

## Principles of PPGIS for Land Conflict Resolution in Guatemala

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### Introduction

Most of the Guatemalan indigenous and Spanish-speaking people are potential GIS-users with non technical expertise. They may have different spatial categories as compared with technicians since it is different the information regarding land zoning, land uses, and other spatial features in local. Understanding those differences can provide a feedback for participatory production and consumption of spatial information. Differences can be derived from “supervised” learning methods of technicians and “un-supervised learning” for non technicians. (Lloyd, 1997. P.189).

Analysis of the spatial categories of Guatemalans with low or non technical expertise in mapping and planning will let to provide input for a desired spatial cognitive compatibility between the public user’s and a public-geographic information system for land conflict resolution. With a cognitive approach, the cognitive compatibility can be at the “conceptual, semantic, syntactic, and physical levels”. (Davies et al. 1995. P. 124)

Spatial cognitive compatibility might be also culturally determined in Guatemala because Spanish and indigenous native potential users of English designed software, to European and USA consulting, and Guatemalan local Spanish speaking technicians. In theory, “*there might be cultural differences in the cognitive accessibility of thought processes. Societies differ in the cultural practices that they promote, affording differential expertise in the use of a cognitive strategy or differential knowledge about a domain*”. (Nisbett, 2002. P. 589).

The following photo of 2002 shows the centennial celebration that occurs in November 1<sup>st</sup>. in the Cemetery of Santiago Sacatepequez, a cackchikel town in the Guatemala City region. It is an example of how the space cemetery becomes a place of a public traditional entertainment and exhibition.



Photography 1.  
Celebration of Saints Days, November 1  
In the cemetery of Santiago Sacatepequez  
Guatemala. (Marco Chacon. 11-01-2002)

Local Guatemalan technicians mostly speak Spanish, but they do not speak indigenous languages. Hence, it is meaningful to understand the conception and representation of spatial concepts and objects, and furthermore it will be useful to describe differences for building compatible criteria of cognitive semantics among users, and particularly for a GIS for land conflict resolution.

Based on survey results, this paper examines 5 aspects of geographic information and maps: legibility-accessibility, performance of maps' contents, comprehension of maps, performance of maps as compared to oral and written information, performance of line-maps as

compared to text-titles. It includes an analysis of the public property. The main criteria are to enrich a PPGIS with an understanding of the differences of conventional maps performance and spatial representation between indigenous and Spanish-speaking population. Reader will find that Spanish and indigenous-speaking Guatemalan would be communicating better among each other if they find a supporting PPGIS with multimedia that combines and translates the differences of spatial representation. PPGIS would provide support to make more compatible the spatial cognition of indigenous and Spanish with the technicians in governmental agencies and municipalities.

## 1. Legibility and Accessibility of spatial and geographic representation

The survey used legibility as one indicator of the performance of maps and photographs of geographic features representing geographic concepts. The subjects believe that persons are not a good indicator to establish a territory or a property. The following illustrations (1 to 4) were part of the questionnaire. The question to one group was *How good are the following photos as examples of property?* The question to another group was *How good are the following photos as examples of territory?*

The options to respond were: 1, if the photos were an excellent example; 2, if the photographs were a good example; and 3, if the photographs were a bad example of property or territory.

The Spanish-speaking subjects answered that a photograph of out-door public market crowded with persons is nearly a bad example of property and a bad example of territory. The mean was 2.37 for the performance of the photographs as example of territory and the mean was 2.23 for the photograph as example of property. The bilingual indigenous subjects answered that the crowded market is a bad example of property reflected in the mean of 2.26, and a bad example of territory as shown in the mean of 2.33. Therefore, Spanish and indigenous subjects agree with the bad performance of photograph of crowded areas as bad examples of property and territory.

In addition, Spanish speaking subjects did not find a map of the country with its departments (states) an excellent example of territory since the mean was 1.78, though it is a good example. The same map for another group of Spanish-speaking subjects answered that it is a good example of property since the mean of answers was 1.98; although, the answers showed that the best example of territory is the map as compared to the photographs. The indigenous

subjects answered that the map of Guatemala is near to a good example of property as indicated in a mean of 2.08, and it is good example of territory with a mean of 1.73.

Moreover, the Spanish-speaking subjects answered that a photograph of a sugar plantation in a valley is not a good example of territory, and the same photograph showed better performance as an example of property. The answers concerning the sugar cane plantation had a mean of 2.32 for territory, and a mean of 1.88 for property. This photograph had the performance of the best example of property, among the other photograph and the map. Indigenous speaking subjects answered that sugar cane plantation photograph is good example of Property with a mean of 2.00; and for them it is a good example of territory with a mean of 1.90. It is in the territory where there is a difference between Spanish and bilingual-indigenous subjects; for the indigenous it is a better example of territory than it is for the Spanish speakers.

In addition, the Spanish speaking subjects answered that the photograph of a traditional bridge in the Magdalena River in the town of Amatitlán is not a good example of territory. In this case, the bridge is a better representation of property than territory. The mean of subjects' answers is 2.31 for territory, and 2.00 for property. The bilingual indigenous subjects answered that the same photo of the bridge is a good example of property with a mean of 2.04; and for them it is a good example of territory. It is another difference between Spanish speaking and bilingual indigenous subjects; for the indigenous the bridge is a better example of territory than it is for the Spanish speaking population

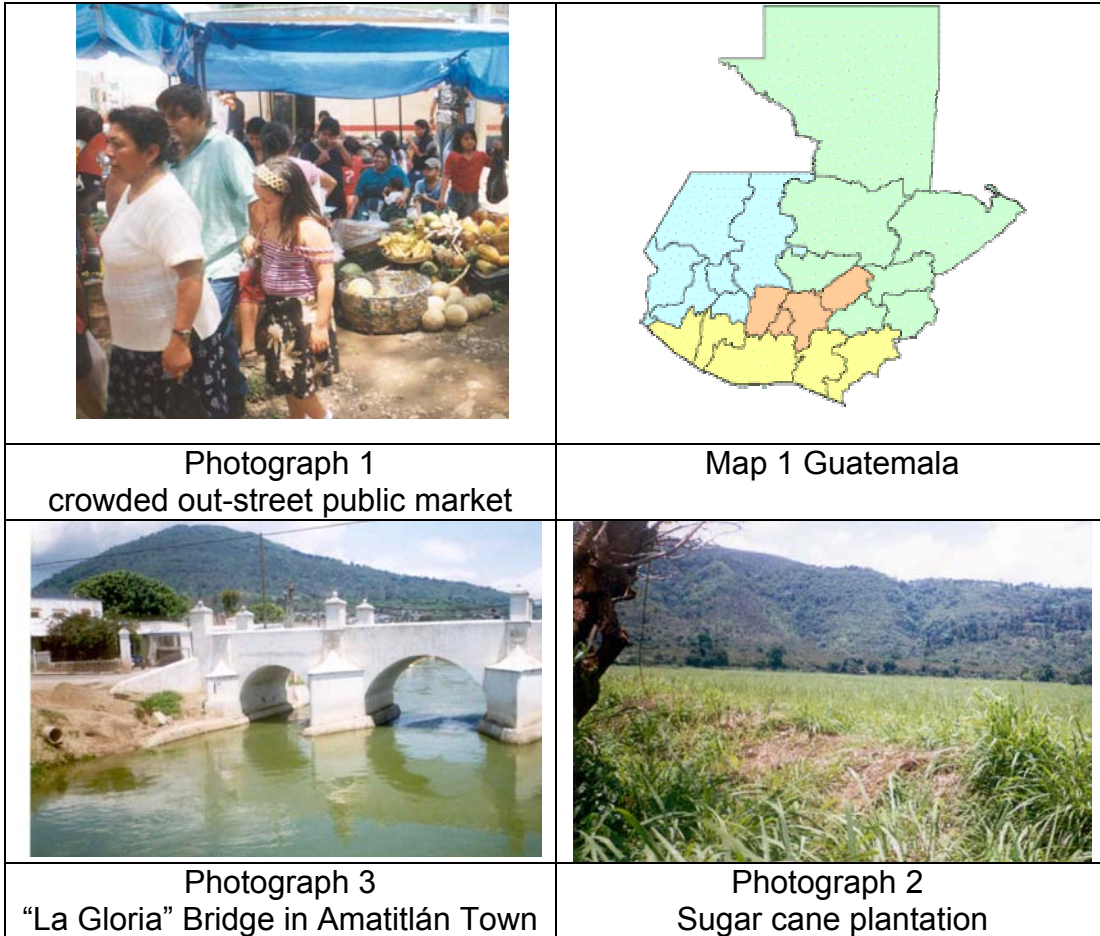
Comparing all the indicators, in summary, photographs and maps are not the best examples of property or territory since the mean of subjects was not nearly 1; Although, among these photographs' territory, a map showed a better performance as example of territory, and the photograph of a plantation showed an even better performance as example of territory.

See Table 1 has a summary of the means. To both Spanish speaking and bilingual indigenous, the map is a good example of property and territory, and the crowded public market is a bad example of property and territory.

There is sensitivity of representation between the Spanish speaking and bilingual indigenous; the sensitivity is indicated in the representation of property and territory of plantations and infrastructure. For the indigenous, a plantation and a bridge can be legible representations of territory and property, although it can be improved. However, for Spanish speaking subjects, the plantation and the bridge are good representations of property, but they are bad representations of territory.

In this case, the results suggest that using the same representation will have different meaning for both groups. The difference is in that fiat and bona fide features need different representations. Territory is perhaps a more abstract concept for the Spanish population than it is for indigenous subjects. Property is for the indigenous a very specific category that can't be easily represented only with maps and photographs. Perhaps a textual description is useful and it will be suggested in the following pages as indicated in the results of a question that compares maps with oral and written descriptions.

Although the groups are Guatemalan, the results imply that it is necessary to calibrate the representations according to the groups. It is illustrated by Chart 1, which compares mean of answers; Chart 2 contains the results for the sample of the bilingual population who speaks indigenous languages and Spanish.



Photograph 1  
crowded out-street public market

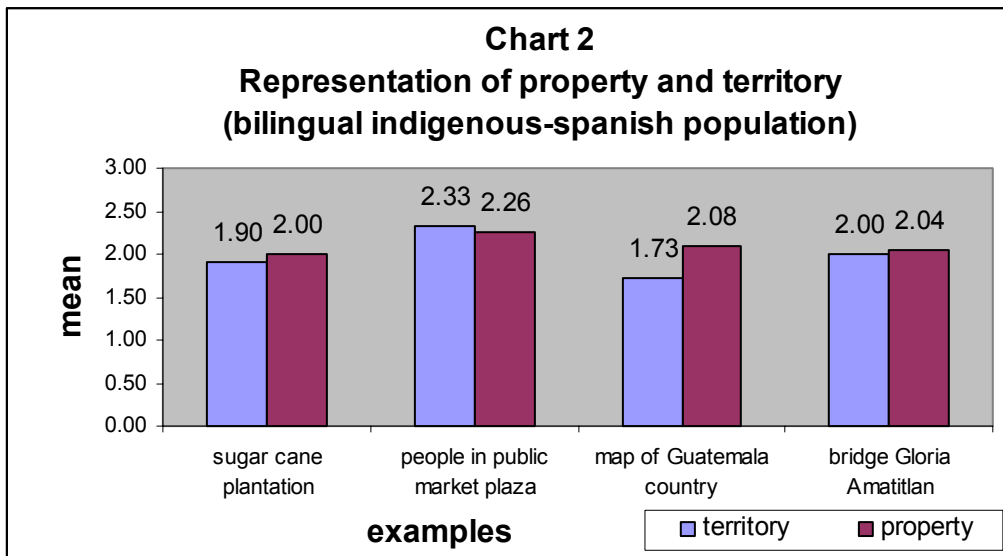
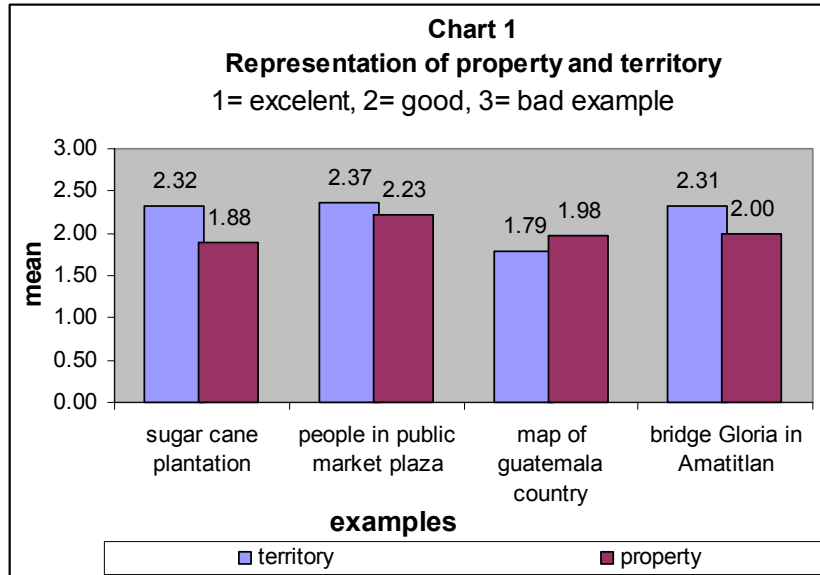
Map 1 Guatemala



Photograph 3  
"La Gloria" Bridge in Amatitlán Town

Photograph 2  
Sugar cane plantation

Table 1. Comparing representations of property and territory (1= excellent, 2= good, 3= bad example)				
Property		Territory		example
Spanish	Bilingual	Spanish	bilingual	
1.88	2.00	2.32	1.90	sugar cane plantation photograph
2.23	2.26	2.37	2.33	people in public market plaza photograph
1.98	2.08	1.79	1.73	map of Guatemala country
2.00	2.04	2.31	2.00	bridge Gloria Amatitlán photograph





## 2. Performance of Maps

The survey had a question about the performance of maps and information according to legibility, usefulness, user satisfaction and accessibility. Legibility evaluated characteristics of the information in maps, such as color, numerical data, symbols, text, and distances. Usefulness of maps was evaluated in relation to the needs of the users in terms of the clarity that the user needs, the updated data that maps provide to the user, and level of truth they have to satisfy user needs. Accessibility was evaluated according to convenience of location of site where maps are distributed, the affordability of maps (price), and the availability of public transportation supply. The options for answers were, 1 (agree), 2 (can not answer), and 3 (disagree).

Indicator	Mean spanish	Mean bilingual indigenous	Performance of maps
Legibility	1.56	1.59	Lines shown in maps are legible and clear
	1.58	1.94	Numerical data is legible and clear
	1.59	1.97	symbols of maps are legible and clear
	1.63	1.49	colors of maps are clear
	1.65	1.81	text of maps is legible and clear
	1.73	1.86	distances represented in maps are clear
	1.76	2.08	size of maps is according to the contents
Accessibility	1.88	1.66	There is enough public transportation available to the center of distribution of maps
	2.06	1.81	Location of center of distribution of the maps is convenient
	1.58	1.77	Price of maps is affordable
Usefulness	1.90	2.14	information that you need is clear in maps
	1.98	1.86	information that you need is truthful in maps
	2.08	2.03	information that you need is available in maps
	2.23	2.22	information that you need is updated in maps

Table 2 shows that the critical results are for the variable of usefulness, since the mean of the indicators is greater than 2. For Spanish speaking subjects, a mean of 2.23 showed that the most critical issue is the updatability of maps. It is followed by the availability of maps, which had a mean of 2.08.

For the indigenous bilingual subjects, the information they need is not satisfactorily clear as indicated by a mean of 2.14; in contrast to the Spanish speaking population, the clarity is not an issue. For the indigenous bilingual subjects the availability and updatability of information they need is not good as indicated by means of 2.03 and 2.22.

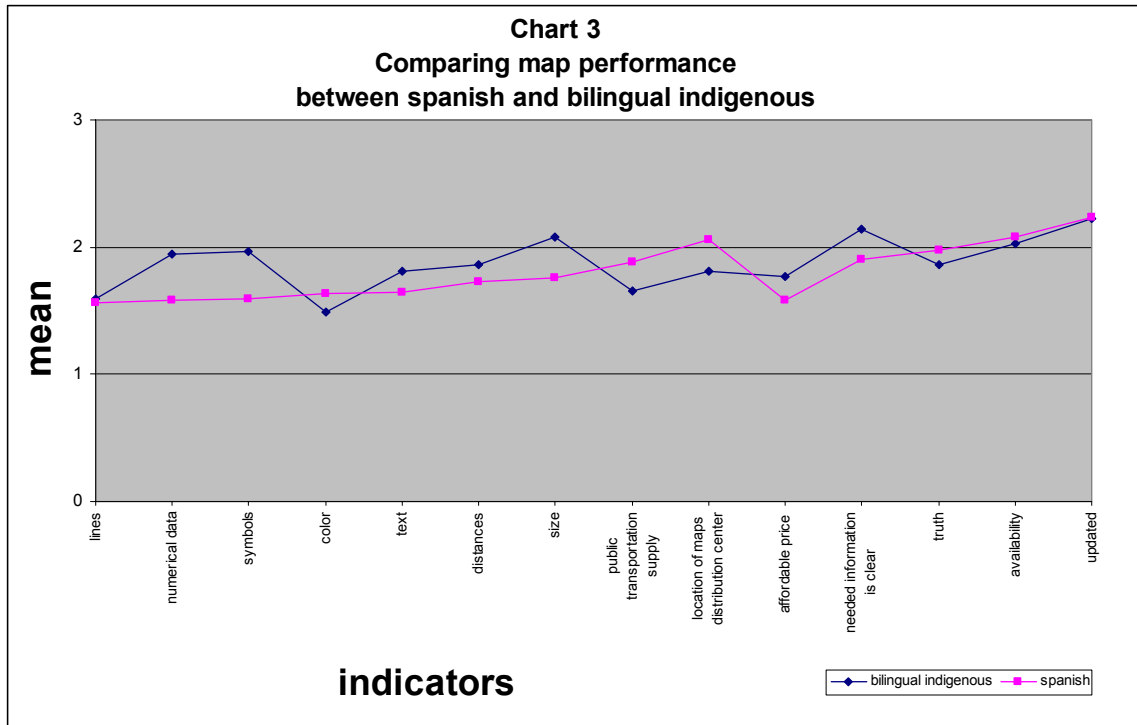
Moreover, table 2. shows also that accessibility is critical for the Spanish-speaking population due to the location of the center of distribution, which has a mean of 2.06. The accessibility is not a critical issue for the indigenous population, although the location center has a less satisfactory response from the subjects.

The legibility is not in a critical situation, but the mean of the legibility is greater than 1.5, which means that the legibility can be improved. In addition, the legibility is less satisfactory for the indigenous subjects as shown by table V.2. Although the means are below 2, they are also greater than the means of the Spanish subjects.

The concern comes from the big difference that is in the legibility of numerical data, legibility of symbols, legibility of text and distance. For the indigenous subjects, the size of maps is not good as shown by a mean of 2.08. Interesting is that colors are more clear for the indigenous subjects than they are for Spanish-speaking subjects.

The differences are illustrated by Chart 3, and it can be observed that the map performance is better for the Spanish-speaking than for the indigenous bilingual subjects, since all factors but the color are more satisfactory for the Spanish-speaking subjects.

Chart 3 shows also a summary of the results of performance of maps in both Spanish and bilingual indigenous subjects. The lines, numerical data and the symbols show the better performance as far as legibility. In contrast, the text, distances and sizes of maps have showed that they are less legible than the lines and numerical data.



### 3. Comprehension of maps by media of portrayal

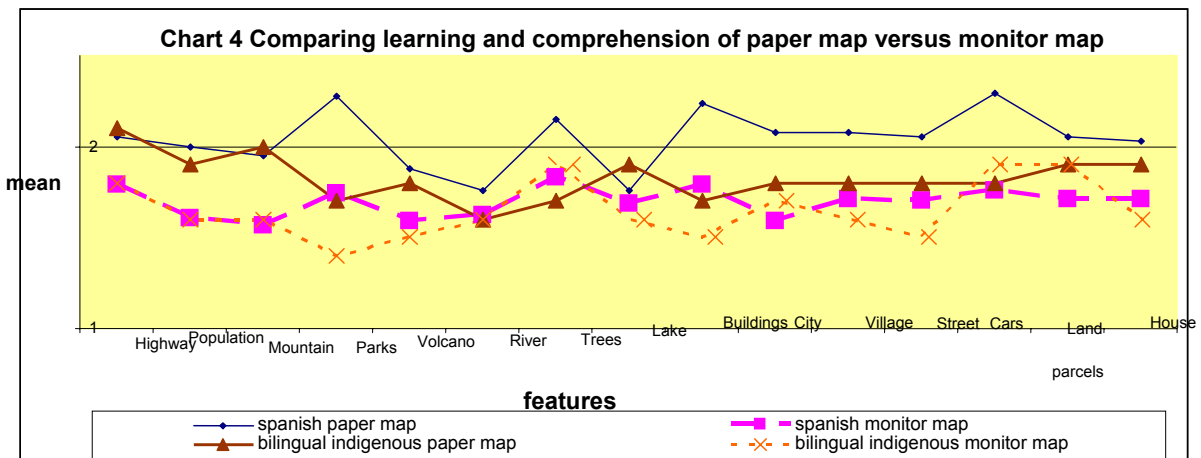
An additional question asked to the Spanish and bilingual indigenous subjects was to compare the learning and comprehension derived from paper maps as compared with computerized maps portrayed on a monitor.

The question has a list of specific geographic and spatial features that subjects would find represented in a paper printed map and in a monitor computerized map. The purpose of the question is to establish which items are easier to understand if they are portrayed on paper or a computer monitor.

The rank scale is 1 if the comprehension and learning is excellent, 2 if those are good, and 3 if those are bad. Table 3 shows that Spanish-speaking subjects find more satisfactory comprehension in monitor maps as compared with paper maps. It is indicated by means above 2 in several items that have local scale, such as buildings, city, village, street, car, parks, land parcels, and house. The Spanish-speaking find more satisfaction in learning derived from maps portrayed on a monitor. Volcanoes, rivers and lakes still yield satisfactory comprehension from paper maps.

Table 3. shows that bilingual Indigenous speaking subjects find more satisfactory maps than the Spanish speaking population, as indicated by lower means between 1.8 and 2.0. A highway is a point of critical concern, since it has a mean of 2.05 for Spanish speaking and 2.1. for bilingual indigenous subjects. Although, the Spanish-speaking seem to be satisfied with the learning derived from printed maps, they are even more satisfied by maps portrayed by monitor. For example, parks, volcanoes, villages showed much better learning on a monitor than on paper maps.

Spanish		Indigenous		Feature	
Paper	Monitor	paper	Monitor	Spanish	English
2.05	1.79	2.1	1.8	Carretera	Highway
2.00	1.61	1.9	1.6	Poblacion	Population
1.95	1.57	2.0	1.6	Montaña	Mountain
2.28	1.74	1.7	1.4	Parques	Parks
1.88	1.59	1.8	1.5	Volcan	Volcano
1.76	1.62	1.6	1.6	Rio	River
2.15	1.83	1.7	1.9	Arboles	Trees
1.76	1.69	1.9	1.6	Lago	Lake
2.24	1.79	1.7	1.5	Edificios	Buildings
2.08	1.59	1.8	1.7	Ciudad	City
2.08	1.71	1.8	1.6	Aldea	Village
2.05	1.70	1.8	1.5	Calle	Street
2.29	1.76	1.8	1.9	Vehiculos	Cars
2.05	1.71	1.9	1.9	Parcela de tierra	Land parcels
2.03	1.71	1.9	1.6	Viviendas	House



Therefore, the learning and comprehension derived from a printed map can be different for subjects from the same country and with the same level of education. Chart 4 shows that overall, the monitor map provides more satisfactory learning in indigenous subjects than in Spanish-speaking; it also shows that paper maps are still satisfactory for the indigenous, while the paper maps are not satisfactory for the Spanish-speaking population, although they find satisfactory learning of large scale features in printed maps.

#### 4. Performance of Maps as compared to Oral and written descriptions

In addition, the survey included an additional question regarding the performance of maps as compared with oral and written description. This particular question included specific geographical and spatial features. The question was: *How would you evaluate the clarity of the following examples if they were shown in a map, or through written or oral-written descriptions?* The same geographical features were examples for both options (map or oral-written descriptions) and to Spanish and bilingual indigenous subjects. The options to answer were 1 (excellent), 2 (good), 3 (bad).

##### 4.1. Spanish-speaking subjects

As Chart 5 shows, for Spanish speaking subjects the map had better performance representing some features, but it also has the worst performance in representing other features. In contrast, the oral and written descriptions show a better performance compared to the maps, although, in some features, the maps have better performance. Maps had means between 1.5 and 2.4, and oral written descriptions had means between 1.7 and 2.2.

Spanish subject answers had a mean of 1.5 when the maps are having their best performance for showing large scale things such as mountains, volcanoes, highways, capital cities, countries, lakes, rivers and lands. In contrast, oral-written descriptions have the best performance of a 1.7 mean for representing abstract territorial concepts and general categories such as population, country, animals, municipality and capital city. Maps are better at representing more specific categories such as districts and borders since they have a 1.7 mean, while the oral and written descriptions had a mean of 1.9 for the same features (districts and borders).

The oral-written descriptions are almost as good as maps for showing land, since they have a mean of 1.8 and 1.7, respectively. The oral and written descriptions are also as good as maps for showing a capital city, because the mean is 1.7 and 1.6, respectively. Although, they still could improve to a level 1.

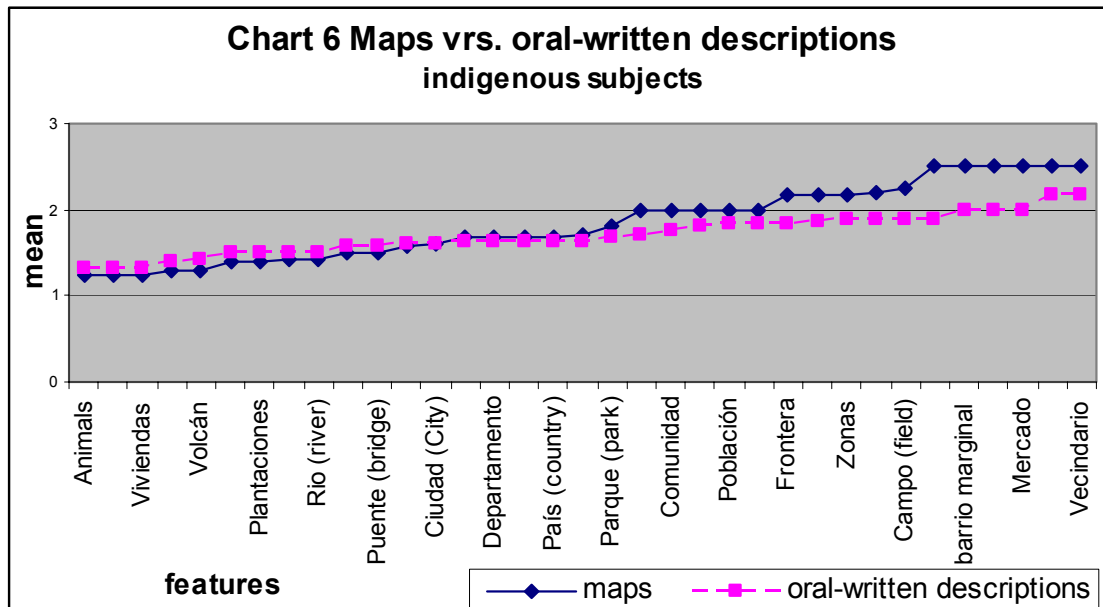
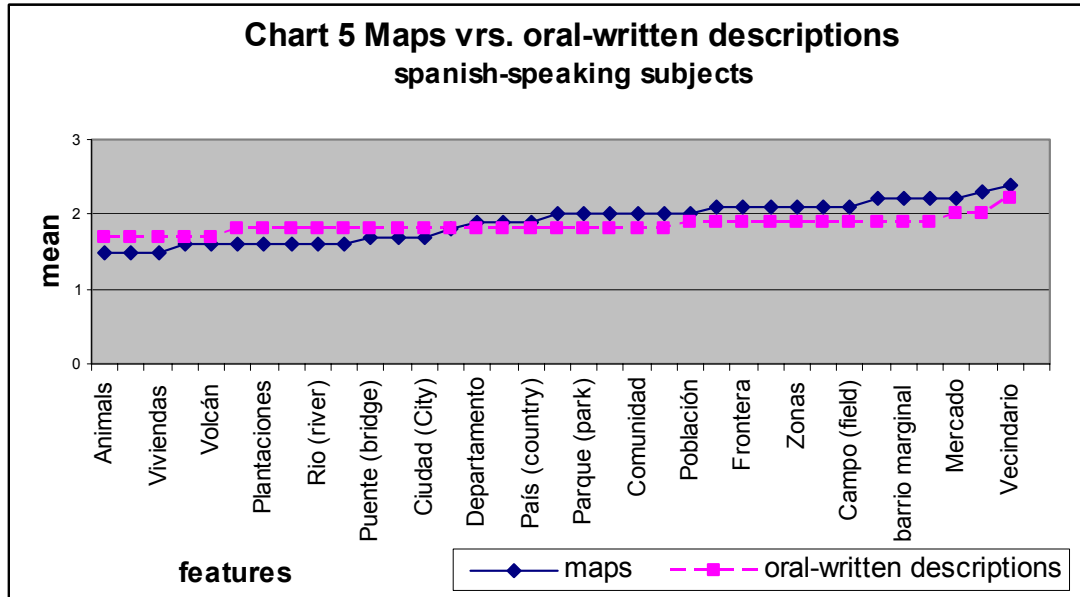
Although it is still good, the lower performance of oral-written description has means between 2.00 and 2.2 for representing specific territorial categories such as land parcels, highways, and bridges. The mean between 2.2 to 2.4 shows the worst performance of maps for the representation of abstract concepts and general territorial categories such as sky, population, and municipality. Subject results had for maps a mean of 2.1 or 2.2 for the representation of social constituencies and territories such as neighborhoods, community, field, plantations, tree, and marginal resettlement.

In addition, the oral-written descriptions show less performance as the features become more specific in territorial scale and categorization. Subject results had a mean of 1.9 for oral and written descriptions of village, beach, church, marginal resettlement, river, state, districts, city, and valley.

For Spanish speaking population, oral-written descriptions show a 1.8 mean for a better performance in representing urban features of collective or social constituency, such as county, neighborhood, a public market, a community, a school, and houses. Oral-written descriptions have a good performance in representing regional to local scale territories such as a field, a tree, plantations, volcano, school, houses, sky, mountain, or lake.

For Spanish-speaking subjects maps have a tendency to improve their performance in representing more specific territorial categories and less abstract concepts. Maps had a mean of 1.8 and 1.9 when representing community, valley, and village. Maps

had a mean of 2 for representing church, beach, animals, forest, market, and land parcel. Maps had a mean of 2.1 when representing field, plantations, tree, marginal resettlement, school, bridge, park, and houses.





#### 4.2. Bilingual-indigenous subjects

There are interesting differences with the Spanish subjects. Initially, the indigenous subjects are more satisfied with the oral written descriptions than the Spanish subjects. And they are also more satisfied with the maps than the Spanish subjects. They have means below 1.5 for oral-written descriptions and maps.

In addition, they are less satisfied than the Spanish subjects in some items represented by the maps, such as Frontera (border), Valle (valley), Zonas (districts), parcela de tierra (land parcel), Campo (field), Aldea (village), barrio marginal (marginal settlement), Iglesia (church), Mercado (market), Municipalidad (municipality), and Vecindario (neighborhood). As shown by table 5 most of those mentioned items have a mean of 2.5, and it is lower than the mean those items performed with the Spanish-speaking subjects in maps.

In contrast, for indigenous subjects some items are better represented by maps since the mean is higher than the mean of items for Spanish subjects in table 4. For example, tree and houses have a mean higher than 2 for Spanish-speaking subjects, and they have a mean lower than 1.5 for indigenous speaking subjects.

A very interesting difference is that representation of enclosure and enclosed spaces has different levels of satisfaction for the subjects. As Table 5 and 4 shows that for Spanish-speaking subjects the land has a mean of 1.8 and 1.7, and for indigenous-speaking subjects the land has a mean of 1.43 for oral-written description, and 2.00 for map. It means that for indigenous-speaking population the oral knowledge and written descriptions are better representation of land. It is consistent with the land parcels, since the indigenous subjects' means are 1.71 for oral-written description and 2.20 for maps for

the term land parcel. And for Spanish-speaking subjects both the oral-written descriptions and maps have a mean of 2.00 for the land parcel.

For Spanish-speaking subjects map has a mean of 2.0 for representing the term border, and the oral-written description mean is 1.9. For indigenous-speaking subjects the map has a mean of 2.17 for representing border, and the oral written description's mean is 2.00. Therefore, the representation of the border needs an improvement for both groups in the maps and the oral-written descriptions.

#### 5. Performance of line-maps as compared to text in titles of property

An additional question concerned the performance of representation of spatial features by map's lines as compared to text in titles of property. The question was: *How good do you evaluate the clarity of the following features if they were shown in maps as compared with their description in titles of property?* The options to answer were 1 (excellent), 2 (good), and 3 (bad).

##### 5.1. Spanish-speaking subjects

Table 4 shows also that lines are as good as text to represent the concept of territory since both have means of 1.6. The best performance of both is for representing territory. In contrast, the worst performance of both is for representing the spatial limits or limits of spatial objects, since both have a mean of 2.5, nearer to the option 3 of "bad".

Table 4 shows also that text of titles of property have means that suggests a better performance than lines in maps for representing the municipal borders, perimeter of a neighborhood, and property limits. The mean of texts is 1.8 for municipal border, 1.9 for property limits, and 1.9 for neighborhood perimeter. In contrast, the lines in maps have

means of 2.0 for municipal border, 2.2 for property limits, and 2.3 for neighborhood perimeter.

In addition, table 4 shows that line-maps are better than text of titles in representing the roads. Maps had a mean of 2.0 and texts of titles have a mean of 2.1. In contrast, line-maps are not as good as text-titles in representing paths and trails, since they had means of 2.4 (lines) and 2.1(texts). Moreover, text in titles of property is a little better than line-maps in representing spatial endings: they had means of 2.3 (lines), and 2.2 (texts).

Finally, the text in title of property is better than line-maps for representing private possession, and public property. The text had means of 1.9 and 1.7 respectively, and the line-maps had means of 2.3 and 2.1, respectively.

As chart 7 shows, in general terms, both lines in maps and text in titles of property have low performance, but text of title of property shows better performance than maps in representing concepts of private possession and public property, as well as representing linear spatial features such as roads and borders. Lines in maps have means between 1.6 to 2.5, and text of titles has means between 1.6 to 2.5.

It is crucial to recognize that maps need help from other sources to improve their performance in representing private possession and public property. Hence, both the lines and text need an improvement to increase their performance in representing critical issues to solve conflict disputes, such as roads and spatial endings.

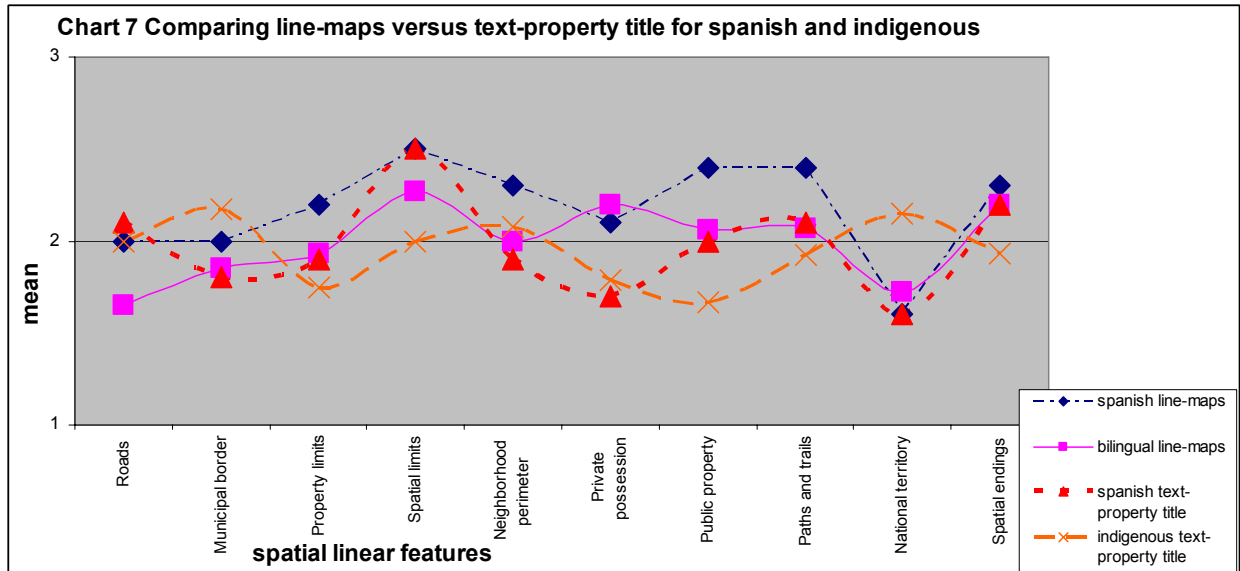
## 5.2. indigenous-speaking subjects

Table 4 shows the bilingual indigenous subjects have more satisfaction with line maps than text tiles of property in representing roads, municipal borders and national territory, since they have a mean lower than 2 for maps and higher than 2 for text-titles.

Moreover, results suggests that text-title are more satisfactory than maps for representing private possession, public property and paths and trails since the mean for indigenous subjects for text-titles are 1.79, 1.67 and 1.92, respectively, and for maps the means are 2.20, 2.06 and 2.07 for private possession, public property and paths and trails, respectively. In contrast, Spanish-speaking subjects showed less satisfaction with maps and text-titles in representing public property and paths and trails.

In addition, indigenous subjects show also great dissatisfaction with the line-maps and text-titles in representing the spatial limits and the neighborhood perimeter. Table V6 showed that they have means greater than 2.

#	Subjects	Line-maps		Text-titles of property	
		Spanish mean	Bilingual indigenous	Spanish	Bilingual indigenous
1	caminos (roads)	2.0	1.65	2.1	2.00
2	frontera municipal (municipal border)	2.0	1.85	1.8	2.17
3	limites de propiedad (property limits)	2.2	1.93	1.9	1.75
4	orillas espaciales (spatial limits)	2.5	2.27	2.5	2.00
5	perimetro del barrio (neighborhood perimeter)	2.3	2.00	1.9	2.08
6	posesion privada (private possession)	2.1	2.20	1.7	1.79
7	propiedad publica (public property)	2.4	2.06	2.0	1.67
8	senderos y brechas (paths and trails)	2.4	2.07	2.1	1.92
9	territorio nacional (national territory)	1.6	1.72	1.6	2.15
10	Topes espaciales (spatial endings)	2.3	2.20	2.2	1.93



## 6. Public User performance

Another question of the survey is: What is represented in the following map? Map 3 used a map of Guatemala that included state and county divisions, as well as names of some states and highways. The options to answers were open. They would want to answer what they find legible in the map. The goal of this question is to establish the level of understanding and the level of similarities of public users when they use maps.

Table 7 shows the first two ranks, as the subjects mostly saw the middle categories of state and counties as a primary object represented in the map. The greater frequency and mean is for states and counties. States have a mean of 1.3, while the counties had a mean of 2.2.

Furthermore, Table 7 shows also that the general category “country” ranked 12<sup>th</sup>, with a low frequency, although if had a high mean of 1.3.. Following in rank, the subjects answered the villages, which are a very specific category but were not included in the map.

Interesting is to realize that subjects answered to see the state capitals in the 3<sup>rd</sup>. rank with a 2.6 mean, while they also answered in 4<sup>th</sup> rank and 2.8 mean to see rivers. It is interesting because the map was not representing rivers or states' capitals. Perhaps, the subjects interpreted that states had capitals, so if the states are there then their capitals must be there regardless of being represented or not in the map. Another reason could be that names of the states are also the same as their capitals in Guatemala. However, in rank 11<sup>th</sup>. with a mean of 1.3, the subjects answered the “names of states and counties”.

In the 5<sup>th</sup> rank with a 3.4 mean, the subjects answered the “geographic limits”. It is followed by highways in the 6<sup>th</sup> rank, with a mean of 3.1.

Another interesting result is the fact that subjects answered in the last ranks the territorial concepts which were drawn on the map, such as geographic division (rank 14<sup>th</sup>.) and borders (rank 15<sup>th</sup> ).

As a result, Table 7 showed that most public users first read and understand the territorial features that have middle categories. The largest or most general category contained in the map is not the main focus of the public. Then, subjects interpret that the map also represents the components of those middle categories, in this case the state's capitals. Finally, the subjects read and find legible the abstract territorial concepts represented, such as borders. It is very interesting to find that in this map most of the subjects answered “rivers”, probably because they understood lines as rivers, though those lines were symbols of state borders and highways.

Spanish			
Rank	N	Mean	Feature
1	50	1.3	Departamentos (states)
2	41	2.2	Municipios (counties)
3	19	2.6	Cabeceras departamentales (state capitals)
4	12	2.8	Ríos (rivers)
5	11	3.4	Límites geograficos (geographic limits)

6	9	3.1	Carreteras (highways)
7	5	3.2	Límites (limits)
8	4	4.0	Puertos (ports)
9	3	2.0	Belice (Belize)
10	3	2.7	División por departamentos (division per states)
11	3	1.3	Nombre de departamentos y municipios (state and county' names)
12	3	1.7	País (country)
13	2	3.5	Aldeas (villages)
14	2	3.0	Division geográfica (geographic division)
15	2	3.5	Fronteras entre países (countries' borders)
16	2	3.5	Lagos (lakes)

## 6. Public Property

An additional question in this survey for the subjects was to provide in one minute as many examples of public property as they could. Both groups of subjects answered mostly governmental buildings, open spaces, and land as examples of public property.

The Guatemalan Spanish speaking subjects answered with the highest frequency 14 and a mean of 2.1 the Municipality; they also answered with the highest frequency of 14 and a mean of 2.7 Hospitals. Parks also had a high frequency of 13 and a mean of 2.4. Schools had a frequency of 11 and a mean of 2.7. Streets had a frequency of 11 and a mean of 2.7. In addition, Highways and Public schools had a frequency of 7 and a mean of 3.3 and 3.6. Guatemalan Spanish speaking subjects also answered that houses, water supply, public market and land parcels were examples of public property.

It is noted that most of examples of public property were open fields and sport fields, including a cemetery; although, cemetery is subdivided in several parcels for those who obtain possession rights to municipalities or private rights to those who buy in private cemeteries to private corporations. Eventually, a public cemetery is moved to other place, but a conflict is less likely to occur as compared to other public and private fields. Sport fields have different size, “canchas” are smaller than “campos”, although sometimes they are the same thing. It is interesting that Spanish speaking subjects mentioned houses as examples of public property, which was not mentioned by indigenous people.

The Guatemalan indigenous bilingual subjects answered with highest frequency parks, followed by the schools, municipalities and hospitals. They also mentioned churches and other governmental buildings such as health centers.



In addition, bilingual subjects also mentioned highways, water supply, electricity and bridges as examples of public property. Indigenous people mentioned rivers and “salones” (communal gathering places), which were not mentioned by Spanish speaking subjects. Indigenous subjects did not differentiate between avenues and streets as the Spanish speaking subjects did.

The learned lesson is that the spatial category of public property includes governmental buildings that provide services, such as health and education. Governmental buildings, public markets and parks are also gathering places. Open spaces are also included in the Guatemalan spatial category of public property.

Here, it is very relevant to mention that there are several types of open spaces that are fields and sports fields, such as “canchas” campos”, and “cemetery”. Finally, it should be mentioned that land parcels are included as public property because there is communal land, which is one option of tenure that is not the same as governmental property.

The category of public property includes the space of communal property and the space of governmental property, which can be buildings, roads, fields, or bridges. In the Guatemalan context, a complication is derived from a spatial conception of public property that includes collective use of the space such as gathering, consumption and recreation.

In contrast, Guatemalan Spanish speaking subjects, the category of public possession does not include open fields, land parcels, and trees. However, it includes governmental buildings and roads. The private possession category includes private buildings for business and shopping, and also houses (“casas” and “bienes inmuebles”)

but not open fields. Hence, open fields is included in the category of public property or governmental.

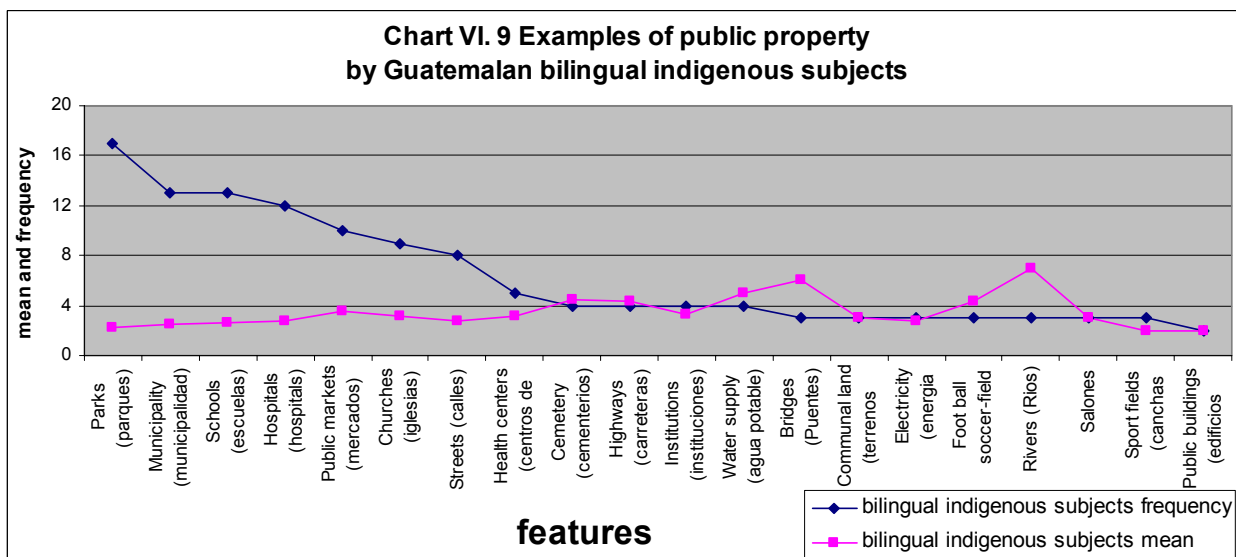
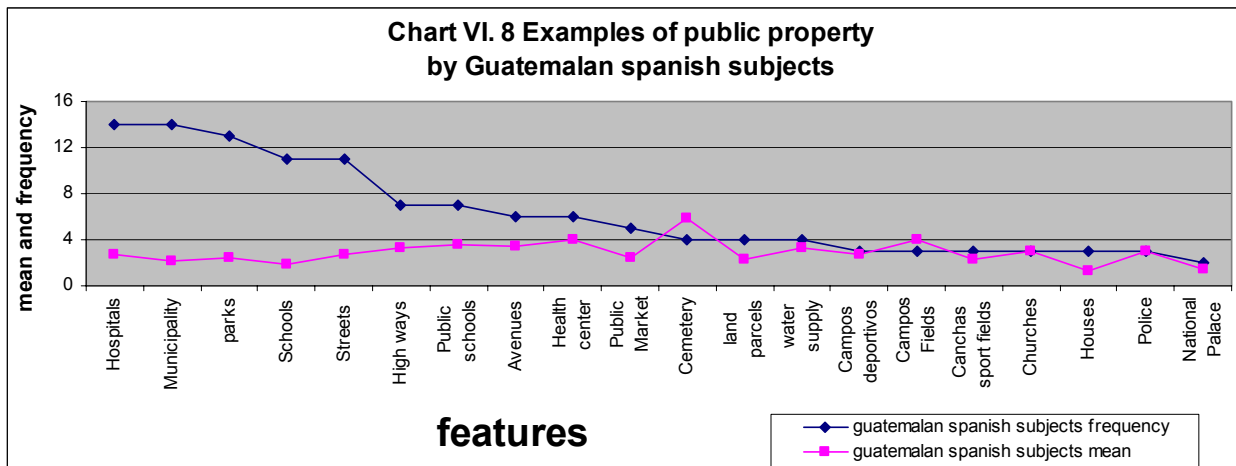
The representation of open fields in maps and plans are different for technicians since they include “vacant” land, “forested” and reservation areas. For non-technicians all open fields appear to be public property or space owned by national government.

Technicians in mapping and planning agencies have a classification and representation of open fields as “vacant” land which usually are private land, which owners are waiting the best moment to invest, plant, build, urbanize, or sell. Other “vacant land” includes “reforestation areas”, “protected areas for environmental protection”, “areas in reserve for public roads expansion”, “areas in reserve for future educational buildings” (health or any other governmental buildings), or “areas for safety protection of land slide areas surrounding rivers”.

Sometimes the open fields have multiple and seasonal uses such as markets on Sundays, monthly festivals. Other times the public land is registered owned by one governmental agency, such as municipalities; but another agency has the capacity to build on it, such as the case of schools. Some open fields with no use, no maintenance and no peripheral delimitation, are considered vacant land but they still have use as illegal garbage disposals.

Most of the land conflicts have occurred after takings of open fields owned by the private sector or government. Therefore, representation and classification of open fields in a conflict resolution process should be specially considered in a participatory GIS where non-technician-public users can distinguish the representation of private fields from governmental and communal lands.

Frequently trees are planted as peripheral walls in the limits and borders of land parcels in rural areas. The trees are planted in one of the sides, so they belong to the owners of one land parcel. After years trees grow up and increase in size mostly in one of the two land parcels sides. The trees' bigger sizes make it difficult to define where the exact imaginary line is dividing the two land parcels, but they are still sometimes included in titles of property. Trees are also used as land mark in the oral and written descriptions of the corners of land parcels. However, trees are easily identifiable land marks in the vegetation and plantations landscape.



## 7. Maps and spatial representation

(The following is an analysis surveys conducted to Spain Spanish-speaking subjects, and Guatemalan subjects. This material is based upon work supported by the National Science Foundation, Geography and Regional Science program, under Grant No. BCS-9975557. Support of the National Science Foundation is gratefully acknowledged)

The subjects were asked to provide in one minute as many examples as they could about examples of things that can be portrayed on maps. Subjects from Spain answered in the highest frequency several large and relatively small scale features, such as “carreteras” (highways), “montañas” (mountains), “rios” (rivers), “hoteles” (hotels), “ciudades” (cities), “gasolineras” (gas stations). In contrast, the Guatemalan Spanish speaking subjects answered in the highest frequencies mostly large scale features, such as “rios” (rivers), “lagos” (lakes), and “volcanes” (volcanoes), “montañas” (mountains). They also mentioned with high frequency the large scale spatial features and territories such as “paises” (countries), “municipios” (counties), “ciudades” (cities) “departamentos” (kind of states), and “pueblos” (towns). In addition, they mentioned the “limites” (borders), public roads network of “carreteras” (highways), and in the lowest frequency they answered a few small scale three dimensional spaces such as “iglesias” (churches) and “monumentos” (monuments). The Guatemalan bilingual indigenous subjects answered in the highest ranks the large scale features such as volcanoes, mountains, rivers and lakes. They also mentioned roads and towns. These differences between subjects may make difficult the communication about information on maps.