

Landscape in language: integrating topography in linguistic spatial reference.

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Introduction

- This talk is about two crucial interlocking issues relating to spatial reference in language.
- The nature of absolute frame of reference, specifically to what extent is it:
 - abstract and arbitrary, or
 - motivated by and anchored in the environment.
- The degree to which systems of absolute spatial reference correlate to features in the environment.

Frames of Reference

- “Frames of reference are coordinate systems for expressing the spatial relationship between Figure and Ground.” (Terrill & Burenhult 2008:93)
- A Frame of Reference (FoR) is a strategy for locating or orienting an object or path in relation to another object.
- E.g. *The car is in front of the house.*
- One object, *the car*, is located in relation to another object, *the house*.
- The term *in front of* invokes a particular FoR.

- How does a FoR work? (See Levinson 2003:34-53)
- The object to be located (*the car*) is the ‘figure’ or ‘referent’, *F*.
- The object it is located in relation to (*the house*) is the ‘ground’ or ‘relatum’, *G*.
- The referent is located in relation to the relatum by means of a ‘search domain’ or path that is projected off some facet of the relatum.
- An anchor point, *A*, locks labelled coordinates into the coordinate system.

- A FoR is therefore a strategy for projecting a search domain or path off a relatum (or in some instances a referent (see Terrill & Burenhult 2008:120))
- This is done by imposing an asymmetry on the scene in which the relatum and referent are found.
- E.g. *The car is in front of the house.*
- The car is located in a search domain projected off the house.
- It’s projected off a named facet of the house, its *front*.
- Here the asymmetry assigned to the scene is assigned to the relatum itself.

Static and dynamic relations

Static relations

- In static relations one entity - the referent - is located in relation to another entity - the relatum.
- A search domain is projected off the relatum.
- The referent is located in that search domain.

*The car waited **north** of the house.*

- The referent car is located in a search domain projected off the relatum house (on the basis of a cardinal directional system).

Dynamic relations

- In dynamic relations a path is projected off the relatum.
- The referent is moving along that path.
- The referent and relatum may (but need not) be the same entity with the added dimension of time.

*The car drove **north** from the house.*

- The referent car is moving along a path projected off the relatum house.

*The car drove **north**.*

- The relatum is the car at time T .
- The referent is the car at time T^n .
- The referent car at T^n is moving along a path projected off the relatum car at T .

	relation	projection	relatum	referent
<i>The car waited north of the house.</i>	static	search domain	house	car
<i>The car drove north from the house.</i>	dynamic	path	house	car
<i>The car drove north.</i>	dynamic	path	car at T	car at T^n

Frame of Reference typology

- Three strategies exist for projecting a search domain or path off a relatum. Each is a FoR:
 - intrinsic
 - relative
 - absolute
- These “exhaust the major types of [coordinate system] used in natural languages.” (Levinson & Wilkins 2006a:4)
- Each has its own logical properties.

Intrinsic FoR

- Definition based on Levinson (1996:125-152, 2003:41-43)
- Intrinsic FoR operates by assigning an asymmetry to the relatum itself.

*The car is **in front** of the house.*

- The search domain is projected off the relatum on the basis of the house’s perceived asymmetry – the house itself has a front.
- Anchor point A is within relatum G .

- Intrinsic FoR is a binary relation.
- An intrinsic spatial relation involves only two arguments, the referent *F* and the relatum *G* (I refer to this as the 'referent-relatum dyad').
- The FoR assigns an asymmetry to *G*.
- Anchor point *A* is an intrinsic facet of *G*.
- A search domain is projected off *G* on the basis of its facet *A*.

- E.g. *The car is **in front** of the house.*
- *G (the house)* has an intrinsic facet *front*.
- A search domain is projected off that facet.

- To construct or interpret an intrinsic spatial reference it is necessary to know both the location and internal spatial structure of the relatum.
- It is not dependent on anything outside the referent-relatum dyad.

Relative FoR

- Definition based on Levinson (2003:43-47)
- Relative FoR operates by assigning an asymmetry to the scene in which the relatum occurs on the basis of a third participant, a viewpoint, *V*.

*The ball is **in front** of the post.*

- The relatum post has no perceived intrinsic asymmetry.

- The search domain is projected off the relatum on the basis of an asymmetry given to the scene by the presence of *V*.
- Anchor point *A* is within (actually the location of) *V*.

- Relative FoR is a ternary relation.
- A relative spatial relation involves three arguments: referent *F*, relatum *G*, and viewpoint *V*.
- The FoR assigns an asymmetry to the scene.
- Anchor point *A* is the location of *V*.
- A search domain is projected off a facet of *G* assigned to it by *V*.

*The ball is **in front** of the tree.*

- *V* assigns to *G* (*the tree*) a facet *front* facing *V*, and a search domain is projected off that facet towards *V*.

- To construct or interpret a relative spatial reference it is not necessary to know anything about the internal spatial disposition of the relatum.
- It is necessary to know both the location of the relatum and the location of the viewpoint.
- It is necessary to know something outside the referent-relatum dyad.

Absolute FoR

- Levinson's (2003) definitions of intrinsic and relative FoR are unproblematic.
- Levinson's (2003:47-50) definition of absolute is problematic.
- The rest of this talk focuses on absolute FoR.

- For Levinson, absolute FoR operates by assigning an asymmetry to the scene in which the relatum occurs on the basis of a system of arbitrary fixed bearings. (2003:47-50)

*The car is **north** of the house.*

- No intrinsic asymmetry in the relatum is invoked, and the reference is independent of any viewpoint. *Absolute directions give us external bearings on an array, but without viewpoints...* (Levinson 2003:90)

- Absolute FoR involves "a system of coordinates anchored to fixed bearings." (2003:48)
- This system is a conceptual "slope" *S*.
- Slope is a system of fixed bearings imposed on a scene.
- A search domain is projected off the relatum on the basis of asymmetry given to the scene by *S*.
- Anchor point *A* is within slope *S*.

- For Levinson, this makes absolute FoR a binary relation.
- He argues it involves only two arguments: referent *F*, and relatum *G*.
- The FoR assigns an asymmetry to the scene.
- Anchor point *A* is within *S*.
- A search domain is projected off a facet of *G* assigned to it by *S*.

*The cat is **north** of the house.*

- S assigns to G (*the house*) a facet *north*.
- A search domain is projected off that facet.

- To construct or interpret an absolute spatial reference it is not necessary to know anything about the internal spatial disposition of the relatum.
- It is necessary to know both the location of the relatum and the bearings of the slope.

Diversity in absolute systems

- North-south/east-west. E.g. Arrente (Australian, Central Australia) (Wilkins 2006:52-60)
- Landward-seaward/parallel to coast. E.g. Kokota (Oceanic, Solomon Islands) (Palmer 2002:135-137,153-154, 2009).
- Upriver-downriver/away from river-towards river. E.g. Jaminjung (Australian, Northern Australia) (Schultze-Berndt 2006:103-107)
- Uphill-downhill (elevational)/across on same level. E.g. Nimboran (Trans-New Guinea, PNG) (Steinhauer 1997)
- Uphill-downhill (fall of land)/across. E.g. Tzeltal (Mayan, Mexico) (Brown & Levinson 1993; Brown 2006)
- many others

Re-examining absolute FoR

- Foundational to Levinson's definition of absolute FoR are four terms that are different faces of the same notion.
- Absolute FoR involves bearings that are:
 - abstract;
 - arbitrary;
 - fixed.
- Absolute relations are binary, not ternary.

Binary or ternary

- In fact Levinson sets up a dichotomy between intrinsic on the one hand, with its clearly binary nature, and relative and absolute, with their dependence on something outside the referent-relatum dyad.

[I]n the intrinsic frame of reference the angles are found by naming a designated facet of a landmark or ground object... within the scene to be described.

In the case of relative and absolute frames of reference, the angular distinctions are mapped onto the scene from outside it, using the observers own axes... in the relative frame, and fixed absolute bearings... in the absolute frame... (Levinson & Wilkins 2006a:20)

- Pederson et al (1998:572) observe that absolute FoR *uses information external to both the speech participants and the figure-ground scene*
- They don't discuss the implications of this for a binary notion of absolute FoR.
- We'll return to this issue shortly.

How fixed?

- According to Levinson absolute FoR works: *by fixing arbitrary fixed bearings, 'cardinal directions', corresponding one way or another to directions or arcs that can be related by the analyst to compass bearings.* (Levinson 2003:48)

fixed bearings – independent of the scene... the names and directions of the fixed bearings are fixed once and for all. (Levinson & Wilkins 2006a:4)

- What does it mean to say directions are "fixed"?
- Is fixedness a principled definitional requirement for absolute FoR?

Radial and curved axes:

- Manam (Oceanic, Papua New Guinea, Lichtenberk 1983:569-597) has an axis *auta* 'landward' – *ilau* seaward.
- This is crossed by an axis corresponding to the line of coast.
- Manam is a round island. The coastal axis curves around the island with two lexified directions: *ata* 'clockwise around the island' – *awa* 'anticlockwise around the island'.
- Because the island is round, the landward-seaward axis radiates out from the centre of the island.

- From the perspective of compass bearings, both directions on both axes point in every direction, so are not fixed in Levinson's sense.
- In one place *ilau* points north, in another east, etc.
- But within the conceptual framework of the Manam system, in all places *ilau* points consistently in the same direction: seaward.
- Within the Manam conceptual framework, *north* points in all directions: in one place *ilau*, in another *awa*, etc.

Wind direction

- The Manam directions are fixed in the sense that they apply in an invariant and consistent manner in any location on the island. (Palmer 2005:5-6; Terrill & Burenhult 2008:123)
- Many absolute directions are fixed in Manam sense.
- But even this is not an operational requirement of absolute FoR.
- Absolute directions need not depend on a predictable conventionalised bearing. (Palmer 2003)

- E.g. axes associated with wind direction:

windward-leeward

upwind-downwind

*the ship is placed to windward of the man
before the boat is lowered*

([www.bruzelius.info/Nautica/Seamanship/Alston\(1860\)_s358.html](http://www.bruzelius.info/Nautica/Seamanship/Alston(1860)_s358.html))

*Make sure you wait downwind from where the
wild pigs are expected to appear.*

(www.jessesshuntingpage.com/site/hog.html#TopOfDoc)

- These invoke absolute FoR.
- They give external bearings on an array, without a viewpoint.

*you wait **downwind** from the pigs' position*

- The referent (*you*) is located in a search domain is projected off the relatum (*the pigs' position*), not on the basis of an internal asymmetry of the pigs' position itself (so not in intrinsic FoR), or a viewpoint (so not in relative FoR), but on the basis of anchoring phenomenon in the external world (wind direction at a particular time).

How abstract? How arbitrary?

- Directions in absolute systems are not necessarily arbitrary in an operational sense.
- The direction indicated by *ilau* is determined by the actual location of the sea in relation to the relatum, etc.
- The direction indicated by *downwind* is determined by the actual wind direction at a particular time.

- **Jahai** (Mon Khmer, Malay Peninsular) (Burenhult 2005; Terrill & Burenhult 2008:101-111) has an upriver-downriver system.
- *these directions are dependent on the actual [river] profile and are not abstracted away from the direction of water flow; the referential direction changes with individual rivers, streams and even bends.* (Terrill & Burenhult 2008:102)

Ad hoc references

- The degree to which absolute systems need not be abstractions can be seen in truly *ad hoc* non-conventionalized references that invoke absolute FoR.
- In English these are productively generated morphologically using the suffix *-ward*. (Palmer 2004:7-8)

*his barefoot trail led **schoolward** from the little
farm* (www.rootsweb.com/~mahampde/commerce/05.html)

*the North Atlantic Cold Storage wharf, a stone's
throw **beachward** from our house*
(www.upne.com/features/gasporex.html)

*Wilson, lazily wandering **storeward** from the
boarding house after dinner, seated himself
upon a box*

(www.archive.org/stream/barbaraofsnows00greeuoft/barbaraofsnows00greeuoft_djvu.txt)

- These *ad hoc* references invoke absolute FoR.
- They give external bearings on an array, without a viewpoint.

*the wharf is just **beachward** from our house*

- The referent (*the wharf*) is located in a search domain is projected off the relatum (*our house*), not on the basis of an internal asymmetry of the house itself (so not in intrinsic FoR), or a viewpoint (so not in relative FoR), but on the basis of an anchoring phenomenon in the external world (the location of the beach).

- The central morphological function of *-ward* is to productively generate spatial adverbs expressing *ad hoc* absolute spatial relations,
- and mark the suffixed noun as the third participant in a ternary spatial relationship.
- These *ad hoc* relations inherently cannot be fixed and are therefore inherently non-arbitrary.

The external world in absolute FoR

- Despite the dominant view that absolute systems are arbitrary and abstract, acknowledgement of the role of the external world in motivating absolute categories is pervasive in the literature.
- *Absolute coordinates can be based on many different sources – solar compass, sidereal motion, wind direction, river drainage, mountain slopes... For example, the Tenejapan Tzeltal system is transparently based on mountain slope, and the Jaminjung system on river drainage.* (Levinson & Wilkins 2006a:22)

- Even with systems less transparently connected to the environment, Levinson assumes that the environment plays a crucial role in orienting the coordinate system.
- *More abstract systems, as exemplified by Arrernte..., are probably based on a fusion of cues, e.g. solar compass and prevailing winds.* (Levinson & Wilkins 2006a:22)

- Absolute systems require that speakers *maintain their orientation with respect to the fixed bearings at all times... [To do this] we may presume that a heightened sense of inertial navigation is regularly cross-checked with many environmental cues.* (Levinson 2003:48)

- However, according to Levinson, *none of these environmental gradients can provide the cognitive basis of abstracted systems. Once the community has fixed a direction, it remains that direction regardless of fluctuations in local landfall, drainage, wind source, equinox, and so on...* (Levinson 1996:163)
- This is true only if many coordinate systems, or in some cases just certain parts of a coordinate system, are excluded simply by failing to satisfy a definitional requirement that they be fixed and abstract.
- This is stipulative and circular.

- Manam 'landward'-'seaward' and 'clockwise'-'anticlockwise' axes do not conform to this.
- Jahai 'upstream'-'downstream' axis does not conform to it.
- *Upwind-downwind* and *windward-leeward* axes do not conform to it.
- All are operationally identical to uncontroversially absolute axes like north-south.

- Some systems conform to it in one context but not in another.
- According to Levinson, one "ambiguity" in absolute systems is:
where the system is abstracted out of landscape features, the relevant expressions (e.g. 'uphill'...) may refer to places indicated by relevant local features (e.g. local hill...) or to the abstracted fixed bearings, where these do not coincide. (Levinson 2003:49)

- E.g Tenejapan Tzeltal has an 'uphill'-'downhill' axis in which *ajk'ol* 'uphill' indicates a direction towards the highlands in the south of the language territory, and *alan* 'downhill' indicates a direction towards the lowlands in the north. (Brown 2006:263-270; Levinson 2003:148-149)
- If a ridge rises towards the lowlands, ascending that ridge is still 'downhill', in the sense of the abstracted uphill-downhill axis.
- It can simultaneously be 'uphill' in the sense of this local topographic feature.

- However, the ambiguity here does not demonstrate a conceptual distinction between a local landmark reading, and abstract fixed reading.
- The distinction depends on scale.
- A location further up the slope of a ridge in the general direction of the lowlands is literally uphill if thought of in terms of the immediate ridge, and simultaneously downhill if thought of in terms of the overall fall of land across the entire territory.
- In both situations the use of the axis is the same.

- A similar situation occurs in Makian Taba (Austronesian, Halmahera) (Bowden 1997; Palmer 2002:148)
- Taba is spoken on Makian, a small round island resembling Manam, and has:
 - an *akle* 'landward' – *akla* 'seaward' axis.
 - an *appo* 'clockwise' – *attia* 'anticlockwise' axis.
- Taba is also spoken on mainland Halmahera.
- In the strait between Makian and Halmahera one can be simultaneously travelling *akle* or *akla*, or *attia* or *appo*, depending on whether one is thinks of oneself in relation to Makian or Halmahera.

Landmarks?

- Can these systems be treated as invoking landmarks, and not instances of absolute FoR?
- *[S]ome languages use conventionalized landmark systems that in practice grade into absolute systems, although there are reasons for thinking that landmark systems and fixed bearings [i.e. absolute] systems are distinct conceptual types.* (Levinson 1996:161)
- What are these reasons?

- However, the distinction between conventionalized landmark systems and absolute FoR is not explicitly expressed in the literature.
- This is a “murky area”. (Terrill & Burenhult (2008:122))
- Why? Because landmarks “challenge categorization based on concrete vs. abstract and ad hoc vs. conventionalized spatial cues.” (Terrill & Burenhult (2008:122))
- Their degree of concreteness and conventionalization varies across languages.
- In some they form “vectors which abstract away from actual geography, while in other languages this is not the case at all.” (Terrill & Burenhult (2008:122))

- Levinson regards landmarks and absolute FoR as distinct because landmarks do not conform to a definition of absolute FoR in which absolute axes must be fixed, arbitrary and abstract.
- *Absolute directions give us external bearings on an array, but without viewpoints... Local landmarks can give us some of the same abstract properties... but do not have the same abstract properties as notions like 'north'.* (Levinson 2003:90)

- This is not a principled distinction.
- If a definition is a statement of a Platonic ideal or prototype, then “landmark systems” are too far from the ideal or prototype to count as absolute.
- This is why landmark systems “grade into” absolute systems:
there can be no principled distinction – there must be grey areas.

- But if a definition is an attempt to capture an empirically motivated distinction, then an observable distinction must exist.
- If no observable distinction occurs, a definition that excludes some instances of a phenomenon does so by fiat and is unmotivated.
- The murkiness relating to landmarks arises because an observable phenomenon challenges the definition.
- The problem is not with the phenomenon – it’s with the definition.

- What principled basis exists for distinguishing between landmarks and absolute FoR?
- No attempt has been made to “operationalize” the distinction between absolute FoR and landmarks (Terrill & Burenhult 2008:124).
- I propose a two pronged basis for doing this:
- There is a grammatical distinction between expressions of one vs expressions of the other.
- There is an operational distinction between references based on one vs references based on the other.

Landward and east

- *East* is uncontroversially regarded as absolute.
- *Landward* could be construed as invoking a landmark (it is not abstract, arbitrary, or fixed in Levinson’s sense - it is whatever direction land happens to be).

- Grammatically a distinction can be drawn in English between nouns expressing entities that may refer to places in a spatial expression, and forms constituting members of spatial referential systems, such as directional adverbs.

- Spatial relations may be expressed using NPs referring to landmarks:

*The yacht sailed towards **the land**.*

*The yacht sailed towards **the open ocean**.*

*The yacht sailed towards **the rocks**.*

*The yacht sailed towards **the treacherous uncharted reef**.*

*The yacht sailed towards **Sydney**.*

- or directional adverbs:

*The yacht sailed **landwards**.*

*The yacht sailed **seawards**.*

The yacht sailed **rockswards.*

The yacht sailed **treacherous uncharted reefwards.*

*?The yacht sailed **Sydneywards**.*

- Grammatically, the NPs occur within a PP expressing a goal, source or location.
- They don't form part of a coordinate system imposing an asymmetry on the scene, so don't invoke a FoR.
- Operationally the directional adverbs do form part of a coordinate system which imposes an asymmetry on a scene so a path or search domain can be projected off a relatum.

*The yacht sailed **landward**.*

*The yacht is anchored just **landward** of the freighter.*

- A path or search domain is projected off the relatum yacht, not on the basis of:
 - a perceived internal asymmetry of the yacht itself (so not in intrinsic FoR), or
 - a viewpoint (so not in relative FoR),
- but on the basis of an anchoring phenomenon in the wider world (the location of land).

- This must involve a FoR, as it is a coordinate system whose function is to impose an asymmetry on a scene in order for a path or search domain to be projected off a relatum.
- It does not operate in intrinsic or relative FoR.
- Recall Levinson regards intrinsic, relative and absolute FoRs as having exhaustive coverage.
- Recall also that Levinson defines absolute FoR as giving "external bearings on an array, but without employing viewpoints." (Levinson 2003:90)

- Note also that *landward* clearly expresses a ternary relation:
- In our example the path or search domain is projected off the relatum yacht on the basis of a participant outside the referent/relatum dyad – the land.

- Now consider *east(ward)*.
- Grammatically, *east(ward)* behaves in the same way as *landward*: as a directional adverb in a spatial referential system:

*The yacht sailed **landward**.*

*The yacht sailed **east/eastward**.*

- Operationally *east(ward)* forms part of a coordinate system which imposes an asymmetry on a scene, so a path or search domain can be projected off the relatum.

*The yacht sailed **east/eastward***

*The yacht is anchored just **east** of the freighter.*

- A path or search domain is projected off the relatum yacht on the basis of an anchoring phenomenon in the wider world (whatever observable environmental cues motivate and anchor the east-west axis).

- *East(ward)* and *landward* behave grammatically and operationally in the same way in a FoR that is neither intrinsic nor relative.

- If we call this FoR absolute for *east(ward)*, then we must call it absolute for *landward*.
- The English *landward-seaward* axis and *east-west* axis both operate in absolute FoR.

- Note also that *east* can occur as the head of an NP referring to the goal of verbs of movement or change of location.

*The yacht sailed towards **the east**.*

*The yacht sailed towards **the land**.*

*The yacht sailed towards **the treacherous uncharted reef**.*

- In the definition of 'landmark' taken here, if *the land* a landmark, *the east* must also be a landmark.

Summary:

- *Landward* and *east(ward)* are members of coordinate systems operating in absolute FoR.
- *The land* and *the east* are landmarks.

- Moreover, the degree of abstractness of notions such as *east* may be overstated.
- Speakers anchor cardinal directions to landmarks.
- E.g. Calgary is east of the mountains.
- For at least some English speakers in Calgary, *west* is the direction towards the mountains, and *east* is the direction away from the mountains.
- The directions indicated by *north* and *south* are less confidently used.

- In Lavukeleve (Papuan, Solomon Islands) (Terrill 2003; Terrill & Burenhult 2008)
- *Knowing the direction of one compass point does not automatically enable a speaker to work out where the other compass points are. It seems, rather, that they are known singly in relation to obvious landmarks...*
They are less concrete than expressions such as 'mountain', but they are nonetheless tied to concrete landmarks. (Terrill & Burenhult 2008:125)

Logical properties of each FoR

- The logical properties of references reveal which FoR is invoked in these references (see Levinson 2003:50-52).
- Transitivity works in absolute FoR:

The dinghy is east of the yacht.
 + *The yacht is east of the freighter.*
 = *The dinghy is east of the freighter.*

- Transitivity does not work in intrinsic FoR:

Tom is at Mary's left.
 + *Mary is at Sam's left.*
 ≠ *Tom is at Sam's left.*

- Whether this is true or not depends on which way each is facing.

- Transitivity works in relative FoR, but only if the viewpoint is held constant:

The ball is to the left of the post.
 + *The post is to the left of the tree.*
 ? *The ball is to the left of the tree.*

- Converseness works in absolute FoR:

The yacht is east of the freighter.
 = *The freighter is west of the yacht.*

- But not in intrinsic FoR:

Tom is at Mary's left.
 ≠ *Mary is at Tom's right.*

- And only in relative if viewpoint is constant:

The ball is to the left of the post.
 ? *The post is to the right of the ball.*

- Transitivity and converseness both work with *landward-seaward*:

The dinghy is landward of the yacht.

+ *The yacht is landward of the freighter.*

= *The dinghy is landward of the freighter.*

The yacht is landward of the freighter.

= *The freighter is seaward of the yacht.*

- Transitivity and converseness work with the various systems we've looked at:

– *upwind-downwind*

– clockwise-anticlockwise in Manam

– upstream-downstream in Jahai

– cardinal directions in Lavukaleve

Three case studies

Balinese

- Spatial reference in Balinese (Wassman & Dasen 1998) is an interesting test of this distinction between absolute FoR and reference to landmarks.
- Pederson regards the Balinese system as “an intermediate case between local landmarks and an absolute coordinate system”. (Pederson 2003 footnote 2)

- For Levinson, Balinese exemplifies systems that *may employ true abstracted cardinal directions on one axis, but landmark designations on the other... one axis is determined by monsoons, and is a fixed, abstracted axis, but the other is determined by the location of the central mountain.* (Levinson 2003:49)
- Note that even here the ‘abstracted’ axis is explicitly stated to be motivated by an external phenomenon – the monsoon.

- Balinese has a four term system of spatial reference lexifying polar directions on two axes:

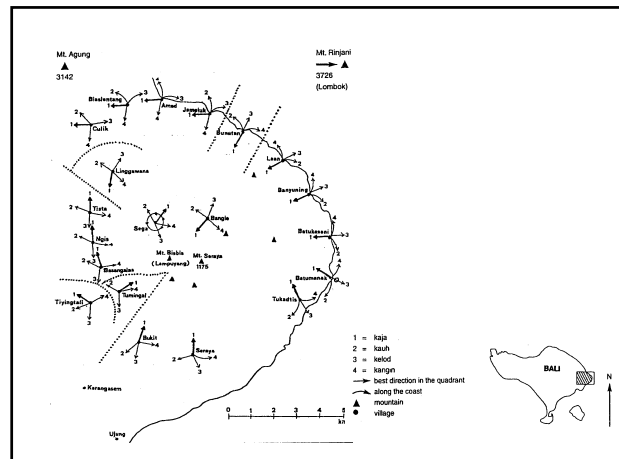
kaja-kelod mountainward-seaward

kangin-kauh east-west

- For native speaker Indrawati (1993), these indicate:
 - kaja* the direction of the mountain
 - kelod* the direction of the sea
 - kangin* the direction of sunrise
 - kauh* the direction of sunset

- Note that *kangin* ‘east’ is motivated by the east-west direction of the monsoons according to Levinson (2003:49), and to the location of sunrise according to Wassman & Dasen (1998:692) and Indrawati (1993) .

- Bali has high mountain range running east-west across the island.
- Most Balinese live north or south of this range, so the two axes cross orthogonally – with *kaja* corresponding to ‘north’ in southern Bali and ‘south’ in northern Bali. (Arka 2006; Wassman & Dasen 1998:692)
- At the eastern tip, the direction indicated by *kaja* depends on the location of the largest visible mountain, with commensurate adjustments of the east-west axis. (Wassman & Dasen 1998:698-670)



- Grammatically the terms can be nouns expressing landmarks in the same way as other nouns:

uli kaja
from inland
'from the inland'

uli kangin
from east
'from the east'

uli gunung
from mountain
'from a mountain'

- But only the directional terms can be verbs:

Nyoman ngaja-n-an.
N. AV.inland-LIG-LOC
'Nyoman is going inland.'

Nyoman ngangin-an.
N. AV.east-LOC
'Nyoman is going eastwards.'

**Nyoman ngunung-an.*
N. AV.mountain-LOC
'Nyoman is going mountainwards.'

- Operationally these verbs project a path off the relatum (*Nyoman* at time *T*) on the basis of an anchoring phenomenon in the wider world:
 - the largest visible mountain in the case of *kaja*,
 - the location of sunrise in the case of *kangin*,
 - etc.
- The 'mountainward-seaward' terms and 'east-west' terms behave in the same way operationally and grammatically, and are explicitly anchored in external world phenomena for speakers.
- There are no grounds for treating them as distinct.

Upsun and downsun

- *East* is motivated by and anchored in the path of the sun, but it may be conventionalized.
- The location of the sun may motivate and anchor spatial references where no other suitable phenomenon is available, or the location of the sun is relevant to the purpose of the reference.
- In English this is expressed using an axis lexified as *upsun-downsun*.
- This resembles concepts such as upwind-downwind.

*I had spotted 22 ME-109s and couldn't let them see me. I kept **up-sun** from them with my squadron of sixteen P-51s. Finally, when they leveled out and headed over towards the bombers, I just moved in behind them, **down-sun**. I got within two hundred yards behind them.*
 (www.achievement.org/autodoc/page/yea0int-2)

*I flew straight **downsun** just after dawn...*
 (www.bethwaite.com/10264.02.2-0-automatic-rig--part-2.html)

- The *upsun-downsun axis* invokes a coordinate system, not a landmark.
- The terms are adverbs expressing vectors, not nouns expressing goals, sources or locations.

*I kept **up-sun** from them.* coordinate system
*I kept towards **the sun** from them.* landmark

- *Upsun-downsun* operates in absolute FoR.
- It give external bearings on an array, without a viewpoint.

*I kept **up-sun** from the ME-109s.*

- The referent (*I*) is located in a search domain is projected off the relatum (*the ME-109s*), not on the basis of an internal asymmetry of the ME-109s themselves (so not in intrinsic FoR), or a viewpoint (so not in relative FoR), but on the basis of an anchoring phenomenon in the external world (the location of the sun).

- In Levinson's terms, slope *S* (in this case the *upsun-downsun axis*) assigns to relatum *G* (*the ME-109s*) a facet *upsun*.
- A search domain is projected off that facet.

- *Upsun-downsun axis* has the following properties.
- It is not fixed in the sense of Levinson (2003), but is fixed in the Manam sense (Palmer 2002).
- It is concrete, not abstract.
- It is not arbitrary.
- It is ternary not binary.

The ship as an external world

- *Upsun-downsun* operates in very large domains, for practical purposes unbounded.
- The external worlds in which absolute FoR can operate can be much smaller and more constrained.

- A maritime vessel comprises a small bounded domain with named boundaries.
- The named boundaries are toponyms that can function as landmarks.
- Each corresponds to a spatial adverb that operates in intrinsic FoR,
- Each also corresponds to a spatial adverb that operates in absolute FoR. (Palmer 2003)

toponym	intrinsic	absolute
<i>bow</i>	<i>ahead/forward</i>	<i>forward</i>
<i>stern</i>	<i>astern</i>	<i>astern/aft</i>
<i>portside</i>	<i>port(side)</i>	<i>port(side)</i>
<i>starboard side</i>	<i>starboard</i>	<i>starboard</i>

Landmarks:

*everyone was asked to move to **the bow** of the boat* (waterski.about.com/od/glossaryofterms/g/bldef_bow.htm)

*Because of the tremendous weight of the three large propellers in **the stern** of the ship, the stresses in the ship's midsection increased immensely...* (www.writing.engr.psu.edu/uer/bassett.html)

*the baggage doors on the **portside** of the ship are re-opened* (www.sterling.rmpc.co.uk/visions/rdeckexplanation.html)

Intrinsic FoR:

*the lookouts in the crow's nest sighted an iceberg immediately **ahead** of the ship* (www.tms.org/pubs/journals/jom/9801/felkins-9801.html)

*Crew on the deck then reported a u-boat **astern** of the ship.* (www.nc-wreckdiving.com/WRECKS/ABRAMS/ABRAMS.HTML)

*Hassayampa is one of ships **portside** of battleship USS Iowa* (www.angelwind.com/hassayampa/photo_suisun-bay.html)

- This is intrinsic FoR.

*a u-boat **astern** of the ship*

- The referent (*a u-boat*) is located in a search domain is projected off the relatum (*the ship*) on the basis of the internal asymmetry of the ship.
- It is projected off an intrinsic facet of the ship – its stern.

Absolute FoR:

*the remaining ones were stowed within a small area amidships just **forward** of the stone-boulder ballast* (www.diveturkey.com/inaturkey/serce/cargo.htm)

*The engine hatch is mounted immediately **astern** of the cabin* (www.fishing-boats.info/Arvor215.htm)

*The 'L' shaped galley, positioned **aft portside** of the main saloon, is impeccably presented* (www.formulacruisers.co.nz/review_express45.htm)

- This is absolute FoR.
- It give external bearings on an array, without a viewpoint.

*the remaining ones were... just **forward** of the stone-boulder ballast*

- The referent (*the remaining ones*) is located in a search domain is projected off the relatum (*the stone-boulder ballast*).

- This is not projected off the relatum on the basis of an internal asymmetry of the relatum itself.
- The ballast cannot be construed as having an intrinsic forward facet.
- Instead a forward facet is assigned to the ballast on the basis of an anchoring phenomenon in the external world (the location of the bow).
- In Levinson's terms, slope *S* (in this case the forward-astern axis) assigns to relatum *G* (*the ballast*) a facet *forward*.
- A search domain is projected off that facet.

- The absolute *forward-astern* and *portside-starboard* axes have the following properties.
- They are fixed in the sense of Palmer (2002), but not fixed in the sense of Levinson (2003),
- They are concrete, not abstract.
- They are not arbitrary.
- They are ternary not binary.

Topographic Correspondence Hypothesis

- Research by the Cognitive Anthropology Group at the Max Planck Institute for Psycholinguistics (MPI) and others has shown that systems of absolute spatial reference vary considerably across languages. (See e.g. Levinson & Wilkins 2006b; Pederson et al 1998)
- This prompted a Whorfian conclusion in which the choice of absolute FoR, and the choice of vectors forming the coordinate system, are arbitrary.

- Coordinate systems in absolute FoR *fix the directions once and for all... It matters not at all where the angles or directions are fixed, just so long as everyone in the community adopts the same solution... an absolute, arbitrary fixed direction is necessarily a social artefact... A child must learn whatever the local system is and treat it as an arbitrary invariant...* (Levinson 1998:13)

- I've argued that absolute coordinate systems are not merely motivated by, but anchored in, the environment.
- Directions in even apparently abstracted absolute systems are anchored in environmental cues.

- This leads to a hypothesis that a correlation exists between topography of a language locus and a language's system of absolute spatial reference, that cross-cuts other factors such as genetic affiliation. (Palmer 2002, 2004, 2005)
- The implication is that coordinate systems in absolute FoR are constructed in response to the environment.
- This hypothesis makes two predictions.

Variation in diverse environments

- Languages spoken in diverse topographic environments will tend to have systems of absolute spatial reference that differ in ways that correlate to topographic variation, no matter how closely related the languages are.
- Individual languages spoken in a range of environments will show similar diversity.

Similarities in similar environments

- Languages spoken in similar topographic environments will tend to have similar systems of absolute spatial reference, regardless of genetic, areal or typological affiliation.

Urban/rural FoR choice correlation

- It is now accepted that environment correlates with FoR to the extent that:
urban environments associated with relative FoR, rural environments associated with absolute FoR (Majid et al 2004:111; Burenhult & Levinson 2007:136).
- Even within one language this may be true:
Rural Tamils use absolute FoR while urban Tamils use relative FoR (Pederson 1993; 2006:429-434).

- Presumably environmental factors are less regular and less accessible in a dense network of streets and buildings, so relative directions are easier to monitor and manipulate.

Hunter-gatherer lifestyle

- A hunter-gatherer lifestyle correlates with primary use of absolute FoR (Levinson 2003:212; Majid et al 2004:112; Terrill & Burenhult 2008:102)
- This is true of the Guugu Yimithirr (Aboriginal, North Queensland) (Haviland 1998; Levinson 1997, 2003:113-146) and Arrente (Aboriginal, Central Australia) (Levinson 2003:170-215; Wilkins 2006), the Hai//om (Khoisan, Namibia) (Widlok 1997), and the Inuit (Eskimo-Aleut, Alaska) (Fortescue 1988).
- All occupy relatively featureless environments.

- However, it is also true of the Jaminjung (Aboriginal, Northern Territory), who use a riverine system regarded by Schultze-Berndt (2006) as absolute FoR.
- The Jahai also were traditionally hunter-gatherers, using a riverine system comparable to Jaminjung.

- Because the Jahai riverine system is dependent on actual river-flow direction, it is not regarded by Terrill & Burenhult as an abstract system of fixed bearings,
- so it's treated as an exception to the association between hunter-gatherer lifestyle and absolute FoR (Terrill & Burenhult 2008:102).
- Under the definition of absolute proposed here, the Jahai system does invoke absolute FoR so is not a counter-example.

- Despite these correlations, the MPI school reject "ecological determinism".
- Beyond the urban-relative and rural-absolute association, Majid et al find no correlates between FoR and environment (2004:112).
- However, Majid et al categorize environment only on very broad categories based on ecological zone, such as 'temperate' or 'subtropical', and looked only at FoR choice, not type of system within a FoR.

Wider correlations

- Recent work examining landscape has found considerable cross-linguistic diversity in topological terminology (Burenhult 2007; Burenhult & Levinson 2007).
- However, grammaticized systems of spatial reference invoking absolute FoR strip away much of this diversity, revealing systems that look more similar.

- To test the Topographic Correspondence Hypothesis a more fine-grained analysis of linguistic systems of spatial reference and topography of language locus is needed than simple ecological zone and FoR choice.
- We need a methodology that makes the environment an independent variable.

- Palmer (2002:141-146) proposes what I'm calling the 'environment variable method'.
- Carefully targeted languages are chosen for comparison along two orthogonal paradigms:
 - Paradigm 1: closely related languages spoken in diverse environments.
 - Paradigm 2: unrelated languages spoken in similar environments.

- In paradigm 1 languages that are as closely related as possible should be compared.
- Dialects of a single language can be compared.
- The environments in which they are spoken should be maximally different.
- In paradigm 2 the languages compared should belong to completely unrelated language families to rule out genetic influence,
- and should be spoken in quite separate locations to rule out areal influence.
- The topographic environments in which they are spoken should be as similar as possible.

Preliminary findings – closely related languages in diverse environments

- Diversity in three closely related South Sulawesi languages (Palmer 2005).
- All belong to the South Sulawesi branch of the West-Malayo-Polynesian subgroup of Austronesian
- Makassarese (coastal) (Jukes f.c.:208-209)
- Embaloh (riverine interior) (Adelaar 1997:69-70)
- Aralle-Tabulahan (mountainous interior) (McKenzie 1997)

Makassarese (coastal)

<i>raya</i>	'landward'
<i>lau</i>	'seaward'
<i>wara</i>	'clockwise around peninsular'
<i>timboro</i>	'anticlockwise around peninsular'

Embaloh (riverine interior)

<i>urait</i>	'upriver'
<i>kalaut</i>	'downriver'
<i>anait</i>	'away from river', 'upward'
<i>indoor</i>	'towards river', 'downward'
<i>suali</i>	'across' (away from bank across river)

Aralle-Tabulahan (mountainous interior)

watercourse	elevational
<i>tama</i> 'upriver', 'inward'	<i>dai</i> 'uphill', 'upward'
<i>sau</i> 'downriver', 'outward'	<i>naung</i> 'downhill', 'downward'
	<i>pano</i> 'along' (same altitude along hillside)
<i>bete</i> 'across' (same altitude to far side of river/valley)	

Preliminary findings – unrelated languages in similar environments

- Similar systems in four unrelated languages (Palmer 2005).
- Samo (Trans New Guinea, New Guinea Highlands) (Shaw & Shaw 1973)
- Dyirbal (Australian, North Queensland) (Dixon 1972)
- Aralle-Tabulahan (Austronesian, Sulawesi) (McKenzie 1997)
- Florutz German (Indo-European, Italian Tyrol) (Rowley 1980)

Samo

- "the land... consists of parallel ridges rising between innumerable streams and rivers which generally run from east to west... on the north-south axis one is continually crossing streams and traversing ridges" (Shaw & Shaw 1973:158-159)

watercourse	elevational
<i>to-</i> 'upriver'	<i>fo-</i> 'uphill', 'upward'
<i>ya-</i> 'downriver'	<i>mun-</i> 'downhill', 'downward'
<i>sou-</i> 'across' (same altitude to far side of river/valley)	

Dyirbal

- Dialect of groups “at the foot of the range [and in] higher country around the upper reaches of the Tully River.” (Dixon 1972:24) “There are many short rivers, waterfalls and swamps.” (Dixon 1972:27)

watercourse	elevational
<i>-dawa</i> 'upriver'	<i>-daya</i> 'uphill'
<i>-balba</i> 'downriver'	<i>-bayja</i> 'downhill'
<i>-guya</i> 'across' (same altitude to far side of river/valley)	

Aralle-Tabulahan

- “a region of high mountains and many rivers” (McKenzie 1997:224)

watercourse	elevational
<i>tama</i> 'upriver', 'inward'	<i>dai'</i> 'uphill', 'upward'
<i>sau</i> 'downriver', 'outward'	<i>naung</i> 'downhill', 'downward'
	<i>pano</i> 'along' (same altitude along hillside)
<i>bete'</i> 'across' (same altitude to far side of river/valley)	

Florutz German

- A region of alpine river valleys. (Rowley 1980)

watercourse	elevational
/in/ 'upriver', 'inward'	/ao/ 'uphill', 'upward'
/aos/ 'downriver', 'outward'	/o:/ 'downhill', 'downward'
	/um(-a)/ 'along' (same altitude, along hillside)
/du:r/, /he:r/ 'across' (same altitude, far side of river/valley/mountain)	

Future research – atoll based languages

- Atoll-based languages are a useful test case because the atoll is a highly unusual environment: narrow strips of land and fringe reef surrounding a large central lagoon.
- The hypothesis predicts that atoll-based languages should have unusual features that correlate with unusual features of the environment.
- And that genetically diverse languages spoken on atolls will display similarities in these features.

- Preliminary research compared Marshallese (Oceanic, Micronesia) (Palmer 2007), Kiribati (Oceanic, Micronesia) (Palmer 2007), Tokelauan (Oceanic, Polynesia) (Hoëm 1993; Hooper f.c.; Palmer 2007) and laai (Oceanic, New Caledonia) (Ozanne-Rivierre 1976, 1997, 2004).
- Each has several complementary absolute systems: a supplementary cardinal system for use in all domains, a maritime system for use at sea, and one unique system used on atoll islands:

	Marshallese	Kiribati	Tokelauan	laai
Oceanward	<i>lik</i>	<i>-rake</i>	<i>tua</i>	<i>cōu</i>
Lagoonward	<i>ar</i>	<i>-rio</i>	<i>namō</i>	<i>goony</i>
Wildernessward	<i>ooj</i>	-	<i>vua</i>	<i>hnyoot</i>

- Although in distantly related, all are Oceanic.
- A future field-based project will test the Topographic Correspondence Hypothesis using the environment variable method to .
- For unrelated languages in similar environments we will compare space in Marshallese as used on an atoll with space in Dhivehi (Indo-European, Maldives) as used on a similar shaped atoll.
- For related languages in different environments we will compare atoll-based Marshallese with Marshallese as used on a small round Manam-like non-atoll island, and as used in heavily urban Orange County, California.

Space in language and non-linguistic behaviour –relativist or universal?

- Considerable cross-linguistic diversity exists in linguistic systems of spatial reference.
- Spatial language correlates with non-linguistic behaviour, so both manifest a cross-modal conceptual representation (or compatible representations) of space. (Pederson et al 1998:574-584; Levinson 2003:130-142,154-168,178-188)
- What implications does this have for the relationship between language and thought?

A Whorfian account

- Levinson and collaborators take a relativist view.

it is the communal possession of a shared linguistic system that coerces our private conceptual systems into shared directions. (Levinson 1992b:25, note 67)

- Why?
since you may want to described arbitrary spatial experiences in the future, you must remember them in terms which will support that later linguistic description. (Levinson 2000:281)

- We remember arrays in a particular way so we can later talk about them, rather than talking about them in the way we have remembered them, or talking about them and remembering them in a way that emerges from some more general conceptual representation.

It may be objected that the whole system of absolute orientation is much more than a linguistic phenomenon, and therefore cannot be considered an example of linguistic determinism.

Why not, for example, reverse the argument, and claim that the cognitive system of absolute spatial conception drives the language?

The answer is that there is no way in which a community-wide cognitive practice of this sort could come to be shared except through its encoding in language and other communicative systems like gesture.

It is the need to conform to these communicative systems that requires convergence in cognitive systems, not the other way around. (Levinson 1992a:35-36; 1997:125)

A categorial universalist account

- The traditional view in cognitive science is that linguistic spatial categories themselves are pre-linguistic innate cognitive categories (see Majd et al 2004:113).
- *[L]inguistic categories and structures are more or less straightforward mappings from a pre-existing conceptual space programmed into our biological nature.* (Li & Gleitman 2002:266)

- The extensive diversity of systems of absolute spatial reference make this implausible.
- The path of the sun is universally available to all humans, so it might be reasonable to hypothesise the existence of a preexisting conceptual category such as an 'east' anchored in the path of the sun, and that as well as underlying east, this category may also underlie references such *upsun* in 3D aerial space.

- It might be reasonable to hypothesise the existence of preexisting conceptual categories such as a 'down' anchored in the path of movement of inanimate objects without outside agency and in the ease of movement of humans, in contrast with the difficulty of movement 'up'.
- As well as underpinning *down* in the vertical domain, this may underlie *downhill* (inanimate movement on sloping land), *downriver* (inanimate movement on a watercourse), *downwind* (inanimate movement in wind). (See Levinson 2008:283-285)

- However, it's implausible that this hypothesis is correct for all spatial categories in language.
- The boundary between land and sea is not available to all humans (presumably until recently it was unknown to many continental dwellers).
- But could it be sufficiently widespread and salient to motivate a prelinguistic conceptual category such as 'seaward', that remains dormant in continental humans?

- Is it plausible that a hypothesis of this kind may be correct for every one of the diverse spatial categories found in language?
- Are we all born with the innate spatial category 'lagoonward', given that atolls have only been part of the human topographic experience for a relative short time, and almost all humans have never set foot on an atoll and are only vaguely aware at best of the nature of the topography of atoll islands.

An environmental response account

- The sheer diversity of absolute systems makes universal innate prelinguistic categories implausible.
- However, if, as I've argued, absolute spatial systems are not arbitrary fixed abstractions but motivated by and anchored in the external world, and a predictable correspondence exists between linguistic spatial systems and topography, then absolute spatial systems are not motivated by arbitrary linguistic categories.
- They are universal responses to environment.

- How do representations of perceptually accessed pre-existing external world phenomena end up in linguistic systems?
- I suggest three alternative hypotheses (Palmer 2004).

Hypothesis 1:

- Perceptual input feeds directly into language with no mediating cognitive domain.
- The resulting linguistic structures then motivate spatial representations employed by non-linguistic modalities.
- It's not clear how perceptual modalities like vision could interact directly with language without any mediating domain.
- This also implies that language mediates between perception and all other modalities - kinesthetics, memory etc. This is implausible.

Hypothesis 2:

- Perceptual input feeds directly into language with no mediating cognitive domain, but separately feeds into non-linguistic representations.
- Correlations between linguistic and non-linguistic behaviour occur because of comparable responses across domains.
- This again involves perception interacting directly with language with no mediating domain.
- It also implies that linguistic representations correlate with representations independently constructed in other modalities. It's not clear what mechanism could ensure this correspondence.

Hypothesis 3:

- Perceptual input feeds into some non-linguistic conceptual representation or representations.
- The resulting conceptual representations then motivate representations employed by language.
- Perception plays a part in constructing a conceptual representation, and through that provides input into language.
- Humans respond to their environment in the way they think about space, and construct a linguistic system to express that.

- The Whorfian approach asks 'How can speakers of a language share a way of thinking about space if they're not directed to it by their language?'
- I ask 'How can languages respond to the environment if not through the way people think about those phenomena?'

Conclusions

- Absolute FoR does not require arbitrary fixed coordinates.
- Absolute relations are ternary, not binary.
- While an absolute coordinate system may involve axes that are to varying degrees abstractions from external phenomena, they are conceptually motivated by, and operationally anchored in phenomena in the external world.

- Systems of absolute spatial reference are not arbitrary abstractions, or reflect universal conceptual categories
- On the basis of inherent perceptual salience, and to a degree human affordance, certain external world phenomena motivate and anchor axes in absolute coordinate systems.
- Humans universally respond to particular external world phenomena by constructing conceptual and, on the basis of that, linguistic, representations of space with specific characteristics.

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