Linguistic Untranslatability vs. Conceptual Nesting of Frames of Reference

Giovanni Bennardo (bennardo@niu.edu)
Department of Anthropology and Cognitive Studies Initiative, Northern Illinois University
DeKalb, IL 60115 USA

Abstract

This work focuses on the concept of frame of reference. Levinson (2003) suggested that spatial information encoded in one frame of reference cannot be translated into another one. While this is partially true in language, I argue for a nesting relationship between frames of reference at the conceptual level. A set of spatial concepts suggested by Lehman & Bennardo (2003) informs this investigation. In closing a new typology of frames of reference is proposed.

Introduction

The concept of frame of reference (FOR) is widely used in the literature about the mental and linguistic representations of spatial relationships. After a review of the terminologies used in different disciplines such as philosophy, linguistics, psycholinguistics, developmental and behavioral psychology, brain sciences, and vision theory Levinson (2003) proposed a definition of the concept and a typology of frames of reference.

A FOR is defined as a system of three coordinated axes that create a 3-dimensional space within which spatial relationships are established cognitively and expressed linguistically. Levinson's typology of FOR includes three systems labeled relative, intrinsic, and absolute. When a FOR is realized linguistically, the information coded in one FOR (e.g., 'the ball is behind me') is not translatable into another (e.g., 'the ball is south of me'). While I agree with most of the discussion presented by Levinson, I find problematic the untranslatability issue. I suggest that untranslatability only holds between linguistically instantiated FORs, while at the conceptual level they are nested into each other.

This investigation uses a set of spatial concepts found in Lehman & Bennardo (2003). This conceptual apparatus is the result of analyses conducted on English spatial prepositions, and languages like Burmese, Thai, Italian, and Tongan (Polynesian). After sketching the apparatus, the three FORs are analyzed ending with a suggestion about their conceptual contents and a new typology.

The conceptual apparatus

A computational approach to the general architecture of cognition was adopted to arrive at the set of spatial concepts suggested by Lehman & Bennardo (2003). Within this approach, cognition is conceived as computational (cf. Ballim & Wilks, 1992), thus generatively 'abstract'. Only the characteristics of the computational, or, relational spaces that make up what we call 'cognition' are reiterated in each cognitive module and not the specific characteristics of the substantive content that instantiate these 'abstract' relationships.[1]

A computational approach to cognition can be proposed by accepting compositionality without embracing a Fregean (logico-positivist) point of view and by turning to the domain of mathematics (e.g., algebra and geometry). In mathematics the primitives of a system are a set of axioms. These axioms generate indefinitely many theorems and each theorem can establish a foundation for yet another theorem. Furthermore, theorems may share parts with other theorems in a redundant manner. The set of relational properties of any cognitive system could be, then, nothing but a theorem derived from a set/s of other theorems. Such a system is compositional by definition.

The linguistic analyses in Lehman & Bennardo (2003) yielded the following set of spatial concepts.[2]
State: Object; Place Or Locus; Neighborhood: Vicinity, Contact, Interiority; Motion: Time; Direction; Path: Beginning, Body*, End, (Direction)*; Verticality: Angle: Unit, Quantity (+ or -); Horizontality: Visibility, Left or Right; Center; Part*. (*conceptual content of *Vector*)

Some concepts are not primitives, but rely on other concepts of the same group to function as their axioms. This is the minimal set of axioms that is necessary to account for the theorems (e.g. prepositions, directionals, spatial nouns) that make up the representations of spatial relationships in the languages analyzed.

The concept of Object is used with the meaning of any entity existing in a possible world, either concrete or abstract, e.g. table, idea. The place of an Object is the actual amount of Space that it occupies. In other words, a Place is the set of all points within the boundary of an Object (including the boundary points). The Locus of an Object in projective geometry is defined as the collapse of a Place onto any of its interior points. Then, a Locus is a neighborhood of possible projection points, the lower limit being one point. Thus, while a Place is defined by the size, shape, and specific geometry of the Object, a Locus is not and can be arbitrarily reduced to a point.

The concept of Neighborhood includes the concept of Vicinity (more than zero distance) between two Objects, the concept of Contact (zero distance) between them and the concept of Interiority, or, one Object in the interior of another. The Neighborhood's border is pragmatically determined. These concepts make up the concept of State.

The concept of Motion is an ordered sequence (consequently, with a Direction) of Places (of an Object)

[1] Hirschfeld & Gelman (1994) draw a similar distinction between 'module' and 'domain.'

[2] From now on a concept is indicated by initial capital letter.

in Time, bounded by two Places without either left or right directionality in a disjunctive fashion and never missing both. The concept of Path, instead, is a geometrical (purely spatial) description of motion 'abstracted' from Motion. The focus is not on the moving Object, but on the ordered sequence of Places, now considered as Loci. The concept of Motion is inextricably tied to Time, but the concept of Path is partially free from it. In fact, we can indicate a Path at $Time_1$ and then indicate another Path at $Time_2$ and state that they are the same without incurring a contradiction as would happen if the two parts of the comparison were two instances of Motion. The instances of time used in the construction of a Path are not unique, but they are repeatable.

Two features that Path also shares with Motion are ordered sequence and boundedness. The interior points of a Path are an ordered sequence of Loci with a Direction, that is, they are Vectors with a finite magnitude. This magnitude we call its Body and consists of a set of Loci whose members may at a limit be one, thus, overlapping with the first constitutive Locus. The boundary of a Path consist of two Loci, a Vector that lacks left directionality (Beginning), and one that lacks right directionality (End). Object and Place (axioms of State) participate in the construction of Motion. Locus, instead, participates only in the construction of Path. Thus, the difference between Place and Locus is used to separate the temporally bound Motion from the spatially bound Path.

Verticality and Horizontality were not analyzed in as much detail as State and Motion, and only some conceptual components are indicated. First, Object, Locus, and Vector (a Beginning, a Body or magnitude, and a Direction) participate in their composition. The concepts indicated for Verticality are Angle and Quantity (Increasing or Decreasing). The instantiation of one or other type of Quantity will determine the 'up' or 'down' Direction of a Vector. Angle and Quantity are also part of the concept of Horizontality together with those of Visibility and Left or Right. Visibility contributes to the construction of a 'front-back axis.' After this, Left or Right can be constructed. Finally, the two concepts of Center and Part were added after the analyses of Tongan directionals and spatial nouns (Bennardo, 2000).

The conceptual content of the Relative FOR

Levinson (2003) defines a relative FOR in this way:

> This [a relative FOR] is roughly equivalent to the various notions of viewer-centered frame of reference mentioned above (e.g. Marr's 2.5D sketch, or the psycholinguistics' 'deictic' frame). But it is not quite the same. It presupposes a 'viewpoint' V (given by the location of a perceiver in any sensory modality), and a figure and ground distinct from V. It thus offers a triangulation of three points, and utilizes co-ordinates fixed on V to assign directions to figure and ground. (Levinson, 2003, p. 43)

He continues by pointing out that the viewpoint V does not necessarily coincide with the speaker even though deictic uses can be considered 'basic' or 'prototypical.' (Levinson, 2003, p. 43)

The axiomatic distinction between the figure F (sensory input, Object) and the viewer V (or cognizer in any sensory channel) is conceivable as a primary one, but the distinction between viewer V and ground G can be dispensed with and be regarded as constructed at a later stage in the ontogenic sequence. Both the research on the visual system (Marr, 1982) and on the developmental sequence (Cohen, 1985; Pick, 1993; Bowerman & Levinson, 2001) point towards the primacy of a stage in which viewer V and ground G are conflated. It is exactly the capacity to assign independent sets of coordinates to objects that marks one of the milestones of cognitive development (Piaget and Inhelder, 1956). I feel, then, justified in suggesting this definition for the relative FOR.

A Basic relative FOR is one centered on the speaker, viewer, cognizer (viewer). From the viewer three axes (or six vectors) are constructed, one vertically and two on the horizontal plane (front-back and left-right). In other words, the viewer can be thought of as a point and as such it implies a field (space) around it. This field will be oriented. This orientation process takes into consideration gravity and several bodily characteristics, both static (orientation of face, eyes, etc.) and ambulatory (habitual direction of movement). The viewer necessarily (ontogenically) maps these axes onto himself/herself, that is, considers himself/herself the origin of these axes.

Any Object in this field will be described in relation to the viewer, thus viewer V and ground G are considered as conflated, rather, they have not yet been cognitively constructed as separated. If the viewer moves in any direction, the axes will move accordingly, keeping their origin on the viewer. These axes are an abstraction from 3-D and conic spaces that originate on the viewer and where the angular limit is 180˚. Each axis, in fact, stands for a collection of possible axes whose limits are provided by the following (on three sides) relevant axes.

The appearance of a second Object in the field of the viewer creates the double possibility of treating this latter in direct relationship with the viewer, thus, continuing to map the axes on the viewer, or relating the second Object to the first one. This latter case entails the possibility of assigning orienting axes to the first Object, thus making it function as if it were the viewer. The orientation of the axes mapped onto this Object are the same as that of the axes the viewer had mapped on himself/herself. That is, the coordinates of the viewer's field can be kept constant. The second Object (figure) is described as in relationship with the first Object (ground). The front or 'away' Vector of the viewer is now divided in two parts by the first Object. Then, a new possibility is created. The ground front-back axis may keep the same orientation of the viewer's field, thus, we get the Translation subtype of relative FOR (e.g., 'the ball is in front of [beyond] the tree'). Or the front and back mapping can be flipped so that the front of the first Object (ground) faces the viewer, thus, yielding the Reflection subtype of relative FOR (e.g., 'the ball is in front of [facing viewer] the tree').

Both the Translation and the Reflection subtype of relative FOR are subtypes of the Basic relative FOR. In fact, their left and right assignments are congruent with those of the viewer. In other words, the first Object or ground is not yet considered as a point with an oriented field of its own, but is still tied to the field of the viewer.

It is not possible to arrive at the construction of the Translation and Reflection subtypes without using (consciously or unconsciously) a Basic subtype of relative FOR. In fact, there would be no axis to 'translate' or 'reflect' at all without having already constructed one in advance. And this can only have happened through the use of a Basic relative FOR.

This typology is suggested: a Basic, a Translation, and a Reflection relative FOR.[3] The label Basic highlights the ontogenic primacy of the construction in which viewer and ground G are conflated, that is, a set of coordinates is mapped onto the viewer by him/herself. The other two subtypes are derivative from the Basic and represent a move towards recognizing that Objects have relationships among themselves and not just with the viewer.

Let us now look into the conceptual content of the Relative FOR. We already know from the content of the conceptual apparatus that both vertical and horizontal axes are only the interaction of a subset, labeled Vector, of the concept of Path (Beginning, Body and Direction) with the two concepts of Verticality and Horizontality. The Beginning of these Vectors is a unique anchoring point (the viewer) that is a Locus because its geometric features are not relevant in the construction of the relative FOR (also, the Beginning of a Path is by definition a Locus). Another participating concept is Orthogonality that is the distinguishing factor between vertical and horizontal axes, and between front-back and left-right axes. Orthogonality contains Angle and Unit (degree) with a fixed Quantity attached to this last (90˚ degrees).

All the conceptual content so far listed brings with it other more finely grained content, and, specifically, Vector (as a subset of Path) and Locus. Moreover, this FOR assigns front and back to the Object that becomes the ground by mapping the viewer's coordinates onto it (see the Translation and Reflection subtypes). This mapping can be done by simply applying the 'repeat function' (as for the Translation subtype) or by applying the 'repeat function' and then letting Visibility determine which side is front or back (as for the Reflection subtype). The side that is not visible (beyond the Object) is the back in the same way as it is done for one's body.

The concept of Figure (any possible Object) is also a participant in this construction. Is this Object to be considered a Locus or a Place? Do its geometrical characteristics matter in constructing a FOR? Perceptually these geometrical characteristics are available, but do they play a role in the construction of the FOR? The answer is 'no.' Knowledge about the geometrical characteristics of the Figure does not seem to play any role in the construction of a FOR (see Talmy, 2000). What is relevant, instead, is the fact that a point, the Object, is being picked up in the world by means of a 'choice function' (clearly not provided by perception, but by our intentional thinking) and later put in a spatial relationship with either oneself or another Object according to a specific set of coordinates (in this case a relative FOR).

What does it mean to 'pick an object' in the world? In order to 'see'[4] an object our line of sight has to 'meet' it in the world. In order to think of this object as separated from our self, our line of sight has to be conceived as first leaving our eyes, then penetrating the outside world and finally meeting the object. In other words, the actual construction of any Object requires our use of the concept of Path, with a Beginning (self), Body (penetration of the world outside self), and an End (object in the world). It follows that Path needs to be postulated as participating in the construction of the Relative FOR.

The conceptual difference between the Basic and the Translation and Reflection subtypes of the relative FOR is the following. The two subtypes consider the viewer and two Objects (instead of only one), iteratively employing the concept of Path, a process that needs the use of the 'repeat' function. The coordinates of the oriented field of the viewer are still mapped onto the viewer. In the Translation type the front Vector is kept constant in orientation, while in the Reflection type its orientation is changed as a consequence of the salient use of the concept of Path (from viewer to Object) and Visibility.

The assignment of front and back that distinguishes between the Translation and the Reflection subtypes is left open to cultural variations. Since all the axiomatic conceptual material is already available (Locus, Path, Vector, etc.), the 'repeat' function can be arbitrarily applied to any of these concepts. However, minimally, the Translation subtype is conceptually simpler. In fact, it does not require the use of the concept of Visibility. Then, it is the salience of Visibility in specific cultures that may determine the preferred instantiation of one subtype over the other. Cases in point are Dutch (and English) speakers who habitually use the Reflection subtype (Levinson, 2003); Hausa and Tongan speakers who habitually use the Translation subtype (Hill, 1982; Bennardo, 2000); and Japanese speakers who use both (Levinson, 2003). This is a summary of the conceptual content of the Relative FOR. *Object; Locus; Path; Six Vectors, each with a Beginning (Locus of viewer, or anchor point), Body, Direction; Verticality; Horizontality; Visibility; Orthogonality, with an Angle, Unit (degree), Fixed Quantity (90˚ degrees).*

To this we need to add the 'choice function' used to construct an Object. For the Translation and Reflection subtypes, we must add also the 'repeat function' yielding two Objects and the construction of the front and back Vectors onto one of them. Both functions are axiomatic cognitive processes. For the Reflection subtype, repeated use of the concept of Visibility must be added.

The Intrinsic frame of reference

An Intrinsic FOR is one centered on an Object that is not the viewer. From the Object, three oriented axes (or six vectors) are constructed, one vertically and two on the horizontal plane. Any Object in the space defined by these coordinates is described in relation to the Object from which the space was constructed. When the Object

[3]The 180˚ rotation subtype of relative FOR in Levinson (2003) is not indicated here because within this work that subtype is considered as an instantiation of an intrinsic FOR.

[4]This discussion is limited to only visual input.

moves, the axes will move accordingly keeping their origin on the Object and the assigned orientation as well.

What differentiates the Relative and the Intrinsic FORs is that the Beginning of the Vectors is not from the viewer, but from an Object other than viewer. We have already seen that this is also the case for the Translation and Reflection subtypes of relative FOR. What is it that distinguishes these latter two FOR from the Intrinsic one?

The difference lies in the quality of the oriented field that is constructed for the Object or ground. This field is completely independent in orientation from the viewer; it is in other words a new separate field from that of the viewer. This difference has very important consequences, among which the most relevant is that the description of the spatial relationship between two Objects will be freed from references to the viewer. This, however, does not mean that the field of the viewer has not been used to construct the new field. Specifically, when we express linguistically a spatial relationship by utilizing an Intrinsic FOR, conceptually we must have used a Basic relative one in order to arrive at the construction of the first Object (Figure) and the second Object, making this latter a ground by constructing from it oriented axes.

What remains to be seen is how the axes of this new field are oriented. Typically the following three concepts have been associated with the Object that functions as ground in order to orient the axes mapped onto it: Animacy, Habitual Direction of Motion, and Habitual Use (Herskovits, 1986; Talmy, 2000). It is understood then that these three concepts participate in the construction of the Intrinsic FOR in a disjunctive fashion. That is, usually only one is necessary. It is, then, a specific characteristic of the Object picked to function as ground that determines the orientation of the axes mapped onto it. Only one axis need to be oriented, typically the frontal one, and the orientation of the others will follow.

Regarding the conceptual content of the Intrinsic FOR, all the content suggested for the Relative FOR needs to be postulated for the Intrinsic FOR as well. We also have to include the 'choice function' and the 'repeat function.' New concepts to be added are Animacy, Habitual Direction of Motion, Habitual Use (disjunctively used, even though they may overlap), and finally Part. In fact, the Object onto which the coordinates are mapped, needs to be assigned a 'front.' That is, a minimal subdivision of the Object into parts must be done.

The Absolute frame of reference

An Absolute FOR is neither centered on the viewer nor on an Object. First, the two Vectors related to the vertical axis are constructed. Second, on the horizontal plane one or more Objects (e.g., areas, points, landmarks) in the field of the viewer are chosen as orienting points. Third, either the viewer or any Object in its field is put into relationships with these Objects or fixed points.

Two examples of this system are the one that uses cardinal points, and the one that uses landward-seaward directions used by the speakers of many Oceanic languages. In many other cases the environmental features selected differ profoundly and may range from a mountain to a lake, or from a river to a building.

The process of selecting fixed orienting points in the environment requires minimally the activation of the Relative FOR. Once these fixed points have been conceptually established and agreed upon socially, these same points may function as an orienting framework between either one Object in the field of the viewer and one of the fixed points (e.g. North) or between any two Objects in the field of the viewer and one of the fixed points. We have already seen in the previous discussion of the other two types of FOR that the process of selecting/choosing an Object to function either as figure or ground implies the use of the concept of Path. For the construction of the absolute FOR, then, we need minimally either one or two Paths required for the construction of the Object or Objects to be put into relationship with any of the orienting fixed points. To these we have to add two (for the Oceanic system) or four (for the cardinal points system) Paths for the choice of the fixed points of reference.

Table 1 summarizes the conceptual content of the various types of FOR. A capital X indicates the presence of a concept in the construction of a FOR. For the concepts of Object, Path and Vector a number indicates how many times the concept is minimally used.

Table 1: The conceptual content of FORs

Concept/Axiom	Relative			Intrinsic	Absolute
	Basic				
		Transl	Reflect		
Locus	X	X	X	X	X
Object	1 + V	2 + V	2 + V	2 + V	1/2+2/4+V
Path	1	2	2	2	3/5 or 4/6
Vector	6	6	6	10	6
Verticality	X	X	X	X	X
Horizontality	X	X	X	X	X
Orthogonality	X	X	X	X	X
Visibility			X		
Part				X	
Animacy**				X**	
Hab Dir Mot**				X**	
Habitual Use**				X**	
Choice Funct*	X	X	X	X	X
Repeat Funct*		X	X	X	X

*These two are cognitive processes.
**Only one is necessary.

From Table 1 it can be seen how the conceptual axiomatic content of the Basic relative FOR is properly contained in its entirety in all the others, both subtypes (Translation and Reflection) and types (Intrinsic and Absolute). The Intrinsic and the Absolute are both derived from the Relative, although not in an ordered sequence. The Relative FOR, then, is suggested as an axiom for both the Intrinsic and the Absolute ones.

The Intrinsic and Absolute FORs are made of two different sets of concepts. The Intrinsic FOR expresses more attention to the nature of the Object functioning as ground (see the participation of the concepts of Part, Animacy, Habitual Direction of Motion, Habitual Use in

Table 1). The Absolute FOR, instead, expresses greater attention to the nature of the field (see the participation of a greater number of Objects and Paths in Table 1).

These findings are perfectly congruent with those of Baayen & Danziger (1994) and Levinson (2003) regarding a preferred use of the Intrinsic FOR by speakers of Mayan languages, where an extremely elaborate vocabulary also exists for describing parts of objects. Similar congruency can be highlighted with the findings of Levinson (2003) concerning the preferred use of the Absolute FOR by speakers of Australian Aboriginal languages where a very elaborate system of naming landmarks in one's environment has also been reported.

Finally, we look closely at the issue of 'untranslatability' among the various FORs suggested in Levinson (2003, p. 57-59). When we consider FORs as instantiated into linguistic expressions, it is true that in principle only two cases of translation are possible from one FOR to another (i.e., from either Absolute or Relative to Intrinsic). Do we deduce that there is 'untranslatability' among FORs at the conceptual level? Our discussion points towards a negative answer. In fact, the conceptual content of the Relative FOR has been suggested as an axiom for the Intrinsic and the Absolute ones. Thus, if at the linguistic level we find 'untranslatability' between FOR, at the conceptual level we find 'nesting.' Besides, the direction of the translatability from Relative and Absolute to Intrinsic correlates with one independent field in the former vs. two independent fields in the latter.

A Radial subtype of the absolute FOR

Bennardo (1996) reported the results of an investigation of the uses of FORs in Tongan language, spatial cognition, and culture. During this investigation a Radial subtype of absolute FOR was suggested as having a privileged status. This FOR consists in positing a center in one's field out of which movement is conceived either centripetally or centrifugally on any plane. This finding requires a reexamination of the typology of FORs. In particular, we need to look closer at the subtypes of the absolute FOR: Radial, Single Axis, and Cardinal Points.

For each of the three subtypes there are two cases to be considered. The first is when the ground is the viewer, e.g. "X is north of me.' The second is when the ground is an Object different from the viewer, 'e.g. X is north of Y.' Each case yields different conceptual content.

In the first case we need a Center that is the viewer and an Object (Figure). A Path from the viewer to the Object is also required as well as (minimally) a Vector made up of the Body of a Path and its End (centrifugal movement) or Beginning (centripetal movement). Either the End or the Beginning of this Path would be co-indexed with the Center. In the second case we have to add a second Object, which will function as Center, and a Path that is used to determine this Center (or second Object). The difference between the two cases is crucial. Choosing a Center different from viewer, makes possible the construction of a second field different from the one constructed around the viewer.

The conceptual content for the Single Axis subtype consists, in the first case, of one Object (Figure) plus two Objects (the two ends of the axis), the viewer, three Paths (from the viewer to the three Objects), and six Vectors (up, down, front, back, left, and right). In the second case, an Object for the new ground Object and a Path for its construction are added. A new field different from the viewer's is not constructed.

The conceptual content for a Cardinal Points subtype consists, in the first case, of one Object (Figure) plus four Objects (the cardinal points), the viewer, five Paths (from the viewer to the five Objects), and six Vectors (up, down, front, back, left, and right). An Object is added for the new ground Object and a Path for its construction. A new field different from the viewer's is not constructed.

Table 2: Conceptual content for types of Absolute FOR

	Concept		
Subtype of Absolute FOR	Object	Path	Vector
Radial 1	1 + V	1	1
Radial 2	2 + V	2	1
Single Axis 1	1 + 2 + V	3	6
Single Axis 2	2 + 2 + V	4	6
Cardinal Points 1	1+ 4 + V	5	6
Cardinal points 2	2 + 4 + V	6	6

In Table 2, the conceptual content of the Radial subtype is the simplest. The contents of the two Radial subtypes are also simpler than the content of the Basic subtype of the relative FOR in Table 1. Consequently, the axiomatic relation between the Relative, the Intrinsic, and the Absolute FORs needs some further attention.

A new typology of Frames of Reference

In discussing the relationships between the types and subtypes of FOR three parameters are considered. The first is the magnitude of the conceptual content, that is, the number of concepts necessary to derive each theorem. The second is the reference that will be made to axiomatic relationships. When the content of a FOR is completely contained in another, then the former will be considered an axiom of the latter. The third is the emergent properties that each FOR displays. Namely, it must be considered if a FOR is based on the construction of one or two fields.

The minimal conceptual content and the construction of only one field associated with the Radial 1 subtype of the absolute FOR make it the choice as the most basic. This FOR, then, is an axiom for all the other types and subtypes. Its great simplicity makes it highly context bound and hence very unlikely to be the only one that any individual/culture will have. Nonetheless, it represents a minimal stage of spatial organization assigned to the external world. Evidence from languages around the world suggests that this system is always used, i.e., in demonstrative systems.

Looking for a FOR at the second stage of complexity, or more precisely, the first theorem derived from a set of axioms whose content is at a limit only the Radial 1 axiom, we confront two options. The first is to choose the Radial 2 subtype of the absolute FOR, simple in conceptual content, though it uses two fields. The second

is the Basic relative FOR that is more complex conceptually (it needs six Vectors instead of one), but uses only one field. A decision is not strictly necessary at this juncture; both options are viable. Empirically, there are language speakers that choose to use prevalently one option only (e.g. English speakers choose a Basic relative FOR), and other that choose both (e.g. Tongan speakers).

We have stated that the Relative FOR functions as an axiom for the Absolute and the Intrinsic FOR, and for two subtypes of the Relative FOR. These latter keep the single field feature, but increase their conceptual content because of their complex treatment of the front-back axis.

The Single Axis and Cardinal Points subtypes of the absolute FOR and the Intrinsic FOR are obtained in substantially different ways. The two Absolute FORs represent an increased conceptual content from the Relative FOR and use a single field. This is confirmed by the fact that they both use the vertical axis. The Radial 1 and 2 subtypes did not have it in their conceptual content.

The intrinsic FOR is obtained by an increased conceptual complexity due to two other factors (besides the addition of the vertical axis). The first is a closer attention devoted to the Object that functions as figure. The second is the construction of two fields (the viewer's and the figure's). We have seen that the construction of two fields is part of the conceptual content of the Radial 2 subtype of the absolute FOR. Then, we suggest that the conceptual content of the intrinsic FOR is derived from the Basic subtype of the relative FOR, from the Radial 2 subtype of the absolute FOR, and from conceptual characteristics of the Object/Figure.

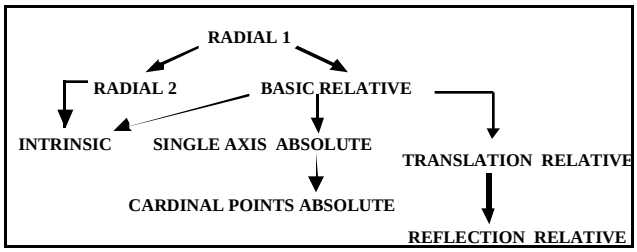

Figure 1: A typology of Frames of Reference

The arrows in Figure 1 indicates that the FOR receiving the content of another FOR treats this latter as an axiom of its conceptual content. Further conceptual material is added at each stage. Thus, the necessity of a new label for that particular type of FOR.

Conclusion

The first part of this work was devoted to the introduction of the conceptual apparatus that is the major theoretical tool employed in the analyses of the conceptual content of FORs. Each member of the typology of FORs suggested by Levinson (2003) was later analyzed. and a primary revision was suggested. Nesting of FORs was proposed at the conceptual level instead of untranslatability. Then, a Radial subtype of absolute FOR was introduced. This made clear that a further revision of the typology was needed. Finally, the revision resulted in the proposed typology of FORs in Figure 1. It is believed that this typology can be useful for further investigation of FORs.

Acknowledgement

My special thanks go to Kris Lehman and Janet Keller for reading through various drafts of this work. Mistakes, misrepresentations or fallacies are mine.

References

Baayen, H., & Danziger E. (Eds.) (1994). *Max-Planck Institute for Psycholinguistics: Annual Report 14, 1993*. Nijmegen, The Netherlands: Max-Planck Institute for Psycholinguistics.

Ballim, A., & Wilks Y. (1992). *Artificial Believers: The Ascription of Belief*. Hillsdale, NJ: Lawrence Erlbaum.

Bennardo, G. (1996). *A Computational Approach to Spatial Cognition: Representing Spatial Relationships in Tongan Language and Culture*. Doctoral dissertation, Department of Anthropology, University of Illinois at Urbana-Champaign, Urbana, Illinois.

Bennardo, G. (2000). Language and Space in Tonga: 'The Front of the House is Where the Chief Sits!' *Anthropological Linguistics*, 42,4, 499-544.

Bowerman, Melissa, & Levinson S. C. (2001). *Language Acquisition and Conceptual Development*. Cambridge: Cambridge University Press.

Cohen, R. (Ed.) (1985). *The Development of Spatial Cognition*. London: Lawrence Erlbaum Associates, Publishers.

Herskovits, A. (1986). *Language and Spatial Cognition : An Interdisciplinary Study of the Prepositions in English* . Cambridge: Cambridge University Press.

Hill, C. (1982). Up/Down, Front/Back, Left/Right. A Contrastive Study of Hausa and English. In J. Weissenborn & W. Klein (Eds.), *Here and There: Cross-Linguistic Studies on Deixis and Demonstration*. Amsterdam: John Benjamins.

Hirschfeld, L. A., & Gelman S. A. (Eds.) (1994). *Mapping the Mind: Domain Specificity in Cognition and Culture*. Cambridge: Cambridge University Press.

Lehman, F. K. & Bennardo G. (2003). A Computational approach to the cognition of space and its linguistic expressions. *Mathematical Anthropology and Cultural Theory*, 1, 2, 1-83. See: www.mathematicalanthropology.org/

Levinson, S. C. (2003). *Space in language and culture: Explorations in cognitive diversity*. Cambridge: Cambridge University Press.

Piaget, J., & Inhelder B. (1956). *The Child's Conception of Space*. New York: The Humanities Press Inc.

Pick, H. L. (1993). Organization of Spatial Knowledge in Children. In N. Eilan, R. McCarthy, & B. Brewer (Eds.), *Spatial representation: Problems in Philosophy and Psychology*. Oxford: Basil Blackwell Ltd.

Talmy, L. (2000). *Toward a Cognitive Semantics, Volume 1: Concept Structuring Systems*. Cambridge, MA: The MIT Press.