Conceptualization of Space: Frames of Spatial Reference[1]

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Abstract:

Members of the MPI for Psycholinguistics are researching the interrelationship between language, culture, cognition and the conceptualization of space in various languages. Research results show that there are three frames of spatial reference, the absolute, the relative, and the intrinsic frame of reference. This study first presents results of this research in general and then discusses the results for a number of (mostly non-Indo-European) languages. These results confirm the hypothesis that languages seem to influence the choice and the kind of conceptual parameters their speakers use to solve non-verbal problems within the domain of space.

Aims of the "Space Project" at the Max-Planck-Institute

The central aim of the former Cognitive Anthropology Research Group, now the Language and Cognition Department of the Max-Planck-Institute for Psycholinguistics, has been to further research into the relationships between language, culture and cognition by conducting fieldwork on issues of common interest to anthropology, psychology, and linguistics (see Levinson 1992, 1996a; Senft: 1994a, 1995). There are many important questions about the nature and extent of universal human intellectual endowments in various domains, for which there has been little reliable cross-cultural data so far. The goal of the department is to fill some of these gaps and to contribute to the development of more sophisticated theories about the relationship between learned and native abilities, about the contribution of culture to cognition, and about the nature and transmission of culture itself and its relation to social structure and process. The discussion of questions like these has a rather long tradition, of course, with Kant, Herder, Humboldt, Boas, Sapir, and Whorf as its most prominent

[1] This paper is a shortened and slightly modified version of Senft (2001: 521-532 & 535) combined with Senft (2014, 113-119); see also Senft (1994a).

protagonists. Edward Sapir, one of Boas's students, took up his professor's rather cautiously formulated idea that it may be well to discuss the relation between language and thought. It has been claimed that the conciseness and clearness of thought of people depend to a great extent upon their language' (Boas 1911: 60) and then summarized his own ideas about the topic in the following provocative statements:

> Language is a guide to 'social reality'. Though language is not ordinarily thought of as of essential interest to the students of social science, it powerfully conditions all our thinking around social problems and processes.
> Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression for their society.
> It is quite an illusion to imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the 'real world' is to a large extent unconsciously built up on the language habits of the group.
> No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels.
>
> (Sapir 1929: 210)

A few years later he even speaks of 'the tyrannical hold that linguistic form has upon our orientation in the world' (Sapir 1931: 578). However, it was Sapir's student Benjamin Lee Whorf who finally came up with the formulation of the concept of linguistic relativity, namely in two papers that were published in 1940 (and reprinted in 1956). There Whorf states the following:

> We dissect nature along lines laid down by our native languages. The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds – and this means largely by the linguistic systems of our minds.
>
> (Whorf 1956: 213 [1940a])

This is the weak version of the linguistic relativity principle: It claims that language influences thought.

Whorf also came up with another version of this principle, the so-called strong version which claims that language determines thought.

These hypotheses have been discussed quite controversially. Many cognitive scientists have been fascinated by the challenge presented in the weaker version – which claims that language influences thought. Is there a way to empirically test this claim? With our interest in the inter-relationship between language, culture and cognition this challenge was crucial for our research. We tried to answer the following leading questions:

- Do we find any differences in the semantic parameters that are basic to specific lexical domains in different languages – and if so, what are these differences?
- Are these differences dependent on cultural findings?
- Can we draw inferences from these – lexical semantic – differences between different languages as to differences in cognitive conceptualization – and more generally – as to differences with respect to cognitive processes that are important for speakers of these languages?

As Brown and Levinson (1993, 1) point out, our department tries to investigate some of these questions on possible interdependencies between language, culture and cognition empirically via the following stratagem:

> '(a) first, pick a conceptual domain; (b) second, find two or more languages which contrast in the semantic treatment of that domain (i.e., where very different semantic parameters are employed); (c) third, develop non-linguistic tasks which will behaviourally reveal the conceptual parameters utilized to solve them; (d) compare the linguistic and non-linguistic representation systems as revealed by (b) and (c), and assess whether there is any correlation between linguistic and non-linguistic codings in the same domain.'

The (first) conceptual domain we have been 'picking' is the domain of 'space'. Thus, our initial major goal of research was to investigate the conceptualization of space and spatial reference in a cross-cultural/cross-linguistic perspective (see Pederson et al. 1998).[2]

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[2] The research which is partly documented in this paper was done by the following former or present members and guests of the "Language and Cognition" department, the

Methods to elicit verbal reference to space

To do this, we had to develop methods to build a comparative data base through parallel field research in different languages and cultures. This data base should then serve us as a kind of 'natural laboratory' for testing and revising theories in psychology and theoretical linguistics. For the purposes pursued here I will only describe some of the many methods we developed for data elicitation (see Senft 1994a). All these methods make use of various sets of interactive 'games' which are used to elicit task-oriented verbal descriptions in native speakers of the language under study. Most of these tasks involve the recognition or the construction of spatial arrays from systematic sets of two- or three-dimensional stimuli.

The interactional games for focused linguistic elicitation were especially developed for our research purposes (see also Hill 1993)[3]. They all involve a 'director' consultant who is allowed to see a certain stimulus, and a 'matcher' who is not. The players are sitting side by side with a screen separating them so that they cannot see each other's stimuli. The orientation of the players is taken note of, and the field researcher instructs the players what to do in their own language — all instructions are standardized. Moreover, the field

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former "Cognitive Anthropology Research Group" — the languages on which the members work and the respective LANGUAGE FAMILY are given in brackets behind the researcher's name: Giovanni Bennardo (Tongan, AUSTRONESIAN), Balthasar Bickel (Belhare, TIBETO-BURMAN), Penelope Brown (Tzeltal, MAYA), Eve Danziger (Mopan, MAYA), James Essegbey (Ewe, NIGER-KORDOFANIAN), John Haviland (Guugu Yimithirr, PAMA NYUNGAN & Tzotzil, MAYA), Deborah Hill (Longgu, AUSTRONESIAN), Kyoko Inoue (Japanese), Elizabeth Keating (Pohnpeian, AUSTRONESIAN), Anna Margetts (Saliba, AUSTRONESIAN), Sotaro Kita (Japanese), Lourdes de Leon (Tzotzil, MAYA), Paulette Levy (Totonac, TOTONAC), Sabine Neumann (Kgalagadi, BANTU), Eric Pederson (Tamil & Bettu Kurumba, TAMIL), Eva Schultze-Berndt (Jaminjung & Ngaliwurru, NON-PAMANYUNGAN), Gunter Senft (Kilivila; AUSTRONESIAN), Christel Stolz (Yucatec,MAYA), Jürg Wassmann (Yupno, PAPUAN), Thomas Widlok (Hai//om, KHOISAN), David Wilkins (Mparntwe Arrernte, PAMANYUNGAN), and Roberto Zavala (Oluta Popoluca, MIXE-ZOQUEAN). The director of the "Language and Cognition" department is Stephen C. Levinson (Guugu Yimithirr, PAMA NYUNGAN & Tzeltal, MAYA).

We would like to thank all the institutions involved in granting us the permission to do research in their countries and we express our deep gratitude to all the native speakers of these languages, to our friends and consultants in our fields, for their friendly and patient cooperation.

[3] These games were piloted for, and introduced to us by Lourdes de Leon and John Haviland with inspiration from Herbert Clark and Deanna Wilkes-Gibbes, Christiane von Stutterheim, and others. The method was further developed and finally revised by other members of our project, especially by Eve Danziger, Eric Pederson, Sotaro Kita, David Wilkins and also by Penelope Brown, Stephen Levinson, and Gunter Senft.

researcher encourages the players to interact verbally, especially if they think they have difficulties understanding each other. On the basis of the verbal descriptions given by the 'director' in the game, the 'matcher' is asked to reproduce threedimensional models involving familiar objects with intrinsic orientations, like a human statuette in various body poses and mini-landscapes inhabited by model farm animals, as well as unfamiliar and abstract objects. Some games also involve the matching of photographs on the basis of verbal descriptions; these photographs systematically cover certain spatial oppositions. All games are played at least three times with two consultants in two runs each. In the second run the matcher of the first run takes over the role of the director, and the director of the first run becomes the matcher. Figure 1 illustrates the basic idea of these games.

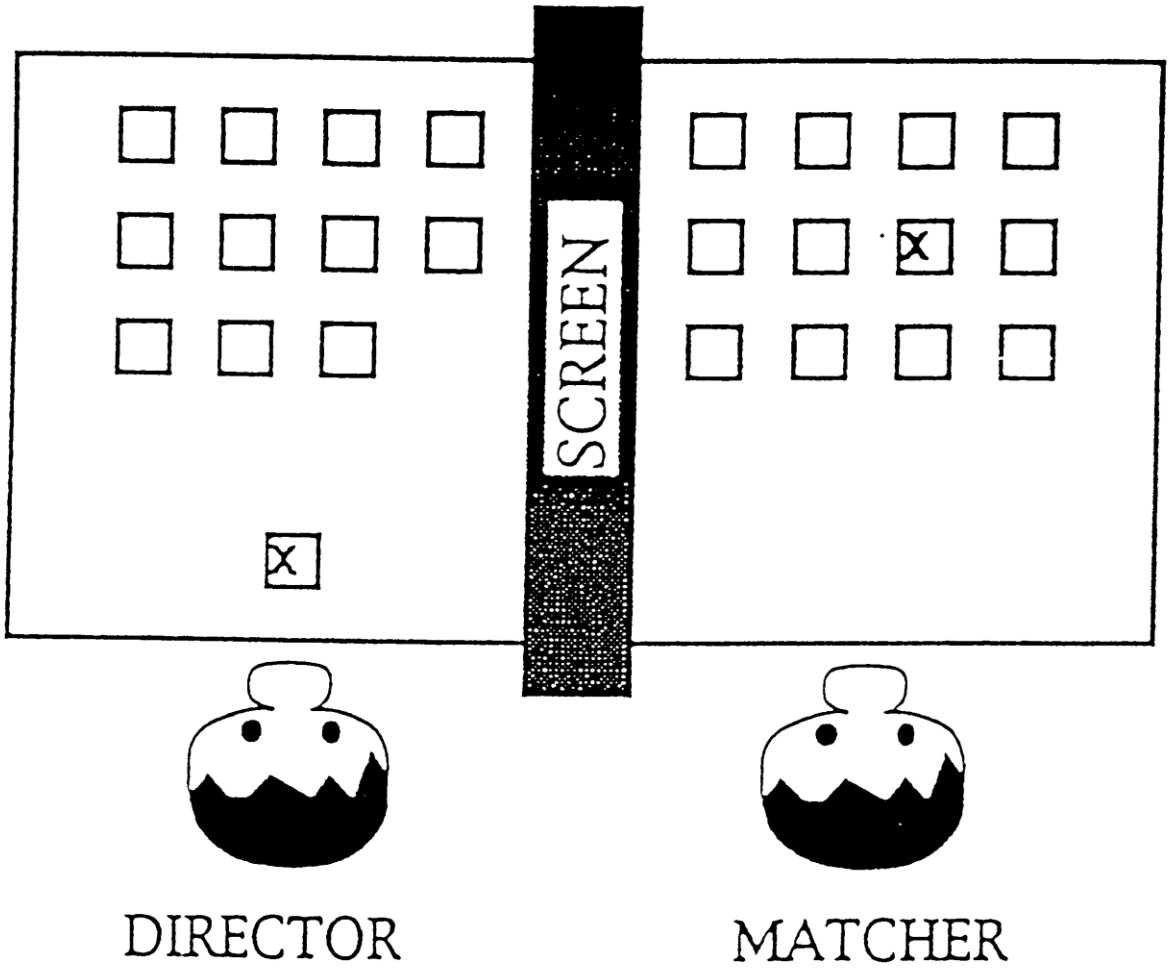

Figure 1:

The interactional games that are relevant for this paper can be described as follows:

1. The ‘photo-object-game’ (or ‘farm animals game’) is played with three-dimensional plastic toys and photos depicting a certain spatial configuration of these toys. The director describes the photo, and on the basis of this description the matcher uses the toys to rearrange the spatial configuration (see Photo 1).

2. The ‘wooden-man-game’ requires that the director, on the basis of photos or on the basis of a wooden human statuette with flexible angles, describes certain body-poses. The matcher has to adjust his or her statuette in such a way that the resulting body pose matches the description (see Photo 2).

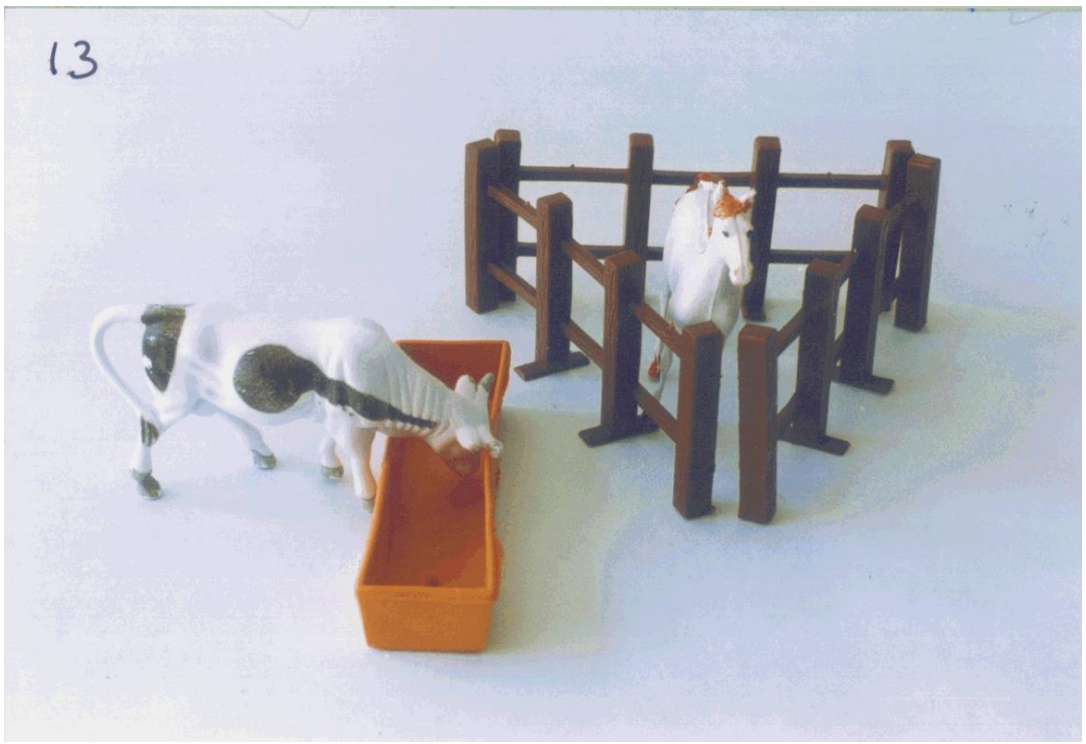

Photo 1: A photo from the photo-object-game

Photo 2: A photo from the wooden-man-game

3. In the ‘Tinkertoy-games’ (see Photo 3) the matcher—with the help of a building system for children—has to build a number of three-dimensional configurational and non-configurational constructions on the basis of the director’s description which itself is based either on the same object or on a photo of the object to be constructed (see Senft: 1994b).

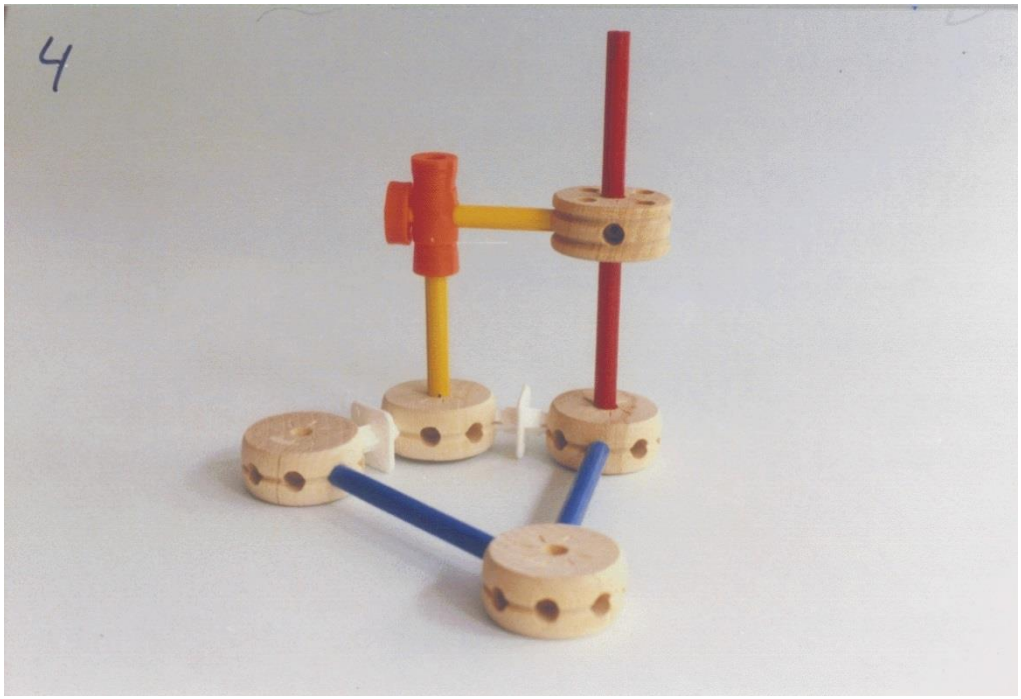

Photo 3: A photo from the Tinkertoy-games

4. The ‘photo-photo-game’ (see Photos 4 and 5) consists of four series of 2x12 photographs; here the matcher has to select one photo on the basis of the director’s description. The photos depict certain localizations and configurations of objects with and without intrinsic features (like men vs. trees and balls) in four directions on the horizontal plane (see Pederson: 1993). Moreover, the set contains a number of distractor photos, so it did not become too obvious to the players what we were after with the game.

Photo 4: A photo from the man and tree series of the photo-photo-game

Photo 5: A photo from the man and tree series of the photo-photo-game

As already mentioned above, these four games were designed to elicit descriptions of spatial arrays and configurations.

So much for some of the methods we developed to elicit verbal reference to space. Right from the beginning of our research we were aware of the fact that these games have

certain inbuilt restrictions and constraints with respect to what kind of data on spatial language is elicited with them — this was necessary for eliciting comparative data (see Senft 2007). However, we attempted to design these games so that they really elicit as broad a range as possible of the vocabulary for spatial reference to be found in the speech community under study. Moreover, it goes without saying that playing these games requires a certain familiarity of the researchers with their fields and with the languages they research and speak themselves. It is only on the basis of their experience and their competence in the languages under study that researchers can adequately use these games for linguistic elicitation, that they can give the instructions to their consultants and that they can decide whether or not the gathered data represent — at least in part—the everyday usage of these expressions for spatial reference or whether the elicited data have to be regarded as 'artefacts' of the elicitation method.

With the above described methods of data gathering we elicited corpora of contextually anchored yet complex interactive texts that incorporate many examples of spatial language. This corpus constitutes our comparative data base for the research on verbal reference to space in different languages and cultures. In what follows I will briefly report on the general result of first analyses of these data.

Frames of spatial reference

First analyses of the data gathered in the languages researched by members of our project5 revealed fundamental differences in how these languages refer to space. For describing these differences we use an — at least at the moment somewhat simplified — typology of spatial systems or frames of spatial reference. This typology defines three such systems. We refer to them as 'relative', 'absolute', and 'intrinsic' (see Levinson 1996a: 359, 365–373; 1996b; Senft: 1994a: 419; see also Bühler 1934). They differ with respect to how angles are projected from the 'ground' (or 'relatum') in order to situate the location of the 'figure' (or 'theme') that is referred to (Talmy 1978: 627; see also Senft 1997: 10).

Relative systems are viewpoint-dependent: Localisations in space are derived from, and described on the basis of, the position and orientation of the speaker. In these systems a sentence like

'The ball is to the right of the man'

is understood from the speaker's point of view only — i.e., this reference completely neglects the orientation of the man.

Absolute systems operate on absolute concepts of direction (which may be linear or defined by quadrants). They are based on conventionalized directions or other fixed bearings that can be derived from metereological, astronomical, or landscape features. In these systems (and in our data) we find sentences like e.g.,

'The ball is to the west of the man/
uphill fromthe man/
seawards from the man.'

(see Senft 2017).

Intrinsic systems utilize inherent, intrinsic features of an object to derive a projected region or to anchor the spatial reference to an object in these features. In these systems a sentence like

'The ball is to the man's right.'

is understood as follows: A man is an object with a front and back, a left and right side assigned to it. Thus, in intrinsic systems this sentence refers to the position of the ball on the basis of the orientation of the man—the ball is at the right side of the man, then—the orientation of the speaker does not play any role whatsoever and is — within this system — completely irrelevant for the understanding of this sentence. However, we want to note here that speakers using intrinsic systems for their spatial references also refer to the same configuration with the sentence we already mentioned above, namely:

'The ball is to the right of the man.'

Thus, languages can be ambiguous with respect to whether they use an intrinsic or a relative perspective in their spatial references. Sentences like the last one presented can only be disambiguated in the actual situation and context.

All three systems can be found in a given language, and they can be utilized for spatial reference; however, many of the languages we have been studying so far frequently seem to prefer one frame of reference in a particular context.

Because of these observations we came up with the following hypothesis:

If speakers of a language preferentially use one reference system in a particular spatial domain, then these speakers will rely on a comparable coding system for memorizing spatial configurations and making inferences with respect to these spatial configurations in non-verbal problem solving.

To falsify or verify this hypothesis we developed a number of experiments to test the interrelationship between space and cognition. In what follows I briefly present these tests.

Non-verbal experiments

The next step in our research was to explore the cognitive implications of the three systems of verbal spatial reference. Relative (R), absolute (A), and intrinsic (I) systems differ with respect to their dependence (+) or independence (−)

– with respect to the speaker's location and orientation,

R + A − I −

– with respect to the rotation of the spatial configuration,

R + A + I −

and

– with respect to the rotation of the ground

R − A − I+.

Based on these differences of the three frames of spatial references we developed 5 different non-verbal experiment-like tests. These experiments for the investigation of non-verbal spatial cognition explore the nature of the spatial coding for memory and inference, and make it possible to determine whether this non-verbal coding has certain specific properties. These properties can then be compared to the verbal codings elicited by the first kit to see whether there is a correlation between the verbal and the non-verbal systems of spatial coding (see Danziger: 1993; also Senft 1994a: 420–427).

I will only very briefly describe these experiments and the considerations they are based on here (for detailed descriptions see Brown, Levinson: 1993; Danziger: 1993; Senft: 1994a). First I want to mention that all the five tasks attempt to investigate the opposition between two different coding systems of space, namely between what we call the 'relative' coding system or frame of reference that uses expressions like 'left/right/front/back' for spatial references and the 'absolute' system or frame of reference that uses expressions like 'north/south/east/west, uphill/downhill, seawards/landwards, upriver/downriver', etc., for spatial references. All five tasks within this kit have the same fundamental design. The consultants are shown a stimulus on one table (Table 1) and are instructed to memorize what they have seen. After a short delay they are rotated 180 degrees and led across to another table (Table 2) at a certain distance which faces in the opposite direction from Table 1. The consultants are now asked to reconstruct the same array, or to select the same array from a set

provided. The stimulus arrays are so designed that they have either a left/right or a front/back asymmetry when viewed on Table 1.

To give an illustrative example (see Brown, Levinson: 1993, 8): Suppose the consultants see an arrow on Table 1 that is pointing from their point of view to the right. After a short pause and after having been turned 180° they are led to Table 2. There they find two arrows; again, from their point of view one arrow is pointing to the right and the other arrow is pointing to the left. The consultants are asked now to chose the arrow that resembles the one they just saw half a minute ago on Table 1. Consultants who memorized the orientation of the arrow on Table 1 on the basis of a relative system of spatial coding will select at Table 2 the arrow that — from their point of view — is also pointing to the right — here the fact that standing in front of Table 2 the consultants have turned 180° is of crucial importance. Consultants, however, that use an absolute system of spatial coding memorize the fact that the arrow on Table 1 pointed, e.g., towards north — they will then select the arrow which is also pointing towards this direction at Table 2, completely independent of the fact that they have turned 180° (see Figure 2).

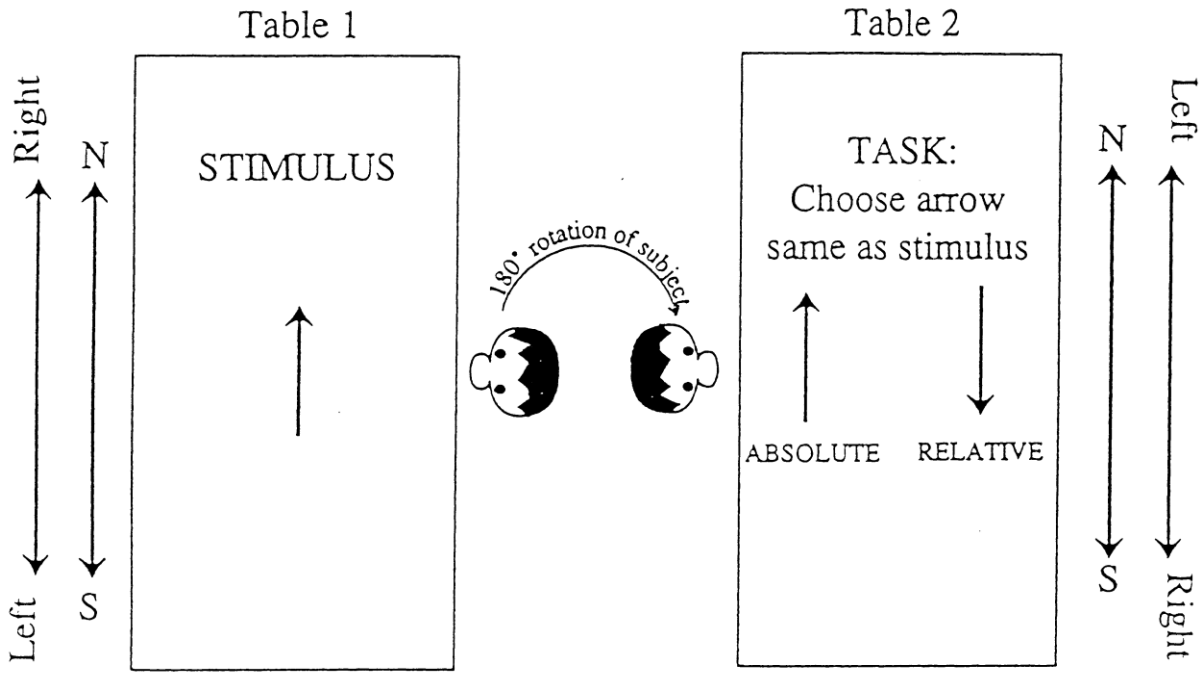

Figure 2.

The first experiment—'animals in a row'—tests recall memory for spatial configurations (see Figure 3). Subjects look at 3 animals in a row, should concentrate on the relative order of animals, are then twisted 180° and asked to remake the same assemblage. The experimenter, however, is really only interested in the alignment direction.

The second experiment—'red and blue mazes'—tests recall and recognition memory for spatial configurations (see Figure 4). This test uses 5 identical cards with 2 differently colored circles of different size. Subjects look at a card and should concentrate on the orientation of the circles, are then turned 180° and are asked to select the card with the same orientation of the circles from among 4 choices of identical, but differently oriented cards.

The third experiment — 'man and paths' (or 'motion maze task') — tests recall and recognition memory with respect to movement in space and the transformation of movement into the construction of a path (see Figure 5). The test consists of a figure resembling a little man and a maze. Subjects look at the little man being walked by the experimenter in a certain complex path and should remember this path; they are then turned 180° and are asked to select the endpoint on a maze where the little man would end up if he had followed that path and not others on the maze.

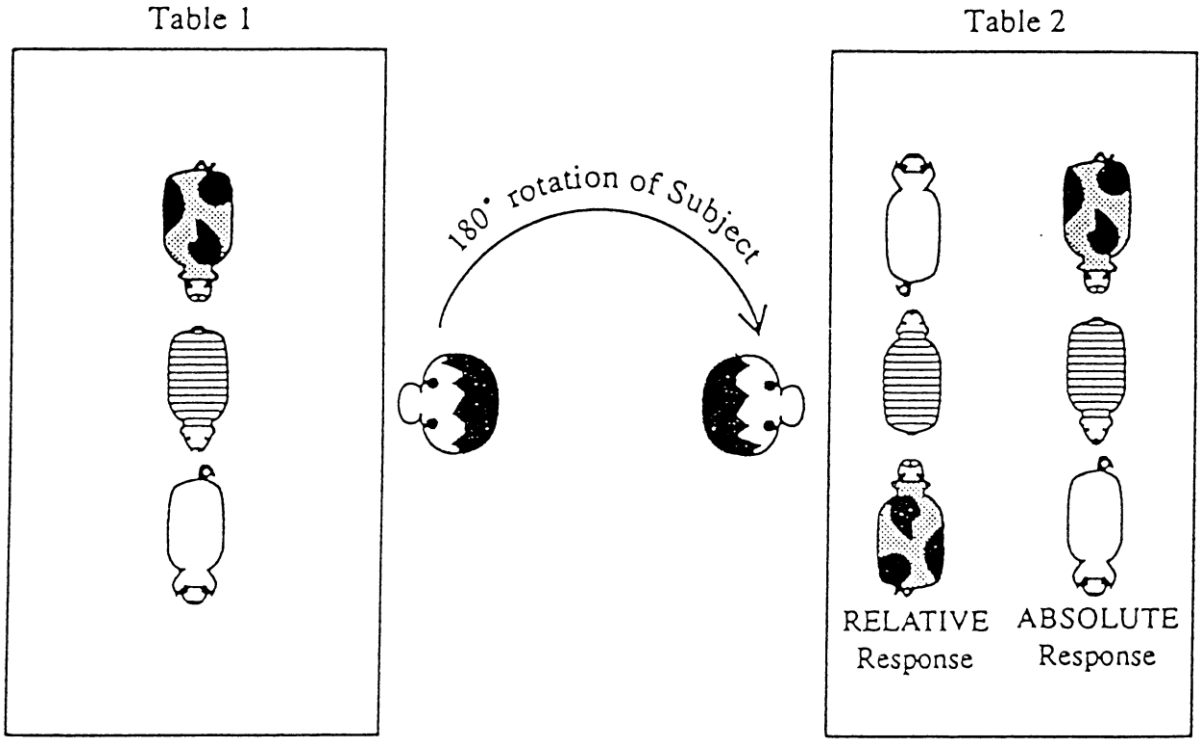

Figure 3. "Animals in a row game"

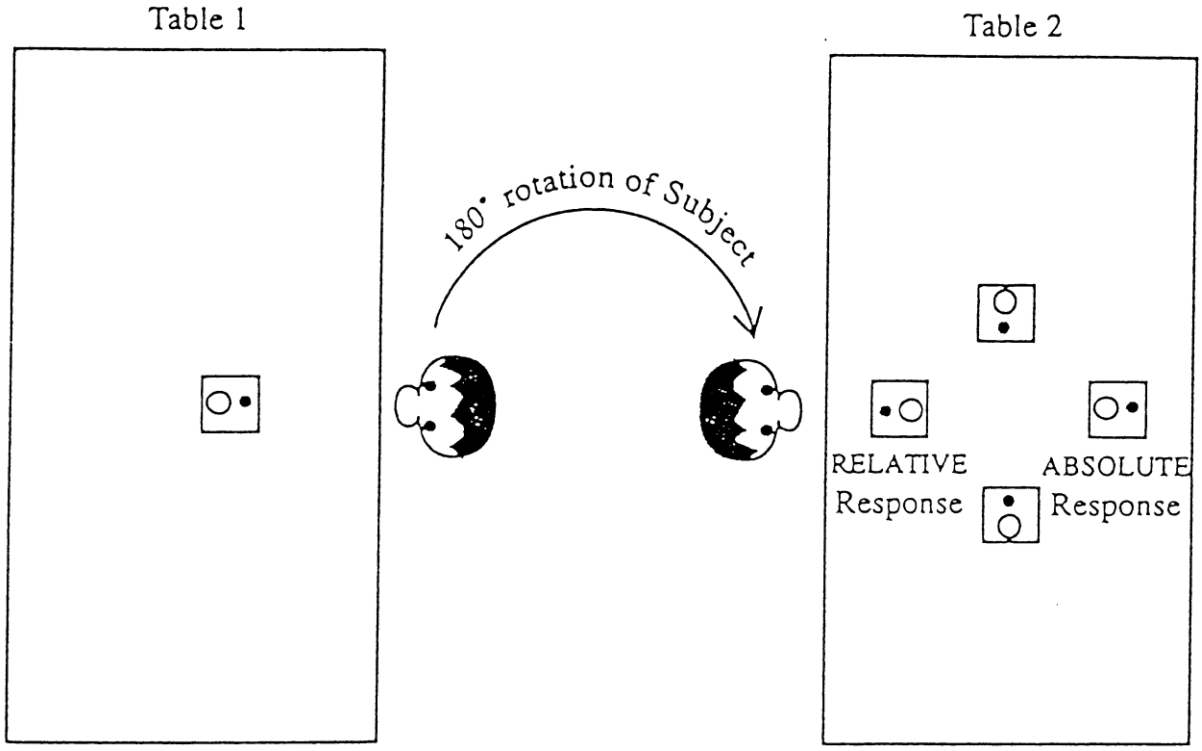

Figure 4. “Red and blue mazes game”

The fourth experiment — ‘the scout game’ (or ‘completed path task’) — tests the ability to finish an incomplete path and recognition memory (see Figure 6). It consists of 5 separate maps with 3 cards—a distractor with a path that does not complete the path seen on the map, a card with a path that is chosen in an absolute response and a card with a path that is chosen in a relative response. Subjects have to look at the map, memorize it, then rotate 180° and are asked to choose one of the three cards that will finish the incomplete path seen on the map.

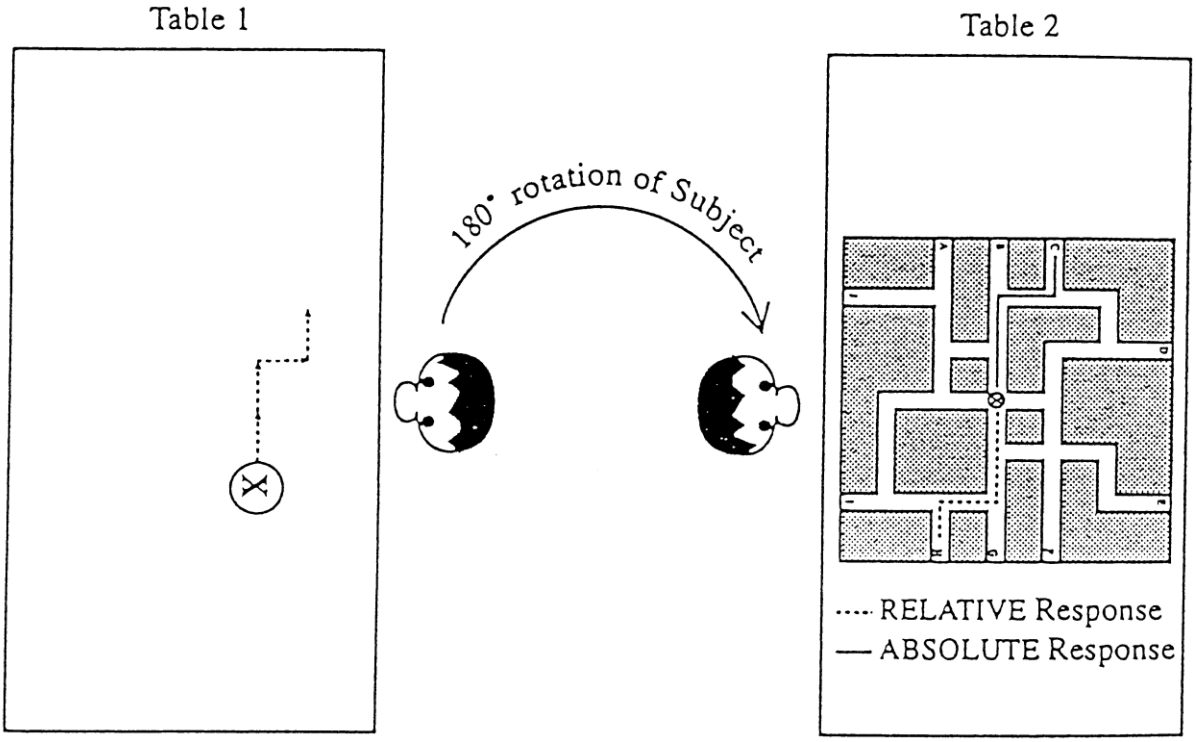

Figure 5. “Man and paths game”

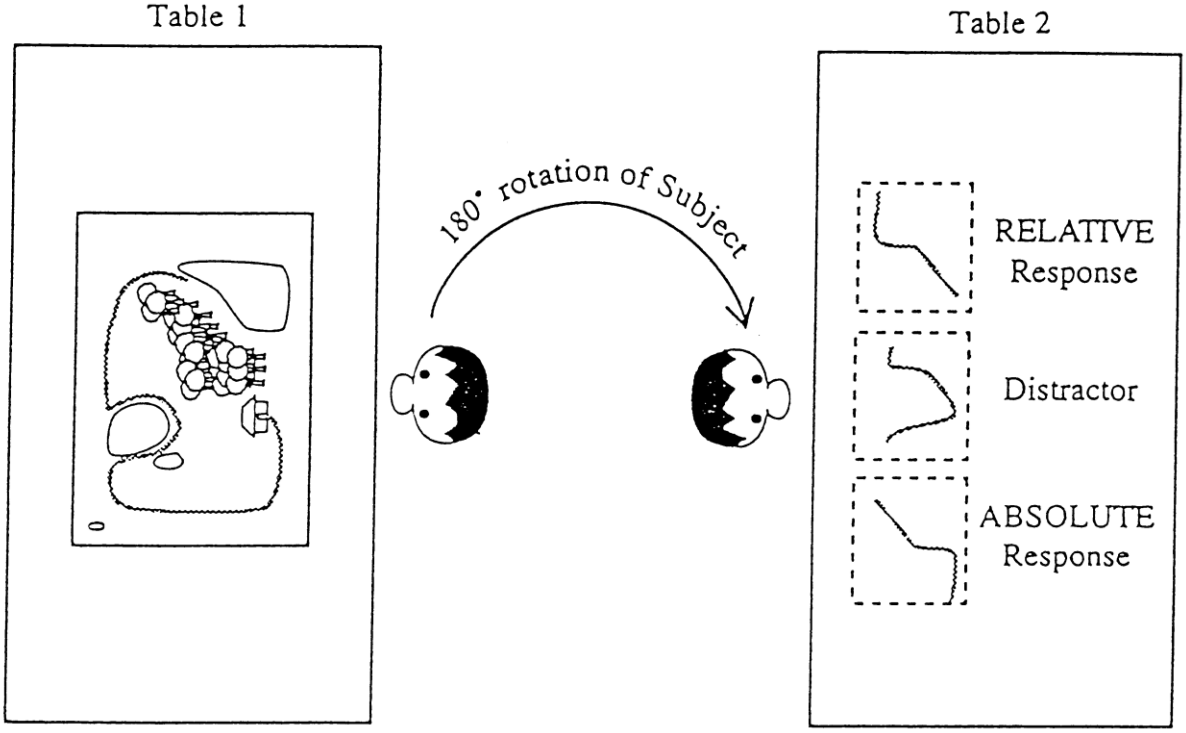

Figure 6. “The scout game”

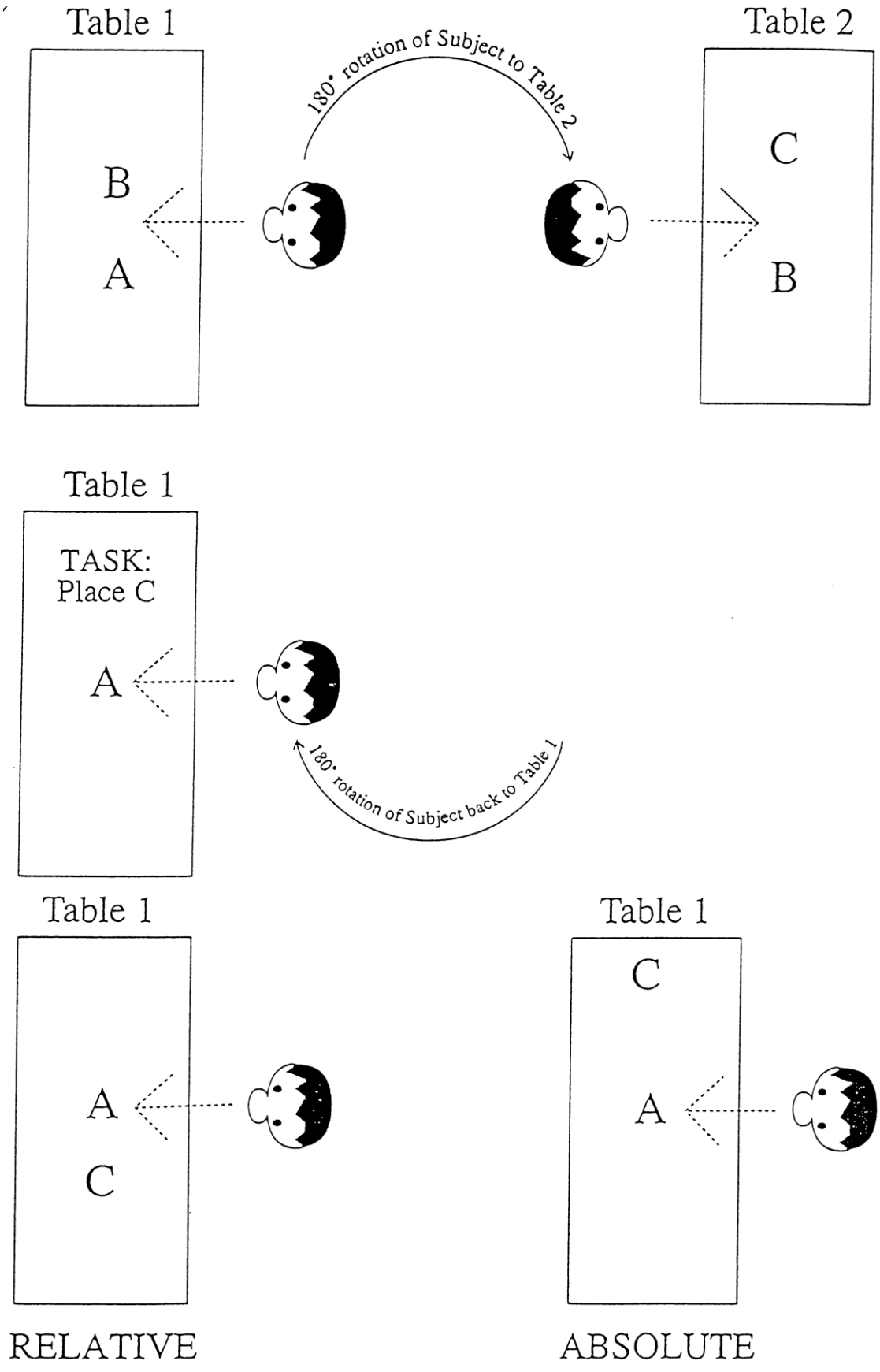

Figure 7. The "transitivity task"

The fifth experiment—'the transitivity task' (or 'transitive inference') — tests the ability to make transitive inferences (see Figure 7). Subjects look at a relationship between the two objects A and B on one table and remember it; then they turn around 180° and go to another table where they look at a relationship of the two objects B and C and remember it; then subjects turn around 180° again and go to the first table; there they see object A — and they have to specify which side of A object C could be located by transitive reasoning (see Figure 7).

Language, cognition and the conception of space

First, though still rather impressionistic and quick, analyses of the elicited verbal data revealed which systems of spatial reference were to be found in the languages researched and which systems were preferentially used by the speakers of these languages. Based on these very first results and with our general hypothesis in mind we made predictions with respect to which results could be expected in the non-verbal cognitive tasks for the various speech communities. Table 1 (see Senft 1995a: 170) summarizes these predictions and presents the results we actually observed in analyzing the subjects' behaviour in the non-verbal tasks:

- The relative, instrinsic, and absolute frames of reference can all be found and can be utilized for verbal spatial references in a given language.
- However, languages seem to prefer certain frames of reference in particular contexts that ask for different spatial tasks and that may require different means and ends of spatial reference, like, for example, expressing the location of objects with respect to each other, and/or with respect to the space and the spatial configuration in which the speaker and hearer are in relation to these objects, and/or expressing the orientation of these objects in space.
- Therefore different means and tasks within the realm of spatial reference may evoke the preferred use of similarly different frames of reference in a given language.
- Thus, if speakers of a given language prefer a specific system of spatial reference in a specific spatial domain for a specific end and with a specific function, then these speakers will use a similar codification system for memorizing spatial configurations and for solving other non-verbal problems in connection with such spatial configurations!

Table 1. Verbal and non-verbal codification of spatial configurations

language	preferred system(s) of verbal codification	system(s) of non-verbal codification	
		predicted	found
Arrernte	A	A	most A
Hai//om	A, (I)	A	most A
Tzeltal	A	A	A
Longgu	A	A	A, also R
Dutch	R	R	R
Japanese	R	R	R, also A
Kilivila	I, R	R	A, also R[4]
Belhara	A	A	most A
Tamil (rural)	A	A	A
Tamil (city)	R	R	R
Kgalagadi	R (A, I)	R	R, also A
Mopan	I	ad hoc	R, A
Totonac	I	ad hoc	R, A

A = absolute reference system
R = relative reference system
I = intrinsic reference system

To sum up, this table shows that our hypothesis with respect to the interrelationship between verbal and non-verbal coding of spatial configurations is verified. It seems that languages indeed do influence the choice and the kind of conceptual parameters their speakers use to solve certain non-verbal problems within the domain 'space', to memorize certain spatial configurations, and to represent them in their long-term memory (see also Levinson 2003).

However, even with results of studies like the one presented here, it remains somewhat problematic to argue that it is only language that influences thought in general. Although the research results show

- that speakers of specific languages have clear preferences for frames of spatial reference in their verbal behaviour

[4] The results for Kilivila do not falsify our hypothesis, as analyzed and explained in detail in Senft (2001: 532 ff); see also Senft (2006).

and

- that these preferences allow for predictions with respect to the speakers' behaviour in non-verbal problem solving tasks in the spatial domain, the following crucial facts should be taken into account:

All speakers who prefer the absolute system can easily switch to forms of behaviour that are based on a relative system of spatial reference if necessary, for example when driving a car and respecting right of way traffic rules. However, speakers that prefer a relative or an intrinsic frame of spatial reference have severe difficulties in switching to an absolute system without using devices like a compass or a GPI system. It is interesting to connect these observations with Dan Slobin's insight that

> the expression of experience in linguistic terms constitutes **thinking for speaking** – a special form of thought that is mobilized for communication. Whatever effects grammar may or may not have outside of the act of speaking, the sort of mental activity that goes on while formulating utterances is not trivial or obvious, and deserves our attention. We encounter the contents of the mind in a special way when they are being accessed for use. That is, the activity of thinking takes on a particular quality when it is employed in the activity of speaking. In the evanescent time frame of constructing utterances in discourse, one fits one's thoughts into available linguistic frames. "Thinking for speaking" involves picking those characteristics of objects and events that (a) fit some conceptualization of the event, and (b) are readily encodable in the language ...
>
> (Slobin 1996: 76)

Slobin also points out that the

> languages we learn in childhood are not neutral coding systems of an objective reality. Rather, each one is a subjective orientation to the world of human experience, and this orientation **affects the ways in which we think while we are speaking**.
>
> (Slobin 1996: 91; see also 1991: 23).

A similar idea to Slobin's concept of 'thinking for speaking' seems to be the basis for Steven Pinker's criticism of Whorf. Pinker states that

> Whorf was surely wrong when he said that one's language determines how one

> conceptualizes reality in general. But he was probably correct in a much weaker sense: one's language does determine how one must conceptualize reality when one has to talk about it.
>
> (Pinker 1989: 360)

And Herbert Clark comments on Whorf's hypotheses in his article 'Communities, Commonalities and Communication' as follows:

> Whorf seemed to take for granted that language is primarily an instrument of thought. Yet, this premise is false. Language is first and foremost an instrument of communication – the '*exchange* of thoughts' – as one dictionary puts it – and it is only derivatively an instrument of thought. If language has an influence on thought, as Whorf believed, that influence must be mediated by the way language is used for communication. The alliteration in my title is not accidental, for communication, as its Latin root suggests, is itself built on commonalities of thought between people, especially those taken for granted in the communities in which each language is used. Once this is made explicit, I suggest, we will find it difficult to distinguish many potential influences of language on thought from the influences of other commonalities of mental life, especially the beliefs, practices, and norms of the communities to which we belong.
>
> (Clark 1996: 325)

By pointing out that language is not primarily an instrument of thought and just one part of many 'other commonalities of mental life' Clark reduces the impact of even the weak version of the Whorf hypothesis to a piece, albeit an important one, within the complex mosaic of the interrelationship between language, culture and cognition. Consequently, Clark defines his position with respect to Whorf's doctrines as follows: 'There can be no [human, G. S.] communication without commonalities of thought. But there can be commonalities of thought, without communication' (Clark 1996: 353).

It should be evident by now that researching the relationship between language, culture and cognition is a challenging but rewarding enterprise. Boas and Sapir and other scholars like Malinowski insisted that the use of language must be studied in its social context. However, whoever wants to investigate the role of language, culture and cognition in social interaction must know how the researched society constructs its reality. Researchers

need to be on 'common ground' with the researched communities, and this common ground knowledge is the prerequisite for any successful research within this domain.

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