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Relating Language to Other Cognitive Systems: An Overview

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Abstract

This article proposes how language relates structurally and evolutionarily to cognition. It heuristically divides cognition into cognitive systems and the organizing factors that structure them. The general finding is that cognitive systems share these structural properties to different degrees. This is termed the "overlapping systems model of cognitive organization". The specific finding is that the cognitive system of language shares many structural properties with the cognitive systems of visual perception, of somatosensory perception and motor control, and of understanding, but shares few structural properties with those of affect and of culture.

Keywords

cognitive organization – language structure – visual perception – motor control – affect – culture – force dynamics – fictive motion

1. The Overlapping Systems Model of Cognitive Organization

This article proposes in outline how language relates structurally and evolutionarily to cognition. Cognition is here heuristically separated into two main divisions: "cognitive systems" that perform some integrated function, and "organizing factors" that structure those systems. The general finding is that cognitive systems share structural properties to different degrees. This is termed the "overlapping systems model of cognitive organization". Section 1 addresses these cognitive systems and organizing factors generally. With language understood as one of the cognitive systems, each of the remaining sections addresses the structural relation of language in particular to one other cognitive system. [2]

This outline is heuristic—its proposals about intracognitive relationships are solely suggestive—but it affords a framework that empirical approaches can amend or refine. Since my expertise is in language, all suggestions about other cognitive systems await others' expertise.

1.1 Cognitive Systems

Human cognition appears to include certain relatively distinct cognitive systems ranging from major to minor. A cognitive system consists of a set of mental capacities that interact with each other to perform a particular integrated and coherent function. In possible order of their appearance in phylogenetic evolution, relatively major cognitive systems of this sort may include those listed in (1).

(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

  forward simulation

  inferencing

- most recently evolving systems in the human lineage

  language

  culture

  story (conceptions connected in a temporal pattern)

  music

  dance

Most of these entries might be readily viewable as cognitive systems or are discussed as such below. But two merit immediate comment. With regard to "culture", Talmy (2000b, chapter 7) develops the idea of a distinct cognitive system for culture that underlies the occurrence, learning, and imparting of the diverse cultures found among humans (see section 6 below).

And with regard to "story", Talmy (2000b, chapter 8) proposes that a more general cognitive system of pattern formation has a particular application to the patterns formed by concepts connected through time. These "story" patterns then underlie such human constructs as tales, history, and individuals' personal life narratives.

1.1.1 **The most recently evolving cognitive systems**

The six cognitive systems listed last may all have evolved in the lineage leading to modern humans (though more rudimentary forms of some of them—especially culture and gesture—may have arisen earlier and appear currently in other primate species). Moreover, these six systems all coevolved in the human lineage, and they all have certain significant properties in common that presumably were part of that co-evolution. Two of these properties—group variability and combinatoriality—are addressed next in turn.

Group variability

One major property in common across all six systems can be called "group variability". To place it within a larger context, this property can be located at the high end of a parameter of "degree of group variability" that a cognitive system can exhibit within a species (= organizing factor (2p)). Now, at the low end of the parameter, the apparently two earliest cognitive systems to evolve, perception and motor control, seem largely uniform within any given species. For example, visual processes and flight patterns are generally the same across any particular bird species. Some latitude in these systems' realization does occur in accord with individual variation and with accommodation to local conditions through learning. But bird species generally seem to lack a capacity for division into subpopulations with major differences in their modes of realizing vision and flight. Even within our species, where such divisions do exist, humans largely perceive and move alike—that is, they are similar in how they process perceptual input and motor output.

By contrast, major aspects of the last six cognitive systems to evolve in the human lineage can vary greatly across different social groupings of humans. That is, great differences can exist across groups of people in certain major aspects of their languages, gestures, and cultures, as well as of their story, music, and dance. For example, languages can vary greatly across speech communities with respect to their phonology, morphosyntax, semantic patterns, and lexicon. Such differences are enabled by learning processes in each individual born into or otherwise new to a particular group (it remains to be determined whether these processes are the same as or different from those for accommodation to local conditions).

The property of group variability itself had to evolve. Consider vocalized communication. The various semantically distinct calls of vervet monkeys are essentially uniform across that species (Seyfarth and Cheney, 2012). The cognitive system that underlies them (if a single such system can be posited) has within-species uniformity. But as the cognitive system of human language evolved, one major property to arise was that certain major aspects of the system could differ greatly across groups and need to be learned by new group members. That is, language evolved to have group variability.

It should be noted that the so-called Sapir-Whorf hypothesis, however valid it may be regarded, crucially rests on comparisons between group-variable aspects of the cognitive systems that have them. Thus, the particular realization of the language system existing in one speech community can be compared with the particular realization of the culture system in that community, as well as with the particular realization of the thought system in that community (see below for the further evolution of the inferencing system into the complex human system of thought). But a Sapir-Whorf type of hypothesis would make no sense for group-invariant cognitive systems or aspects of cognitive systems.

Combinatoriality

Another common property that the last six cognitive systems to evolve in humans all share in great elaboration is a significant feature of organization: combinatoriality (= organizing factor (2a1)). These cognitive systems together exhibit a number of distinct forms of combinatoriality, but all with the same following set of characteristics. Each form of combinatoriality has a particular inventory of basic elements. For any given instance of use, a particular subset of the basic elements is selected. The elements in that subset are arranged in accord with the principles or rules of combination in that form of combinatoriality. And, in some cases, that arrangement constitutes a new higher-level unit.

More than one form of combinatoriality can exist in a single cognitive system. The cognitive system of language may have the greatest number. Its nonsemantic forms of combinatoriality include the following: selections from the inventory of phonetic features are combined into phonemes by the rules of feature combination; of phonemes into morphemes by the rules of phonotactics; of morphemes into words by the rules of morphology; and of words into sentences by the rules of syntax. The phonemes and morphemes that result from combination in the first two cases behave like new or emergent higher-level units.

Further, in each realization of a cognitive system within a distinct social grouping, each form of combinatoriality has its own specific realization. Thus, two different languages, such as English and Japanese, have different sets of basic elements in any given inventory and different rules for combining those elements—e.g., different sets of phonemes in their phonemic inventories and different phonotactic rules for combining those phonemes into morphemes.

To consider one other late-evolving cognitive system, music may be thought to have at least three forms of combinatoriality. In one form, the inventory consists of the notes of a scale, and each instantiation includes a selection of those notes arranged in accord with rules of melodic composition. In another form of combinatoriality, the inventory consists of different temporal lengths, and each instantiation includes a selection of those lengths for assignment to each note and each interval between notes in accord with rules of rhythmic patterning. And in the third form, the inventory consists of degrees of emphasis, and each instantiation includes a selection of such emphases for assignment to the notes in accord with rules of beat patterning. In combination, these three forms of combinatoriality yield an emergent higher-level unit, a melody. Further, as with language, different realizations of the cognitive music system in distinct social groupings can have different inventory members and rules for their combination.

As with group variability, the property of combinatoriality itself had to evolve. But it is unclear if it arose with the last six listed cognitive systems, or arose with earlier cognitive systems and was greatly elaborated by the last six.[3]

1.1.2 The cognitive systems evolving at an intermediate time depth

It seems that the three cognitive systems listed as having evolved at an intermediate time depth have simpler organization in nonhuman species, but continued to evolve in the human lineage, resulting in their great elaboration. Consider affect first. On the one hand, analyses like that of Ekman (e.g., 2006) may suggest that certain basic elements of the inherited affect system have stayed largely the same in humans. But the affect system overall may nevertheless be part of an elaboration trend in that humans are capable of experiencing numerous distinct complexes of feeling perhaps not occurring in other species.

Consider next the cognitive system listed as forward simulation. Positing such a system accords with research (e.g., Battaglia et al. 2013, Smith et al. 2013) on the human visual processing capacity to imagine the trajectory that a static object would take on the basis of its current disposition, or that an already moving object will take on the basis of its current motion. While this basic form of the cognitive system seems present in other species, a more elaborated form of it may have evolved in the human lineage in our capacity for complex planning, which involves envisaging potential sequences of occurrences and of actions taken with respect to them.

Finally, in its basic form, the cognitive system of inferencing is taken to be at work in any species where the combination of an individual's perceptions, memory, and knowledge about physical, psychological, and social organization yields assessments about unperceived circumstances. In the human lineage, this cognitive system may have evolved into our capacity for complex reasoning and understanding, that is, into our complex system of thought.

In evolving complex elaboration within the human lineage, these three intermediate cognitive systems may have incorporated something of the two properties cited above as being characteristic of the six systems last to evolve. In regard to group variability, these three cognitive systems may exhibit a degree of variability across human social groups that is in fact intermediate between that of the earliest and the most recently evolved cognitive systems. And in regard to combinatoriality, the advanced forms of the three intermediate systems that evolved in the human lineage—complex affect, planning, and reasoning/understanding—seem in fact to have become highly combinatorial.

1.2 Organizing Factors

Each cognitive system has certain structural properties or properties of organization. Some properties are shown by only one system, some by several, some by all. Those properties shown by all systems reflect the fundamental structuring of cognition. As noted, this arrangement is here termed the overlapping systems model of cognitive organization. This model can be represented by partially overlapping Venn circles. We label them "systems" because they in fact seem not to behave as autonomous Fodorian "modules" (Fodor, 1983), in part due to their overlap of properties.

Many of the more widespread structural properties can be grouped into categories here called "organizing factors". A heuristic list of seventeen such organizing factors—in turn grouped into four classes—is presented in (2).

(2) **Heuristic List of Organizing Factors**

• Constitutive factors

a. configurational structure: any 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: any time-related properties in 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: any causal / force interactions in a system, e.g., the

1. causing 2. letting 3. preventing 4. helping 5. hindering
   by one entity of another entity's action or inaction

d. categorial structure: any form of categorization exhibited by a system, e.g.,

1. superordinate and subordinate category inclusion 2. prototype structure

e. metric structure: any type of metric in effect in a system, e.g.,

1. discrete vs. gradient 2. absolute vs. relative

f. quantity structure : the amount or intensity of any aspect of a system, e.g., it

s:

1. scope 2. granularity 3. "density"

g. degree of differentiation: the degree to which any aspect of a system is differentiated, e.g., its being

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: any relations of an adopted perspective point to a system, e.g.,

1. its location 2. its distance from the target 3. whether it is stationary or moving

j. memory structure: any relations of memory to a system, e.g.,

1. storage and retrieval characteristics 2. novelty vs. familiarity

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

1. doubt vs. certainty about a phenomenon

2. experiencing a phenomenon as originating externally vs. internally

l. evaluation: any assessments applied to any aspect of a system, e.g., its

1. significance (important/irrelevant) 2. merit (good/bad)

3. esthetic quality (beautiful/ugly [not modality specific]) 4. appeal (liked/disliked)

• Processing and housekeeping factors

m. monitoring: a system's online monitoring and upkeep of its functions and operations, e.g.,

1. error detection and correction 2. maintenance of internal integrity

n. affectability: the degree to which and the ways in which a cognitive system can be affected by other cognitive systems within the individual or by an outside agent (= its level of modular autonomy), e.g., what and how it processes is largely

1. fixed 2. influenced by current outside conditions

o. plasticity: type and degree of long-term modifiability exhibited by any aspect of a system, e.g.,

1. developmental changes through life span 2. response to environmental changes

p. group variability: the degree to which, across different social groupings of individuals within a single species, a cognitive system

1. is largely the same 2. can exhibit major differences of structure and function

• 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, e.g.,

1. synthesizing distinct processes 2. assessing needs for more or less of particular processes

1.3 Illustrating the Organizing Factors

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, configurational structure. It may well occur across all the cognitive systems, which would make it part of the fundamental structure of cognition.

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 that arrangement, such as individual tables and people. The lowest level might consist of the external features or the internal structural schemas of the individual elements, such as, respectively, the clothing or the Marrian skeletal structure (Marr, 1982) 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 a particular neural mechanism underlies any structural property appearing 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 explanation. Three possible 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 neural connections with that mechanism. For example, if our cognitive capacity for multiple hierarchical embedding is underlain by a single independent neural mechanism, then all the cognitive systems exhibiting that capacity do so because they have evolved to form connections with that mechanism.

Second, the neural mechanism might exist as part of a particular cognitive system, but only that one system. Other cognitive systems with the same property tap into the mechanism in that one system. The mechanism would then have evolved as part of the first system, and as later systems evolved, they acquired the property by establishing neural connections with the first system. For example, if our cognitive capacity for multiple hierarchical embedding rests on a neural mechanism that originally evolved as part of the visual cognitive system and remains alone there, then the other cognitive systems exhibiting that capacity do so because they have evolved to form connections with that mechanism within the visual system.

Third, separate instances of the neural mechanism might exist in each cognitive system exhibiting the same property. Each instance would then have evolved on its own. This case might involve more a similarity than an identity across the instances of the neural mechanism and of the property. For example, the cognitive capacity for multiple hierarchical embedding that is exhibited by different cognitive systems might rest on similar but separate neural mechanisms that evolved independently in each such system. 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.

1.5 Structural Overlap Between Language and Other Cognitive Systems

In the rest of this article, each section examines structural overlap between language and one other cognitive system. The first two sections below look at structural properties across language and visual perception, showing ones that are respectively different and shared. The shared set is extensive, demonstrating a substantial structural overlap between these two cognitive systems. Section 4 next shows a comparably extensive structural overlap between language and somatosensory perception. The next two sections argue that there is relatively little structural overlap between language and, respectively, the affect system and the cognitive culture system. We end with a section showing substantial structural overlap between language and the understanding system. Although particular observations on the issue are made along the way, we as yet have no overall theory to account for the pattern in which structural overlaps do and do not occur between language and other cognitive systems.

Since this comparison between language and other cognitive systems is based on structural properties, we take space here to outline the type of structural properties of language used for the comparison. Basically, these are the properties of conceptual structure represented by closed-class forms (see Talmy, 2000a, chapter 1).

In outline, then, the task of conceptual representation by language is functionally divided between two categories of linguistic forms. One category consists of open-class, or lexical, forms—primarily the roots of nouns, verbs, and adjectives. The other category consists of closed-class, or grammatical, forms—including bound forms like inflectional and derivational affixes; unbound forms like prepositions, conjunctions, and determiners; word order; grammatical categories and relations; and syntactic constructions. These two categories of forms perform complementary functions, representing conceptual content and conceptual structure, respectively. Thus, in the total conception evoked by any single sentence of a language, most of its content is contributed by the open-class forms, while most of its structure is determined by the closed-class forms.

Further, the meanings represented by all the closed-class forms of all languages are highly constrained, both as to the conceptual categories and as to the member concepts within a category that they can ever express. For example, although many languages have noun endings that indicate the number of the noun's referent, no language has noun endings indicating its color. Thus, the conceptual category of 'number' is among the categories that closed-class forms can express, but the category of 'color' is universally excluded from closed-class representation. And with respect to the member concepts within the category of number, many of the languages that do indicate number on their nouns have endings for concepts like 'singular', 'dual', and 'plural', but no such language has endings that indicate 'even', 'odd', 'dozen', or 'numerable'.

The severe semantic limitations on closed-class forms entails that the structural meanings they express comprise a largely closed inventory. The conceptual classes and member notions of this inventory can then be understood to constitute a fundamental conceptual structuring system of language. It is this grammatically represented conceptual structuring system, then, that is mainly used for the language side of the comparisons below between language and other cognitive systems.

For each case of structural comparison discussed below, the relevant organizing factors out of those listed in (2) are shown in brackets or otherwise indicated.

2. Non-Overlap of Structural Properties Across Language and Visual Perception

The present section and the next section both address language and visual perception, looking respectively at where they do not and where they do structurally overlap. That is, 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.

2.1 Prominent in Language Structuring, Minimal in Visual Structuring

As noted, 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 (2k)]

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

(7) Closed-class 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. It seems that, if viewed, a scene is simply taken to be actual.

2.1.2 Modality [causal structure (2c)]

Perhaps all languages have closed-class indication of what is traditionally known as "modality". Talmy (2000a, chapter 7) places modality within the larger framework of "force dynamics" (see section 4 below). Specifically, modality can be characterized as a sentence's indication of the pattern of forces acting for or against the occurrence of the event expressed 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. It seems that, if viewed, the scene is simply taken to be in occurrence.

2.1.3 Addressee's Inferred Knowledge Status ("Definiteness") [epistemic structure (2k)]

Many languages have closed-class 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 an entity 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 cannot 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 ("Evidentiality") [epistemic structure (2k)]

Many languages have closed-class 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 3:00 PM and he usually chops wood at 3:00 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 inferencing and 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 [configurational + temporal structure (2a, 2b)]

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 closed-class 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 closed-class form *around* indicates a vertical spin axis, as in (10a), and the closed-class 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 closed-class forms that would distinguish, for example, the amount of rotation. Thus, the same closed-class form *around* is used in (11) for all four choices of time length shown there. These time lengths are intended to indicate respectively 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 one minute. c. for several minutes. d. for three hours.

Comparably, English lacks closed-class forms for distinguishing the geometric relation of the spin axis to the moving entity. Thus, the same closed-class form *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 produced a whoosh as it spun around.
c. The bird kept flying around the flagpole.

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). With respect to this aspect of spatial structuring, then, signed language has a greater overlap with vision than spoken language does.

2.2.2 Dilation (expansion/contraction) [configurational + temporal + quantity structure (2a, 2b, 2f)]

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-- e.g., 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 physical growth or shrinkage; the dimensionality of the dilation—along a 1-D line, over a 2-D plane, or throughout a 3-D volume; the aspect of a geometric figure exhibiting dilation—the filled-in whole versus the periphery; the continuity of the entity—a single object stretching or shrinking, versus multiple objects dispersing or converging; and, of course, the sign of the dilation—expansion versus contraction.

But, like many languages, English has closed-class representation only for the last two of these structural distinctions, continuity and sign. Thus, for a single continuous object, the closed-class form *out* represents expansion, as in (13a), while the closed-class form *in* represents contraction, as in (13b). Comparably for a discontinuous set of objects, the closed-class form *apart* represents expansion, as in (13c), while the closed-class form together represents contraction, as in (13d).

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

b. When air was suddenly removed from it, the bladder snapped in.

c. When air was streamed at them, the particles all flew apart.

d. When air was blown in on them, the particles all flew together.

English does not have additional closed-class forms that would distinguish, for example, the dimensionality of a dilation. Thus, the same word *out* is used in (14) for expansion in one, two, and three dimensions.

(14) a. The bungee cord stretched out.

b. The sheet of rubber stretched out.

c. The dough puffed out.

Comparably, English lacks closed-class forms for distinguishing the aspect of a geometric figure that exhibits dilation. Thus, the same word *out* is used to refer to the expansion of the filled-in interior of a circle in (15a) and of its circumference in (15b), as well as of the filled-in interior of a sphere in (15c) and of its outer shell in (15d).

(15) a. The rubber disk stretched out.

b. The rubber ring stretched out.

c. The ball of dough puffed out.

d. The balloon puffed out.

Closed-class representation for a few further dilational distinctions does exist. Thus, some languages, e.g., Atsugewi, grammatically distinguish between a two-object bilateral dilation and a many-object multiradial dilation corresponding to English *together* and apart. And in the Yiddish closed-class representation of contraction, the satellites *tsunoyf* and *tsuzamen* tend to indicate respectively a merger and an aggregation (though both can refer to either). 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 [configurational (+ 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 1-D line, over a 2-D plane, or through a 3-D 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; any arrangement of the objects, as whether they occur in concentric circles or parallel zigzag lines; or any 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 closed-class indication only of the first two of these structural distinctions, density and dimensionality. 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 has closed-class marking for 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, though, American Sign Language regularly represents just such structural distinctions in its classifier subsystem.

2.2.4 Bilateral Symmetry [configurational structure]

It appears that the perception of bilateral symmetry—as when viewing a human or animal from the front—is a relatively prominent structural feature of vision. If so, language contrasts strongly, with seemingly minimal closed-class representation of it. One such case was cited in section 2.2.2: the closed-class representation of two objects moving bilaterally together or apart. The only other 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.

Yet again, though, American Sign Language's classifier subsystem readily represents bilateral symmetry.

3. Overlap of Structural Properties Across 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 an overlap of properties. We consider such overlaps with respect to three of the organizing factors: configurational structure (2a), attentional structure (2h), and perspectival structure (2i).

3.1 Language-Vision Overlap in Configurational Structure

We here look at three properties that overlap across language and vision with respect to the organizing factor of configurational structure (2a).

3.1.1 Spatial Structure

One configurational property that seemingly manifests greatly in both cognitive systems can be called "spatial structure". This is the cognitive representation of the structure of an object or an arrangement of objects in space. In particular, perhaps all languages have closed-class forms 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 grammatically represents these geometric Figure-Ground relations mainly with prepositions and satellites.

Thus, the preposition *in*, as illustrated in (18a and b), indicates that a Ground object (here, the dumpster, vase) can be schematized as a plane so curved as to define a volume of space. The Figure object (here, the radio, water), then, occupies a portion of that volume of space. Comparably, the preposition *along*, as in (18c and d), indicates that the Ground object (here, the ledge, trail) can be schematized as a line.

The Figure object (here, the ball, hunter) can then be schematized as a point that moves along a linear path, 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.

b. Some water is in the vase.

c. The ball rolled along the ledge.

d. 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 in each scene. 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 with closed-class forms across languages. But overlap between the linguistic and the visual structuring of spatial relations seems likely.

3.1.2 Interior Structuring Within Bulk

Another property involving configurational 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 here understood as the "skeletal structure" of a bulk object. The bulk of the object can extend outward in some measure from such a representation with that representation still functioning as the object’s skeletal structure. To that degree, the representation is thus "bulk neutral".

Language extensively exhibits this kind of skeletal representation in its grammatically indicated spatial schemas. The same English prepositions just seen in section 3.1.1 can in fact illustrate the matter. For example, the preposition *along* can be used in both (19a) and (19b), in which the Ground objects differ greatly in their radial bulk extension. The preposition’s requirement that the Ground object (here, the filament, trunk) be schematizable as a line holds in both cases. And this is so even for (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 configurational structure where a viewer perceives virtual delineations within a bulk figure, whose exterior form is all that she sees explicitly. Generally known in vision science in fact as "skeletal structure" or a "topological skeleton", particular formulations of such configurational 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 her hand movements are mainly the lines of a stick figure. The child's cognitive processing must convert the former input to the latter output. Perhaps this processing in its earlier activities includes a perceptual representation of a skeletal structure within the original bulk figure and then produces an explicit representation of that skeletal representation through a motoric linkup with it.

3.1.3 The Topological Character of Such Structuring

The spatial schemas represented by closed-class 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, e.g., a pill in the thimble, lava in the volcano).

(16) 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.

3.2 Language-Vision Overlap in Attentional Structure

Five forms of attentional structure are treated in Talmy (2000a, chapters 1 and 6). The choice of closed-class forms can determine whether greater attention is to be allocated to an exemplar or the full complement of a multiplexity (level of exemplarity); to the whole, a part, or individual features of a hierarchy (level of baseline); to a more specific or a more generic level for representing an entity (level of particularity); to the componential or the Gestalt level of an aggregate (level of synthesis); and to one as against another portion of an event (windowing of attention). The last of these is illustrated here.

We consider the case in language where a sentence represents a certain whole event. The inclusion of overt linguistic material referring to particular portions of that event increases attention on those portions, while the omission of material referring to other portions decreases attention on them. This inclusion or omission of overt linguistic material is regarded as a closed-class category with two members. In the terminology of Talmy (2000a, chapter 6), which analyzes this issue, the portions of the event that are foregrounded in attention in this way are "windowed" and the backgrounded portions are "gapped", with the whole process termed the "windowing of attention".

We illustrate this process in (21) with the case where the event is an object moving along a path, and different portions of this path—specifically, the initial, medial, and final portions—are either windowed or gapped.

(21) The ball I'd thrown up on top of the house fell--

A. with maximal windowing over the whole of the path: --off the roof, through the air, onto the ground.

B. with gapping over one portion of the path:

1. medial gapping

--off the roof onto the ground.

2. initial gapping

--through the air onto the ground.

3. final gapping

--off the roof through the air.

C. with windowing over one portion of the path:

1. initial windowing --off the roof.

2. medial windowing --through the air.

3. final windowing --onto the ground.

Where the same event that is represented linguistically can be perceived visually, it can be conjectured that different portions of the scene can comparably receive greater or lesser attention. Thus, a subject who views the falling of a ball thrown onto a roof might, on separate occasions, attend and disattend to different portions of its downward path in a way perhaps quite parallel to that of the linguistic example.

3.3 Language-Vision Overlap in Perspectival Structure

Where a sentence represents a certain scene, closed-class forms can set up a conceptual perspective point from which one is to cognitively regard the scene. Prototypically, such a perspective point is where one places one's "mental eyes" to "look out" upon the scene. Four parameters of perspectival structure are treated in Talmy (2000a, chapter 1). The choice of closed-class forms can determine a perspective point's location within a larger frame; the direction of the view from it to the referent entity; its distance away from the referent entity; and its motive state—stationary or moving along a particular path. The first two and the last two of these parameters, respectively, are illustrated by the following two examples.

For the first example, consider the two-sentence narrative in (22). In (22a), the use of a third-person pronoun, together with spatial prepositions in construction with referents to physical objects, invites the listener to place his perspective point somewhere in the depicted room looking at the sitting woman. But in (22b), the exclamatory *how*-construction (see Michaelis, 2001, for an analysis of such exclamatives), together with the expression of subjective experience, induces the listener to relocate his perspective point to the location of the sitting woman, in effect, looking out through her eyes toward the sky. The location of the listener's perspective point within the depicted scene and his direction of viewing from that location are thus linguistically directed.

(22) a. She sat in the rocker near her bed and looked out the window.

b. How lovely the sky was!

Now, if an observer were to perceptually view the physical scene just represented linguistically, we suggest that he would be able to retain the perspective point of his own location in space and a viewing direction from that location toward the woman or, alternatively, imaginally project his perspective point to the woman's location and adopt her direction of viewing toward the sky. If so, then the structuring of visual perception overlaps with linguistic structuring with respect to perspectival location and viewing direction.

For the next example, consider the two sentences in (23), here assumed to be referring to the same single scene. The choice of certain closed-class forms in (23a)—the collective quantifier *some*, plural number and agreement, and the locative preposition *in*—lead the hearer to imagine the represented scene as if from a distal stationary perspective point. From there, she in effect regards the scene as a whole with global scope of attention. By contrast, different closed-class forms in (23b)—singular number and agreement, an adverbial expression of temporal distributedness, and the motion preposition *through*—lead the hearer to imagine the same represented scene as if from a proximal moving perspective point. From there, she in effect regards each house in turn with local scope of attention. The distance of the hearer's perspective point from the referent and its motive state are thus grammatically directed.

(23) a. There are some houses in the valley.

b. There's a house every now and then through the valley.

Again, if an observer were to perceptually view the physical scene just depicted linguistically, we conjecture that she would be able to retain her actual distal and stationary perspective point or, alternatively, imaginally project her perspective point closer in and move it from house to house. If so, then the structuring of visual perception overlaps with linguistic structuring with respect to perspectival distance and motive state.

4. Structural Properties Across Language and Somatosensory Perception

It is proposed here that causal structure—organizing factor (2c)—is a structural property extensively realized in common across the cognitive systems of language and somatosensory perception—as well as those of motor control and visual perception.

Language has extensive closed-class, as well as open-class, representation of a semantic category that Talmy (2000a, chapter 7) terms "force dynamics", a generalization over causativity. That analysis proposes a single framework that captures a range of concepts of force, placing them into systematic relations with each other. These force concepts include: an object's tendency toward motion or rest, another object's opposition to this tendency, resistance to such opposition, and the overcoming of such resistance; the presence, appearance, disappearance, or absence of blockage; the concepts of causing, letting, preventing, helping, and hindering; and the concepts expressed by such locutions as *because of* and *despite* (concessive).

Most force-dynamic patterns involve two opposed entities. One entity, the "Agonist", has a tendency toward motion or rest, and our attention is on the outcome of this tendency. The other entity, the "Antagonist" opposes the first, and can be either stronger or weaker than it, thus either overcoming its tendency or merely hindering it. The Agonist and Antagonist usually direct their forces in diametric opposition against each other, but can also direct them circumferentially inward and outward (as in confining).

The sentences in (24) illustrate a small sample of force-dynamic patterns.[4]

(24) a. The ball kept rolling because of the wind.

b. The ball kept rolling despite the stiff grass.

c. The barrier kept the log from rolling down the hill.

d. The barrier's coming loose let the log roll down the hill.

The ball is the Agonist in the first two sentences. Its tendency is toward rest in (24a), and this tendency is overcome by the stronger Antagonist, the wind. Its tendency is toward motion in (24b), and this tendency is merely hindered by the weaker Antagonist, the grass. In both the final two sentences, the log is the Agonist with a tendency toward motion, and the barrier is the stronger Antagonist, able to block that tendency. In (24c), the barrier is in position and performs that blockage. This is a steady-state force-dynamic pattern, as is the case for the first two sentences. But in (24d), the barrier leaves its position of blocking, thus enabling the log to realize its tendency toward motion in a "letting" pattern. This last force-dynamic pattern is thus not a steady-state type, but a shifting type.

With respect to cognition overall, force dynamics in language seems to have the most in common with somatosensory perception, and the next most with motor control. More specifically, force dynamics seems most akin to the perception of pressure—whether from mechanoreceptors or from proprioceptors—often in conjunction with the exercise of motor control. Such pressure perception can presumably detect—and motor control can help generate—some of the same categories of phenomena prominent in force dynamics. These may include the exertion of force against an object, resistance by the object to that force, and the overcoming of that resistance or blockage by it. To the extent that these linguistic, somatosensory, and motor systems share such representations or manifestations of force, they exhibit overlap.

The perception of force interaction appears to be a substantial component of vision as well. If so, then visual perception overlaps in some measure with linguistic force dynamics, with somatosensory perception, and with motor control in the domain of force interaction. And this overlap in structural properties pertaining to force can then be added to those already cited in section 3.

In this regard, Talmy (2000a, chapter 2) proposes a scale of "ception" that covers both perception and conception. It runs from the fully concrete level of palpably perceiving a phenomenon, through a semi-concrete level, through the semi-abstract level of "sensing" a phenomenon, to the fully abstract level of conceiving a phenomenon. It further proposes that the visual ception of objects is at the fully concrete level, while the visual ception of force interactions between objects is at the semi-abstract level.

To illustrate, consider a scene in which a large concrete slab is leaning at a forty-five degree angle against the outer wall of a rickety wooden shed. A person viewing this scene would explicitly see the slab and the shed in their particular identities and geometric relationships at the fully concrete level of palpable perception. At the same time, the viewer would implicitly sense the interaction of forces between the two objects at the semi-abstract level of ception. In particular, the viewer might sense a force manifested by the shed (the Agonist) that is now successfully but tenuously resisting an unrelenting outside force impinging on it, manifested by the slab (the Antagonist), and that may incrementally erode and give way.

Among earlier corroborative studies, Engel and Rubin (1986) reported that subjects perceive (in our terms, sense) forces at the cusps when viewing a dot that moves along a path like that of a ball bouncing. When the bounce is progressively heightened, then the perception is that a force has been added at the cusps. Complementarily, when the dot’s bounce is reduced, the force is perceived as being dissipated. More recently, Philip Wolff—e.g., Wolff and Shepard (2013)—has shown numerous parallels between linguistic force dynamics and the visual sensing of force interactions.

5. Structural Properties Across Language and the Affect System

Our argument here will be that the semantic domain of affect—perhaps surprisingly—has relatively poor systematic closed-class representation in language. Accordingly, there is comparatively little overlap of structural properties between the cognitive systems of language and of affect. Factor (2m), evaluation, would then be the most implicated in failing to organize the two cognitive systems comparably.

Now, on the one hand, open-class representation of affect within a language can be extensive and comprehensive, and is certainly so cumulatively across languages (Ellsworth, 2015). We can give some idea of such representation by listing just a few of the over 160 English affect verbs cited in Talmy (2000b, chapter 1). Some of those with the experiencer as subject are *love, hate, fear, envy, grieve, enjoy, suffer*; and with the experiencer as object are *soothe, incense, astonish, irk, amuse, embarass, intrigue*. To these, of course, the numerous English affect nouns and adjectives can be added.

By contrast, though, closed-class representation of affect is relatively scant, noncomprehensive, and unsystematic.

With respect to scantness, a scattering of individual closed-class forms with affective reference does appear across languages, but not to any great extent. Each such form that does occur generally represents the quality of the feeling; the possessor of the feeling—the speaker, the subject NP, or another NP-identified experiencer; and the object of the feeling—an entity, event, or other factor identified in the sentence.

For illustration, a sample of eight such grammatically represented feelings—concern, amazement, hopefulness, desire, pleasure, displeasure, affection, and dislike—are next presented with the constraints on their usage. Note that a number of further closed-class forms might be interpreted as having affective implications, and hence as extending the sample. For example, a speaker using an interrogative marker or the modal *should* might be attributed with the affective states of being quizzical or judgmental. But many phenomena are tinged with affect to this relatively lesser degree, and such examples are here not counted among the forms with more direct affective reference like those presented next.

For the first four examples, a subject's feeling of concern or fear as to a potential unpleasant event is indicated by the English conjunction *lest*, as in (25a). Next, a speaker's feeling of amazement or surprise at the greatness of some variable's degree can be indicated by exclamatives or miratives (Michaelis, 2001), e.g., in English by the forms *so* and *such*, as in (25b) as well as by the specific constructions in (25c) and (25d). A speaker's wish or hope for an event to occur can be indicated by optative or subjunctive morphology on the verb referring to that event in some languages, e.g., classical Greek, as well as by the English *may* construction in (25e). And a speaker's desire to perform an action is indicated by desiderative morphology on the verb referring to that action in some languages, e.g., Sanskrit.

(25) a. Jim cleared the path lest his father trip.
b. It's so vivid!
c. Was she ever hungry!
d. What a fool I was!
e. May you live long and prosper!

Continuing with the examples, an experiencer's feeling of pleasure at an event undertaken for her sake can be indicated by benefactive forms, e.g., in English by the preposition *for* with an NP indicating the experiencer, as in (26a). An experiencer's feeling of displeasure at an event that occurs can be indicated by malefactive or adversative forms, e.g., in English by the *on NP* construction, where the NP indicates the experiencer, as in (26b). A speaker's feeling of affection toward an entity can be indicated by "hypochoristic" morphology on the noun referring to that entity, e.g., the Yiddish suffix *-ele*, as on the noun *hunt* 'dog' to yield *hintele*, a dog endearing to the speaker. And a speaker's feeling of dislike, contempt, or distaste toward an entity is indicated in some languages by pejorative morphology on the noun referring to that entity, e.g., by *-accio* in Italian.

(26) a. I vacuumed her carpet for her.

*ab. My plants all died on me. (Contrast: *My plants all thrived on me.)

Closed-class representation of affect is not only scant but noncomprehensive. The eight feelings just cited as having grammatical representation may in fact be among the main instances. Thus, crosslinguistically, there is seemingly no closed-class representation for such feelings as hate, anger, mercy, grief, envy, pride, or fascination.

Most importantly, closed-class representation of affect seems largely unsystematic. It seems rather to have a more sporadic distribution, often appearing in grammatical categories that mainly express other types of concepts. For example, English *lest* is in the grammatical category of conjunctions, but may be alone there in expressing a type of affect. And while the optative constitutes a whole conjugational category in classical Greek verb morphology, it too may be alone there in expressing a type of affect.

What appears to be missing from languages, then, is a distinctive syntactic category of closed-class forms that, in its central semantic function, comprehensively and systematically represents the domain of affect. Examples of just such representation do exist for other semantic domains. Thus in English, the syntactic categories of subordinating and coordinating conjunctions together represent the semantic domain of inter-event relations: the temporal, causal, augmentive, etc., relations that the event expressed by one clause can have to the event expressed by an adjacent clause (Talmy 2000a, chapter 6). And the syntactic categories of satellites and prepositions together represent the semantic domain of spatial relations: the paths and locations that a Figure object can manifest relative to a Ground object (Talmy 2005).

To elaborate a bit on the latter case, comprehensiveness is seen in that the dozens of English satellites and prepositions together subdivide spatial relations in a way that, by various metrics, most basic paths and locations are covered. And systematicity is seen in that the spatial schemas represented by satellites and prepositions largely consist of the components of an organized matrix or grid, e.g., the positively and negatively opposed directional components in *up/down, in/ out, on(to)/off (of)*.

We might gain some heuristic sense of how a closed-class category pertaining to affect might behave by devising one. We could imagine, for example, that English has a set of closed-class clitics on a verb that represent particular combinations of affective components from a matrix. These components might consist of whether the experiencer of the feeling is the speaker, the subject, or another indicated entity; whether the feeling is of strong or mild intensity; which parameter of affect is at issue; and whether the positive or negative pole of that parameter is in effect.

Thus, the positive and negative poles of a parameter of ‘happiness’ experienced mildly by the subject might be respectively represented by the invented forms -*beglad* and -*besad*. These forms might then appear in sentences like (27a) and (27b) with meanings something like those shown in quotes. This invented closed-class set might also include the clitics *-afavor* and *-afear* pertaining to a parameter of "disposition", indicating that the subject has a strong feeling respectively of kindliness or of fear toward an indicated entity. These particles might then appear in sentences like (27c) and (27d), again with meanings something like those shown in quotes. The point of this exercise, though, is to note that no such closed-class affective system seems to occur in language.

(27) a. I ate-beglad the food. "I enjoyed eating the food."

b. I ate-besad the food. "I disliked eating the food."

c. I fed-afavor the wolf. "I fed the wolf with a feeling of kindliness toward it."

d. I fed-afear the wolf. "I fed the wolf with a feeling of fear toward it."

It might be held that some cases of just such closed-class affect systems do in fact occur. One candidate might be the sentence-final particles that appear as an areal phenomenon in many southeast Asian languages (Matisoff, 2015). But a closer look shows that these particles are better characterized as mainly expressing mood (indicative, interrogative, etc.) and evidentiality (probability, hearsay, etc.). And while final particles in Lahu (a language with this areal phenomenon) do include a number of "interjectories" (Matisoff, 1973), they are all equally emphatics indicating affective intensification and do not distinguish among different types of affect. Individual speakers simply settle on using one or another of the particles by personal preference.

The conclusion seems to be that language has little structural overlap with the cognitive system of affect, in contrast with the substantial overlap it has with other cognitive systems. The question of course arises why this might be. One explanation that might be offered is that facial expressions and other forms of body language already constituted a rich channel by which states of the affect system were communicated in the human lineage. As language evolved, by this argument, there was accordingly little selective pressure on it to develop a structural system for representing affect. This account is faulted, though, by noting that gestures are an equally rich channel for communicating spatial relations, specifically, the paths and locations of one object relative to another. Yet language evolved with extensive structural representation of just such spatial relations. The scantness of structural overlap between the cognitive systems of language and affect thus remains puzzling.

6. Structural Properties Across Language and the Cognitive Culture System

The proposal elaborated in Talmy (2000b, chapter 7) is that, in the lineage leading to the human species, there has evolved an innately determined brain system whose principal function is the acquisition, exercise, and imparting of culture. This structured system for cultural cognition encompasses certain cognitive capacities—ones involving conceptual, affective, and behavior patterns of particular types—most of which are either less developed or absent in other species. But the structural aspects of these patterns seem to have relatively little overlap with the closed-class conceptual structuring system of language.

Since both the cognitive system of language and that of culture have the property of being group-variable, the seeming dearth of structural commonality between them can be examined in two ways—across groups and within a single group, as seen respectively in the next two subsections. Specifically, the first subsection below looks beyond particular group variations at properties either that are universal or that can be collectively gathered from across group particulars. The second subsection looks for any overlap of linguistic and cultural properties within a single group.

6.1 Comparison Across Languages and Cultures

To begin with the culture side of the cross-group comparison, we here simply present Murdock's (1965) list of seventy-three cultural universals, that is, of phenomena that were present in all the cultures of which he had knowledge. Though matters of fact and of interpretation may have changed substantially for anthropologists since the publication of this list, it may still serve heuristically. Various particular entries in the list may not play a structural role in the cognitive culture system, but perhaps enough do to indicate what universals of cultural structure might consist of. A number of the organizing factors listed in (2) might have a prominent role in such structuring, including, for example, categorial structure (2d), epistemic structure (2k), and evaluation (2l).

(28) age-grading, athletic sports, bodily adornment, calendar, cleanliness training, community organization, cooking, cooperative labor, cosmology, courtship, dancing, decorative art, divination, division of labor, dream interpretation, education, eschatology, ethics, ethnobotany, etiquette, faith healing, family, feasting, fire-making, folklore, food taboos, funeral rites, games, gestures, gift-giving, government, greetings, hair-styles, hospitality, housing, hygiene, incest taboos, inheritance rules, joking, kin groups, kinship nomenclature, language, law, luck superstitions, magic, marriage, meal times, medicine, modesty concerning natural functions, mourning, music, mythology, numerals, obstetrics, penal sanctions, personal names, population

policy, postnatal care, pregnancy usages, property rights, propitiation of supernatural beings, puberty customs, religious ritual, residence rules, sexual restrictions, soul concepts, status differentiation, surgery, tool making, trade visiting, weaning, weather control

Noteworthy here is that of this list's seventy-three apparently universal cultural categories, only eight have any representation in the closed-class conceptual structuring system of language, and of these eight, only some three or so have extensive representation.

In particular, one cultural category well represented structurally in language is "status differentiation", which, for example, is expressed by the familiar vs. the formal forms of the second person in many European languages, as well as by the elaborate pronominal and inflectional forms of Japanese. Also well represented is the cultural category of "etiquette", which is grammatically expressed by various markers and constructions, for example, for requesting as against commanding, as in (29a); for suggesting as against directing, as in (29b); and for many other forms of politeness (cf. Brown and Levinson 1987). And the culture category of "property rights" can be linguistically represented by those closed-class forms that express ownership and transfer of possession, e.g., in Russian by the preposition *u*, 'in the possession of', and the dative case, 'into the possession of'.

(29) a. Could you please speak up? vs. Speak up!

b. Why not go abroad? vs. You should go abroad.

Involving a lesser degree of structural representation, languages can have specialized syntax in representing the cultural categories of "personal names", "kinship nomenclature", "greetings", "numerals", and "calendar designations".

But aside from these several relatively modest forms of intersection between the conceptual structuring system of language and that of culture, it can be seen that there is remarkably little structural overlap between these two cognitive systems.

6.2 Comparison Within a Single Language and Culture

This same line of argument can be pursued for the language and culture of a single people. In his work on the language and culture of the Mparntwe Arrernte, an Australian Aboriginal group, Wilkins (1993) has gathered together all that he could discern of the grammatical forms in the language that seem to reflect aspects of cultural structure. There are indeed several such forms, almost all of them involving kinship relations and totemic affiliations for both people and places—intense cultural preoccupations in Aboriginal Australia, as documented by Heath et al. (1982). Nevertheless, the number and extent of these forms is minute compared to the entire grammatical system of the language. And even here, several of these cases involve no novel grammatical categories but only certain special applications of familiar categories. We here describe two of the six or so cases that Wilkins has found for Mparntwe Arrernte.

For the most telling case, in Mparntwe Arrernte all dual and plural pronouns in all three persons come in three distinct forms. One form refers to two or more people who are members of different patrimoieties. A second form refers to people of the same patrimoiety but of different generations, while the third form refers to people of the same patrimoiety and of the same generation. Thus, where English would just use *we, you,* and *they* without regard to any characteristics of the groups referred to by these pronouns, this Aboriginal language pronominally distinguishes such groups with respect to kinship relations of relevance to the culture.

For a second case, Mparntwe Arrernte has a "switch-reference" system—itself common enough in languages around the world—by which the verb in a dependent clause takes inflections that indicate whether its subject is the same as or different from the subject of the main clause verb. For example, consider a sentence referring to two geographically distinct locations: *Location A became defiled, when location B broke apart*. Usually the verb for *broke apart* would be inflected for 'different subject'. But if the two locations have the same totemic affiliation, and this fact is pertinent to the meaning of the sentence, and the speaker wishes to foreground that fact, then the verb can be marked with the 'same subject' inflection. Thus, while a switch-reference grammatical system per se reflects no cultural patterns, its application in this language does reflect the culture's emphasis on and specifics of totemic affiliation.

While the above examples and several further cases do indeed seem to reflect some cultural penetration into the grammar of Mparntwe Arrernte, these few cases represent the full extent of such penetration. The vast remainder of the language's grammatical system manifests conceptual categories widely represented among the languages of the world, regardless of their cultural contexts. It might have been expected that progressively more of a culture's conceptual structure would enter into the conceptual structuring system of the language the longer that continuous forms of the language and the culture co-existed for a single people. Certainly, this Australian group is an instance of such a people. Nevertheless, their language and culture reflect little of each other. Apparently, each of these two cognitive systems follows principles of organization that remain largely independent of the other's.

Accordingly, the Sapir-Whorf Hypothesis—which includes the proposal that there is much parallelism between the conceptual structure manifest in the grammatical system of a language and that in the culture of the people who speak the language—at least in this site of its testing, seems not to be borne out.

7. Structural Properties Across Language and the Understanding System

In section 1.1.2, it was proposed that an earlier cognitive system of inferencing evolved in the human lineage into our current elaborate capacity for reasoning and understanding. We here address the amplified understanding system in particular. This system can be characterized as generating mental models that are experienced as accounting for or explaining the structure and function of some domain of phenomena. There is latitude in what can be experienced as an explanation in this way. Such an explanation can range over various levels of consistency, elaboration, and sophistication. And its source can range from idiosyncratic personal accounts, to folk cultural accounts, to scientific theories.

It is proposed here, then, that there is a substantial overlap in structure between concepts represented by the closed-class system of language and concepts prominent in certain forms of the understanding system. These forms of the understanding system seem to include childhood conceptualizations of phenomena, adult naive science, traditional cultural lore, early science, and casual science. The last two forms of the understanding system are illustrated respectively in the following two subsections.

7.1 Structural Properties Across Language and Early Science

What follows are six conjectures about a correspondence between particular properties of conceptual structure found in closed-class forms and ones found in early science. The assumption here is that conceptions built into the fabric of language are among the most readily available for theoretization, that is, for use as elements in an initial theoretical system.

7.1.1 Fictive Sensory Paths and the Extramission Theory of Perception

A semantic domain with extensive structural representation is that of "fictive motion" (Talmy 2000a, chapter 2), in which motion is linguistically represented as present where none would be observed. One type of fictive motion is that of "sensory paths". In this type, an experiencer's perception of an experienced phenomenon is represented as the motion of something intangible in a straight path between the two entities in one direction or the other. In the experiencer-as-source conceptualization, the Experiencer emits a Probe that moves to the Experienced and detects it upon encounter with it, whereas in the experienced-as-source conceptualization, the Experienced emits a Stimulus that moves to the Experiencer and sensorily stimulates her on encounter with her.

Now, in English and perhaps most other languages, any representation of agentive vision with the use of fictive motion is expressed exclusively in terms of the former conceptualization. As shown in (30a), this is the case with the agentive vision verb *look*, which takes the Experiencer as subject and allows a range of directional prepositions. Here, the conceptualization appears to be that the Agent subject volitionally projects his line of sight as a Probe from himself as Source along the path specified by the preposition relative to a Reference Object. However, there is no (30b)-type construction with *look* in which the visual path can be represented as if moving to the Experiencer as goal.

(30) a. I looked into / toward / past / away from the canyon.

b. *I looked out of the canyon (into my eyes).

<where I am located outside the canyon>

Now, this experiencer-as-source conceptualization of agentive vision in the conceptual structuring of language is essentially the same as the "extramission" theory of visual perception held by a number of classical Greek and Roman thinkers, as well as by naive subjects today (Winer and Cottrell, 1996). In that theory, sight takes place by means of light or other emanations projected from the eyes in a straight line into contact with the seen object. This early (and persistent) theory of vision of course does not accord with modern scientific optics, but does overlap with linguistic conceptual structure. This overlap mainly involves organizing factor (2a), configurational structure.

7.1.2 Linguistic Topology and Mathematical Topology

As seen in section 3.1.3 above and elaborated in Talmy (2000a, chapter 1), the schemas represented by closed-class forms across languages—especially those for spatial or temporal relations—are generally topological in character, rather than Euclidean. What is intended by this characterization, in particular, is that such schemas are largely distinguished from each other by the qualitative arrangement of their components, not by any specifics of magnitude, shape, closure, discontinuity, or bulk, which they are instead neutral to.

For a new illustration, consider the spatial schema represented by the English preposition *across*. In this schema's prototype form, the Ground consists of a plane bounded on opposite sides by two parallel lines, and the Figure moves from one line to the other along a path perpendicular to both. But this schema is magnitude neutral, as shown by the fact that the preposition *across* can be used equally well in both sentences of (31a), referring to paths and planes with sizes ranging from inches to thousands of miles. And the schema is shape-neutral, given that the *across* in (31b) can equally refer to a straight path from one side to the opposite side of a square lake, and to a zigzag path from any point to any relatively distal point on the shore of an irregularly shaped lake.

(31) a. The ant crawled across my palm. / The bus drove across the country. b. I swam across the lake.

This form of topology built into the closed-class system of language—as well as its possible counterpart in visual perception (see section 3.1.3)—may have been one basis for the development of the field of topology in mathematics. Although that field has become differentiated and rigorous, its earliest insights overlap with conceptual structuring in language in such notions as that a small circle and a large square are the same topological object. This possible overlap again involves organizing factor (2a) for configurational structure.

7.1.3 The Linguistic Something/Nothing Distinction and the Early Absence of Zero

In using closed-class forms to refer to semantic domains involving quantity, languages generally mark a major distinction between zero quantity and positive quantity. They may further treat positive quantity as a scale and grammatically mark particular degrees along it.

But they generally do not treat zero quantity simply as a zero degree alongside the positive degrees on that same scale—that is, treat the full range as a single scale.

This pattern can generally be seen, for example, in the domain of "motive state". Here, one set of closed-class forms may distinguish between stationariness and motion, and another set may distinguish between certain rates of motion from very slow to very fast. But no unified set of closed-class forms simply treats stationariness as an absolute form of slowness on the same scale as other rates of speed. Thus in English, the preposition *at* indicates stationariness, as in (32a), while the preposition *into* indicates motion, as in (32b). Further, as seen in (32c), the closed-class forms *(rather) un-, somewhat, quite,* and *more* can indicate different degrees pertaining to positive speed. But there is no comparable closed-class morpheme indicating a zero degree of speed to represent stationariness.

(32) a. I stayed at / *into the library. b. I went into / *at the library.

c. I went into the library rather unquickly / somewhat quickly / quite quickly / more quickly than you.

The same linguistic pattern can hold in the semantic domain of number. For example, one set of closed-class forms might mark the distinction between zero and any positive number, while another set marks a distinction among positive numbers between one and more than one (singular vs. plural). English shows this pattern for example in responses to questions about number. Thus in (33a), speaker X asks about dog-sightings using the plural form *dogs*. Speaker Y responds with *yes* if she in fact saw a plural number of dogs. But she also responds with *yes* if she saw only a single dog, in divergence from the plurality of the question. These two values along the scale of positive numbers are thus grouped together under the closed-class form *yes*. She switches to the closed-class form *no* only if the number of dogs spotted was zero. Comparably in (33b), speaker X asks about dog-sightings using the singular form *dog*. Speaker Y again uses *yes* either if she in fact saw a single dog or if she, in divergence from the singularity of the question, saw a plural number of dogs. But she again uses *no* only if she saw zero dogs.

(33) a. X: Did you see any dogs there?

Y: Yes, several. / Yes, one. / No, none.

b. X: Did you see a dog there?

Y: Yes, I saw one. / Yes, several. / No, I didn't.

This linguistic pattern can be compared with our understanding of number and its graphic representation. In seemingly every tradition of representing numbers, the concept of a zero as just one more number among the rest—where "1" is equally a single unit away from "0" and "2" in opposite directions—is a later development. In earlier stages, the concept of zero quantity was accorded some type of special status, whereas positive numbers were treated as the same type of phenomenon, simply with incremental intervals between them. A familiar example is that of Roman numerals, with such representations of positive numbers as I, II, III, V, X. and L, but without any representation for zero. The proposal here is thus that the major distinction structurally marked in language between nothing and something—with a separate distinction marked between degrees of something—formed one basis in the human understanding system for early theories of number. This possible overlap between the linguistic and understanding systems would then involve organizing factor (2f) for quantity structure.

7.1.4 Force Dynamics and Early Theories of Motion

As structured within the linguistic representation of force interactions—the force dynamics of section 4 above and Talmy (2000a, chapter 7)—one of the basic patterns is the extended causing of motion. In this pattern, the object of interest, the Agonist, has a tendency toward rest, but an opposing object, the Antagonist, is stronger and overcomes this tendency, with the resultant that the original object moves. An example of this pattern was shown in (24a), modified here as: *The ball kept rolling because of the wind blowing on it*.

This conceptualization of the force interaction accords with early theories of motion. Thus, Aristotelian theory held that a moving object will intrinsically come to rest unless some external force keeps it in motion. And the medieval theory of impetus continued this view in holding that a separate force, the impetus imparted to an object, was needed to keep the object in motion.

The linguistic conceptualization, however, is at variance with modern physical theory, where an object has no internal impulsion toward a particular state of motion but, rather, continues at its current velocity unless externally affected. Here too, then, the conceptual structuring in language overlaps with early forms of scientific understanding. This overlap now involves organizing factor (2c) for causal structure.

7.1.5 Frame-Relative Motion and Geocentric Theories

Within the conceptual structuring that fictive motion has in language (section 7.1.1 and Talmy, 2000a, chapter 2), one property in the category of "frame-relative motion" is that stationariness is basic for an observer. Now, the case where an observer is in fact moving and the observed is stationary can be directly represented as such, as in (34a). But the fictive representation of this situation in (34b) allows a reframing in which the observer is treated as stationary and the observed as moving in relation to the observer.

(34) a. I rode along in the car and looked at the scenery we were passing through.

b. I sat in the car and watched the scenery rush past me.

But consider now the reverse case where the observer is in fact stationary and the observed is moving. This actual situation can again be represented directly, as in the two separate examples in (35a). But now, English, and perhaps other languages, do not allow the complementary fictive reframing in which the observer is treated as moving while the observed is stationary, as seen in (35b).

(35) a. The stream flows past my house. /As I sat in the stream, its water rushed past me.

b. *My house advances alongside the stream. / *As I sat in the stream, I rushed through its water.

This linguistic behavior is explained by the property initially cited for fictive frame-relative motion. The former case allowed a fictive reframing because, in it, the observer could be depicted in his basic motive state, stationariness. But in the latter case, the observer was already in his basic stationary motive state, and so could not be fictively reframed into the non-basic state of moving.

This bias in language and perhaps other cognitive systems toward treating an observer as stationary may accord with earlier geocentric theories that regarded the earth as stationary while the sun and stars moved across the sky. It is in fact noteworthy that the geocentric view persisted so long in the mainstream of scholarly theory, given our extensive capacity in language and perhaps other cognitive systems (see section 3.3) to adopt alternative perspectives. But the overlap between conceptual structuring in the language system and in the understanding system may have been strong enough to long delay the conceptualization of a rotating earth and stationary bodies in the sky. This overlap would then mainly involve organizing factor (2i) for perspectival structure.

7.1.6 Force Dynamics and Freudian Psychological Theory

The structured patterns of force dynamics in language apply not only to the physical domain (as in sections 4 and 7.1.4) but largely apply as well to the psychological domain. In particular, the opposition between an Agonist and an Antagonist can be attributed to an opposition between two components of the psyche in a so-conceived "divided self".

For one such case, an Agonist's tendency toward action can be overcome by a stronger Antagonist in the "extended causing of rest" pattern. This case is illustrated in (36). Here, the direct object reflexive pronoun *myself* represents the Agonist: a more central portion of the speaker's self that has a tendency toward an action, specifically, toward responding. In this psychological con-text, this tendency amounts to the Agonist's "wanting" to respond. The subject pronoun *I* represents the Antagonist: a more peripheral portion of the self that opposes the first portion's tendency and, because it is stronger, blocks it. The resultant of this force interaction is that no response is undertaken. The semantic roles of subject *I* as Agent and of direct-object *myself* as affected Patient accord with the force-dynamic conception of the Antagonist as affecting the Agonist.

(36) I held myself back from responding.

If Freudian psychological theory can be regarded as early science, it shows substantial overlap with the force-dynamic structures of language with such "psychodynamic" concepts as libido and drives, repression and resistance, the tension-reduction model for restoring equilibrium, and the id-superego conflict. The last of these, in fact, can be virtually mapped onto the type of linguistic example just shown. The notion of associating the pronoun *myself* with an id generating a desire and the pronoun *I* with a superego suppressing such desires can in effect be directly read off of the syntactic and semantic pattern of the sentence in (36). Thus, the Freudian psychodynamic concepts involving force opposition may in part have arisen as a theoretization of concepts already built into language in its syntactic and semantic organization of force dynamics. This overlap would then mainly involve organizing factor (2c) for causal structure.

7.2 Structural Properties Across Language and Casual Science

The term "casual science" is used here to refer to conceptualizations used by modern scientists when they are not being rigorous. Such conceptualizations often match ones in naive or early science and—of significance here—in the closed-class conceptual systems of language.

For a first illustration, some of the most basic concepts of force dynamics in language—e.g., resistance and overcoming, blocking and letting, the Agonist/Antagonist distinction—have no counterparts in rigorous modern physics, which, at a certain level of granularity, deals instead with concepts of individual particles and forces in local interaction. Nevertheless, where it does not lead to false results, scientific discourse can readily revert to the force-dynamic conceptions, seemingly as a more familiar and perhaps more basic mode of thinking about a subject. Consider the following examples involving organizing factor (2c) for causal structure. The quote in (37a) is taken from a *Scientific American* article on primitive evolutionary processes at the molecular level, and that in (37b) was noted down from a chemist speaking.

(37) a. "The variant [molecule] that is resistant to this degradation
folds in a way that protects the site at which the cleavage would take place."

b. "To get the molecule to react, you have to add energy to overcome its resistance."

The semantic and syntactic structure of (37a) promotes the idea that one can select a set of atoms for consideration together as a unitized concept, a molecule. But there is no physical property of "entityhood" inhering in this set of atoms such that—as (37a) describes it—the set marshals itself as a unit to "resist" another such unit, or such that a particular spatial configuration constitutes "protection", or such that a separation between the atoms would constitute "degradation". More rigorously, all that can actually happen is the occurrence or non-occurrence of particular shifts of linkages following on a juxtaposition of certain atoms with certain other atoms.

A second illustration involves the frame-relative type of fictive motion (section 7.1.5) involving organizing factor (2i) for perspectival structure. Even an astronomer, on viewing the sun while, say, on a walk, might casually think in terms of its current position in the sky, rather than in terms of the earth's current rotational angle relative to the sun. In doing so, she might be reverting to the basic conceptualization of the observer as stationary built into linguistic fictive motion and to its associated geocentrism.

An issue that arises here is how a person can use the conceptual models that language provides in order to think about domains that have quite different properties. One answer is that we are able to maintain more than one distinct conceptual system side by side and switch as necessary. Thus, the astronomer above may well, in an everyday context, think of the sun as moving across the sky, but can, in a professional context, switch to thinking of the earth as rotating, especially where the everyday model leads to inconsistency.

We thus see that the cognitive system of understanding joins that of visual perception and those of somatosensory perception and motor control in having an extensive structural overlap with the cognitive system of language. We also saw that the cognitive systems of affect and culture have little systematic structural overlap with language. Future research may suggest an evolutionary course that has led to this pattern of great versus scant structural overlap.

Notes

1. My thanks to Stacy Krainz for help in readying this article for publication.

2. Talmy (2000a and 2000b) presented some comparisons between language and other cognitive systems and introduced the overlapping systems model of cognitive organization. The present article largely covers those earlier comparisons but adds many more, bringing them all together for a single examination; and it greatly elaborates the overlapping systems model, advancing its degree of consolidation.

3. Talmy (2007) looks at the possibility that visual perception and motor control themselves have forms of combinatoriality, as well as examining other aspects of combinatoriality.

4. In these examples, force-dynamic concepts are expressed not only by the closed-class forms *because of* and *despite*, but also by the open-class forms *keep* and *let*. However, the latter are included in this discussion, which is based on linguistic closed-class structure, because they have closed-class counterparts. Thus, the *kept rolling* of (24a and b) can be replaced by *rolled on* or *still rolled*, in which the force-dynamic component is represented by closed-class forms. In addition, open-class verbs ex-pressing force-dynamic concepts—like English *make, let*, and the *keep* in (24c)—can correspond to certain closed-class morphological forms in other languages.

References.

All the author's publications listed here are on his website:

http://linguistics.buffalo.edu/people/faculty/talmy/talmy.html

Battaglia, Peter W., Jessica B. Hamrick, and Joshua B. Tenenbaum. 2013. Simulation as an Engine of Physical Scene Understanding. Accessed November 16, 2014. http://www.pnas.org/content/early/2013/10/17/1306572110.full.pdf.

Brown, Penelope and Stephen C. Levinson. 1987. *Politeness: Some Universals in Language Usage.* New York: Cambridge University Press.

Ekman, Paul (ed.). 2006. *Darwin and Facial Expression: A Century of Research in Review*. Los Altos, CA: Malor Books.

Ellsworth, Michael. 2015. Conceptualization Patterns of Emotions: Lexicon and Constructions. Ph.D. dissertation. University of California, Berkeley.

Engel, Stephen A. and John M. Rubin. 1986. Detecting visual motion boundaries. In *Proceedings of the IEEC Workshop on Motion: Representation and Analysis*. IEEE Comp. Society, May 7-9, Charleston, SC.

Feldman, Jacob, and Manish Singh. 2006. "Bayesian Estimation of the Shape Skeleton." *Proceedings of the National Academy of Sciences* 103 (47): 18014-18019.

Fodor, Jerry. 1983. *Modularity of Mind: An Essay on Faculty Psychology.* Cambridge, MA: MIT Press.

Heath, Jeffrey, Francesca Merlan, and Alan Rumsey (eds). 1982. *The Language of Kinship in Aboriginal Australia*. Sydney: Oceania Linguistics Monographs.

Kellogg, Rhoda. 1970. *Analyzing Children's Art.* Palo Alto, CA: Mayfield Publishing.

Marr, David. 1982**.** *Vision: a Computational Investigation into Human Representation and Processing of Visual Information*. San Francisco, CA: W H. Freeman.

Matisoff, James A. 1973. *The Grammar of Lahu*. UCPL no.75. Berkeley and Los Angeles: University of California Press.

Matisoff, James. 2015. Preface. In Alice Vittrant and Justin Watkins (eds.) *The Mainland Southeast Asia Linguistic Area*. Berlin: Mouton de Gruyter.

Michaelis, Laura. 2001. Exclamative constructions. In Bas Aarts and April MacMahon, (eds.), *The Handbook of English Linguistics*, 220-243. Oxford: Blackwell.

Murdock, George Peter. 1965. The common denominator of cultures. In George Peter Murdock (ed.), *Culture and Society: Twenty-Four Essays*. Pittsburgh: University of Pittsburgh

Press.

Seyfarth, Robert and Dorothy Cheney. 2012. Primate social cognition as a precursor to language. In Maggie M. Tallerman & Kathleen R. K. Gibson (eds), *The Oxford Handbook of Language Evolution*, 59-70. Oxford: Oxford University Press.

Smith Kevin A., Eyal Dechter, Joshua B. Tenenbaum, and Edvard Vul. 2013. Physical predictions over time. In *Proceedings of the 35th Annual Meeting of the Cognitive Science Society*, Berlin, Germany, 1342-1347. Austin, TX: Cognitive Science Society.

Talmy, Leonard. 2000a. *Toward a Cognitive Semantics*, volume I: *Concept Structuring Systems*. i-viii, 1-565. Cambridge, MA: MIT Press.

Talmy, Leonard. 2000b. *Toward a Cognitive Semantics*, volume II: *Typology and Process in Concept Structuring*. i-viii, 1-495. Cambridge, MA: MIT Press.

Talmy, Leonard. 2003. The representation of spatial structure in spoken and signed language. In Karen Emmorey (ed.), *Perspectives on Classifier Constructions in Sign Language*, 169-195. Mahwah, NJ: Lawrence Erlbaum.

Talmy, Leonard. 2005. The fundamental system of spatial schemas in language. In Beate Hampe (ed.), *From perception to meaning: Image schemas in cognitive linguistics*, 199-234. Berlin: Mouton de Gruyter.

Talmy, Leonard. 2007. Recombinance in the evolution of language. In Jonathon E. Cihlar, David Kaiser, Irene Kimbara & Amy Franklin (eds.), Proceedings of the 39th Annual Meeting of the Chicago Linguistic Society: The Panels, vol. 39-2, 26-60

Wilkins, David P. 1993. Linguistic evidence in support of a holistic approach to traditional ecological knowledge: linguistic manifestations of the bond between kinship, land, and totemism in Mparntwe Arrernte In Nancy M. Williams and Graham B. K. Baines (eds.), *Traditional Ecological Knowledge: Wisdom for Sustainable Development*, 71-93. Canberra: CRES Publications.

Winer, Gerald and Jane Cottrell. 1996. Does anything leave the eye when we see? Extramission beliefs of children and adults. *Current Directions in Psychological Science* 5(6); 137 - 142.

Wolff, Phillip and Jason Shepard. 2013. Causation, touch, and the perception of force. *Psychology of Learning and Motivation* 58: 167 - 202. (PDF)