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RELATING LANGUAGE TO OTHER COGNITIVE SYSTEMS -- AN ABRIDGED ACCOUNT

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ABSTRACT: An important research direction in cognitive science consists of cross-comparing the forms of organization exhibited by different cognitive systems, with the long-range aim of ascertaining the overall character of human cognitive organization. Relatively distinct major cognitive systems of this sort would seem to include: (different modalities of) perception, motor control, affect, reasoning, language, and cultural structure. The general finding is that some properties of organization are shown by only one system, some by several, and some by all. This arrangement is called the "overlapping systems model of cognitive organization". This paper demonstrates the model by comparing properties of organization across language and vision. Language is first shown to represent certain features of cognitive organization not well realized in vision, such as the representation of "reality status", with such member notions as factual, conditional, potential, and counterfactual. In turn, vision is shown to represent certain features of organization not well realized in language, such as symmetry, rotation, dilation, and pattern of distribution. Finally, both language and vision are shown to represent certain features of organization in common, such as the schematization of spatial relations between objects.

KEYWORDS: cognitive organization; language structure; visual structure

1. THE OVERLAPPING SYSTEMS MODEL OF COGNITIVE ORGANIZATION

The overall topic here is cognitive organization, and this paper provides one small look at how language relates to it. Cognition is here heuristically divided into two parts: "cognitive systems" whether major or minor, that perform some consolidated function, and "organizing factors" that structure those systems.

1.1 ***Cognitive Systems***

Human cognition appears to include certain relatively distinct major cognitive systems. In possible order of their appearance in phylogenetic evolution, these include:

(1) heuristic list of major cognitive systems

- earliest systems to evolve

perception in general or in its modalities: chemical, tactile, visual, auditory, etc. motor control

- later evolving systems

affect
reasoning / inferencing
forward simulation / planning

- last systems to evolve -- all coevolved in the human lineage language

gesture
culture (see Talmy 2000b, chapter 8, for a proposed system of cultural structure) music, dance

1.2 ***Organizing Factors***

The major cognitive systems each have certain properties of organization. These are the "organizing factors", or particular realizations of these factors.

Many of these properties are comparable across systems. Some properties are shown by only one sys-tem, some by several, some by all. Those properties shown by all systems are aspects of the fundamental structuring of cognition. We call this arrangement the "overlapping systems model of cognitive organization" It can be represented by partially overlapping Venn circles. We label them "systems" because they are not autonomous Fodorian "modules", due in part to their overlap of properties.

(2) heuristic list of organizing factors

- constitutive factors

a. schematic structure: the abstracted schematic delineations and partitionings that structure a system, e.g.,:

1. multiple hierarchical embedding of structure [perhaps present in all cognitive systems]

2. combinatoriality: the system has an inventory of units;

different subsets of units can be selected and arranged to form higher-level entities. [perhaps strongest in the cognitive systems coevolving last in the human lineage]

b. temporal structure: temporal characteristics of particular aspects of a system, e.g.,:
1. "phase": starting, continuing, stopping, nonoccurring
2. "interrupts": putting on hold, resuming, waiting (until a triggering event)

3. "rate": functioning quickly, functioning slowly, speeding up, slowing down
4. coordination with the timing of another process: synchronizing, sequencing, concurrence, alternation, etc.

c. causal structure: causal / force interactions in particular aspects of a system
d. categorial structure: any form of categorization exhibited by a system, e.g.,:
1. superordinate and subordinate category inclusion 2. prototype structure

e. type of metric prevalent in particular aspects of a system, e.g.,:
1. discrete vs. gradient 2. absolute vs. relative

f. quantity structure : the amount or intensity of particular aspects of a system, e.g., as to its:
1. scope 2. granularity 3. "density"

g. the degree of differentiation in particular aspects of a system, e.g.,:
1. precise vs. approximate 2. elaborated vs. sketchy 3. clear vs. vague

- cognizing factors

h. attentional structure: the distribution of attention over a system, e.g.,:
1. the current pattern of foregrounding / backgrounding of different aspects of the system
2. the level of accessibility to consciousness that particular aspects of the system have

i. perspectival structure: the ways an adopted perspective point relates to a system, e.g.,:
1. distance away 2. stationary vs. moving

j. memory structure: how memory relates to particular aspects of a system, e.g.,:
1. storage and retrieval characteristics 2. novelty vs. familiarity

k. epistemic structure: assessments of one's knowledge of or the reality of, particular aspects of a system, e.g.,:

1. doubt vs. certainty about a phenomenon
2. experiencing a phenomenon as originating externally vs. internally

l. evaluation: assessments applied to particular aspects of a system, e.g., its:

1. significance (important/irrelevant)
2. value (good/bad)
3. esthetic quality (beautiful/ugly [not modality specific])
4. appeal (appealing/unappealing)

- processing and housekeeping factors

m. online monitoring of different aspects of a system, e.g.,:
1. error detection and correction 2. the tailoring of system inputs and outputs to each other

n. affectability: the degree to which and the ways in which a cognitive system can be affected by other cognitive systems in the individual or by an outside agent (= its level of modular autonomy)

o. plasticity: type and degree of long-term modifiability exhibited by particular aspects of a system, e.g.,: 1. developmental changes through life span 2. response to environmental changes

p. maintenance: a system's upkeep of its functions and operations, and of its internal integrity, across local and neighboring changes

- integrative factor

q. framework structure: a system's type of containing and integrating matrix in which all other organizing factors are combined and coordinated in their specific interrelations

1.3 ***Example of an organizing factor***

To illustrate the organizing factors, the very first case listed above is amplified here. It is the property of "multiple hierarchical embedding of structure" that a cognitive system can exhibit -- itself an instance of the (2a) factor, schematic structure. It may well occur across all the cognitive systems, which would make it part of the fundamental structure of cognition. Here and in the rest of the paper, it should be noted, my expertise is only in language, so that all suggestions pertaining to other cognitive systems await the assessments of others with the relevant expertise.

In vision, then, a viewer might be able to perceive the nesting of structures from the coarser-grained to the finer-grained. For example, someone viewing the interior of a restaurant from the entryway might, at the top hierarchical level, perceive its overall framing structure, including the delineations of the room formed by the edges where walls and ceiling meet. The next level embedded within that might consist of the arrangement of elements within the framework, such as the pattern of tables and the people around them. The next level might consist of the particular elements within the arrangement, such as the individual tables and people. The lowest level might consist of the external features or internal structural schema of the individual elements, such as the clothing or Marrian skeletal structure of individual persons.

A comparable hierarchical embedding might occur in the cognitive system of motor control, for example, where a person moves across a room to a table to pick up a pen lying on it. The levels of nesting might then include the whole-body movement across the floor to the table; the arm extending forward during this large-scale movement; and the hand orienting and the fingers on the hand curling in preparation to grip the pen during the arm's reach.

The cognitive systems of reasoning and planning also show multiple hierarchical embedding. A global conclusion or goal can have local conclusions and goals nested within it, and so on to a potentially great degree of embedding.

Multiple hierarchical embedding is also present in the cognitive system of language, both in syntax and in semantics. It occurs in syntax, for example, in the form of clause embedding. The example sentence in (3) has three levels of clause embedding, shown by the bracketing.

(3) The woman [holding the baby [that's drooling]] is my sister.

And the nesting of, for example, spatial structures can be represented semantically. The sentence in (4e) expresses a nesting of five levels. The five sentences in (4) build up to it one level at a time. In particular, the sentence in (4b) results from (4a) through a semantic process of "multiplexing"; that in (4c) from (4b) through a process of "bounding"; that in (4d) from (4c) through an additional process of multiplexing; and finally, that in (4e) from (4d) through an additional process of bounding.

(4) a. I saw a duck (in the valley).

b. I saw ducks (in the valley).
c. I saw a group of 5 ducks (in the valley).
d. I saw groups of 5 ducks each (in the valley).
e. I saw 3 acres of groups of 5 ducks each (in the valley).

The sentences in (5) show a wholly analogous semantic representation of temporal structure, again attaining five levels of embedding.

(5) a. The beacon flashed (as I glanced over).
b. The beacon kept flashing.
c. The beacon flashed 5 times in a row.
d. The beacon kept flashing 5 times at a stretch.
e. The beacon flashed 5 times at a stretch for 3 hours.

The structural complexes shown embedded in the preceding two examples are presented in their abstract form in (6).

(6) a. !
b. ...!!!!!!...
c. [!!!!!]
d. ... [!!!!!] - [!!!!!] ...
e. [[!!!!!] - [!!!!!] ... [!!!!!] - [!!!!!]]

1.4 ***Three Accounts of Overlap and its evolution***

It can be proposed that some neural mechanism underlies any property -- that is, an organizing factor, or a particular realization of an organizing factor -- that appears in a cognitive system. Then what can be said if the same property appears in two or more cognitive systems? An example of a property doing so might be the one just considered, that of multiple hierarchical embedding. The neural architecture underlying such a commonality and how it might have evolved require an account (see Talmy 2007). Three accounts are proposed here.

First, the neural mechanism might exist separately in the brain, not as part of any particular cognitive system, and all cognitive systems with the common property tap into it. As each such system evolved, it in turn established connections with that mechanism.

Second, the neural mechanism might exist as part of a particular cognitive system, but only that one. Other cognitive systems with the same property tap into the mechanism in that one location. The mechanism would then have evolved as part of the first system, and as later systems evolved, they acquired the property by establishing connections with the first system.

Third, separate instances of the neural mechanism might exist in each cognitive system with approximately the same property. Each instance -- perhaps differing somewhat from the others -- would then have evolved on its own. Three ways in which such instances could have ended up similar to each other can be proposed. One is that the mechanism originally evolved as part of one cognitive system, but at some point a duplicate copy of the genes for the mechanism formed and became available for incorporation into a later evolving cognitive system. Another is evolutionary convergence, where similar conditions favor the selection of similar formations. And another, of course, is accidental coincidence.

2. NON-OVERLAP OF STRUCTURAL PROPERTIES BETWEEN LANGUAGE AND VISUAL PERCEPTION

In the rest of this paper, we consider just two cognitive systems, language and visual perception. We look at their structural properties, and see that there are some properties occurring in just one system but not the other, as well as properties common to both. These two cognitive systems -- behaving like partially intersecting Venn circles -- are thus seen to manifest the overlapping systems model of cognitive organization.

As argued in Talmy (2000a, chapter 1), in all languages, the meanings expressed by grammatical or "closed-class" forms -- including syntactic constructions -- function to provide conceptual structure. For example, in the overall conception evoked by any sentence, the closed-class forms in the sentence provide most of the structure of that conception (while the lexical or "open-class" forms provide most of the conception's content). Since structural properties are here the main issue of comparison across the two cognitive systems, the language side of the comparison will here always be based on these structural meanings of closed-class forms. For each example discussed below, the relevant organizing factors out of those listed in (2) are indicated in brackets.

2.1 ***prominent in language structuring, minimal in visual structuring***

We begin with properties not common to both cognitive systems, first looking at properties strongly represented in language but minimally, if at all, in vision.

2.1.1 Reality status ("mood") [epistemic structure]

Seemingly all languages have grammatical indication for what is traditionally called "mood". This is the reality status of the proposition that the rest of the sentence indicates. For example, English can grammatically indicate the five types of reality status listed and exemplified in (7).

(7) Grammatical indications in English that an event is:
a. actual (indicative): I ate.
b. potential: I might eat.
c. conditional: I would eat if ...
d. counterfactual: I should have eaten.
e. negative: I didn't eat.

By contrast, visual perception apparently lacks a range of ways to interpret the reality status of a scene. If viewed, a scene is simply taken to be actual.

2.1.2 Modality [causal structure]

Again, perhaps all languages have grammatical indication of what is traditionally known as "modality". Talmy (2000a, chapter 7) subsumes modality under the notion of "force dynamics". This is a sentence's indication of the pattern of forces acting for or against the occurrence of the event indicated by the rest of the sentence. Thus, different force-dynamic patterns are indicated by the different modals in the English sentence in (8). For example, the use of must in the sentence would indicate that the speaker or some other enforcing agency is exerting moral force or the threat of physical force on the addressee toward the indicated action (sitting down on a seat), while the addressee maintains a psychological force that opposes the outside force.

(8) You must / should / may / can take your seat.

Again by contrast, vision apparently lacks a range of different ways to perceive different patterns of forces underlying the occurrence of a scene. If viewed, the scene is simply taken to be in occurrence.

2.1.3 addressee's inferred knowledge status ("definiteness") [epistemic structure]

Many languages have grammatical indication of what is traditionally known as "definiteness". In our analysis, this category amounts to the speaker's inference as to the addressee's knowledge status about something referred to in the speaker's sentence. For example, the speaker's use of the "definite" form the in the sentence in (9a) indicates that he infers that his addressee can readily identify the cat being referred to. It might be a pet belonging to them both. But in (9b), the speaker's use of the "indefinite" form a indicates that he infers that his addressee can not readily identify the cat being referred to. It might have been an unknown cat encountered along the way.

(9) a. I fed the cat. b. I fed a cat.

In vision, by contrast, a viewer's perception of a particular object in a scene apparently does not regularly include an indication of that object's identifiability for another viewer.

2.1.4 speaker's knowledge status ("evidentials") [epistemic structure]

Many languages have grammatical indications, traditionally called "evidentials", of how the proposition expressed by a speaker's sentence relates to the speaker's knowledge. Some languages obligatorily mark (as with verb inflections) numerous distinctions within this category. These distinctions seem to group into two main divisions. In one division, the speaker indicates her view that the proposition is a fact that is known to her. Separate distinctions within this division can indicate that the knowledge is from the speaker's visual perception (John was chopping wood -- I know because I saw him); from the speaker's causing the result (The beads are on the string -- I know because I put them there); or from the speaker's assumption of common ground (Horses eat grass -- as everyone knows).

In the other division, the speaker indicates her view that the proposition is a possibility or probability that has been inferred by her or reported to her. Distinctions within this division can indicate, in the case of an inference, that it comes from evidence (John must be chopping wood -- I infer this because the access is missing from its usual spot), or from temporal periodicity (John must be chopping wood -- I infer this because it's 3 PM and he usually chops wood at 3 PM); or, in the case of a report, from another's claim (John is apparently chopping wood -- I heard it said).

By contrast, visual perception seemingly does not mark elements within a scene for their relation to the viewer's knowledge or for their evidentiary status. For example, the visual system does not flag an occluded portion of a configuration -- e.g., the portion of a molding behind a cabinet -- as being `unknown' or `inferred as present'. Rather, the system generally "fills it in" unconsciously with the expected characteristics. This perceptual filling-in process is, in effect, the opposite of a linguistic evidential, an "anti-evidential".

The evidential indications of language, if anything, have more in common with the cognitive system of reasoning, which presumably includes assessments of a conception's status as being factual or merely potential, and whether it is known, inferred, or claimed. In terms of the overlapping systems model of cognitive organization, then, the Venn circles representing language and reasoning would intersect with respect to evidentiary status, while the circle representing vision would not overlap with that intersection.

2.2 ***prominent in visual structuring, minimal in language structuring***

To continue with areas where the cognitive systems of language and vision do not overlap, we turn now to the complementary case in which vision prominently exhibits structural properties that are only minimally represented in language.

*2.2.1 Rotation [*schematic + temporal structure*]*

Visual perception can presumably distinguish numerous structural aspects of the rotation that objects and materials can exhibit. These aspects might include the amount of the rotation, the geometric relation of the spin axis to the moving entity, and the orientation of the spin axis.

But in surveying the grammatical indication of rotation across languages, English may be representative in marking only the last of these, the orientation of an entity's spin axis, and then in making only two distinctions within that. The English grammatical form around indicates a vertical spin axis, as in (10a), and the grammatical form over indicates a horizontal spin axis, as in (10b).

(10) a. I turned the pail around. b. I turned the pail over.

English does not have additional grammatical forms that would distinguish, for example, the amount of rotation. Thus, the same word around is used in (11) for all four choices of time length shown there. These time lengths correlate with part of one full circuit, one complete circuit, several circuits, and many circuits around the house.

(11) I ran around the house a. for 20 seconds. b. in 1 minute. c. for several minutes. d. for 3 hours.

Comparably, English lacks grammatical forms for distinguishing the geometric relation of the spin axis to the moving entity. Thus, the same word around is used in (12a), where the axis is at the entity's center, in (12b), where it is at the entity's endpoint, and in (12c), where it is wholly outside the entity.

(12) a. The record spun around on the spindle.
b. Each blade of the helicopter propeller made a sound as it spun around.
c. The bird kept flying around the pole.

Note that as a visual language, American Sign Language -- perhaps representatively of other sign languages -- does in fact structurally represent all these distinctions in its so-called "classifier" subsystem (see Talmy 2003).

2.2.2 Dilation (expansion/contraction) [schematic + temporal + quantity structure]

Visual perception can again presumably distinguish numerous structural aspects of the dilation -- that is, expansion or contraction -- that an entity can exhibit. These aspects might include the cause of the dilation-- the viewer's moving closer to or further from the entity, the entity's moving closer to or further from the viewer, or the entity's autonomous movements; the dimensionality of the dilation -- along a line, over a plane, or throughout a volume; the continuity of the entity -- a single object stretching or shrinking, vs. multiple objects dispersing or converging; the part attended to -- the whole of the entity or just its outer boundary; and, of course, the sign of the dilation -- expansion vs. contraction.

But, like many languages, English has grammatical representation only for the last of these structural distinctions. The grammatical form out represents expansion, as in (13a), and the form in represents contraction, as in (13b).

(13) a. When air was introduced into it, the bladder suddenly snapped out. b. When air was removed from it, the bladder suddenly snapped in.

English does not have additional grammatical forms that would distinguish, for example, the dimensionality of a dilation. Thus, the same word out is used in (14) for expansion in 1, 2, and 3 dimensions.

(14) a. The bungee cord stretched out. b. The sheet of rubber stretched out. c. The dough puffed out.

Comparably, English lacks grammatical forms for distinguishing the internal continuity of the dilating entity. Thus, the same word out is used to refer to the expansion of a continuous mass in (15a) and a non-continuous aggregate in (15b).

(15) When the barrel broke, the a. mass of oil /
b. heap of ball bearings it contained spread out in all directions.

Some languages do in addition grammatically mark a non-continuous "together/apart" distinction for two objects vs. multiple objects moving toward or away from each other. But this may be the full extent of structural dilation distinctions in language. Again, as a visual system, American sign Language does mark many of the same structural distinctions as visual perception within its classifier subsystem.

2.2.3 pattern of distribution [schematic (+ temporal) structure]

For a third case, visual perception can presumably distinguish numerous structural aspects of the patterns in which multiple objects can be distributed in space. These aspects can include the density of the objects' distribution, from sparse to dense; the dimensionality of the distribution, whether along a line, over a plane, or through a volume; the evenness of the objects' distribution, from even spacing to clumping; the orientation of the objects relative to each other, as whether several linear objects are all parallel, at perpendicular angles, or at random angles; the shape and arrangement of the objects, as whether they constitute concentric circles or parallel zigzag lines; or the type of texture that can be perceptually associated with a distribution, as in viewing wood grain or sea foam.

Languages, by contrast, seem to have grammatical indication only of the first two of these structural distinctions. English, for example, has distinct prepositional forms for each of the three dimensions where the distribution is sparse, as in (16a), and where it is dense, as in (16b).

(16) a. There are peas along the knife. / on the table. / in the gelatin.
b. There are peas all along the knife. / all over the table. / throughout the gelatin.

Perhaps no language grammatically marks whether distributed objects are randomly located, evenly spaced, or in clumps; whether a dense distribution leaves some space or no space between the objects; or if, say, referring to straws on a table, whether they are aligned in parallel, crisscrossing, or at random angles. Once again, American Sign Language regularly represents such structural distinctions in its classifier subsystem.

2.2.4 Bilateral symmetry [schematic structure]

It may be that the perception of bilateral symmetry -- as in viewing people, animals, and some plants from the side -- is a prominent structural feature of vision. If so, language is in strong contrast, with seemingly minimal grammatical representation of it. The only type of case that comes to mind, and then questionably so, is the reciprocal in certain of its uses. Thus in (17), the English reciprocal form each other might suggest an image in which two heads are in bilateral symmetry on either side of their lips meeting.

(17) They kissed each other.

3. OVERLAP OF STRUCTURAL PROPERTIES BETWEEN LANGUAGE AND VISUAL PERCEPTION

We have just seen that each of the two cognitive systems, language and visual perception, extensively realizes certain structural properties that are minimal or absent in the other, thus illustrating a certain non-overlap of organizing factors across those two cognitive systems. But we now turn to other structural properties that in fact are extensively realized in both cognitive systems, thus illustrating the over-lap of organizing factors across those systems. This brief paper looks only at three such properties, all pertaining to the organizing factor of schematic structure.

3.1 ***Configurational structure [schematic*** **(+ temporal) structure]**

One schematic property that seemingly manifests greatly in both cognitive systems can be called "configurational structure". This is the cognitive representation of the structure of an object or an arrangement of objects in space. Perhaps all languages have grammatical forms specifically representing the geometric relation of one object to another. These two objects are respectively called the "Figure" and the "Ground" in Talmy (2000a, chapter 5). English represents these geometric Figure-Ground relations mainly with prepositions. Thus, the preposition in, as illustrated in (18a), indicates that a Ground object (here, the dumpster, vase) can be schematized as a plane so curved as to define a volume of space, and that a Figure object (here, the radio, water) occupies a portion of that volume of space. Comparably, the preposition along, as in (18b), indicates that the Ground object (here, the ledge, trail) can be schematized as a line, and that the Figure object (here, the ball, hunter) can be schematized as a point that moves along its own line, one that is parallel and adjacent to the Ground line. Such prepositions represent what are called "spatial schemas".

18) a. The radio is in the dumpster. / Some water is in the vase.
b. The ball rolled along the ledge. / The hunter walked along the trail.

Now consider someone directly viewing each of the four scenes depicted in (18). His visual processing may produce schematic representations of the geometric relations of the two principal objects. If so, we conjecture that these visual representations may well be quite comparable to the linguistic representations. If visual schematizations of this sort do occur, the particular spatial configurations most readily abstracted out would need to be determined experimentally, and then compared with the configurations most commonly represented grammatically across languages. But overlap is perhaps likely.

3.2 Interior structuring within bulk [schematic structure]

Another property involving schematic structure that seemingly manifests greatly in both language and vision consists of the cognitive representation of interior structure within bulk. A representation of this kind -- generally consisting of points, lines, or planes, whether present singly or in an arrangement -- is treated as the skeletal structure of a bulk object. Bulk can extend outward to a certain degree from such a representation, while the representation still functions as its skeletal structure -- and is to that degree "bulk neutral".

Language extensively exhibits this kind of skeletal representation in its grammatically indicated spatial schemas. The same English prepositions just seen in section 3.1 can in fact illustrate the matter. For example, the preposition along can be used in both (19a) and (19b). The preposition's requirement that the Ground object (here, the filament, trunk) be schematizable as a line holds in both cases, including that in (19b), where the bulk of the tree trunk greatly extends radially outward from the schematic line that can be imagined within it.

(19) The caterpillar crawled up along a. the filament. b. the tree trunk.

Visual processing seems to include a comparable form of schematic structure where a viewer perceives virtual delineations within a bulk figure, whose exterior form is all that he sees explicitly. Generally known in vision science as "skeletal structure" or a "topological skeleton", particular formulations of such schematic structure include Marr's (1982) "axes of elongation", and Feldman and Singh's (2006) "medial axis transforms". For example, to pick a vivid image, a viewer looking at a kneeling elephant might perceive something like a virtual skeletal structure within its explicitly seen bulk form.

Another parallel in visual processing may be the stick-figure drawings that a child might make on viewing, say, a standing human figure (Kellogg, 1970). What impinges on the child's retinas consists of the figure's contours, textures, shadings, etc., but what emerges from his hand movements are mainly the lines of a stick figure. The child's cognitive processing must convert that input to this output. Perhaps the processing first produces a perceptual representation of a skeletal structure within the original bulk figure, and then produces an explicit representation of that through a motoric linkup with the perception.

3.3 The topological character of such structuring **[schematic structure]**

The spatial schemas represented by grammatical forms across languages seemingly all abstract away from -- that is, are neutral to -- such Euclidean specifics as magnitude and shape. In that respect, they have more the character of mathematical topology (see Talmy 2000a, chapter 1). The English spatial prepositions seen above then also exhibit this topological character. Thus, the preposition in has the four spatial neutralities cited in (20) (appropriate Figure objects can be imagined for each of the eight cases).

20) Topology-like neutralities of the preposition in
 a. magnitude neutral: in the thimble / volcano
 b. shape-neutral: in the well / trench
 c. closure neutral: in the beachball / punchbowl
 d. discontinuity neutral: in the bell jar / birdcage

It can be conjectured that visual processing produces not only a Euclidean representation of a viewed configuration that includes such specifics as its magnitude and shape, but also a more topological representation. For example, perhaps someone viewing scenes corresponding to the eight linguistic representations in (20) would have a type of perception in which they all manifest a topological relation of inclusion. Such a perceptual representation would lack specifics of size and shape, and would instead consist of one object included or surrounded by another.

4. THE LARGER ANALYSIS.

This abridged account is excerpted from a larger analysis of overlapping cognitive systems that we have carried out so far. First, remaining within the comparison of language and vision, this analysis shows that these two cognitive systems overlap further in their representations of causal and force-dynamic structure (2c), of attentional and perspectival structure (2h and i), and of framework structure (2q). Some of this comparison appears in Talmy (2000a, chapter 2).

The analysis has in addition compared the structural representations of grammatical forms in language with structural representations in cognitive systems other than vision. One overall finding is that language structure has much overlap with structure in the cognitive systems of vision, kinesthesia, and reasoning, but little overlap with structure in the cognitive systems of afffect and culture.

For more on comparisons of language with kinesthesia, see Talmy (2000a, chapter 7); on language with affect, see Talmy (2000a, chapter 1); and on language with culture, see Talmy (2000b, chapter 8).

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