3. Spatial Frames of Reference

Reference frames are coordinate systems used to interpret linguistic and nonlinguistic representations of the location, motion, and orientation of entities. They are constituted by an origin and one or more (semi-)axes. In representations of location/motion, the origin is a reference point, most commonly a reference entity or **ground**. The axes are defined with respect to a contextual index, the **anchor**. Psychologists are accustomed to classifying frames on the basis of the identity of the anchor in terms of **egocentric** vs. **allocentric** frames, as illustrated in the left column of Figure 1. As it turns out, however, this classification does not capture the variation in frame use across languages: egocentric and allocentric frames are used in all languages, but certain subtypes are not. These subtypes differ by the operations involved in deriving the axes. Thus, all egocentric frames are anchored to the body of an observer, but only **relative** frames involve projection (geometrically, translation ± reflection) of the observer's body axes onto a distinct ground (as in 'The ball is left of the tree'). In small-scale horizontal space, speakers of Dutch, English, and Japanese use relative frames and to some extent **intrinsic** (object-centered) frames, but not **geocentric** frames derived from the environment. In contrast, speakers of Tenejapan Tseltal and many other languages use intrinsic and geocentric frames, but not relative ones. Figure 1 shows correspondences between the classifications used by much research in psychology and those that language typology has been found sensitive to. MesoSpace is going with the fine-grained classification shown in the central column of Figure 1, since it supports analyses of the data according to both the classification favored by the psychological literature and that used by typologists. The term 'egocentric' is understood here in the sense of involving an observer perspective, regardless of whether the observer is the speaker or addressee of an utterance or some other person. For example, the observer of the direct frame in (1) can be the addressee, but also a generic person on the impersonal interpretation of the pronoun:

(1) *When you enter, the bar is on your left*

Both egocentric and geocentric FoRs can be either **angular-anchored**, in which case their axes are derived through transposition or abstraction from axes or gradients of the anchor, or **head-anchored**, in which case their axes point towards or away from the anchor. Object-centered descriptions are by necessity angular-anchored. The descriptions in (2), in the context of their egocentric interpretations, involve angular-anchored FoRs. Examples of head-anchored egocentric descriptions are shown in (4):

(2) a. *The ball is left/in front of the chair*
b. *The ball is left/in front of me*
(3) a. *The ball is toward the door from the chair*
b. *The ball is seaward from the chair*
c. *The ball is uphill from the chair*
(4) a. *The ball is toward me with respect to the chair*
b. *The ball is on my side of the chair*

Geomorphic descriptions such as (3c) are angular-anchored, whereas landmark-based descriptions such as (3a) and (3b) are head-anchored. In the Nijmegen classification, head-anchored egocentric descriptions such as those in (4) are necessarily intrinsic, whereas angular-anchored egocentric descriptions can (and generally will) have both intrinsic and relative interpretations. Both angular-anchored and head-anchored geocentric FoRs can be intrinsic or absolute depending on whether their axes are merely transposed or abstracted from those of the anchor. Table 1 summarizes the relationship between the three classifications. The classification by anchoring type is complementary to the existing classifications of FoRs and does not replace any of them.

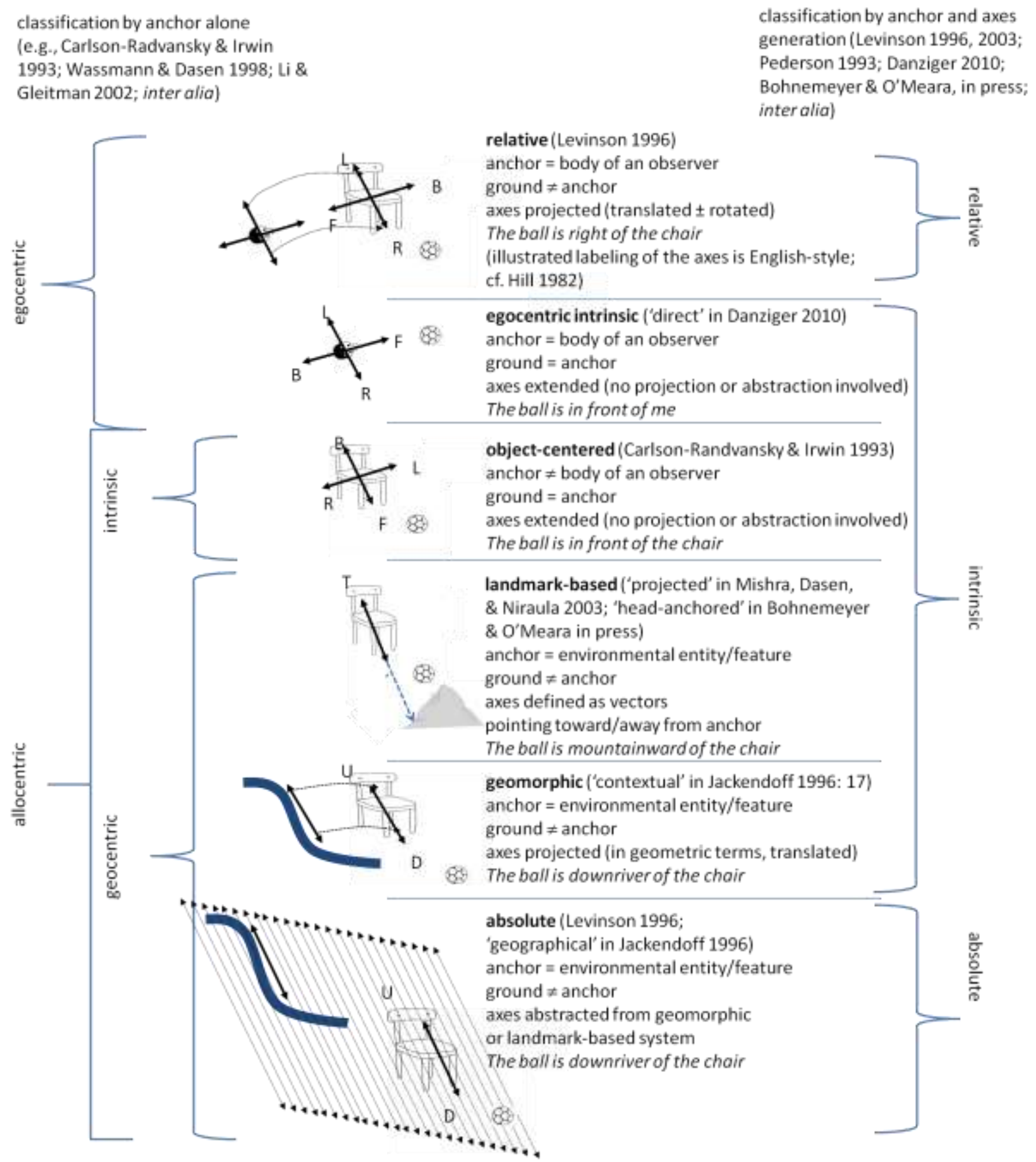

Figure 1. *Reference frame types and their classification (A - 'away from', B - 'back', D - 'downriver', F - 'front', L - 'left', R - 'right', T - 'toward', U - 'upriver')*

Table 1. *Existing classifications of FoRs and anchoring type*

psych. classific-ation	Egocentric				object-centered		geocentric			
typological classific-ation	intrinsic		relative		intrinsic		intrinsic		absolute	
anchoring type	ang.-anch.	head-anch.	ang.-anch.	head-anch.	ang.-anch.	head-anch.	ang.-anch.	head-anch.	ang.-anch.	head-anch.
comment	"direct" in Danziger 2010			N/A		N/A	"geomorphic"	"landmark-based"		
example (locative descriptions)	*The ball is left/ in front of me*	*The ball is on my side of the chair*	*The ball is lef/in front of the chair*		*The ball is left/in front of the chair*		*The ball is uphill/downriver from the chair*	*The ball is toward the door/seaward from the chair*	*The ball is north of the chair*	N/A

The angular-anchored/head-anchored dichotomy affects the diagnostics of reference frames. Head-anchored representations – of location and orientation alike – resemble angular-anchored representations in that they are "perspectival", i.e., their interpretation depends on a perspective. But there is a fundamental difference between the two types in how this perspective manifests itself: the truth conditions of angular-anchored representations depend on the orientation of the anchor, but not on its location, whereas the truth conditions of head-anchored descriptions conversely depend on the location of the anchor, but not on its orientation. Consider, for illustration, the angular-anchored locative descriptions in (5):

(5) a. *The ball is left/in front of the chair*
b. *The ball is uphill from the chair*

The truth of (5a) depends, under the egocentric/relative interpretation, on the orientation of the observer vis-à-vis the chair and, under the object-centered interpretation, on the orientation of the chair. In the egocentric/relative interpretation, the truth of the representation changes as the observer's body rotates, while rotation of the chair does not affect it. In the object-centered interpretation, it is the inverse: it is in this case a rotation of the chair around its top-down axis that affects the truth conditions of the description. In contrast, changes to the location of the anchor – the body of the observer under the relative interpretation and the chair under the intrinsic one – have, at least in first approximation, no impact on the truth of the representation. This holds with the general proviso that relative FoRs tend to presuppose that the observer is facing the ground, and changes of the observer's position that affect the satisfaction of this presupposition may thus indirectly affect the truth conditions of the description. The same holds for (5b): its truth conditions are affected by the orientation of the hill, but not by the location of the hill. In this case, too, there is an independent constraint that muddies the waters somewhat. Imagine moving the hill from a location in which (5b) is true to the other side of the configuration of the ball and chair. Even if the direction vector from the ball to the chair that was identified as 'uphill' previously remains the same, it is likely that the configuration of ball and chair is now closer to a different slope of the hill and the vector will therefore be labeled 'downhill'.

The principal dependence of angular-anchored FoRs on the orientation of the anchor also holds for orientation descriptions such as those in (6):

(6) *The chair is facing left/uphill*

In Levinson (2003: 50-53), orientation dependence is in fact used as a diagnostic for distinguishing relative, intrinsic, and absolute FoRs. However, on closer inspection, the dependence on the orientation of the ground Levinson considers a diagnostic of the intrinsic type in fact holds for object-centered FoRs only, but not for head-anchored intrinsic descriptions such as those in (7):

(7) a. *The ball is toward me/the door from the chair*
b. *The chair is facing me/the door*

In these cases, it is changes in the location of the anchor that affect the truth of the representation, whereas they are completely insensitive to the rotation of the anchor. This difference in the behavior of angular-anchored and head-anchored FoRs follows straightforwardly from the difference in how their axes are constituted. The axes of angular-anchored FoRs are derived from those of the anchor through transposition or abstraction. As a result, the FoR rotates with the axes of the anchor. In contrast, head-anchored FoRs are calculated based on vectors defined in terms of their beginning and end coordinates. The region occupied by the anchor characterizes one of these two places. Consequently, the (semi)axis of the FoR thus constituted changes with the location of the anchor, whereas its orientation plays no role.

The Earth's field of gravity serves as the anchor of absolute FoRs that are apparently accessible for the interpretation of vertical spatial relations in all languages. At any rate, no language has been attested to date in which vertical relators do not have viewer- and ground-independent interpretations. Since the use of gravity-based FoRs is not typologically restricted in the way the use of other absolute types of FoRs is, it should be treated as a separate category. Another coding choice, in addition to the seven types of FoRs distinguished above (i.e., the six of Figure 1 plus the vertical absolute type), is that of **topological** locative descriptions in the sense of Piaget and Inhelder (1956). The interpretation of these does not depend on FoRs. They involve non-perspectival figure-ground relations such as containment, contact, proximity, and distance. In research on spatial FoRs, topological and intrinsic descriptions are often lumped together. Here, too, the fine-grained coding schema makes it possible to analyze the data in this fashion should one so desire.

3.1. Hypotheses and Research Questions

A growing controversy has arisen around the demonstration in Levinson 1996 and 2003 and Levinson et al. 1998 of a robust crosslinguistic alignment of FoR use in language, recall memory, and spatial inferences. Pederson et al. 1998 show that speakers of a language that prefers relative FoRs in a given domain will also rely on relative FoRs in memory and inferences in the same domain, whereas speakers of a language that employs an absolute FoR in the same domain will encode states of affairs in this domain in absolute terms in memory and derive placement inferences based on an absolute FoR. These findings are consistent with a relativistic interpretation according to which FoR selection in language determines FoR selection in internal cognition. On the basis of experiments with American college students, Li & Gleitman 2002 have sought to invalidate the interpretation of possible effects from language onto internal cognition, arguing that FoR preferences in recall memory are easily mutable. The authors replicated one of the designs used in Pederson et al. 1998, in which participants memorize an array of toy animals and then reproduce it after undergoing 180-degree rotation (cf. §3.2-3.3). Li & Gleitman 2002 introduced a new condition employing an ad-hoc landmark (a toy duck pond). This induced a shift in the participants' recall memory strategy that the authors interpret as evidence for employment of an absolute FoR. The authors reason that if American college students can be induced to perform like the Tenejapan Tseltal speakers described in (Levinson 1996 & 2003, Pederson et al. 1998), then the crosslinguistic differences found in these studies may be no more than shallow artifacts of environmental conditions and cultural factors. However, Levinson et al. 2002 and Levinson 2003 demonstrate that the experimental results of Li & Gleitman 2002 do not in fact straightforwardly support the authors' conclusions. Replication of the duck-pond condition under 90-degree, rather than 180-degree, rotation shows clearly that the landmark-based frame projected from the toy duck pond is an intrinsic, not an absolute, FoR. Li & Gleitman 2002 failed to properly distinguish between landmark-based (geomorphic) and absolute FoRs. Consequently, they did not, in fact, demonstrate that Westerners can be easily induced to perform like Tenejapans. Similarly, Li et al. 2005 report what they argue to be evidence of egocentric FoRs in recall memory used by Tenejapan participants in their experiments. In these experiments, participants had to reproduce the orientation of a playing card after having rotated 180 degrees. The original card was concealed in a box which was given to the participants prior to rotation. In a "geocentric" condition, the box with the card would not change orientation while the participants rotated, whereas in the "egocentric" condition, it would rotate with the participants. It was found that the difference between the conditions had no significant effect, which the authors present as evidence that the use of egocentric and allocentric FoRs in recall memory is equally natural to Tenejapans. However, as discussed in §3.4, a FoR projected from the observer's own body is, in fact, an intrinsic, not a relative, FoR. Thus, just as Li & Gleitman 2002 did not actually demonstrate that Euroamericans are easily induced to perform like Tenejapans, so Li et al. 2005 did not actually demonstrate the Tenjapans are easily induced to perform like Westerners.

The MA area provides a unique opportunity to improve our understanding of language and culture as factors in determining the use of FoRs in internal cognition. It puts us in a position to study populations that are closely matched in terms of their environment, modes of production, and literacy, with language being the potential major differentiating factor – the position of Li & Gleitman 2002 would seem to predict that language should not be able to make a fundamental difference in cognitive performance here. We have, moreover, for the first time possible linguistic predictors of FoR preferences in language, and may thus be able to pit these against other cultural factors to see just how autonomous FoR choices in language use really are. Lastly, we have the ability to study, in some communities, monolingual and bilingual speakers of the same language. On the interpretation of Pederson et al. 1998 and Levinson 2003, bilingualism is expected to critically affect FoR selection (in both language and cognition); on the position of Li & Gleitman 2002, it is not.

Preliminary results suggest that the use of relative FoRs is dispreferred throughout MA, as predicted. This pattern appears to extend to Mayangna and Seri, suggesting that it may not be a feature of the MA *sprachbund*. The B&C task newly developed for this project has produced pervasive evidence of object-centered intrinsic FoRs (as in the intrinsic interpretations of 'The ball is in front of the chair') throughout the sample languages. In stark contrast to the predominantly relative Western languages, but also to the best-documented case of FoR use in MA prior to MesoSpace, that of the Tseltal of Majosik', Chiapas, as described by (Brown 2006; Brown & Levinson 1992, 1993; Levinson 1996, 2003; Levinson & Brown 1993),the object-centered frame type appears to be the most frequent for locating the ball with respect to the chair in most of the languages of the sample, especially in the Mayan and Mixe-Zoquean languages. In the two Uto-Aztecan languages of the sample, Cora and Nawat, and in Isthmus Zapotec, geocentric and **head-anchored** descriptions (8; see below), which use local landmarks or the bodies of the participants as heads of vectors that define axes of FoRs ('The ball is on my side of the chair', 'The ball is toward the door from the chair'), dominate in locative descriptions. There are no languages in the sample in which relative frames dominate in locative descriptions.

The most unexpected of these findings are the pervasive use of cardinal direction terms and absolute FoRs in Isthmus Zapotec and the low importance of absolute FoRs in the three Tseltal varieties studied by Polian. Absolute terms dominate in the Zapotec locative descriptions, and the orientation descriptions are almost entirely absolute. No obvious correlation with age, gender, or literacy of the speakers has emerged. In the case of Tseltal, absolute descriptions play a secondary role in Ch'ajkoma, the closest of the three communities to Majosik', where Brown and Levinson's studies were conducted; their use in the other two is marginal. Polian met with Brown and Levinson to determine the source of the discrepancy between his data and theirs. It was found that neither the differences between the stimuli nor variation in literacy or bilingualism could account for the variation. Instead, topography was isolated as at least one likely influence. The same absolute terms *ajk'ol* 'uphill' and *alan* 'downhill' are present in all four communities. The reason these terms are used more frequently in Majosik' than in Ch'ajkoma and much more frequently in Ch'ajkoma than in the other two communities is the relative location and orientation of each community vis-à-vis the mountain slope. This may at first seem to support Li & Gleitman's (2002) environmental determinism. However, the variable language does not vary across the four Tseltal communities. But Li & Gleitman hold that FoR use is not affected by the variable language in situations where it *does* vary. Their position predicts, for example, that if one were to discover somewhere in the Rocky Mountains an English-speaking community in a place whose topography is an exact mirror image of that of Majosik', then – all else being equal - those English speakers should use the terms *uphill* and *downhill* in the same way the inhabitants of Majosik' use *ajk'ol* and *alan*, and those English speakers would show the same linguistic and cognitive bias in favor of absolute FoRs. The MesoSpace Tseltal data neither contradict nor support this prediction.

Another surprising finding that has emerged from the B&C data in Yucatec is the routine intrinsic, object-centered use of place functions in the vertical even when these applications clash with the actual orientation of the ground and the observer. An example is a ball resting on top of an inverted chair being described as 'under' the chair; cf. §4.1. For further theoretical and typological work on FoRs that has emerged from MesoSpace so far, cf. (7-8). The New Animals recall memory task (cf. §2.3) has produced evidence of a preference for geocentric memory coding in 12 of the populations and "mixed" responses without a clear bias for either geocentric or egocentric coding in the others. None of the populations displayed a preference for egocentric coding. Analysis of the results continues.

The aim of the second phase of the project, "MesoSpace Ib", is to further examine the questions that have arisen from the findings of the first phase by bringing in additional researchers working on non-MA languages, but to also do additional work on the languages of the MA sample. The new studies aim to advance the debate on what factors influence FoR use, pitting possible linguistic against non-linguistic determinants. On the side of linguistic determinants, the hypothetical nexus between the frequent use of geometric meronyms as a resource in spatial descriptions and a bias against relative FoRs will be tested in languages outside the MA area, to see whether the correlation observed in MA is the result of causal agency of meronym use in FoR selection or merely an artifact of language contact. On the side of non-linguistic determinants, both inside and outside MA, the apparent language-specificity of the principal of canonical orientation will be tested. The interest in this phenomenon comes from the highly restricted role the intrinsic uses of vertical relations play in Western languages.

3.2. Elicitation task: frames of reference in discourse – the Ball & Chair pictures

3.2.1. Stimuli and task in a nutshell – Picture-to-picture matching task employing seven sets of photos featuring a ball and a chair. The goal is to assess for each language which types of frames of reference (FoRs) are used in discourse about spaces of no more than a few feet in diameter and which FoRs are preferred in this domain.

3.2.2. Materials – You'll need two copies of each of the seven sets of pictures. Each set consists of 12 pix, so there is a total of 2 x 7 x 12 = 168 pix. Furthermore, you'll need 2 x 11 color chips, to be placed on those photos that have been successfully matched, to mark the fact without taking the pix off the table (thereby reducing the contrast set - this was a significant flaw of Men & Tree (see background)). You'll need table space to seat two participants per trial next to one another (see Figure 3.1) and a screen to separate them.

Two sets of photo prints are provided to you by the MesoSpace project. As a backup, photoprint quality jpgs of the photographs are included in the MesoSpace zipfile. Should you need to reproduce the sets, try to print in true digital print size to avoid cropping problems.

3.2.3. Layout – see Figure 3.1. In contrast to Men & Tree (see background), the orientation of the pix (and the table and the participants) shouldn't matter, since the pictures feature contrasts not just laterally, but along four different axes (the ball may occur in eight different absolute locations vis-avis the chair distributed evenly in term of cardinal directions). The screen should ideally inhibit attention sharing between the participants entirely, but at a minimum must occlude the pix.

3.2.4. Recording – The central data are the verbal descriptions produced by the participants. Audiorecording - ideally with two mics feeding into separate channels for easy transcription - is sufficient to capture these. However video-recording - alternatively or in addition - is recommended to capture gestures and gaze patterns, which may come to play an important part in the analysis. Once a pic has been matched, the experimenter records the number (printed on the back). At the end of each set, the researcher will reconstruct the matches that were made and record discussion of reasons for mismatches. For further information regarding the processing of the data, see section 3.2.10.

3.2.5. Time constraints – One pass through the seven sets should take you 55-80 minutes. If you need to split a pass through the series of seven games among two or more pairs of participants, remember to always start with the first game, as this is specifically meant for training, and be sure to always conduct the games in the order in which they are enumerated (1-2-3-4-5-6-7).

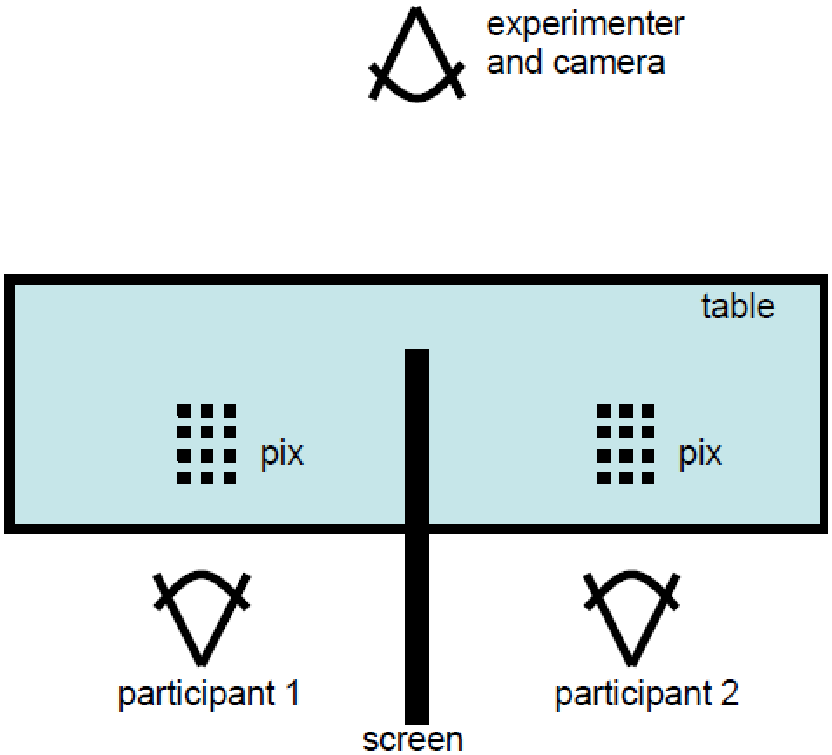

Figure 3.1. B&C matching game layout

3.2.6. Participants – Should be run with a minimum of five pairs of speakers per language.

3.2.7. Background – Ball & Chair (B&C) evolved out of the Men & Tree (M&T) matching games, designed by Eve Danziger and Eric Pederson and released with the very first field manual of what was then the Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics in November 1992. B&C improves on M&T in a number of respects. M&T effectively suppresses intrinsic choices; B&C is designed for the study of the selection among all types of spatial FoRs. People and trees are not particularly good as figures and grounds. Trees often lack a canonical "orienting" (i.e., front-back) axis - the tree of M&T certainly did. And the toy men were more featured than the tree. B&C has many more pictures that show canonical figure-ground asymmetry and simultaneously force FoR selection for disambiguation. Another complication that B&C avoids is the use of pictures of toys - representations of representations, which makes it hard for the participants to consistently operate within the same scale.

For MesoSpace 1, four sets of B&C pictures were created and run with the populations of MesoSpace 1. To further investigate the Principle of Canonical Orientation (see background), an additional three sets were created. These additional sets feature the same chair and a similar ball and background, but consist mainly of configurations of a ball with a fallen chair (a chair in non-canonical orientation). The original four sets included pictures that did not fit the overall design scheme of the extended stimuli set; therefore, of the 84 pictures described, only 48 need be transcribed and coded.

3.2.8. Protocol – The following is adapted from the M&T instructions. There are two differences: the order in which the four games are played is fixed with B&C (see above); and instead of the participants putting matched pictures on piles, the experimenter records the match and the director places markers on the matched items instead of taking them off the board (thereby reducing the remaining number of contrasts). The experimenter then conducts a post-mortem with the participants at the end of each set, showing them which items they have matched, asking them to confirm whether these indeed match, and probing for explanations where the match failed according to the participants.

Record the instructions that the players receive. Players should be told, in their own language, the following:

> This is a game with photographs. You each have the same set of pictures, and the game is for one person to choose pictures one by one and to tell the other person which picture s/he has chosen, WITHOUT LOOKING (just with language, try not to point or gesture), so that the other person can pick out the one that matches from their own set. You can talk back and forth as much as you want, for as long as it takes you to make sure you have picked the matching photo. I'll show you how to do it while you play the first game with this set.

When playing Game 1, keep in mind that the idea is to show them exactly how you want them to play the later games. Use the same procedure you will use for the other three games. Language data from game 1 may turn out to be interesting by itself, but the main point is to make sure that people know how to play.

For each game, shuffle the photos beforehand and lay them out right way up in front of each player in a 3 x 4 grid (3 across, 4 down). The players are then free to choose the order in which to pick and describe the photos. When the "matcher" has chosen the picture they think fits the "director's" description, make both participants hold out the pictures to you. Record the matches and mismatches that are made without correction for any mismatches. Ask the director to place a coin on the matched pictures and then carry on until all pix have coins on them (so do make them describe even the final picture!). At the end of the set, reconstruct the matches, showing the pictures to the participants and letting them identify any mismatches. Then, ask them to find the source of the problem.

It seems to make it easier to play a series of games if you allow the players to switch roles as they go (e.g., "director" in game 1 becomes "matcher" in game 2). In addition, you get more language for the effort if you have players double up roles, and play each game once in each role (i.e., once as "director" and once as "matcher"). This may, however, be boring or slow for the players. Make your own decision. If you do this, keep in mind that the second time through a set of photos for a given player has a different status from the first, and keep records accordingly. Doubling up is interesting if you want to investigate reductions and special accommodations that develop as people become expert at the game. If you do double up, you still count only one pair (the first run-through for each player) for the comparative project, where the same people are playing.

As well as playing the games, have an assistant explain the differences among the photos to you in elicitation fashion, on some other occasion. If you use your elicitation assistant as a player of the games, don't do the elicitation until after he or she has played the games for you!

The suggested strategies for the game are the following:

- The director has coins to mark the photos they have already explained.
- The matcher doesn't have coins and does not mark the photos s/he has identified.
- Every time the matcher declares a photo matched, the participants will need to show the number on the back of each picture to the researcher for note taking. Researcher notes down matches and mismatches according to those numbers.

3.2.9. Transcription, coding, analysis

3.2.9.1. General principles

3.2.9.1.1. Description vs. proposition – Assume that every dyad produces maximally one description of any given picture. That description encodes arbitrary many propositions, but minimally one. Propositions are the smallest representations of states of affairs that can be true or false. Different propositions of the same description may be interpreted in different FoRs. Therefore, it is the propositions we code for the FoRs they rely on, not the descriptions. An example of a description that encodes multiple propositions is (8):

(8) *The chair is facing me and the ball is near it on the left*

The propositions encoded in (8) are listed in (8'):[1]

(8') a. 'The chair is facing me'
b. 'The ball is near the chair'
c. 'The ball is left of the chair'

In the coding sheet, each row that has cells for data entry represents a unique description (one dyad, one picture). Each cell of that row in which a "1" is entered represents a unique proposition of the description in question – namely, a proposition that is interpreted in the frame type encoded in the column to which the cell belongs.

3.2.9.1.2. Which propositions to code? – To be able to identify the type of frame in which a given proposition is to be interpreted, it is necessary to assume that the proposition is true of the figure in the picture at issue (see section 3.2.9.1.4). Consequently, only propositions that are truthfully asserted by the director of the particular dyad are coded. Questions asked by the matcher should be ignored, even if the director answers in the affirmative. The same holds for propositions that are obviously – according to native speaker consultants – false, i.e., have no viable interpretation in the picture at issue. There are identification errors where the matcher misinterprets a picture and production errors during which the matcher picks the wrong relator from the mental lexicon to describe the picture. Identification errors must not be confused with systematic culture-specific interpretations, e.g., descriptions of a ball that is behind the chair in the picture as being 'above' the chair on a two-dimensional visual parse of the picture. This kind of description is true based on a (culturally) legitimate interpretation of the picture and should be treated accordingly (that is, in the example, the proposition should be coded as specifying a vertical and/or intrinsic 'above' relation).

One often encounters descriptions that state that the figure is oriented or located the same/opposite way it is in the previously described picture. Such propositions should not be coded, since the asserted identity may be purely extensional; i.e., we cannot assume that the director is asserting the same locative/orientation proposition they asserted with respect to the previously described picture.

3.2.9.1.3. Locative vs. orientation propositions – In the legacy format, we coded five types of propositions:

- disposition of the chair
- orientation of the chair
- disposition of the ball
- location of the ball vis-à-vis the chair
- location of the ball in the picture

[1] In addition, (1) *presupposes* a number of propositions, such as 'There is a chair in the picture' and 'There is a ball in the picture'. We ignore these here.

(Some people apparently added a column for a sixth type, location of the chair in the pic.) Locative propositions answer the question 'Where is the FIGURE?', orientation propositions the question 'Which way does the FIGURE face?'. There is no idiomatic way to ask about the disposition of a figure in English. In Yucatec and other Mayan languages, it is perfectly idiomatic to ask 'How is the FIGURE?' and thereby invite a dispositional description as answer. The new format is designed for the coding of only the orientation of the chair and the location of the ball vis-à-vis the chair. Dispositional information – information about whether the chair is 'standing' or 'lying on its side' or 'overturned' and about whether the ball is 'lying on the ground' or 'hanging/floating in the air', etc. – is for several reasons difficult to integrate into the new format and does not require FoRs for its interpretation anyway. Location of the ball in the picture is not included by default since we have reservations against including ball-pic data in the analysis of FoRs. However, anybody who would like to add ball-pic columns can of course do so.

In the past, we have encoded horizontal orientation of the chair in the orientation columns, but vertical orientation in the dispositional column. This is because vertical orientation is routinely expressed by dispositional predications in Mayan languages, and such predications tend to have distinct morphosyntactic properties. Even though there is perhaps no purely semantic basis for this distinction, we suggest we stick with it. To make the criterion independent of the formal properties of Mayan languages, we recommend establishing the possible morphosyntactic forms of orientation descriptions in the horizontal. If there are any vertical orientation descriptions of the same form, code these as orientation descriptions. But if vertical orientation is expressed through a distinct form of predication, ignore it. If the language by that criterion does express vertical orientation, you will likely have to add columns for vertical absolute and intrinsic/absolute-ambiguous frames to the orientation group of columns.

3.2.9.1.4. How to identify the FoR(s) of a given proposition – Assume that the proposition in question is in fact true of the figure in the picture at issue. Any frame type that makes the proposition true of the figure with respect to the picture is a frame type in which the proposition has a viable interpretation in the context of the particular description. If there is more than one such frame type, the proposition is ambiguous; see below. How do you know which interpretations = frame types are viable in reference to a particular pic? If in doubt, ask a native speaker. How do you do this? You rely on the diagnostics spelled out below. A frame type is constituted by the kind of anchor – the entity that serves as the model for the axes of the FoR - and the operations involved in deriving the axes. You can test whether a given entity or feature serves as the anchor of the FoR of a given proposition by asking the consultant whether the proposition remains true when the orientation or location of the entity is varied. If the speaker confirms this, the entity/feature in question is not the actual anchor of the FoR, although it may be the anchor of a different FoR under an interpretation that is viable of the same – ambiguous – proposition. Ambiguity is of course identified by showing that the truth of the proposition depends on the orientation or location of more than one anchor.

3.2.9.1.5. Ambiguity – There are two sources of ambiguity we have to contend with when coding the B&C data: underspecification of the anchor and underspecification of the ground. The former is addressed here, the latter below. As mentioned, if there is more than one frame type that makes the proposition true of the figure with respect to the picture at issue, the proposition is ambiguous. As a consequence of one of the coding policy revisions of the summer of 2010, we now treat propositions that are ambiguous between viable interpretations in frames of type *a* and *b* as representing an ambiguous frame category *a/b* distinct from both *a* and *b*, following the model of Carlson-Radvansky & Irwin 1993, 1994. There are three pairs of frame types that may cause ambiguity in the B&C data: object-centered intrinsic vs. relative; object-centered intrinsic vs. vertical absolute; and geomorphic or landmark-based vs. absolute. Figure 2 is an example in which the ball is 'left of' the chair both intrinsically (= from the chair's perspective) and relatively (= from the observer's perspective). In Figure 3, the ball is 'on/above' the chair both intrinsically and absolutely.

Figure 2. *B&C 1.8*

Figure 3. *B&C 3.6*

The ambiguity between geomorphic or landmark-based and absolute descriptions is of a somewhat different kind. Absolute FoRs are constituted by abstraction from the concrete anchor of geomorphic or landmark-based frames. Examples include celestial systems the axes of which do not vary seasonally with the direction in which the Earth' axis points and mountain slope or riverine systems in which 'uphill' and 'downhill' or 'upriver' and 'downriver' denote the same directions regardless of where the origin of the coordinate system is placed vis-à-vis the river or mountain slope. The available evidence suggests that while by no means all geomorphic and landmark-based systems have absolute interpretations, all absolute systems have also non-abstracted geomorphic or landmark-based uses. For this reason and since it can in practice be difficult to determine whether a given use is absolute or non-abstracted (the two types of frames do not differ with respect to the diagnostics), researchers may decide to code all uses of a given set of geocentric terms as either landmark-based/geomorphic or absolute (cf. Polian & Bohnemeyer 2011 for a case in point) – this, however, would have to be decided on a case by case basis.

3.2.9.1.6. Wrinkles and pitfalls

3.2.9.1.6.1. Unspecified grounds – The reference entity or ground in locative and motion descriptions tends to be old, previously mentioned information. It is moreover backgrounded vis-à-vis the figure in the sense that the figure is topical in the description – the description answers an implicit question about the figure, not the ground, which plays merely an ancillary role. For these reasons, it is hardly surprising that the ground is often represented anaphorically or even omitted altogether. Implicit grounds, however, can be a source of massive ambiguity. Consider the - rather complex – example in (9), a description of the picture reproduced in Figure 4; the additional features of this one will help illustrate other issues and the general style of our coding policy.

Figure 4. *B&C 2.5*

(9) SME (Describer), RMC (Matcher), picture 2.5

D: Estée, u séegere-e-e … chan fòotoa',

esté	u=séegir	le=chan	fòoto=a',
HESIT	A3=follow	DET=DIM	photo=D1

'Uh, this next-uh-little photo,'

2 u frèente e sìiyao', tu tohile don Jorgeo',

u=frèente	le=sìiya=o'	tu=tohil	le=don	Jorge=o'
A3=front	DET=chair=D2	PREP:A3=straight:REL	DET=don	Jorge=D2

'the front of the chair, in the line of that don Jorge,'

3 ti' yàani'. Tu'x ku nakta' máako',

ti'=yàan=i'	tu'x	k-u=nak-tal	máak=o'
PREP=EXIST(B3SG)=D4	where	IMPF-A3=lean-INCH.DIS	person=D2

'there it is. The back rest (lit. where a person leans (against)),'

4 estée, ta frèente súutu'.

estée	ta=frèente	súut-ul
HESIT	PREP:A2=front	turn\MIDDLE-INC(B3SG)

'uh, it's turned (towards) your front.'

5 Ta xno'hk'abile' ti' yàan ump'ée bòolai'.

ta=x-no'h+k'ab-il=e'	ti'=yàan	hun-p'éel	bòola=i'
PREP:A2=F-right+hand-REL=TOP	PREP=EXIST(B3SG)	one-CL.IN	ball=D4

'On your right, there is a ball.'

6 Ta xts'íi - ta xts'íihk'abil [unintelligible], ti' yàan ump'éel bòolai',

ta=x-ts'íik+k'ab-il=e'	ti'=yàan	hun-p'éel	bòola=i'
PREP:A2=F-left+hand-REL=TOP	PREP=EXIST(B3SG)	one-CL.IN	ball=D4

'On your le – on your left [unintelligible], there is a ball,'

7 kàasi tu tohil u yòok yàan ti'.

kàasi	tu=tohil	uy=òok	yàan	ti'=i'
almost	PREP:A3=straight:REL	A3=leg/foot	EXIST(B3SG)	PREP(B3SG)=D4

'it's almost in the line of its leg with respect to it.'

In line 6, the director is correcting himself. The propositions encoded by the description as a whole are thus the ones in (9'):

(9')
- a. 'The front of the chair is facing JB'
- b. 'The back of the chair is facing RMC'
- c. 'The ball is left of RMC'
  OR 'The ball is left of the chair from RMC's perspective'
  OR 'The ball is on the left side/near the left edge of the picture from RMC's perspective'
- d. 'One leg of the chair is almost pointing toward the ball'

Part of what makes this example interesting is the representation of the chair's orientation. This is taken up in the next subsection. Line 6 is at least three ways ambiguous, as shown in (9'c). 'Left' is encoded by a possessed meronym, the possessor of which refers to the addressee, RMC. The possessor of the meronyms 'left' and 'right' must be understood as the anchor of the reference frame, but not necessarily as the ground. The ground is left unspecified in (9). If RMC is assumed to be the ground as well, the proposition falls under the egocentric 'direct' subtype of the intrinsic type. If not, the ground may be either the chair or the picture. In either of these two cases, the frame would be relative. If the ground is either the addressee or the picture, the proposition does not represent the location of the ball vis-à-vis the chair and thus would not be coded under the current policy. A fourth interpretation, under which 'left' refers to the chair's intrinsic left, is excluded by the possessor marking in (9).[2]

Above, ambiguity caused by underspecification of the anchor was treated in terms of 'aligning' FoR union categories, following Carlson-Radvansky & Irwin (1993, 1994). But it seems intuitively misleading to apply the same treatment to ambiguity caused by underspecification of the ground. In (9), for example, the director does choose an anchor, and thereby presumably also a unique type of frame. The problem is that we cannot be sure what this choice is since the ground, i.e., the origin of the frame, is unspecified. The practice we have been following instead is to ask native speaker consultants what they consider the most likely interpretation of the utterance. This is admittedly problematic; there is simply no guarantee that speakers agree on the most salient interpretation of utterances such as (9) (but that is at least an empirical question and so can be tested). In the case of (9), what we need to know is whether the chair is understood as ground – because under all other interpretations, the proposition does not represent the location of the ball with respect to the chair. If the ground is the chair, the frame must be relative, so the truth of the utterance should change with RMC's orientation. This, however, is also the case under either of the two competing interpretations. However, neither of the two interpretations would be compatible with an alternative picture just like Figure 4 except that the ensemble of ball and chair has been moved all the way over to the right edge of the picture (while their relative locations have been maintained). If the consultant judges this manipulation not to affect the truth of (9), then - and only then – do they understand the proposition to be relative.

3.2.9.1.6.2. Orientation by location of parts – As illustrated in (9), the director may provide multiple orientation propositions in a single description just as they may give multiple locative propositions. In the case of orientation, the different propositions typically describe the way different parts of the chair face, as in (9) (see Bohnemeyer & O'Meara in press for an analysis of such representations). Now, it is also possible to describe the orientation of the chair by *locating* two or more parts with respect to one another in some appropriate extrinsic reference frame. Such as description might look like (10):

(10) *The seat is in the east/on the left, and the backrest is in the west/on the right*

In this case, the frames used for the interpretation of the locative propositions should be coded in the appropriate orientation columns.

3.2.9.1.6.3. Meronyms in topological vs. intrinsic descriptions – A matter of longstanding debate among the MesoSpace members: should topological descriptions that involve meronomys be treated as intrinsic? The correct answer to this question is really unclear. The pragmatic recommendation is, however, to treat meronyms as frame-dependent (intrinsic, relative, or direct) relators whenever they are used to denote projected oriented regions of space, as opposed to regions in contact with or included in parts of the figure. An oriented region of space is clearly designated in (11d), and possibly also in (11c), but not in (11a):

(11) a. *There's a fly on the back of the dog*
b. *There's a fly over the back of the dog*
c. *There's a fly near the back of the dog*
d. *There's a fly toward the back of the dog*

In (11a), the orientation of the dog is irrelevant for the truth of the proposition. The description is true as long as there is a fly that is in contact with that outer surface of the dog designated

[2] However, possession by a speech act participant does not block intrinsic interpretations in *all* contexts. It does not in a description such as 'Imagine you are sitting in the chair: then the ball is on your left'. See section 5.4 for further discussion of this type of description.

by 'back'. This is thus a topological description, and even though it involves a meronym, it does not involve a reference frame. In (11b), the truth of the description does potentially depend on the orientation of the dog, but in a way that is governed, so to speak, by the preposition *over*, not by the meronym *back*. That is, (11b) has the usual range of possible interpretations of vertical descriptions, including the possibility of a "disaligned" intrinsic interpretation (imagine the dog is climbing a steep staircase and the fly is accompanying him on a trajectory that runs parallel to the dog's main body axis; cf. Carlson-Radvansky & Irwin 1993, 1994). In (11d), however, it is again a topological relator that is applied to a possessed meronym. But in this case, rotating the dog falsifies the description. And (11c), which like (11a) involves a topological relator, is an unclear intermediate case between (11a) and (11d).

It is often objected at this point in the argument that rotation of the dog also renders (11a) false – as long as the fly does not rotate along with the dog. Now, let's ignore the fly – it is a distraction. The question is how do you know where the region of space denoted by *on the back of the dog* is, and more specifically, whether you need to compute a coordinate system a.k.a. reference frame to answer this question. The answer appears to be negative. Find the back of the dog, a body part; find its outer surface – done! In contrast, to know where the region of space denoted by *toward the back of the dog* is, one has to compute the set of all beginning points of vectors that point towards the back of the dog and not toward any other part of it/him. At sufficient distance from the dog, this is going to be equivalent to the set of all beginning points of vectors that form an acute angle with the dog's chest-back axis. This is a rather technical description of a reference frame (see Bohnemeyer 2011, based on Zwarts & Winter 2000). As for (11c), if *near the back of the dog* is understood as denoting the unions of the regions of proximity around every point that is on the surface of the dog's back, then no reference frame is necessary. But if (11c) is understood as denoting the region of all points that are closer to the dog's back than to any other part of it, then I suspect (11c) becomes synonymous with (11d) and thus likewise involves a reference frame.

3.3. Elicitation task: frames of reference in discourse – Talking Animals

3.3.1. Stimuli and task in a nutshell – Referential communication task with two participants per trial matching stimulus configurations of toy animals through verbal descriptions. One speaker (the "Director") produces a verbal description of the stimulus configurations and the other (the "Matcher") reproduces the configurations according to the description, asking clarification questions if necessary.

3.3.2. Materials – You'll need two sets of Cuckoo Alex Rub a Dub Farm Animals Squirters for the Tub bath toys. You'll need table space to seat two participants per trial next to one another (see Figure 3.2) and a screen to separate them. In addition, a coding sheet is provided in Appendix TSELTAL.

You'll also need one table large enough to seat two participants next to one another facing in the same direction with a screen separating them (or to stand them up next to one another facing in the same direction in face there is no seating furniture and/or the participants prefer to stand), or two smaller tables that can be placed one next to the other to accommodate the two participants and the screen between them. If there are no tables, the task can be conducted on the ground or on a blanket or cloth instead. Any level horizontal surface of sufficient size will do; however, the surface should be delineated rectangularly

3.3.3. Layout – see Figure 3.2. The screen should ideally inhibit attention sharing between participants, but at a minimum must occlude the animals. The Director should be able to look over to see the Matcher's side between attempts.

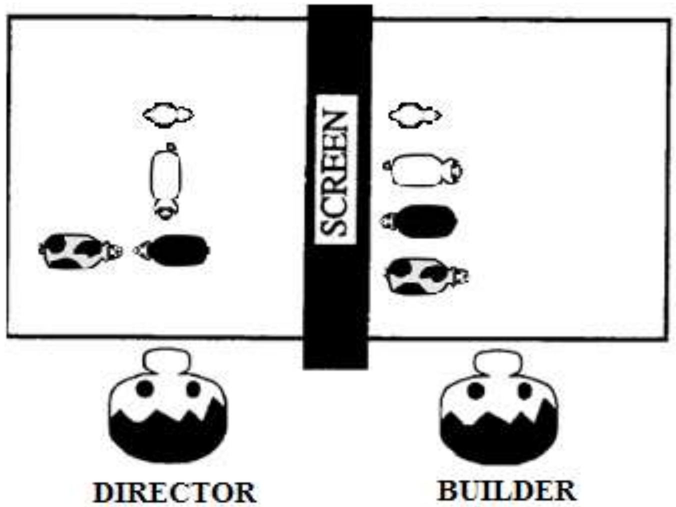

Figure 3.2. Talking Animals matching game layout

3.3.4. Recording – The central data are the verbal descriptions produced by the participants. Audiorecording - ideally with two mics feeding into separate channels for easy transcription - is sufficient to capture these. However video-recording - alternatively or in addition - is highly recommended to capture gestures and gaze patterns, which may come to play an important part in the analysis. Once a pic has been matched, the experimenter records the number (printed on the back). At the end of each set, the researcher will reconstruct the matches that were made and record discussion of reasons for mismatches. For further information regarding the processing of the data, see section 3.2.10.

3.3.5. Time constraints – Expect about 25 minutes each for most dyads including the training phase. Coding of the data may take between 20 minutes and an hour per dyad.

3.3.6. Participants – The task should be conducted with a minimum of 40 dyads of adult native speakers of the language. A roughly even breakdown by gender is preferable but not strictly required. No speaker should participate in more than one dyad. If the community is too small for this number to be recruited, the task may be performed with only 5 dyads. The reason for collecting data from 40 dyads is to explore inter-speaker variability and achieve greater power and significance in quantitative analyses. If this cannot be achieved, the results of the task may still inform us of the differences of FoR use in describing 3-D objects as compared with 2-D photos.

3.3.7. Background – Talking Animals (TA) was designed to serve as a complement to the Ball & Chair (B&C) task. Like B&C, TA was designed for the elicitation of preferences in reference frame selection for reference to small-scale space. TA differs from B&C in the greater simplicity of its stimulus set (four configurations of four toy animals each instead of four sets of 12 configurations of a ball and chair) with the objective of permitting more rapid testing of a larger number of speakers (40 dyads compared to five in the case of B&C). In addition, TA utilizes three-dimensional stimuli instead of photographs. It has been suggested that photographs may depress the use of geocentric reference frames.

3.3.8. Structure of the stimulus – The set up for this task is identical to that of the B&C and Novel Objects ("chunches") tasks except for the stimulus sets:

- The task should be conducted indoors if at all possible. Li & Gleitman (2002) suggest that outdoor settings may favor the use of geocentric frames independently of population. If correct, this entails that indoor recording is more suitable to bring out differences across populations. It is important that the MesoSpace researchers conduct this and all tasks in a manner that adheres as closely to a single protocol as possible. Thus, all should conduct the task indoors if possible.

- Position the two participants side by side along the table(s) or level horizontal surface such that they face in the same direction. If there is evidence of conventional geocentric reference frames in the community, the participants should be facing either in (one of) the most readily and widely recognized direction(s) identified in this frame type or in a direction that is orthogonal to it. In other words, do not orient the participants at an odd angle to any of the major axes of this frame type, as that may depress the application of it.

The camera should be placed opposite the participants with the table(s) or horizontal surface between the participants and the camera, ideally at such a distance that both the Director's and the Matcher's stimulus configurations are just visible on the recording. If two microphones are used, they should be placed in front of the participants with the stimuli between the microphones and the participants.

3.3.9. Protocol – Training - Although brief, this task is relatively demanding on the participants. Reproduction of the stimulus configuration requires the description of the orientation of each animal plus its location and distance (but see below) from some reference point (another animal or a part of the set up, such as the table, the participants, or a microphone). Participants may not spontaneously grasp these requirements. Since their understanding of the requirements – or, for that matter, the accuracy with which they reproduce the configuration – are not part of what is tested (i.e., they are not independent variables of the design), it is helpful to explain them during a short training phase. The following procedure may be used:

- Without the screen in place, put one set of five animals on the table in front of one speaker and the other set on the table in front of the other speaker. Make sure that the participants realize that each of them has one of each kind of animal. Pick up the animals one after another, one of each kind, asking the participants to label them, explaining that they will need to agree on how to refer to each animal.
- Still without the screen in place, put a configuration of four animals in front of one speaker and ask the other to rebuild it. Do not use any of the four test configurations. Instead, use a similar configuration that has the four animals placed in four cells of the same 3x3 grid, each facing parallel to one of the four sides of the table(s). Explain that the participant (the Matcher) should rebuild the configuration in such a way that each animal on their (side of the) table is in the same place as the corresponding animal on the other (side of the) table and facing in the same direction.[3] When the Matcher is done, ask the other participant (the Director) to evaluate whether the two configurations are identical. If there are differences the participants do not comment on themselves, point these out and do your best to make sure that the participants understand that the task requires specifying the location and orientation of each animal. There is no need to comment on distances, as distance is not an independent variable to be measured in this task.
- Now explain that you will play a game with the participants that will involve them doing exactly what they just did except for the screen making it impossible for the Matcher to

[3] We should not *prima facie* exclude the possibility that there are cultures that systematically do not preserve one or two of the three properties – orientation, location (in a particular region or search domain), and distance – in reproductions (or representations) of spatial configurations, as unlikely as this seems. If you find evidence of systematic non-preservation in the first dyad you test, it may be a good idea to postpone the TA study and try to confirm or disconfirm the non-preservation phenomenon first. If non-preservation is confirmed, the TA task should be conducted without reference to the non-preserved property.

see the Director's configuration and vice versa. So in order for the Matcher to know where to put each animal and in which direction to turn it, the Director has to describe this accurately. Explain that the point of this game is to find out how one describes where things are and which way they face in their native language. Accordingly, they are not supposed to take a peek at each other's configurations, and they are not supposed to gesture to each other either – you want them to solve the task exclusively by talking to one another.

- Say that you will give them one more opportunity to practice. Put up the screen. Create another practice configuration, again not identical to any of the four test configurations, but like them in the respects described above. Ask the Director to tell the Matcher exactly where each animal is and which way it is facing. Encourage the Matcher to ask questions whenever they did not quite understand something or are missing a piece of information. When the participants decide that they are done, remove the screen and ask the participants to compare the two configurations. If there are differences – ignoring matters of distance and precise angle – try to engage the participants in a discussion as to what caused these. Try your level best to ensure that they understand the need to specify, in an unambiguous manner, both orientation and location of each animal. If a particular property was largely or systematically not encoded during the descriptions – say the location as opposed to the orientation of the animals – get the participants to come up with possible descriptions of this kind of property, so that they have a format at their disposal during the test trials. Obviously you want to do this without suggesting actual descriptions that might bias the participants' use of FoRs. It may also be helpful to encourage the participants to use whatever language/terms they are comfortable and familiar with. It could be the case, for instance, that some participants have normative expectations of being required to avoid loan words, but are not really accustomed to using whatever indigenous terms there may be.

This should be the last point in the protocol at which you make any attempt to correct the participants' performance. Going forward, whatever linguistic descriptions the Director produces will count as data regardless of the properties of the reproduced configuration. If, for example, a particular speaker or dyad even after the training phase continues to only describe the orientation of the animals but not their relative locations, then the data set collected from that particular speaker/dyad will only include orientation descriptions and that will be that.

Test Phase – The screen between the participants remains in place during the entire test phase. At the outset of each trial, both participants should have the set of four animals that are needed for this trial in front of them – and only those. The four animals should be bunched together at one side of the table. (Avoid any orderly looking "stand-by" configuration so as to not confuse the participants.)

Build the target configuration in front of the Director and ask them to tell the Matcher where to put each animal and in which direction to orient it. At least at the onset of the first test trial, you may want to remind the Matcher that they should ask for any information they are lacking and both participants that they should try to communicate verbally only and not by gesture and gaze[4] and should never ever take a peek around the screen at each other's configuration unless you tell them to.

[4] Referential communication tasks are not particularly natural. People are rarely if ever required to coordinate on two identical objects without either of them being able to see the object in front of the other. Referential communication tasks are no replacement for the observation of referential practice in spontaneous interactions. They create a controlled context for the study of such practices in a crosslinguistically comparable fashion, allowing us to compare what the speakers of different languages do when faced with a problem that is equally unnatural to all of them.

When the participants decide that the Matcher has rebuilt the configuration (or is stuck), annotate the result on the coding sheet for the configuration and then ask the Director to look around the screen and check the Matcher's result. Be sure to continue to prevent the Matcher from looking at the Director's table!! If the Director detects discrepancies, ask them to explain to the Matcher how to fix them. The Director may look at both configurations at this time. Encourage discussion of the reason for the mismatches. Annotate the final configuration in case it still deviates from the stimulus configuration.

At the onset of each new test trial, the two participants should switch roles. When all four test trials are completed, ask the participants to comment on the task, especially anything they found challenging and why.

3.3.10. Transcription, coding, analysis – The target data to be analyzed are the linguistic descriptions produced by the Directors. There are no current plans for analyzing the configurations reproduced by the Matchers – we currently collect these only in case this should somehow become an issue in the future.

The descriptions of the animals contain two kinds of predications we are interested in:

3.4. Elicitation task: frames of reference in recall memory – New Animals

3.4.1. Stimulus, task, and goal in a nutshell – Participants commit arrays of toy animals to memory and reproduce them having turned 180 degrees to another table. The question is which spatial frame of reference (FoR) they rely on when encoding the array in memory. This can be deduced from the location and orientation of the reproduced array (provided the task is administered properly and the participant recalled the array correctly). The goal of this study is the profiling of participants and populations in terms of FoR use in recall memory, to test the hypothesis that preferences for particular FoRs in discourse and recall memory align within, but not across, populations defined in terms of language use.

3.4.2. Materials – One set of Cuckoo Alex Rub a Dub Farm Animals Squirters for the Tub bath toys :-), consisting of a pig, cow, sheep, chicken, horse, and a transparent plastic case to hold them. To keep results comparable with those obtained by Pederson et al. 1998, Li & Gleitman 2002, and Levinson et al. 2002, we only use the pig, cow, sheep, and horse - hold the chicken :-). Two tables, as similar to one another as possible, or at any rate two horizontal surfaces (including, e.g., two blankets spread on the ground). The surfaces should be of roughly the same size and shape and without marks of any kind[5]. They need to be positioned exactly parallel and at a little distance from one another (see Figure 3.1). You will need one copy of the coding sheet for each participant. The coding sheet is available in Appendix E at the end of this manual.

Several issues regarding the placement of the tables have been raised. First, evidence from Tseltal collected with a different recall memory task (Levinson 1996: 115-117) suggests that accuracy of memory for the orientation and location of a stimulus may vary with the actual orientation and location of the stimulus in absolute space. In Tenejapan Tseltal, (roughly) north and south are lexically distinguished as "downhill" (or rather "downmountain") and "uphill" ("upmountain"), respectively, whereas east and west are lexically conflated as "across". And Tenejapans appear to recall spatial information memorized vis-à-vis the uphill-downhill axis more accurately than information memorized wrt. the across axis. Thus the placement of the array of animals on the stimulus table could potentially affect the accuracy of the participants' performance. If you know or suspect that the people you study routinely use an absolute FoR,

[5] If you use tables with some sort of markings on the surface, consider getting two identical pieces of cloth to drape over them.

try to align the main axes of the tables with the main axes of that FoR (e.g., N-S and E-TSELTAL rather than NNE-SSW; in the case of Tenejapan Tseltal, uphill-downhill rather than across). Use the schematic compass rose on the coding sheets to capture the orientation of the tables (or rather, the orientation of the array of animals on the stimulus table - but the animals are always placed along the participant's transversal, parallel to the table's main axis (see Figure 3.1)) with respect to the axes that are primarily lexicalized (i.e., that have the simplest expressions).

In addition, Li & Gleitman 2002 found an effect on the performance of American college students depending on whether the task was conducted indoors or outdoors. However, Levinson et al. 2002 were unable to replicate this effect with Dutch college students.

3.4.3. Layout – see Figure 3.3. Concerning the distance between the tables, Levinson & Schmitt (1993: 65) comment as follows: "Two tables or places at some remove (as for all rotation experiments); you need to engineer up to a minute (not less than 30 sec) delay without distraction of subject, so distance helps."

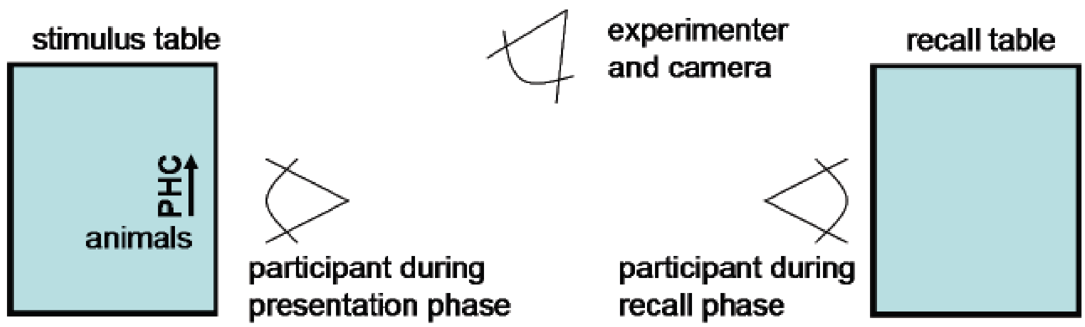

Figure 3.3. New Animals recall memory task layout (this example shows a trial in which the array Pig-Horse-Cow faces in the direction of the arrow, from the participant's perspective).

3.4.4. Recording – The central data are the orientations of the reproduced arrays of animals, recorded on the coding sheet (which you find at the end of this manual entry). This is not a linguistic task, so audio-recording is pointless. However video-recording is recommended to capture any information that may help in the analysis of the responses (e.g., signs of hesitation or confusion; self-corrections; verbal and/or gestural representations produced in reasoning or as mnemonics). Your contribution to group analyses will be PDF copies of the coding sheets.

3.4.5. Time constraints – The task takes a total of 10-20 minutes per participant.

3.4.6. Participants – Should be run with a minimum of 16 participants per language community. The orientation of the animals in the training and the trials needs to be randomized among the participants. You will therefore need to run training runs and trials according to Table 1:

Table 1. Randomization in New Animals task

# of participants	Animal orientation in training	Sequence of trials as per coding sheet
4	Left to right	Start with trial 1, end with trial 6
4	Left to right	Start with trial 6, end with trial 1
4	Right to left	Start with trial 1, end with trial 6
4	Right to left	Start with trial 6, end with trial 1

In other words, you need to ensure that there work with the same number of speakers for every logical possibility in the combinations between switching animal orientation in training runs and switching the order of the trials. Note the labels "Training" and "Trial Order" at the top of the coding sheet. It is intended for you to plan ahead and record which combination you are to conduct with a given speaker. Circle the combination of training and trial arrays ahead of time to ensure you always know which combination you are due to conduct.

3.4.7. Background – New Animals is a near-identical replication of the Animals In A Row (AIAR) task originally released as part of the July 1993 "Cognition and Space Kit" of what was then the Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics[6]. The design was developed by Steve Levinson and Bernadette Schmitt (Levinson & Schmitt 1993), based on pilots conducted by Levinson with Guugu Yimithirr speakers and Levinson and Penny Brown with Tenejapa Tseltal speakers. AIAR was designed to distinguish relative and absolute coders in terms of their responses. Since the participants turn 180 degrees between stimulus and recall tables, relative and absolute reproductions of the same array were readily identifiable as mirror images of one another. Data collected with AIAR formed the basis of Pederson et al. 1998.

The most important limitation of the AIAR design is the lack of a predictable discernible intrinsic response pattern. Intrinsic coders' responses are either masked as relative or absolute responses or, in case they conform to neither pattern, produce noise (in Levinson 1996 and Pederson et al. 1998, they were treated as errors). For MesoSpace, we piloted various versions of a design aimed at fixing this problem through the use of a cue on the stimulus and recall tables intended to allow intrinsic coders to project their preferred FoR. Unfortunately, in all variants we tried, this intrinsic cue had the effect of pushing most of the participating UB undergrads towards intrinsic solutions.

As a result, New Animals, like AIAR, lacks the capability of detecting intrinsic coders in any straightforward manner. Given the goals of MesoSpace, this situation is clearly suboptimal. Our central hypothesis is that productive meronymies may favor the use of allocentric FoRs in language and cognition - meaning of absolute or intrinsic FoRs! And it may well turn out that overall, intrinsic FoRs play a more important role across MA than absolute FoRs. Unfortunately, the only prediction for intrinsic FoRs we will be able to test is the prediction that predominantly intrinsic populations have no single statistically dominant response pattern[7]. However, even if this prediction is confirmed, the finding would be at best weak, since there is no principled way of distinguishing random responses caused by intrinsic coding from random responses caused by error.

3.4.8. Procedure – The following is adapted from the AIAR instructions (Levinson & Schmitt 1993) and the protocol in Levinson 1996 and Pederson et al. 1998. Use as test trial the PHC trial of Figure 3.1. Coding conventions: all animals face in the direction of the arrow. The letters stand for the animals - Cow, Horse, Pig, Sheep. The order of the letters, read from right to left, codes the order of the animals from the tail to the head of the arrow: if you look at the letters so that they appear right side up, the rear of the right-most animal is the tail end of the array and the front of the left-most animal is the front or head of the array in the direction in which the animals face.

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[6] New Animals differs from AIAR in three respects: (a) it uses a different set of toy animals; (b) it prescribes the arrays to be used in the trials (AIAR merely requires no array to be used more than once with the same participant and for the orientation of the stimulus array to alternate regularly); (c) it involves six test trials rather than five, to make counter-balancing for the orientation of the stimulus array easier.

[7] Individual intrinsic coders may respond consistently pseudo-absolutely or pseudo-relatively simply by way of a response strategy (meaning they choose a pattern arbitrarily). However, in an exclusively intrinsic population, one would expect the number of participants picking pseudo-absolute and pseudo-relative responses to approach 50% given a large enough sample.

Explain the toys as animals and answer any questions. Introduce all four animals. Then build the PHC array of Figure 3.1, taking the sheep off the table (it is best to keep it in your hand). Now instruct the participant as follows:

> Look carefully. Remember just how it is! I am going to take it away and ask you to make it again. OK, have you remembered it/are you ready?

Remove the array. You should now have all four animals in your hands. Ask the participant to wait a moment. Between 30 and 60 seconds need to pass between removing the stimulus array and reproducing it, without undue distraction of the participant. If need be, just look at your watch and wait. You can use the time to turn the camera from the stimulus to the recall table. After 30-60 seconds, ask the participant to walk over to the recall table. Hand them all four animals! The purpose of making the participants choose the correct three animals from the total set of four is to mask the real purpose of the experiment. Tell the participant:

> "Now make it again!"

If the participant asks whether the order of the animals matters, answer affirmatively. If the participant asks whether the location and/or orientation of the array matter, answer evasively:

> "I want you to show me on this table exactly what you saw on the other table."

If the participant makes a mistake during the practice trial, explain the problem and run another practice trial. You can run as many practice trials as seems useful to you - just make sure that you do not accidentally use one of the test trials! The following count as errors: no array or more than one; wrong number of animals; wrong animals; inconsistent orientation (not all animals facing in the same direction). Do not, however, correct the orientation of the array - not even during practice trials.

When you have convinced yourself that the participant has understood the task, proceed to the first test trial (i.e., the first trial of the experiment, as opposed the practice trials). Record the reproduced array on the coding sheet. If the response fits any of the patterns on the sheet, encircle it. If not, draw your own diagram in the "other solution" box. In this case, it is particularly important to use the little compass rose in the lower left corner to mark the directions labeled linguistically in an absolute or geomorphic FoR in the community, so that it becomes apparent how the response is oriented with respect to this system. Do not point out or correct any errors during test trials - just note down the problem on the coding sheet and move on.

3.4.9. Stimulus – Two sets of 4 toy animals will be provided by the MesoSpace project. In addition, a coding sheet is provided in Appendix E