Exploration in the acquisition of geocentric location by Tzotzil children[1]

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Abstract

Some Australian, Austronesian, Papuan, and Mayan languages employ geocentric locative descriptions. This form of describing both macro- and micro-location involves fixed points of reference, based on the landscape or cardinal directional terms. An example glossed into English would be 'The axe is west of the tree'. The use of geocentric location in a Mayan language has been documented by Brown and Levinson (1993), and cognitive implications of languages with these systems have been suggested by Levinson (1992).

The present paper describes a system of geocentric location in Tzotzil (Mayan). It explores the development of such a system, previously unreported in studies of the acquisition of spatial language. The use of the system among adults and children is presented on the basis of cross-sectional tasks, linguistic and ethnographic observations, and preliminary longitudinal work. Our findings suggest that children acquire the system around age 4;6;[2] it appears to develop in stages of successively more integrated frames of reference: (a) egocentric, (b) locally anchored, and (c) abstractly coordinated.

The acquisition of the geocentric system by Tzotzil-speaking children in the hamlet of Nabenchauk, Zinacantán, México seems to follow Piagetian predictions that projective location is acquired after topological notions of space. However, our Tzotzil data show that Tzotzil children begin to master the geocentric system between ages 4 and 5, an age at which European children cannot systematically label their own right and left (Piaget and Inhelder 1956). This finding suggests that the presence of a geocentric system in grammar may orient language learners to more rapid acquisition of a spatial skill than might be predicted by Piagetian research.

Introduction

This paper examines how Tzotzil children of Nabenchauk, Zinacantán, in the south of México, use what has been referred to as a "geocentric"

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locative system based on the coordinate *upland* (east) *downland* (west). The first section describes how geocentric location works in Tzotzil. The second section shows how geocentric locatives are produced and comprehended, on the basis of ethnographic and linguistic observation and on cross-sectional work with Tzotzil children and adults. The final section outlines a possible developmental model for the acquisition of the system.

1. Geocentric location

Several language families of the world, including Australian, Austronesian, Papuan, and Mayan present systems of geocentric location (Brown and Levinson 1993; Evans n.d.; Haviland 1986, 1991, 1992, 1993; Heeschen 1982; Laughren 1978; Levinson 1991, 1992; Steinhauer 1991).[3] Geocentric location involves the use of fixed points of reference based on the landscape, social landmarks, or cardinal terms with a function similar to that of prepositions in European languages. An example of geocentric location glossed into English would be

(1) The stone is north of the table.

The same situation could be described in normal English as, for example,

(2) The stone is behind the table.

In (1) the location of the stone is described through a fixed or absolute coordinate, "north." In (2) the stone is located via the deictic coordinate projected from the perspective of the speaker: "behind" the table from his/her deictic point of view.

The use of geocentric location in Mayan languages has been documented by Brown and Levinson (1993) for Tzeltal. They claim that instead of grounding locative expressions in deixis, Tzeltal speakers use angles of orientation that are fixed with respect to the lay of the land, glossed as "uphill" vs. "downhill." Hanks also reports the use of cardinal terms in Yucatec Mayan to describe location (1990: 298).

Tzotzil, a close neighbor of Tzeltal, has geocentric location based on a coordinate denoting two contrastive regions or directions: upland (east)/downland (west). The directional contrast corresponds to the local inclination of the terrain and reflects, as well, the path of the sun (see Figures 1 and 2).[4] From the perspective of the hamlet of Nabenchauk in the municipality of Zinacantán,

The ceremonial center and its surrounding hamlets are often simply called Ak'ol ('higher'), whereas hamlets to the west down the mountains are often called

Figure 1. *Chiapas in the map of Mexico*

collectively Olon ('lower') or Chobtik ('cornfields') — a reference to the reputation of these warmer areas as good corn-growing lands (Haviland 1977: 21).

Thus, in Nabenchauk speech, the upland (east)/downland (west) coordinate may be expressed through different formal devices: (i) the relational nouns *ak'ol*[5] and *olon* that mean 'up' and 'down'; (ii) the directionals *muyel* 'ascending' and *yalel* 'descending'; (iii) the terms *lok'eb k'ak'al* 'place of sunrise' and *maleb k'ak'al* 'place of sunset'; or (iv) reference to two towns in the area where Zinacantecs carry out important agricultural and commercial activities: *Jobel* (San Cristóbal de las Casas), to the east, and *Tuxta* (Tuxtla Gutiérrez), to the west (see Table 1).

The upland/downland coordinate may be used in *macro-location*, that is, to describe large-scale geography, as with other systems of cardinal terms.

(3) (Xunka`-geoghout)
mas *ak'ol* tal jutuk ta Ni`bak ch-kom Burrero
more up/E come DIR little PREP Nibak ICP-lies Burrero[6]
'Burrero is *upland/E* from Nibak toward here.'

(4) (José Lol)
ta *olon* Setelton ch-kom Yokvitz
PREP down/W Setelton ICP-lies Yokvitz
'Yokvitz lies *downland/W* of Setelton.'

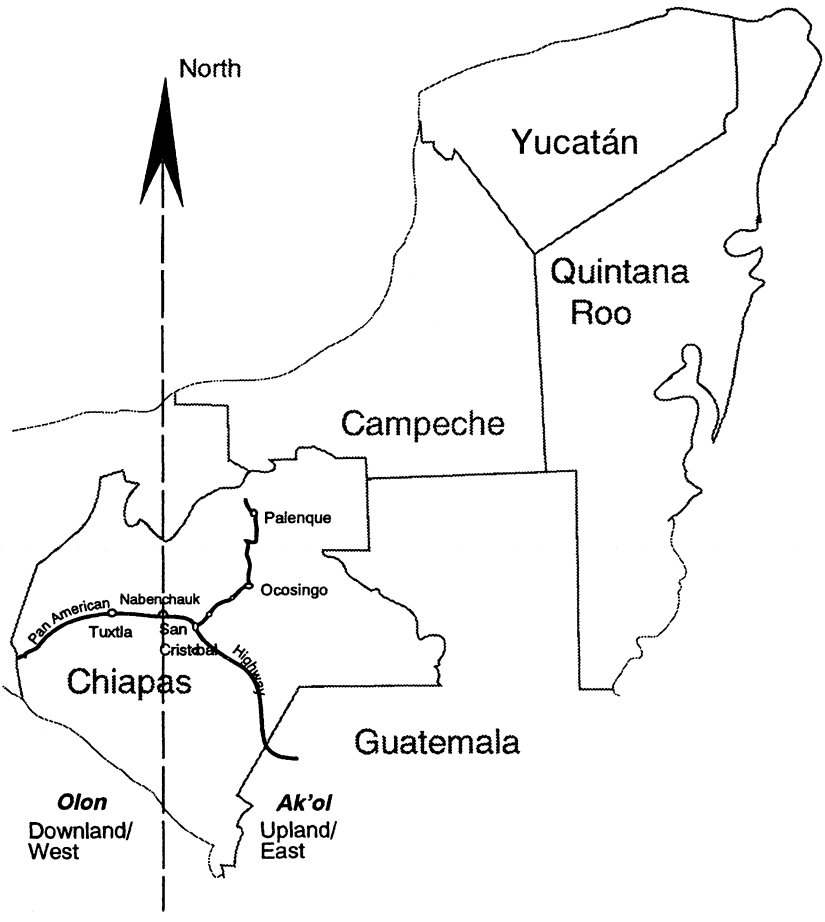

Figure 2. Ak'ol *'upland (east)' and* olon *'downland (west)' in the map of Chiapas*

Table 1. *The upland (east)/downland (west) coordinate*

Terms	Towns	Regions
olon 'down' *yalel* 'descending' *maleb k'ak'al* 'sunset'	Tuxta	downland/west
ak'ol 'up' *muyel* 'ascending' *lok'eb k'ak'al* 'sunrise'	Jobel	upland/east

Moreover, in Nabenchauk Tzotzil the locally oriented grid provided by the geographic coordinate is used in *micro-location* as well, to describe locative relations on a horizontal plane. Thus we can say, "the stone is at the east side of the table." In this case, the geocentric system performs a function similar to that of the English locative expressions "at the front," "at the back," "left," or "right." To express a similar arrangement of objects Tzotzil uses either (i) relational nouns and locative body-part terms or (ii) the geographic coordinate. The use of locative body part terms is *object-centered.* By this I mean that location is centered on the specific parts of objects; Tzotzil projects neither a front/back nor a left/right coordinate FROM THE POINT OF VIEW OF THE OBSERVER. When speakers need to disambiguate otherwise symmetric sides of an object they use geocentric location instead.[7]

The following examples show the use of object-centered location and geocentric location for the same configuration of figure and ground.[8]

The first two examples involve a ball placed next to a pig, a "fronted[9] ground":[10]

(5) p'ejel *ta* *s-ni`* chitom li pelota-e
sit roundly PREP 3E-nose pig ART ball-CL
'The ball is *in front (at the nose)* of the pig.'

or

(6) p'ejel *ta* *ak'ol* chitom li pelota-e
sitting roundly PREP up/E pig ART ball-CL
'The ball is *at the east* (of the pig).'

The following example shows object-centered vs. geocentric location when a pig is placed near a corral, a nonfronted ground:

(7) ali chitom-e kotol *ta* *pat* koral
hmm pig-CL stand on fours PREP side corral
'The pig is standing *at the side* of the corral.'

(8) ali chitom-e kotol *ta* *ak'ol* koral
hmm pig-CL stand on fours PREP up/E corral
'The pig is standing *upland/E* side of the corral.'

Thus, the same figure/ground configuration can be described either (1) by locating the figure by reference to a "body part" of the ground; or (2) by locating the figure by reference to the upland/downland coordinate with respect to the ground.

Geocentric location may involve combining a general preposition *ta* with a relational noun:

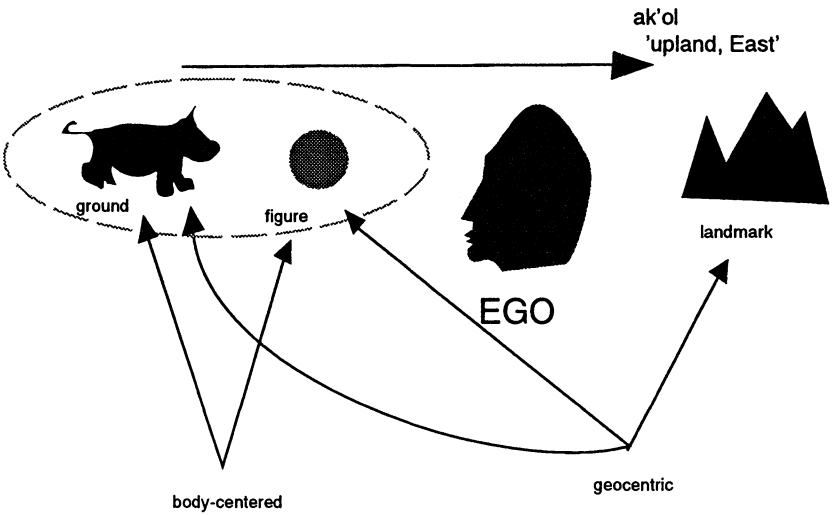

Figure 3. *Body-centered and geocentric location*

(9) ta ak'ol
PREP up/E
'at upland/east'

(10) ta olon
PREP down/W
'at downland/west'

Or it may be expressed by a general preposition with a directional particle:

(11) ta muyel
PREP ascend/E (DIR)
'at ascending/east'

(12) ta yalel
PREP descend/W (DIR)
'at descending/west'

Another construction used for geocentric location is the verb *k'el* 'to look' plus a relational noun, a directional term, or a local landmark. Thus, if we have a ball at the east side of the corral the description might be

(13) p'ejel ta pat koral pero *s-k'el-oj*
sitting roundly PREP side corral but 3E-looks-PF
muyel li pelota-e
ascend/E (DIR) ART ball-CL
'The ball is sitting at the side of the corral, but *facing east*.'

In such constructions, the absolute coordinate upland/downland may be replaced by local landmarks, including mountains, roads, and towns:

(14) tey ta pat koral li pelota-e *s-k'el-oj* *Nachij*
LOC PREP side corral ART ball-CL 3E-look-PF Nachij
'The ball is at the side of the corral, *facing Nachij.*'

Even domestic landmarks can play the role of geographic anchor, as in

(15) tey ta pat koral li pelota-e *s-k'el-oj* *ta* *vo`*
LOC PREP side corral ART ball-CL 3E-look-PF PREP water
'The ball is outside the corral, *facing the well.*'[11]

The geocentric locative system is oriented to such local landmarks as mountains, towns, roads, waterholes, caves, domestic landmarks (waterholes, the orchard, poles, trees), and the regions denoted by the coordinates upland and downland.[12] When people are away from the village, they rely on the sun as the criterion for orientation.

In sum, the use of the system involves knowledge of a general directional coordinate as well as knowledge of the local geography.[13]

2. Exploring the use of geocentric location among Tzotzil children

On the basis of the way adults use geocentric location in Tzotzil, several tasks were designed to explore the production and comprehension of spatial descriptions by children from two to 14 years of age in experimental, seminatural, and natural contexts.[14]

The study took place over several periods of fieldwork beginning in 1990. The number, sex, and age of the subjects varied in each of the tasks. Pilot placement tasks were done in January 1991 with 12 children of the local kindergarten aged 3 to 7. In the summer of 1991 we carried out comprehension tasks with nine caregiver–child dyads where the children ranged in age from 2 to 5, and interactive placement tasks with 20 children aged 5 to 14. All tasks were videotaped and transcribed by the researcher. In 1992 we began longitudinal observations of two 24-month-old boys and their caregivers. Our longitudinal data have not been fully analyzed but will be mentioned here to clarify and contextualize the findings.

From the perspective of the present study, the tasks are conceived as *complementary sources* of data to explore how children use geocentric location. Data were supplemented by ethnographic and linguistic observations of Nabenchauk children in periodic fieldwork since 1990.[15] The questions we had in mind were (i) given the fact that Tzotzil has both

object-centered and geocentric location, how do the two systems interact in their acquisition? and (ii) what patterns are evident in the development of the geocentric system?

2.1. *Naturalistic production of geographic terms and geocentric location*

As a preamble to presenting the experimental work, we will comment about the natural use of geographic terms and outline some preliminary findings based on a collection of spontaneous utterances by a boy called Xun starting at the age of 24 months.

Conversation about everyday activities and movements both in and out of the village abound in Nabenchauk. When people meet on the path, after greeting each other they normally ask *bu chabat* 'where are you going?' A normal reply is simply *chibat ta ak'ol* 'I am going upland/E' or *chibat ta olon* 'I am going downland/W'. The reply, which can be easily inferred by the greeter, who is also walking in some direction, is part of a normal greeting routine that follows rules of privacy and politeness (Haviland and Haviland 1983). Children out and around the village doing errands are aware of where their house is. When they are asked *bu nakalot* 'where is your house?' they will normally say, with an accompanying pointing gesture, *tey ta ak'ol* 'it is upland/E' or *tey ta olon* 'it is downland/W'.

I observed that a normal routine between the caregiver and young Xun was asking questions about movement and place: 'where are you going?' or 'where did your father or mother go?' Starting at 24 months, Xun talked about going to the forest, to the *molino* (to grind corn), to visit his grandmother, to the center of the village, to the big road (the Panamerican Highway). The following is a fragment of a transcript where the child was interacting spontaneously with his uncle. He is 24 months old here (Caregiver: C; Xun: X):

(16) C: bu i-bat l-a-me`
where CP-go ART-2E-mother
'Where did your mother go?'
X: bat ta te`tik
go PREP woods
'She went to the woods.'
C: bu i-bat l-a-tot-e`
where CP-go ART-2E-father CL
'Where did your father go?'
X: bat-em ta olon osil
go-PF PREP down/W land
'He went to the lowlands.'

C: bu ch-a-bat?
where IC-2A-go
'Where are you going?'
X: ch-i-bat ta olon
ICP-IA-go PREP down/W
'I am going downland/W.'
C: k'usi ch-a-pas ta olon
what IC-2E-do PREP down/W
'What are you going to do downland/W?'
X: ch-i-bat ta k'in
ICP-IA-go PREP fiesta
'I am going to the fiesta.'

The following conversation between Xun and his father was recorded a month later:

(17) (XG; 9-05-93; 157)
X: mansana
'Apple.'
C: buy a-man?
where 2E-buy
'Where did you buy it?'
X: ta Jobel
PREP Jobel
'In San Cristóbal.'

(18) (XG; 9-05-93; 165)
C: k'usi ma a-pas ta Jobel
what CL 2A-do PREP Jobel
'What else were you doing in San Cristóbal?'
X: ay j-man tal poxil [=x-poxil] k-alak'
go and come 1E-buy (DIR) medicine [3E-medicine] 1A-hen
'I went to buy medicine for my hen.'

Both fragments of interaction reveal that the child has acquired a conversational routine that involves knowledge about the local space and the relevant places and activities in which people are engaged in Nabenchauk. His mother is in the woods collecting firewood, a normal everyday activity for women. His father is in the lowlands working in the cornfields. Xun himself is presumably going west to the fiesta. San Cristóbal is the place for acquiring goods, such as medicine for a sick hen.

At this stage, it is clear that Xun uses geographic terms among his repertoire of replies about places, and that he associates places with

activities.[16] However, we have no evidence of whether Xun associates the geographic terms with a REGION or a DIRECTION as is the case for adult Tzotzil, nor have we evidence of his use of geographic knowledge in micro-location.

However, we have observed that caregivers use geocentric location when giving placement instructions to children as young as 24 months. The following example comes from a semiexperimental task where the mother asks a 24-month-old child to place a bead beside a Duplo hen.

First, she asks the child to place the bead at the east side of a cubic container:

(19) (dan 7A)
ak'-o li` ta *ak'ol* li baso-e
give-IMP ART PREP up/E ART cup-CL
'Put it *upland/E* of the container.'
ja` chak le`e, chak le`e
yes like that, like that
'Yes, like that.'

The child follows the instruction and places it on the correct side.

In the following instruction another mother reprimands her 38-month-old son for not knowing where east is. She is asking the child to place a hen at the east side of a corral using in her instruction both the directional term (*muyel*) and the relational noun (*ak'ol*) to refer to the east direction:

(20) (8A Xun Perez)
ak'-o s-k'el-oj *muyel*
give IMP 3E-see-PF *ascend/E* (DIR)
'Put it looking *upland/E.*'
ak'-o ta *ak'ol*, ta *ak'ol* ch-av-ak'
give-IMP PREP *up/E* PREP *up/E* ICP-2E-give
'Put it *upland/E*, put it *upland/E*!'
ak'ol, mu x-a-na`?
up/E, NEG ASP-2A-know
'*upland/E*, don't you know?!'

After several trials, the boy succeeds.

In sum, ethnographic observations show that talk about socially relevant places is common with children as young as 24 months, the youngest of our subjects. Caregivers use geocentric location with children as young as 24 months and explicitly teach it to them. However, the production

and comprehension of geocentric location in micro-location starts after 48 months, as will be described in the following sections.

2.2. *Placement tasks*

Placement tasks were used to obtain production and comprehension data. The tasks followed a design of tasks used by researchers in the acquisition of prepositions in European languages (Clark 1980; Johnston and Slobin 1979; Johnston 1985).

Production data were obtained from 12 children (aged 3 to 7) of the local kindergarten in pilot tasks that involved dyadic interaction with the researcher. Comprehension data were obtained from nine caregiver/child dyads. The children were aged 2 to 5.

The same placement task was used for both the production and the comprehension parts of the pilot study. It involved descriptions of configurations with fronted and nonfronted figures and grounds. A Duplo doll (a little boy), a Duplo hen, and a bead were used as a figure. A Duplo car, a Duplo horse, a Duplo man, a cubic container from a set of nesting cups, a (bracelet-sized) ring, and a Duplo corral were used as grounds.

In the production part, after a session of free play with the toys the researcher asked the child what he called each of the toys and then arranged them in specific configurations. Before each placement the researcher asked,

(21) buy ch-kom li krixchano?
where ICP-stay ART man
'Where is the man?'

Most of the children agreed that the doll should be called *krixchano* 'man' ('Christian'). However, some young children decided to call the doll *j'elek'* 'thief' or *pukuj* 'demon', which was then inserted in the question.

After each placement the child was asked about the location of the figure.

In the comprehension part, the caregiver was given a set of pictures reproducing the figure and ground configurations of the production part. After a session in which the children played freely with the toys, the caregiver instructed the child to place the objects as shown in each one of the pictures. In none of the tasks did the figure touch the ground. The researcher noted the orientation of the seating arrangement. The task was videotaped and audiotaped.

The seating arrangement of researcher/caregiver and child (as seen from above) and the placements of the figure are illustrated in Figure 4.

2.3. *Production tasks involving geographic knowledge*

Task 2 involved a simulated "trip" by the doll in his car. This "trip" took place on the table next to which the researcher and the child were sitting. The car was moved from one point toward a direction, such as north, and then returned to the opposite direction, south. Every time the car was moved to a new position, the child was asked where the Duplo boy was traveling to in his car.

This task was followed by explicit questioning about local landmarks such as towns, mountains, houses, etc., to explore the child's knowledge of the local geography. From the same sitting position where he or she had performed the travel task, the child pointed to the places in question. Relevant place names had previously been obtained from informal talk with older children and adults.

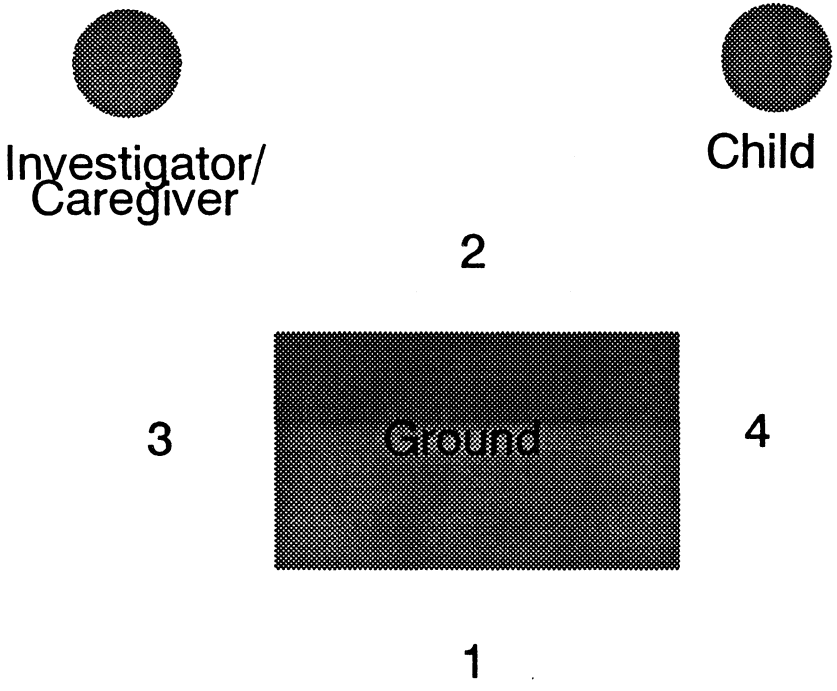

Figure 4. *Placement task*

2.4. *Interactive tasks*

In order to explore how children use geocentric location in a communicative setting, interactive tasks were used with 20 children from 5 to 14 years of age.[17]

Here one child (the Director) was given a picture of a farm scene and the other child (the Matcher) was given a set of farm toys. The Director told the Matcher how to arrange the toys in order to reproduce the scene in the picture. Both players sat side by side and could converse freely but they could not see each other.[18]

3. General results

3.1. *Production tasks*

In the placement tasks children produced the following pattern of locative descriptions:

i. *Demonstratives* were used by the youngest group of children (3–4 years). Thus when asked *where is the X?* they answered with an accompanying pointing gesture *li` toe* 'there' or *taj toe* 'there [far]'. They used locative body parts and geographic terms only when prompted by the researcher.

ii. *Locative body parts* and *geocentric location* were used by children older than age 4 to describe relations of a figure to both fronted and nonfronted grounds. Children used the Tzotzil terms for the locative notions of 'front', 'behind', and 'side' and also geocentric terms.

iii. Children from ages 4 to 7 produced geographic terms to describe the doll's journey.

iv. None of the children used the terms for 'sunset' (*maleb k'ak'al*) and 'sunrise' (*lok'eb k'ak'al*) in their replies.

3.2. *Comprehension task*

i. Caregiver locative instructions included both object-centered and geocentric expressions with children as young as 24 months, who were the youngest of the group.

ii. Children as young as 3;4 interpreted the geocentric terms as representing opposing — but not necessarily correctly oriented — directions. Children from 4;6 made correct placements with instructions involving geocentric location.

iii. Instructions that included the terms for 'sunset' (*maleb k'ak'al*)

and 'sunrise' (*lok'eb k'ak'al*) were not comprehended. Children only understood such instructions when they were rephrased with the terms *ak'ol/olon* ('up/E'/'down/W') or *muyel/yalel* ('ascend/E'/'descend/W') to denote the geocentric coordinate.

iv. When producing geocentric descriptions, caregivers made extensive use of domestic landmarks such as walls, doors, furniture, houses, people, and local landmarks such as towns and mountains in the local area.

3.3. *Interactive tasks*

Starting at age 5, children used both object-centered and geocentric location in the interactive tasks. Instructions with geocentric location involved the use of domestic and local landmarks and the terms for upland/E and downland/W. None of the children used the 'sunset' and 'sunrise' terms.

4. Discussion

4.1. *Placement tasks: production part*

In the placement task, children described locative relations using body parts or geographic locations. In examples (22) and (23) a doll has been placed before a fronted ground: a car. Both the doll and the car are facing the child and pointed toward the east, the upland region where the town Jobel is located. The researcher asked,

(22) Researcher
buy ch-kom li krixchano?
where ICP-lie ART man
'Where is the man?'

Here are some sample replies:

(23) Child
a. Answer 1: body part (Paxku` 4.4)
tey ta s-ni` karo
LOC PREP 3E-nose car
'It is at the front (nose) of the car.'
b. Answer 2: geographic location (Palas 5.2)
s-k'el-oj Jobel
3E-look-PF Jobel
'It is looking toward San Cristóbal.'

c. Answer 3: geographic location (Natal 5.6)
tey ta ak'ol
LOC PREP up/E
'It is at the upland/E.'

In answer (i) the figure/ground relation is thus indicated through the locative body part *ni`* 'nose' and, in examples (ii) and (iii), through the use of geocentric location, where the relation between the figure and the ground is described in terms of the local geography (the town San Cristóbal) or the term *ak'ol* 'upland/east'.

In the next examples, the doll was placed beside a nonfronted ground: a ring.

The replies show that children also locate figures in relation to nonfronted grounds both with locative body parts and with geographic terms.

(24) a. Answer 1: body part (Terex 4;?)
tey ta x-xokon
LOC PREP 3E-flank
'It is at the side' (undifferentiated).

b. Answer 2: body part (Xun 7;11)
tey ta s-pat
LOC PREP 3E-back
'It is outside (at the edge)' (undifferentiated).

(Here the term *pat* is used to denote 'outside'.)

(24) c. Answer 3: geographic location (Maruch 4;?)
tey ta ak'ol, s-k'el-oj muyel
LOC PREP Up/E 3E-look-PF ascend/E (DIR)
'It is upland/E, looking upwards/E.'

Table 2 summarizes the overall distribution of the linguistic devices used in the placement task when the ground was a fronted object (car) or a nonfronted object (ring).

The use of demonstratives and geocentric location follows a distribution by age. Children younger than age 4 used demonstratives, whereas children older than age 4 used locative body parts and geocentric location with both fronted and nonfronted grounds, beginning roughly at the same time.

Thus, children showed no major preferences for object-centered vs. geocentric location when grounds had no inherent front. They were able to handle both locative systems with both kinds of grounds, roughly after age 4.[19]

Table 2. *Locatives produced with a fronted ground (car) and a nonfronted ground (ring)*

Subject/age	Fronted ground			Nonfronted ground		
	dem	body part	geog	dem	body part	geog
Lol 3;8	×			×		
Ran 3;8	×			×		
Paxku` 4;4	×	×			×	
Terex 4;?	×				×	
Maruch 4;?	×		×		×	×
Palas 5;2			×			×
Xunka` 5;4		×	×		×	×
Natal 5;6		×			×	×
JLuis 6;0	×			×		
Marian 6;4		×	×	×		
Loxa 7;6			×		×	×
Xun 7;11			×		×	×

Key: dem: demonstrative
geog: geographical

4.2. *Production task involving geographic knowledge*

On the trip task children formulated descriptions using coordinates *`olon/ak'ol* (*yalel/muyel*), towns of the area like Jobel, Nachij, Apas, and Tuxta, or the region *olon osil* (lowlands) as landmarks. To characterize direction we had answers such as

(25) Researcher:
buy ch-bat li karoe?
where ICP-go ART car
'Where is the car going?'
Reply:
Answer 1: *chbat ta olon*
'It is going downland/W.'
Answer 2: *chbat ta Nachij*
'It is going to Nachij.'

Table 3 shows the use of geocentric location to describe the static figure/ground placements in task 1 and the motion of a traveling car in task 2. Children use their geographic knowledge to describe both micro-location and oriented motion. Table 3 also shows the range of geographic terms they used. Here we see that the terms are, in general, used as polar opposites. Although the children may not know the proper denotation of the terms, they conceive them as opposites. The set of terms used includes the names of towns and regions, Jobel and Nabenchauk (in the

Table 3. *Geocentric terms used in describing static location and motion*

Subject/age	Placement	Trip
Lol 3.8	demonstrative	demonstrative
Ran 3.8	demonstrative	demonstrative
Paxhu` 4.4	demonstrative	demonstrative
Terex 4.?		Jobel/Tuxta
Maruch 5.?	muyel/yalel	ak'ol/olon Jobel/Tuxta
Palas 5.2	muyel/yalel	Jobel/olon osil
Xunka` 5.4	`olon	`olon
Natal 5.6	muyel/yalel	Jobel/Tuxta muyel/yalel
Marian 6.4	Jobel/Tuxta Jobel/México Jobel/olon osil	muyel/yalel
Loxa 7.6	muyel/yalel yalel/olon osil	
Xun 7.11	Jobel/Tuxta Jobel/olon osil Tuxta/Nabenchauk	Jobel/Tuxta Jobel/olon osil Tuxta/Nabenchauk

Key: *muyel* 'ascend/E'; *yalel* 'descend/W'; *ak'ol* 'up/E'; *olon* 'down/W'; *olon osil* 'lowlands'; Jobel 'San Cristobal' (town); Tuxta 'Tuxtla' (town); México (town); Nabenchauk (town).

highlands at the east) in contrast to Tuxta and Olon Osil (in the lowlands at the west); the directional terms *muyel* 'ascend/E' *yalel* 'descend/W'; the relational nouns *ak'ol* 'upland/E' and *olon* 'downland/W'; but not the terms for 'sunrise' and 'sunset', which appear in adult Tzotzil.

The task was followed by direct questioning about places in the local geography. Here again, the coordinate system emerged, and towns and other local landmarks were located on the basis of the downland/upland contrast.

4.3. *Comprehension task*

In the comprehension task, caregivers instructed children from age 2 to 5 to place Duplo toys in figure/ground configurations like those in the placement tasks. They offered instructions with geographic references to all children regardless of age. In order to assure comprehension, the adults rephrased their instructions using the child as a landmark, using local landmarks, and using the geographic coordinates. In the following

example, a father asks his 4-year-old daughter to place a hen on top of a box and to orient it toward the west:

(26) Ach' M: Marian (father); T: Terex (daughter)

a. M: ak'-o talel li kaxlan-a le`av-il
give-IMP come (DIR) ART hen-CL there 2E-see
'Put toward here the hen, see.'

T: li`-e?
here-CL
'Here?'

b. M: ak'-o tal li` ta s-jol!,
give-IMP come (DIR) here PREP 3E-head
'Put it toward here, on the top (head).'
ak'-o ta s-ba, luchan-o
give-IMP PREP 3E-face, perch-IMP
'Put it on top, perch it (on the top).'

c. pero ja` *ch-a-s-k'el vo`ot-e*
but yes ICP-2A-3E-look you-CL
'But, looking *at you.*'
ak'-o *s-k'el-ot vo`ot un*!
give-IMP 3E-look-2A you CL
'Put it looking *at you.*'
[...]
joyip'in-o!
turn around-IMP
'Turn it around.'

d. ak'-o ak'-bo *s-k'el xi-to-e*
give-IMP give-BEN-IMP 3E-look thus there-CL
'Put it looking *toward here.*'
(points with gaze to wall)

e. ak'-o *s-k'el tal* li' to av-il!
give-IMP 3E-look DIR here CL 2E-see
'Put it looking *toward you,* there.'
(points with finger toward her)

f. ak'-o *s-k'el yalel*
give-IMP 3E-look descend/W (DIR)
'Put it *looking downland/W.*'
ja` chak le`e
yes, like that
'Yes, like that.'

In order to achieve comprehension, the father rephrases his instructions using an independent second person pronoun (*vo`ot*) (c), a landmark (d),

the deictic directional *tal* 'come' (e), and finally the directional *yalel* 'downland/W' (f). The rephrasing from (d) to (f) reflects a progression from deictic to geographic anchoring.

The rephrasing of instructions works as a kind of "spatial scaffold" where the geocentric system is presented in a gradation of frames. The frames seem to be successively integrated in the following order: (i) egocentric, (ii) local (landmarks), (iii) absolute (upland/E//downland/W). Children's comprehension of the three frames suggests an implicational scale (i) to (iii). All of the nine children taking part in the task made successful placements in the egocentric frame (i.e. 'it looks toward you') and the local-landmark frame (i.e. 'it looks toward the wall'). However, the geocentric coordinate was successfully matched only from 4;6 onward. None of the nine children was able to follow instructions with the terms referring to 'sunset' and 'sunrise'.

4.4. *Interactive tasks*

In the interactive tasks even the younger children — aged 5 — produced and comprehended the geocentric coordinate correctly anchored with local landmarks. The following fragment of an interactive task shows the production and comprehension of the geographic coordinate by a 5-year-old girl.

First, when Lucy is instructed by her aunt (María, 24) and her sister (Xunka`, 12) to place a pig inside a corral, she asks about the appropriate orientation of the pig using the directionals *muyel* 'ascend/E' and *yalel* 'descend/W':

(27) Directors: Maria (M), Xunka` (X); Matcher: Lucy (L)

X: le`e ja` li mol chitom le` a`a
that ! ART large pig that indeed
'That one, that's the big pig there.'
tik'-o ta y-ut koral un
insert-IMP PREP 3E-inside corral PT
'Put it in the inside of the corral, then.'
kotan-o
stand-up-IMP
'Stand it up (on all fours).'

L: k'u x-`elan mi ta *muyel* mi ta
what NT-seem Q PREP ascend/E (DIR) Q PREP
yalel?
descend/W (DIR)
'How, is it *going up/E* or *going down/W*?'

M: *ta* *yalel*
PREP descend/W (DIR)
Going down/W.
(laughter)

In the next instruction she is asked to place a horse at the east side of the corral, facing west. She follows both instructions and places it correctly:

(28) Directors: Maria (M), Xunka` (X); Matcher: Lucy (L)
M: x-av-ak' ta pat koral li ali ka`e
NT-2E-give PREP side corral ART uh horse-CL
'Put the horse at the side of the corral.'
L: ja` li xi ta ak'ol-e
! ART thus PREP up/E-CL
'It's this way, up/E.'
(puts on east side facing east)
M: ta ak'ol
PREP up/E
'Upland/E.'
L: tey yo`e
LOC there
'There?'
(the horse should be facing west)
X: i`i ta yalel ta s-k'el
no PREP descend/W (DIR) ICP-3E-look
'No, it's looking downward/west.'
(Lucy reorients the horse facing toward the west)
chak le`e
like that
'That way.'

In the interactive tasks, as in the placement tasks, children aged 5 to 9 used relational nouns, directional terms, or names of towns but not the terms for 'sunset' and 'sunrise'. They start producing these only after age 9, which suggests that around this age the child shifts the local center of the orientational grid to the absolute coordinate provided by the sun.

5. An outline of the development of geocentric location

The developmental sequence of the *olon/ak'ol* 'downland (W)/ upland (E)' coordinate is roughly the following: the terms are initially

randomly used, then the children become aware of the fact that they are opposites but do not always use them in a correct reference to the regions they denote. Finally, the terms are associated with the correct directions. This process develops from age 3 to 5. At a later stage, around age 9, the contrast is associated with the sun and becomes an independent system of the specific local terrain. On the basis of the complementary sources of cross-sectional data we can give a preliminary outline of the development of geocentric location:

i. In the first stage, there is a *locative concept* opposing HERE/NOT HERE. At this initial stage — roughly between ages 3 and 3;6 — the child is aware of domestic landmarks, some salient local landmarks such as the nearby towns of Apas or Nachij, some relevant mountains and caves (Jap'osil, Yoch'ob), and the Panamerican Highway. The terms *olon*, *Tuxta*, or *Jobel* just mean 'NOT HERE' and are not contrasted. The child will point radially in any direction from his center using any of the three terms (see Figure 5).

ii. In the second stage, there is a contrast between 'HERE' and 'DOWNLAND' represented by the association of *olon* with the region

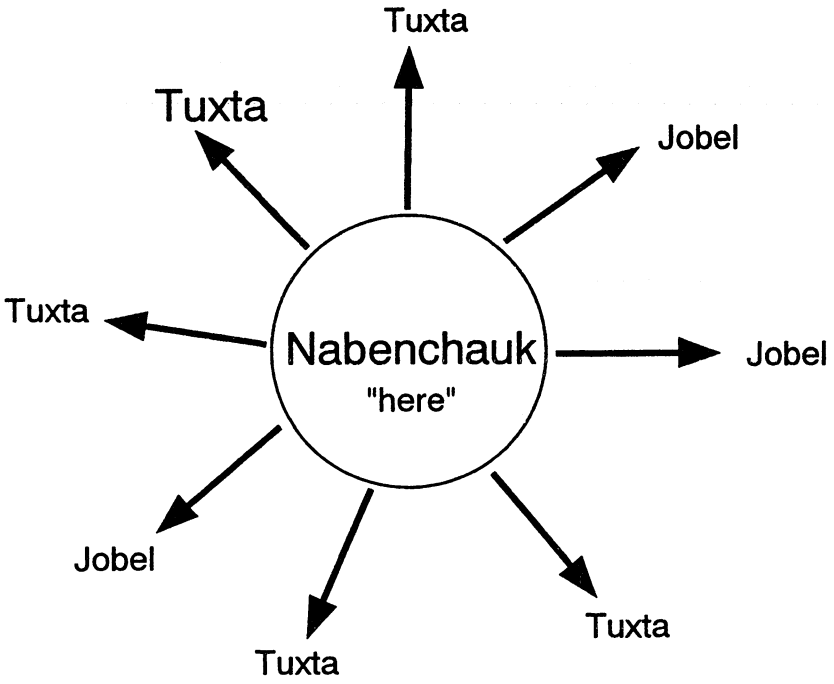

Figure 5. *Stage 1: "here" vs. "not here"*

called *Olon osil* (lowlands), in contrast to Nabenchauk, the village of the study. At this stage, the social saliency of the lowlands emerges as a first contrast between the HERE (Nabenchauk) vs. the NOT HERE (DOWNLAND) (see Figure 6). The age range at this stage is roughly from 3;6 to 4.

iii. In a third stage — roughly between age 4 and 4;6 — *Jobel* emerges as a third location in contrast to *olon* 'DOWNLAND' and Nabenchauk 'HERE'. *Jobel* is located to the east of Nabenchauk with the term *ak'ol* (UPLAND) (see Figure 7).

iv. Around age 5, the UPLAND/DOWNLAND opposition represents a socially conceptualized space with more emergent locations on the local map, such as the towns P'ij, Chikinibalvo`, etc. (see Figure 8).

v. At a final stage, around age 9, the UPLAND/DOWNLAND contrast is associated with the path of the sun and becomes a terrain-independent system of geocentric location.

The stages are successively integrated into the following frames of reference:

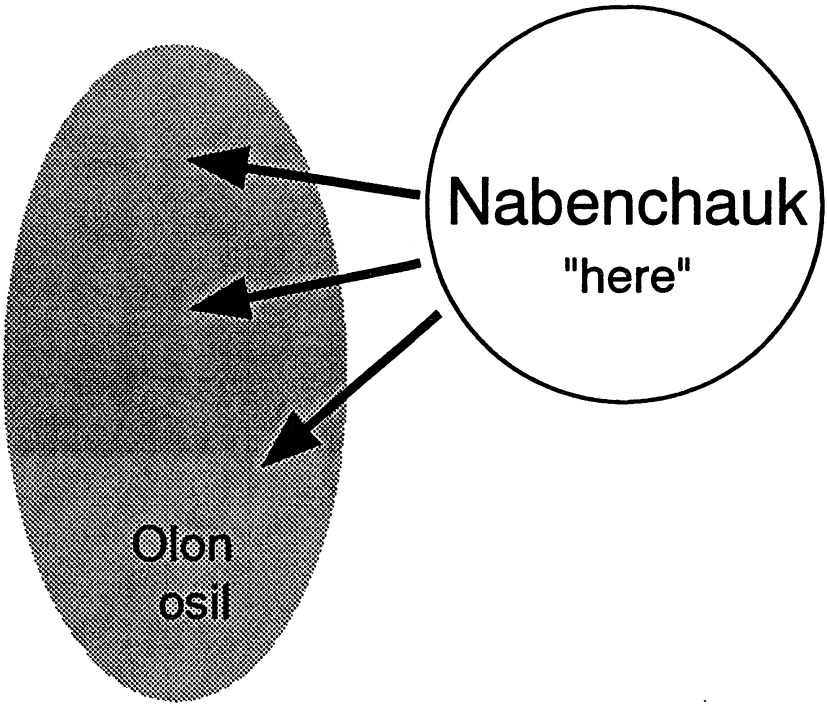

Figure 6. *Stage 2: "here" vs.* olon *'down/west'*

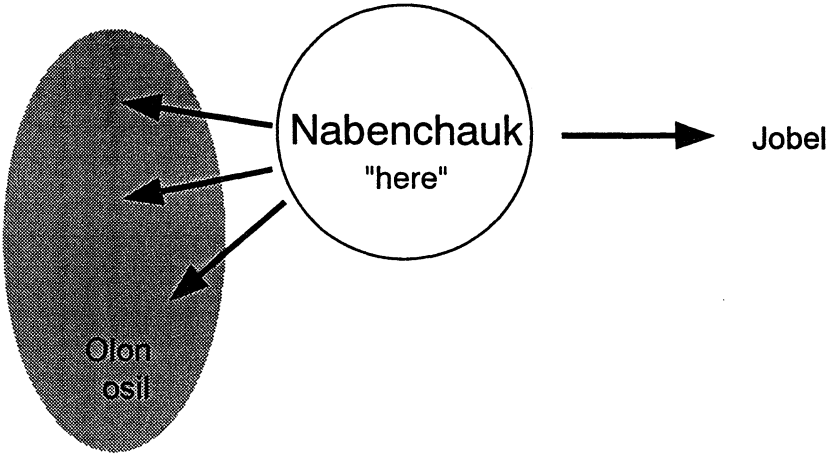

Figure 7. *Stage 3: "here" vs.* olon *'down/west' vs. Jobel*

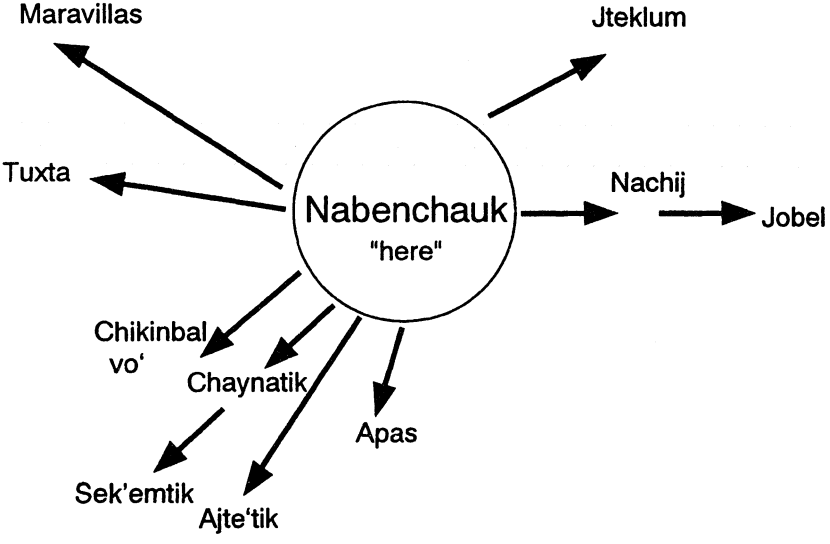

Figure 8. *Stage 4: emergence of the local geography*

i. Egocentric: The child is aware of his/her center in relation to some relevant landmarks in the domestic and local space.

ii. Locally anchored: The child is aware of the local inclination of the terrain, refers to places and regions located in contrastive directions, and imposes the orientational grid in micro-location.

iii. Abstractly coordinated: eventually the upland/downland coordinate denoting east and west is used as an absolute system of location.

6. Conclusions

As shown in de León (1992c), in Guugu Yimithirr — an Australian Aboriginal language — the development of a geocentric system also proceeds, as in Nabenchauk Tzotzil, from a locally anchored to an absolute use. In both the Tzotzil and Guugu Yimithirr cases the development of the system is initially dependent upon the social salience of locations and only later associated with absolute directions.

These results show that the progression of the geocentric system seems to proceed in a way parallel to the spatial cognitive progression outlined by Piaget and subsequent Piagetian researchers: "progressive differentiation of self-orientation from outside-orientation, and the development of a notion of object bearing" (Siegel and White 1975: 41).

Our results in Tzotzil and Guugu Yimithirr suggest that children learning these languages acquire geocentric location after age 4, presumably after they have acquired some basic topological spatial notions, such as containment and support. This seems to follow the predictions advanced by Piaget and Inhelder (1956) on cognitive spatial development, and of Johnston (1985), Johnston and Slobin (1979), and Slobin (1985) on linguistic spatial development. However, within the context of the Piagetian model of spatial development, the acquisition of geocentric location appears earlier with Tzotzil children relative to the age of acquisition of left/right concepts in European children.

Levinson and Brown (1992: 596) suggest that in Tzeltal the "uphill"/"downhill" system of orientation substitutes for the use of left and right, which is absent in this language. Tzotzil shows a similar pattern of lack of the front/back and left/right coordinates and uses instead geocentric location, locative body-part terms, and relational nouns. Our Tzotzil data show that, whereas Tzotzil children begin to master the geocentric system between ages 4 and 5, European children cannot systematically label their own right and left even at a much later age (Piaget and Inhelder 1956).

In a recent paper based on experimental research, Levinson claims that the system of absolute location in Guugu Yimithirr has a cognitive effect on attention, memory, and inference in its speakers (Levinson 1992). In the present case, Tzotzil children seem to acquire an orientational skill at an earlier age than is predicted by Piagetian studies of the development of spatial cognition. The data reported here thus suggest that a geocentric

system in grammar may have an influence on the acquisition of a spatial skill. More comparative research between languages with and without geocentric location remains to be done to assess this preliminary finding.

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Notes

1. The present paper is part of an earlier draft (de León 1992a). Earlier versions were presented at the German Linguistic Society, Bremen, February, 1992; and at the Workshop on Cross-linguistic Studies of Space, organized by Melissa Bowerman and Soonja Choi at the Stanford Child Language Forum, April, 1992. An earlier short version was presented at the American Anthropological Association invited session "My Space or Yours: Beyond the Individual in Cognitive Science," organized by Eve Danziger, November, 1992. I acknowledge comments on earlier drafts by Penny Brown, Eve Danziger, John Haviland, Stephen Levinson, John Lucy, Dan Slobin, and Jürg Wassman. I absolve them of any responsibility for the arguments developed here. I also thank John Haviland for help with the English text. Research for this study was supported by the Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics, The Netherlands. Correspondence address: Department of Linguistics, Reed College, Portland, OR 97202, USA.
2. We will use this convention to indicate children's ages. The first number represents years and the second, months.
3. See Levinson (1991) for a thorough account of systems of spatial reference.
4. Among Chamulas (Tzotzil-speaking neighbors) "the eastern part of the earth is believed to be tilted upward (*ta ak'ol*) and the western part downward (*ta'olon*) (Gossen 1974: 35).
5. A Spanish-based practical orthography is used in Tzotzil examples.
6. I follow Haviland's grammatical analysis. In the glosses E stands for ergative and A for absolutive; thus 2E means "second person ergative." In my glosses, I have not shown 3A (3rd person absolutive) affixes, which are realized as zero. Other abbreviations in glosses include 1PlE first person plural exclusive; 1PlI first person plural inclusive; ART article; ASP neutral aspect; AUX auxiliary verb; BEN benefactive ditransitivizing suffix; CJ conjunction; CL clitic; CP completive aspect; DEM demonstrative; DIM diminutive; DIR directional; EL deverbal suffix; ICP incompletive aspect; IMP imperative; NAME personal or place name; NC numeral classifier; NEG negative particle; PASS passive; PL 2nd and 3rd person plural; PREP preposition; PT particle; Q question sentential proclitic; QUOT evidential "2nd-position" clitic; REL relational particle; STAT stative (perfect) aspect; SUBJ subjunctive.
7. Brown and Levinson (1993) describe the lack of left/right terms for locative descriptions in Tzeltal; de León (1992b, 1993) shows that Tzotzil does not have general terms denoting the locative notions of 'front' and 'behind'.
8. Following Talmy (1983) "the *figure* is a *moving* or conceptually move*able* object whose site, path, or orientation is conceived as a variable the particular value of which is the salient issue. The *ground* is a reference object (itself having a stationary setting with a

reference frame) with respect to which the figure's site, path or orientation receives characterization" (Talmy 1983: 232).

9. In the literature on acquisition "fronted" or "featured" objects (such as a car, a desk, a TV) have an inherent front and back; "nonfronted" or "nonfeatured" objects (such as a ring, a ball, a corral) lack an inherent front and back. I will refer to these with the terms "fronted" and "nonfronted" respectively. It should be mentioned here, however, that the distinction between "fronted" and "nonfronted" objects is not given naturally but depends also on the particular ways a culture characterizes objects. In African languages, for instance, trees have an intrinsic front (Heine and Noske 1988: 11). Tzotzil does not have a general word for 'front' and has two words for 'behind' derived from the body parts 'back' and 'buttock' (de León 1992b, 1993).
10. Examples (5), (6), (7), and (8) were given by my Tzotzil assistant Marian Ach'eltik in the description of spatial configurations.
11. In de León (1991: 70) I describe how children negotiate domestic landmarks in an interactive task. Note the different syntax here, in which *-k'el* 'watch' has no direct object but instead a prepositional phrase as complement. Perhaps such a construction is characteristically used to express orientation.
12. Haviland comments that within Nabenchauk local geography "in fact, natural landmarks (trees, rocks, notable formations) mark the map almost as frequently as do house groups or waterholes ... A hamlet like Nabenchauk ... falls into several natural areas (the 'first curve' in the road, the ridge 'overlooking low country' (...) each of which contains several house groups, some notable landmarks" (1977: 21).
13. Haviland (1991) describes how gestures are geographically oriented in Tzotzil conversation.
14. Data for this work originally come from cross-sectional tasks designed to explore spatial description in adult Tzotzil (de León 1991). Results from these tasks showed that Tzotzil speakers use a system of landmarks and the upland/downland coordinate starting by age 4 (de León 1992a). These results pushed us to design specific tasks in order to explore how younger children use the system.
15. I thank my assistant Romin Vaskis, now 11 years old, for his enthusiastic collaboration since 1990, both in his village and in the neighboring village of Apas. I also thank Xun Perez Vaskis for patiently following his 2-year-old nephew with a tape-recorder, month by month.
16. He also has acquired the complex path verb *ay* 'go and return' and the deictic directional *tal* 'come' (cf. example 18).
17. We tried this task with younger children but it did not work. Both parties were interested in handling the toys and ignored the picture.
18. For details of method see de León (1991). I thank the staff of the local elementary school for support.
19. Our longitudinal study in progress suggests that the locative body-part terms develop earlier than the geocentric system, but we don't know yet how their acquisition proceeds.

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