(23.69781,120.9605)
map.type <- 'mapmaker-roadmap' #or: roadmap,
           satellite, hybrid
canvas.penghu <- GetMap.bbox(destfile=
  'PenghuCanvas.png', zoom=10,
NEWMAP=NEW, maptype=map.type, center=geo.penghu)
canvas.taiwan <- GetMap.bbox(destfile=
  'TaiwanCanvas.png', zoom=8,
NEWMAP=NEW, maptype=map.type, center=geo.taiwan)
```

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<sup>12</sup>As maps and geo-locations are loaded through the internet, this step requires your computer to be online.





**Fig. 3.2** Tombs of the Zheng (orange), Qing (blue), Japanese (green) and ROC (red) period on Penghu and Taiwan

Using our prepared canvases, we can draw a convex hull around all tombs of specific periods to approximate the distribution of tombs. The result is shown in Fig. 3.2.

```
map.period <- function(canvas, df, color, size) {
  map.chull (canvas, df$x, df$y, col=color)
  map.points (canvas, df$x, df$y, size, color) }
####
roc <- period.is.roc.roc(df.asia)
japan <- period.is.roc.japan(df.asia)
qing <- period.is.roc.qing(df.asia)
zheng <- period.is.roc.zheng(df.asia)
PlotOnStaticMap(canvas.taiwan)
```

(continued)

```
zero <- mapply(map.period, list(canvas.taiwan),
               list(roc, japan, qing, zheng),
               c(color.roc, color.japan, color.qing, color.zheng),
               c(2, 1.5, 1.1, 0.8))
```

As we can see, even though most tombstone of the Zheng area (orange) have been lost, their spatial distribution has been limited, owing to the fact that the Zheng family controlled mainly Penghu and the Tainan area. The Qing (blue) extended their control of territories, but not to the south, east, or the central mountain range. The Japanese forces (green) forcefully brought the entire island under their control, providing the ground for the first Han-settlers to establish farms and villages along the east-coast from 1910 on. Most tombs on these maps are Han tombs. Indigenous tombs appear on this map from the late Japanese period on, when the Austronesian communities, moved to lower locations and forced to bury in regular graveyards, started to use permanent grave markers. Most red dots with or without tiny green spots thus point to Indigenous communities.

Plotting data points on a map, as we did above, is a way of reporting surveyed data. Plotting a convex hull around data points (`map.chull`) is an act of generalization, an attempt to come up with a story the dispersed points cannot tell. Unfortunately, the convex hull we created glosses over a complex reality, as being based on closeness in terms of geo-references alone, not considering the nature of the terrain or the availability of transportation routes. The interpolation over the central mountain range, which separates Taiwan's east and west at an altitude of 3000 m, shows that this technique has to be handled with more delicacy. Striking the balance between reliably reporting data, on the one hand, and mapping an interesting story, on the other, remains a permanent struggle when drawing maps or timelines. Whenever values are rounded, lines smoothed or interpolated, the story should originate from that part of the graph where data and generalizations seem to converge.

### 3.3 Approaching Penghu

Doing fieldwork on Taiwan and analyzing its burial and epigraphic practices, we soon realized that our original spatial framing limited the ability to interpret the emergence, variation, and distribution of observed practices. We hypothesized that funerary and epigraphic practices outside Taiwan would hold important keys for understanding our observations on Taiwan (Streiter et al. 2010). Considering migration paths and colonial influences, the project thus extended systematically its scope. Burial grounds on Penghu, Jinmen and Mazu, Okinawa, Honshu, Zhejiang, Fujian, Hong Kong, and Macao have been documented, as well as graveyards in

places where migrants from Guangdong, Fujian, and Zhejiang have moved to in the USA, Europe, and Southeast Asia.

In this process, Penghu was studied intensively, as on our first few visits we found in most parts of the archipelago Qing and Japanese period tombs in larger quantities than on Taiwan. We hoped that this rich historical resource of epigraphic practices would allow us to identify influences on practices on Taiwan given the large-scale migration, including that of carvers, that took place in the twentieth century from Penghu to Taiwan. Yet, to our surprise, we found that Penghu was not a space of homogeneous cultural practices.

As our documentation proceeded from islands of island, we found on Penghu yet undocumented island-specific carving practices, unknown on Taiwan or regions in China we had surveyed. The formation or the preservation of these idiosyncratic practices had been facilitated by the natural fragmentation of Penghu into relatively autonomous islands, an isolation that might have ended not before the arrival of modernity in form of the Japanese colonial army and its systematic effort to construction harbors on islands that before could only be reached by rowing boats. Having thus found practices that matched those on Taiwan and practices unknown on Taiwan, we had to understand what distinguished these practices so that some were exported to Taiwan while others were not.

As a result, between 2010 and 2017 we undertook 19 field trips on Penghu documenting 77 burial grounds on 14 islands through 30,437 photos of 8154 tombs. Although these numbers seem to compare unfavorably to those of Taiwan, many small islands and many burial sites have been exhaustively documented. We thus estimate to have surveyed more than 70% of all existing tombs, which represents a larger coverage than we can ever achieve on Taiwan.

Penghu is an archipelago about 45 km to the west to Jiayi on the west coast of Taiwan and 185 km to the east of Shantou, China. China is closest when heading in the direction of Jinmen, from where most families on Penghu had migrated in the late Ming and early Qing period. The ferry from Jiayi takes 2 h to carry a swarm of tourist to the harbor of Makong. The cargo ferry from Kaohsiung travels overnight, leaving the traveller stranded on the pier among refrigerators, bags of rice, flowers, motorbikes, and huge piles of cement bags. Modern Makong lies at the periphery of Kaohsiung, at least in the world of goods and many family links. Already before entering the harbor of Makong, many of the 80 islands and islets of this archipelago can be spotted from the ferry. Military outpost and defensive structures are omnipresent, towering over harbors and cliffs. Most islands are lower than 40 m above the sea level. The highest peak can be found on Maoyu at 79 m (Tsao et al. 1999).

Most islands of Penghu came into existence millions of years ago, when basaltic lava, lava that has been formed by melting the earth's mantle, was poured into the cold ocean, where it cooled down relatively fast, contracted, and fractured, sometimes into hexagonal columns (Chen 1995, p. 452). When coral reefs settled on the uplifted basaltic structures, vegetation and humus started to develop wherever they could resist wind and waves. Depending on how much these structures have been raised above the sea level, coral stones, basalt, and, as lowest level, sedimentary



**Fig. 3.3** An eroding landscape on Dongyudongping. In front, a rubble field with remains of a former tomb, a layer of sedimentary stones, and above this a layer of basalt

sand or mud stone are visible and accessible to different degrees. Granite only occurs naturally on the most western island of Penghu, Huayu (花嶼, Huāyǔ), situated on the continental shelf. Much of Penghu's bedrock consists of softer sedimentary stones below the basalt. The basalt bedrock is weakened as this soft sedimentary stones are eroded, resulting in the collapse of basalt columns. This creates a rubble field along the coast line, a geologic landscape of strewn rocks has been used for burial grounds, e.g., on Dongji (東吉, Dōngjí), Dongyudongping (東嶼東平, Dōngyǔdōngpíng), Tongpan (桶盤嶼, Tǒngpányǔ), and Xiyu (西吉, Xīyǔ) (Fig. 3.3).

The harsher the living conditions of a region are, the more they are likely to influence the way that burial are conducted, and, consequently, how people think and talk about their practices. Deserts and permafrost, rocky ground and rain forest, each physical condition provides the framework to which cultural conceptions have to adapt physically, conceptually, and spiritually. Similar must have happened on Penghu, where a primordially continental and agrarian funerary practice and its conceptualization encountered water, wind, and rocks.

One of the most striking properties of tombs on Penghu is their dispersion. According to Chen (1953, 1995), an average of 10% of the total surface of Penghu is occupied by burial sites, a number that on smaller islands may reach up to 40%. Such a high percentage might come as a surprise, especially as Penghu is overpopulated with respect to its surface and, even more so, with respect to the fertility of the ground: Through erosion and salty rain, the agricultural production could nourish the population, statistically seen, for 4 months of a year only, see Chen (1953, 1995). A partial explanation for what seems to be an unproductive use of land might be that burial sites occupy the least profitable land, on which only some low pioneer plants, cacti, and agaves can survive. The smaller the island, the larger the

**Fig. 3.4** The spatial distribution of tombs surveyed on Penghu within the ThakBong project



percentage of coast-near, eroded, and flood-prone areas, which can be left to the ancestors without a real loss in agricultural production. Using our background map of Penghu, we can actually bring all surveyed tombs of Penghu to a map. Central in this process of mapping tombs is the translation of geo-references into pixels of the map. This is done by the function `LatLon2XY.centered()` which extracts all relevant parameters for this translation from the canvas that this function requires as parameter. Indeed, we see in Fig. 3.4 that smaller islands disappear under a cloud of tombs.

```
PlotOnStaticMap(canvas.penghu);
list.pix <- LatLon2XY.centered(canvas.penghu,
df.penghu$tomb.y,df.penghu$tomb.x)
points(list.pix$newX,list.pix$newY,pch=23,bg='black',
cex=0.2)
```

The consequences of this dispersion of tombs are an objectively noticeable state of abandonment of tombs and an almost complete absence of social control over whether and how families maintain their tombs. We interpret this as an implicit agreement on these islands, which allows families, especially poor families, to let the tombs of a certain number of ancestors to be taken over by nature to avoid the financial burden that would require an exponentially growing number of ancestral

tombs. The dispersion, matched by the repeatedly told story of having forgotten the location of an ancestral tomb, allows for a wilful shaping of an ancestral line in accordance with one's financial possibilities, without having to articulate a violation of cultural codes. Dispersion is the local answer to the unrealistic requirement of an ancestral worship that did not originate on these islands but was imported in the cultural luggage of migrants. Considering the climatic conditions on these islands, we easily understand the gap between the cultural claim and reality of practices.

A feature that shaped Penghu as much as the waters around the islands are the winds of the winter monsoon, which hold the islands in their bitter grip. In the 6 months from October to March, the average wind speed in Makong is 17 m/s (Chen 1995, p. 453), see also (澎湖縣政府民政局 Pēnghúxiàn Zhèngfǔ Mínhèngjú (Penghu County Civil Affairs Bureau) 2005, pp. 51–54). These winds cause a rough sea, irregular transportation between the islands, an interruption of the fishing period, massive erosion, salty rain through flying salt crystals, and an evaporation that exceeds the amount of rainfall (Chen 1995, p. 456). These winds and their physical consequences shape almost everything on the islands: Landscapes, vegetation, land utilization, agriculture, fishing, transportation, architecture, and the design of villages.

Typical for the architecture of Penghu, including tombs, is the extensive use of the resources that are locally accessible. Importing construction material not found on Penghu, such as wood, clay, or granite, was difficult and expensive as distances to both sides were long, currents dangerous and transportation facilities limited. A systematic net of harbors was cast over the islands as late as during the Japanese period, requiring during Qing period or earlier that each beam and each slate be reloaded from the cargo vessels to rowing boats that could safely cross the shallow waters around islands.

Coral rocks and basalt have thus been the fundamental building material on the islands, used for houses, temples, tombs, terraced fields, and windbreaks. Coral rocks, located above the layer of basalt, are accessible to everyone in need of building material. Their low density of 1,5 g/cc makes them also more easy to move and to carve than basalt with a density of 3 g/cc. Where basalt is more easily accessible than coral rocks, e.g., on the island of Tongpan, it became the primary building material. Although basalt is much harder than coral rocks, both erode within the storm of sand and salt particles that blows over the islands half of a year.

### 3.4 Penghu Epigraphies

In this harsh environment, tombs and tombstones that spread out along cliffs, beaches, and hills are so brittle and fade away so easily that one might wonder, how epigraphic practices can be perpetuated from generation to generation. Many of these practices have no other source or documentation than previously inscribed tombstones. There is no administrative regulation, no religious norm, and no

discourse in relation to tombstone inscriptions, as death is a taboo in Han societies. Only professional carvers might maintain such a discourse. All other inhabitants of these islands construct their proper conception of what they perceive to be a local tradition through the abstraction, generalization, and interpretation of observed practices. A fundamental question we thus have to address is whether epigraphic practices would be readable for a time span that is long enough to guarantee their perpetuation or whether the perpetuation of a carving practice would depend entirely on the discourse maintained by professional carvers.

The time period for which epigraphic inscriptions are readable to the local people can only be estimated as unreadable tombstones usually can no longer be dated. For our estimate, we follow the assumption that local people, unlike researchers and professional, see mainly their family tombs and the easily accessible tombs on their way to their family tombs. We estimate that they do not see the oldest 25% of those tombstones that we have documented in our exhaustive research, removing vegetation, cleaning tombs, digging into the ground, and using specific photographic techniques to get the last readable stroke out of each tombstone. We thus use the second quartile of the tombstones of our digital documentation as the time that tombstones are no longer visible or readable.<sup>13</sup>

Calculating the readability of tombstones for different islands and different materials as shown in Table 3.1, we notice that on some islands erosion may affect the readability already after two generations (60 years). After three generations (90 years), tombstones usually become unreadable. This means that upon the death of the parents, some of the tombstones of the generation of the grandparents and

**Table 3.1** The effect of location and material on the readability of tombstones on Penghu, estimated in the number of years

	Magong	Baisha	Xiyu	Wangan	Qimei	Mean
Basalt	113	84	94	137		107
Concrete	72	78	59	74	71	71
Coral	94	43	116	56	99	82
Granite		77	149	270	155	163
Mean	93	71	104	134	108	102

<sup>13</sup>The assumption of a cutoff point at 75% is arbitrary in absolute terms. Yet, if applied consistently, the estimate would allow to compare the readability of tombstones depending on the region or the material. And still, this assumption seems to match the extent to which local people know their local graveyards. Talking after a survey to local people about the graveyard we have visited, our interlocutors are usually surprised to hear us talking about readable Qing tombstones. Likewise, people refer to tombs of the 1960s as old tombs, although we have found tombs of the Japanese period in the same graveyard. In one particular instance, locals on the Tongpan island told us that people started to inscribe their tombstones about 100 years ago, although we found among the ten remaining inscribed tombstones two Qing tombstones, dating back at least 120 years. The knowledge that local people have of their graveyard is thus astonishingly precise, but not as precise as the data that we get through our digital documentation.

most tombstones of the generation of the great grandparents have been eroded. The erosion affects particularly tombstones carved into concrete and coral rocks and islands with exposed graveyards, Baisha, with no natural protection against winds from the north, and Qimei where most graveyards are located along the northern cliff. The surprising long readability of coral rocks relates to the fact that this soft stone is usually carved up to more than a centimeter deep, while hard materials, such as concrete, basalt, and granite, are usually carved only a few millimeters deep.

```
df.penghu.mat <- stone.has.material(df.penghu.year)
df.penghu.read <- inscription.has.family(df.penghu.mat)
df.penghu.read <- stone.creation.is.before
  (df.penghu.read, 1970)

list.islands <- split(df.penghu.read,
  list(df.penghu.read$graveyard.island, df.penghu.read
    $stone.material), drop=TRUE)
readable <- sapply(list.islands, function(x) 2010 -
  quantile(get.year(x)) [2])
```

This substantial erosion is a key feature for development of epigraphic practices through time. We argue that when older tombstone inscriptions become unreadable, a newer carving will turn into a visible model from which tradition, identities, and narratives are constructed. For Penghu, this means that traditions are based on still visible practices that date back not much longer than two generations. A person burying, for example, one of his or her parents after WWII might find as a template only family tombstone carved during the Japanese period, unable to distinguish aspects of these inscriptions conditioned by the Japanese occupation from those that reflects older practices. Thus, although the visibility of tombstones on Penghu may be long enough to perpetuate a practice from generation to generation, it is difficult for local people to understand how inscriptions have historically been formed. A mental conception of an epigraphic tradition is thus either formed from a limited point of view or put into the hands of a few professionals, who are interested, more than in historical truth, in the economic success of their craft enterprise. Interestingly, in tombstone inscriptions we find both paths along which traditions are constructed, craggy carvings of dodgy content, as well as perfectly shaped and structured gravestones. While the former reflect the individual effort to make sense of epigraphies, the latter embody the constructed tradition the carver might have presented to his clients, as well as the economic model that underlies the carving of this myth.

The material of the tombstones, granite, basalt, or coral rocks, not only differentiates tombstones as to their durability but also as to their geographic origin, the



route they have taken from the quarry and, accordingly, the type of carver or even a specific carver family.

The relation between the material of the tombstone and the type of carver is relatively straightforward. Professional carvers went through an apprenticeship with a master, frequently an elder family member. They have learned how to handle and inscribe hard stones, granite and basalt, and their inscriptions are based on a syntax, a system of abstract rules. Trying to distinguish themselves from nonprofessional carvers, they tend to use hard materials as an expression of their concern for quality, to rely on a specific syntax to produce auspicious tombstones and, if required, to explain to a customer the advantage of their carvings in comparison to that of a competitor.

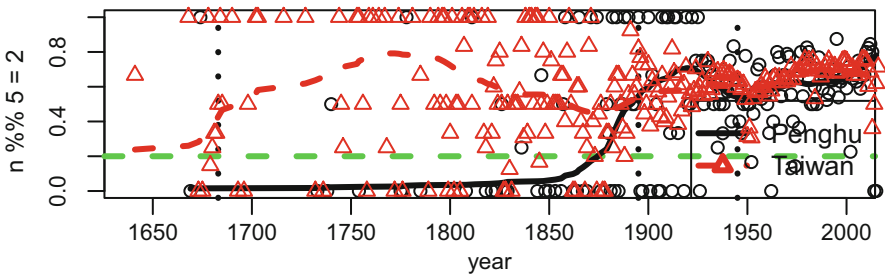
Semiprofessional carvers are construction workers who set up the tomb and take over the carver's job of procuring a tombstone and carving the inscription. This is technically possible, as the carver tends to be subcontracted by the construction worker. Thus, unless required by the family of the deceased, there might be a tendency of construction workers to infringe into the realm of the carver to increase their profit margin. Their material chosen for the tombstone is similar to the material the tomb has been made of. Examples are tombstones made from bricks and then covered with a layer of cement, or concrete slates, into which characters are scratched while the cement is drying. As bags of concrete and bricks belong to the general purpose material that can be found even on smaller islands, tombs are easily and quickly set up, avoiding the logistic problems involved in procuring a tombstone from a carver located on a larger island. Semiprofessional carvers may or may not have acquired the syntax of a tombstone inscription from their trained colleagues (Figs. 3.5, 3.6, and 3.7).



**Fig. 3.5** A tomb and tombstone on Dongyudongping, very likely to have been set up by the one and same craftsman, potentially a semiprofessional carver according to our classification. The tombstone has been made from concrete and characters have been scratched into an outer layer of fresh fine cement



**Fig. 3.6** A tombstone found on Dongyudongping that is likely to have been carved by a nonprofessional carver. The inscription is carved into a soft sedimentary stone. The inclusions of sea shells are well visible. The stone has not been shaped into a particular form and characters are irregular in size and arrangement. The content of the inscription has been reduced to two semantic roles and a total of seven characters, while professional carvings require four semantic roles and at least 21 characters



**Fig. 3.7** The relative usage of auspicious character numbers on Penghu and Taiwan through time

Nonprofessional carvers, the group we know very little about, may be family members of the deceased. They usually carve the tombstone if the tombstone is the only visible marker of the tomb, meaning that even the second group of professionals is not involved in setting up the tomb. On Penghu, this third group prefers to carve into coral rock, an omnipresent material which is easy to cut, to transport, and to inscribe. Nonprofessional carvers are not in professional exchange with carvers. They might copy and adapt the surface form of professional inscriptions found on a burial ground, without necessarily understanding the syntax of the expressions. This may result in the violation of the less obvious syntax rules that professional carvers tend to follow.

We distinguish three tombstone properties that professional carvers might take into their consideration when designing a tombstone. Classifying tombstones with respect to these properties, we are in state not only to distinguish professional from nonprofessional carvers but also to distinguish different carving practices, potentially of different carving families.

Most stone carvers of Penghu and Taiwan, when interviewed as to how they design a tombstone inscription, will sooner or later come to the point to explain a complex numerical grammar that is supposed to render a tombstone auspicious. As part of this grammar, the middle line of the tombstone inscription, the line that refers to the deceased, should be composed of seven, twelve, seventeen, etc., characters. Mathematically, this requirement can be expressed as  $(n \text{ modulo } 5) = 2$ , i.e., the number of character modulo 5 equals to 2. Why this should be the case is a story in itself, telling much about how practices are formed:

Having its origin in Buddhism, the phrase ‘生老病死’ (shēng lǎo bìng sǐ, birth, aging, illness, death) represent the circle of rebirth and suffering. These four elements are thus ‘苦’ (kǔ bitter). In Sanskrit *jāti-jarā-vyādhī-maraṇam*, the equivalent of ‘生老病死’ are equal to *dukkha* (suffering). In Korea, for example, the phrase ‘生老病死’ is known, while the phrase ‘生老病死苦’ is not. In the Chinese folk religion practised on Penghu and Taiwan, this wisdom transformed into the aphorism ‘生老病死苦’ (*idem kǔ, idem suffering*), which is pronounced in a circle ‘生老病死苦生老...’ to assign auspicious or non-auspicious meaning to numerals. Most tombstones on Taiwan and Penghu thus have turned into a documentation, carved into stone, how Chinese folk religions transformed Buddhist teachings. The first (sixth, eleventh, etc.) character is associated with ‘生’ (shēng, birth), the second (seventh, etc.) with ‘老’ (lǎo, old), etc. ‘生’ (shēng, birth) and ‘老’ (lǎo, old) are considered auspicious characters, while the others are not. The numbers 7, 12, 17, etc. would be considered to be auspicious numbers for the central line in combination with the right and left line ending in ‘生’ (sheng). These two ‘生’, when read in a row, yield a ‘老’ (lǎo), cf.  $6 + 6 = 12$ . Adding a focus in top of two characters, a place name or a loyalty expression, adds another ‘老’ (lǎo). Three ‘老’ (lǎo) add to the tombstone another ‘生’ (sheng), cf.  $12 + 7 + 2 = 21$ . In total, there are three ‘生’ (sheng) and three ‘老’ (lǎo), the ‘老’ (lǎo) generated from ‘生’ (sheng) and vice versa. Analyzing the number of characters in the central line is thus

a simple way to check the syntax of the tombstone inscription, especially if other parts of the inscriptions, usually with smaller characters, have become unreadable.

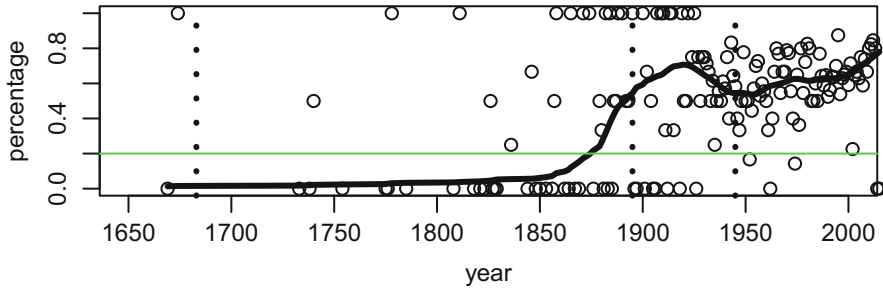
Using a timeline, we can pinpoint the transformation from an unorganized random state into a regulated state. Plotting the relative percentage of various values (“yes”) of one attribute (“lao”), in relation to a random distribution of that attribute, we can identify when the number of values that represents a regulated state exceeds the baseline of a random distribution.

```

funct.plot.line <- function(x,y,mycol,mylty,myf) {
  points(x,y,pch=mylty,col=mycol)
  lines(x,lowess(y,f=myf)$y,col=mycol,lwd=3,lty=mylty) }
####
lao.per.year <- function(df,mycol,mylty) {
  vec.middle <- get.inscription.length.middleline(df)
  vec.lao <- (as.integer(vec.middle) %% 5) == 2
  df.lao.year <- aggregate(vec.lao,FUN=mean,
  by=list(get.stone.creation.year(df)))
  ####
  funct.plot.line(df.lao.year[,1],df.lao.year[,2],
    mycol,mylty,0.2) }
df.middle <- inscription.has.length.middleline(df.asia)
df.middle <- stone.has.creation.year(df.middle)
plot(0,0,xlim=c(1640,2000),ylim=c(0,1),xlab='year',
  ylab='n %% 5 = 2',col='red')
abline(v=c(1683,1895,1945),lty=3,lwd=3)
abline(h=1/5,col='green',lty=2,lwd=3)
legend('bottomright',c('Penghu','Taiwan'),lty=c(1,2),
  pch=c(1,2),lwd=3,col=c(1,2))
zero <- mapply(lao.per.year,list(is.penghu(df.middle),
  is.taiwan(df.middle)),c(1,2),c(1,2))

```

Our claim here is that the success of this feature was the result of the commercial advantage that those carvers who offered this feature had over carvers who did not. On Penghu, for example, we can observe that the probability for this feature to be applied was before 1850 below random chance (20%), c.f. Fig. 3.8. After 1850, this feature propagated quickly and developed within a short time into a local standard. The reason for this general spreading is easy to understand. Once a feature is used by a carver with an important market share in combination with a convincing story, the remaining carvers had to apply the same feature likewise, if they did not want to appear as an incompetent carver who carves inauspicious tombstones. Why carvers on Penghu have not used this feature before 1850, as it has been in Taiwan, and how it arrived on Penghu is currently still unclear.



**Fig. 3.8** The percentage of tombstones on Penghu with an auspicious number of characters

```
df.penghu.lao <- inscription.has.length.middleline
  (df.penghu.year)
vec.length.middle <- get.inscription.length.middleline
  (df.penghu.lao)
df.penghu.lao$lao <- as.integer(((vec.length.middle)
  %% 5) == 2)
df.penghu.lao.mean <- aggregate(df.penghu.lao$lao,
  FUN=mean,
  by=list(get.year(df.penghu.lao)), SIMPLIFY=F)
plot(0, 0, xlab='year', ylab='percentage', xlim=c(1650,
  2000), ylim=c(0, 1))
funct.plot.line(as.character(df.penghu.lao.mean$
  Group.1), df.penghu.lao.mean$x, 1, 1, 0.2)
abline(h=0.2, col='green', lty=1)
abline(v=c(1683, 1895, 1945), lty=3, lwd=3)
```

Plotting in Fig. 3.9 the spatial distribution of Qing tombstones with (green) and without (red) an auspicious number of characters on four maps for different materials, we can identify two separated areas. In the north-west of Penghu, we see a few potential centers of professional carvers, located in close neighborhood to each other, i.e., the north of Xiyu, Xiaomen, and Baisha. In these places, an auspicious number of characters is used on granite and basalt, presumably by professional carvers. In Wang'an, the percentage of stones with an auspicious number is close to the random baseline of 20%. Further to the south and east of Penghu, this relatively new feature is not found. Additional analyses will be required to clarify whether either carvers in the south were generally not professionals or the professionals located on the southern islands did not have been in dialogue with the north-western carvers, and had simply missed a new trend.

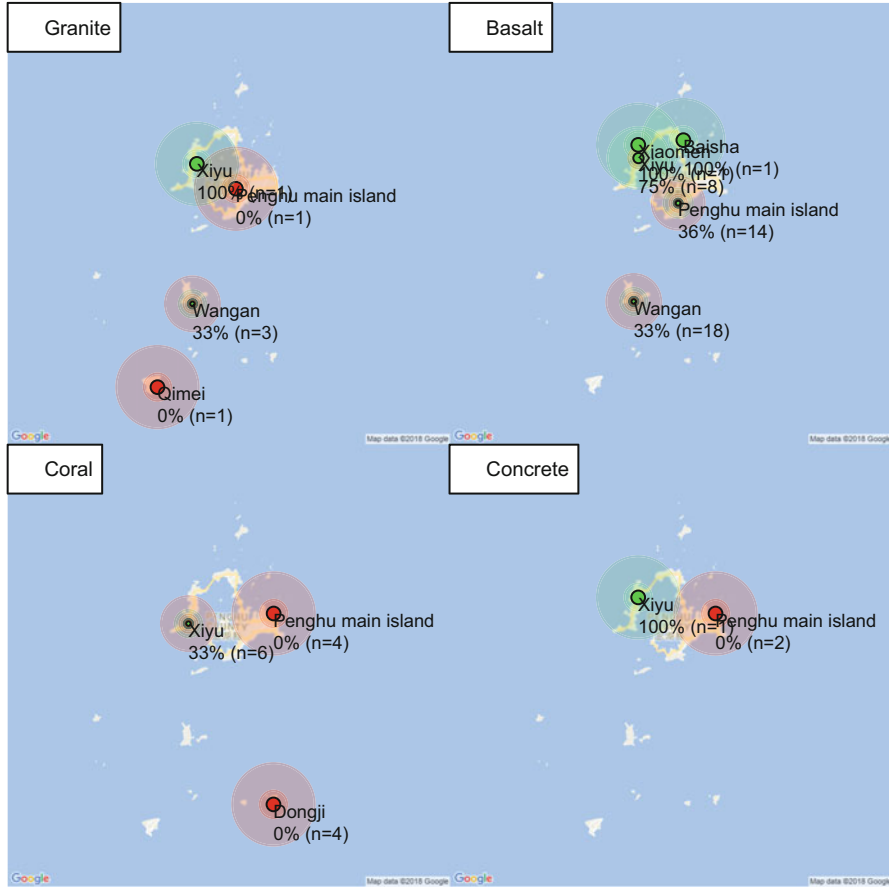


Fig. 3.9 Tombstones with (green) and without (red) an auspicious number of characters

```
percentage <- function(x) { return(sum(x)/length(x)) }
####
plot.dot.on.island <- function(df,col.index,text.cex,
  message) {
  vec.criteria <- df[,col.index]
  list.stats <- mapply(aggregate,
    list(vec.criteria,df$x,df$y,vec.criteria) ,
    list(list(df$graveyard.island)) ,
    list(percentage,mean,mean,length) ,SIMPLIFY=FALSE)
  PlotOnStaticMap(canvas.penghu)
```

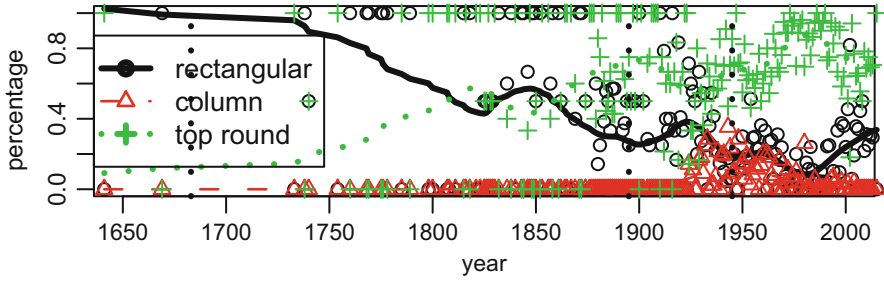
(continued)

```

map.points(canvas.penghu,list.stats[[2]]$x,list.stats
  [[3]]$x,
3* (1-list.stats[[1]]$x), 'red')
map.points(canvas.penghu,list.stats[[2]]$x,list.stats
  [[3]]$x,
3* list.stats[[1]]$x, 'green')
legend('topleft', message, bg='white')
map.text(canvas.penghu,list.stats[[2]]$x,list.stats
  [[3]]$x, cex=text.cex,
paste(list.stats[[1]]$Group.1, '\n', round(list.stats
  [[1]]$x*100), '% (n=', list.stats[[4]]$x, ')', sep=''))}
####
df.penghu.lao.qing <- period.is.roc.qing(df.penghu.lao)
col.index <- grep('lao', names(df.penghu.lao.qing))
par(mfrow=c(2,2))
plot.dot.on.island(is.granite(df.penghu.lao.qing), col.
  index, 0.9, 'Granite')
plot.dot.on.island(is.basalt(df.penghu.lao.qing), col.
  index, 0.9, 'Basalt')
plot.dot.on.island(is.coral(df.penghu.lao.qing), col.
  index, 0.9, 'Coral')
plot.dot.on.island(is.concrete(df.penghu.lao.qing), col.
  index, 0.9, 'Concrete')

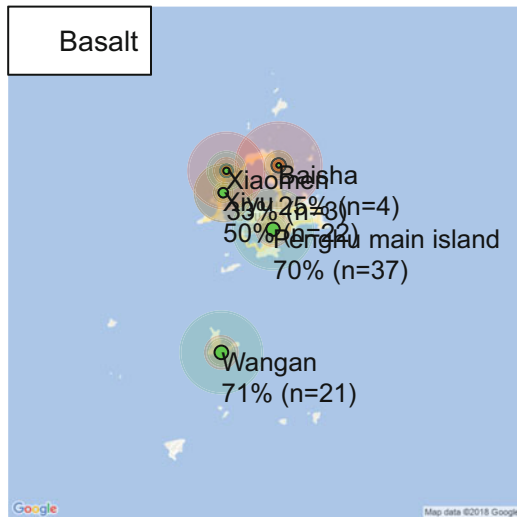
```

A tombstone with a rounded top is in Taiwan and Penghu assumed to be more auspicious than a rectangular tombstone. The reason for this is that cosmical energy is believed to be transmitted along mountain peaks from high mountain ranges in China. A mountain-shaped tombstone is thus assumed to capture this cosmical energy and tunnel the energy through the bones of the deceased onto the family members. As rounded tombstones are difficult to carve, they might also be an indicator for professional carving. Drawing a timeline of the categorical distribution of tombstone forms, we can indeed observe a systematic trend towards rounded tombstones. This trend started in the beginning of the eighteenth century and continued into the middle of the twentieth century. During the Japanese colonial period, the Japanese tombstone in the form of a column became popular for reasons that relate to the position of local people within the society under the Japanese (Figs. 3.10 and 3.11).



**Fig. 3.10** The categorical distribution of tombstone shapes on Penghu through time

**Fig. 3.11** The percentage of top-rounded tombstones on Penghu through time



```
df.penghu.form <-subset(df.penghu.year,
  grepl('4c$|^top round|column)', stone.form)
vec.form <- get.stone.form(df.penghu.form)
vec.year <- get.stone.creation.year(df.penghu.form)
tab.form.year <- table(vec.form,vec.year)
tab.prop <- prop.table(tab.form.year,2)
plot(0,0,xlab='year',ylab='percentage',xlim=c(1650,
  2000),ylim=c(0,1))
zero<-mapply(funct.plot.line,list(colnames(tab.prop)),
  get.tab.row(tab.prop),1:3,1:3,0.2)
abline(v=c(1683,1895,1945),lty=3,lwd=3)
legend('left',c('rectangular','column','top round'),
  col=1:3,lty=1:3,pch=1:3,lwd=3)
```





Fig. 3.12 A wooden Luban measure for yang fengshui. Used for measuring tables, chairs, windows, doors, etc.



Fig. 3.13 A wooden Luban measure for yin fengshui. Used for measuring tombs and tombstones

Differently from the auspicious number of characters, stones are rounded in the south of Penghu but less so in the north. Roughly speaking, the auspicious stone shape and the auspicious number of characters seem to exist in complementary distribution, pointing to two professional carving practices, one with its center on Xiyu, the other with its center on Wang’an.

```
df.penghu.form.qing <- period.is.roc.qing(df.penghu.
  form)
df.penghu.form.qing <- stone.material.is.basalt(tomb.
  has.xy(df.penghu.form.qing))
df.penghu.form.qing$form2 <- 0
df.penghu.form.qing$form2[df.penghu.form.qing$stone.
  form=='top round'] <- 1
col.index <- grep('form2', names(df.penghu.form.qing))
plot.dot.on.island(is.basalt(df.penghu.form.qing), col.
  index, 0.9, 'Basalt')
```

A third indicator of professional carving is the width and the height of a tombstone. From 1850 on, professional carvers tended to determine the width of the tombstone by the auspicious measures for the living (yin) and the dead (yang) as printed on a Fengshui tape measure (魯班尺 lǔbānchí, 文公尺 wéngōnchí, 風水尺 fēngshuǐchí), cf. Figs. 3.12, 3.13, 3.14 and 3.15. Before 1850, only the yin fengshui was used to determine the size of a tombstone.

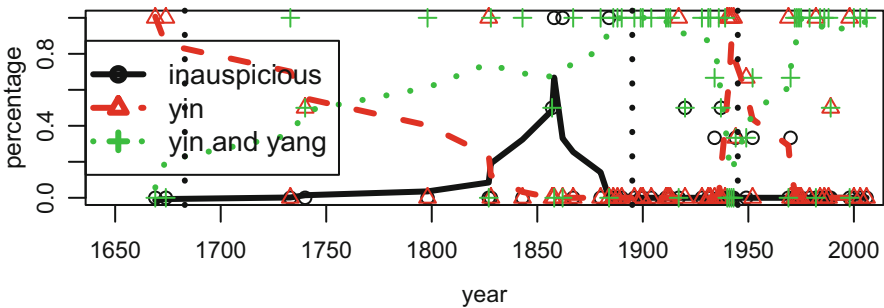
Notice, the number of characters on a tombstone and the width of a tombstone showed significant changes around 1850. Yet, as both curves show a different slope, we assume that these transformations were not introduced by the same agent or process (Fig. 3.16).



**Fig. 3.14** Modern metal Luban measure, combining the measure for good yin and yang fengshui. Yang is arranged at the top, yin at the bottom of this measure



**Fig. 3.15** A tombstone of the year 1898 having a width of 47 cm. This width is auspicious, as 47 cm are red (auspicious) for yang, marked above, and yin, marked below



**Fig. 3.16** The percentage of tombstones with an auspicious tombstone size on Penghu through time

As our analysis in Fig. 3.17 and Table 3.2 shows, basalt tombstones show more features of a professional carving than coral rocks.



**Fig. 3.17** Tombstones with an auspicious yin and yang (green) versus tombstones with only an auspicious yin (red)

**Table 3.2** The material and properties of tombstones

	Basalt	Coral	Granite
<i>N</i>	665	310	26
Usage	1754–1979	1669–1979	1733–1973
Char. in LAO	61%	48%	46%
Yin and yang width	64%	50%	75%
With Tanghao	1897–1979	1911–1978	1943–1959
<i>N</i> 1895–1945	228	142	9
Tanghao 1895–1945	36%	18.3%	11.1%

```

df.penghu.width <- stone.has.width(df.penghu)
vec.penghu.width <- get.stone.width(df.penghu.width)
df.penghu.width$black.yang <- measure.is.black.top
  (vec.penghu.width)
df.penghu.width$black.yin <- measure.is.black.bottom
  (vec.penghu.width)
df.penghu.width$red.yin <- measure.is.red.bottom
  (vec.penghu.width)
df.penghu.width$red.yang <- measure.is.red.top
  (vec.penghu.width)
df.penghu.width$red.black <- df.penghu.width$red.yin *
df.penghu.width$black.yang
df.penghu.width$red.red <- df.penghu.width$red.yin *
df.penghu.width$red.yang
df.penghu.width$luban <- 'inauspicious'
df.penghu.width$luban[df.penghu.width$red.black==T]
  <- 'yin'
df.penghu.width$luban[df.penghu.width$red.red==T]
  <- 'yinyang'
df.penghu.width.year <- stone.has.creation.year
  (df.penghu.width)
vec.year <- get.stone.creation.year
  (df.penghu.width.year)
vec.luban <- df.penghu.width.year$luban
tab.form.year <- table(vec.luban,vec.year)
tab.prop <- prop.table(tab.form.year,2)
plot(0,0,xlab='year',ylab='percentage',xlim=c(1650,
  2000),ylim=c(0,1))
zero<-mapply(funcplot.line,list(colnames(tab.prop)),
  get.tab.row(tab.prop),1:3,1:3,0.2)
abline(v=c(1683,1895,1945),lty=3,lwd=3)
legend('left',c('inauspicious','yin','yin and yang'),
  col=1:3,lty=1:3,pch=1:3,lwd=3)

```

```

df.penghu.width.qing <- period.is.roc.qing(df.penghu.
  width)
df.penghu.width.qing <- subset(df.penghu.width.qing,
  luban!='inauspicious')

```

(continued)

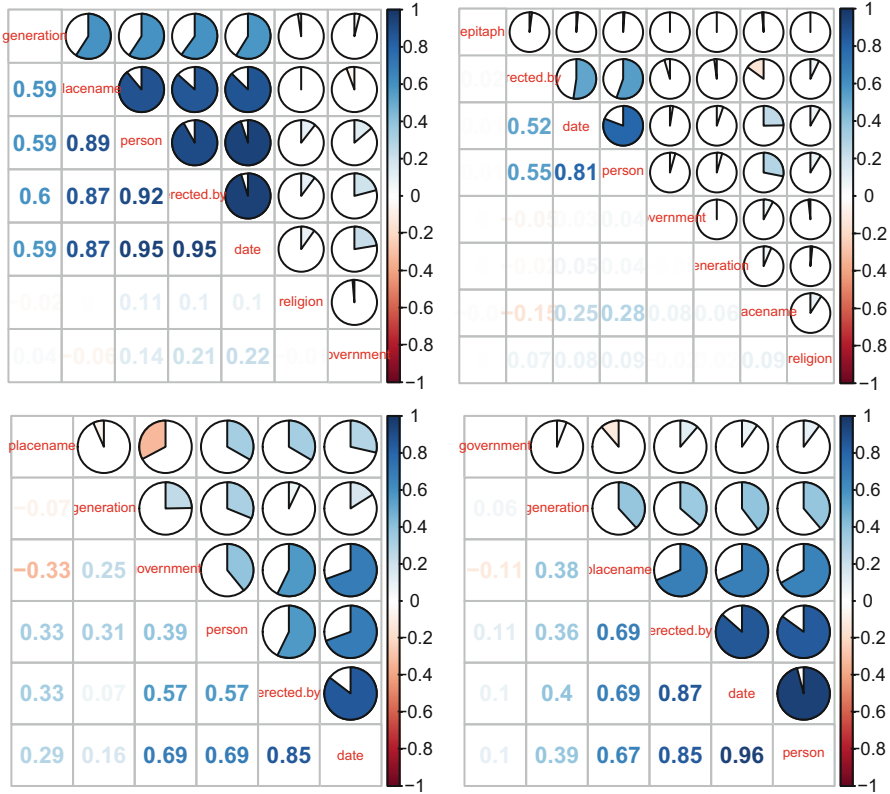
```
col.index <- grep('red.red', names(df.penghu.width.
  qing))
par(mfrow=c(2,2))
plot.dot.on.island(is.granite(df.penghu.width.qing),
  col.index, 0.9, 'Granite')
plot.dot.on.island(is.basalt(df.penghu.width.qing),
  col.index, 0.9, 'Basalt')
plot.dot.on.island(is.coral(df.penghu.width.qing),
  col.index, 0.9, 'Coral')
```

Some additional features of tombstones inscription we have to discuss are the *semantic roles* and the *focus* of tombstone inscriptions, as well as the various forms the *focus* might take, either as *loyalty expression*, as *jiguan* (籍貫 jíguàn), or as *tanghao* (堂號 táng hào).

In linguistic theories, a semantic role describes the kind of semantic contribution that a phrase adds to its larger linguistic unit. For example, in the sentence “*Kim comes today*,” *today* functions as a temporal complement. In the same line, we define the *semantic role* of a tombstone inscription as the semantic contribution that a phrase adds to an epitaphic inscription. Semantic roles vary from community to community. Examples are: *the deceased*, *date of birth*, *date of death*, *date of burial*, *date of tombstone erection*, *placename*, *religious affiliation*, *generation number*, *profession*, *political affiliation*, *buried with*, *buriers*, etc.

As not all semantic roles can enter a tombstone inscription, and communities and carvers like to maintain a certain order in the arrangement of the inscription as a proof of their professionalism, semantic roles are classified into paradigms of grammatical functions that contain mutually exclusive semantic roles. Syntactic functions in many natural languages are subject, predicate, and object, but also topic, focus, and contrast. Not only have different languages different grammatical functions, they also have different limitation as to which semantic role can enter which grammatical function. German, for example, has the semantic role of *experiencer* which can enter an indirect object (*Mir ist kalt*, literally: *To me is cold*, translated as: *I have cold*, a combination that is not possible in modern English. Likewise, the tombstones of different carvers or different regions have their sets of semantic roles and grammatical functions they can enter.

Of particular interest, because showing a remarkable variation between regions, time periods, and religious or political regimes is the grammatical function that we call *focus*, a formally identified function that identifies a social community as the main source of a social identity. A *focus* can be a placename, a religious symbol, or a reference to a government. As there is usually only one main source of a social identity, there tends to be a competition as to which semantic role will enter this function.



**Fig. 3.18** The correlation of semantic roles as indicators of syntactic functions in tombstone inscription, top-left: Penghu, top-right: Wenzhou, bottom-left: Penghu in Qing period, and bottom-right: Penghu in the Japanese period

Comparing in Fig. 3.18 the correlation matrixes of semantic roles in Penghu and Wenzhou, we notice that in both cases, the *the person*, co-occurs freely with *date*, *placename*, and *erected.by*. The function of the *placename* however is different in both cases. While in Penghu *generation*, *placename*, *religion*, and *government* compete for the same *focus* position, with the *placename* as default, in Wenzhou, where there is no formally marked focus position, the *erected.by* competes with *government*, *generation*, and *placename* for the function *social.identity*. Looking at Penghu in Qing and Japanese period, we see that the opposition of *government* and *placename* is a historical one. In Qing dynasty, the default *focus* was *government* and the *placename* was marginalized. In the Japanese period, the opposition still existed, but the quantitative relations of these two roles were inverted. It is this inversion which is the heart of our investigation.

```

funct.empty.col <- function(x) {return(sum(x)==0)}
####
funct.corr.sem.roles <- function(mydf) {
  library('corrplot')
  mydf <- transcription.is.completed(mydf)
  vec.role.idx <- grep('inscription.xml', names(mydf))
  tab.sem.roles <- !mapply(is.na, mydf[,vec.role.idx])
  vec.empty.col <- -1 * which(mapply(funct.empty.col,
  split(tab.sem.roles, col(tab.sem.roles))))
  tab.sem.roles <- tab.sem.roles[,vec.empty.col]
  colnames(tab.sem.roles) <- mapply(gsub, 'inscription.
  xml.', '', colnames(tab.sem.roles))
  corrplot.mixed(cor(tab.sem.roles), upper='pie',
  order = 'hclust', tl.cex=0.6) }
####
par(mfrow=c(2,2))
zero <- mapply(funct.corr.sem.roles, list(df.penghu,
  is.wenzhou(df.asia),
  period.is.roc.qing(df.penghu), period.is.roc.japan
  (df.penghu)))

```

Most tombstones in Taiwan are written with a Chinese script, usually from top to bottom, from left to right. The upper part of these tombstones, written mainly from right to left, is what we call the *focus* position. The focus is thus marked by its flipped writing direction in that area of the tombstone, from where the reading of most lines starts. The content of a focus can be described by its semantic role, e.g., *generation number*, *place name*, *loyalty expression*, *religious affiliation*, etc. All other rows in the tombstone can also be ascribed as semantic role, such as *deceased*, *mourners*, *date*, etc., the content of most semantic roles which are not focused reports distinctive information, i.e. information that distinguishes the deceased from all other deceased on this burial ground. The focus, however, through its form or through its content, through its type or through its token represents real or imagined communities, in this or beyond this burial ground. A cross on a Christian tombstone, or the placename 台南 (Tainán) on the largest graveyards of Tainan, Taiwan are good examples of how these foci function.

A common way to fill in the focus position is by using a placename. We distinguish three reference types placenames: The *local placename*, which references the birth or living place of the deceased on Taiwan or Penghu, the *jiguan* (籍貫), where a family was registered in China before migrating to Penghu or Taiwan (Fig. 3.19), and the *tanghao* (堂號), a maybe historical, maybe mythological place from where the surname is thought to have originated 2000 years ago.



Fig. 3.19 A placename in China in focus position

Before the appearance of the *tanghao* on tombstones of Penghu and Taiwan, the *tanghao* was a component of statal strategies to define its space. For centuries, *tanghao* have been traded in the canonical book *Baijiaxing* (百家姓), which is usually translated as *The Hundred Family Surnames*. Through this book, people acquired literacy over the last eight centuries, along with the Neo-confucianist *Three Characters Classic* (Sanzijing 三字經) and the earlier *Thousand character Classic* (Qianzi Wen 千字文).<sup>14</sup> This book listed originally 400 Chinese surnames in quadrisyllabic rhyming couplets. It is assumed to have been composed during the period of the Northern Song (960–1127), as the first surname in the book, Zhao (趙), is the surname of the Song dynasty, to whom the author of the *Baijiaxing* might have wanted to pay a homage.<sup>15</sup> In later dynasties, new editions of the *Baijiaxing* rearranged the order, so that the surname of the respective ruling dynasty was in first position.<sup>16</sup>

<sup>14</sup>Peng, *Five Hundred Years Ago, It Was One Family*: 16.

<sup>15</sup>Ibid.16.

<sup>16</sup>Examples of these derivations are the Liu Zhongzhi (劉仲質), the *Yuzhi Baijiaxing* (御制百家姓), and the *Baijiaxing Er2bian* (百家姓二編) Theobald (2011).



The most common *tanghao* referred to in Taiwan, *Yingchaun* (潁川) is the *tanghao* of families surnamed Chen (陳), Zhong (鍾), Lai (賴), Wu (烏), and Gan (干).<sup>17</sup>

We refer as *loyalty express* to those expressions which mention the ruling dynasty, the government, a form of a government, or the loyalty or devotion to the government. The highest percentage of tombstones with a loyalty expression can be found, according to our data, on tombstones of the Zheng era. After all, the Zheng family claimed to be loyal to the Ming dynasty, even though the Manchurian Qing had conquered China. During that time, we find frequently the expression 明 (míng) or 皇明 (huángmíng) on the top of the tombstone. Much of the loyalty expression is represented in the Chinese character ‘皇’ (huáng, emperor) which represents the emperor (王 wáng) under the white light of the sun. Putting this on top of the tombstone, above the name of one’s ancestors means to accept this hierarchy of commoners under the emperor, who himself is gifted with cosmical power.

The interpretation of these expressions as loyalty expression derives also from the fact that after a government had been replaced, a loyalty expression has usually been avoided for a couple of generations. Not using the loyalty expression was a form of protest. When the loyalty expression reappeared again on the tombstones of Taiwan and Penghu in Qing dynasty, it was written 皇清 (huángqīng) and only occasionally 清 (qīng).

Towards the end of the Japanese colonial period, the loyalty expression reemerged in various forms, of which 皇日 (huángri), 皇民 (huángmín) and 皇恩 (huángēn) are the most common.

### 3.5 Penghu Epigraphies Under the Ming and Qing

For a long time, Penghu could neither nourish its population nor provide a product the local people could use for trading. The settlements on Penghu thus have been and are to our days not the outcome of economic projects of the local people, but of political and economic projects of the state and its elites. Local people were needed as work forces, food providers, and placeholders who prevented pirates, smugglers, or outlaws to settle on these islands. For a long time, Penghu thus functioned only as a state subsidized trading hub and as military outposts, creating a small market on which local people could access imported products. The economic dependence on merchants, soldiers, and officials influenced tombstone inscriptions depending on how close or far people were to the center of this military and economic power.

---

<sup>17</sup> *Yingchaun* can neither be found on a modern map of China nor in *The China Historical GIS*. Yet, numerous publications locate *Yingchaun* in Henan (河南). Most of these publications, unfortunately, work without historical sources and copy instead widely from each other. Without proper sources, these publications do not lend themselves to corroborate or refute the historical existence of Yingchuan (潁川). Many other *tanghao* are without doubt historical placenames and some have even equivalents in the modern world.

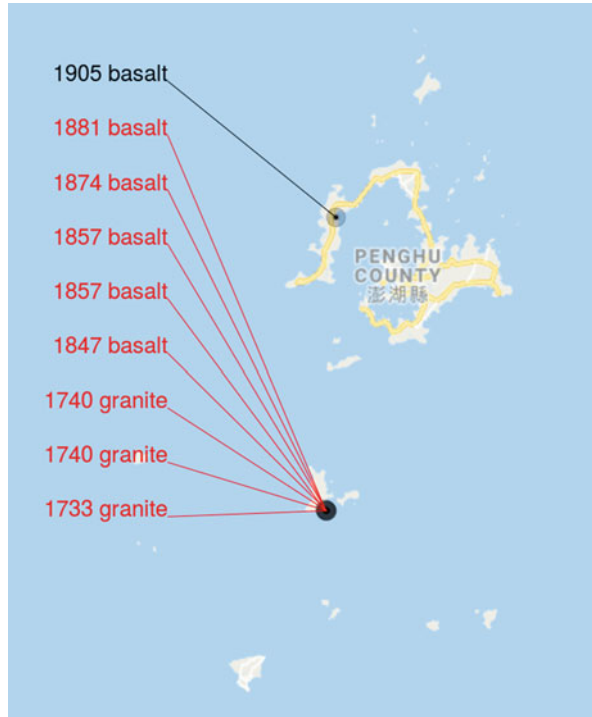
After the last evacuation of Penghu under the military ban in the fifteenth century, fishing communities were resettled under the Ming towards the end of the sixteenth century and military forces were stationed on Penghu from 1603 on. In 1622, the Dutch Vereenigde Oost-Indische Compagnie (VOC) (United Dutch East India Company) occupied Penghu but eventually had to leave in 1624 and moved to Taiwan. The VOC was ousted in 1661 by the Ming-loyalist Koxinga (鄭成功 Zheng Chenggong), which caused the Qing to issue another maritime ban with the unintended side effect of triggering a migration wave not landward, but to Penghu between 1662 and 1664. After the battle of Penghu in 1683, the Qing conquered Penghu and shortly later also Taiwan.

Having experienced maritime ban, relocation, foreign occupation, reoccupation, maritime ban again, migration, the loss of the emperor, and his replacement by a swashbuckler, the local people were aware that their presence on the islands would depend on the government and its ability to stay in power. Especially, during the period of the Zheng regime, the time most known Ming tombstones fall into, a considerable part of the population were Ming loyal soldiers, prepared to face the Qing who were gathering their strength at the Chinese coast. Loyalty and support of the current government, whatever it was, might have been the tactics of most inhabitants to avoid future uncertainties. It thus seems almost natural, that on Penghu as in Taiwan, the most common focus position on tombstones was the expression of loyalty to the Ming, expressed mostly as 皇明 (huang2ming2).

Unfortunately, we cannot reconstruct the transition of tombstones on Penghu from Ming to Qing in detail, as the earliest preserved Qing tombstone dates from 1733, 50 years after the establishment of the Qing on Penghu. This tombstone can be found on the burial ground of Dong'an on Wang'an, a few hundred meters from the harbor, with a loyalty expression to the Qing carved into granite. Granite tombstones can be usually found where boats were unloaded and thus indicate a direct shipping link to China. The majority of loyalty expressions however can be found not on Wang'an, but on Xiyu, where the Qing took over the West Fort from Koxinga and added the East Fort in 1883.

Wang'an finally adopted the *jiguan* as its principal focus on tombstones about 1750, while the loyalty expression continued to be used on Xiyu. For this to happen, it was not enough that Wang'an was unreachable from Makong during the months of the winter monsoon. In order not to become the periphery of another, more central culture, Wang'an must have been a cultural center on its own, a center that could promote its own practices and thus avoid the import of practices. Traces of this cultural center can be attested in the form of unique local carvings. The character '穀' (gǔ, corn or lucky), employed as synonym of '吉' (jí, lucky), is found almost exclusively on tombstones on Wang'an (Fig. 3.20). The most likely interpretation for this distribution is that for more than 150 years a tombstone carver family must have been active in Dong'an, using this character in its carvings, where other carving families would use the character '吉'.

**Fig. 3.20** The spatial and temporal distribution of tombstones with the character ‘穀’ (gǔ), in the sense of ‘auspicious’ on Penghu



```
df.penghu.mat <- stone.has.material(df.penghu.year)
has.GU <- grepl('穀', df.penghu.mat$inscription.xml.date)
df.penghu.GU <- subset(df.penghu.mat, has.GU)
mysorted <- sort.by(df.penghu.GU, df.penghu.GU$stone.
  creation, TRUE)
l <- nrow(df.penghu.GU)
x <- mysorted$tomb.x
y <- mysorted$tomb.y
x2 <- rep(119.35, l)
y2 <- 23.8 - rep(0.05, l) * 1:l
lab <- paste(mysorted$stone.creation, mysorted$stone.
  material)
col <- rep('orange', l)
col[mysorted$stone.creation.year > 1683] <- 'blue'
col[mysorted$stone.creation.year > 1895] <- 'green'
PlotOnStaticMap(canvas.penghu)
map.points(canvas.penghu, x, y, l, 'green')
```

(continued)

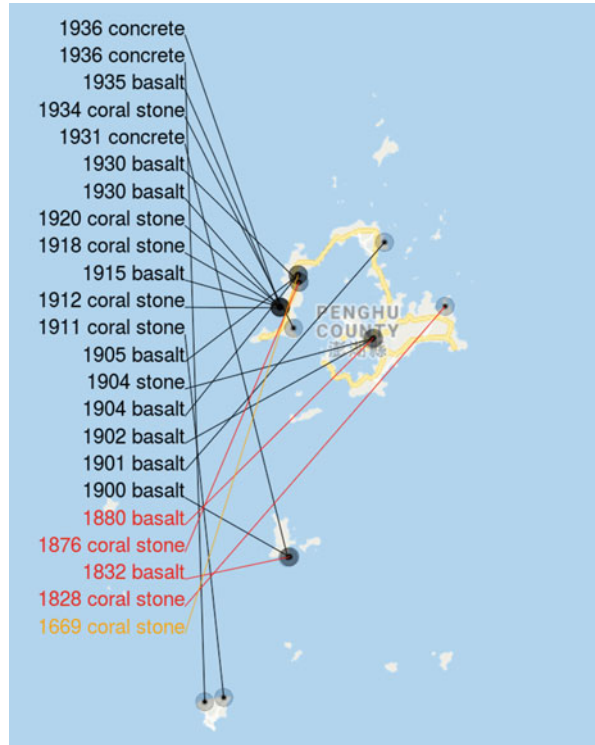
```
map.text(canvas.penghu, x2, y2, lab, cex=0.9, adj=c(1, 0),
         col=col)
map.lines(canvas.penghu, x, x2, y, y2, col=col)
```

Wang'an was not the only center during the Qing period. A second center can be located on Xiyu, identified by the character '𠄎', a variant to '時' (shí, time), in expressions like (在)辛未孟夏吉旦 (shí (zai) xīnwèi mèngxià jídàn, time (is) metal-sheep year first lunar month auspicious morning), which themselves are quite particular, not only by the character “”, but also by its phrasing.

```
df.penghu.mat <- stone.has.material(df.penghu.year)
df.penghu.mat <- stone.creation.is.before(df.penghu.
mat, 1940)
has.SHI <- grepl('𠄎', df.penghu.mat$inscription.xml.date)
df.penghu.SHI <- subset(df.penghu.mat, has.SHI)
mysorted <- sort.by(df.penghu.SHI, df.penghu.SHI$stone.
creation, TRUE)
l <- nrow(df.penghu.SHI)
x <- mysorted$tomb.x
y <- mysorted$tomb.y
x2 <- rep(119.4, l)
y2 <- 23.88 - rep(0.026, l)*1:l
col <- rep('orange', l)
col[mysorted$stone.creation.year > 1683] <- 'blue'
col[mysorted$stone.creation.year > 1895] <- 'green'
lab <- paste(mysorted$stone.creation, mysorted$stone.
material)
PlotOnStaticMap(canvas.penghu)
map.points(canvas.penghu, x, y, l, 'green')
map.text(canvas.penghu, x2, y2, lab, cex=0.8, adj=c(1, 0),
         col=col)
map.lines(canvas.penghu, x, x2, y, y2, col=col)
```

What appears to be a relatively unsystematic spreading of a specific character variant represents however a very precise sequencing in terms of market power and market share. We observe the loss of a proper tombstone tradition on Wang'an after 1881 and the import of tombstones from Xiyu to Wang'an and Qimei after 1900, see Fig. 3.21. We interpret this as a relative loss of economic power and cultural independence towards the end of the Qing period.

**Fig. 3.21** The spatial and temporal distribution of tombstones with the character '祟'(shí), in the sense of 'auspicious' on Penghu



After a carver from Xiyu took over the work on Wang'an, we find inscriptions typical for Wang'an on Xiyu and vice versa. First, there is a single instance of the character '穀' (gǔ), originally unique on Wang'an, carved into a tombstone with a '祟'(shí) on Xiyu. We interpret this occurrence as an inspiration the Xiyu carver got on Wang'an. Second, as Fig. 3.22 shows, a tombstone with a loyalty expression has been imported to Wang'an in 1894, most probably from Xiyu, where this loyalty expression has been very common. The shift of carvers from Wang'an to Xiyu thus took place between 1881 (last '穀' on Wang'an) and 1894 (first loyalty expression on Wang'an). In addition, the first '祟' is found on Wang'an in 1900 and the first '穀' on Xiyu in 1905.<sup>18</sup>

Also, Makong and Baisha were probably served from Xiyu in the very late Qing period, before Makong developed into the unrivalled center of Penghu. After 1902, we see no export to Makong or Baisha, both places are by then probably taken over by a carver from Makong. Which used neither '穀' (gǔ) nor '祟'(shí).

<sup>18</sup>The only tombstone on Wang'an with a '祟'(shí) that predates this hypothesized shift after 1881 has unfortunately been used as target for shooting games by bored ROC soldiers. One of their bullets hit what might have been the character '祟', right in its center, leaving only a few millimeters of the upper character component unscattered.

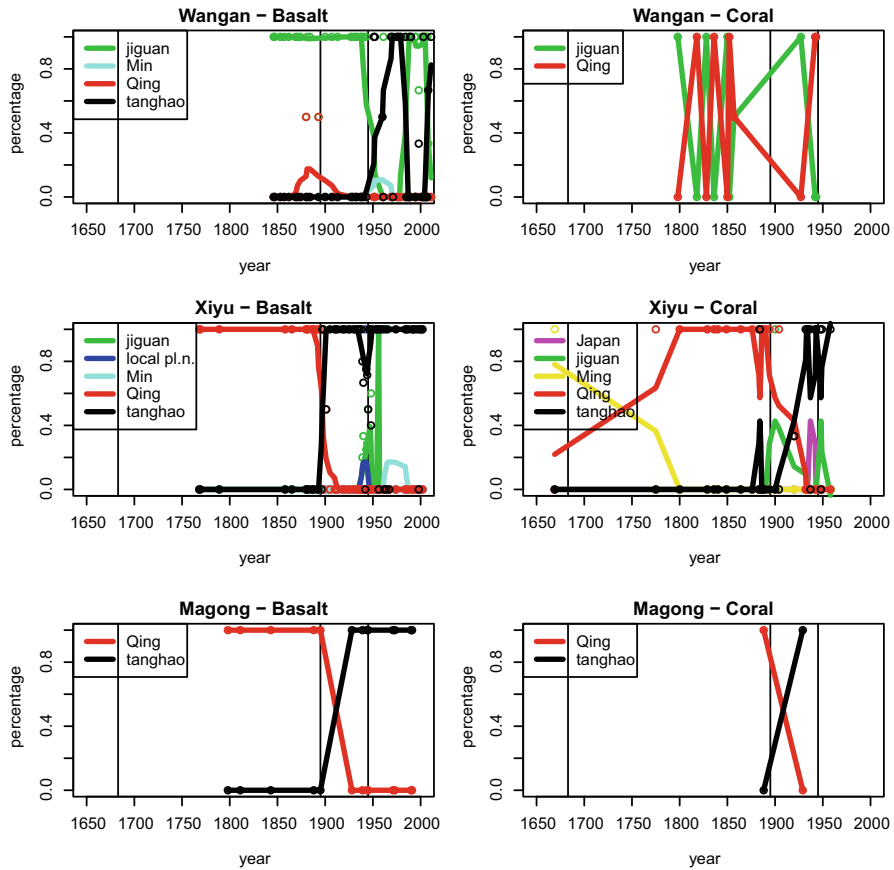


Fig. 3.22 The transformation of the focus on Penghu through time

The distribution of the character '甌' provides us with an additional piece of information: Exported tombstones are more likely to be of basalt. The reason for this might be that, when ordering a stone from a professional stone carver and not from a local worker, one wants to obtain a professional product. Likewise, the professional carver wants to show his professionalism with a hard stone, applying to the stone knowledge and skills that the untrained worker does not have. Coral rocks travelled an average distance of 5 km, from Xiaochijiao in Xiyu and basalt travelled 11 km. Surprisingly, tombstones made of concrete seem to have travelled furthest, an average of 13 km. According to our understanding however, tombstones in concrete have not travelled physically, as they are the product of local workers who create the tombstone on the graveyard, usually where and when professional carvers do not serve tombstones.

We thus observe in the Qing period the existence of different cultural centers, not all of which are also military centers. Xiyu was a military center, while Wang'an was

not. Xiyu used the expression of loyalty, Wang'an maintained the *jiguan*. Makong acquired the central position it has today towards the end of the Qing period and then became the unrivalled center with the arrival of the Japanese navy. This rise of power of Makong under the Qing is reflected by a shift from the *jiguan* to the loyalty expression from 1820 on, a period in which the Qing started to invest in Makong, as documented by a row of construction projects during that time.

### 3.6 皇日, The Rising Sun, Penghu Under the Japanese

The loyalty expression on the tombstones devoted to the Qing, however, plunged the inhabitants of Penghu into despair when the Japanese forces landed, as the practice to carve this focus was no longer opportune and dangerous or even life-threatening when continued. Having witnessed the violent occupation of Penghu, the local people understood the risk of continuing a practice that obviously sympathized with the former regime. The solution to the question of how to carve a focus for their tombstones could not follow any historical example and had to be flexible enough to adapt to a completely uncertain future. Even the option of an opportunistic expression of loyalty to the Japanese emperor (皇日, huángrì) had to be discarded, as Penghu might have returned at any time in the future to the Qing. The Qing also would after an eventual reoccupation of Penghu not have been amused by such a welcoming attitude towards the Japanese. The desperation was probably biggest in Xiyu, where the loyalty expression had been used most extensively for 200 years and it was in Xiyu where, within a very short time, a very important epigraphic invention took place. This invention was actually only possible on Penghu, where wind and weather had eroded the visibility into the past. For centuries, the only way to continue a practice had been to copy the practice of the previous generation, or to receive an imported practice that came by boat from a hired carver. But, Xiyu and Makong were not importing tombstones, they were exporting. They were the trendsetters and there was no way back. Copying the practice of the previous generation had become impossible and the practices of many generations before had been eroded and equally become inaccessible. People were forced to invent a tradition.

Since the tombstones on Xiyu had no alternative semantic role to fill the focus position, i.e., no *jiguan*, no generation number that counts up from a selected ancestor to the deceased, such as found in Meinong, the vacant position was filled with a new element, the *tanghao* (堂號 táng hào). This element, one might claim was not completely new, as all over Taiwan and Penghu there have been seven tombstones with a *tanghao* in the period from 1798 to 1884. Most of them are individual occurrences without systematic relations. Yet, two of them are located in Penghu. In 1830 and in 1884, we find two tombstones of a Wu (吳, Wú) family that uses the *tanghao* '延陵' (Yánlíng), the first in Makong, Caozhang and the second

in Xiyu, Zhuwan. Whether the second tomb, carved 11 years before the Japanese invasion, has served as inspiration for the systematic application of the *tanghao* remains currently an open question.

In contrast, in Makong, where tombstones retain their readability for more than 80 years, carvers could reanimate the *jiguan*, which had fallen out of usage in Makong only 70 years before. The tombstones in Wang'an, which were most probably served in the Japanese period by professional carvers from Xiyu, retained the local tradition of a *jiguan*, although the same carvers invented and promoted in Xiyu the *tanghao*. Comparing in Table 3.2 the material of tombstones in the Japanese period, we see that the *tanghao* was primarily introduced on basalt tombstones and thus most probably through professional carvers.

```
plot.focus <- function(df, island, mat, colors) {
  plot(0, 0, ylim=c(0, 1), xlab='year', ylab='percentage',
       xlim=c(1650, 2000), main=paste(island, '-', mat))
  abline(v=c(1683, 1895, 1945), lty=1, lwd=1)
  vec.y <- get.inscription.focus.sub(df)
  vec.x <- get.stone.creation.year(df)
  tab.form.year <- table(vec.y, vec.x)
  tab.prop <- prop.table(tab.form.year, 2)
  n <- length(get.tab.row(tab.prop))
  col <- colors[rownames(tab.prop)]
  zero <- mapply(function(plot.line, list.colnames)
                 (tab.prop), get.tab.row(tab.prop), col, 1, 0.18)
  legend('topleft', rownames(tab.prop), col=col, lty=1, lwd=3) }
####
plot.mat <- function(df, label, colors) {
  list.mat <- split(df, list(df$mat), drop=TRUE)
  zero <- mapply(plot.focus, list.mat, label, c('Basalt',
        'Coral'), list(colors)) }
####
df.focus <- inscription.has.focus.sub(df.penghu)
df.focus.year <- stone.has.creation.year(df.focus)
df.focus.year <- stone.has.period(df.focus.year)
df.focus.year$inscription.semantic.roles.focus.sub
  <- rename.vec.val(
df.focus.year$inscription.semantic.roles.focus.sub,
  'tw', 'local pl.n.')
df.focus.year$inscription.semantic.roles.focus.sub
  <- rename.vec.val(
df.focus.year$inscription.semantic.roles.focus.sub,
  'ch', 'jiguan')
df.focus.year$inscription.semantic.roles.focus.sub
  <- rename.vec.val(
```

(continued)



```

df.focus.year$inscription.semantic.roles.focus.sub,
  'th-other', 'tanghao')
df.focus.year$inscription.semantic.roles.focus.sub
  <- rename.vec.val(
df.focus.year$inscription.semantic.roles.focus.sub,
  'th-bjx', 'tanghao')
vec.focus <- unique(get.inscription.focus.sub
  (df.focus.year) )
library(hashmap)
hash.focus <- hashmap(vec.focus, 1:length(vec.focus))
df.focus.year$wangan <- grepl(', Wangan,', df.focus.year
  $graveyard.name)
df.focus.year$xiyu <- grepl(', Xiyu,', df.focus.year
  $graveyard.name)
df.focus.year$magong <- grepl(', Magong,', df.focus.year
  $graveyard.name)
df.focus.year <- df.focus.year[which(
  (df.focus.year$wangan + df.focus.year$xiyu + df.focus.
  year$magong) >0),]
df.focus.year$mat[df.focus.year$stone.material=='basalt']
  <- 1
df.focus.year$mat[df.focus.year$stone.material=='coral
  stone'] <- 2
df.focus.year$ming <- period.is.roc.ming.logic
  (df.focus.year)
df.focus.year$qing <- period.is.roc.qing.logic
  (df.focus.year)
df.focus.year$japan <- period.is.roc.japan.logic
  (df.focus.year)
df.focus.year$roc <- period.is.roc.roc.logic
  (df.focus.year)
par(mfrow=c(4,2))
df<-df.focus.year
label <- c('Wangan', 'Xiyu', 'Magong')
list.island <- split(df, list(df$wangan, df$xiyu, df$magong),
  drop=TRUE)
zero <- mapply(plot.mat, list.island, label, list(hash.focus))

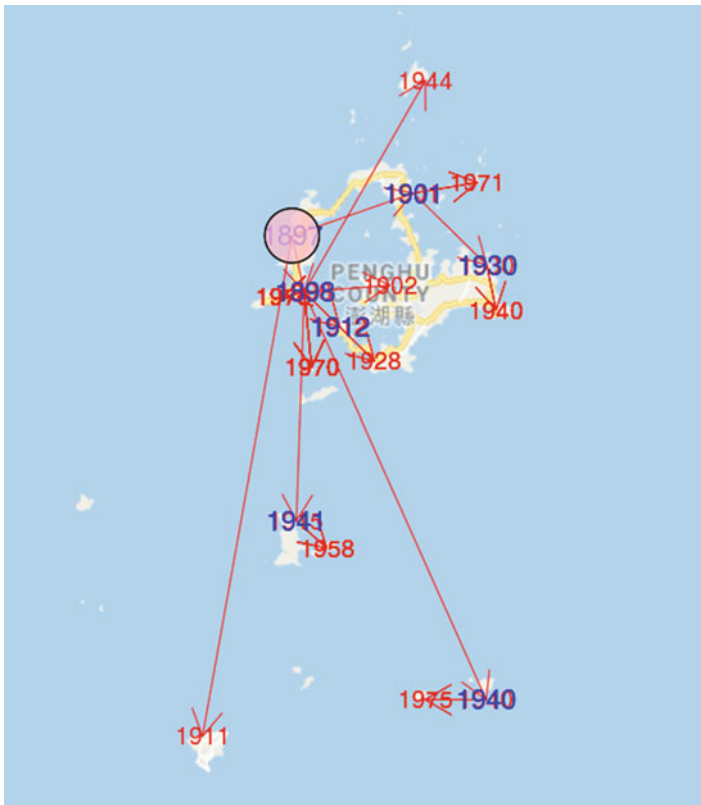
```

As the data in Fig. 3.22 show, professional carvers and untrained carvers behaved very differently during this period. Professional carvers adopted quickly a new solution and applied it systematically. Untrained carvers show more random-like patterns, as each tombstone reflects a different approach to handle a particular situation. Some untrained carvers continued to use the expression of loyalty to the Qing, either as an act of bravery that is supposed to challenge the Japanese empire or simply because a carver ignored that world history had arrived on Penghu. While

nonprofessional carvings reflect more personal attitudes, knowledge, life styles, and identities, the professional carvings are designed as market products.

We hypothesize that a systematic nature of tombstone inscriptions is at the heart of any professional tombstone carver, simply because this systematicity leads to a belief in his authority, which is at the foundation of his commercial model. Through a fast and systematic reaction, carvers could show that they reliably master the situation.

We further hypothesize that the reason why carvers on Xiyu did not return to the *jiguan*, which they practised simultaneously on Wang'an, was that the *jiguan*, a family history, had been simply forgotten on Xiyu. Carving a *jiguan* requires the memory of a specific historic placename for each family, which, contrary to the *tanghao*, listed for many surnames in the *Baijiaxing*, could not be provided by the



**Fig. 3.23** The propagation of the *Baijiaxing tanghao* from Xiyu over the Penghu archipelago following a model that limits the *p*-value of the space–time correlation to 0.005. Minimizing in addition to this the average spatial distance, the model identifies potential multipliers, i.e., potentially professional carvers. The spreading from carver to carver is colored blue, the spreading from a center to a spatial periphery is colored red

carver. Once forgotten by families on Xiyu, the *jiguan* would have been an imperfect solution to a general problem. At Makong, where we observe, differently from Xiyu, the return to the *jiguan*, the *jiguan* might have been readable on family tombstones and thus have still been part of the active memory. After all, the tombstone is not only the expression of a social identity, it is for many families also the memory of this social identity.

After the WWII, the practice of the *tanghao* expanded to all corners of the archipelago, even to the smaller islands, such as Jiangjun'ao, where before the arrival of the *tanghao*, tombstones had no inscription. This massive application of the *tanghao* was largely the result of the import of tombstones from two carvers, one in Baisha and one in Makong, who towards the end of the 20th assumed an absolute monopoly on the archipelago. What unites these carvers is that the carver in Baisha and the father of the carver in Makong did their apprenticeship in Yanshui, Tainan, Taiwan, with a Master from Penghu. After their apprenticeship, they returned to Penghu to open their workshops.

Modeling the propagation of the *tanghao* over the islands of Penghu, we have to make first assumptions on how such a feature might spread, forming a conceptual model, and find a solution among thousands of randomly created propagation paths that best fits the general assumptions. One of its many similar outcomes is shown in Fig. 3.23. Marked in pink is the onset of the practice, in blue the potential location of multipliers, i.e., carvers, and in red and orange the arrival of the practice on an island.

```
eval.model<-function(argtab) {
  gvs <- unique(argtab$gv1)
  pval <- cor.test(argtab$time.diff.norm, argtab$loc.
    diff.norm) [3]
  if(is.na(pval)) { return(100000000000) }
  if(pval > 0.01) { return(100000000000) }
  for (i in 1:length(gvs)) {
    smalltab <- argtab[which(argtab$gv1==gvs[i]),]
    if(length(smalltab[,1]) < 2) { return(100000000000) } }
  return(mean(argtab$loc.diff))
  #####
  st<-graveyard.has.xy(df.penghu.year)
  st<-stone.creation.is.after(st,1894)
  st<-inscription.has.placename(st)
  st<-inscription.has.date(st)
  st<-inscription.loc.is.tanghao(st)
  st<-stone.creation.is.before(st,1980)
  # merge graveyards that are very close
  st <- merge.graveyards.dist(st,0.04)
```

(continued)

```

# create a tab that contains all possible graveyard
  combinations
st.early <- earliest.token(st)
mytab <- cbind(
  expand.grid(x=st$graveyard.id,y=st.early$graveyard.id),
  expand.grid(x=st$stone.creation,y=st.early$stone.
    creation),
  expand.grid(x=st$x,y=st.early$x),
  expand.grid(x=st$y,y=st.early$y))
# giving names to the columns
colnames(mytab) <- c('gv1','gv2', 'date1','date2',
  'x1','x2','y1', 'y2')
# remove gv1==gv2
mytab<-mytab[which(mytab$gv1!=mytab$gv2),]
# adding time difference and distance
mytab$time.diff <- mytab$date2 - mytab$date1
# remove negative time difference
mytab <-mytab[mytab$time.diff > 0,]
# calculating the distance between the points
mytab$loc.diff <- distVincentyEllipsoid(cbind(mytab$x1,
  mytab$y1),
  cbind(mytab$x2,mytab$y2))
# adding pixel points
mypix1 <- LatLon2XY.centered(canvas.penghu,mytab$y1,
  mytab$x1)
mypix2 <- LatLon2XY.centered(canvas.penghu,mytab$y2,
  mytab$x2)
mytab$pixx1 <- mypix1[[1]]
mytab$pixy1 <- mypix1[[2]]
mytab$pixx2 <- mypix2[[1]]
mytab$pixy2 <- mypix2[[2]]
# normalizing distance and time diff
mytab$time.diff.norm <- normalize.vector(mytab$time.
  diff)
mytab$loc.diff.norm <- normalize.vector(mytab$loc.diff)
mytab$id <- 1:length(mytab[,1])
min <- 100000000000; runs <-100000; trial <- 0; mytab
  $connected <-0
while(trial < runs | min == 100000) {
  trial <- trial+1; tab<-mytab
  while(length(tab[,1]) > sum(tab$connected)) {
  # reuse a random number of connections of the most
    successful model
  if(min < 100000 & (sum(tab$connected)==0) & (1

```

(continued)

```

    < sample(c(1:10), 1)) {
reuse <- sample(model$id, sample(1:length(model[, 1]), 1))
connect <- which(is.element(tab$id, reuse))
}
# connect randomly one graveyard to another unconnected
graveyard
else { # select one graveyard from which to connect
selected.gv <- tab[sample(which(tab$connected==0), 1), ]
$gv1
connect <- which(tab$gv1==selected.gv & tab$connected==0)
l.sel <- length(connect)
if (l.sel > 5) { connect <- sample(connect, sample
(6:l.sel, 1)) }
}
if (length(connect > 0)) {
tab[connect,]$connected<-1 # mark as connected
exclude <- tab$gv2[connect] # exclude: connected
graveyards
# remove connections to the same
graveyard
tab <- tab[which(tab$connected==1 | !is.element(tab$gv2,
exclude)), ] }
}
comp <- eval.model(tab)
if (comp < min) {
min <- comp; trial <- 0; model <- tab;
PlotOnStaticMap(canvas.penghu)
arrows(model$pixx1, model$pixy1, model$pixx2, model$pixy2,
cex=2, col='red')
text(model$pixx2, model$pixy2, col='orange', labels=model
$date)
mult <- sort.by(model, model$date, dec=F)
mult <- unique.by(mult, mult$gv1)
text(mult$pixx1, mult$pixy1, col='blue', labels=mult$date)
starting.points<-which(!is.element(model$gv1, model$gv2))
points(model$pixx1[starting.points], model$pixy1
[starting.points],
col='black', cex=3, pch=21, bg=adjustcolor('pink',
alpha.f=0.2)) } }

```

Yet, we still can only speculate, how the *tanghao* come towards the end of WWII to Makong and Wang'an, where, after all, the *jiguan* had been predominantly carved during the Qing and the Japanese period. Our interpretation of the data is the following: As the local tombstone carving tradition expired on Wang'an in the

late Qing period, tombstones were served from Xiyu by a carver who respected the local tradition of the *jiguan* on Wang'an. Towards the end of the Japanese period, probably one or several sons of the Xiyu carver moved to Makong to increase their revenue, introducing the *tanghao* in Makong and Baisha. The hypothesis of this movement is supported by fact that around this time the practice of carving a *tanghao* started to decrease in Xiyu.

### 3.7 Conclusion

Tombstone inscriptions, like languages, can thus be said to have life cycles and to play different roles in different periods of this cycle. Tombstone inscriptions may at one point in time be the reflection of an identity based on a geographic origin and turn in later generations into a means of how identities and geographic origins are transmitted. We argued that the difference between Xiyu, where the *tanghao* was invented as systematic focus and Wang'an and Makong, where a *jiguan* was used in the Japanese period, is the result of a literally eroded memory of the *jiguan* on the tombstones of Xiyu.

Through time, the inscription may become obsolete and require an adaptation. These adaptations do not reflect necessarily a changing identity, but the best possible inscription under unstable and potentially unpredictable conditions. Especially, the carvings of professionals, who try to establish systemic solutions that highlight their professional status and guarantee their economic continuity, do not reflect family traditions or social identities. The constructed narrative, that has to introduce the transformation of their product, might leave the first customers in speechless disbelief, and yet, it might ascend to a national rhetoric or national ideology, from where it provides the next generation with an interpretation of their ancestor's tombs. The newly invented inscription is perceived as a tradition from the moment that previous generations of inscriptions have become unreadable. The interpretation given to these traditions is that elaborated in a state-mediate discourse, potentially inspired by the carvers' original narratives. It is this interpretation of a practice perceived as tradition which is then projected onto the past.

Finally, our work stipulates, in addition to a life-cycle model for the development of cultures and practices, a three-party model of power structures. Theories in the Marxist tradition underline the influence of the superstructure, e.g., the cultural hegemony, or as de Certeau calls it the *strategy* (de Certeau et al. 1980/1990, p. 59). But, de Certeau reminds us equally that there is the creativity of the oppressed, the ruse of the powerless, or as he calls it, *tactics* (de Certeau et al. 1980/1990, p. 60), an ingenuity however, that usually remains without a lasting impact on the flow of history. In our analysis, we could notice the absence of a significant influence of the untrained carvers on the transformation of tombstone inscriptions. Instead, a third group sneaked into the limelight, the mediator: a poet, painter, priest, or tombstone carver, who has the power to pick up elements of the arts of the powerless, similar to what we have seen on Xiyu, where a carver potentially picked up a singleton

occurrence of a *tanghao* in focus position, and to merge these elements in form and function with the requirements of the ruling class. As our analysis demonstrates, the influence of this third party cannot be underestimated and merits further studies. Accordingly, most of our hypothesis we had to formulate was related to the question how these mediators reasoned, where they moved, and how they tried to survive politically and economically.

### 3.8 A Case for Digital Humanities

Having summarized in a few sketches the transformation of epigraphies on Penghu, we have not yet evoked the scientific paradigm this research is embedded in, the Digital Humanities (DH). Our personal conception of Digital Humanities is that of an empirical approach to the Humanities and Social Sciences that relies on the digitization of the study object and, subsequently, computational methods to analyze or visualize the digitally represented objects. In this sense, DH can be brought to the center of a wide range of academic disciplines. Some of these disciplines involve by definition digital representations, such as corpus linguistics or computational linguistics. Other disciplines integrate the digital approach quite naturally, such as archaeology, geography, history, and musicology. Yet, no matter how much the individual disciplines embrace the digital approach, this trend will transform the scientific landscape and our way of teaching Social Sciences and the Humanities. This transformation is driven by the digitization of the research object, in our study tombs and epigraphic inscriptions. This common denominator in various research activities levels the barriers between traditionally defined disciplines, as the creation and exploration of digital data requires similar if not identical procedures, techniques, and tools across different fields. And, even if tools are different, they are frequently mere variances of more general approaches to extract meaning from data. One of these techniques is the analysis of co-occurrences, called in linguistics *collocations*, in geography *spatial correlations*, and in many other disciplines simply *correlations*. These correlations can be established on the basis of inherent categorical values, such as colors, or by mapping objects onto a common referential space, such as embodied in maps and timelines. High correlations indicate similar meanings. Negative correlations indicate paradigmatic oppositions, i.e., different functions within a common larger referential system. Network analyses as used in many fields ranging from linguistics to art history are equally based on correlations and allow for more systemic views on collections of objects.

As techniques for the creation and exploration of data are similar or transferred from one discipline to another, thematic distinctions become difficult to maintain. This claim might come as a surprise. Yet, using their scientific denomination as pretext, many academic disciplines only pretend to be defined by their research object, as *anthropology* the study of humans, *sociology* the study of societies, etc. Yet, historically these disciplines have been divided by their research method, qualitative in anthropology and quantitative in sociology, or using observation in

anthropology and the experiment in psychology. The advance of polythematic data in one digital format promises to bridge the academic islands that in the last two centuries have become consolidated through institutions, journals, and an academic habitus.

As we show in this paper, the bridging between the academic islands is not only something we can observe to happen, but it is something we need and long for. The study of products of the human hand and brain, the Humanities, and the Social Sciences, the study of human behavior, are fragmentary when considered in isolation. If working with rich data, pursuing a fragmentary approach might produce only scattered insight. If, however, the data themselves are fragmented and incomplete, as in the study of previous societies and languages, every piece of information, no matter which scientific field it might be formally associated with, is worth of being pulled into a pool of data to overcome knowledge gaps through various reasoning techniques which can integrate these data, be they interpolations, analogies, or models.

The research presented here addresses the transformation of practices and to do so, looks narrowly at intertwined linguistic, anthropological, sociological, economic, and archaeological aspects of epigraphic practices. None of these academic disciplines would be in a state to analyze their transformation on Penghu alone. As we have shown, the geological conditions of the islands influence funerary and epigraphic practices and it is the choice of the material, reflecting the economic conditions of the family of the deceased, that triggers the involvement of different kinds of carvers. Different carvers slate stones of different shape and size and produce distinctive linguistic features with a distribution in time and space that reflects the economic state of the home village of the carver, his market share at different times, and thus the potential to disseminate specific epigraphic practices over a certain area. These practices, which evolved out of political and social transformations, ascend to perceived traditions once older inscriptions have become erased by the storm of salt and sand particles that batter the islands. The *tanghao* as a systematic focus of tombstone inscriptions proved to be a successful invention, as it allowed the carver to present a coherent narrative and the community to have an feature that could be woven into the fabric of a social identity with interpretations that ranged from resistance to assimilation. Each of these aspects involved in the transformation of practices and the emergence of a tradition would be irrelevant when considered in isolation. After all, the transformation of practices and the emergence of a tradition involves a material culture, a physical space, a geopolitical constellation, professional groups, their economic models, a psychological reception of their products as well as a discursive elaboration of the products' interpretations.

How to bring these entities together, and how to interpret their correlations is what I tried to show in this contribution, using the ThakBong database and R as principal tools. Similar to fishermen, who maintain their nets and develop the art of casting them out in the sea, digital humanists have to study, elaborate, and sharpen their tools. Only when attaining the agility to manipulate one's tools freely in conventional and unconventional ways, one can trace the hidden story in one's



data that eventually would keep the audience breathless, when the world around them, like basalt, seemingly petrified, transpires as scalding liquid lava of meaning.

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## References

- Brown, H. I. (1985). Galileo on the telescope and the eye. *Journal of the History of Ideas*, 46(4), 487–501.
- Brown, M. J. (2004). *Is Taiwan Chinese? The impact of culture, power, and migration on changing identities*. Berkeley: University of California Press.
- Chen, C.-s. (1953). The Pescadores. *Geographical Review of Japan*, 26(1), 77–88.
- Chen, C.-s. (1995). The Pescadores. In *Geo-essays on Taiwan* (pp. 450–466). Taipei: SMC Publishing Inc.
- de Certeau, M., Giard, L., & Mayo, M. (1980/1990). *L'invention du quotidien. Arts de faire*. Paris: Gallimard.
- Harrison, K. D. (2007). *When languages die: The extinction of the world's languages and the erosion of human knowledge*. New York: Oxford University Press.
- Leech, G. (1993). 100 million words of English. *English Today*, 9(1), 9–15.
- Ptak, R. (2015). *Fujian – Penghu – Taiwan. Frühe Kontakte, nach Texten zusammengefaßt (ca. 200–1450 n.Chr.)*. Abhandlungen für die Kunde des Morgenlandes. Wiesbaden: Harrassowitz Verlag.
- R Development Core Team. (2008). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing. ISBN 3-900051-07-0.
- Streiter, O., Goudin, Y., & Huang, J. C. (2011). ThakBong, digitizing Taiwan's tombstones for teaching, research and documentation. In *TELDAP 2010 - The International Conference on Taiwan e-Learning and Digital Archives Program* (pp. 146–157). Taipei: TELDAP agency.
- Streiter, O., Goudin, Y., Huang, J. C., Lin, A. M.-f., & Yen, S. K.-j. (2010). Places of shared histories: Spatial patterns of placename types on Taiwan's tombstones. In *GeoInformatics for Spatial-Infrastructure Development in Earth and Allied Sciences (GIS-IDEAS)* (pp. 29–34). Hanoi: Japan-Vietnam Geoinformatics Consortium (JVGC).
- Theobald, U. (2011). *Chinese literature: Baijiaxing 百家姓 "the hundred family names"*. Last modified 2011, accessed August 16, 2013.
- Tsao, S., Song, S.-r., Lee, C.-y., & Shea, K.-s. (1999). *Explanatory Text of the Geological Map of Taiwan, Scale 1:50,000 Sheet 73, Sheet 74, Sheet 75, Sheet 76, Penghu Islands*. Taipei: Central Geological Survey.
- 汪大淵 Wáng Dàyuán (Wang Dayuan). (1339/1981). 島夷誌略校釋 *Dǎo yí zhì è xiào shì (A Brief Account of Island Barbarians)*. Beijing: Zhonghua.
- 澎湖縣政府民政局 Pēnghúxiàn Zhèngfǔ Mínhèngjú (Penghu County Civil Affairs Bureau). (2005). 續修澎湖縣志 · 卷二 · 地理志 *Xù xiū pēnghúxiàn zhì. Juǎn èr: Dìlǐ zhì (The Annals of Penghu County. Volume XIII. Geography)*. Magong: Government of Penghu County.