Chapter 10

Culture and Cognitive Development: The Development of Geocentric Language and Cognition

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In this chapter we examine the role of culture in cognitive development. The focus is on the development of geocentric spatial cognition. We also examine the linkage between language and cognition, a theme which has been fairly controversial in research carried out during the last decades. The research presented here is rooted in non-western cultures, which are not much studied, and hence not represented in theories of cognitive development. We summarize the findings of a major research study (see Dasen & Mishra, 2010) that focuses on the development of the geocentric spatial frame of reference (FoR). A geocentric FoR means using a wide-range orientation system for localizing objects for small scale space, such as a table top space, and using it inside a room as well as outside. Constantly updating one’s position in the environment (dead reckoning) and describing a display independently of one’s position are some other features of a geocentric FoR.

Developmental studies of spatial cognition have been mainly carried out in the Piagetian tradition, which holds that children build up spatial concepts in relation to their own body, following the sequence of topological, projective and Euclidean space (Piaget & Inhelder, 1956). The distinction between these spatial concepts is similar to the distinction established at the
linguistic level between object-centred (or intrinsic), viewer-centred (relative or egocentric) and extrinsic or environment-centred (absolute, geocentric) spatial terms. In an intrinsic frame, the objects’ location is described in relation to each other. In the relative frame, the objects are described in relation to a viewer’s front, back, left, and right. In the absolute frame, objects are located according to a co-ordinate system that is external to the scene; knowledge of the viewer’s position and orientation in space is not required in this case. Research indicates that different language communities preferentially use different reference frames (Levinson, 1996, 2003).

While the ability to use geocentric spatial representations varies with age, Western research generally suggests that it occurs only when the child has built up body-related spatial representations. There is some indication that both of these abilities may evolve together, and that the choice of a reference frame may be situation-dependent rather than a developmental feature (Allen, 2007). However, there is no evidence to suggest a reversal from the sequence originally described by Piaget. Much of the evidence (e.g., Taylor & Tversky, 1996; Werner & Hubel, 1999) supports the theory that spatial representation is basically built up from the point of view of the human body.

Studies of spatial concept development have been carried out largely with Western samples (Mishra, 1997). Researchers have never questioned whether the same sequence of stages of development can be found in other cultures. That individuals construct space on the basis of their body could be a theoretical conceptualization biased by Western individualism. In some cross-cultural studies the issue has been addressed from the emic and etic points of view (Segall, Dasen, Berry, & Poortinga, 1999). On the emic side we find anthropological descriptions that tell us how space is organized in different cultures (e.g., Gladwin, 1970; Hutchins, 1983), but they
speak little about developmental aspects. On the etic side we find the cross-cultural replication of Piaget’s theory, using classical “Piagetian” tasks, research which neither suggests any reversals in the sequence of stages, nor indeed any culturally specific cognitive processes (Mishra, 1997). Greenfield (1976) indicates that there could be different developmental pathways, and hence different developmental end stages, but this proposition has never been empirically established. Wassmann and Dasen (1998) noted a reversal in the development of spatial concepts in Bali, a finding that has motivated some of our research in this domain (Mishra, Dasen & Niraula, 2003; Dasen, Mishra & Niraula, 2004; Niraula, Mishra & Dasen, 2004; Dasen & Mishra, 2010).

**Linguistic Relativism**

Does language determine the way one thinks? Whorf’s hypothesis of linguistic relativity has been revisited in some recent cognitive research (Gumperz & Levinson, 1996; Levinson, 1996, 2003; Lucy, 1997). Cross-cultural research not only shows that basic cognitive processes are universal (Mishra, 1997; Segall, Dasen, Berry, & Poortinga, 1999), but also that languages themselves seem to follow many universal principles (Holenstein, 1993). A widely held assumption is that the coding of spatial arrays for memory will be determined by general properties of visual perception, and hence it should also be natural and universal to conceptualise space from an egocentric or "relative" point of view. Research also indicates that speakers of European languages habitually use egocentric encoding. Thus, it is not surprising that the egocentric conception of space is considered as universal and “more natural and primitive” (Miller & Johnson-Laird, 1976, p.34).

Some researchers (e.g., Wassmann, 1994; Wassman & Dasen, 1998) have questioned these basic assumptions. In English language we generally describe the position of an object or
person with respect to another by using the projective notions of right and left in reference to the speaker’s body. There are languages that do not use body-centred spatial notions of right, left, front and back; they use environment-centred or geocentric frames of reference. While in a relative frame, the description of an object or person changes depending on one’s body position (e.g., left may become right and vice versa), in the geocentric frame, the description does not necessarily change with the change in viewer’s position (e.g., north remains north even if the viewer’s body position is changed).

This kind of (geocentric) linguistic coding of spatial objects raises a fundamental question regarding the correspondence between linguistic and conceptual differences. We may assume that spatial representations are influenced either by sensory information (which is egocentric) or by language (which may or may not be egocentric). In European languages, that are egocentric, the two are confounded, but there are other languages that use either intrinsic or absolute (geocentric) or mixed frames of reference. It is possible to dissociate these influences by carrying out studies with speakers of these languages.

Working mainly with adults, cognitive anthropologists (e.g. Danziger, 1993; Levinson, 1996, 2003; Pederson, 1993; Pederson, Danziger, Levinson, Kita, Senft, & Wilkins; 1998) have carried out research in several locations. In language development studies de León (1994, 1995) found an overall developmental trend that seemed to go from intrinsic terms to locally geocentric, and in some cases, to abstract geocentric terms. Since the populations de Leon studied do not at all use relative terms (left/right), this research does not tell us much about the relationship between the egocentric and the geocentric systems. However, this clearly brings out the need for research in locations where an egocentric system exists in the language, but is not
the predominant one. These studies also deal only with the development of language; they do not allow us to conclude that cognitive development has to follow necessarily the same sequence of development.

A study of geocentric language and cognition

This study is a part of a larger project, which Dasen and Mishra (2010) have carried out at several locations in India, Indonesia, Nepal and Switzerland. The major research questions addressed in this research are: (1) How does the geocentric FoR develop with age? (2) Is there a link between language and encoding at the individual level? (3) What is the role of culture (e.g., religion, type of schooling, socio-economic features of groups, etc.) in spatial language and cognition?

Our previous research in India and Nepal (Mishra et al., 2003; Dasen et al., 2004; Niraula et al., 2004) provided us with some interesting indications. For example, we found that the geocentric FoR in both language and cognition was used more systematically in rural than in urban settings, and in all samples, it increased with age. Schooling had only a limited impact on its development; for example, in rural Nepal, unschooled children tended to use the geocentric FoR with two sectors (up and down, which is quite appropriate in a mountain setting), while schooled children learned to use cardinal directions (i.e., north, south, east, west).

Method

Insert Table 1 about here

Design and Sample

Children were studied using a combination of observation, interview, testing and
experimentation. In this paper we summarize the findings obtained at Varanasi (India) and Kathmandu (Nepal). The details of the samples are given in Table 1. At Kathmandu, we had the opportunity to sample 4 to 12 year old children from English and Nepali medium schools. At Varanasi we took the advantage of sampling slightly older children (10-15 years) from Sanskrit (traditional) and Hindi (modern) medium schools.

An ethnographic survey of the populations in Varanasi indicated that children from Sanskrit schools described space and spatial relationships mainly in geocentric (NSEW) terms, whereas those from Hindi school used both geocentric and egocentric (LRFB) terms. On the basis of the impact of bilingualism we found in Bali (cf. Dasen and Mishra, this volume), we initially expected more use of geocentric terms by Kathmandu children in Nepali medium schools, whereas in English medium schools egocentric terms should be more common. This led to the expectation that children’s socialization in a traditional culture context (e.g., in Sanskrit or Nepali medium schools) would encourage the use of a Geocentric FoR, while in a relatively non-traditional context (e.g., in English or Hindi medium schools) the use of an Egocentric frame will be encouraged.

Tasks

The tasks used in this study were divided into three main categories: Language elicitation tasks, encoding tasks and spatial cognitive tasks. These tasks are described in detail in Dasen and Mishra (2010). Here we introduce them briefly.

Language elicitation tasks

These tasks are designed to produce spatial language systematically. One is called the Perspectives task in which the child describes a very simple display of three objects from
different positions. Another is the Road task, in which a car is moved along a path model, which has several right angle turns and one diagonal turn. At every turning point the child describes the direction in which the car should be moved. The third one is a set of three Encoding tasks (described below). In these the language recorded on two items of each task is recorded. This allows us to study more closely the correspondence between non-verbal behaviour and how it is justified verbally. These tasks were generally used in the local language except in English medium school of Kathmandu where much of the testing took place in English language.

Language coding scheme

The language produced on the three tasks was coded using a scheme adapted from Pederson (1993). This is shown in Table 2. The terms are grouped into the three broad categories of topological, projective and Euclidean space according to Piagetian theory.

Insert Table 2 about here

The scores on each task are the number of items classified into each language category (out of 9 for Perspectives, 8 for Road, and 6 for Encoding tasks). We computed for each task a geocentric language score, subtracting E from G items. The assumption is that if a person scores as many E items as G items, there is no evidence that this person uses a geocentric or an egocentric FoR.

(B) Non-verbal spatial encoding tasks

These tasks were initially devised by the Cognitive Anthropology Research Group (CARG) at the Max Planck Institute (MPI) for Psycholinguistics in Nijmegen, The Netherlands. Hence, they are sometimes called the ‘Nijmegen tasks’. Precise procedures are provided in the “Cognition and space kit, version 1.0” by Danziger (1993; see also Levinson, 2003; Senft, 2007).
We have used three of these tasks in our study.

One is the “Animals in a Row”. This task presents the child with four familiar animals, three aligned along a table (only two in the case of 4-6 year olds), all facing in one direction, and the fourth animal at right angle. The child is asked to remember this display, and move on to another table after a 180 degree rotation (90 degree rotation on the last two trials) to align another set of the same animals the way they were shown before. Another is the “Chips task” in which two-dimensional shapes in which small or large, red or blue squares are drawn on cards. After a series of practice trials, the child is presented one of these cards on in a particular orientation. The child moves on to another table (after a 180 degree rotation) to identify a similar card from a set of four arranged as a cross pattern. Two items with a 90 degree rotation are also used. The third task, called Steve’s Maze (also called the ‘scout’ game, Senft, 2007, p. 239), consists of six pictures of landscapes that depict a house, rice fields, trees, and an incomplete pathway. The child is presented with a picture and is told a story, showing the route that one can take from the end of the drawn path back to the house. The child is asked to remember this route while moving on to another table (with 180 degree rotation) where three cards are displayed showing three different path segments. One of these represents a egocentric encoding, another is a geocentric solution, and the third one is an irrelevant choice (called distractor). One item is used for demonstration; another five items constitute the test series.

We computed for each task a geocentric encoding score, for which E encoded items are subtracted from G items. These scores (with a constant added) are then submitted to a Princals data reduction procedure, producing a summary object score (dimension 1) of geocentric non-verbal spatial encoding.
(C) Knowledge of orientation system and egocentric references

This procedure was used to check the actual knowledge of spatial vocabulary in relation to the egocentric and geocentric FoR. Children were asked to indicate their Left, Right, Front and Back (LRFB). They were also asked about the four directions of the local orientation system (“Show me where is North”). We did this first outside in the school yard, where cues such as the sun’s position were available, and then again inside the room used for testing.

(D) Additional cognitive tasks

1. Block Designs Test (BDT)

This test, which is a standard of psychological testing (also called Kohs Blocks), involved the construction of pictorially presented designs of increasing difficulty with the help of 4, 9 and 16 blocks within specified periods of time. A short (10 designs) version of the test (Mishra, Sinha & Berry, 1996) was used. Both time and accuracy of performance were recorded; in our data analysis, we report only the number of correct items (but we checked that similar results are obtained when using the timed measure).

2. Story-Pictorial Embedded Figures Test (SPEFT)

The SPEFT (Sinha, 1984) comprises eleven sets of pictures. Each set consists of a simple and a complex card. In the simple card some objects and animals are depicted, which are embedded in a larger scene depicted on the complex card (e.g., snakes in the forest). The child has to locate in the complex card, within a maximum of 90 seconds, the objects or animals of the simple card, in the background of a story that is narrated with each card to encourage the child to locate the embedded items. Time taken and the number of objects correctly located by the child are recorded, but in the analysis of results, only the number of correct items is reported. In this
study we used only seven sets of pictures, two for practice and five for testing.

3. Hemispheric Lateralization Tests

For hemispheric lateralization we used a peripheral measure (called handedness) adapted from Mandal, Pandey, Singh and Asthana (1992) and a central measure. The peripheral measure consisted of a number of tasks that the child could do with hand, foot, eye or ear. Children were first asked about their preference to do the task with the left or right limb/organ, and whether they would do it “always” or “sometimes”. Then they were asked to perform the tasks with hand, foot, eye and ear (there were separate tasks for these organs). The use of the limb/organ was recorded.

The central measure consisted of a brain lateralization task administered with the help of a laptop using a program developed by Mandal (personal communication). It used the “split-field” technique in which the child was asked to concentrate on a black spot that appeared in the centre of the computer screen. Then an arrow appeared that pointed either to the left or right in a random order. The child was asked to look at the object or the word that appeared in the direction the arrow pointed to. The child’s hand was placed on a key that was to be pressed soon after the stimulus pointed by the arrow was correctly recognized. The presentation time of each stimulus was 180 milliseconds. The child’s reaction time to stimuli presented to left and right was assessed with the help of the computer programme. Accuracy of response was recorded manually on a sheet developed for that purpose. In one sequence of trials, the child responded to words of objects and animals. In another sequence, responses for male and female faces were obtained. Before conducting the test, the child was given practice trials to make sure that responses were not made just randomly; the eligibility criteria was eight correct responses out of twelve
presentations during practice trials.

**Procedure**

While in Kathmandu, all tasks were given to all children, at Varanasi the brain lateralization measure were administered to children who were classified as using either a “geocentric” (G) or an “egocentric” (E) frame of reference, called G and E groups. In this classification consistency in correct language use and encoding were considered together. Of 376 children only 88 could be placed in the G and E groups; others tended to use the frames inconsistently. A child questionnaire and a home questionnaire were also administered to children and their parents to assess a number of socio-environmental variables that might be linked to G or E FoR.

**Results**

**Language**

The mean scores of the groups at various age levels were computed. The G and E scores were also scored for accuracy (called G+ and E+) of language use. An obvious feature of the finding at Varanasi is that G language is used most frequently and systematically in both school groups. The gap between the use of G and G+ in the Sanskrit school is very small, which is not true for the Hindi school. This indicates that while children in the Hindi school also tend to use the normative geocentric language, they are less perfect in getting the directions right than the Sanskrit school children. Some Egocentric language does occur, mainly in the Hindi school group and on the Road task. The other language categories (D, SL, CL) are negligible.

In Kathmandu language in the younger age groups (4 to 6) is strongly characterized by the use of D (deictic – “this way”), usually accompanied by a gesture. In this age-group,
Situational landmarks (SL) also occur, but diminish with age. Egocentric (E) language occurs to a small extent throughout the age groups (4-12 years). Some Intrinsic (I) references occur in the middle age group, while Conventional Landmarks (CL) is almost never used. Geocentric (G) language clearly replaces D by age 7, and it continues to increase with age to dominate all other language categories. The difference between G and G+ shows that, while using cardinal directions is the norm, it is not easy to do it correctly. Even in the older age groups, there remains a gap.

For each of the language elicitation tasks, a summary score was computed by subtracting E language from G, and these scores, treated as ordinal, were submitted to a Princals Optimal Scaling procedure. The object scores obtained on Dimension 1 were used as the summary measure for the language variable.

**Knowledge of NSEW and LRFB**

In the Sanskrit school group at Varanasi, the knowledge of NSEW was almost perfect; the knowledge of right, left, front and back was also better than that of the Hindi-medium group ($F = 92.20, p < .001$ for NSEW and $F = 19.97, p < .001$ for LRFB). In the Hindi-medium school group, the knowledge of relative directions was fairly high and accurate, but the correct knowledge of cardinal direction was far from perfect. There was no difference between performance inside and outside the building in either school group.

In Kathmandu, almost no child of 4-6 age knew the cardinal directions, while starting with age 7-8 in the English group and 9-10 in the Nepali group, about half of the children could tell these directions. Although the NSEW system is the cultural norm for children in both types of schools, it was not acquired by many children even by age 11-12. ANOVA indicated a
significant effect of age, and a significant difference between the school groups, in favour of the English school group ($F = 4.83, p< .05$).

With respect to the use of LRFB, English schooling had some impact. In the English school group all four egocentric references were known perfectly at age 5, while in the Nepali school group some of the children before age 8 knew only Left/Right. ANOVA indicated a significant difference between the school groups ($F = 9.173, p< .01$) in favour of the English group.

**Non-verbal encoding**

We computed encoding for the Animals task, Chips and Steve’s maze. Higher G encoding was found on the Animals task followed by Chips task. On the Steve’s task, it was very low. The pattern was almost the same for Varanasi and Kathmandu samples.

In order to discover a structural relationship among the three tasks (Animal, Chips and Steve’s Maze), we used the Princals procedure, which resulted in a two-factor solution. Dimension 1 was used as a summary measure for non-verbal encoding at both the locations.

In Varanasi the mean object scores of Hindi and Sanskrit school children on correct G language and G encoding (both derived from Princals) were higher in the Sanskrit than Hindi school group ($F = 117.27, p< .001$ for language and $F = 21.07, p < .001$ for encoding). There was a significant effect of age for encoding ($F = 4.38, p< .05$), but not for language. In Kathmandu the mean object scores on correct G language showed only the significant effect of age ($F = 10.88, p<.001$). On the encoding summary score ANOVA showed a significant difference between the English and Nepali groups ($F = 5.115, p< .05$) with more geocentric encoding in the English group. A significant school-type by age interaction ($F=3.548, p< .01$)
showed more geocentric encoding in the English group, and a stronger increase with age in that group, a finding which goes against our prediction: in Kathmandu, bilingualism with English does not seem to foster more egocentric encoding.

The findings also reveal that the choice of a FoR for encoding is not homogeneous across different tasks. In particular, Steve’s Maze always fosters more egocentric encoding than the Animals and Chips tasks.

**Language and encoding**

Pearson correlation between geocentric language and G encoding in the Varanasi sample was found to be moderate ($r = .39, p<.01$). Controlling for age and school type, the partial correlation was still significant (age controlled $r = .33, p<.01$; school type controlled $r = .25, p<.01$). Controlling for grade or years of schooling does not change the value of this correlation.

In Kathmandu we find a statistically non-significant correlation ($r = .11, p>.05$). If these correlations are computed separately for the two school groups, it is somewhat higher in the English group ($r = .22, p<.05$), but very low ($r = .002, p>.05$) in the Nepali school. These results allow us to argue against a strong link between language use and encoding.

**A summary model for Varanasi**

Amos modelling was used to derive a summary model showing the relationships among the variables of the study. The modelling was carried out with the sub-sample of 80 children, since most of the background variables were available only for this group. The model is illustrated in Figure 1. Fit statistics are quite satisfactory. The graph does not include “error terms”.

Insert Figure 1 about here
The main variable is school type, Hindi vs. Sanskrit. This variable covers a large array of socio-cultural aspects, such as language spoken in the home or SES, migration history and contact with the village, two aspects that were linked to using G language in separate analyses. The age range of the sample is more reduced (11–15 years), so that age does not come into the model as a significant variable.

The interesting aspect of the model is the contribution of a virtual variable, “spatial ability”, which is quite strongly linked to knowledge of the NSEW orientation system, and G encoding, and weakly to G language. This variable is assessed through SPEFT and BDT. Performance on SPEFT is itself linked to school type, indicating that Sanskrit school pupils seem to have overall better spatial skills.

Spatial ability is also influenced by other cognitive process measures, notably overall processing speed (mean reaction time on the lateralization task), and right hemispheric dominance (on the same test). These measures also show a direct link to G language, which could indicate that those who have a faster processing capacity, especially in the right hemisphere, are better able to deal with the complex aspects of geocentric language, independently of, or in addition to the link through spatial ability, which is itself more strongly linked to knowledge of the orientation system and encoding than to language.

A striking feature of the model is the absence of a direct relationship between spatial language and encoding; introducing a link reduces the fit statistics. On the other hand, the model shows that geocentric language itself is part of a pattern that includes socio-cultural variables subsumed under school type, and other psychological and neuro-physiological characteristics of children.
A summary model for Kathmandu

We had information about several contextual variables through our child and family questionnaires. These included variables like child’s mobility, activities outside of school, contact with village, language spoken in home, socio-economic status, migration history, and parents’ language, etc. Component scores were derived by using Princals. We present here a summary model in which the relationships of these variables with each other as well as with geocentric language and encoding can be easily visualized.

Since the age range of children in Kathmandu was large (4 to 12), it was difficult to find an Amos model suitable for the whole sample. The model discussed here (Figure 2) is produced with age groups 7 to 12. The same model shows reasonable fits when applied separately to 7-9 and 10-12 year olds. On the other hand, it does not fit well for the youngest group, perhaps due to low reliability of psychometric test scores. For the sake of clarity, age as a variable is not shown in the graph; it has a -.30 link with English in home, .21 with passive mobility, .19 with independent mobility, .57 with spatial ability and .16 with G language.

Insert Figure 2 about here

In Kathmandu, the “traditional culture” variable (a virtual variable) is linked to school type (more traditional families in Nepali schools), and contact maintained with the village, and also to whether English is used in the home (.72). Contrary to what we found in Bali (cf. Dasen and Mishra, this volume), traditional culture is not linked with a higher use of the geocentric FoR; the links with G language and encoding are negative, even though they are quite small (.18 and -.03). This finding is congruent with what other data analyses indicated, namely that the pupils of the English school show not less but more G encoding than the Nepali school group.
On the other hand we get a positive link to the Knowledge of the NSEW system, which dissociates this variable somewhat from G language and encoding, even though it is itself linked positively to G language. A variable reflecting the foreign (and egocentric) language spoken in the home is part of the model. It is linked to passive mobility (English speaking children live further away from school and are driven there).

The link between this variable and SPEFT reflects some higher test sophistication in the upper class children speaking English. On the other hand, there is also a positive (.19) input from traditional culture, which could be due to the fact that this test has been adapted, in terms of content, to make it more appropriate to the Indian children than the BDT.

The second virtual variable is “spatial ability”, measured through BDT and SPEFT, and influenced by both mobility variables. This shows that both passive and independent mobility are linked to increased spatial ability. Spatial ability, in this model, is directly linked to knowledge of cardinal directions and G encoding, but the link to G language occurs only through knowledge. Passive mobility has a separate negative direct link to G language, indicating that being driven through the city may foster an egocentric rather than a geocentric FoR.

In this model, contrary to Varanasi, G encoding is linked to G language, although not very strongly (.16). Reversing the arrow (from language to encoding) would diminish the statistical fit of the model.

These models bring out not only the complexity of experiences embedded in the eco-cultural system, but also the role of different elements of this system in the organization of spatial language and cognition. The message is clear: spatial cognitive processes cannot be attributed to a single cultural variable called language; a number of other variables that constitute
the textured context of children’s development need to be considered in order to understand the relationship between language and cognition.

**Discussion**

The findings from Varanasi indicate that geocentric spatial cognition is significantly linked to fundamental spatial cognitive ability as measured by SPEFT and BDT. The dominant use of G language and G encoding in Sanskrit medium compared to Hindi medium school children suggests that the use of the ability can be sharpened by its practice and actualization in day-to-day life. In a previous publication (Vajpayee, Dasen & Mishra, 2008) we have noted how Sanskrit school children in daily activities are exposed to a variety of experiences that predispose them to organize space in a geocentric manner. Their previous learning of geocentric references in the village environment gets reinforced in the city with Sanskrit medium schooling.

The geocentric orientation also exists in the environment of Hindi medium school children, but it is not strongly emphasized in their daily routines, except in the matters of eating, sleeping or a few other activities. It may be noted that all children in Varanasi learn a distinction between right and left hand from a very early age of life. However, Sanskrit school children learn this distinction in a more active manner because of their participation in certain rituals that require habitual switch from left to right hand, and vice-versa.

The picture of spatial cognitive development noted in Kathmandu is somewhat different from that found at Varanasi. One significant feature of the findings is the dominant occurrence of geocentric over egocentric encoding only on one task (i.e, Animals), and in the older age groups only. This presents us with evidence of discrepancy between the use of language (which is geocentric) and nature of encoding (which is egocentric). This discrepancy is obvious in the very
low correlation coefficients between language and encoding and also when we compare encoding and the language used to explain it on the three encoding tasks.

This discrepancy shows that the choice of one system or the other becomes more unpredictable in an urban environment such as Kathmandu when the egocentric and the geocentric systems are both available, with the geocentric one emphasized more by the cultural environment (even in the school curriculum) and the egocentric one more functional in the daily city life.

The most unexpected result comes from the comparison between the English and Nepali school groups. We had expected that learning English, and spending the whole day in this language environment, would strongly encourage children towards using egocentric language and encoding, but this is not the case. Although we find significantly greater use of geocentric language in the higher age-groups of the Nepali school, there is greater geocentric encoding in the English, not in the Nepali school group. In other words, bilingualism with English does NOT seem to foster more egocentric encoding in the Kathmandu situation.

This lack of effect of bilingualism with English is further confirmed by a micro-analysis of the impact of actually choosing English on the Road task. There is a small but statistically significant correlation ($r = .14, p<.01$) between choosing English and geocentric encoding (on Animals and Chips), and this finding is confirmed by a significant correlation ($r = .11, p<.05$) between using English in the home and geocentric encoding.

Thus we seem to have a coherent set of data here to show that, in this case, bilingualism with English does not have the same effect as was found with Indonesian in Bali (Dasen & Mishra, 2010, and this volume). The finding warrants discussion of some possible explanations,
such as other differences between the English and Nepali school groups that could provide alternative explanations (or, at least, post-hoc hypotheses). The link of religious practices to SES is one of these.

The English school group in Kathmandu is clearly composed of families with higher SES, higher contact with the media, and less contact with the rural area. In our results (based on home interviews with a sub-sample of 70 families), we found that high SES children indeed use less geocentric language ($r = -.24, p < .05$), but there is no relationship with encoding. In other words, SES does not “explain” the finding by itself. In fact SES as a “packaged” variable itself is a composite of many possible variables.

One of these could be religious practices. Our observational data indicate that the English school families (largely Brahmin) spend more time on Hindu rituals in the home (and, as we know, cardinal directions are very important in these). From our study in Varanasi, we know how important Hindu religious rituals can be in fostering a geocentric FoR. This emphasis on the symbolic aspects of geocentric spatial orientation could therefore explain why geocentric encoding is as important in this group as it is in the Nepali school group. It would be interesting to collect more detailed information on these practices to appreciate their role in the development of a geocentric FoR more precisely.

It may also be noted that in Nepal, the geocentric system of cardinal directions is taught explicitly in grade 2 of all schools, including the English medium schools. All teachers being Nepali with English as their second language, it is quite likely that they tend to use the locally predominant spatial system when they speak about space, even in English, and even for small-scale space inside the classroom. It would be interesting to document this further through
behaviour observations in the schools.

Coming back to the Varanasi study we notice that although Sanskrit school children use the geocentric FoR almost exclusively, in both language and cognition, they also have the egocentric FoR at their disposal (and even manage it very accurately). The Hindi-medium school children also have both frames at their disposal, but they tend to choose the egocentric FoR more often. For both groups, it can be said that the “choice” of a frame of spatial reference is a matter of cognitive style: The cognitive processes for both frames are available to all, but which one is chosen in any particular situation depends on a variety of eco-cultural variables (see Dasen & Mishra, this volume).

How does the geocentric FoR develop with age? In fact, this question has been addressed specifically in much of our research (cf. Dasen & Mishra, 2010) where we included children with a full developmental range, from age 4 to 15. Generally speaking, we found that the use of a geocentric FoR, in both language and cognition, tended to increase with age in all locations where such a frame is culturally appropriate in adulthood. Our previous research (Mishra et al, 2003) shows that in rural settings of India and Nepal it gets established by age 6-8, but somewhat later in urban settings such as Kathmandu or Varanasi. Nevertheless, from the data at hand, we can conclude that, at the level of language use, there is no developmental change after age 10. On the other hand, there is still an increase of geocentric encoding in both the locations.

This difference in developmental trends between language and encoding reflects the more general finding that the relationship between the two domains is only moderate. This does not go well with the position of strong linguistic relativism taken by Levinson (2003), for whom it is only language that determines cognition. That there is a link is obvious at the group level: in
societies in which geocentric language is used predominantly, there is also a tendency to prefer a
geocentric FoR in cognition. But this link is far from deterministic. Depending on the features of
the task at hand (e.g. Animals and Chips vs. Steve’s Maze), and depending on various eco-
cultural variables, individuals may choose one frame or the other, and they may even choose one
for speaking and the other one for encoding. Indeed, when the relationships between all of the
available variables is analysed through structural equation modelling, the best fit at Varanasi is
obtained with a model showing no direct link between geocentric language and encoding. In
Kathmandu, the best fit is achieved in a model in which the path is drawn from G encoding to G
language, NOT from G language to G encoding.

We strongly feel that research focusing on other eco-cultural variables is necessary. In
this particular research, we have looked at the role of Hindu religious practices, but a geocentric
orientation system is also important in other religions such as Islam and Buddhism. Several
hunting and gathering populations, who display extremely accurate “dead reckoning” skills (such
as pointing to far-away landmarks), also use this system (Levinson, 2003), and it would be
interesting to follow up on this research with other religious and relevant Adivasi groups in India.
The relationship between the use of a geocentric FoR and dead reckoning skills (see Mishra,
Singh & Dasen, 2009; Dasen & Mishra, 2010) and other cognitive tasks (e.g. Mishra et al, 2003)
begs the question of relationships to other cognitive processes. We take these findings as an
indication that the geocentric FoR is indeed linked to wider aspects of cognition, but much more
research is needed on this issue.
References


### Table 1: Sample Characteristics

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<tr>
<th>Locations</th>
<th>School type</th>
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<td>101</td>
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<td>Topological</td>
<td>I</td>
<td>Intrinsic</td>
<td>Next to, near, before, etc. (topological)</td>
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<td>------------------------------------------</td>
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<tr>
<td>Projective</td>
<td>E</td>
<td>Egocentric (Relative)</td>
<td>Left, right, in front, in back (LRFB) in relation to speaker</td>
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<tr>
<td>Intermediate</td>
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<td>Situationally specific Landmarks</td>
<td>Towards the window, the door (landmarks within the room)</td>
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<td>CL</td>
<td>Conventional landmarks</td>
<td>Towards the temple, the hospital, a locality (landmarks outside the room)</td>
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<tr>
<td>Euclidean</td>
<td>G</td>
<td>Geocentric (Absolute)</td>
<td>Cardinal directions: North, South, East, West</td>
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<tr>
<td></td>
<td></td>
<td>NSEW</td>
<td>Up represents the North and East sectors; down South and West (in Dolakha, Nepal)</td>
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<tr>
<td></td>
<td></td>
<td>Up/Down</td>
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<tr>
<td></td>
<td>KKKK</td>
<td>Kaja, kelod, kangin, kauh (in Bali)</td>
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<tr>
<td>Other</td>
<td>D</td>
<td>Deictic</td>
<td>“This way, that way“ (usually accompanied with the gesture of a finger or the whole hand or arm)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1: Amos structural equation model for Varanasi

CMIN = 7.300  df = 12  p = .837
RMSEA = 0  GFI = .978  CFI = 1  TLI = 1.058
CMIN = 20.0   df = 32 p = .952
RMSEA = 0   GFI = .986   CFI = 1   TLI = 1.025

Figure 2: Amos structural equation model for Kathmandu