Map Drawing in Tonga, Polynesia: Accessing Mental Representations of Space

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On the island of Vava'u in the northern archipelago of the Kingdom of Tonga, Polynesia, the author asked informants to draw a map of their village and later of the island they live on. Combining the drawing strategies used and the representational distortions inferred from the maps, the author arrived at hypotheses about how mental representations of spatial relationships are habitually organized in Tongan minds. The drawing tasks are described in detail.

At O'Hare Airport, Chicago, waiting for my delayed plane, I am lazily browsing through the pages of a glossy magazine in one of the many shops inviting passengers to spend money. The shop is also full of Chicago memorabilia, such as t-shirts with logos of the local teams, useless little objects with sparkling pictures of Chicago on them, and even mugs. On one of these mugs there is a representation of the city.

It is a common representation of big American cities (the first one was of New York): The world appears squeezed into very few landmarks (mostly American as well). The representation may cause a smile and maybe a quick thought about the "provinciality" of big-city dwellers.

This work is based on extensive fieldwork I conducted in the Kingdom of Tonga between the summer of 1991 and the spring of 1997. It was supported by the Cognitive Anthropology Research Group at the Max-Planck Institute for Psycholinguistics, Nijmegen, the Netherlands. Some funds were also provided by a Summer Research Award from the Department of Anthropology and by a Graduate College Dissertation Research Grant, both at the University of Illinois at Urbana-Champaign. I thank the Office of the Dean of the School of Humanities and Social Sciences at the College of Charleston, Charleston, South Carolina, for generously supporting me with a Dean Grant during the summer of 2000 while I was writing and editing this work. I also thank Bill Brewer, Janet D. Keller, Kris K. Lehman, Steve C. Levinson, Gunter Senft, and anonymous reviewers for reading and commenting on various drafts of this work. A warm thank you to Katharine L. Wiegele who read, edited, and discussed the article with me before, during, and after its completion. Thanks also to my Tongan assistants, informants, and friends who made this project possible. All mistakes and omissions are my own.

Field Methods, Vol. 14, No. 4, November 2002 390–417
DOI: 10.1177/152582202237727

Scholars, however, mainly psychologists, have taken these representations very seriously. Gould and White wrote a seminal book in 1974 that generated a lot of research on "cognitive maps,"[1] that is, how people mentally represent their environment. Specific cultural perceptions of the environment—such as being desirable places to move and work—are mapped on geographical maps, thus causing clear distortions (Gould and White 1974; see also Ittelson 1973; Downs and Stea 1977; Golledge and Stimson 1997, chap. 7). The mental distortion of the environment represented by the drawing of Chicago on the mug is defined and clarified in this type of research. However, the two mental representations—the one of Chicago on the mug and the one obtained by the researchers—share a similar nature: Geography is modified according to cultural perceptions of that same environment. That is, cultural knowledge interferes with and distorts the mental representation of geographical reality.

Tversky (1981) has investigated "systematic errors in memory for real and artificial maps, local environments, and visual forms" (p. 407). These errors are attributed to heuristic strategies such as aligning figures relative to one another, thus distorting their respective geographical positions. This research starts to separate in memory for maps—or cognitive maps—what is spatial (perceptual heuristics) and what is cultural.[2] In research that followed (Franklin, Tversky, and Coon 1992; Taylor and Tversky 1992; Tversky 1993), the distinction was made even clearer. Tversky (1993:14) proposed the term "spatial mental models" for mental representations of the environment that regard spatial relationships only. Significantly, in this research, participants were asked not only to remember maps or describe them linguistically but also to produce (i.e., draw) maps of their own.[3]

Although it contributed important data, map drawing remained secondary to the extensive question-and-answer session that followed exposure to various stimuli such as route or survey descriptions of environments (Tversky 1993:19). Reliance on linguistic production relegates map-drawing production to a supportive role (see Golledge and Stimson 1997:242; Golledge 1999:14). Map drawing instead, by avoiding any linguistic interference with mental representations, can be illuminating in investigating cognitive maps, that is, "spatial mental models" whose content is strictly spatial.[4]

In extensive fieldwork in the Kingdom of Tonga, Polynesia, starting in the summer of 1991 and spanning through the spring of 1997, I investigated features of the mental representations of spatial relationships for Tongans. Major goals of the research were to ascertain the way in which Tongans express spatial relationships linguistically and represent them mentally (Bennardo 1996, 2000a, 2000b). During my investigation, among other methodological tools, I used one I call "map drawing."

In this article, I illustrate what map drawing consists of, how it is administered, and at what stage of the research and for what purpose it can be used. I discuss how this useful methodological tool yields reliable data about the mental representations of space. I also demonstrate the crucial role it can play in clarifying other types of data collected with other methodological tools.

INVESTIGATING MENTAL REPRESENTATIONS OF SPATIAL RELATIONSHIPS

Choosing a frame of reference (FOR), or perspective taking, is a universal prerequisite of any spatial description. A FOR is a set of coordinates—three intersecting axes: vertical,[5] sagittal (front-back), and transversal (left-right)—used to construct an oriented space within which spatial relationships among objects are identified (see Brewer and Pears 1993 for a discussion of FOR). There are three major types of FOR: relative, intrinsic, and absolute (see Levinson 1996 for a typology of FOR, and Bennardo 1996, n.d., for a revision of that typology; see also Carlson-Radvansky and Irwin 1993 and Tversky 1996). A relative FOR is centered on a speaker and remains as such when the speaker moves, for example, when one says, "The tree is on my left." An intrinsic FOR is centered on an object, and it remains centered on the object when the speaker or the object moves (e.g., "The ball is in front of the car."). An absolute FOR uses fixed points of reference (e.g., north, south, east, west, as in "The town is south of the river.").

Research conducted in a variety of cross-linguistic and cross-cultural contexts all over the world has offered evidence of the peculiar preferences of some languages and cultures to express spatial relationships in habitual modalities (see Hill 1982; Pederson 1993, 1995; Pederson and Roelofs 1995; Levinson 1996, 1997; Bickel 1997; Hill 1997; Ozanne-Rivierre 1997; Senft 1997; Bennardo 2002). In other words, some speaking communities, culturally defined, show mental and linguistic preferences for certain FORs in describing spatial relationships linguistically and in representing them mentally.

In the early 1990s, under the direction of Stephen C. Levinson, a kit was prepared by the Cognitive Anthropology Research Group at the Max-Planck Institute for Psycholinguistics, Nijmegen, the Netherlands, for cross-cultural investigation of possible preferences in representing spatial relationships linguistically and mentally. During my association with the institute as a graduate fellow, I participated in the refining stage of the kit's development and used it in my fieldwork in Tonga. For a full description of the content of the kit, see Levinson (1992), Cognitive Anthropology Research Group (1992),

and Bennardo (1996). Below, I describe one of the tasks in the kit. This task is intended to detect a preference for a FOR in mentally representing spatial relationships in a small-scale space.

THE TASK "ANIMALS IN A ROW"

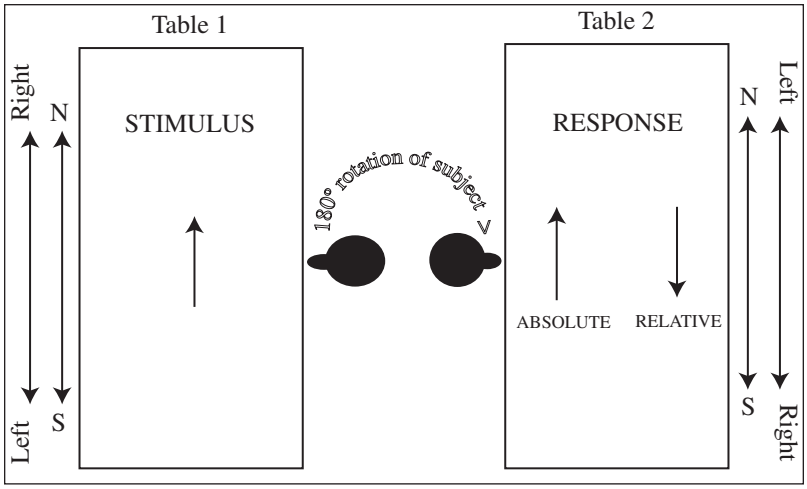
The animals-in-a-row task was administered to twenty-seven informants in three different places: Ngele'ia, a village/suburb of the Tongan capital town Nuku'alofa; Hihifo, a village on the remote northern island of Niuatoputapu; and Houma, a small village on the northern island of Vava'u, the main island of the homonymous archipelago in the north of Tonga (see Bennardo 1996:131, for justification of choice). Informants who participate in the task stand in front of a table (in some cases a box, a trunk, or an elevated surface). Three small plastic farm animals—a cow, a pig, and a horse—are positioned on the table. Animals are used because they have an intrinsic front and back. They also are culturally salient.

The plastic animals are shown standing in a row, all facing the same direction, either to the right or the left on the transverse axis in front of the informant. Informants are then asked (in their native language) to memorize the position of the animals. When an informant says he or she is ready to go to the next step (typically, after a few seconds), the animals are taken away and a minimum of sixty seconds must elapse in which some conversation takes place between the informant and the researcher. This is done to engage the informant's long-term memory.

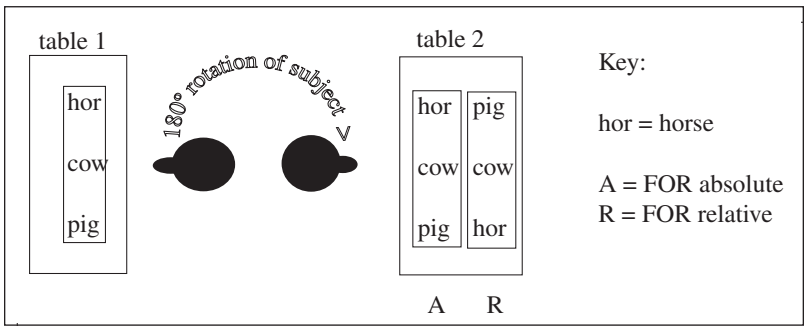
After sixty seconds, the informant is directed to another table situated at some distance from and opposite the first one. Here he or she is asked to stand in front of this second table in a position that requires a 180-degree rotation from the previous one. The researcher then hands the three animals to the informant, and he or she is asked to put them on the new table, replicating the sequence and direction he or she earlier memorized. This constitutes the end of one trial, and careful note is taken of the direction in which the informant chooses to align the three animals. The trial is repeated five times for each informant, and each time the sequence and overall direction of the three animals shown changes randomly. A training trial precedes the beginning of the five-part task to make sure that it has been clearly understood.

The way in which the informants aligns the animals on the second table provides a clear cue for understanding which FOR he or she has used to remember the spatial arrangement of the animals. In fact, there are only two ways (other solutions are considered mistakes) in which informants can arrange the overall direction of the three animals (their actual sequence is

FIGURE 1
The Task Animals in a Row



A



B

SOURCE: Adapted from Levinson (1996:113).

also registered by the researcher but has little relevance in the task). If informants use a relative FOR, the overall direction of the animals would stay the same relative to the informant's own left or right. If they use an absolute FOR, the direction of the animals would stay the same relative to some landmark or cardinal point but not to the informants' left or right. Figure 1 illustrates this.

TABLE 1
Results of the Animals-in-a-Row Task

Site	*Number of Informants*	*Absolute*	*Relative*
Ngele'ia	9	6	3
Hihifo	8	7	1
Houma	10	8	2
Total	27	21	6
Percentage	100	78	22

Figure 1A shows how the choice of the FOR (relative or absolute) for coding in memory eventually determines the informant's responses. Figure 1B illustrates the same phenomenon by showing a written version of the three animals involved in the task.

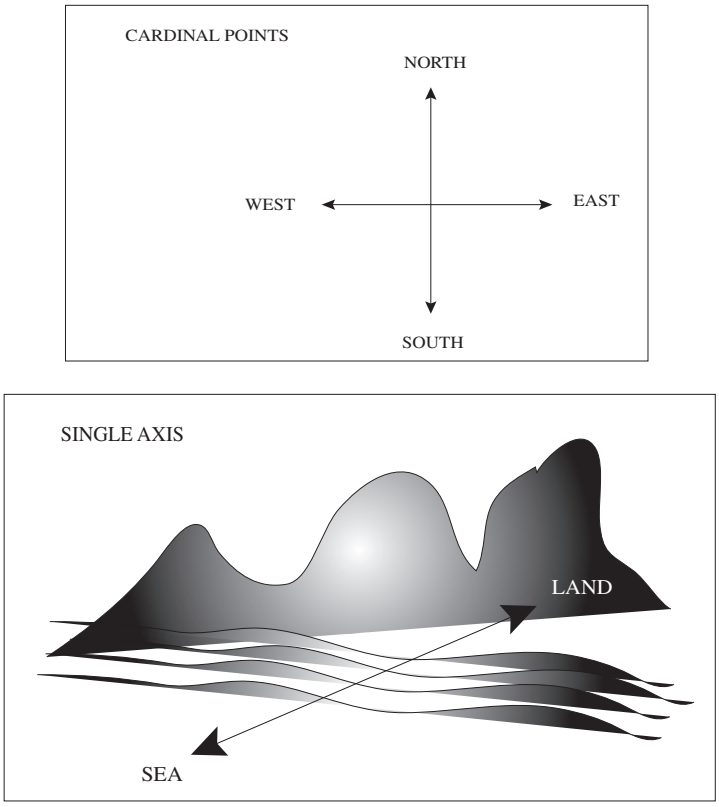
Beyond understanding the instructions in the native language, language has no other overt role in this task. The stimulus involves only visual perception and the response only motor activity. Of course, between the time of exposure to the stimulus and the time of the response, some mental coding of spatial relationships by means of a FOR in nonperceptual (long-term) memory is involved. The nature of this mental coding is exactly the target of this task. It is clear, then, how the nature of this task taps into psychological processes, keeping them as distinct and separate as possible from language. Table 1 shows the results for this task when it was administered to Tongans.

An indisputable preference for the absolute FOR is detected by this task (78% of responses). The administration of a number of other tasks confirmed these results (see Bennardo 1996). However, it is well known that the absolute FOR has a variety of forms, including the cardinal-points subtype—north, south, east, west—and the Oceanic single-axis subtype—land, sea[6] (for the latter, see Hill 1997; Ozanne-Riviere 1997; Florey and Kelly 2002; Hyslop 2002; Palmer 2002). A graphic illustration of these two subtypes is given in Figure 2.

"The town is south of the river" is the example I have already provided as an illustration of the use of the cardinal-points subtype. "The tree is on the sea-side of the house" is an example of the use of the single-axis subtype. Both subtypes provide absolute information, that is, the position of the town and the position of the tree can be understood without their being perceptually accessible.

While the animals-in-a-row task provides a good indication for a preference for the absolute FOR, the question remains as to which subtype of the

FIGURE 2
Two Subtypes of the Absolute Frame of Reference:
Cardinal Points and Single-Axis Oceanic



absolute FOR Tongans use in their preferential way of representing spatial relationships mentally. It is at this point of my investigation that I decided to administer another set of tasks and included two types of the map-drawing task. Since the map-drawing task also avoids interference from the linguistic system, its results should be comparable to the ones obtained by the animals-in-a-row task. In addition, I expected the map-drawing tasks to provide more explicit information (i.e., which subtype of the absolute FOR) about the Tongan mental preference of representing spatial relationships.

THE MAP-DRAWING TASK

The map-drawing task consists of asking the informant to draw a map of a specific environment on a provided sheet of paper. The instruction were given in Tongan and kept to a minimum such as, "Please draw a map of X."[7] Basically, the language of instruction was kept to a minimum (i.e., "Do this") to avoid any linguistic interference on the output of the activity.[8]

I administered two different types of tasks: one in which I asked the informants to draw their village from memory and one in which I asked them to draw their island, also from memory. Due to the nature of the Tongan village cultural milieu—a small number of houses (thirty-five in this case) and the majority of activities conducted outdoors—the perceptual access to at least part of the village while drawing is unavoidable (i.e., part of the village can be seen). This may affect the nature of the drawing, and it must be remembered when analyzing the results of the task. Regarding the second task, the size of the island—several miles in extension—renders the perceptual access to a relevant section of the environment while drawing much more limited and thus less likely to be conducive to distortions. Quality and quantity of perceptual availability, however, must be noted down and considered when analyzing the results. I discuss now the context in which the tasks were administered and the results they yielded.

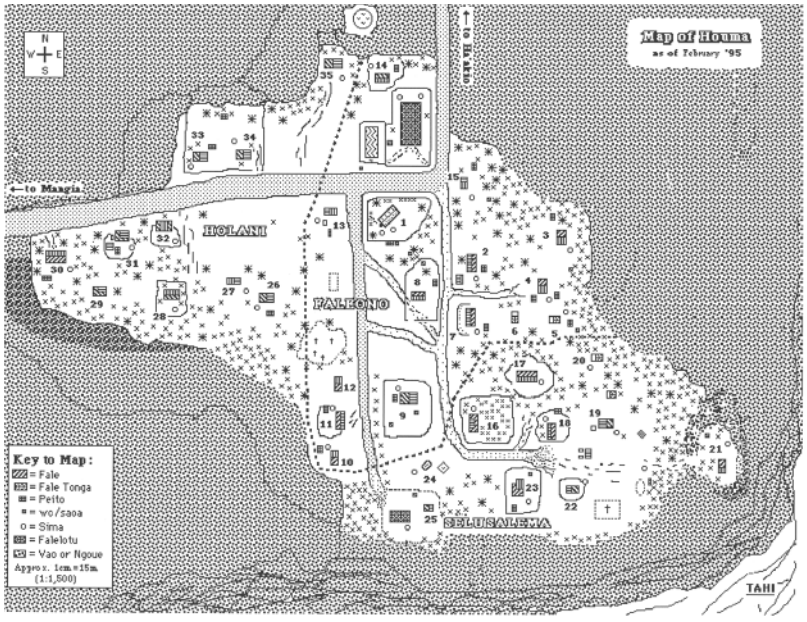
ADMINISTRATION OF THE MAP-DRAWING TASK

I administered the map-drawing tasks in the village of Houma, in Vava'u, the northern archipelago of the Tongan islands group, over a period of approximately one week in January 1995 (see Figure 3 for a map of Houma). Houma is located roughly north-northeast of the main town of Neiafu (see Figure 4 for a sketch of the island of Vava'u).

Eight men and eight women participated in the map-drawing task. According to my personal census,[9] there were only 172 people in the village of Houma during my stay there, so I could not vary the sample systematically by age. Even villagers who had attended school for several years were unfamiliar with maps.[10] Furthermore, drawing ability turned out to be poor in most of the informants. However, I did not consider that this factor seriously affected the possibility of externalizing in the drawing a point of view or FOR of the environment. The type of the maps produced confirmed such assumption.

With the exception of two pairs of informants, the sessions took place with one informant per time and all in different places of the village. The sessions

FIGURE 3
Map of Houma, Vava'u, Kingdom of Tonga

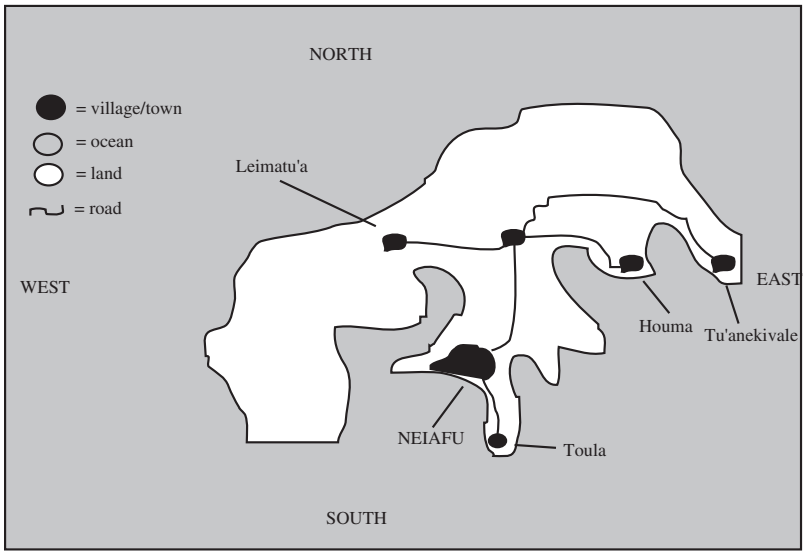


were conducted either inside (56%) or just outside (or very close to) (44%) the informant's residence as indicated in Table 2. Informants could choose the place in which they felt more comfortable.[11] The informants could also decide the direction they faced during the task. Only three of them deliberately chose a specific direction when starting the drawing (indicated by a superscript "b" in Table 2), changing their position from the previous one they occupied while the task was explained to them. Had I asked informants to sit facing a specific direction, such relevant information about a preferred direction would not have been available.

ANALYSIS AND RESULTS OF FIRST MAP DRAWING (THE VILLAGE)

The analyses of the results regard two types of data: (1) the content and characteristics of the maps drawn by the informants and (2) the notes taken during the task about specific features of the individual's drawing activity.

FIGURE 4
Sketch of the Island of Vava'u, Tonga



Analysis of the Content of the Maps

The first characteristic of the drawings I considered was the cardinal orientation of the map. In other words, I checked which cardinal point in real space had been put at the top of the paper, that is, the side where cartographers usually put north.[12] The assumption is that the cardinal point put on the "top" of the map is the most salient for the informant. The universality of the saliency of the vertical axis with "up" considered positive and "down" either neutral or negative is widely accepted (see Miller and Johnson-Laird 1976; Lakoff 1987; Carlson-Radvansky and Irwin 1993). The results are indicated in the column headed by "Top 1" in the rightmost column of Table 2. In this column, eight informants (50%) chose south, seven (44%) chose north, and one (6%) chose west.

It is important to note that the cardinal direction going from Houma to Neiafu—the main town on the island of Vava'u—is southwest, but Houma villagers always indicate it as south. The road to Neiafu—the major dirt road crossing almost the entire length of the village—exits (or enters) Houma on the west side (see Figure 3). Furthermore, for all those informants that put north at the top, the road to Neiafu was to their geographical north (also shown clearly in their drawings).

TABLE 2
Gender, Place, and Orientation of Informants for Task 1

Name	*Male*	*Female*	*House Number*[a]	*Inside*	*Outside*	*Facing*	*Top 1*
Esala	X		13		X	**West**	**West**
Ana S.		X	34		X	**South**	**South**
Siale		X	11		X	West	South
Tomoua	X		1	X		South	North
Sunia	X		14	X		**South**[b]	**South**
Va'inga	X		14		X	**South**[b]	**South**
Mula	X		35		X	**South**	**South**
Lea	X		30	X		**North**	**North**
Sia		X	19		X	**North**	**North**
Fakalelo		X	23		X	West	North
Saane		X	2	X		**North**[b]	**North**
Amelia		X	2	X		West	South
Ana V.		X	3	X		**South**	**South**
Mani	X		10	X		**North**	**North**
Salote		X	18	X		West	North
Tevita	X		5	X		West	South
Total	8	8		9	7		
Percentage	50	50		56	44		

NOTE: Bold indicates same cardinal point in the "Facing" and "Top 1" columns.
a. The house numbers refer to the map of Houma provided in Figure 3.
b. A deliberate choice on the part of the informant.

Next, I compared the direction the informants faced while drawing with the choice of cardinal direction they had made in orienting the map in their drawings. The majority of the informants (ten out of sixteen, or 63%) paired their facing direction and the cardinal point they put on the top side (cartographer's standard north) of the map. This pairing is indicated by boldface in Table 2.[13] The pairing was more likely when the session took place outdoors (five out of seven times, or 71%) than when indoors (five out of nine times, or 55%).

It seems that the orientation of the environment faced by the informants is reproduced in the orientation of their maps. In fact, they drew with the sheet of paper in the horizontal plane; thus, the so-called top is nothing but the part of the environment in front of them. This may lead to the conclusion that they used a relative FOR to orient the maps drawn. However, informants who oriented their maps in a different way from their facing direction give an important clue about a phenomenon that might have been obscured otherwise.

The remaining informants paired either their west-facing direction to an orientation of the map toward south (three cases) or toward north (two cases), and there was only one case with a pairing of a south-facing direction to an orientation of the map toward north. Their pairings can be interpreted as a movement from a drawing orientation toward the *mu'a* (front) of the village where the road from/to Neiafu enters/exits (see Bennardo 1996) to either real cardinal directions to Neiafu (the three cases of a shift from west to south) or toward the road (the whole road and not just the entering/exiting direction) to Neiafu (the two cases of a shift from west to north). This latter interpretation is also possible for the only case of a shift from south to north.

In other words, the direction to Neiafu (south) or the direction to the road to Neiafu (north) account for fifteen cases (94%) of the directions chosen. The only exception is Informant 1 who oriented the map toward the west, that is, toward the mu'a (front) of the village. Below we see how this is a salient landmark in the village.

Analysis of the Drawing Activities

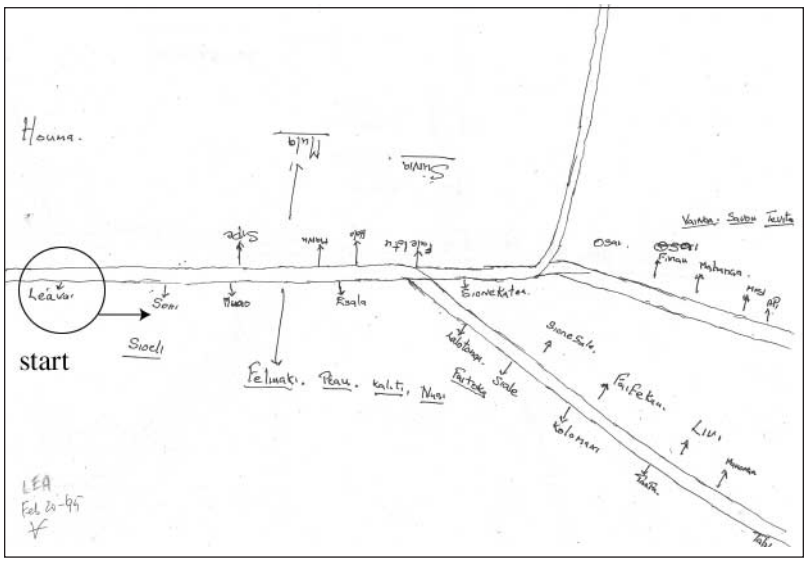
While the drawings were being produced, I took notes about some specific characteristics of the events. For example, I wrote down from which side of their sheet of paper they started to draw the map of their village and which side of the village they drew first. I also noted how often they looked at their surroundings. Although difficult to evaluate in isolation, all of this information becomes meaningful when analyzed jointly.[14] In fact, after carefully going through these notes and comparing them with the actual drawings, I was able to highlight three strategies adopted by the informants in the production of the drawings.

The first strategy is to start from the self, or better, the area close to and containing the self, and continue with what is present in the environment in front of the informant (for a good example, see Drawing 1 in Figure 5). Later adjustments are, of course, made to complete the map.

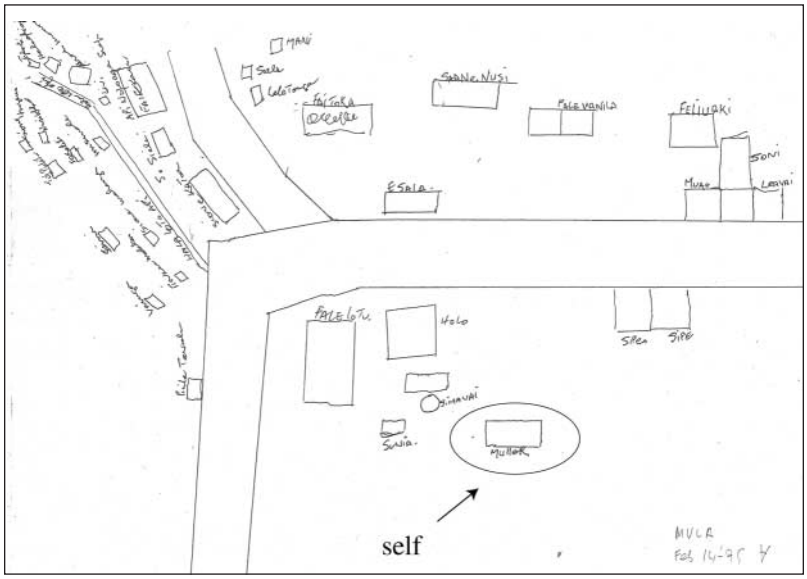
A second strategy is to start the drawing from what is visible in the environment in front of the speaker and finish by later adding what is not visible and finally the person's own location/house or self. The self is at times added before other nonvisible parts. These nonvisible parts of the village are usually drawn smaller than the visible parts, and they appear more crowded on the page than the other parts of the drawing (for a good example, see Drawing 2 in Figure 5).

A third strategy is to start the drawing from the road to Neiafu, actually from that part of the road that enters/exits the village, in other words, from the mu'a (front) of the village (for a good example, see Drawing 3 in Figure 5). I

FIGURE 5
Drawings of Houma (Village)

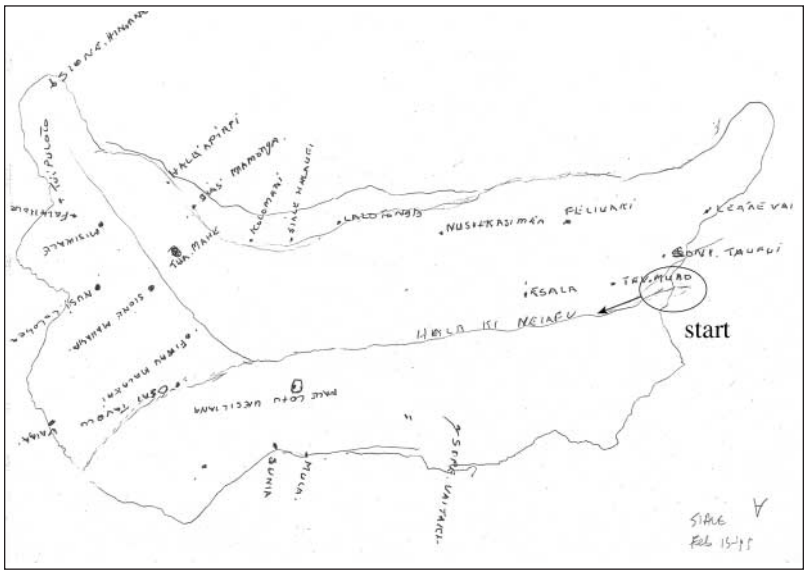


Drawing 1: Map of Houma by Lea (Self Strategy)



Drawing 2: Map of Houma by Mula (See Strategy)

FIGURE 5 (continued)



Drawing 3: Map of Houma by Siale (Mu'a Strategy)

have indicated the first strategy with the word "Self," the second as "See," and the third as "Mu'a" in Table 3.

A dash (—) in Table 3 indicates the presence in some drawings of the salient participation of a secondary strategy to the production of the map in addition to the primary one. In the three cases indicated, the major strategy used was Mu'a and the secondary one was See. It can easily be seen how the simultaneous use of more than one strategy never involves an overlap between the strategies Self and Mu'a but only the Mu'a and the See strategies. It seems that after deciding whether to start from the self or from the environment (not-self), informants made another choice between giving precedence to the perceivable environment or to the culturally relevant (and seldom perceivable) one of mu'a (front of village).

I have described three types of a single-axis absolute FOR used in Tongan and specifically by villagers of Houma (see Bennardo 1996:246ff). I named one of them *kolo-'uta* (town, in this case, Neaifu-inland). The end of the axis termed *kolo* (town/Neiafu) is often used with the meaning of road to Neiafu. The two directions in the village of Houma differ in cardinal direction—Neiafu is southwest (usually referred to as south) and road to Neiafu is west—but they are used without mistakes by the villagers (paralinguistic features of

TABLE 3
Drawing Strategies for Task 1

Name	*Self*	*See*	*Mu'a*
Esala		—	X
Ana S.		X	
Siale			X
Tomoua			X
Sunia		—	X
Va'inga		—	X
Mula		X	
Lea	X		
Sia	X		
Fakalelo			X
Saane			X
Amelia			X
Ana V.			X
Mani			X
Salote			X
Tevita			X
Total	2	2	12
Percentage	12.5	12.5	75

NOTE: X = primary choice; — = secondary choice.

communication must help). The absolute nature of this axis is of particular interest to this discussion.

The results in Table 3 show that the privileged strategy used by the informants is the one called Mu'a (twelve cases, or 75%) over the other two (both with only two cases, or 12.5% each). Either visible or not visible, then, the major concern of the informants in organizing their spatial information to be translated into the map was the absolute axis with the direction road to Neiafu as one of its ends. This anchoring was independent of the specific positions of the informants in the space of the village. In fact, all the informants who showed this concern were located in a variety of different positions in the village. This is deducible from the number of their houses—shown in Tables 2 and 3—whose locations can be found in the map of Houma (see Figure 3).

Their concern with this absolute axis is also shown by the way in which they anchor the top side of their drawings: They chose either south, the direction to Neiafu from Houma; north, the direction toward the road to Neiafu; or west, the direction toward the mu'a (front) of the village. Although the two results may appear to be separate, I suggest that understanding their map drawings from two different perspectives—map anchoring and drawing strategy—provides us with similar conclusions.

The first map-drawing task adds clarifying details to the preference for the absolute FOR detected in the animals-in-a-row task. We can confidently state that the subtype of the absolute FOR preferentially used by Tongans is the single-axis one, specifically the kolo-'uta (town/Neiafu-inland) axis. This finding is in line with the literature about Oceanic representations of spatial relationships (see Senft 1997; Bennardo 2002; specifically, Hill 1997; Ozanne-Riviere 1997; Florey and Kelly 2002; Hyslop 2002; Palmer 2002), where an Oceanic land-sea axis (see Figure 2) is often suggested as typically used by Oceanic people. Tongans use a land-sea axis (see Bennardo 1996: 251) but also display the use of other similar single-axis absolute FORs such as the town/Neiafu-inland FOR. Relevantly, they use the single-axis subtype of the absolute FORs more often and prior to any use of the cardinal-points subtype of the absolute FOR (Bennardo 1996:249).

ANALYSIS AND RESULTS OF SECOND MAP DRAWING (THE ISLAND)

The second task administered involved drawing a map of the island of Vava'u, that is, the island where the village of Houma is located (see Figure 4). The contexts in which these drawings were produced were exactly the same as in the first one. In fact, this second task was administered to the informants a few minutes after they had finished drawing the map of their village. The cardinal point they put on the top of their second map was again mainly south (nine cases, or 56%) as compared to north (two cases, or 12.5%) and west (one case, or 6%). However, in some cases (four, or 25%), it was impossible to determine the exact cardinal point they had used. In fact, these maps have representations of places that do not correspond to their real geographical locations. Furthermore, the spatial relationships among these dislocated places do not provide any clues as to the orientation used in creating the maps (see Table 4).

Without considering the ambiguous maps, the number of drawings showing congruence between the facing direction of the informants and the cardinal point they chose to anchor the map is 50%, the same percentage as in the previous task. Again, there are more cases among informants who were sitting outdoors. Regarding the remaining informants, four shifted from a real facing direction toward the west to an anchoring point on the map toward the south. One informant shifted from facing the north to anchoring point toward the south and one from the south to the north. The tendency was to orient the map toward the south,[15] an orientation that corresponds to the cardinal direc-

TABLE 4
Gender, Place, and Orientation of Informants for Task 2

Name	*Male*	*Female*	*House Number*[a]	*Inside*	*Outside*	*Facing*	*Top 2*
Esala	X		13		X	West	South
Ana S.		X	34		X	**South**	**South**
Siale		X	11		X	West	South
Tomoua	X		1	X		**South**	**South**
Sunia	X		14	X		**South**[b]	**South**
Va'inga	X		14		X	South[b]	North
Mula	X		35		X	**South**	**South**
Lea	X		30	X		**North**	**North**
Sia		X	19		X	North	?
Fakalelo		X	23		X	West	?
Saane		X	2	X		North[b]	?
Amelia		X	2	X		West	South
Ana V.		X	3	X		South	?
Mani	X		10	X		North	South
Salote		X	18	X		West	South
Tevita	X		5	X		**West**	**West**
Total	8	8		9	7		
Percentage	50	50		56	44		

NOTE: Bold indicates same cardinal point in the "Facing" and "Top 2" columns.
a. The house numbers refer to the map of Houma provided in Figure 3.
b. A deliberate choice on the part of the informant.

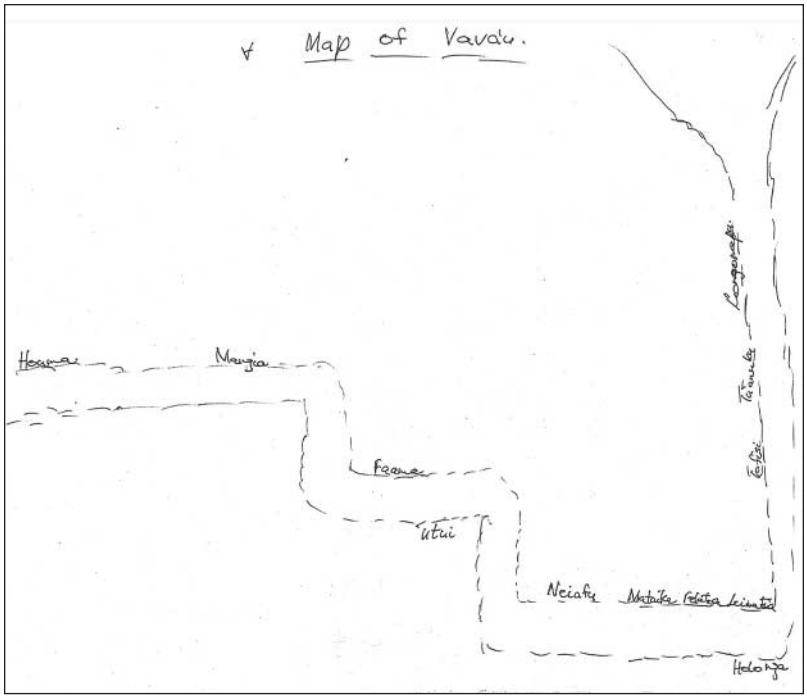
tion toward Neiafu (the main town on the island) as perceived by the people of Houma.

Three major strategies were used to produce the drawings. The first, which I labeled "Village," uses the village of Houma as a starting point (for a good example, see Figure 6a). The second I labeled "From Neiafu," that is, the starting point of the drawing is the town of Neiafu, the main town on the island (for a good example, see Figure 6b).

In the third case, "Center," the center of the drawing and of the island is the town of Neiafu. Figure 7 contains two drawings in which this strategy is used (Drawing 2 in Figure 6b is also an example of this strategy).

The central position of Neiafu in these maps does not correspond to its real geographic position on the island (see Figure 4). In real geographic terms, Neiafu is on the coast and in the south part of the island. Table 5 shows the results of the analysis of this second group of drawings.

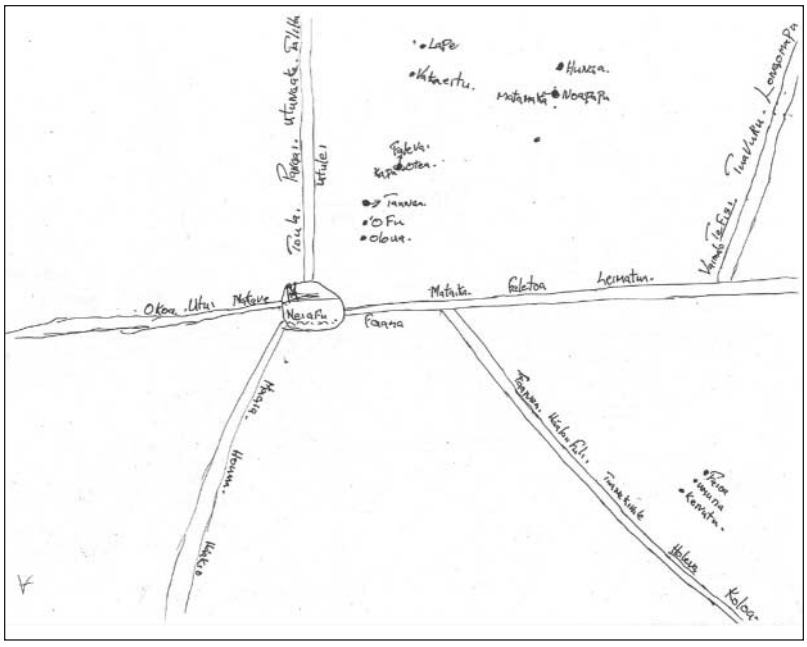
FIGURE 6a
Map of the Island of Vava'u by Saane, a Tongan Woman



The results in Table 5 show a clear privileging of the Starting-from-Neiafu strategy (fourteen cases, or 87.5%). This strategy is often but not always combined with the Center one; that by itself has a high incidence (ten cases, or 62.5%). On the other hand, the Center strategy is always used with the Starting-from-Neiafu strategy. Finally, the Village strategy is used in only one case.

It seems, then, that Neiafu plays a very primary role in Houma villagers' mental representations of their island. They orient their drawings toward it, start their drawings from it, and locate it in the center of their drawings. In other words, it is a cultural landmark that induces a systematic distortion (see Lloyd 1997:59) of the cognitive map of their island. Moreover, by looking at the explicit characteristics of their drawings (see Figures 6b, 7a, and 7b), their mental representations of space have a specific, salient, and notable feature: radiality. A large nonperceivable environment, such as the island they live on, is represented with a central point (Neiafu), and all the other places are

FIGURE 6b
Map of the Island of Vava'u by Mani, a Tongan Man



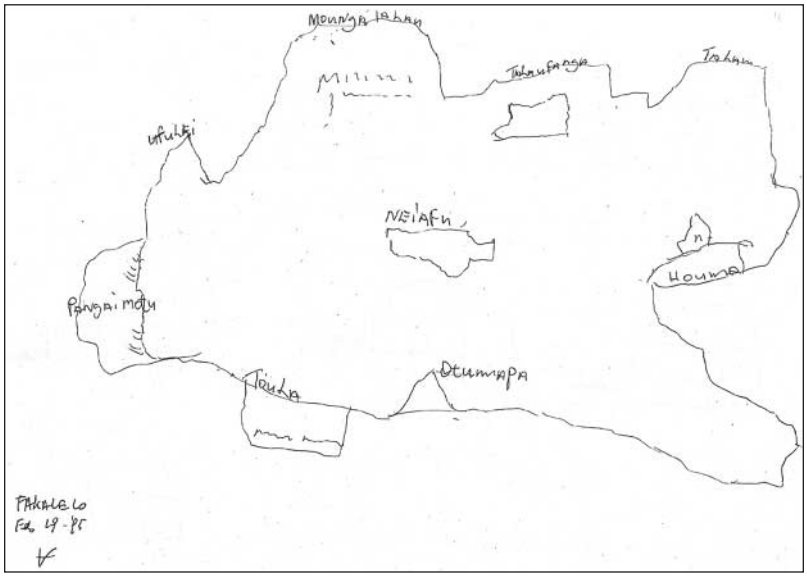
represented as radiating from it, that is, put in relationship with the center of the representation as points on rays.

How does this finding relate to the previous ones? The absolute FOR is constructed mentally by choosing a set of fixed points of reference—four in the cardinal-points subtype and two in the single-axis subtype. These fixed points and relative axes (one or two) are later used to locate objects in the environment. The procedure used by Houma villagers to draw maps of Vava'u is similar: Choose a fixed point of reference (only one) and then draw others radiating out from it (see Figure 8). I have called this FOR a radial subtype of the absolute FOR.

The radial subtype of the absolute FOR does not use axes as the other two subtypes but only points and vectors. It is, however, as absolute and efficient in obtaining appropriate descriptions of spatial relationships as all the other subtypes of the absolute FOR.

"The idea of 'center' and 'periphery' in spatial organization is perhaps universal" (Tuan 1974:19). Moreover, in discussing the use of landmarks in cognitive maps, Golledge (1999) said, "Landmarks may be defined in a num-

FIGURE 7a
Map of the Island of Vava'u by Fakalelo, a Tongan Woman

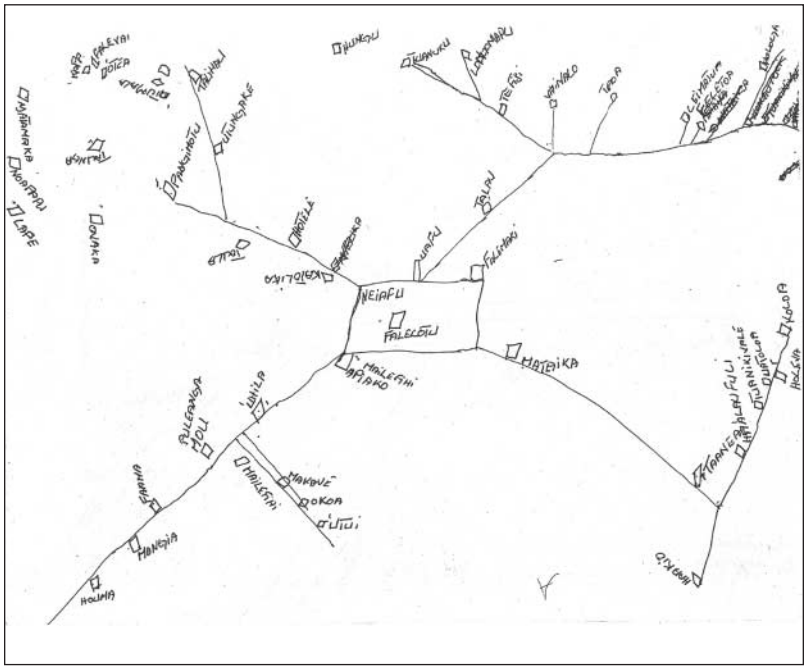


ber of ways, such as strategic foci toward or away from which one travels" (p. 16). Later, he added, "They [landmarks] may be used as a centroid for spatially partitioning a region" (p. 17). Similarly, Lloyd (1997) said, "Reference points on cognitive maps apparently have a special significance. Some have argued that special landmarks in environment serve as anchor points for encoding other information" (p. 69).

These extremely brief excerpts from the vast literature about cognitive maps and the environment support my findings. However, there is a novelty in my proposal that needs to be pointed out. The choice and use of a landmark is considered evidence for the choice and use of a radial FOR, a subtype of the absolute FOR. This suggestion clarifies what is left unsaid in the literature about landmark use where the consequences of choosing one are examined—distortion of the cognitive map—but not what the choice of a landmark or a sequence of landmarks implies as a mental activity, that is, the use of a FOR (see also Bennardo n.d.).

In conclusion, the analysis of the results of the second map drawing task provides supporting evidence about the preference for the absolute FOR indicated by the results of the animals-in-a-row task. In addition, the use of the radial subtype of the absolute FOR was discovered and proposed as a rele-

FIGURE 7b
Map of the Island of Vava'u by Salote, a Tongan Woman



vant aspect of Tongan mental representations of spatial relationships. Finally, the spatial choice of using a radial FOR is combined with the cultural choice of using Neiafu (major town on the island and site of economic and sociopolitical power) as the center of their attention.

EVALUATING THE MAP DRAWING TASKS

Administering a map-drawing task is relatively easy and enjoyable both for the researcher and the informant. Humans seem to be born map makers who enjoy both the process and the results of this activity (see Golledge 1999:13). I felt comfortable asking my informants to draw the map; no informant ever overtly refused to participate, nor did any evince any noticeable embarrassment regarding their participation. I don't know if this is due to the Tongan sociocultural milieu or to the keen interest that humans have in map making. I lean toward the second hypothesis.

TABLE 5
Drawing Strategies for Task 2

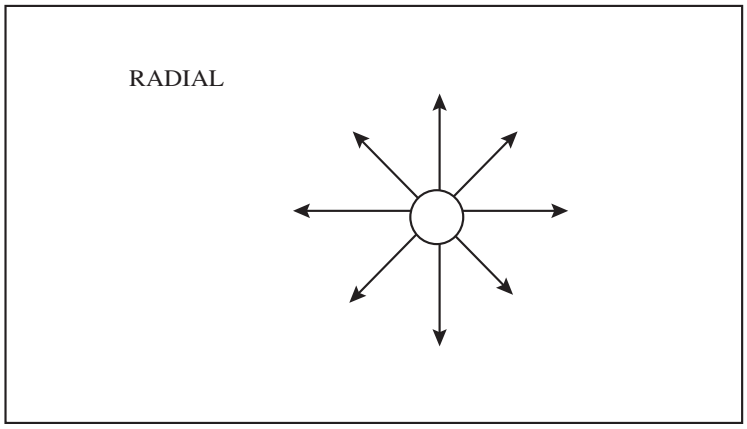
Name	*Village*	*From Neiafu*	*Center*
Esala		X	X?[a]
Ana S.		X	X
Siale		X	X
Tomoua		X	X
Sunia		X	
Va'inga		X	
Mula		X	X
Lea		X	
Sia	?[b]	?	
Fakalelo		X	X
Saane	X		
Amelia		X	
Ana V.		X	X
Mani		X	X
Salote		X	X
Tevita		X	X?
Total	1	14	10
Percentage	6	87.5	62.5

NOTE: The percentages for each column represent the total sample of informants. The question marks in the row headed by Sia are due to the fact that there is not enough information in the field notes to fill either boxes. The only thing that can be indicated for certain is the fact that she did not put Neiafu in the center of her map. The two question marks in the Center column refer to the fact that these two informants did not put Neiafu in the center of the island, but they put it correctly on the coast as it is in real geographical space. However, they still put it in the center of their drawing space (the sheet of paper). All the remaining informants (eight) drew Neiafu inland, in the middle of the island. Drawings in which Neiafu appears more schematically as a central box from which lines depart are interpreted in the same fashion. On these lines, other locations on the island are indicated.
a. Neiafu is on the coast but at the center of the sheet of paper.
b. No information available.

Besides, even in fieldwork situations in which an activity focused exclusively on map drawing is not culturally acceptable, it is always possible to obtain drawings or sketches of maps by informants within the wider context of informal (and/or formal) conversations or interviews. Compare this with the artificiality of the situation required by the administration of the animals-in-a-row task: a very demanding task for both the researcher and the informants.

The map-drawing task provides plenty of complex and superior information about the mental representations of spatial relationships in long-term memory. In fact, the animals-in-a-row task, which has been specifically designed to collect information about the mental preference of FOR, did not

FIGURE 8
Radial Subtype of the Absolute Frame of Reference



provide information as complete as the results of the two map-drawing tasks later administered. While the animals-in-a-row task detected a preference for the absolute FOR, the map-drawing tasks made clear which two subtypes of the absolute FOR are used: the single-axis kolo-'uta (town/Neiafu-inland) and the radial.

I want to stress that by comparing the two tasks, I am not implying that the researcher should make a choice between them. Nothing could be further from my intention. I am simply suggesting that the map-drawing task, because of the results that it can yield, deserves a more prominent place in investigations of the mental representations of spatial relationships.

Sociocultural knowledge is also used and displayed during this task, especially in the characteristics of the resulting drawings. The houses and the places left out provide information about cultural (i.e., hierarchy, kinship) saliency.[16] Size distortions of drawn places are also extremely revealing. Furthermore, it is well known how informing the sequence of recall is in several types of activities (see Romney 1989). The specific sociocultural knowledge used and displayed in the drawings is as relevant and salient as the spatial relationship information. The information about spatial relationships, however, remains primary and can be comfortably evinced by the researcher.

Another important aspect of the administration of the map-drawing task is the note-taking activity that the researcher (or any assistant) should carefully

conduct. I particularly stress this point because in the rare instances in which this is used in the psychological literature, the focus of the analyses is usually restricted to the products of the activity. That is, only the inherent qualities of the drawings (i.e., distortions) are considered for analysis (for an exception, see Levelt 1996). By recalling the discussion of the tasks in the above two sections, it can be seen how much the notes about the performing of the tasks contribute to a systematic disclosure of their potential meaning.

FINAL COMMENTS

The map-drawing task discussed here was used in a particular location and in a specific moment within the research project. I suggest, however, that asking people to draw maps of specific environments is a simple but efficacious way to obtain important data in any type of field situation. Obviously, map drawing should be used in conjunction with a variety of other methodological tools. Nonetheless, it has been vastly underused by researchers in the investigation of mental representations of spatial relationships.

Before closing, I summarize some of the points I have made:

1. The map-drawing task is simple to administer.
2. It is well received by informants who seem to enjoy the activity.
3. It can be administered almost anywhere and anytime.
4. The researcher only has to carry some sheets of paper and a pencil.
5. It needs a systematic administration.
6. A target group/sample needs to be selected in advance.
7. The selection of a specific environment to draw can make the activity culturally salient and provide relevant results.
8. It needs accurate observation and note taking before and during the activity. The researcher needs to take notes minimally of the coordinates of the place, the position of the informant, and the sequence and type of the drawing activities.
9. The results yield mental representations of spatial relationships, but variety of sociocultural information is elicited as well.
10. The co-occurrence of spatial data and sociocultural data within the same task enhances the interpretation of the strictly spatial data.
11. The results can be quantified and analyzed statistically.
12. It is fun both to administer and to analyze!

I am currently investigating possible relationships between cultural practices and the Tongan preference for a radial subtype of the absolute FOR in cognitive maps. Specifically, I am investigating village layouts, land distribution, kinship structure, navigation, patterns of exchange, and social net-

works. Aside from the various difficulties inherent in such research, it feels more comfortable knowing that my methodological toolbox is enriched by the presence of the map-drawing task.

NOTES

1. The expression "cognitive map" was first introduced by Tolman (1948) when reporting about his experiments with rats.

2. These two types of knowledge can be mentally accessed, activated, and possibly represented together as shown by McNamara, Halpin, and Hardy (1992). However, the different nature of the two types of knowledge needs to be addressed, investigated, and clarified.

3. For specific investigations about the relationships of language and cognitive maps, see Plumert et al. (1995) and Taylor and Tversky (1996).

4. For a methodology that tries to circumvent linguistic influences on mental representations of spatial relationships, see Levinson (1992, 1997) and Pederson (1995).

5. Since the vertical axis is common to any type or subtype of frame of reference (FOR), it will not be mentioned any more.

6. In both subtypes, the vertical axis is not considered in the present discussion because it is common to any FOR.

7. Another example of the instruction used is, "This is the village of X, can you draw a map of it on this sheet of paper?"

8. As I will discuss later, informants had little familiarity with maps and map drawing. This, however, does not mean that they did not know what a map is and what it entails to draw one on a piece of paper.

9. The official census figure from the 1996 census was 180 (Kingdom of Tonga 1999).

10. I have visited several Tongan schools, both elementary schools and high schools, and have seen no maps on the walls except in very few cases. There is an elementary school in the village of Houma, and I did not see any map on the walls there either. Familiarity with maps, however, does not prevent the administration of this task (see Gould and White 1974). An anonymous reviewer pointed out that Polynesians have a long history of the use of complex charts for their navigation, so it was surprising that my informants had little familiarity with maps. I am well read about Polynesian navigation and have also written about it (Bennardo 1998). It seems to me that the reviewer has not taken into consideration a few facts: (1) The art of Polynesian navigation was restricted to few masters and not available to the population at large, (2) this art has completely disappeared in Polynesia and survives with only few individuals in Micronesia, and (3) contemporary Tongan villagers are mainly subsistence farmers, as were the majority of their ancestors. Thus, their unfamiliarity with maps could simply be a result of the deficiencies of their education system or, more likely, a reflection of their lifestyle.

11. Both entering a Tongan house or asking a resident to come outside call for a series of ritualized behaviors that I did not want to initiate by asking my informants either to come outside or to go inside. The impact of this uncontrolled variable on the results of the activity is less salient than the impact that unwanted social obligation could have on the disposition of the informant who performs it (i.e., she or he did not want to invite me in because of a temporary lack of necessary food to offer).

12. No informants wrote the cardinal points on the maps they drew, but the orientation of the contents of their drawings indicated which arrangement of the cardinal points they had implicitly used.

13. Chi-square result for "Facing" matching "Top 1" is very significant even with χ^2 at 0.001.

14. I agree with an anonymous reviewer who pointed out the difficulty to assign specific meaning to a temporal precedence (i.e., one place drawn before another). However, in line with Romney's (1989) suggestions, and the just-stated step of considering all this information jointly, I feel confident about my analyses.

15. Chi-square result for south in both tasks combined is very significant even with χ^2 at 0.001.

16. Gärling and Evans (1991:4) noticed that not enough attention has been devoted to the effects of culture on environmental cognition.

REFERENCES

Bennardo, G. 1996. A computational approach to spatial cognition: Representing spatial relationships in Tongan language and culture. Ph.D. diss., Department of Anthropology, University of Illinois, Urbana-Champaign.

Bennardo, G. 1998. Conceptual semantics and linguistic knowledge, cognitive anthropology and cultural knowledge: A common enterprise? Paper presented in session, Cognitive Anthropology and Formal Linguistic Models: Their Uses and Limitations. Ninety-seventh annual meeting of the American Anthropological Association, 5 December, Philadelphia.

———. 2000a. A conceptual analysis of Tongan spatial nouns: From grammar to mind. *Languages of the World* 12.

———. 2000b. Language and space in Tonga: The front of the house is where the chief sits! *Anthropological Linguistics* 42 (4): 499–544.

———. 2002. *Representing space in Oceania: Culture in language and mind*. Canberra, Australia: Pacific Linguistics, Research School of Pacific and Asian Studies, the Australian National University.

———. n.d. A typology of frames of reference based on their axiomatic content. Manuscript in preparation, Department of Anthropology and Cognitive Studies Program, Northern Illinois University.

Bickel, B. 1997. Spatial operations in deixis, cognition, and culture: Where to orient oneself in Belhare. In *Language and conceptualization*, edited by J. Nuyts and E. Pederson, 46–83. Cambridge, UK: Cambridge University Press.

Brewer, B., and J. Pears. 1993. Introduction: Frames of reference. In *Spatial representation: Problems in philosophy and psychology*, edited by N. Eilan, R. McCarthy, and B. Brewer, 25–30. Cambridge, MA: Blackwell.

Carlson-Radvansky, L., and D. Irwin. 1993. Frames of reference in vision and language: Where is above? *Cognition* 46:223–44.

Cognitive Anthropology Research Group. 1992. *Manual for the space stimuli kit 1.1*. Nijmegen, the Netherlands: Max-Planck Institute for Psycholinguistics.

Downs, R. M., and D. Stea. 1977. *Maps in minds: Reflections on cognitive mapping*. New York: Harper & Row.

Florey, M. J., and B. F. Kelly. 2002. Spatial reference in Alune. In *Representing space in Oceania: Culture in language and mind*, edited by G. Bennardo, 11–46. Canberra, Australia:

Pacific Linguistics, Research School of Pacific and Asian Studies, the Australian National University.

Franklin, N., B. Tversky, and V. Coon. 1992. Switching points of view in spatial mental models. *Memory & Cognition* 20 (5): 507–18.

Gärling, T., and G. W. Evans. 1991. *Environment, cognition, and action: An integrated approach*. Oxford, UK: Oxford University Press.

Golledge, R. G. 1999. *Wayfinding behavior: Cognitive mapping and other spatial processes*. Baltimore: Johns Hopkins University Press.

Golledge, R. G., and R. J. Stimson. 1997. *Spatial behavior: A geographic perspective*. New York: Guilford.

Gould, P., and R. White. 1974. *Mental maps*. New York: Routledge.

Hill, C. 1982. Up/down, front/back, left/right. A contrastive study of Hausa and English. In *Here and there: Cross-linguistic studies on deixis and demonstration*, edited by J. Weissenborn and W. Klein, 13–42. Amsterdam: John Benjamins.

Hill, D. 1997. Finding your way in Longgu: Geographical reference in Solomon Islands' language. In *Referring to space: Studies in Austronesian and Papuan languages*, edited by G. Senft, 101–26. Oxford, UK: Oxford University Press.

Hyslop, C. 2002. Hiding behind trees on Ambae: Spatial reference in an Oceanic language of Vanuatu. In *Representing space in Oceania: Culture in language and mind*, edited by G. Bennardo, 47–76. Canberra, Australia: Pacific Linguistics, Research School of Pacific and Asian Studies, the Australian National University.

Ittelson, W. H. 1973. *Environment and cognition*. New York: Seminar Press.

Kingdom of Tonga. 1999. *Population census 1996: Administrative report and general tables*. Nuku'alofa: Statistics Department.

Lakoff, G. 1987. *Women, fire, and dangerous things: What categories reveal about the mind*. Chicago: University of Chicago Press.

Levelt, W. J. P. 1996. Perspective taking and ellipsis in spatial descriptions. In *Language and space*, edited by P. Bloom, M. A. Peterson, L. Nadel, and M. F. Garrett, 78–107. Cambridge, MA: MIT Press.

Levinson, C. S. 1992. Primer for the field investigation of spatial description and conception. *Pragmatics* 2 (1): 5–47.

———. 1996. Frames of reference and Molyneaux's question: Cross-linguistic evidence. In *Language and space*, edited by P. Bloom, M. A. Peterson, L. Nadel, and M. F. Garrett, 109–70. Cambridge, MA: MIT Press.

———. 1997. Language and cognition: Cognitive consequences of spatial description in Guugu Yimithirr. *Journal of Linguistic Anthropology* 7 (1): 98–131.

Lloyd, R. 1997. *Spatial cognition: Geographic environments*. Boston: Kluwer Academic.

McNamara, T. P., J. A. Halpin, and J. K. Hardy. 1992. The representation and integration in memory of spatial and nonspatial information. *Memory & Cognition* 20 (5): 519–32.

Miller, G. A., and P. N. Johnson-Laird. 1976. *Language and perception*. Cambridge, MA: Belknap.

Ozanne-Rivierre, F. 1997. Spatial references in New Caledonian languages. In *Referring to space: Studies in Austronesian and Papuan languages*, edited by Gunter Senft, 83–100. Oxford, UK: Oxford University Press.

Palmer, S. 2002. Absolute spatial reference and the grammaticalisation of cognitively salient phenomena. In *Representing space in Oceania: Culture in language and mind*, edited by G. Bennardo, 107–57. Canberra, Australia: Pacific Linguistics, Research School of Pacific and Asian Studies, the Australian National University.

Pederson, E. 1993. Geographic and manipulable space in two Tamil linguistic systems. In *Spatial information theory: A theoretical basis for GIS*, edited by A. U. Frank and I. Campari, 294–311. Berlin: Springer.

———. 1995. Language as context, language as means: Spatial cognition and habitual language use. *Cognitive Linguistics* 6 (1): 33–62.

Pederson, E., and A. Roelofs, eds. 1995. *Max-Planck Institute for Psycholinguistics: Annual Report 15, 1994*. Njemegen, the Netherlands: Max-Planck Institute for Psycholinguistics.

Plumert, J. M., C. Carswell, K. De Vet, and D. Ihrig. 1995. The content and organization of communication about object locations. *Journal of Memory and Language* 34:477–98.

Romney, A. K. 1989. Quantitative models, science and cumulative knowledge. *Journal of Quantitative Research* 1:153–223.

Senft, G., ed. 1997. *Referring to space: Studies in Austronesian and Papuan languages*. Oxford, UK: Oxford University Press.

Taylor, H. A., and B. Tversky. 1992. Description and depictions of environments. *Memory & Cognition* 20 (5): 483–96.

———. 1996. Perspective in spatial descriptions. *Journal of Memory and Language*. 35:371–91.

Tolman, E. C. 1948. Cognitive maps in rats and men. *Psychology Review* 55:189–208.

Tuan, Y.-F. 1974. *Topophilia: A study of environmental perception, attitudes, and values*. Englewood Cliffs, NJ: Prentice Hall.

Tversky, B. 1981. Distortions in memory for maps. *Cognitive Psychology* 13:407–33.

———. 1993. Cognitive maps, cognitive collages, and spatial mental models. In *Spatial information theory: A theoretical basis for GIS*, edited by A. U. Frank and I. Campari, 14–24. Berlin: Springer.

———. 1996. Spatial perspective in descriptions. In *Language and space*, edited by P. Bloom, M. A. Peterson, L. Nadel, and M. F. Garrett, 463–529. Cambridge, MA: MIT Press.

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