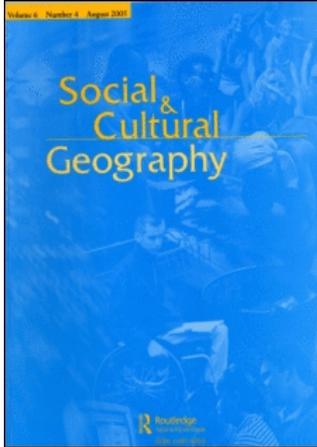


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## Geographic patterns of Zhuang (Tai) kinship terms in Guangxi and border areas: a GIS analysis of language and culture change

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*Historically-speaking, centuries of interactions between Han Chinese newcomers from the north of China and indigenous Tai-speaking ethnic minorities in the south have left deep, indelible traces in the language and culture of the latter and raise questions of identity and language policy in modern times. The language and culture in this study is Zhuang, one of many Tai languages and the largest minority language in China today. Using kinship terms as an example, we employ the analytical tools of Geographic Information System (GIS) to map and analyze the spatial pattern of sinification of kinship terms and attempt to explain the process of cultural and linguistic interaction that may have led to such distribution in the Zhuang domain. We use published data on Zhuang kinship terms from thirty-four representative locations in Guangxi and border areas (four in eastern Yunnan and one in western Guangdong) and semi-quantify them according to their pronunciations: three for Han-like pronunciations, one for more clearly Zhuang, and two for linguistic forms in between. The spatial pattern of kinship term sinification scores based on interpolation of the sampling locations shows that high degrees of sinification are located in areas close to the coast or international border with Vietnam, with gentle land slope and close proximity to major transportation hubs, reflecting the importance of both physical features and economic development in those areas in facilitating interactions between the two cultures in the sinification process. The degree of sinification of kinship terms also varies with their positions in a family kinship tree, perhaps reflecting Han social customs and male dominance in society more than traditional Tai kinship systems, which are generally more bilateral in nature.*

**Key words:** sinification, Zhuang (Tai), GIS, spatial patterns, kinship terms, comparative-historical reconstruction, ethnic identity, language programs.

## Introduction

### *General background*

The geography of languages is a long-standing area of geographical research (Desforges and Jones 2001). Modern studies of geography and language in the West often arise out of issues relating to nationalism and cultural politics, such as the Welsh in the UK or the Basque in Spain. Matters of political power, educational opportunities, economic advancement, preservation of language, promotion of cultural and religious values all come into play and demand attention. Some of the main research foci concerning geography and language include mapping the distribution of languages (Iannaccaro and Dell'Aquila 2001), exploring the links between language and national identity (e.g., Berdichevsky 2004; Williams 1993), and the more practical question of language planning (e.g., Eastman 1983). However, most of these studies are qualitative in nature. This paper differs from these studies in at least two aspects: (1) methodology and (2) scope. Our methodology relies on the quantitative and analytical capabilities of Geographic Information System (GIS) as a means to be both more precise and more nuanced in visualizing and explaining language and geography. Although this paper focuses on kinship terms, our methodology can be extended to other dimensions of the language, e.g., the use of agricultural terms—or to other languages. Since the rest of the paper is primarily focused on methodology, we will briefly describe the uniqueness of the language, culture, history and politics of Tai-speaking ethnic minorities (Zhuang in particular) in southern China in the Introduction.

In China and socialist countries such as Vietnam, Laos, Cambodia, Burma, the geography and history of languages share some

commonalities, but are unique in other ways. Starting as early as 214 B.C.E., Han Chinese imperial governments promoted a policy of 'sinification' that historically involved forcing large numbers of Han from the north to migrate, mix, and intermarry with the minority peoples in the south. The government also established the Han culture and educational system in minority areas and forced minority people to learn Han culture (Huang 2003). In more recent times in China under the Chinese Communist Party, some minorities, such as Zhuang, were 'created' as part of the new nationalism of communist egalitarian ideology and, more cynically, to reduce the opposition of minorities to the central authority (Kaup 2000). The central government even helped the Zhuang to devise a Latin-based alphabet (in 1955, revised in 1980), and set up Zhuang language programs at all educational levels. However, by 2000, such efforts largely failed and there were no real Zhuang language schools in the Zhuang language area (Huang 2003). One of the major reasons is that such programs were set up with the unspoken ultimate goal of sinification, i.e., regarding Zhuang language as a 'bridge to Chinese education,' or as a 'walking stick' or crutch for the Zhuang people to use in learning Chinese, which can be thrown away once they master Chinese (Huang 2003). The younger generation of Zhuang feels that Zhuang is a 'backward' language and are reluctant to admit they are Zhuang because of social bias. It is more to their economic benefit to master Mandarin Chinese because the latter is required in university entrance examinations and getting university degrees would mean better access to better jobs. By contrast, in Europe, with the expansion of the Roman Empire, the Celtic language, which had dominated Central and Western Europe, was pushed to the periphery,

e.g., Welsh (Aitchison and Carter 2000: 23). Many people speaking such languages actively seek to promote their language and culture and demand their wider recognition and acceptance.

*The Zhuang language, history of Zhuang–Han interaction, and sinification*

The Tai languages are a subgroup of the Tai-Kadai language family. The Tai-Kadai languages are spoken by more than 85 million speakers in areas extending across southern China and include areas of northern Vietnam, Burma, and all of Laos and Thailand (Figure 1; Edmondson 1992; Li 1960). The two national languages of the group, Thai and Lao, account for well over half the total of Tai-Kadai speakers. The spelling ‘Thai’ is used for the national language of Thailand. ‘Tai’ is used for the wider Tai subfamily of Tai-Kadai and also in the names of some specific varieties (Diller 2005).

Tai-speaking people were thought to be closely related in physical shape and language to the Yue, an ancient group of people that made up different tribes who spoke different languages and lived in large areas of south-eastern and southwestern China along the Yangtze River before the Xia and Shang

dynasties (Luo 1996: 36). The Tai emerged from Yue as a distinct ethnolinguistic group about 2,000 years ago and began to spread out of their purported homeland in the borderlands of Guangxi and Vietnam and into Laos and Thailand (Hartmann 1998: 82). Because their culture and agriculture has centered on the production of rice in irrigated fields, Tai-speaking people generally live in areas along waterways at lower elevations with gentler slopes in contrast to most of the non-Tai ethnic groups in southern China (Hartmann 1998; Luo, Hartmann, Li and Sysamouth 2000). One of the major reasons for their migration may be related to their searching for the best ecological environment to grow wet rice (Luo, Hartmann, Li and Sysamouth 2000).

The general area of southwestern China where Tai-speaking people lived was not penetrated by Han Chinese until about 225 B.C.E. when 100,000 Han troops moved in following the Qin subjugation of the Yue kingdom (Barlow 1987: 251; Marks 1998: 56). Subsequently, there were several large waves of Han Chinese moving into this area, mostly fleeing from wars in the north. The ‘Yongjia Panic’ in the early fourth century triggered one of the earliest movements of Han into the south because of invasions by nomadic tribes from the north. In the 1200s

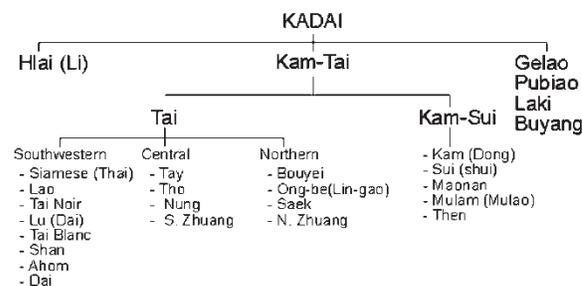


Figure 1 Tai language family tree. Adapted after Edmondson (1992) and Li (1960).

the Mongols conquered almost all China, resulting in great migrations southward and a sudden population surge in the study area (Marks 1998: 65).

The term ‘Zhuang’ used in this study to designate a Tai-speaking group, indeed now the largest in China, did not appear prior to the Communist takeover. Earlier, the tribal groups of the region thought of themselves as one of twenty or more local ethnic or tribal groups found in southwestern China or northern Vietnam. In Vietnam they are referred to as Nung. Throughout much of their known past, villagers in these areas were often in savage battle against a particular other ‘people’ (Kaup 2000: 5). It was the frequent attempts by the Han Chinese throughout the history since the Song dynasty to conquer this area that forced these tribal groups to gradually unite themselves (with a Tai upper strata; Moseley 1973: 17) in their effort to resist a common outside enemy (Zhu 1996: 197). The Chinese government, in a political move, constructed a Zhuang ‘nationality’ to include all of these disparate and competing peoples as a means to creating a unified and historical ‘Chinese Nation,’ while the reality is that their actual history was one of ‘fusion and fission’ (Harrell 1996: 1).

The Han Chinese who came to conquer and rule over the Tai-speaking people and other minorities in China have fostered a policy of acculturation not unlike the assimilationist programs of other nation states like the USA and Thailand (Hartmann 2003). The degree to which Tai-speaking people have been influenced by Han Chinese is referred here as sinification. The interaction between Zhuang and Han Chinese and the sinification of Zhuang is a complicated historical process. For the most part, this process was peaceful. The Han Chinese brought with them a superior culture, which was readily adopted by indigenous

peoples. ‘By adopting Chinese language and dress, large number of Yi and Chung [Zhuang] “became” Chinese’ (Moseley 1973: 18).

Barlow provides a concise narrative of what took place in the Song dynasty.

The pacification of the [Zhuang] region attracted an increased flow of Han immigrants. Early in the Song period one district registered a total of 17,760 households, both Zhuang and ‘guests’ (Han immigrants). By 1078–1085, the same zhou registered 56,596 ‘guest’ households alone. Some minority districts which had previously had no Han households were suddenly overwhelmed by immigration.

With the new immigrants came Han culture. Chinese intellectuals began schools and academies in which the sons of the Zhuang who took posts in the new bureaucracy often enrolled. The court also ordered the enforcement of the Chinese dress style. Naturally, sumptuary decrees initially affected the Zhuang who began to work with the Han, but these were the upper strata of Zhuang society, and influenced the social groups below them. Men and women began to button their clothing on the right, women donned bodices, give up their trousers for skirts, and hair styles too began to reflect Han Chinese practices.

In the old Zhuang society courtship had been a playful institution with trial marriages, frequently contracted by the partners themselves at periodic song fetes when the Zhuang youth assembled, ‘smiled, sang and married.’ Now the rigid protocol of the arranged Confucian marriage began to penetrate Zhuang society. (1987: 262)

Besides the Zhuang (Tai) language, three other languages are spoken in Guangxi today, which are all branches of Chinese: (1) Guilin language system (or the ‘official language’ system), came with people who immigrated

from Hunan and Hubei in the north; (2) Guangdong language (also called 'white language' or Guangzhou language), which came with people who immigrated from Guangdong in the east; and (3) 'Guest' (Hakka) language system (also called 'mountain' language, because they came after the other two Han groups, who occupied the lowlands, leaving only the mountains for the 'guest' people to settle) (Zhu 1996: 194).

In his paper entitled 'Sinification of the Zhuang People, Culture, and Their Language,' Zhuang scholar Huang Pingwen summarizes the historical progression of the sinification of the Zhuang along similar lines.

The Han population penetration of the Zhuang area was in eastern Guangxi and western Guangdong first and then later in western Guangxi. The penetration into the Zhuang heartland in western Guangxi did not start until the Tang dynasty (618–907 A.D.). Han Chinese immigrated into the region not only from northern China but also from Guangdong. They moved along the Xijiang River toward the Yuejiang River, the Zuojiang River, and the Youjiang River. Even in Xilin county which is located at the border of western Guangxi, there were Han immigrants by the time of the Ming dynasty (1368–1644). From then on almost all of the Zhuang counties had Han Chinese immigrants. In the following dynasties, the Han population in Guangxi increased quickly. The Han population constituted less than 20 percent of the Guangxi population in the mid-sixteenth century. By the end of the nineteenth century this percentage had increased to over 50 percent and, by the mid-twentieth century, was nearly two-thirds. (Huang 2003: 6)

Following many centuries of Chinese military, political and cultural control, large numbers of Han settlers began entering Guangxi during the Ming dynasty (1368–1644) but continued to

populate the region during the Qing dynasty (1644–1911) and the Republican era (1911–1945), reducing the non-Han population to about one-third (Moseley 1973: 1–2, 7). It was thought that during the Tang dynasty (618–907) the Zhuang–Han ratio was the reverse, 70:30, which was already rather high (Barlow 1987: 258). The Han colonists lived in relatively concentrated areas, mostly urban centers, leaving the more remote upland, 'geographically hostile' regions to the indigenous peoples (Kaup 2000: 3; Moseley 1973: 2, 16). During the Song dynasty (960–1126), the Zhuang were given control of the plain between the You and Zuo rivers, a district they called the Guang-yuan zuo (Barlow 1987: 255). What we find today is a concentration of the Zhuang population (more than 90 percent Zhuang-dominated) in just a handful of counties in the Guangxi Zhuang Autonomous Region with its fourteen designated prefectures shown in Kaup (2000: maps xi–xiii) and Figure 3. It is in this region that we might expect to find less Chinese influence on Zhuang language.

The sinification of the Tai language is a representative example of the overall sinification process. In this paper we use sinification of kinship terms as an example, attempting to shed light on this complicated process. Understanding the process of sinification also has important implications for the impact of current ever-increasing globalization on Tai-speaking ethnic minorities in the whole of Southeast Asia and other marginalized ethnic groups in other parts of the world, where the dynamics of social change and its impact on linguistic change remains to be explored in depth.

### **Hypothesis to test and purpose of the paper**

Since historically a major means of travel and transport has been by water, the routes by

which the Han Chinese entered the south and the Guangxi region in particular, was likely along major rivers (Marks 1998: 21–22, 33–34). Figure 2 shows two likely routes: (1) going upstream of Gan Jiang, a tributary of the Chang Jiang (Yangtze River) in Jiangxi Province northeast of the study area, and then over the Meiling Pass, an important roadway at the border between Jiangxi and Guangdong Provinces, ‘chiseled’ by human labor during the Tang dynasty (Marks 1998: 33–34); this route then continued along the Bei Jiang southward and the Xi Jiang (West River) westward into Guangxi; and (2) going upstream from Xiang Jiang (another tributary of Chang Jiang) in Hunan Province, through Ling Qu (an important man-made canal that connects Xiang Jiang and Li Jiang) to continue south along Li Jiang (Marks 1998: 21–22). These two routes are also corroborated by Moseley (1973: 15–16). According to Barlow

A permanent settlement, the ‘Han City’, evolved northeast of today’s Guilin, and Chinese influences emanated south from there. The Han followed the Gui river south to where it joins the Liu to form the West river, at today’s city of Wuzhou ... Chinese expansion during the Han period into the south and east of Guangxi left the center of Zhuang population, the region of the You and Zuo rivers in southwestern Guangxi, largely untouched. (1987: 252)

Given the above likely migration routes (see Figure 2) and assuming a diffusive sinification process, we can put forth the following hypothesis: the sinification process would be more intense along the Gui Jiang and Xi Jiang and northeast of Guilin to the north and less intense away from the waterways and farther southwest.<sup>1</sup> The Zhuang region between the You and Zuo rivers (both meeting in Naning) in southwestern Guangxi, which was left

outside of Chinese control during earlier waves of Han migration, should give evidence of weaker sinification (Barlow 1987: 252) (see Figure 2 and 3). We would expect to find a higher preservation of Zhuang kin terms in this area, the center of Zhuang population.

The purpose of this paper is to illustrate how GIS can be used to help us reveal, visualize and quantify the spatial pattern of sinification of Tai languages (as reflected in Zhuang kinship terms), to see if that pattern is consistent with our hypothesis based on qualitative reasoning, and to shed more light on the complex and dynamic sinification process.

### Study area, data source and kinship terms

The study area is located mostly in the Guangxi Zhuang Autonomous Region (Guangxi AR)<sup>2</sup> and a few counties in the neighboring Yunnan and Guangdong provinces (Figure 3). The Zhuang language (including Southern Zhuang and Northern Zhuang) is part of the Tai language family (see Figure 1) spoken by the ethnic minority residing mostly in the Guangxi AR. The Zhuang people are the largest minority ethnic group in all of China (17.8 million population estimate in 2000). The highest concentration of the Zhuang population is located in the southwest corner of Guangxi AR and spreads across the border into Yunnan Province (Figure 2).

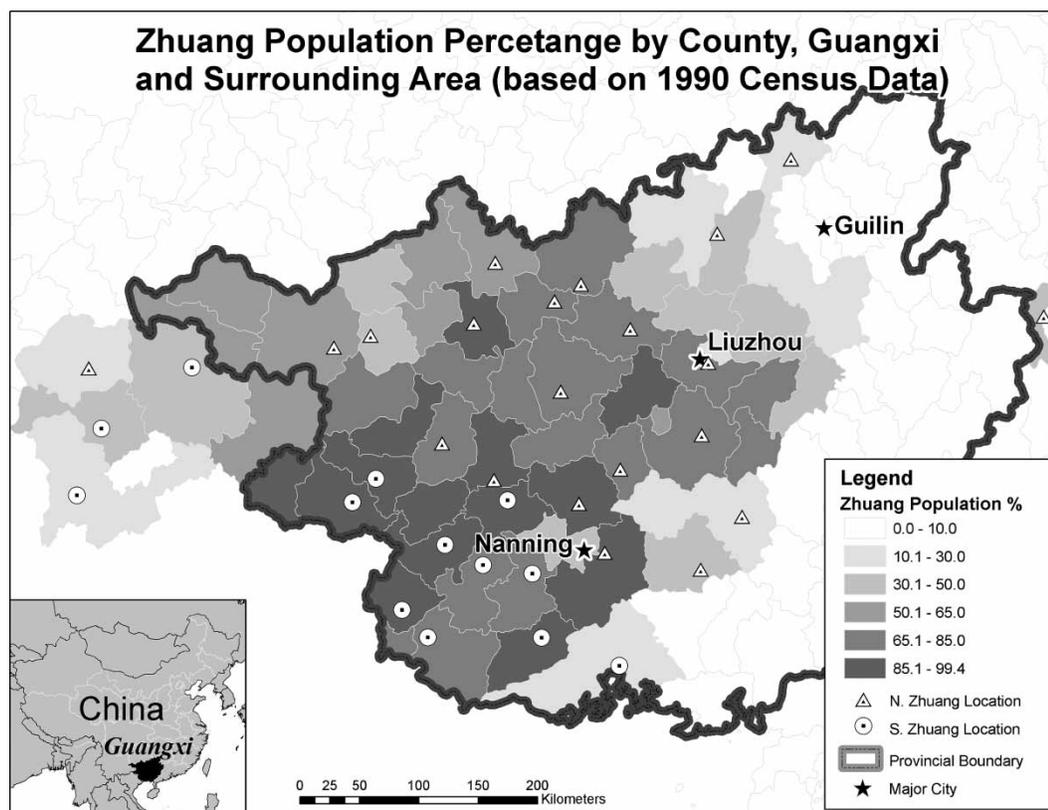
The data for this study come from Zhang *et al.* (1999), who compiled an extensive Zhuang vocabulary list of 1465 words based on fieldwork done in 1954, 1955, 1977, 1992, and 1993 at thirty-six representative locations. Of these thirty-six data points, twenty-two of them belong to Northern Zhuang and the other fourteen belong to Southern Zhuang; thirty



Figure 2 Major features of Guangxi and possible routes by which the Han entered Guangxi (shown by arrows).

places are in Guangxi, five are in Yunnan, and one is in Guangdong. Most are places at the county level, except for four points: Guang Nan North and Guang Nan South (which are in Guang Nan county), and Yong Nin North and Yong Nin South (which are in Yong Nin county). In order to be consistent and for easy regression analysis with explanatory variables at the county level, we averaged the kinship sinification scores (see methodology section) of the two points within the same county as the score for that county. So we have thirty-four sampling data points, all at county level (see Figure 3 for their locations).

We selected the forty-five kinship terms from the vocabulary list in the book by Zhang *et al.* (1999) as the focus of our study. The reason we chose kinship terms is because kinship relationships exist in every culture, so when two cultures interact, changes in kinship terms will likely reflect the influence of one culture on the other. In other words, no matter what cultural or ethnic group we belong to and how the society, economy, or technology develops over time, we all need to identify ourselves and others in a social context (Huang and Jia 2000). So the actual kinship relationships, e.g., birth-mother, father, mother's father, and so on are



**Figure 3** Zhuang population percentage by county, Guangxi and surrounding areas. Also shown are the thirty-four locations where Zhuang kinship terms were sampled and three major cities.

biological constants. What changes is how we label those relationships (the kinship terms), which can truly reflect the influence of cultural interaction. This will not be the case for other terms, such as terms referring to industry or tools, which may be borrowed intact as new things are invented or enter the community from the outside. Furthermore, unlike in English, in Tai and Chinese languages, kinship terms are used to address others in place of pronouns. So they have great utility in everyday life both at home and in the marketplace. In families where a Chinese male has married into a Tai/Zhuang family, children of such a bicultural union will likely address the

father with a Chinese term, but the mother with a Zhuang term. Once the Chinese father becomes a grandfather, he will be addressed by his grandchildren with the Chinese term.

Even in places such as Bangkok, which has a very large Chinese population, Thai children with an ethnic Chinese father will address him as Chinese 'pa', not Thai 'phou.' A popular Thai novel, *Living with Grandpa*, uses the Chinese term 'Gong' in its title, not Thai 'ta or pu.' In Thai markets, a Thai female merchant or an ethnic Chinese female shopper can be addressed as 'je,' the Chinese term for 'elder sister' (Hartmann 1997: 112). In a survey of 'Language Use of the Chinese in Bangkok,'

Srinarawat (1988: 276) reported that among the Teochiu Chinese interviewed, nearly 60 percent spoke Theochiu and Thai. Almost all respondents spoke Chinese to their older relatives and parents, especially in families engaged in trade. Those who were less educated spoke to their spouses in Chinese; those educated in Thai schools were more likely to speak to their spouses in Thai and generally were more acculturated to Thai. Both the Siamese Thai in Bangkok and the Zhuang Tai in Guangxi have experienced the adoption of Chinese kinship terms in daily use, especially in family settings with a Chinese father. What is different is that the Zhuang, who were in their remote past the majority of the Guangxi population, were inundated by Han migrants and became the minority that they now are.

From a cursory look at the Zhang *et al.* (1999) list of kinship terms, it is clear that some Han kinship terms have been borrowed by the Zhuang to varying degrees at different geographical locations. It was our goal then to discover some of the geographical correlates of this sinification process using GIS.

## Methodology

To show how the degree of sinification of kinship terms change over space (and, by implication, time), we semi-quantified the kinship terms by giving each term a score between 1 and 3 based on their phonological shape. For those terms that retain an obvious Zhuang pronunciation, a numerical score of 1 was assigned to them; to those that are recognizably Han Chinese, a score of 3 was assigned; and those in between or a hybridization of sorts were assigned a score of 2. Thus the higher the score value, the higher the level of sinification. An excerpt of the data and score assignment are shown in Table 1.

We took the mean of the scores of all terms at each location (i.e., each row in Table 1) to represent the degree of sinification there. We then mapped the spatial patterns of mean score distribution using the kriging interpolation algorithm in GIS and analyzed the patterns to infer the reasons for such distribution. The kriging interpolation method uses a variogram to express spatial variation, and it minimizes the error of predicted values which are estimated by spatial distribution of the predicted values (Cressie 1993). It is also called the best linear unbiased estimator. The ArcGIS implementation can also generate a kriging variance grid, which acts as an estimate of the errors of the predicted value.<sup>3</sup>

## Results and discussion

### *Qualitative analysis*

Figure 4 shows the thirty-four county-level sampling point locations, the average score of all forty-five terms at each location, and the interpolated contours from the average scores at the sampling locations. The highest scores are concentrated in the south and southwest corner of the Guangxi AR, close to the coastal line and international border with Vietnam. This also roughly corresponds to the areas of highest Zhuang percentage counties, contrary to what we expected. Another high score area is located near Liuzhou. Also shown in this figure are the major streams of the Xi Jiang drainage system that flows into the neighboring Guangdong Province. These high score areas do not follow the two likely waterway routes we hypothesized and showed in Figure 2: the areas around Guilin and the Li Jiang are low and the areas along the main stream of Xi Jiang are low. Also shown in Figure 4 are the railroad network and the

Table 1 An excerpt of the kinship terms and sinification score assignment

Location ID	Father's Father	Father's Mother	Father	Mother	Husband	...
1	takɔŋ 2	təjaj 1	təpɔ 1	təmɛ 1	koŋkwaan 3	...
2	koŋ 2	ja:pou 2	ʔi[θok] 3	mi[θim] 2	poukoŋ 3	...
3	paɯ 1	ja 1	pɔ[jɛ] 2	mɛ 1	poukoŋ 3	...
4	kuŋ[paɯ] 2	pɔ[jaj] 2	pɔ[paj] 2	mɛ[ma] 2	kwaan 3	...
5	paɯ[kuŋ] 2	pɔ[jaj] 2	pɔ[tia] 2	mɛ 1	kwaan 3	...
6	paɯ[kuŋ] 2	mɛ:pɔ 2	pɔ 1	mɛ 1	kwaan 3	...
7	tɛ[laaɯtɛ] 3	naai 3	pɔ 1	mɛ 1	pu 1	...
8	ti[kuŋ] 3	naai 3	pɔ 1	ma 3	pu 1	...
9	koŋ 3	pə[naai] 3	pɔ 1	mɛ[ma] 2	pu:aaɪ 1	...
10	koŋ 3	pwa 3	ja[pɔ] 2	mɛ 1	koŋ 3	...
11	koŋ 3	ja 1	pɔ 1	mɛ 1	tɔ:aaɪ 1	...
12	paɯ 1	ja 1	pɔ 1	mɛ 1	ku:uɯɪ 1	...
13	paɯ[kuŋ] 2	naai 3	ti[pɔ] 2	mɛ:ma 2	kjaau 1	...
14	kuŋ 3	naai 3	pɔ[jɛ][ti] 2	mɛ 1	kwaan 3	...
15	/aikoŋ 3	pajaj 2	pɔ 1	pa:mɛ 1	ʔaiko:waan 3	...
16	koŋ 3	pəpu 2	pɔ 1	mɛ 1	ʔaiko:waan 3	...
17	koŋ 3	ma[pu] 2	pɔ 1	mi[mɛ] 2	kwaan 3	...
18	koŋ 3	pu 3	tɛ 3	mi 1	poukwaan 3	...
19	/aikoŋ 3	ʔajaj 1	ʔapɔ 1	ʔakɯnɛ[ku] 2	pu 1	...
20	/aikuoŋ 3	ʔama 3	ɬuk 3	ʔame 2	pu:fuŋ 3	...
...	...	...	...	...	...	...

major railroad exchanging stations. There is a striking coincidence between the two high score areas and the major railroad exchange stations in Nanning and Liuzhou. So the level of economic development brought about by the easy transportation of the modern railroad appears to have contributed to high sinification scores. The lowest scores are located in topographically higher and more rugged areas in the northwestern part of Guangxi and into Yunnan, which may have made it harder for the Han to interact with the Zhuang.

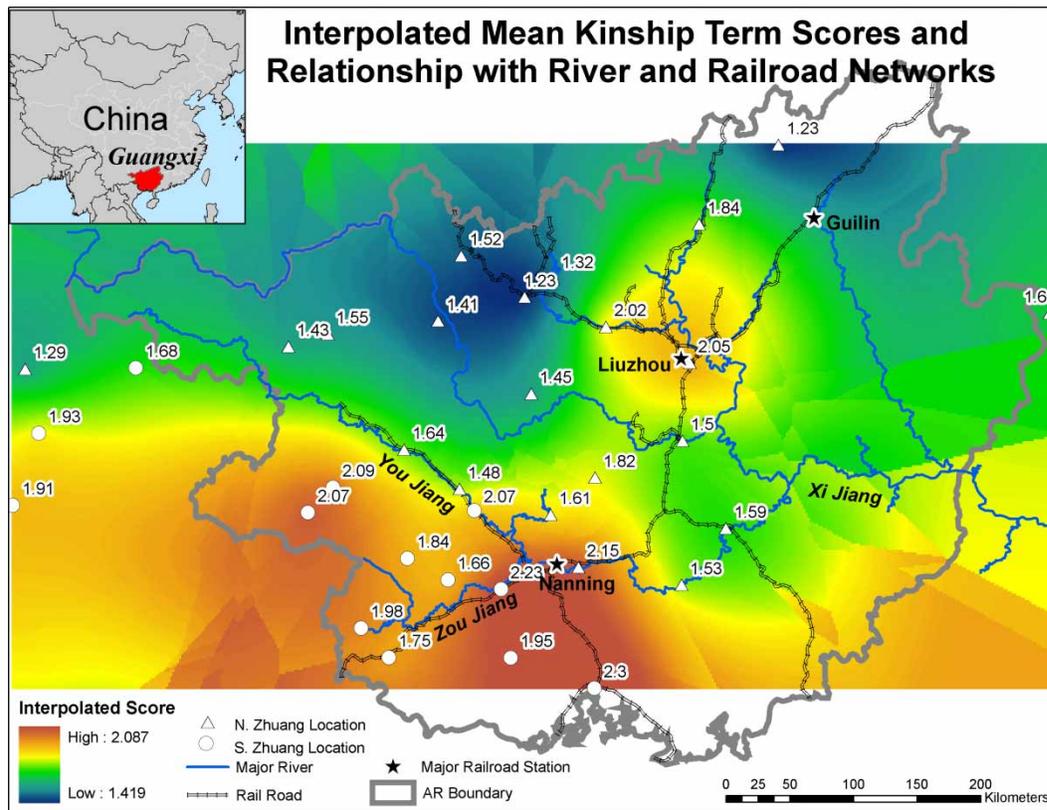
Figure 5 shows the error estimate of the kriging interpolation. It shows that the center of the figure with more data points has low error value and thus is more reliable than the outer edge of the figure where there are fewer data points to constrain interpolation values. The large uncertainty and the lack of sampling data

points in the eastern part of the study area prevent us from interpreting much more about the sinification process there. However, we can say that the sinification pattern of the interior of the study area does not appear consistent with the hypothesis we put forth earlier. We will explore further using quantitative regression analysis to explain the pattern.

### *Regression analysis and interpretation*

#### *Regression analysis*

In order to explain the spatial pattern of the average sinification scores of kinship terms quantitatively, we selected the following variables as shown in Table 2 (based on the history of the area and the above qualitative analysis) and conducted regression analysis.

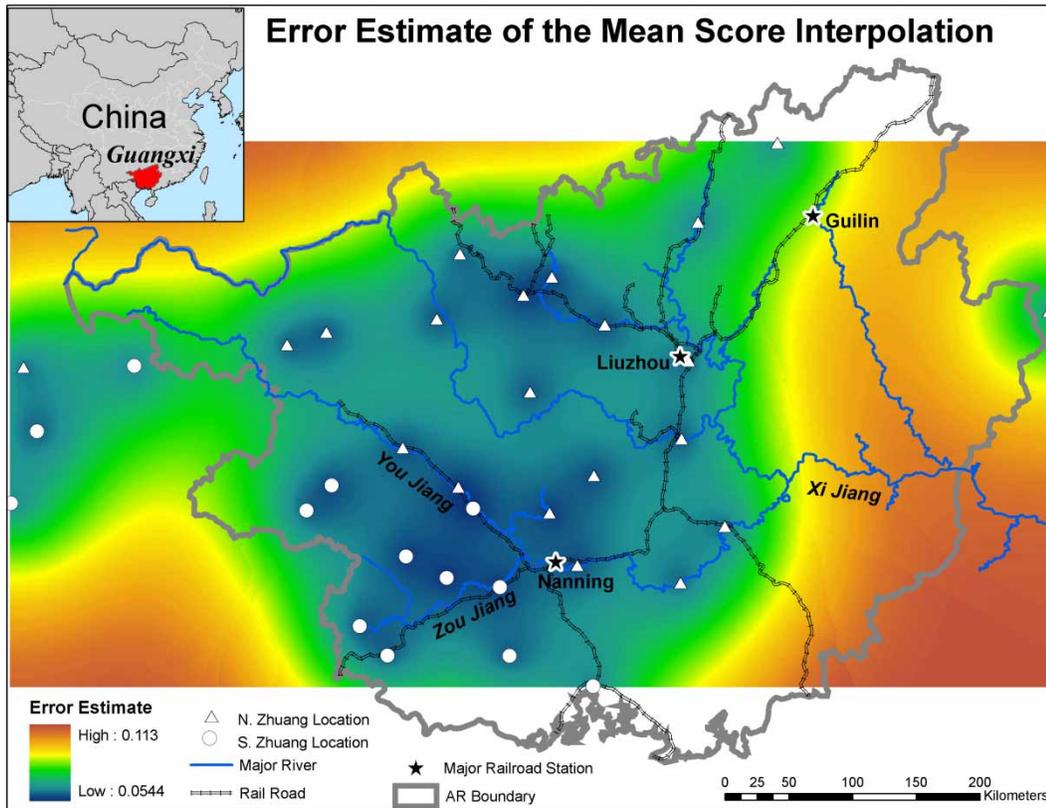


**Figure 4** Interpolated mean kinship term score contours based on the thirty-four sampling points and their relationship with major rivers and the railroad network. Also shown are the sampling locations and the mean score at each location. Note the mean of the mean scores  $\pm$  SD =  $1.7248 \pm 0.2983$ .

*Including all sample points.* We used the average score of the all the kinship terms at each location as the dependent variable and regressed it against the above variables using SAS's REG procedure. We used the popular stepwise method to select the variables that will enter the model. The stepwise method adds the variables into the model one at a time and calculates the  $F$  statistics to test if its contribution to the model is significant at the specified level. Only variables that are significant at the specified significance level for entry are added. After a variable is added, the stepwise method

looks at all the variables already included in the model and deletes any variable that does not produce an  $F$  statistic significant at the specified significance level for stay.<sup>4</sup> The result is shown in Table 3: the average score was found to correlate significantly with distance to coast or international border, distance to major railroad exchange stations, distance to major rivers, and the mean slope. All other variables turned out to be statistically insignificant.

These four variables can explain nearly 50 percent of the variations. The sign of each parameter indicates that the higher sinification



**Figure 5** Error estimate of the spatial interpolation shown in Figure 4. The more reliable interpolation values (small errors) are located in the center of the figure where there are more data points.

score can be expected in areas farther away from the major rivers, closer to the coast or international border, with gentler slope and closer to a major railroad station. The

regression result supports the result from historical analysis and qualitative analysis except for the distance to major rivers, which will be discussed next.

**Table 2** Variables selected for regression analysis

Physical variables	Non-physical variables
Distance to nearest major rivers	Gross value of agricultural output
Distance to nearest coast/border	Gross value of rural industrial output
Mean slope	Zhuang population percentage
Mean elevation	Han population percentage
Mean temperature	Road network density (major roads)
Mean precipitation	Illiterate/semi-illiterate rate (age > 15)
River network density	Distance to nearest major railroad stations

Note: except for the three distances (in meters, obtained with NEAR tool in ArcGIS), all other variables are county-level average values (by the county in which the data point resides).

Table 3 Regression analysis result

Samples included	Variable	Parameter estimate	SE	Type II SS	F value	p > F
All points	Intercept	2.0995	0.0954	25.1103	484.8000	<0.0001
	Distance to major river	$3.81 \times 10^{-6}$	$1.3 \times 10^{-6}$	0.4464	8.6200	0.0065
	Distance to coast/border	$-1.1 \times 10^{-6}$	$4.90 \times 10^{-7}$	0.2486	4.8000	0.0367
	Mean slope	-0.0873	0.0471	0.1779	3.4300	0.0740
	Distance to major rail station	$-1.2 \times 10^{-6}$	$4.97 \times 10^{-7}$	0.2880	5.5600	0.0253
Northern Zhuang	Intercept	1.7785	0.0856	22.2020	431.9500	<0.0001
	Mean elevation	-0.0004	0.0001	0.3897	7.5800	0.0126
Southern Zhuang	Intercept	1.9075	0.1548	3.6503	151.9100	<0.0001
	Illiterate/semi-illiterate rate	-0.7620	0.3921	0.0908	3.7800	0.0806
	Road network density	0.0036	0.0016	0.1228	5.1100	0.0473

For the All Points model,  $R^2 = 0.4884$ , Adjusted  $R^2 = 0.4134$ ,  $F = 6.92$ ,  $p = 0.0005$ .

For the Northern Zhuang model,  $R^2 = 0.2852$ , Adjusted  $R^2 = 0.2476$ ,  $F = 7.58$ ,  $p = 0.0126$ .

For the Southern Zhuang model,  $R^2 = 0.4766$ , Adjusted  $R^2 = 0.3719$ ,  $F = 4.55$ ,  $p = 0.0393$ .

All results are based on the entry and stay significance levels of 0.15.

SS = Sum of Squares.

One of assumptions of the regression analysis is that the observations are independent of each other. For spatially distributed data, this assumption may be violated, as the observed sample values often tend to be related to those samples that are spatially nearby. To make sure the above regression analysis is valid, we conducted spatial regression using spatial lag model in GeoDa software (Anselin, Syabri and Kho 2006), which uses the average of neighboring observations as a new independent variable (in the form of a spatial lag weight matrix). The results indicate that the spatial lag component is not statistically significant ( $p = 0.27$ ). The spatial error model essentially gave rise to the same results. Thus the classical regression model will be sufficient.

*Separating Northern Zhuang and Southern Zhuang.* Since the Northern Zhuang and Southern Zhuang are two separate branches of the Tai language family (see Figure 1) and they may have undergone different historical

and linguistic changes, we ran the same step-wise regression analysis using the same variables as above but for sample points belonging to Northern Zhuang (triangles in Figure 3) and Southern Zhuang (circles in Figure 3) separately. The results are shown in Table 1. For Northern Zhuang, the only variable that is found to correlate significantly with the average sinification score is elevation. The sign of the parameter indicates that the lower the elevation, the higher the score. This makes sense in that Han Chinese also grow wet rice in the lowland areas and thus there is more interaction between the Han and Zhuang and higher sinification of Zhuang. For the Southern Zhuang, two variables were found to be significantly correlated with the mean sinification score: road network density and illiterate/semi-illiterate rate. The signs of the parameters show that the higher the road network density, the higher the sinification score; the lower the illiteracy rate (i.e., the more people are educated), the higher the sinification score. This also makes sense

because road network density would facilitate the interaction between Han and Zhuang and education (mostly conducted in Chinese) would also enhance the sinification of Zhuang.

### *Interpretation and discussion*

The result of the above quantitative regression analysis is generally consistent with the qualitative analysis from visually comparing the mapped spatial pattern of kinship term scores with other features such as rivers and railroad networks. The gentler mean slope is a physical feature that could greatly facilitate interactions between Zhuang and Han. The distance to major railway stations may reflect the importance of economic development in facilitating interaction between the two cultures and the sinification process. Although the first railroad in Guangxi was constructed only in the late 1930s to early 1940s (China Ministry of Railways 2005), the physical locations of major land travel routes remained relatively stable throughout history (Lu 1997). Thus these locations, particularly the transportation hubs such as Nanning and Liuzhou, would be more economically developed and more likely to bring interaction between the two cultures through economic activities such as trade, resulting in more sinification there.

The distance to coast or international border may also reflect the level of economic development and economic activities (such as trade), which would involve interactions with Han Chinese. In fact, the coastal area of Guangxi was one of the important grain trade flow routes from Guangxi to Guangdong at least during the Qing dynasty (*circa* 1770; Marks 1998: 254).<sup>5</sup>

Another reason that could explain the higher sinification in the southern part of the study area is the Mongol invasion of the late thirteenth century. In the early centuries before

the Mongol invasion, the Han inhabited the northern hill regions just south of the Nanling mountains (in Guangxi, they settled early around Guilin) because of tropical disease (malaria) and swamps farther south in the river valleys (Bello 2005; Marks 1998: 53). The Mongol invasion of the south in the 1270s forced large numbers of Han Chinese to migrate farther south in a short period of time, causing a population surge in the area south of Xi Jiang (Marks 1998: 60, 65). Since this migration happened quickly, it might not have left any sinification trace along the way. The impact of sinification would have been made manifest after the Han settled down in the south. This is consistent with the pattern we see in Figure 4.

Based on historical accounts of early settlements, earlier we put forth a hypothesis that the degree of sinification would be highest in the north in the Guilin region and in areas closest to interior rivers and lowest in areas with high concentration of Zhuang population. The quantitative GIS regression analysis indicates that the sinification scores of kinship terms are positively correlated with distance to major rivers (i.e., the further away from major rivers, the higher the sinification scores). This result is inconsistent with our hypothesis. We here offer the following possible explanations of this discrepancy. (1) Initial river valley environments were not suitable for newcomers to live in (e.g., diseases such malaria; Bello 2005; Marks 1998: 71–76). (2) Zhuang are indigenous riverine people (thus would have acquired certain immunity to malaria); the highest Zhuang population densities would be closest to rivers, and the degree of sinification therefore less pronounced there. (3) Rivers as a means of transportation were only important for short-distance travel, not for long-distance migration, especially in the rugged north and

west parts of Guangxi AR (Ren Lu, Yunnan University, Kunming, China, personal communication, June 2005). (4) The influence of the earliest migration of the Han into this region through the two routes outlined in Figure 2 may have been overshadowed by subsequent Han penetration through land transportation routes (e.g., railroad) and through trade in coastal/border areas. (5) During the eighteenth century, the population doubled, which prompted the state to promote land reclamation and development by the Han (Marks 1998). In Guangxi, there was not much land to be reclaimed by those seeking it, who were mostly individual families. What was available then were 'odd lots' in the hills. This suggests new settlements of expanding populations away from the major waterways, such as the West River. (6) The assumption of a spatially diffusive sinification process might not be correct, i.e., the sinification process might have happened in a 'leap-frog' fashion, leaving traces of sinification only at a few discrete locations. This is possible because the major historical events such as war or trade only occurred or were concentrated in certain places in space. (7) The thirty-four sampling points might not be enough to resolve the details of sinification pattern along the rivers.

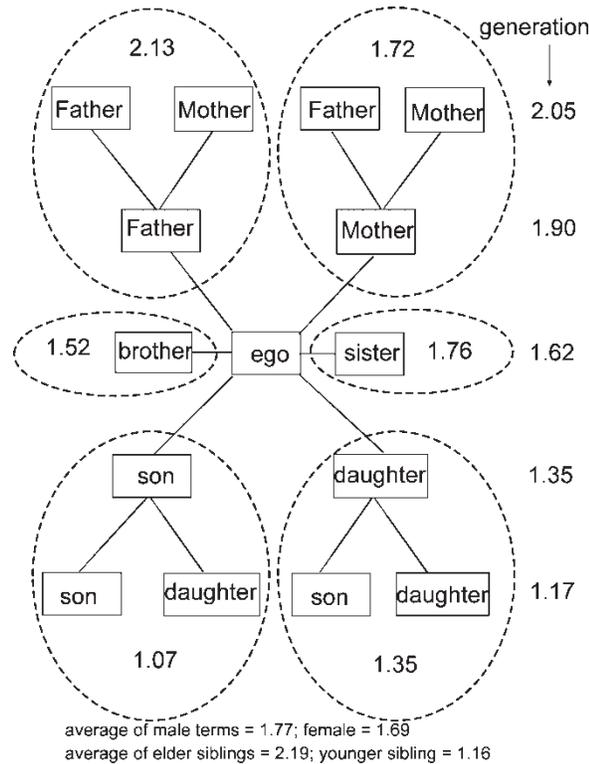
Although the step-wise regression analysis showed no significant relationship between sinification and percentage of Zhuang population, visual inspection does indicate that the highest mean scores of sinification in the south and southwest of the AR roughly correspond to an area with high concentration of Zhuang population (compare Figures 3 and 4). This is another unexpected outcome that needs further study. Our surprising finding is a special challenge to comparative linguistics, because the usual expectation is that indigenous languages will be preserved in

areas of high concentrations of indigenous populations, such as the Zhuang communities living in the region between the Zuo and You rivers. The high sinification at the southwestern part of the study area bordering Vietnam also calls for further study of the social, cultural, and political processes involved in relation to what happened in Vietnam, but this is beyond the scope of this paper. In addition, it is interesting to note that for the Northern Zhuang, where they are less concentrated, sinification is controlled by a physical variable (elevation), whereas for the Southern Zhuang, where they are more concentrated, sinification is more controlled by non-physical variables (road network, education). Perhaps more human forced intervention such as education and economy played a major role creating the high sinification there. Again, further study will be necessary to examine the exact social, cultural, historical, and political processes behind the sinification of the two branches of the Zhuang.

#### *Variations in relation of the kinship position in a family tree diagram*

##### *Observation*

We also examined the variations of the kinship terms in relation to their position in a family tree diagram. Figure 6 shows a simplified family tree. At each node (dashed oval), there are more branches that are not shown. For example, for the brother node, terms such as elder brother, elder brother's wife, elder brother's son, elder brother's daughter, younger brother, and younger brother's family members are not shown. The dashed oval and the number inside it indicate the average kinship term score of that group. The following can be observed from



**Figure 6** The simplified family tree and mean of kinship term score for different groups. See text for detailed discussion.

this diagram: (1) the Father branch of the family tree has a higher mean score than the Mother branch; (2) the Sister branch is higher than the Brother branch; (3) the Daughter branch is higher than the Son branch; (4) the average of all terms referring to the male is higher than that of the female; (5) the older the generation, the higher the degree of sinification. The statistical *t*-test was also conducted to see if these differences are statistically significant. The result is shown in Table 4: most of the above differences are statistically significant except for the differences between grandparent and parent generations and between the means of female and male terms.

### *Interpretation*

The significantly higher scores of the Father branch than the Mother branch and the generally higher scores for males than those for females, although not statistically significant, may reflect the dominant role of men in both present-day Zhuang and Han society. It is likely that, unlike the past, the Zhuang males now go out to interact commercially with the Han Chinese. Terms referring to the older generation (e.g., father's father) generally have higher scores than those referring to younger generation (e.g., son). This is because there is a lack of Zhuang terms or a lack of detailed categories referring to older generations in

Table 4 Result from statistical *t*-test

Variable	Mean	SD	<i>t</i>	<i>p</i> >   <i>t</i>
Father branch	2.1312	0.4526	3.4800	0.0009
Mother branch	1.7219	0.5157		
Brother branch	1.5231	0.2565	-2.4100	0.0186
Sister branch	1.7598	0.5111		
Son branch	1.0699	0.1417	-3.5100	0.0008
Daughter branch	1.3578	0.4571		
Grandparent generation	2.0490	0.4434	1.3300	0.1880
Parent generation	1.8995	0.4826		
Parent generation	1.8995	0.4826	2.9600	0.0043
Ego generation	1.6162	0.2814		
Ego generation	1.6162	0.2814	3.7900	0.0003
Child generation	1.3505	0.2971		
Child generation	1.3505	0.2971	2.6100	0.0112
Grandchild generation	1.1716	0.2674		
Female terms	1.6890	0.2877	-1.01	0.3176
Male terms	1.7673	0.3504		
Elder siblings	2.1863	0.6165	9.17	<0.0001
Younger siblings	1.1569	0.2207		

Note: all differences are significant except for the differences between grandparent and parent generations and between the means of female and male terms.

Zhuang and other Tai languages. Thus in their interaction with Han Chinese, the Zhuang simply borrow Han terms. Looking from a different angle, since the 'seniors' mean the elder and the aged, the adoption of Chinese terms and hierarchical, patriarchal Confucian philosophy thus enforces the social inferiority of the younger generation. This is also shown in the significantly higher mean score for terms referring to elder siblings of the same generation than that for terms referring to younger siblings of the same generation (see last pair in Table 4). Another interpretation is that the younger generations stay with mothers at home, and the terms referring to the latter are more preserved. Another factor in the greater persistence of Zhuang female kinship terms is the fact that earlier Zhuang society was decidedly matriarchal and much more egalitarian compared to the Han kinship system (Barlow 1987: 255). More details of social dynamics are needed to

explain higher mean scores for the Daughter branch and the Sister branch.

### More discussion

The inconsistency between the hypothesis we set out to test and the GIS analysis result that sinification scores correlated negatively with distances from major transportation hubs and the coast or international boundaries (i.e., the closer the distances to major railway stations and to coast or international borders, the higher the sinification scores) are important discoveries that would not be possible with traditional qualitative reasoning. This shows that applying GIS and quantitative analysis to a field such as linguistics that is traditionally dominated by qualitative reasoning has great potential in revealing the limitation of traditional methods and discovering new knowledge. For example, the inconsistency between

the hypothesis and our GIS analysis result would prompt us to think of alternative explanations (see the section 'Interpretation and discussion') and reexamine the assumptions underlying the hypothesis. The implied assumptions about the lasting effects of the early historical stage of sinification and a gradual sinification process along the migration routes may not be substantiated. It calls for more detailed examination of the rate of sinification over time and what domains of the indigenous lexicon are most subject to change in the process of borrowing Han language and culture. We can put forth a new hypothesis to be tested in future studies: i.e., there is an accelerated sinification rate in more modern times brought about by faster economic development. In other words, we need to examine the temporal dimension of sinification. We are currently working on using place names as a tool to recover the past settlement pattern of Tai people as the name of a place was usually named by the people who lived there before and has linguistic traces that can be identified and their spatial pattern analyzed (Wang, Hartmann, Luo and Huang 2006).

Our current study is based on only thirty-four sampling locations (see Figure 3) that are mostly located in the areas of high current Zhuang concentration, and we only quantify sinification to three levels (1–3). Moreover, those points were at the county level; a different pattern of sinification might appear at the village level. The lack of data in the eastern portion of the Guangxi AR and Guangdong Province and the limited quantification levels may limit our ability to capture and explain fully all the variations. More historical background on the modern period of the region is needed. We need to know more about the effect of the introduction of Confusion marriage practices on Zhuang

kinship terms, i.e., social processes at work. Additional detailed linguistic fieldwork to add more sampling points and at the village level, extending to the eastern portion of Guangxi AR and into Guangdong Province, and adding other data such as inter-racial marriage statistics, social economic development data, such as GDP over time, will certainly shed more new light on the dynamic sinification process that is reflected in Zhuang language change and its implications for studies in social and cultural interaction.

In attempting to use GIS to discover patterns of sinification of the Zhuang as reflected in a scatted sampling of kinship terms, we cannot ignore all of the other variables shaped by uneven events such as movement of minority populations along with the Han penetration into the region, and the effects of wars, disease, changes in population growth and density, land development, and, even climate changes that may come into play to challenge our interpretation.

## Conclusion

We employed GIS to map and analyze the spatial pattern of sinification of Zhuang kinship terms and attempt to explain the process of cultural and linguistic interaction between Zhuang and Han that may have led to such distribution in the Guangxi AR. We used published data on Zhuang kinship terms from thirty-four representative locations in Guangxi and border areas and semi-quantify them according to their pronunciations: three for Han-like pronunciations, one for more clearly Zhuang, and two for linguistic forms in between. The spatial pattern of kinship term sinification scores based on interpolation of the sampling locations shows that high degrees of sinification are located in areas close to the

coast or international border with Vietnam, with gentle land slope and close proximity to major transportation hubs, reflecting the importance of both physical features and economic development in those areas in facilitating interaction between the two cultures in the sinification process. By analyzing the inconsistency between the result on distance to major rivers and our expectation, we found that the sinification process is a dynamic and complicated process that could be influenced by many factors such as wars, disease, trade, changes in population growth and density, land development in history. We also found different correlation for Northern Zhuang and Southern Zhuang, which may reflect the different social, cultural, and/or historical processes that were involved in their respective sinification. To fully understand these processes, temporal information is important and more detailed data are needed. In addition, the degree of sinification of kinship terms also varies with their positions in a family kinship tree, perhaps reflecting Han social customs and male dominance in society more than traditional Tai kinship systems, which are generally more bilateral in nature.

Due to the limitation of data coverage in this study, we cannot prove or disprove with certainty the hypothesis we set out to test. However, we did demonstrate that GIS has great potential in revealing earlier geographical Zhuang settlement patterns in southern China and the dynamic and complex cultural and linguistic changes that occurred as a result of the in-migration of the Han into the Zhuang region. Traditional historical analysis alone cannot measure this change quantitatively. This kind of research has important implications for the impact of globalization on Tai-speaking ethnic minorities in China and the whole of Southeast Asia as well as other marginalized

ethnic groups in other parts of the world, where the dynamics of social change and its impact on linguistic change remain to be explored in depth and with the aid of new research tools such as GIS.

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### Notes

- 1 The earliest Han Chinese in Guangxi were mostly settled in the northern hill regions around Guilin for fear of tropical disease, especially malaria, farther south (Marks 1998: 53).
- 2 An Autonomous Region (AR) is a provincial-level administration unit.
- 3 Environmental System Research Institute ArcGIS 9.2 online manual < <http://webhelp.esri.com/arcgisdesktop/9.2> > (accessed 27 July 2007).
- 4 SAS online manual < <http://support.sas.com/online/doc/913/docMainpage.jsp> > (accessed 27 July 2007).
- 5 The other main grain trade flow route is the Xi Jiang river system (Marks 1998: 254). The two high-score areas (Figure 4) do appear to be aligned with segments of the two tributaries of the Xi Jiang System: the Yu Jiang (including Zuo Jiang and You Jiang) branches at the south and the Yong Jiang branches to the north. Unfortunately, we do not have kinship data in the east part of the study area, where the main stream of the Xi Jiang enters Guangdong.

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### Abstract translations

*Les schémas géographiques du vocabulaire de parenté chez les Zhuang (Tai) dans les zones frontalières du Guangxi: une analyse par SIG des changements dans la langue et la culture*

D'un point de vue historique, les interactions au cours des centaines entre les Chinois Han venus du nord de la Chine et les minorités autochtones et ethniques des régions du sud qui s'expriment en langue Tai ont laissé des traces profondes et indélébiles au niveau de la langue et de la culture de ces derniers et soulèvent des questions sur l'identité et la politique linguistique en cette époque moderne. La langue et la culture Zhuang sous étude est une des nombreuses langues Tai et représente la plus importante langue minoritaire en Chine aujourd'hui. Le recours aux SIG nous permet, à partir de l'exemple du vocabulaire de parenté, de cartographier et d'analyser le schéma spatial de la sinification du vocabulaire de parenté, et de proposer une explication du processus relatif à l'interaction culturelle et linguistique qui aurait pu être à l'origine d'une telle distribution dans le domaine Zhuang. Nous nous servons de données publiées sur le vocabulaire de parenté Zhuang à partir de 34 secteurs représentatifs du Guangxi et de ses zones frontalières (4 dans la partie est du Yunnan et 1 dans l'ouest du Guangdong) afin de pouvoir les quantifier partiellement en fonction de la prononciation: une cote de 3 pour les prononciations Han, 1 pour celles plus près du Zhuang, et 2 pour les formes linguistiques mixtes. Les scores sont basés sur l'interpolation des secteurs échantillonnés et sont attribués au schéma spatial de la sinification du vocabulaire de parenté pour montrer que les niveaux de sinification sont plus importants près des côtes et de la frontière internationale avec le Vietnam et dans les régions dont le relief est en pente légère et qui sont situées à proximité des plaques tournantes de transport. Ce constat traduit bien l'importance des caractéristiques physiques de ces régions et du développement économique

endogène comme éléments facilitateurs des interactions entre les deux cultures qui s'inscrivent dans le cadre du processus de sinification. Le degré de sinification varie aussi en fonction des positions qu'occupe le vocabulaire de parenté dans l'arbre de parenté, et pourrait ainsi rendre compte davantage des coutumes sociales Han et de la société patriarcale que les systèmes de parenté traditionnels Tai qui revêtent de manière générale un caractère plus bilatéral.

**Mots-clefs:** sinification, Zhuang (Tai), SIG, schémas spatiaux, vocabulaire de parenté, reconstitution historico-comparative, identité ethnique, programmes linguistiques.

*Pautas geográficas del lenguaje de parentesco Zhuang (Tai) en Guangxi y zonas fronterizas: un análisis GIS de cambios lingüísticos y culturales*

En términos históricos, siglos de interacciones entre recién llegados Chinos Han del norte de China y los indígenas tai-hablantes de minorías étnicas en el sur han dejado rastros profundos e indelebles en el lenguaje y en la cultura del segundo además de plantear cuestiones sobre la política de la identidad y del lenguaje en la modernidad. El lenguaje y la cultura en este estudio es el Zhuang, uno de los muchos idiomas Tai y el idioma minoritario más hablado en China hoy en día. Usando como ejemplo el lenguaje del parentesco, empleamos las herramientas analíticas de GIS con el fin de mapear y analizar las pautas espaciales de la sinificación del lenguaje de parentesco y para intentar de explicar el proceso de interacción cultural y lingüística que puede haber llevado a esta distribución en la esfera del Zhuang. Hacemos uso de datos publicados sobre el lenguaje del parentesco del Zhuang de 34 lugares representativos en Guangxi y zonas fronterizas (4 en el este de Yunnan y 1 en el oeste de Guangdong) y los calificamos según la pronunciación; 3 significa que la pronunciación se parece al Han, 1 significa que se parece más al Zhuang y 2 significa una forma lingüística entre los dos. Los resultados de las pautas espaciales de la sinificación del lenguaje del parentesco, basado en la interpolación de los lugares elegidos, indica altos niveles de sinificación en las zonas cerca de la costa o de fronteras internacionales con Vietnam, con cuevas empinadas y centros principales de transporte. Esto refleja la importancia tanto de características físicas

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como desarrollo económico en aquellas zonas para facilitar interacciones entre las dos culturas en el proceso de sinificación. El nivel de sinificación del lenguaje del parentesco también varía según la posición de la persona en el árbol de parentesco familiar. Esto tal vez refleje los costumbres sociales Han y la dominación masculina en la sociedad más

que los sistemas tradicionales de parentesco Tai, los cuales son generalmente más bilaterales.

**Palabras claves:** sinificación, Zhuang (Tai), GIS, pautas espaciales, el lenguaje del parentesco, reconstrucción comparativa-histórica, identidad étnica, programas lingüísticos.