How Spoken and Signed Language Structure Space Differently -- a Neural Model

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0. Overall Introduction

this talk: how perceptions and conceptions of space are schematically structured
in the cognitive system of language
first part--spoken language: the system for representing spatial structure in spoken languages
with perhaps the first attempt to catalog all the basic elements making up their spatial schemas
second part--signed language: the system in signed languages for representing space schematically
and its differences from the spoken-language system
signed spatial representation is systematically more like scene parsing in visual perception

unlike the Fodor-Chomsky language module, these findings suggest the presence in the brain of:
a. a smaller core language system responsible for the common properties of spoken and signed language
b. this core system linking up with different outlying systems for the full functioning of the 2 language modalities

Part I: Spatial Structuring in Spoken Language

1. Introduction

NB: Assumed here from my past work is the notion that, in spoken language,
closed-class forms represent conceptual structure,
while open-class forms represent conceptual content
-- i.e., that the two subsystems have a functional division of labor.
Thus, to examine how spatial concepts are *structured* in spoken language,
I look to their representation in the closed-class subsystem.

1.1 Intended target of present analysis

cross-linguistically, all closed-class forms (CCs) that specify spatial structure,
generally whole spatial schemas, including:

1.1.1 CCs for the spatial structure of paths or locations

a. forms in construction with a nominal
adpositions: *into / above* + adpositional complexes: *in front of*
noun inflections: Finnish "illative" *-:n*‘into’
"locative nouns": Japanese *ue* ‘top surface’, as in *teeburu no ue ni* table GEN top at (= "on the table")
b. satellites to a verb
free: *(run) back / apart / ahead*
bound: Atsugewi *-wamm* ‘into an areal enclosure’
c. adverbials: *home*, as in *He isn’t home*.
d. deictics: *this, here*

e. indefinites, interrogatives, relatives, etc.:
everywhere / whither / wherever (I'll go wherever you go)
f. qualifiers: *way, right*, as in *It's way / right up there*.

1.1.2 CCs for the spatial structure of objects

g. markers of plexity / state of boundedness on nominals
English plural *-s*: *birds*; debounding *-ery*: *shrubbery*
h. classifiers: Korean *chang* 'planar object'
i. instrument markers:
Atsugewi *cu* 'as the result of a linear object, moving axially, impinging on the Figure'

1.1.3 CCs for factors involved in / affecting spatial structure (as in a motion/location event)

j. markers for the Figure: some uses of Atsugewi or Caddo verb prefixes
k. markers for the Ground: Atsugewi Path+Ground verb suffix set; Caddo incorporated nouns
l. markers for Manner: Nez Perce Manner verb prefix set
m. markers for Cause: Atsugewi Cause verb prefix set

1.2 Provisional finding of the investigation

1.2.1 basic elements

a. There is an approximately closed universally available inventory of
conceptual elements that are basic -- perhaps primitive --
that recombine in various patterns to constitute the schemas
represented by most of the closed-class spatial forms found across languages.

b. There is a relatively closed set of categories that these elements fall into.

c. Each category mostly contains a relatively closed and small number of particular elements
-- hence, of spatial distinctions that it can ever mark.

1.2.2 whole schemas

a. these basic elements are combined into the whole spatial schemas
that, "pre-packaged", are expressed by CCs -- perhaps under well-formedness conditions (the least well established aspect of this investigation)

b. each language has in its lexicon an approximately closed set of CCs
representing an approximately closed set (larger, due to polysemy) of such whole spatial schemas that a speaker must select among in depicting a spatial scene

1.2.3 processes on whole schemas

a. There are certain properties and processes that apply generally to
the whole spatial schemas expressed by CCs

b. the processes extend or deform the basic form of whole schemas
perhaps as a system for fitting a language's closed schema set to more spatial scenes

2. Method for determining basic schema elements

systematically change candidate elements of a schema expressed by a CC
those changes preventing the use of that CC show the elements essential to it

consider the locative *across* schema; model sentence:
The board (F) lay across the road (G). (vs. the alternatives below)
(F = the Figure object; G = the Ground object)

2.1 Candidate elements that prove out

a. G is ribbonal: a plane with two roughly parallel edges
these edges (as main axis) are longer then or equal to distance between them (as secondary axis)
b. F is linear (and generally bounded at both ends).
-- vs. The wall siding lay over the road.
c. The axes of F and G are roughly perpendicular.
-- vs. The board lay along the road.
d. F is parallel to the plane of G.
-- vs. The board is sticking out of / into the road.
e. F is adjacent to the plane of G.
-- vs. The board lay (buried) in the road. / The board was suspended above the road.
f. F's length is at least as great as G's width.
-- vs. The baguette lay on the road.
g. F touches both of G's edges.
-- vs. The board lay over one edge of the road.
h. The axis of F is horizontal. (The plane of G is typically, but not necessarily, horizontal.)
The spear hung across the wall. vs. The spear hung up and down on the wall.

This shows that at least the following elements figure in CC-expressed schemas:
a point; a line; a plane
a boundary: a point as boundary to a line, a line as boundary to a plane
parallelness; perpendicularity
horizontality
adjacency (contact)
relative lengths of 2 perpendicular axes

2.2 Candidate elements that don't prove out

2.2.1 not in *across*, but in other CCs, hence in inventory: F is a plane and coplanar with G
ok: The board lay flat / stood on edge across the road.
so *across* schematizes the Figure only for its linearity, not for any planarity or coplanarity
hence, this CC shows no requirement for coplanarity, but other CCs do:
A tapestry / *A string of beads hung over the wall.

2.2.2 not in *across*, perhaps in no CC, hence not in inventory: F is rigid
ok: The pole / cable lay across the road
so *across* shows no element "rigid" or category "state of rigidity"; maybe never schema-relevant

2.3 Principle: get down only to the largest necessary granularity for elements

cross-schema analysis might yield a category of "relative orientation" between 2 lines or planes
with no more than two member elements: roughly parallel and roughly perpendicular.
some examples suggest an intermediary "oblique" member:
A secondary pipe branches off from the main sewer line. vs. ... branches out ...
Atsugewi: Ra- 'as a result of a linear object moving obliquely against a surface'
vs. cu- '... perpendicularly ...'; e.g., by poling a canoe vs. prodding a person
But then, this category needs division into at most 2 or 3 elements -- probably nothing finer

3. Sample of basic schema elements and their categories
The categories are here grouped into 3 classes, ones pertaining to:
scene segmentation / a scene component / the relation between 2 scene components

3.1 Categories pertaining to scene segmentation

3.1.1 Basic scene components: 3 members -- Figure, Ground, Secondary Reference Object

the Figure and Ground components were already seen in the *across* example above
Secondary Reference Object can be: encompassive / external
encompassive: e.g., the earth-based reference frame-- The lamp is above the TV.
vs. just Figure + Ground-- The lamp is near the TV.
external: e.g., an observer or viewpoint-- He's beyond the border.
vs. just Figure + Ground-- He's past the border.

3.2 Categories pertaining to an individual scene component
(e.g., the Figure, Ground, or Secondary Reference Object)

3.2.1 Dimensionality: 4 members -- 0 (point), 1 (line), 2 (plane), 3 (volume)

some English prepositions require a Ground object schematizable for only one of the 4 dimensional possibilities:
0: near a dot; 1: along a trail; 2: (a tapestry) over a wall; 3: (berries) throughout the jello

3.2.2 Number: perhaps 4 members -- 1, 2, several, many

some English prepositions require a Ground object schematizable
as comprising one or another number of points:
The basketball lay-- 1: near the boulder; 2: between the boulders;
several: among the boulders; many: amidst the cornstalks.

NB: not found in this category, for example: 'three', 'too many', 'an even number'

3.2.3 Motive state: 2 members -- moving, stationary

motive state of Figure: *at* stationary vs. *into* moving (with stationary Ground)
I stayed / *went at the library. vs. I went / *stayed into the library.
motive state of Ground: *after* moving vs. *up to* stationary (with moving Figure)
The lion ran after the deer. vs. The lion ran up to the deer.

NB: not found in this category, for example:
motion at slow vs. fast rate / location at rest vs. fixedly (staying put)

3.2.4 State of boundedness: 2 main members -- bounded, unbounded (also: bounded at one end/side)

unbounded: along-- I walked along the pier for 10 minutes / *in 20 minutes.
vs. bounded: the length of-- I walked the length of the pier in 20 Minutes / *for 10 minutes.

NB: many English prepositions are polysemous for both member notions:
I walked through the tunnel for 10 minutes. vs. I walked through the tunnel in 20 minutes.

Russian: *Satelit obletel zeml'u za 1 den'* '(the) satellite circum-flew (the) earth in 1 day'
vs. *Satelit letel vokrug zemli 3 dn'a* '(the) satellite flew around (the) earth for 3 days'

NB: not found in this category, for example: a gradient or fuzzy boundary

3.2.5 state of consolidation: 2 members--Compact/precisional, diffuse/approximative

compact/precisional (or neutral) vs. diffuse/approximative:
there vs. *thereabouts*: You'll find her there / thereabouts.
at vs. *around*: The other hiker is waiting at vs. around the landmark.
Mexican Spanish: *estar en* 'be located in' vs. *andar por* 'be located roughly in the region of'

perhaps combined with bounded vs. unbounded:
Malagasy locative adverbs: 2 forms for each of 'here' / 'there' / 'yonder' (<Shingo Imai)
e.g., 'there within that bounded region' - typically indicated with pointing finger
vs. 'there spread over that unbounded region' - typically indicated with sweep of hand

3.2.6 Directedness: 2 members -- basic, reverse

in a Ground object: The axon grows along the chemical gradient. vs. The axon grows against the chemical gradient.
in a Secondary Reference Object
a queue: She is ahead of me in line. vs. I am behind her in line.
the vertical axis of the earth-based reference frame:
The lamp is above the chair. vs. The chair is below the lamp.

3.2.7 Geometric type: 2 members -- radial, rectilinear

elements within the radial geometry type:

a center, a surround, a radius
and motion-- about a center, along a surround, along a radius

applied to a reference frame (a secondary Reference Object):
radial: The boat drifted further and further out from the island.
vs. rectilinear: The boat drifted further and further away from the island.

radial geometry applied to the Figure's path--
motion about center: I turned the pail around / over.
motion along radius toward / away from center:
The sloths on each branch of the tree slowly crawled in toward / out from the trunk.
motion along a linear surround: I walked around the Maypole.

radial geometry applied to the Ground--
cylindrical surround: through the tunnel; spherical surround: into the cave

3.2.8 Phase of matter: 3 main members -- solid, liquid, empty space

Atsugewi: -*ik's* 'horizontally into solid substance' as in chopping an ax into a treetrunk
vs. -*ic't* 'into liquid' vs. -*ipsnu* 'into a volumetric enclosure'
English: unlike *in*, *inside* accepts only an empty-space Ground, not liquid/solid:
The rock is in/inside the box. / in/*inside the puddle of water. / in/*inside the ground.

3.2.9 Intrinsic parts: ? members

e.g., for Ground object: front, side, back, top, bottom
(The cat lay) before / beside / behind / atop / beneath the TV.
Korean: *mit* '(at) the bottom part of'
(There's dirt on / A bug is flying near) the bottom of the cup [whether beneath or over it]
e.g., of the earth-based reference frame: vertical axis, horizontal plane
vertical: It's up there. / It's down there.; horizontal: It's over there.

3.2.10 Object identity: ? members

for the Ground object: e.g., 'home'-- French *chez* 'at the home of

3.3 Categories pertaining to the relation of one scene component to another

3.3.1 Degree of remove: 4 or 5 members
with contact: coincident, adjacent; without contact: proximal, (medial?), distal

coincident: The carousel is in the front of the fairground.
vs. proximal: The carousel is in front of the fairground.
adjacent: The fly is on the table. vs. proximal: The fly is over the table.
proximal: The bike is 10 feet / *10 blocks in front of the church.
vs. proximal+distal: The hawk is 1 foot / 1 mile above the table.
perhaps 'medial' needed for languages with here / there / yonder type deictics

3.3.2 Relative orientation: 2 or 3 members -- parallel, oblique?, perpendicular

parallel: The caterpillar crawled along the crack in the pavement. vs. perpendicular: ... across ...
oblique?: A secondary pipe branches off from the main sewer line. vs. perpendicular: ... branches out ...

3.3.3 Relative magnitude: 2 or 3 members -- less than, (equal to?), greater than

for a Figure's path from one side to the opposite side of a rectangle:
across: rectangle's path-parallel axis is less than or equal to its path-perpendicular axis
vs. along: rectangle's path-parallel axis is greater than its path-perpendicular axis

3.3.4 Degree of dispersion: 2 members -- sparse, dense

Figure = multiple elements of lesser dimensionality than Ground and coincident with or adjacent to it
for stationary Figure and 2- / 3-dimensional Ground:
neutral: There are some/many peas on the table. / in the aspic.
vs. sparse: There are peas here and there on the table./ in the aspic.
vs. dense: There are peas all over the table. / throughout the aspic.

3.4 Nongeometric categories

3.4.1 Force dynamics: 2 members -- present, absent

English *on*: Figure is in adjacent contact with Ground and supported by that contact
contact + support: The poster is on the wall.
contact, no support: The helium balloon is against the wall.
no contact, no support: The helium balloon is near / next to the wall.

3.4.2 Accessibility: 2 members -- accessible, inaccessible;
and 3.4.3 Accompanying cognitive / affective state: ? members

one type: Figure's location as-- inaccessible; unknown, nonvisible, risky, mysterious

beyond vs. *on the other side of* (NB: these both locate viewpoint at same place)
He's beyond the border. / He's on the other side of the border.

Korean: *sok* 'in the recesses of' vs. *an* 'accessibly in'
e.g., He is "sok" the building-- better than "an" in referring to
fugitive hiding somewhere in building to escape police outside

3.4.4 Relative priority: 2 members -- coequal, main/ancillary

I jog together with him. -- we are coequal
vs. I jog along with him. -- he is the main entity, I am ancillary

4 The Issue of Constraints on the inventory of elements making up spatial schemas

4.1 Surmise: the inventory is hierarchical

some elements are universal, some frequent, some low but recurrent across languages
the inventory is not sealed-- further elements can occur sporadically, novelly

e.g.,: in English, the concepts ‘walkway’ and ‘transportation’ are elements in one *on* schema:

on: in a (partially) enclosed vehicle with a walkway currently in use as transport
walkway: in a car / on a bus
in a grain car / on a train
in a helicopter / on an airplane
in a rowboat / on a ship
transportation: The kids played in/*on the abandoned bus. (< Fillmore)

example: intrinsic parts like ‘front’, ‘side’, ‘back’ are frequent,
but Makah has many verb suffixes with meanings like ‘at the neck’, ‘at the groin’ (<Matthew Davidson)

4.2 Response to Bowerman challenge

Bowerman challenge to idea of universal roughly closed inventory of schema primitives:
at same time that kids learn English *in/on*, Korean kids learn
kkita ‘put [Figure] in a snug fit with [Ground]’
and *nehta* ‘put [Figure] in a loose fit with [Ground]’
the factors ‘snug/loose fit’ are presumably rare among world’s spatial schemas
so they don’t come from any preset inventory; are learned from variable adult language semantics

reply-- I surmise: Korean closed-class schemas still largely built from preset inventory
the cited forms are open-class verbs, perhaps learned at same time as English *squeeze* or *puffy/gooey*
open-class semantics is a different cognitive subsystem,
drawing from broader and finer perceptual/conceptual discriminations
thus, kids perhaps know early that *squeeze* involves:
centripetal pressure from encircling or bi-/multi-laterally placed Antagonists (typically arm(s)/hand(s))
Agonist that resists pressure but yields down to some smaller compass where it blocks further pressure
and hence that one can squeeze: a teddy bear, a tube of toothpaste, or a rubber ball,
but not: a piece of string / sheet of paper; juice, cooked cereal, sugar; a table / the corner of a building

5. The elements assembled into whole schemas

a whole spatial schema expressed by a closed-class form is largely
composed of a selection of particular basic elements in a certain arrangement.

5.1 example: the elements arranged to make up the schema for English *past*
as in: The ball sailed past my head at exactly 3 PM.

(the category of an element is named in brackets)
there are 2 basic scene components-- a Figure and a Ground
[scene segmentation]

the Figure is schematizable as a 0 dimensional point
[dimensionality]
the motive state of this Figure point is moving, hence it forms a 1 dimensional line, its "path"
[motive state] [dimensionality]
the Ground is schematizable as a 0 dimensional point
[dimensionality]
there is a point P that is at a proximal remove from the Ground point, defining a line with it
[degree of remove] [state of boundedness]
this line is parallel with the earth-based horizontal
[relative orientation] [scene segmentation (for secondary Reference Object)]
the Figure's path is perpendicular to this line
[relative orientation]
the Figure's path is parallel to the earth-based horizontal
[relative orientation] [scene segmentation (for secondary Reference Object)]
if the Ground has front, back, and side parts, point P is proximal to the side part
[intrinsic parts] [degree of remove]
a nonboundary point of the Figure's path becomes coincident with P at a certain point of time
[state of boundedness] [degree of remove] [coordination of space and time]

5.2 constraints on the combinations of elements into schemas

largely not yet understood. Note:

5.2.1 No apparent principle based on geometric simplicity/regularity governs legality of combinations

some seemingly Byzantine combinations are frequent, as in the *across* and *past* schemas
but most don't occur, e.g., down into a surround that is radially proximal to a center point
as if in: "*I poured water apit my house." to mean--
I poured water down into a nearby hole dug in the field around my house

5.2.2 Some combinations are rare/absent in spoken languages
but largely present in American Sign Language, and probably also in visual parsing

see e.g., below under the English vs. ASL representation of rotation

6. General properties and processes applying to whole spatial schemas

plasticity -- schemas accept processes that extend / deform them

6.1 processes that extend schemas

6.1.1 Topological neutralities

schemas exhibit certain topological or topology-like properties:
magnitude-neutrality--
The ant crawled across my palm. / the bus drove across the country.
shape-neutrality--

I zigzagged / circled through the woods. I swam in a zigzag path across the irregularly shaped lake.

6.1.2 Bulk neutrality

the bulk of objects is conceptually reduced to particular schematic element types:
the Figure and Ground objects reduced to 0 dimensional points --
The ball sailed past the balloon. / The asteroid sailed past the earth.
the Ground object reduced to a 1 dimensional line --
The caterpillar crawled up along the filament / the flagpole / the tree trunk.

6.1.3 Extendability in ungoverned dimensions
a Figure or Ground of dimensionality N in the basic form of a schema
can generally be raised in dimensionality to form a line, plane, or volume
aligned in a way not conflicting with the schema's other requirements

e.g., *out* (in its radial sense) basically refers to a point Figure
moving along a radius away from a center point through a continuum of concentric circles

the Figure = a point (basic)
The boat sailed further and further out from the island
this point is extended along a radius
The caravan of boats sailed further and further out from the island
or the point is extended along a concentric circle
A circular ripple spread out from where the pebble fell into the water
this circle is extended to fill in the interior plane
The oil spread out over the water from where it spilled.
or the circle is extended in the vertical dimension to form a cylinder
A ring of fire spread out as an advancing wall of flames
or the circle is extended to form a spherical shell
The balloon I was blowing into slowly puffed out.
this spherical shell is extended to fill in the interior volume
The leavened dough slowly puffed out.

6.1.4 extendability across motive states

a schema basic for one motive state and Figure geometry can in general
be systematically extended to another motive state and Figure geometry

e.g., the most basic *across* schema is probably for a moving point Figure, as in:
The gopher ran across the road.
the line path formed by the moving point Figure models a related schema with stationary linear Figure
The board lay across the road.
as well as one with a fictively moving linear Figure
The cable extended across the road.
(all the constraints first seen for the stationary linear Figure of static *across*
carry over from the same constraints on the line path of the moving point Figure)

6.2 processes that deform schemas

a schema may have a basic form that it can then deviate from

6.2.1 deviation by stretching (up to a certain degree)

just about okay: I swam across the pool. -- along the longer axis of an oblong pool

6.2.2 deviation by cancellation of one or more schema elements

The shopping cart rolled across the boulevard and was hit by an oncoming car.
The tumbleweed rolled across the prairie for an hour.

Part II: Spatial Structuring in Signed Language

aviso: I here approach signed language from the perspective of spoken language
-- it is not at this point an area of my expertise

For their help with my questions on sign language, my thanks to --
Paul Dudis, Karen Emmorey, Samuel Hawk, Nini Hoiting, Marlon Kuntze, Scott Liddell,
Stephen McCullough, Dan Slobin, Ted Suppala, Alyssa Wolf, and others,
-- who are not responsible for my errors and oversights.

7. Introduction

7.1 What to compare between spoken and sign languages

ultimately, comparison must be made between
the full whole system and associated subsystems of spoken language and those of signed language
candidate division into subsystems for spoken language:
open-class (lexical) forms -- overall representing conceptual content
closed-class (grammatical and syntactic) forms -- overall representing conceptual structure
"vocal dynamics" (e.g., pitch, loudness, rate, timbre, distinctness, unit separation)
associated "somatic subsystem" (e.g., facial expressions, "body language", gestures)
candidate division into subsystems for signed language:
lexical forms (noun, verb, adjective signs)
modulations of ("inflections" on) lexical forms (e.g., for person, aspect)
size and shape specifiers (SASS's)
classifier constructions
gesture (along a gradient of incorporation into all the above)
face-head-torso representations
"bodily dynamics" (e.g., amplitude, rate, distinctness, unit separation)
associated (overlaid) "somatic subsystem" (e.g., further facial expression, "body language")

7.2 The classifier subsystem of sign language

apparently all signed languages have a subsystem of "classifier constructions" dedicated solely to
the schematic structural representation of objects moving / located with respect to each other in space

7.3 optimal initial comparison

for the representation of spatial structure, optimal initial comparison is between:
that subpart of the spoken-language CC subsystem pertaining to space and
the signed-language classifier subsystem
analogous across the two domains:
a. both are schematic and represent structure (in a structure/content distinction)
cf. English OCs *enter / entry* vs. CC *into* and
ASL lexical signs for 'enter / entry' vs. representations for 'into' in classifier expression
b. both structurally schematize objects moving / located with respect to each other in space
c. in both, schematic representations can optionally be elaborated by "outside" lexical forms
e.g., English: I drove it (-- the motorcycle--) in (to the cave) and
ASL: (C-A-V-E) enclosure (MOTORCYCLE) vehicle-move-into-enclosure

7.4 The basic finding

more than spoken language, sign language parallels the apparent structural characteristics
of scene parsing in visual perception.
in 2 venues: in the inventory of basic elements and categories / in the expression

• first venue: in the inventory

8. Larger inventory of basic elements and categories

sign has more total elements, more categories, and generally more elements per category
which seem to parallel elements / categories abstracted out in visual scene parsing

8.1 comparable category membership in signed as in spoken language

basic scene components: 3 members -- Figure, Ground, Secondary Reference Object
dimensionality: 4 members -- 0 (point), 1 (line), 2 (plane), 3 (volume)
state of boundedness: 2 main members -- bounded, unbounded (also: bounded at one end/side)

8.2 slightly greater category membership in signed than in spoken language

motive state: 3 members- moving, simple stationary, remaining fixedly in place
NB: spoken languages typically distinguish the last 2 in their verb-like forms,
not in their preposition-like forms

8.3 moderately greater category membership in signed than in spoken language
NB: the membership of these categories is probably gradient,
but without the capacity to represent many fine distinctions clearly

degree of remove: apparently more than spoken language's 4 or 5 members
(with contact: coincident, adjacent; without contact: proximal, medial, distal)
path length: apparently more than spoken language's 2 members (short, long)
relative orientation: apparently more than spoken language's 2 or 3 (parallel, perpendicular, oblique)

8.4 much greater category membership in signed than in spoken language

path contour: indefinitely many more than spoken language's probable 4
[straight (*across the field*), curved (*over a hill*),
circular (*around the Maypole*), meander (*all about the city*)]
locus within referent space: apparently many more than spoken language's 3 (here, there, yonder)

8.5 categories present in signed, absent in spoken language

relative lengths of Figure's path before and after encounter with the Ground: ? members
pattern of distribution: ? members
e.g., for multiple linear Figure objects dispersed over a planar surface (e.g., dry spaghetti over table):
arrayed in parallel alignment, crisscrossing, in a jumble

8.6 gradient type of membership present in signed, minimal in spoken language
in addition to discrete "elements" that are the "members" of a category,
some sign-language categories include a continuous gradient membership
as for magnitude, rate, contour
vs. spoken language: minimally present, as in English: It's waay / waaaay / waaaaaay over there.

8.7 Closer look: more elements / categories in the semantic domain of rotation

1 spoken-language category: orientation of spin axis: 2 members -- horizontal, vertical
e.g., English *over* (fall/topple over) vs. *around* (turn/spin around)

ASL largely distinguishes in addition the following categories and their members:
a. amount of rotation
turning less than vs. exactly vs. more than vs. several times one full circuit
b. relation of spin axis to object's geometry
at center: perpendicular disk (CD disk) vs. perpendicular line (propeller)
vs. aligned cylinder (pencil spinning on point)
at boundary: line ("hammer" swung in hammer toss) vs. transverse plane (swinging gate)
vs. parallel plane (swung cape)
at an external point: a point (earth about the sun) vs. a circle (spinning hoop)
c. uniformity of rotation?
uniformly through object (spinning rope) vs. differentially through object (twisting rope)

• second venue: in the expression

9. Iconic representation in the expression

spatial representation in signed classifier expressions
is iconic with scene parsing in visual perception in several ways:

9.1 Iconic clustering of categories

in one's perception of a motion scene, e.g., a car driving bumpily along a curve past a tree,

it is the same single Figure entity that:
has object properties as a Figure
moves
has a manner of motion
describes a path of a particular contour
relates to other surrounding objects (Ground) in its path of motion
perceived as separate: a Ground object (and an Agent / prior cause)

ASL (for one sign language) closely matches this perceptual pattern of clustering
dominant hand shows all 5 of the above Figure-related factors:
Figure type, motion, manner, path contour, relation to Ground object
nondominant hand shows the Ground object type

all spoken languages diverge from this visual fidelity to a greater or lesser degree
e.g., one English counterpart: The car bumped along past the tree.; its clusters:
a. subject NP (*the car*): Figure
b. verb (*bumped*): motion + manner
satellite (*along*): translational path
c. preposition (*past*): path in relation to Ground
object NP (*the tree*): Ground

oddity: although the Figure is what executes a path and its relation to a Ground,
and is so represented in ASL, many spoken languages represent this in an adposition with the Ground NP
-- there is almost never some adposition-like path indicator with the Figure NP
exception: preposition with a demoted Figure indicates underlying TO vs. FROM Vector:
The fuel tank slowly filled with gas./ drained of its gas.

9.2 Iconic Representation of object vs. action

in signed languages, virtually always?:
Figure: represented by hand shape; Path: represented by hand movement

but one can conceive an alternative setup, apparently never realized:
Path: represented by hand shape -- e.g.,
a fist = stationary
fingers flat together = a straight path
fingers together in curved plane = a curved path
fingers alternately forward and back = zigzag path
Figure: represented by hand movement, -- e.g.,
hand moves straight =straight Figure
hand moves in circle = round Figure
NB: SASSes do permit the hands to trace out an object's contours (=fictive motion)
e.g., representing a bucket or long pipe)
but the hands cannot at the same time assume a shape representing the object's path

the mapping in sign language is visually iconic: it assigns the representation of
the material object in a scene to the material object in a classifier complex, the hand

the movements of that object in the scene to the movements of the hand.

No such iconic correspondence is found in spoken language:
material objects prototypically represented in English noun but in Atsugewi verb
path prototypically represented in English satellite/preposition but in Spanish verb

9.3 Iconic representation of further particular categories

many of the categories listed below in section 11.1 are iconic with visual parsing, e.g., an object's:

form is often represented by the form of the hand(s)
size by the compass of the hand(s)
number by the number of digits / hands extended
motive state / path contour / path length / manner of motion / rate of motion
by analogs in the hand(s)

by contrast, spatial iconicity is minimal in spoken language:
path length by vowel length: It's waay / waaaay up there.
path length by quantity of iteration: The bird flew up / up up / up up up and away.
perhaps some number by some closed-class reduplication

9.4 Iconic representation of the temporal progression of a trajectory

e.g., for the Figure's path in signing "The car drove past the tree":
the Figure hand progresses from the nearer side of the Ground hand, to beside it, to its farther side

by contrast, the preposition *past* in the corresponding English sentence exhibits no such progression

10. A narrow time-space aperture represented in the expression

tentative principle: a classifier complex readily represents --
what appears within a narrow scope of space and time if one were to zoom in
with one's scope of perception around a Figure object
hence, readily represented are:
Figure and its type/shape
immediately adjacent manipulator or instrument
current state of motion (motion / locatedness)
current manner
path contour / direction
thus, ASL and English can both represent within a single clause:
I pinched moss up off the rock. / I pulled the pitcher along the counter (adjacent manipulator)
I scooped jelly beans up into the bag. (adjacent instrument)
The cork bobbed past the seaweed. (concurrent manner)
but temporally nonlocal factors are little represented in ASL, though still fine in English:
I kicked the football over the goalpost. (kick = prior cause: first I kick, then ball moves off)
They locked the prisoner into his cell. (lock = subsequent event: first he goes in, then they lock)
and spatially nonlocal factors are little represented in ASL, though still fine in English:

I walked/ ran / drove / flew the memo to the home office. (concurrent external agentive causation)
The house burned down to the ground. (concurrent external instrumental causation)

signed language here is closer to visual perception in its temporal narrowness
problems, though, with the spatial narrowness proposal:
a. vision includes not only focused perception but also wide-scoped perception
b. signed language does permit representation of non-adjacent Ground within same clause

311 More independent distinctions representable in the expression

11.1 Greatly more elements / categories representable within a single expression

in a single spoken language clause, CCs can separately represent some 6 spatial categories at most
e.g., English: The bat flew way back up into its cavern niche.
path length: 0 / way / right
state of return: 0 / back
earth-field displacement: 0 / up / down / over
path conformation: in(to) / across / past / ...
but in ASL, by one provisional count, some 30 categories can be represented separately and independently
-- with cooccurrence restrictions and different obligatoriness / optionality --
but still very many together in the same classifier expression
perhaps closer to the granularity of visual parsing

a distinct category is here posited for any group of mutually exclusive elements; this entails:
a. joining together what some sign language analyses treat as separate factors
e.g., Figure, instrument, and manipulator, since these apparently cannot be separately represented
b. making distinctions within some categories that spoken languages treat as uniform
e.g., divertive vs. dynamic Manner

a question mark follows any proposed category or member of a category
for which I have not yet gotten enough evidence one way or another

A. entity properties

1. identity of Figure / instrument / manipulator

only one sign represents choices for all of a, b, and c, at once
a. entity type: Figure / instrument / manipulator
b. entity property indicated: semantic category membership / physical form
c. granularity: coarser to finer

examples for above 3 subtypes:
a. minimal pair-- Figure: ‘a flat plane’, flat hand, thumb slightly apart
manipulator: ‘hand holding flat plane Figure’, flat hand, opposed thumb pressed against fingers
b. category-based for Figure: ‘vehicle’ / ‘animal’ / ‘rifle’
shape-based for Figure: ‘flat plane (e.g., flat piece of paper)’, flat hand
‘cylinder (e.g., paper rolled into tube)’, fingers together curved to meet opposing curved thumb

‘V shape (e.g., half-folded greeting card)’, 2 flat hands in V touching at pinkies
c. a person can be represented as a point / a line / a 2-legged form / a 2-footed form

2. identity of Ground

3. magnitude of some major entity dimension

e.g., ‘pizzalike shape’ can be shown as ‘small’ / ‘medium’ / ‘large’ by degree of separation of 2 hands

4. magnitude of a transverse dimension

e.g., any of the preceding pizzalike shapes, made only with thumb and index finger,
can show depth by adding a second finger or remaining 3 fingers (as for bowl)

5. number of entities

e.g., 1, 2, 3, etc. raised fingers can be used to represent 1, 2, 3, etc. people arriving
e.g., the use of one or both hands in certain manipulator handshapes
can iconically represent the use of one or both hands in the referent action

B. orientation properties
the angle at which an entity is rotated relative to a canonical position

6. an entity’s rotatedness about its left-right axis ("pitch")

7. an entity’s rotatedness about its front-back axis ("roll")

8. a. an entity’s rotatedness about its top-bottom axis ("yaw")
b. an entity’s rotatedness relative to its path of forward motion

e.g., for b: the vehicle classifier moving forward with its "front" leading / trailing / to one side
to represent, say, a car moving forwards / backwards / sideways

C. locus properties

9. locus within sign space

apparently an entity can be located, or its translational path can be begun and ended,
at a choice of points within sign space
that represent locational properties of the space in reference

D. Motion properties

10. motive state: moving / resting / fixed

11. internal motion

certain of the elements making up a Figure or manipulator move relative to each other
-- e.g., dilation (expansion / contraction), change of form, twisting, wriggling, internal swirl

example of change of form:
'a sheet of paper that one holds curved into a tube, places on a surface, and releases
that now opens out flat'
dominant hand with palm down, fingers together curved to meet opposing curved thumb
moves onto back of nondominant hand;
fingers and thumb spread out flat and settle gently back down onto back of hand

12. confined motion

Figure or manipulator moves as intact whole within confined region without overall change of location
-- e.g., straight oscillation, rotary oscillation, rotation, local wander
NB: rotation = change in orientation (earlier category)

examples of rotation (here combined with translational motion):
motorcycle taking a spill; picking up book lying on table and standing it on shelf

13. translational motion

Figure or manipulator moves as intact whole through space with overall change of location

NB: all 3 motion types can co-occur. thus, one can show a sheet of paper
opening out flat from a tube shape, turning rightward, and moving forward in the process

E. Path properties
-- perhaps pertain mostly to translational motion

14. state of continuity: unbroken / saltatory

e.g., 2 flat hands held in a single plane, fingertips joined, palms facing signer:
(a) moved in steady straight path away from one can represent a wall moved progressively outward
(b) moved in quick up-down arc to a point further away from one can represent
a wall relocated to a further spot, whatever its path from the starting location

15. contour of path

16. state of boundedness: unbounded / bounded at start / bounded at stop / bounded at both ends

e.g., as realized for a circular path contour:
1 type of bounded at both ends: whole single arc = one complete revolution
1 type of unbounded: numerous revolutions

17. length of path

18. vertical height

19. horizontal distance from signer

20. left-right positioning

21. up-down angle ("elevation")

e.g., straight path can move sloping upward or downward at some angle
circular path could describe a horizontal or vertical circle

22. left-right angle ("direction")

23. transitions between motion and stationariness

e.g., apparently at least all of the following can be represented distinctly from each other: a Figure's--
stopping normally
slowing to a stop
abrupt stop, as from impact
e.g., showing a pizza that's thrown upward hitting the ceiling
becoming deposited at a point of support
e.g., placing a rifle up onto a rack
being given into someone's grasp
e.g., handing a rifle over to someone

F. Manner properties

24. divertive manner
a movement the Figure makes during and in addition to a forward path motion

probably most of what we think of as manner of motion is simply confined motion
-- sometimes internal motion -- accompanying translational motion
if so, this category reduces to categories 11 and 12 above

e.g., dominant "vehicle" hand moves forward atop other hand held flat, palm up
to show motorcycle driving along road
adding up-down straight oscillation: bumpy ride on irregular road
adding front-back rotary oscillation: driving along with one flat tire

25. dynamic manner: the dynamics with which a Path is manifested

speed: how many and what kinds of distinctions?

can additional dynamic manners be represented, perhaps concurrently? -- e.g.,:
intensity: easygoing / with pent-up energy
Agent's attitude: uncertain / bold
Agent's volitionality: intentional / accidental

G. relations of Figure or Path to Ground

26. path's conformation relative to Ground -- e.g., past it, above it, into it

27. relative lengths of path before and after encounter with Ground
-- e.g., for a Figure moving past a Ground, can show long approach with short post-path
vs. the opposite

28. Figure's path relative to the path of a moving Ground
usually Ground object is stationary; but can also show Ground moving along a path
e.g., for Figure pursuing / catching up with / passing it

29. Figure's proximity to Ground

e.g., for Figure passing Ground: brushing past it / passing at usual distance / at greater remove
e.g., for Figure arriving at Ground: touching it / near it / at greater remove from it

30. Figure's orientation relative to Ground

e.g., for front-back type Figure near a Ground: with front / side / rear toward the Ground

11.2 Elements independently variable in the expression -- not in pre-packaged schemas

the preceding stressed the sheer number of separate categories representable together in a single expression
corollary stressed here: the independent variability of the categories; one can largely:
a. select a category for inclusion independently of other categories
b. select a member element within each category independently of other selections
-- apart from cooccurrence / obligatoriness constraints

e.g., a classifier expression can separately include and independently vary a path's
contour, length, vertical angle, horizontal angle, speed, divertive manner, relation to Ground object.

but in spoken language, each schema represented by a closed-class spatial morpheme is "pre-packaged",
bundling together a particular selection of elements within a selection of categories

The lexicon of each spoken language affords a certain number of such pre-packaged schemas,
a speaker must largely choose from among these to represent a scene, even where the fit is not exact.
the system of plastic extensions and deformations of the set of basic schemas in the lexicon
may exist to compensate for the pre-packaging and closed stock of the schemas

classifier expressions' apparent large-scale lack of pre-packaging, a fixed set of discrete basic schemas,
and a system for extending or deforming the basic schemas
may be more akin to visual parsing

Part III: Cognitive implications of spoken / signed language differences

12. The two language modalities' likeness and difference - a neural model

12.1 where spoken and signed language are alike

with respect to the spoken closed-class subsystem and the signed classifier subsystem, both--

-- represent multifarious subtly distinct complexes of objects
moving/located with respect to each other in space
-- represent such spatial complexes schematically and structurally.
-- have basic elements that in combination make up the structural schematizations.
-- group their basic elements within categories that themselves represent categories of spatial structure.
-- have conditions on the combination of basic elements and categories into a full structural schematization.
-- permit semantic amplification of elements or parts of a schema
by open-class/lexical forms outside the schema.
-- allow alternative conceptualizations of a spatial scene for alternative schematizations

12.2 where spoken and signed language differ

there is no one-to-one match of subsystems across the two language modalities
the representation of spatial structure in signed language seems generally closer to visual parsing
in particular, the signed language classifier subsystem--
-- has more basic elements, categories, and elements per category
-- has much more gradient representation in addition to discrete representation
-- has an iconic clustering of categories in the expression
-- has an Iconic Representation of object vs. action and of other categories in the expression
-- represents only a narrow time-space aperture in the expression
-- can represent many more categories and category elements together within the expression
-- can select categories and category elements independently for representation in the expression
-- avoids pre-packaged category-element combinations and processes for their extension / deformation

12.3 alternative to Chomsky-Fodor model of some distinct whole-language module

both spoken and signed language are based on some more limited core linguistic system
that then connects with different further subsystems for the full functioning of the 2 language modalities.

this core linguistic system might include the spoken-signed commonalities of section 12.1
thus, it might include systems for--
-- using individual unit concepts as the basis for representing broader conceptual content
-- grouping individual concepts into categories
-- associating individual concepts with overt physical representations, whether vocal or manual
-- combining individual concepts -- and their physical representations -- under certain constraints
to represent a conceptual complex
-- establishing a subset of individual concepts as basic and schematic concepts
that, in combinations, represent conceptual structure

in representing at least spatial structure, this linguistic core might then further connect
with 2 different further systems that yield the signed-spoken language differences of section 12.2

a. for signed language: with aspects of the visual system that govern scene-structure parsing

b. for spoken language: with a putative subsystem that--

-- packages disparate elements into stable schema-like complexes
-- affords processes for extending or deforming such complexes
(such a subsystem speculatively might also serve for acquired motor patterns)

this seems consonant with neuroscientific findings: relatively smaller neural assemblies link up in larger combinations in the subservance of any particular cognitive function

In turn, the proposed core language system might itself be found to consist of an association and interaction of still smaller units of neural organization, many of which might in turn participate in subserving more than just language functions.

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