Spatial Schemas and Abstract Thought

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Chapter 5

Cultural Specificity of Spatial Schemas, as Manifested in Spontaneous Gestures

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5.1 Introduction

This paper concerns the question of how the conceptual structuring of spatial information (i.e., spatial schemas) can vary across cultures, and how this variation leads to cultural specificity in the conceptualization of abstract thought. This question is investigated by comparing individuals from two different Mayan cultures: Yucatec in Mexico and Mopan in Belize. Spatial schemas are tapped into by observing gestures that spontaneously accompany speech that expresses spatial and abstract thoughts.

Cultural Specificity of Spatial Conceptualization

In the cognitive science literature, it has been widely assumed that conceptual structuring of space varies minimally across cultures because of the common biological endowment of all humans. For example, Langacker states, "It would appear ... promising to regard the conception of space ... as a basic field of representation grounded in genetically determined physical properties of the human organism and constituting an intrinsic part of our inborn cognitive apparatus" (1987, 148). The conceptual use of the division of space based on the planes defined by the human body—dividing 'front' from 'back' and 'left' from 'right'—is, for example, often presumed to be a biologically determined conceptual human universal (Clark, 1973; Lyons, 1977; Miller & Lohnson-Laird 1976). Consistent with this view, some theorists maintain that metaphorical thought based on space does not vary much cross-culturally because spatial conceptualization is universal (e.g., Alverson, 1994).

This paper concerns the presumption that all cultures divide space outside of the body into two distinct regions, left and right, for conceptual

purposes. The universality of this division has been questioned in recent literature (e.g., Levinson & Brown, 1994; Levinson, 1997; Pederson et al., 1998). These reports describe cultures in which the absolute frame of reference (the frame of reference based on the surrounding geography) rather than the left-right division is used in linguistic and spatial memory tasks for categorizing lateral spatial arrays in front of the body.

In this paper, we will discuss Mopan, a Mayan community in Belize, in which neither the left-right division nor the absolute frame of reference is used to categorize lateral spatial arrays in linguistic and memory tasks. As we will discuss in more detail later, we believe that Mopan Mayans in fact do not conceptually divide the lateral axis of space in front of the body. This is in sharp contrast with Yucatec, another Mayan community in Mexico. We will argue that the use and non-use of right-left contrast on the lateral axis has consequences for the spatial 'shape' of abstract thought in Mopan and Yucatec.

Conceptual Use of the Projected Lateral Axis in the Two Mayan Cultures

The two Mayan cultures that are compared in this paper share many cultural features. The two languages are genetically closely related. The main livelihood of the two groups is slash-and burn subsistence farming. They both live in small communities and have similar material cultures.

Despite these similarities, there is a crucial difference between the two groups in the conceptual structuring of space. It concerns the projected lateral axis, that is, the axis of the space in front of the torso (thus, "projected"), that is parallel to the shoulder line. For Mopan Mayans, the projected lateral axis is not contrastive in the sense that to-the-right-of and to-the-left-of relations do not play a role in the conceptual handling of space. In contrast, the projected lateral axis is contrastive for Yucatec Mayans.

This difference has been demonstrated in results from a non-linguistic pattern-matching task (Danziger & Pederson, 1998; Danziger, 1999; Danziger et al., in preparation). In this task (first used by Levinson & Brown, 1994), a simple figure and a complex figure are presented to a consultant, and the consultant is asked whether the simple figure can be found within the complex figure. In some cases, the simple figure is in fact embedded in the complex figure ("genuine part question"), and in the other cases, only the lateral mirror image of the simple figure is embedded in the complex figure ("mirror-image part question") (see Figure 5.1).

Prior to the experimental trials, training trails are administered. In the training trials, the motivation for distinguishing a genuine part from a

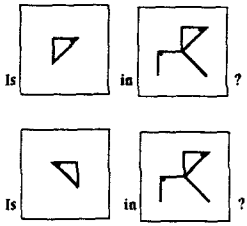

Figure 5.1
Pattern-matching task with lateral mirror-image parts. On top is a genuine part question, and on bottom is a mirror-image part question.

mirror-image part is given by overlaying a transparent version of the simple figure card on top of the complex figure card. All consultants are instructed to give an affirmative answer to a genuine part question, but not to a mirror-image part question. Only the consultants who can follow the instruction proceed to the experimental trials.

It is found that Yucatec Mayans are likely to give an affirmative answer to the genuine part questions, but not to the mirror-image part questions. In other words, they consider lateral mirror image counterparts to be distinct. Thus, for Yucatec Mayans the projected lateral axis is contrastive (i.e., when answering the questions in Figure 5.1, they use information equivalent to saying that the slope of the longest side of the triangle runs upward to right/left of the card). In contrast, many Mopan Mayans give an affirmative answer to both the genuine part questions and to the mirror-image part questions (control questions make sure that Mopan Mayans are not giving an affirmative answer to any questions). In this task, they do not treat lateral mirror images as distinct. This suggests that for Mopan Mayans, different points on the projected lateral axis are not contrastive.

Note that the difference between Mopan and Yucatec is not at the level of visual perception, but at the level of habitual conceptualization. In the training session, Mopan and Yucatec consultants could all "see" the difference between a genuine part and a mirror-image part, and they gave different answers to the two types of questions. However, in the experimental trials, many Mopan consultants quickly reverted to a different way of thinking, and started to give affirmative answers for both types of questions. In summary, there is evidence that different points on the projected

lateral axis are not contrastive in habitual Mopan conceptualization, whereas they are contrastive in habitual Yucatec conceptualization.

Cultural Specificity of Spatial Conceptualization and Metaphorical Use of Space

The cultural specificity of spatial conceptualization might have profound consequences on abstract thought by Yucatec and Mopan Mayans. This is because space is a very productive "source domain" for metaphorical projections to non-spatial "target domains." Spatial conceptualization becomes the vehicle for representing non-spatial abstract thought (Jackendoff, 1983; Johnson, 1987; Lakoff, 1987). In this view, metaphor assists abstract thought, in that the non-concrete entities of the target domain can be cognitively manipulated according to rules which apply to the more tangible components of the concrete source domain. That is, in metaphorical thought, the abstract domain is constructed to possess specific properties directly analogous to those of the source domain. If the source domain is structured differently across cultures, then it is expected that metaphorical thought in target domains would vary accordingly. This paper aims to demonstrate cultural variation of metaphorical thought due to the cultural variation in spatial conceptualization between Mopan and Yucatec already discussed.

Spatial Conceptualization as Revealed in Spontaneous Gestures

One of the ways in which we can observe how space is conceptualized is to analyze the expression of ideas in gestures that spontaneously accompany speech. Here, we are referring to spontaneous co-speech gestures with "iconic" and "deictic" (McNeill, 1992) components, whose form is determined in coordination with the speech content. Unlike "emblems" (e.g., the OK sign with a ring created by the thumb and the index finger) and sign language (cf. Emmorey, this volume), the form-function relationship of spontaneous co-speech gesture is not fully determined by convention, and thus some degree of semiotic freedom is left for idiosyncratic expression. Consequently, spontaneous co-speech gestures (henceforth simply "gesture") can reveal important aspects of the speaker's spatial thinking at the moment of speaking (McNeill, 1985, 1992; Church & Goldin-Meadow, 1986; Kita 2000).

What is revealed by gesture is not merely the speaker's strategic thinking about how to visually convey information to conversational partner via gesture. Gesture reflects a mental representation that serves not only communicative but also speaker-internal purposes (Rimé et al., 1984;

Krauss et al., 1996; de Ruiter,1998; Kita, 2000). The support for this view comes from, for example, experimental studies that indicate that people gesture without visual contact with the interlocutor (e.g., Rimé, 1983).

Speakers use the space around the body gesturally for both iconic and metaphoric signification (McNeill, 1992). They can depict spatial concepts. For example, sweeping a hand from left to right can represent a moving object. Like sign language (Emmorey, this volume), gestures can also depict the spatialization of abstract concepts. For example, sweeping a hand from left to right can represent flow of time (Calbris, 1990). Thus, using gestures as a window into the speaker's mind allows observation of both concrete and abstract use of space.

Goals of This Paper

The question arises as to whether the difference in the habitual conceptual structuring of space between Yucatec and Mopan leads to different spatialization of abstract concepts. This question is investigated through the observation of gestures.

The goal of this paper is two-fold. First, we demonstrate that the difference between Yucatec Mayans and Mopan Mayans, which is revealed by the aforementioned pattern-matching task, is replicated in gestural representation. Namely, to-the-right-of and to-the-left-of relations are relevant in the gestural representation of spatial concepts in Yucatec, but not in Mopan. Second, we show that this difference extends to the spatialization of abstract concepts, as manifested in gestures. The abstract concepts to be discussed are time flow, plot development of the story, and opposition between two similar non-spatial entities. We will conclude that a culture-specific spatial schema leads to culture-specific conceptualization of abstract thought in terms of space.

5.2 Gestures in Mopan and Yucatec Traditional Mythical Stories

In order to elicit gestures, three Yucatec Mayans and three Mopan Mayans were asked to tell a traditional mythical story of their choice (different stories were told by each speaker). All consultants are a member of a small-scale Yucatec and Mopan farming community. The stories are mythical in that they do not involve known real world locations and entities (the stories are, however, believed by the tellers to have actually occurred in some location). The consultants told their stories while seated in a familiar environment such as in their own house, with one of the

investigators as well as other people in the community as audience. The story telling was video-taped with a Hi-8 camcorder. A segment from each story, roughly 10 minutes long, was selected for narrative coherence and for topical match between Yucatec and Mopan. We selected a pair of episodes from one Yucatec and one Mopan story that dealt with various events taking place in the course of a hunting-trip, another pair of episodes that had a trickster theme, and a third pair of episodes that told a get-rich-quick story.

Since the stories are mythical, the gestures are not a response to any externally given spatial array. Rather, they create a virtual space in front of the speaker. For example, the pointing gestures in the stories do not point to any real location or direction. They establish a location or a direction in the gesturally created story-space (they are gestures of what has been called "abstract deixis" in McNeill, Cassell & Levy (1993) and McNeill (to appear)). The structure of this virtual space reveals how space is spontaneously used for representation, given a "blank slate."

Gestures about Spatial Concepts

Quantitative analysis of directionality of gestures The goal of this section is to demonstrate the difference between Yucatec and Mopan with regard to the treatment of to-the-right-of and to-the-left-of relations in their gestural representation of spatial concepts. Among spatial concepts, we focused on motion and location in the story world. A motion in the story world can be gesturally represented by a sweep of a hand, and a location in the story world can be represented by indexing a seemingly empty space near the speaker. "Indexing" refers to a broad range of body movements, in which a location near the speaker's body is singled out. Pointing with an extended index finger or an open hand is one way, and the movement of a hand as if it places an object is another way.

If to-the-right-of and to-the-left-of relations are distinct in the conceptual handling of space, then the two points along the projected lateral axis can represent two different conceptual entities. For example, a particular instance of motion, which involves a source and a goal, can be gesturally represented along the projected lateral axis. Similarly, if the projected lateral axis is representationally distinctive, then gestures representing location can be performed with a predominantly lateral orientation, and the location indicated can be in contrast with another location (which is

indicated by another gesture) along the projected lateral axis. The same holds for a particular narrative instance of caused motion (e.g., a story character puts something somewhere). If the projected lateral axis is distinctive, the gestural representation of caused motion can have a predominantly lateral component, for example, with one point representing the source and the other the goal of the caused motion.

Thus, we expect that compared to Mopan gestures, Yucatec gestures representing motion, location, and caused motion are more likely to be performed with a predominantly lateral orientation.

In order to maximize the match in the representational content of the gestures from the two cultures, a subset of gestures in the recordings were selected, in the following manner. Pairs of cognate lexemes (i.e., historically related lexemes) in Yucatec and in Mopan denoting location, motion, and caused motion that were used in at least one story in each language were listed (only cognate pairs that still retain substantial meaning overlap between the two languages are included in the list). Note that the two languages are genetically closely related, and thus it is relatively straight forward to identify cognate lexemes. The list of selected lexemes is in Table 5.1.

Since co-expressive gesture and speech typically overlap in time (McNeill, 1992), gestures that are synchronized with these lexemes are likely to represent location, motion, and caused motion. We analyzed only those gestures that temporally overlap with the breath group that contained one of the lexemes in Table 5.1 (a breath group was delineated by a pause, or a break in pitch contour, or an abrupt shift in speech rate).

The spatial form of this subset of gestures was coded for either "lateral" or "non-lateral" vector. If a gesture was performed with one hand, and the gestural movement has a predominantly lateral component (as opposed to vertical or sagittal (i.e. front-back) directions), then it was coded as a lateral gesture. If a one-handed gesture had a predominantly vertical or sagittal component, the gesture was coded as non-lateral. If the gesture was performed with two hands and the movement of the two hands was laterally symmetrical (e.g., one hand went to the right and the other went to the left), then it was coded as a non-lateral gesture (because such a gesture used the lateral axis symmetrically). If a two-handed gesture was not laterally symmetrical, but the main movement component was vertical or sagittal (e.g., one arm goes up, and the other arm goes

Table 5.1
The list of cognate location/motion lexemes that appear in at least one Yucatec story and one Mopan story

Cognate label*	Form class	Gloss
Location		
ALAN	preposition	"under"
ICHI	preposition	"in"
YOK	preposition	"*over/on top of*"
NAACH	stative predicate	"far"
KUCH	nominal	"place/niche"
TU	pronoun	"where" (a relative and a question pronoun)
Motion		
BIN	unaccusative verb	"go"
HOK	unaccusative verb	"exit"
KOCH	unaccusative verb	"arrive not-here"
MAAN	unaccusative verb	"travel/pass by"
NAK	unaccusative verb	"ascend"
OK	unaccusative verb	"enter"
TAAL	unaccusative verb	"come"
Caused motion		
CHA	transitive verb	"take"
CHIN	transitive verb	"throw stones at"
MACH	transitive verb	"grab/grasp"
PUL	transitive verb	"throw away"
TSA	transitive verb	"give/put"

* These labels are given in as notational shorthand, which conflates phonological elements of both Yucatec and Mopan.

down), then the gesture was again coded as non-lateral. If a two-handed gesture was not laterally symmetrical and the main movement component was lateral (e.g., two arms *stretched together to the right*), then the gesture was coded as lateral.

The proportions of lateral gestures (among the gestures that temporally overlap a breath group containing a spatial lexeme listed in Table 5.1) are shown in Table 5.2. Yucatec gestures are more likely to be lateral than Mopan gestures (one-tailed T-test, $df = 2$, $T = 11.1$, $p = .01$).

Table 5.2
The proportion of lateral gestures that are synchronized with a breath group containing one of the spatial lexemes listed in Table 5.1

	n	Proportion of lateral gestures
Yucatec		
Story 1	96	.40
Story 2	44	.43
Story 3	46	.39
Mean		.41
Mopan		
Story 1	90	.14
Story 2	20	.10
Story 3	80	.18
Mean		.14

Yucatec and Mopan gestures that express spatial content have different form characteristics. Yucatec gestures tend to be lateral, while Mopan gestures tend not to be. This is consistent with the idea that to-the-right-of and to-the-left-of relations play a role in the conceptual handling of space for Yucatec Mayans, but not for Mopan Mayans. In other words, the two points along the projected lateral axis can represent two distinct conceptual entities, for Yucatec Mayans, but not for Mopan Mayans.

Lateral deployment of non-lateral gestures The above result on the laterality of gestures in fact underestimates the difference between the two cultures. This is because a gesture, which itself may not be lateral, can still be part of a sequential lateral deployment of multiple gestures. That is, a sequence of gestures can discursively establish multiple points with distinct interpretations along the projected lateral axis. Yucatec gesture sequences are often of this type, while Mopan sequences are not.

The following excerpt from a Yucatec story exemplifies the sequential deployment of multiple gestures. In this story, a lazy boy becomes wealthy by the information that he accidentally gets. Because of the laziness of the boy, his father has refused to serve food to him. When his hunger and desperation are at their peak, he happens to see a merchant hide a treasure-trove. (See the Appendix for the speech and gesture transcripts.)

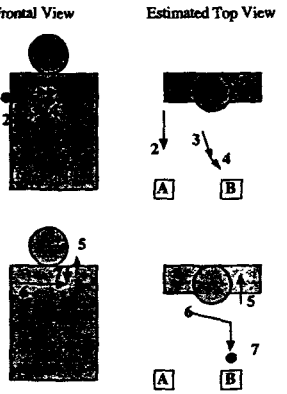

Figure 5.2
Spatial arrangement of gestures in Example 1.

Example 1: Yucatec Motion Scene (Lazy Boy Story)
"Where the boy sleeps," (Gesture 1, 2)
"not far from there," (Gesture 3)
"there he (the merchant) went to hide his money." (Gesture 4)
"So the man (the merchant) had left then," (Gesture 5)
"and so the boy went in order to see" (Gesture 6)
"what was dug in at the trunk of the tree." (Gesture 7)

The description of these events is accompanied by a sequence of gestures that establish two important story locations along the projected lateral axis. Gesture 1 seems to iconically represent a boy who is lying. Gesture 2 points to a location in front of the right edge of the speaker's torso, which represents the location where the boy sleeps. Gestures 3 and 4 point to a location on the speakers left side, which represents the location where the money is hidden (see Figures 5.2 and 5.3). These two locations are connected by Gesture 6, which points to the location A (Figure 5.2) at the beginning, and then traces a path to the location B. This gesture is synchronized with the speech expressing the boy's motion

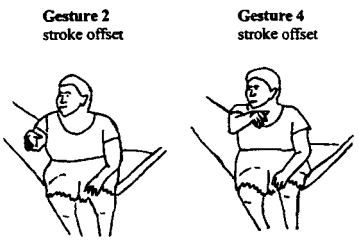

Figure 5.3
Yucatec motion scene: Gesture 2 and 4 in Example 1.

from where he sleeps to where the money is. Gesture 7 taps on the location B with the pointing hand shape. Note that in Gestures 2, 3, 4, and 7, the hand movement is predominantly non-lateral (i.e., forward). Nevertheless they, together with Gesture 6, make up a sequence in which spatial locations are contrastively indicated along the projected lateral axis. This structuring of the gestural representation is consistent with the quantitative analysis of the laterality of single gestures and the pattern-matching task, involving lateral mirror images. Namely, for Yucatec Mayans, to-the-right-of and to-the-let-of relations are conceptually distinct.

In the Yucatec stories, there is an abundance of cases like the above example, in which a sequence of gestures establish multiple story locations along the projected lateral axis. However, there were very few equivalent Mopan cases. The following Mopan example, which involves multiple landmarks, is the most complex motion scene in the three Mopan stories. This kind of case, involving multiple locations, has the best chance for the use of the projected lateral axis through a sequence of gestures. Yet, the gestures in the description of this scene have a non-lateral form, and even when taken as a sequence they do not set up any laterally distinctive locations.

In this Mopan story, a man marries a woman, with whom he has met during his hunting trip. This woman is from a community of "wild people." And, the woman's parents make an elaborate plan to cook and eat the couple. The woman realizes this plan. She outsmarts her parents, and escapes the plot. In the following excerpt, having escaped the plot, the couple is running away from the woman's parents.

Example 2: Mopan Complex Motion Scene (Wild Woman Story)
"They went again." (Gesture 1)
"You see, there were twelve mountains" (Gesture 2)
"that they passed through inside the core." (Gesture 3)
"There were twelve." (Gesture 4)
"And as for the water, it was the same way. There were twelve lakes." (Gesture 5)
"They traveled inside the water." (Gesture 6, 7)
"So they went there." (Gesture 8)
"They went to come out at a village." (Gesture 9)

Gestures 1, 3, 5, 6, and 7 (Figures 5.4 and 5.5) represent the motion of the couple (Gestures 2 and 4 represent the number 12). When the gestures represent motion, the finger orientation and often the movement of the hand indicate a direction straight away from the body. The mountains, the lakes, and the village are gesturally localized roughly straight away from the body. More importantly, these locations are not put into a lateral relationship with each other. This type of gestural representation of motion and location are typical for all of the Mopan stories. This is again consistent with the results of the pattern-matching task, and of the quantitative analysis of the directionality of single gestures. For Mopan Mayans, to-the-right-of and to-the-left of relations are not conceptual distinct.

To summarize, Yucatec and Mopan gestural representations of spatial concepts such as location and (caused or spontaneous) motion differ in the use of the projected lateral axis. The gestural difference between the two cultures is parallel to the differences in the pattern-matching task involving lateral mirror images. Mopan Mayans do not use functional equivalents of the to-the-right-of and to-the-left-of contrast in their spatial conceptualization, whereas Yucatec Mayans do. In the next section, we will show that the same difference holds between Yucatec and Mopan Mayans in their gestural spatialization of non-spatial concepts.

Gestural Spatialization of Non-spatial Concepts

The six stories analyzed above are reviewed for cases of gestural spatialization of abstract concepts. We find two domains of non-spatial concepts that are spatialized in both Yucatec and Mopan gestures: flow of time and plot development, and paradigmatic contrast.

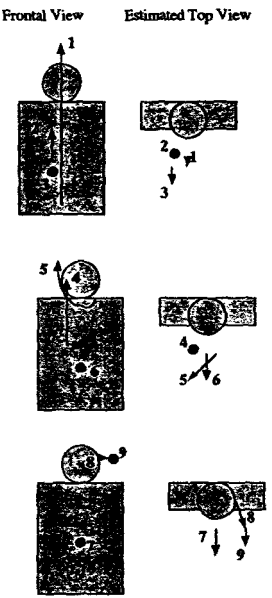

Figure 5.4
Spatial arrangement of gestures in Example 2.

Flow of time and plot development In Yucatec gestures, flow of time and plot development can be represented along the projected lateral axis. In five cases out of a total of six cases from two Yucatec stories, the time flow or plot development is represented by a lateral movement from the speaker's right to left (the last case involves a vertical gesture). It is worth noting that in American Sign Language the time-flow is represented in the opposite direction along the projected lateral axis (Emmorey, this volume). Note also that it has been found that when people are asked to spatially depict temporal increase, the direction of writing determines the

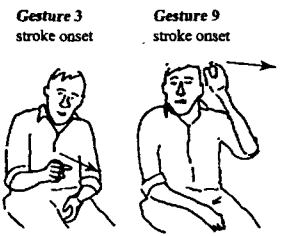

Figure 5.5
Mopan motion scene: Gesture 3 and 9 in Example 2.

direction of increase (Tversky, this volume). The Yucatec consultants have limited literacy in Spanish.

The following excerpt is from a Yucatec story that involves two brothers: an honest hunter, and an evil intellectual. The hunter is puzzled by the fact that he finds a couple of gold coins under the hammock of his children every morning. He visits the intellectual to ask about this mysterious phenomenon. The intellectual suspects that the children have stolen the gizzard of a magical bird, which he has intended to eat. Without giving any answer, he sends the hunter back home. The intellectual interrogates his wife, who has cooked the magical bird, and she admits that the gizzard has been stolen. Immediately after this interrogation scene, the next excerpt follows. The following morning, the hunter goes to the intellectual to get an answer about the mysterious gold coins.

Example 3: Yucatec Time-flow and Plot Development (Golden Bird Story)
"And it dawned again the following day" (Gesture 1)
"and the man went. He says . . ." (Gesture 2)

In Gesture 1 (Figures 5.6 and 5.7) the hand sweeps from the speaker's right to left, and this movement along the projected lateral axis represents time-flow. The relative location of Gestures 1 and 2 also laterally represents the plot development and the passage of time from the breaking of the dawn to the departure of the man. Note that the left hand starts to perform Gesture 2 from the point where the right hand finishes its gesture

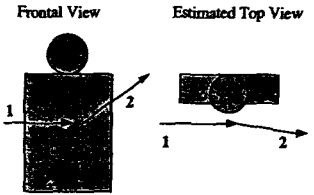

Figure 5.6
Spatial arrangement of Gestures 1 and 2 in Example 3.

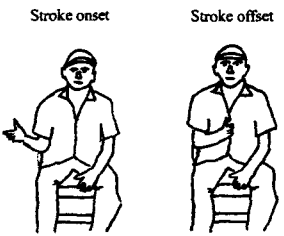

Figure 5.7
Yucatec time-flow and plot development: Gesture 1 in Example 3.

stroke. This suggests that the relative location of the two gestures may be meaningful.

In contrast, in the single example from a Mopan story, time flow and plot development are represented along the sagittal (i.e. front-back) axis. There is no Mopan example in which the projected lateral axis is used to represent time-flow or plot development.

The following example comes from a story, in which a poor man becomes rich by eavesdropping. The poor man has overheard that a certain bush has a special medical potency. In the following excerpt, the pivotal event in the story is described. The poor man, who is unemployed, is staying at an old woman's house. He learns that the king is in a critical condition. The poor man will eventually cure the king with the leaves from the magical bush, which makes him rich.

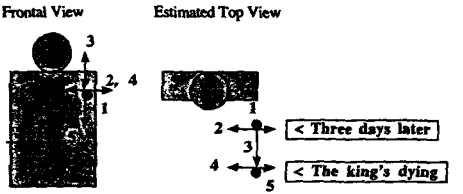

Figure 5.8
Spatial arrangement of Gestures 1–5 in Example 4.

Example 4: Mopan Time-flow and Plot Development (Poor Man Story)
"He rested."
"But when three days had gone by" (Gesture 1)
"There was (still) no work for him." (Gesture 2)
"But what the old woman heard was," (Gesture 3)
"that there was something that—" (Gesture 4)
"that was happening to the king." (Gesture 5)
"The king was dying."

In Gesture 1 (Figure 5.8) the open hand with the fingers upward faces straight away from the body. This may represent the passage of time as a direction away from the body. Gesture 2 is a conventionalized gesture for "nothing." Gestures 1 and 2 represent the state of the affairs before the king's death was mentioned. Gesture 3 (Figure 5.9) connects these gestures with Gestures 4 and 5, which represent an event concerning the king, namely his dying. This is the pivotal complication in this story. Thus, Gesture 3 with the sagittal movement can be interpreted as spatialization of the plot development.

Yucatec and Mopan gestural representations of time-flow and plot development differ in ways that are parallel to their gestural representation of motion and location. For Yucatec Mayans the projected lateral axis is contrastive, thus they can represent time-flow and plot development along the projected lateral axis. In contrast, for Mopan Mayans the projected lateral axis is not contrastive, and thus it cannot be used for representing time-flow and plot development. Instead, the sagittal axis is used for this purpose in the Mopan story. That is to say, the metaphorical spatialization of abstract concepts by gesture follows culture-specific patterns of conceptual structuring of concrete space, as revealed by the

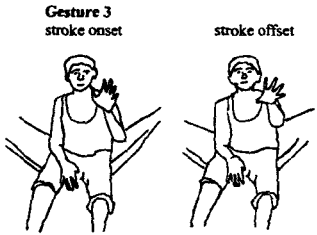

Figure 5.9
Mopan time-flow and plot development: Gesture 3 in Example 4.

gestural representation of spatial concepts and by the pattern-matching task.

Paradigmatic contrast Also spatialized in both Yucatec and Mopan gesture are cases of paradigmatic contrast, in which two things that are the same in some respects but are different in other respects are contrasted. Yucatec Mayans use the projected lateral axis to represent this contrast.

A Yucatec example comes from the story involving a hunting trip. In this story, an intellectual is asked to examine an unusual bird, which his hunter brother has shot. The intellectual finds out that it is a magical bird. If one eats its gizzard, one will get a golden coin under the hammock every morning. In this excerpt, the intellectual is wondering about the possibility of stealing the bird from his brother. The narrator introduces (Line 1) a monologue of the intellectual (Line 2–6) as a direct quote.

Example 5: Yucatec Paradigmatic Contrast (Golden Bird Story)
"And he (the intellectual) said like this:" (Gesture 1)
"I (the intellectual) must take it from my relative (the hunter)."
(Gesture 2)
"If not," (Gesture 3)
"this man will become rich." (Gesture 4)
"Because if I get it from him," (Gesture 5)
"it is me who will eat it," (Gesture 6)
"it is me who will get the money." (Gesture 7)

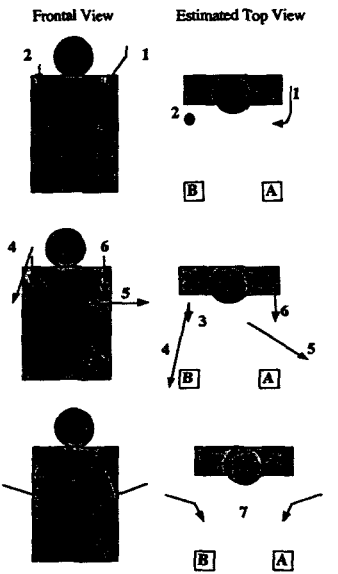

Figure 5.10
Spatial arrangement of gestures in Example 5.

Gestures 1, 2, 3 (Figure 5.10) are all pointing gestures, which indicate a location. Gesture 1, which points to the speaker's left, is synchronized with the utterance that frames the intellectual's monologue. Gesture 2, which points to the speaker's right, is in fact synchronized with the word "my relative" (see Appendix). Gesture 3 (Figure 5.11) is synchronized with the utterance "if not," which sets up a scenario of the hunter eating the bird. That is, these gestures localize the two protagonists and the two possible scenarios on the right and on the left. The speaker's right side represents the hunter and the possible scenario where the hunter eats the bird (the location B in Figure 5.10). The speaker's left side represents the

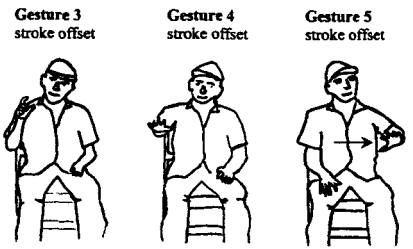

Figure 5.11
Yucatec paradigmatic contrast: Gestures 3, 4, and 5 in Example 5.

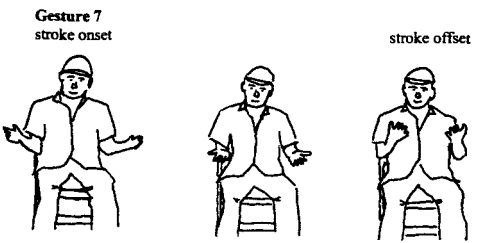

Figure 5.12
Yucatec paradigmatic contrast: Gesture 7 in Example 5.

intellectual and the possible scenario where the intellectual eats the bird (the location A in Figure 5.10). The two possible scenarios are similar, but different in one crucial respect, namely who eats the magical bird. Gesture 5 (Figure 5.11) seems to represent an action of pushing an object, presumably the magical bird, from the location B to the location A. This gesture is synchronized with the utterance, which sets up the second scenario. Gesture 7 (Figure 5.12) brings two hands together: one from the location A and the other from the location B. This may represent the resolution of the two possible scenarios as the intellectual sees it. This example shows that in Yucatec gestural spatialization of paradigmatic

contrast, to-the-right-of and to-the-left-of relations play a crucial role, just like the cases above have shown. (We could not find any example of Yucatec gestures making paradigmatic contrast along the projected sagittal axis. However, because the projected sagittal axis is frequently used for the representation of concrete spatial concepts, we predict that Yucatec Mayans should also in principle be able to use both projected lateral and sagittal axes contrastively.)

In Mopan, paradigmatic contrast is made along the projected sagittal (front-back) axis as will be shown in Example 6. In the hunting trip story, the couple is trying to escape from the wife's parents who plan to eat them. The parents send the husband to cut wood, and the wife to get water. The parents plan to make fire and cook the couple with the wood and water that the couple brings back. The wife is telling the husband her idea to use a woodpecker as a substitute noise maker. Her plan is to run away from her parents while the woodpecker is making the noise of cutting wood. The narrator quotes the words of the wife.

Example 6: Mopan Paradigmatic Contrast (Wild Woman Story)
"You should make use of this bird, the woodpecker." (Gesture 1, 2, 3)
"That's what you will use." (Gesture 4, 5)
"That's your substitute." (Gesture 6)

Gestures 1–5 (Figure 5.13) are pointing gestures, which indicate the direction straight away from the speaker. They locate the woodpecker at the location A in Figure 5.13. Gesture 6 (Figure 5.14) makes an arc back toward the speaker's body to index two locations along the projected sagittal axis. This gesture connects the location A, which has been established as the location of the woodpecker in the preceding gestures, and a newly established location B, closer to the speaker's body, to represent the husband, for whom the woodpecker is a substitute. That is, the gesture spatializes paradigmatic contrast between the husband and the woodpecker, who are similar in one single respect critical to the story: the noise of the woodpecker sounds like a man chopping wood.

For gestural spatialization of paradigmatic contrast, we see again the same kind of difference between Yucatec and Mopan. We could not find any example of Mopan gestures depicting paradigmatic contrast along the projected lateral axis. This is consistent with the claim that the culture specific structuring of concrete space shapes the way in which abstract concepts are construed spatially.

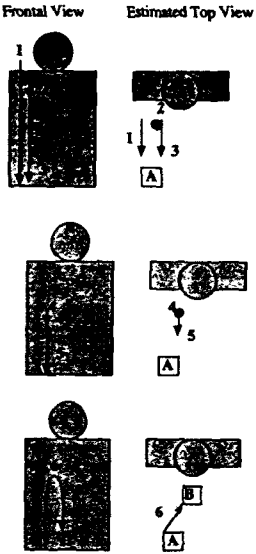

Figure 5.13
Spatial arrangement of gestures in Example 6.

5.3 Discussion

For Mopan Mayans, the projected lateral axis is not contrastive in the gestural representation of motion and location, whereas for Yucatec it is contrastive. When two distinct conceptual entities are to be represented gesturally (e.g., the source and the goal of motion, paradigmatic contrast), Yucatec Mayans, but not Mopan Mayans, use the projected lateral axis to lay out two entities. Mopan Mayans instead use the projected sagittal axis to do so. Note that this difference cannot be reduced to different motoric habits in the two cultures. That is, it is not the case that Mopan Mayans' body movement is restricted in general, nor is it the case

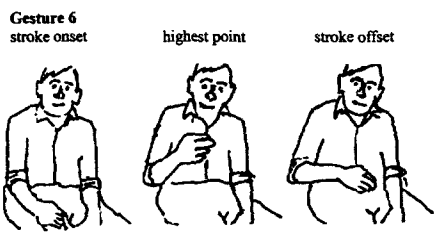

Figure 5.14
Mopan paradigmatic contrast: Gesture 6 in Example 6.

that they prefer to move their arms non-laterally regardless of the purpose of the body movement. Mopan Mayans freely move their arms laterally, like Yucatec Mayans, when the direction of their gesture is anchored to real-world locations (Danziger et al., in preparation). Another argument against motoric habit explanation is that in the Yucatec stories, a sequence of non-lateral gestures often represents laterally distinct points, whereas there are only very few cases of this in the Mopan stories. These facts support our interpretation that the cross-cultural gestural difference reflects a cross-cultural difference in how space is conceptually structured.

Since the stories analyzed in this paper do not involve any real-world locations, there is no extrinsic constraint on the directional characteristics of gestures that create virtual story space and that spatialize abstract concepts. Thus, these gestures provide a window into the 'default' conceptual structuring of space in the two cultures. For Mopan Mayans, the to-the-right-of and to-the-left-of relations are not distinctive in their habitual conceptualization pattern. For Yucatec Mayans, they are. The default status of these structures is also indicated by the reaction of Mopan Mayans and Yucatec Mayans to the pattern-matching task involving lateral mirror images. After the training session, where mirror-image counterparts are distinguished, Mopan Mayans in the experimental trials quickly adapt a different, presumably default, pattern of spatial conceptualization. They treat mirror-image counterparts as equivalent to one another. In contrast, Yucatec Mayans distinguish mirror-image counterparts also in the experimental trials. The converging evidence from the two different sets of observation substantiates the robustness of the finding of cultural specificity in the conceptual structuring of concrete space.

See also Danziger (1999), Danziger (to appear), Danziger et al. (in preparation) for other tasks in which Mopan Mayans behave consistently with these results.

Habitual patterns of spatial conceptualization manifested themselves in two very different behaviors: the pattern-matching task and the gestural representation of spatial concepts. The pattern-matching task involves the analysis of externally given stimuli in terms of what count as the same. In other words, the task involves the categorical analysis of the outside world. The gestural representation of spatial concepts involves building a virtual space in front of the speaker's body. Like the signing space for sign language (Emmorey, this volume), the space for gesture is not monolithic. There are constraints on how the gesture space is used to represent spatial concepts. The categorical structures used in the analysis of the outside world reappear as constraints on representational use of the gesture space. In other words, this structuring of concrete space (i.e., spatial schemas) is not confined to an input or output "module" (Fodor, 1983). The culture-specific spatial schemas are deeply rooted in the mind of Yucatec Mayans and Mopan Mayans.

This depth makes these spatial schemas good candidates to be employed in the metaphorical bridging between concrete space and abstract thought. We, indeed, observed that these culture-specific spatial schemas are used in the spatialization of abstract concepts such as time-flow, plot development, and paradigmatic contrast. For Yucatec Mayans, but not for Mopan Mayans, conceptually distinct entities can be located at different points along the projected lateral axis. Consequently, the "shape" of abstract thought is different in the two cultures: time flows and a plot develops along different axes, and contrasted entities are localized differently. To sum up, spatial schemas are culture-specific in very fundamental ways, and this leads to a concomitant cultural-specificity in the way abstract concepts are construed in terms of space.

Appendix: Speech and Gesture Transcripts

Speech-gesture synchronization is indicated in the following way. Square brackets indicate a single gestural excursion of hands ("Gesture Unit" in Kendon, 1980, "Movement Unit" in Kita et. al., 1998). An excursion can comprise more than one gesture, and gesture boundaries within an excursion are indicated by "|". The number beside "[" or "|" corresponds to the number in the gesture transcript and the diagram of gestural hand

Table 5.3
Abbreviations used in the examples

Abbr.	Term	Abbr.	Term
1	first person	MAN	manner
2	second person	MASC	masculine
3	third person	MD	medial deixis
CL	numeral classifier	NG	negation
CON	connective	OBL	obligation
CONJ	conjunction (clause subordinator)	PD	proximal deixis
D	deixis	PF	perfective aspect
DET	determiner	PL	plural
DUR	durative	PRC	processual
EMP	emphatic pronoun	PREP	preposition
EV	evidential	REL	relativizer
EU	euphonic glide	RES	resultative
EX	existential verb	SG	singular
FUT	future	SUB	subordinator
I	invisible or text/deixis	SBJ	subjunctive
IA	inanimate	TD	text deixis
IPF	imperfective aspect	TERM	terminative
LOC	locative	TRR	transitivizer

movements. The bold-faced portion of the speech is synchronized with the stroke phase of a gesture (the phase that is most forcefully performed), and the italicized portion of the speech is synchronized with a hold phase (the phase in which the limb is held in the air). A stroke and a hold are the phases that bear meaning. (See Kita et al. (1998) for more detailed definition of gesture phases). Abbreviations used in the examples are explained in Table 5.3.

Example 1: Yucatec Motion Scene (Lazy Boy Story)
X: story teller, Y: interlocutor

X: [$_1$ **Tu'x k-u wèen-el** |$_2$ **le chan xib-e',**
where IPF-3 sleep-IPF DEF little male-CON
"Where the boy sleeps,"

Gesture 1 Both hands sweep inwards and outwards in front of the chest. The palms are oriented downward and also facing each other, and the index fingers point away from the body.

Gloss (Possibly) a long horizontal object, namely, the boy lying on the ground.
Gesture 2 Right hand points straight away from the body. (See Figure 5.3).
Gloss The gesture indicates the location where the boy sleeps, located at A in Figure 5.2.

Y: *uh huuuh*

X: |3 **ma' náach-il-e'**,
NG far-REL-CON
"not far from there"

te'l |4 h **bin-∅ u** *ta'k u tàa*k'in-i'.]
there PF go-3.PF 3 hide 3 money-TD
"there he (the merchant) went to hide his money."

Gesture 3 Right hand points forward and towards the midline of the torso.
Gloss The gesture indicates the location where the money is hidden (B in Figure 5.2).
Gesture 4 Right hand points further away, extending the vector defined by the previous gesture. (See Figure 5.3).
Gloss The gesture indicates the location where the money is hidden.

[5 Ts'o'k **u lúuk'-ul túun le máak** *túun-o'*,]
TERM 3 leave-IPF then DEF person CON-MD
"So the man (the merchant) had left then,"

Gesture 5 Left hand moves from the left side of the chest and points backward over the left shoulder.
Gloss The merchant leaves.

[6 **káa** túun h **bin-∅** le chan **xib-o'**, *u-u y-il*
and.then then PF go-3.SG.PF DET little male-MD 3-3 EU-see
"and so the boy went in order to see"

Gesture 6 Left hand, with the index finger pointing away from the body, moves in front of the chest from right to left, and then straight away from the body.
Gloss The boy goes to where the money is hidden (B in Figure 5.2).

ba'x |7 **túun** ***muk-a'n-∅*** *t-u chùun le che'-o'*.]
what then dig.in-RES-3 PREP-3 start DET tree-MD
"what was dug in at the trunk of the tree."

Gesture 7 Left hand, with the index finger pointing away from the body, taps with a wrist movement.
Gloss The boy investigates the location where the money is hidden (the location B in Figure 5.2).

Example 2: Mopan Complex Motion Scene (Wild Woman Story)
[1 **Ka'** **b'in-oo'** tukaye.]
again go-3.PL again
"They went again."

Gesture 1 Right hand moves up. The large vertical component may indicate great distance. The hand is in a loose open hand, with the palm oriented downward and the finger vector (i.e., wrist-to-knuckle vector) oriented forward.
Gloss They go very far.

A-weel a la dose-kuul-∅ a [2 witz']
2-know DET D.1 twelve-round.thing-3 DET mountain
"You see, there were twelve mountains."

Gesture 2 Right hand moves up slightly. The hand is in the edge-wise orientation with the index and middle fingers pointing forward and slightly leftward.
Gloss (Possibly) twelve.

[3 a man-oo' **ich-il** a tz'u'.]
DET travel-3.PL In-REL DET marrow
"that they passed through inside the core."

Gesture 3 Right hand moves forward. The hand is in an edge-wise open hand and the fingers pointing forward (see Figure 5.5).
Gloss They travel straight through the mountains.

[4 **Dose-∅**.]
twelve-3
"There were twelve."

Gesture 4 Right hand moves up. The hand is in an edge-wise open hand with the index and middle fingers extended and oriented upward.
Gloss Twelve.

Uxtun a ja'-a, [5 *b'oob'e lik.*
as.for DET water-TOPIC, D.MAN.1 same
"And as for the water, it was the same way."

Dose-p'eel-∅ |6 a laguna
twelve-CL-3 DET lake
"There were twelve lakes."

Gesture 5 Right hand, with the index and middle fingers extended, makes an arc to the right and upward. At the beginning, the fingers point to the left. During the sweep, the fingers point forward and leftward most of the time, and at the end they point upward. (The opposite laterality of the hand movement and the finger direction neutralize each other to some extent, and the over all effect is that the direction roughly straight away from the body is indexed.)
Gloss Twelve lakes ahead.
Gesture 6 Right hand moves straight forward through the C-shape formed by left hand's thumb and four other fingers (the palm upward). The right hand is in the edge-wise open hand with the fingers pointing forward.
Gloss They travel inside the water.

Man-oo' |7 **ich-il** a ja'.]
travel-3.PL In-REL DET water
"They traveled inside the water."

Gesture 7 Right hand makes the same movement as 6 without the left hand. The hand is in the edge-wise orientation with the index and middle finger pointing forward.
Gloss They travel inside the water.

[8 Pues te'i **b'in-oo'**,]
so D.LOC.I go-3.PL
"So they went there."

Gesture 8 Left hand moves forward and slightly rightward. The height of the gesture may indicate the distance from the evil chasers. The hand is open hand with fingers pointing upward, and the palm faces right and slightly forward.
Gloss They go to a village (which is very far).

[9 **(gesture)** B'in-oo' ti jok'-ol ich-il jun-p'eet a kaj]
go-3.PL PREP exit-IPF in-REL one-spread.out DET village
"They went to come out at a village."
N.B.: the gesture stroke was performed during silence.

Gesture 9 Left hand (the hand configuration the same as Gesture 9) moves forward (see Figure 5.5).
Gloss They go to a village (which is very far).

Example 3: Yucatec Time-flow and Plot Development (Golden Bird Story)

[1 Ka tun bin **sáas-chah-∅** bey] ka' t-u he'l dia-e',
and.then then EV light-PRC.PF-3.PF thus again PREP-3 other day-CON
"And it dawned again the following day."

Gesture 1 Right hand sweeps leftward (see Figure 5.7).
Gloss It dawns.

[2 ka **bin-∅** le **máak-e'** **k-u** y-a'l-ik bin-e']
and.then go-3.PF DET person-CON IPF-3EU say-IPF EV-CON
"and the man went. He says ..."

Gesture 2 Left hand, in an open handshape, moves leftward, up, and slightly forward.
Gloss And then, the man goes.

Example 4: Mopan Time-flow and Plot Development (Poor Man Story)

K'ul-aj-i.
Stay-POS.PF-3
"He rested."

Pes [1 ox p'ee *k'in, k'och-ok-∅,*
So three CL day arrive-SBJ-3
"But when three days had gone by"

Gesture 1 Left hand is held in front of the left side of the chest. The hand in an open handshape with the palm oriented forward and the fingers upward.
Gloss Three days has pasted.

]2 **Ma' yun-meyaj.**
NG exist.3-work
"There was (still) no work for him."

Gesture 2 Left hand waves laterally (leftward, rightward, and then leftward). The hand is in an open handshape with the palm oriented forward and the fingers upward (a conventionalized gesture for "nothing").
Gloss No work.

]3 **Pere k'u u-yub-aj-∅** *a nooch ch'up-u,*
but what 3-hear-PF-3 DET old woman
"But what the old woman heard was,"

Gesture 3 Left hand moves forward, making an arc (up and then down) (see Figure 5.9).
Gloss The plot develops.

[4 ka yan-∅ **k'u** **a** ...
CONJ exist-3 what DET
"that there was something that ..."

Gesture 4 Left hand waves laterally (rightward and then leftward). The hand is in an open handshape with the palm oriented forward and the fingers upward.
Gloss (Possibly) something.

[5 **a** **tun-yan-tal** ti a] rey-e.
DET DUR.3-exist-PRC PREP DET king-TOPIC
"that was happening to the king."

Gesture 5 Left hand moves straight down. The hand is in an open handshape with the palm oriented forward and the fingers upward.
Gloss ? To the king.

Tun-kim-il a rey.
DUR.3-die-IPF DET king
"The king was dying."

Example 5: Yucatec Paradigmatic Contrast (Golden Bird Story)

[1 Ka tun bin **t-u** **y-a'l-ah** **bey-a'**]
and.then then EV PF-3 EU-say-PF thus-PD
"And he said like this:"

Gesture 1 Left hand, with the index finger and the thumb extended, makes an arc downward and slightly to the right. At the end, index finger and the thumb point the space near the left shoulder.
Gloss The intellectual brother, localized at A in Figure 5.10.

[2 Yan in ch'a'-ik-∅ ti' in **láak'-e'**
OBL 1.SG take-IPF-3 PREP 1.SG relative-CON
"I must take it from my relative."

Gesture 2 Right hand, with the index finger and the thumb loosely extended, moves straight downward. Through out the stroke, the index finger points forward and downward.
Gloss The hunter brother, localized at B in Figure 5.10.

|3 wa **ma'-e'**
if NG-CON
"If not,"

Gesture 3 Right hand moves downward and slightly forward (see Figure 5.11).
Gloss A possible scenario, in which the hunter brother eats the bird. The scenario is localized at B in Figure 5.10.

|4 le máak-a' yan u **ayik'al-tal**]
DET person-PD OBL 3 rich-PRC.IPF
"this man will become rich."

Gesture 4 Right hand moves forward and slightly rightward, by fully extending the elbow (see Figure 5.11).
Gloss The wealth will go to the hunter brother, at B in Figure 5.10.

[5 tumen wa t-**in** **man-ah** **ti'-e'**
because if PF-1.SG pass-PF PREP-CON
"because if I get it from him,"
(The perfective aspect in this utterance indicates the hypothetical nature of the proposition.)

Gesture 5 Left hand moves leftward and forward, by extending the elbow almost fully. Through out the stroke, the hand is open and the palm is oriented roughly downward (see Figure 5.11).
Gloss Another scenario, in which the bird is transferred from the hunter brother, at B, to the intellectual brother, at A in Figure 5.10.

|6 **tèen** **ken** han-t-ik-e'|
1.SG.EMP SUB.FUT eat-TRR-SBJ-CON
"It is me who will eat it,"

Gesture 6 Left hand moves forward and downward, by swinging the forearm around the elbow. At the end, the hand is open with the fingers oriented forward, and the palm is oriented rightward.
Gloss The intellectual brother, localized at A.

|7 **tèen** **kun** yantal ten tàak'in]
1.SG.EMP SUB.FUT.3 become 1.SG.EMP money
"It is me who will get the money."

Gesture 7 Both hands move symmetrically, coming closer to each other. And then, the hands move upwards, slightly coming close to each other (See Figure 5.12).

Gloss The resolution of the two possible scenarios, localized at A and B in Figure 5.10, namely, the intellectual brother becoming rich.

Example 6: Mopan Paradigmatic Contrast (Wild Woman Story)

[1 Pere **maant-e'**] [2 a ch'**iich' a** |3 la, aj **kolonte'**].
but borrow-SBJ.3 DET bird DET PD MASC woodpecker
"You should make use of this bird, the woodpecker."

Gesture 1 Right hand, with the index finger extended, moves downward. At the beginning, the index finger points upward and slightly forward. At the end, it points forward.
Gloss for Gestures 1–5 The woodpecker, localized at A of Figure 5.13.
Gesture 2 Right hand, with the index finger extended, moves downward. Throughout the stroke, the index finger points upward and forward.
Gesture 3 Right hand, with the index finger extended, moves down from the same starting point of Gesture 2 onto the lap. At the end, the index finger points forward.

[4 Le'**ek-∅ a kaa** |5 **mant-e'**]
EMP.3-3 DET FUT borrow-SBJ.3
"That's what you will use."

Gesture 4 Right hand, with the index finger extended, slightly moves downward. Throughout the stroke, the index finger points forward and slightly upward.
Gesture 5 After a short pause, right hand, with the index finger extended, moves down from the end point of Gesture 4 down onto the lap. At the end, the index finger points forward.

[6 Le'**ek-∅** a **jel.**]
EMP.3-3 2 substitute
"That's your substitute."

Gesture 6 Right hand makes an upward half circle backward slightly leftward. At the beginning, the palm is oriented leftward and the extended index finger points forward. At the end, all fingers are loosely curled toward the palm, and form a "bunch." The palm is oriented downward and backward, and the finger-tips point downward (Figure 5.14).
Gloss The woodpecker and the husband are different individuals, but equivalent in that they would be making similar noise with trees.

Acknowledgments

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