

## The Origin of Topic/Comment Structure, of Predication, and of Foculation in Asymmetric Bimanual Coordination

Manfred Krifka  
Humboldt Universität zu Berlin  
Zentrum für Allgemeine Sprachwissenschaft (ZAS) Berlin  
krifka@rz.hu-berlin.de

### 1. Overview

#### Bimanual coordination and Topic/Comment structure:

- T/C structure is a universal and unique feature of human language, not found in animal communication.
- Manual lateralization, manifesting itself in asymmetric bimanual coordination, is a central feature of human actions, more pronounced than in other primates.
- There is a structural similarity between asymmetric bimanual coordination and T/C structure, also evident in gesture and sign languages:

“nondominant” (L <sup>1</sup> ) hand ⇔ topic (T) “dominant” (R) hand ⇔ comment (C)
---

- The similarity are striking enough to consider manual lateralization to be a preadaptation for the origin of T/C structure in the evolution of language.

Cf. Krifka, “Functional similarities between bimanual coordination and topic/comment structure”, to appear in R. Eckardt e.a. (eds.), *Language evolution: cognitive and cultural factors*, Berlin: Mouton de Gruyter.

#### Topic/Comment structure and Predication

- T/C structure establishes an asymmetry between two linguistic signs; T refers to something established already, C adds information to the denotation of T.
- Subject/Predicate structure is essentially asymmetric: The denotation of the predicate contains an argument slot that is filled by the denotation of the subject.
- T/C structure is a precursor of S/P structure; hence, manual lateralization is causally related to S/P structure.

topic (T) ⇔ subject (S) comment (C) ⇔ predicate (C)
--

- By recursivity, this extends to other function/argument structures, e.g. Verb – Object NP.

#### Bimanual Coordination and Focus/Background Structure

- F/B structure is also a universal and unique feature of human language. It consists in identifying a focus (F) within a larger expression, the background (B), where for the interpretation of the larger expression alternatives to the subexpression in F play an essential role.
- Asymmetric bimanual coordination can be characterized as the L hand creating a frame into which the R hand inserts content.
- This is structurally similar to F/B structure, which can be seen as establishing a background B into which selected content – the focus F – is inserted.

“nondominant” (L) hand ⇔ background (B) “dominant” (R) hand ⇔ focus (F)
--

<sup>1</sup> I will use L and R for “nondominant” and “dominant” hand, with an apology to all left-handers in the audience.

## 2. T/C Structure in Communication

Examples of T/C structure:

- (1) a. [<sub>Top</sub> This talk] [<sub>Com</sub> is rather speculative].  
b. [<sub>Top</sub> This talk,] [<sub>Com</sub> I don’t feel competent about.]

### 2.1 Characterizations of T/C structure

Hans Georg von der Gabelentz (1869):

- “psychological subject” ≠ “grammatical subject”
  - psychological subject precedes psychological predicate
- (2) “Evidently I first mention that which animates my thinking, that which I am thinking about, my psychological subject, and then that, what I am thinking about it, my psychological predicate.” (370f)

Hermann Paul (1880)

- Highlighting psychological predicate by accent
- Optimization of communication

Anton Marty (1884):

- Categorical (T/C) sentences vs.thetic sentences
- Thetic sentences have a psychological subject that is not expressed.

- (3) “The psychological subject is not expressed in the sentence *es brennt* ‘there’s fire’. But it would be wrong to believe that there is none. In this case we find a combination of two ideas as well. On the one hand there is the realization of a concrete phenomenon, and on the other the notion of burning and fire which already rests in the soul and under which the phenomenon can be subsumed.” (§91).

The notion of T/C was prominently introduced by Hockett (1958) into American linguistic thinking:

- (4) The most general characterization of predicative constructions is suggested by the terms “topic” and “comment” [...]: The speaker announces a topic and then says something about it. [...] In English [...] topics are usually also subjects and comments are predicates: so in *John | ran away*. But this identification fails sometimes in colloquial English, regularly in certain special situations in formal English, and more generally in some non-European languages.

It played a central role in the tradition of the Prague School (Firbas 1964, Daneš 1970, Sgall e.a. 1987), which identified the notion of topic with “old” information, and the notion of comment (or focus) with “new” information:

- (5) Taking for granted that in the act of communication an utterance appears to be, in essence, an enunciation (statement) **about something** (questions should be treated separately), we shall call the parts theme (something that one is talking about, topic), and rheme (what one says about it, comment). Following the other line, linking up utterance with the context and/or situation, we recognize that, as a rule, one part contains **old, already known or given elements**, functioning thus as a ‘starting point’ of the utterance, while the other conveys a new piece of information (being thus the ‘core’ of the utterance). But, as in most cases, the two aspects coincide, we shall, in our following discussion, disregard the said distinction. (Daneš 1970) (emphasis mine).

Another proponent of this identification of T/C with given/new is Chafe (1976). However, the identification is problematic: the topic may be “new” in case of contrastive topics, and the comment may contain “old” parts, cf. Halliday (1970).

- (6) [<sub>Top</sub> A friend of mine] [<sub>Comm</sub> bought a horse last year].
- (7) A: What do your siblings do?  
B: [<sub>Top</sub> My SISTER] [<sub>Com</sub> is working in a hospital],  
[<sub>Topic</sub> my BROTHER] [<sub>Com</sub> is studying physics]/
- (8) a. [<sub>Top</sub> Mary] [<sub>Comm</sub> always goes to TOWN on Sundays].  
b. [<sub>Top</sub> Mary] [<sub>Comm</sub> always goes to town on SUNDays].

Reinhart (1982) proposes a dynamic theory of T/C structuring: Communication consists of adding propositions to the common ground; these propositions are stored in relation to conceptual entities, like in a file-card system. The topic of a sentence identifies the conceptual entity at which the information should be stored. See Jäger (1996), Portner & Yabushita (1998) for theoretical models in Discourse Representation Theory.

- (9) The propositions admitted in a context are classified into subjects of propositions, which are stored under defining entries. (...) NP sentence topics, then, will be referential entries under which we classify propositions in the context set and the propositions under such entries in the context set represent what we know about them in this set. (Reinhart 1982).

Terminology and its application is not very clear; Jacobs (2001) shows that this is partly due to different notions of topics, among those the following:

- Addressing:  
X is an address and Y is an entry iff X marks the point where the information carried by Y has to be stored within the speaker-hearer knowledge at the moment of the utterance. (Cf. Reinhart).
- Frame setting:  
X sets the frame iff it determines the domain within which a predication holds.

- (10) Healthwise / As for his health, John is fine.

T/C structuring plays a major role in linguistic reasoning today, both in functional and formal approaches (Gundel 1988, Lambrecht 1994, Dik 1978, Sasse 1987, Erteshik-Shir 1997, Zubizarreta 1998, SFB 632 University of Postdam / Humboldt University Berlin on Information Structure).

## 2.2 Expressing and interpreting T/C

T/C structure can be expressed in a number of ways. Often, more than one marking strategy applies.

- Left dislocation, with or without resumptive pronoun:
- (11) a. This guy I have met somewhere before.  
b. This guy, I have met him somewhere before.
- Movement into a topic position, e.g. in German in front of higher-order adverbials Frey (2004).

- (12) A: Was ist denn heute in der Küche passiert?  
'What happened in the kitchen today?'  
B: Heute hat sich in der Küche **leider** jemand mit einem Messer geschnitten.  
'Today in the kitchen unfortunately someone cut himself with a knife.'  
B: #Heute hat sich **leider** in der Küche jemand mit dem Messer geschnitten.

- Special topic constructions:

- (13) As for Bill, he won't be able to make it to the reception.

- Morphological topic markers in languages like Korean, Japanese.

- (14) Kuroda (1972):  
a. Inu ga hasitte iru. 'The / a dog is running.'  
b. Inu wa hasitte iru. 'The dog (mentioned) is running.'

- Realisation as a subject, either by passives or directly (e.g., locative subjects, occurring in English but more widespread in e.g. Bantu).

- (15) a. Ellen was awarded a prize by the academy.  
b. This room sleeps ten persons.

- Deaccenting, indicating givenness, which is characteristic of topics (e.g., Halliday 1967).

- (16) a. [Sign in front of escalators.] Dogs must be CARRied.  
b. [Sign in front of restaurant.] SHOES must be worn.

- (17) Reinhart 1982:  
Kracauer's book is probably the most famous ever written on the subject of the cinema. Of course, many more people are familiar with the book's catchy title than are acquainted with its turgid text.

- Topic accent, in particular for contrastive topics.

- (18) A: How are your children doing?  
B: Fine. My ↗son is studying ↘medicine, and my ↗daughter has founded a ↘company.

- T/C structure by ordering, even in mathematical language.

- (19) a. The murderer is the gardener.  
b.  $f(x) = 2x^3 + 3x^2 - 7x + 9$

T/C structuring has distinct semantic effects:

- The existence of topics is presupposed (Strawson 1964):

- (20) a. The king of France visited the exposition.  
presupposes: there is a king of France.  
b. The exposition was visited by the king of France.  
does not presuppose: there is a king of France.

- The domain of quantifiers are topics, which entails that quantifiers are conservative (i.e., it is sufficient to consider the properties of the elements in their domain).

- (21) Most children play in the sand.  
(Truth value can be judged by looking at children only.)

## 2.3 Is T/C necessary for communication?

T/C structure is so pervasive in human communication that it may appear a virtual necessity for communication and/or for the storage of information. However, this is not so.

### The simple picture: Restriction of common ground

Simplest picture of communication (e.g., Stalnaker 1974):

- An information state is a set of situations or possible worlds (which are compatible with the description of the information state).
- Updating of information state restricts this set; no identification of topics necessary.

- (22)  $c + \text{Mary bought a new car}$   
=  $\{w \mid w \in c \wedge \text{Mary bought a new car in } w\}$

Similar with classical discourse theory, e.g. Kamp (1981), which assumes discourse referents, but without distinguishing topical from non-topical discourse referents.

Integration of T/C structures actually lead to a complication of the nature of an information state (cf. Reinhart 1982, Portner & Yabushita 1998).

### Data storage and retrieval in data bases

Example of storage of information not structured by T/Cs

- (23) Relational database (vulcanoes and their eruptions)

Vulcano	Eruption	Expl. Index
Pinatubo	7460 BC	6+
Sakura-Jima	3550 BC	4
Karymsky	2500 BC	5
Pinatubo	3550 BC	6
Sakura-Jima	2900 BC	4

There is no privileged column for topics. The database could answer questions about specific vulcanoes (e.g., *When did Pinatubo erupt?*), as well as questions about years (e.g. *Which vulcanoes erupted in 3550?*) or explosion indices, etc.

Database queries can be executed without the notion of topic by simply identifying open slots by wildcards (= "?"), resulting in a background-focus structure.

- (24) a. When did Pinatubo erupt?  
Vulcano = Pinatubo, Eruption = ?  
b. Which vulcanoes erupted in 3550 BC?  
Vulcano = ?, Eruption = 3550 BC

### Lack of T/C structure in animal communication

There is no evidence for T/C structure in communication of animals, at least those close to humans. (Bee communication may be a case in point, T. Fitch, pers. comm.: Bee presents a quantity of pollen (= topic), and indicates where to find more of it (= comment)).

Tomasello and Zuberbühler (2002) notice that ape gestures are not referential in the sense that they indicate an external entity (there is no pointing in the human fashion). Tomasello (2003) observes that chimpanzees produce attention-getting gestures but have no strategy of combining such gestures with ones that communicate more specific semantic content. They “point” to themselves, not to other things (with the possible exception of captive monkeys desiring an object).

Animal communication is rather similar to so-called thetic sentences about the situation the animal is in, e.g. “Birds of prey!”, or perhaps even: “Birds of prey over there!”, never “Over there – birds of prey!”.

## **3. Asymmetric Bimanual Coordination in Action**

### **3.1 Manual Laterality**

One of the striking features of human behavior: limb laterality, in particular with respect to forelimbs (aka *hands*).

- In all human populations, most people use their hands in different ways for a number of tasks like throwing objects, manipulating objects, writing, etc. that have led us to speak of a dominant hand a non-dominant hand.
- In all human populations, for most people the right hand is “dominant” for most activities considered. Statistics are unreliable because different tasks were considered, and vary between 5% and 20% left-handers. The genetics of this is complex: ambivalent handedness, monozygotic twins can exhibit different handedness (see Annett 2002, Corballis 2003, McManus 2003 for genetic explanations).

For non-human primates there is evidence of asymmetry in hand use, but it is considerably weaker:

- MacNeilage (1984, 1990) presents evidence for a successive development in primates of a specialization of the left hand for grasping, and of the right hand first for clinging in trees, then for manipulating objects.
- But Palmer (2002) criticizes research on handedness in apes as inconclusive.

Evidence for laterality (right-handedness) in human prehistory

- Paleolithic tool making, like handaxe flakes, cf. Faurie & Raymond (2004).
- Paleolithic hand silhouettes mainly of the left hand (cf. also Bradshaw and Nettleton 1981).
- Judges 20: 15-16 reports on Jewish army consisting of about 2,6% left-handed sling-throwers.

### **3.2 Manual Laterality and Brain Laterality**

Ancient discovery of lateral effects of brain damages, in particular left-cerebral dominance for speech (Galen; Broca 1865).

Relation of left-cerebral dominance for speech to right-handedness was already suspected by Broca (1865), and is supported by various types of evidence:

- Rasmussen and Milner (1977): left handedness positively related to right-cerebral dominance for speech, evidence from brain lesions.
- Knecht and e.a., (2000): left cerebral activation during word generation is positively related to degree of right-handedness.

Suspected role of manual lateralization in the evolutionary development of speech:

- Annett (2002), McManus (2003): The same genetic mutation is responsible both for handedness and brain lateralization,

enabling human language; this arguably was then the most important genetic event in human speciation.

- There is evidence for left-hemispheric dominance of vocalization in a wide range of animals. Corballis (2003) and others argue that human language was preceded by a gestural language; evidence includes function of homologue of Broca’s area in apes (F5, mirror neurons, use for perception and production of manual action and grasping).

## **3.3 Asymmetric Bimanual Coordination**

The traditional view of a dominant / non-dominant hand dismisses the differential function of the two hands in bimanual action. Both hands have similarly important functions in many tasks. Even for apparently monomanual tasks the L hand is important, e.g. balancing when throwing objects. E.g. Athènes 1984 showed that the speed of handwriting reduces by 20% when subjects are instructed not to use the L hand for holding the paper.

### The Frame-Content Model of MacNeilage e.a. (1984)

MacNeilage et al. (1984): L hand provides “frames” into which the R inserts “content”.

MacNeilage (1986) argues that this is a homologue to the frame/content organization of speech, in particular organization of syllables (frames) and segments (contents), syntax (frames) and words (contents). Evidence for the model comes from speech errors (spoonerisms) consisting of putting wrong contents in given frames.

- Aspects of speech control have developed from a system originally evolved for bimanual coordination (SMA – supplementary motor area).
- Freedom of environmental constraints in language and in bimanual manipulation
- Frame/content model of bimanual coordination and of hierarchical structuring of language guarantees rapid, well-controlled output.

However, MacNeilage (1998) retracts this explanation of the evolutionary history of the Frame/Content structure in favour of one rooted in cyclic mandibular movement. Reason: He was unable to conceive of a structural transfer from the manual to the vocal system. – This may well be the case for the origin of syllable structure, but T/C structure concerns processes on the conceptual level, for which it seems more plausible to assume evolutionary grounding in non-linguistic action.

### The Kinematic Chain Model of Guiard (1987)

Guiard (1987) argues for a differentiated role of hands seen as “motors” that form a “kinematic chain”, following three principles:

- Spatial reference to manual motion. Motion of the R hand typically finds its reference in the results of motion of the L hand. The L hand keeps the position of an object stationary, R hand manipulates it (e.g., threading a needle, positioning paper in writing, handling cue in billiard, use of fork and knife at table, playing violine, perhaps also arrangement of keys on keyboards).
- Spatial-temporal scale of motion. L hand produces motions on a more coarse-grained scale of time and space, motions of R hand are quicker and more precise (pointing, finger tapping, tracing of points on screen with cursor.) This corresponds to the postural role of the L hand and the manipulative role of the R hand.
- Precedence of L hand in action. The contribution of the L hand to a bimanual action starts earlier than the contribution of the R hand. Reason: The object manipulated on must first be fixed in place.

Kinematic chain model: the two hands act as motors that work in series; the output of one (L) is the input of the other (R).

Other examples that fit the kinematic chain model: the system arm + hand (coarse, initial vs. fine-grained, final movements)

## 4. Bimanual Coordination and T/C Structuring

### 4.1 Similarities between Bimanual Coordination and T/C Structuring

Asymmetric bimanual coordination, as in the Frame/Content and the Kinematic Chain Model, corresponds to T/C structuring in communication:

#### Frame setting topic and Frame/Content Model (MacNeilage)

- The frame-setting topic identifies a frame for which a statement holds, within which it is to be interpreted. This corresponds to the frame-setting role of the L hand.
- The statement is to be interpreted within the frame. This corresponds to the content-contributing role of the R hand.

#### Aboutness topic and the Kinematic Chain Model (Guiard)

- The aboutness topic “picks up” or identifies an entity, typically in the common ground of speaker and hearer, or something that is uncontroversally assumed. This corresponds to the preparatory, postural contribution of the L hand.
- The comment adds information about the topic. This corresponds to the manipulative action of the R hand.

The file-card metaphor of Reinhart (1982) corresponds to this neatly: Speaker takes out and holds the file card with L hand, writes down information on it with R hand.

Specific points of similarity:

- Spatial reference: Identifying a topic is static, it does not change the information state but prepares a change. Adding a comment is dynamic, changing the information state.
- Scale of motion: Topic is deaccented, prosodically weak; Comment is accented, prosodically strong.
- Precedence: Topic precedes comment.

### 4.2 L/R asymmetry in Sign Languages

If there is a relation between R/L dominance and T/C structure, we should expect to find evidence in sign languages, which use hands to communicate.

L hand in sign languages, Sandler (2005):

- L hand plays a minor role in lexical representation, largely redundant, restricted to a small set of handshapes.
- For bimanual signs, L hand is a “place of articulation”; R hand moves towards L hand.
- L hand may function as a classifier (e.g. HUMAN, ANIMAL, VEHICLE), e.g. APPROACH (R hand: pointed finger) + PERSON (L hand: imitation of walking): ‘A person is approaching.’
- L hand may indicate prosodic boundaries (L hand spread).
- L hand may track a topic throughout a discourse segment.

Evidence for T/C structure: Leesan & Saaed (2002) discuss examples of bimanual parallel signing of T/C structures in which the topic is identified and maintained by R hand.

(25) HOUSE      L HOUSE  
                     R TREE (be-located-behind)

“HOUSE is (...) topicalized. The informant holds the sign for house with his non-dominant hand to maintain the referential status of the topicalized constituent. HOUSE is normally articulated with two hand, as in the initial sign. A one-handed version of the normally two-handed sign TREE also occurs with this segment. The signer articulates this with his dominant hand, thus indicating that this has assumed higher informational status (i.e., this is new information) than the preceding constituent, HOUSE.”

Gee & Kegl (1983), Emmorey & Falgier (1999) describe cases in which the classifier is signed with the L hand, denoting a backgrounded discourse topic.

(26) My friend has a fancy car, a Porsche.  
 [Sign: Classifier for car, L hand, kept throughout the following.]  
 (She) drives up and parks. (She) enters a store, does errands, and when finished, she gets back to her car and zooms off. [Classifier signed with L hand moves away.]

Liddell (2003) introduces the notion of “buoys”, signs produced by the L hand that are kept constant and serve as conceptual landmarks while the R hand continues to sign. This includes signs that structure discourse, like the “list buoy” used to list a number of elements in a discourse sequence, a “theme buoy” by which the L hand identifies a topic of discourse, and a “pointer buoy” that points at objects that are of longer-lasting interest for a stretch of discourse and seem to be commented upon in the discourse.

### 4.3 L/R Asymmetry in Gesture

Gesture research identifies handedness of subjects only rarely. One exception: Enfield (2004), describing gestural sequences called “symmetry-dominance” in the gestures that accompany descriptions of fish traps by Lao fishermen. The L hand forms a continuing gesture identifying topical information, while the R hand executes new gestures that identify the comment.

(27) Gestures, description of fish trap

L	R (dominant)	Speech
same as R	Depicting trap move forward as if being placed.	‘And (they) place it in the rice fields, also.’
HOLD	fish swimming into trap	‘Now, when a fish is going to go down (into it) ... it goes in and is inserted there
HOLD	fish coming out of trap, hold outside trap	‘and it can’t get back.’
HOLD	fish going inside trap, with repeated movement of ‘jamming’, holding inside trap	‘(It) goes in and gets jammed in there.’

We need more research on differential hand use, recording of L/R differences, handedness of speakers, specially designed experiments (e.g., pointing for topics vs. comments).

### 4.4 L/R Asymmetry as a preadaptation for T/C?

Hypothesis: The cognitive, and ultimately neural, properties underlying asymmetric bimanual coordination facilitated the development of T/C structuring in language. The way how higher primates and humans manipulated objects in their environment was transferred to the way in which they dealt with information and the transfer of information. Just as *homo habilis* can selectively pick up an object, position it appropriately, and modify it in various ways, *homo loquens* can selectively pick up a topic matter and modify it by adding, or changing information about it.

This appears particularly plausible under the assumption that spoken language was preceded by gesture, but is not necessarily tied to this assumption.

As for neural structure, there is evidence (cf. Rizzolatti & Arbib 1998, McNeill 2005, Fadiga & Craighero 2006) that

- the primate predecessor of (parts of) the Broca area was specialized for coordination, especially sequencing, of manipulative actions
- it is implied in such tasks even with modern humans,
- it contains mirror neurons that fire with observed actions, which might have constituted a bridge to manipulating mental representations

## 5. T/C Structuring and Predication

### 5.1 Predication as an essential feature of language

Aristotle's conception of predication assumes a bipartition of the sentence into a subject and a predicate:

(28) [Bucephalos]<sub>Subject</sub> [is a horse]<sub>Predicate</sub>.

The predicate *is a horse* is affirmed of the subject, *Bucephalos*. Aristotle also has denials (*Bucephalos is not human*), and universal and existential predications with set terms (like *all horses are animals* and *some horses are animals*), but there is always an asymmetry between a subject and a predicate.

For Frege a predicate has an unsaturated meaning that has an open argument place, which is filled by the subject meaning, resulting in a truth value. Predicate meanings are functions that are applied to subject meanings as their arguments.

(29) BUCEPHALOS +  $\lambda x$ [HORSE(x)]  
=  $\lambda x$ [HORSE(x)](BUCEPHALOS)  
= HORSE(BUCEPHALOS)  
= Truth iff Bucephalos is a horse, = Falsity otherwise

There is nothing like that in animal communication. There is some evidence for combinations of signs (e.g. combination of warning calls for leopards and warning calls for eagles in monkeys with a meaning 'let's move!', cf. Arnold & Zuberbühler 2006), but this is not predication. There is nothing like the notion of truth and falsity either. A monkey uttering the warning call against leopards when no leopard is present is not lying in the strict sense, it rather is deceiving, similar to a person calling *Beware of dog!*, or *Run!* for no good reason.

### 5.2 T/C structure and predication

Nehaniv (2000, 2005): Predication emerges from the simple symmetric association of two ideas via a stage in which one idea has a topic role, and the other is a comment.

(30) a. Simple association between two ideas:  
*Berry – Bitter / Bitter – Berry*  
b. T/C structure: *This berry – Bitter!*  
c. Predication: *This berry is bitter.*

Current human languages differ in the extent to which T/C structure has been grammaticalized in predication (so-called topic prominent vs. subject prominent languages, cf. Li & Thompson 1976).

➤ Topic-prominent languages: Any argument, also adjuncts, can become topic of the sentence. Example: Japanese.

(31)

a. Hanako wa tosyokan de Toshio ni hon o age-ta yo  
Hanako TOP library IN Toshio DAT book ACC gave

b. Toshio wa Hanako ga tosyokan de hon o age-ta yo  
Toshio TOP Hanako NOM library IN book ACC gave

c. Hon wa Hanako ga tosyokan de Toshio ni age-ta yo  
book TOP Hanako NOM library IN Toshio DAT gave

d. Tosyokan wa Hanako ga Toshio ni hon o age-ta yo  
library TOP Hanako NOM Toshio DAT book ACC gave

➤ Subject-prominent languages: Privileged argument for topic status, identified by role (agent in English). Other choices have to be marked by special diatheses of the verb (passives).

(32) a. John gave the book to Bill. :  
b. The book was given to Bill by John.  
c. Bill was given the book by John.

Yet even topic prominent languages have predicates with slots that are filled by arguments. They only allow for greater flexibility in associating particular argument places with topics.

### 5.3 Another way to subject/predicate structure?

Hurford (2003) discusses a possible functional precursor of predication in visual processing:

- Dorsal stream: Identifies location of objects
- Ventral stream: Identifies properties of objects

Hurford suggests that this partition corresponds to predicate / argument structure: Predicates correspond to ventral stream information, arguments (= variables) correspond to dorsal stream information.

Differences to explanation sketched here:

- Visual processing is concerned with categorization, not with information and communication.
- Hurford's theory is restricted to arguments that are variables.
- The visual cortex is far removed from Broca's area, in contrast to locus of bimanual coordination.

### 5.4 Recursivity and n-ary predicates

Recursivity as a general feature of human language / thought (Hauser, Fitch, Chomsky 2002) applied to S/P structure allows for predicates of higher arity:

(33) ALEXANDER + (BUCEPHALOS +  $\lambda y$ [ $\lambda x$ [x ADMIRES y]])  
= ALEXANDER + ( $\lambda x$ [x ADMIRES BUCEPHALOS])  
= [ALEXANDER ADMIRES BUCEPHALOS]

Possible explanation for high incidence (50%) of SOV structure in human languages, in particular sign languages / recently emerged languages? This might apply only to referential arguments, but non-referential ones often are incorporated, hence do not fill a regular argument slot.

## 6. Bimanual Coordination and Focus/Background Structure

### 6.1 Focus as a pervasive feature of language

➤ Congruence of questions and answers

(34) a. A: When will Mary go to London?  
B: Mary will go to London [toMORrow]<sub>F</sub>.  
b. A: Who will go to London tomorrow?  
B: [MArY]<sub>F</sub> will go to London tomorrow.  
c. A: Where will Mary go tomorrow?  
B: Mary will go [to LONdon]<sub>F</sub> tomorrow.

➤ Expression of contrast, e.g. in denials.

(35) A: Mary will go to London tomorrow.  
a. B: No, Mary will go to London [on FRIday]<sub>F</sub>.  
b. B: No, [SUE]<sub>F</sub> will go to London tomorrow.  
c. B: No, Mary will go [to PArIs]<sub>F</sub> tomorrow.

➤ Alternative ("contrastive") topics, cf. (7) above.

➤ Focus can be relevant for constructing truth conditions:

(36) Fortunately, Bill spilled [WHITE]<sub>F</sub> wine on the carpet.  
'It was good that the wine Bill spilled on the carpet was white, not red.'

Focus/background structures (von Stechow 1990):

(37) a. Mary will go [to LONdon]<sub>F</sub> tomorrow.  
b.  $\langle \lambda x$ [TOMORROW(WILL(GO TO(x)(MARY))), LONDON]

What is focus? – Indication of the presence of alternatives for semantic and pragmatic interpretation (Rooth 1992).

(34/35)c. Mary will go to {London, Paris, Milan, ...} tomorrow.

(36) Bill spilled {white, red} wine on the carpet.

In (34) and (35), alternatives are used to establish discourse coherence with the question or a previous utterance. In (36), alternatives are essential for the proper interpretation of *luckily*, which identifies among different alternatives the most lucky ones, or the more lucky ones.

### 6.2 Focus and bimanual coordination

According to the (old) Frame/Content model of MacNeilage (1984), the L hand constitutes a frame in which the R hand

inserts content. This is structurally similar to the Background/Focus structure:

- Background: Frame that provides a slot
- Focus: Selected out of a set of alternatives to fill the slot.

The background is already established in the context, or can be accommodated – it is “given”, with respect to the choice of the focus. This corresponds to the observations concerning the L hand to grasp and hold an object.

What is new is that the object is, more specifically, one that provides a “slot” that is to be filled.

## 7. Conclusion

Humans exhibit hand laterality, a feature that can be traced back to apes and monkeys, to some degree. This means that the hands have a differential role in bimanual action: The nondominant hand serves to grasp and fixate an object, whereas the dominant hand manipulates it.

This feature of manual action can be considered a preadaptation for the manipulation of information: As the non-dominant hand can grab an object and hold it in order for the dominant hand to operate on it, so human information processors can identify an entity or class and ascribe a property to it, or change properties ascribed to it before.

In a cognitive perspective, asymmetric bimanual coordination may have led to a different representation of the environment. Many objects can be picked up and positioned properly so that they can get acted upon. In a similar way, pieces of mental representations can be picked up and acted upon.

## 8. References

- Annett, Marian. 2002. *Handedness and brain asymmetry. The Right Shift Theory*. Sussex: Psychology Press.
- Arnold, Kate & Klaus Zuberbühler (2006), “Language evolution: Semantic combinations in primate calls”, *Nature* 441, 303.
- Bradshaw, J. L. & N.C. Nettleton. 1981. “The nature of hemispheric specialization in man.” *The Behavioral and Brain Sciences* 4. 51-91.
- Chafe, William. 1976. “Givenness, contrastiveness, definiteness, subjects, topics and point of view.” *Subject and Topic*. Ed. Li, Charles N. New York: Academic Press. 27-55.
- Corballis, Michael C. 2003. “From mouth to hand: Gesture, speech, and the evolution of right-handedness.” *Beh. & Brain Sciences* 26. 199-260.
- Danes, Frantisek. 1970. “One instance of the Prague school methodology: Functional analysis of utterance and text.” *Method and theory in linguistics*. Ed. Garvin, P. Paris, The Hague.
- Dik, Simon C. 1978. *Functional grammar*. Amsterdam: North Holland.
- Emmorey, K. & B. Falgier (1999), “Talking about space with space: Describing environments in ASL.”, in E.A. Winston, *Story telling and conversations: Discourse in deaf communities*, Washington D.C, Gallaudet University Press, 3-26.
- Enfield, Nick J. (2004), “On linear segmentation and combinatorics in co-speech gesture: A symmetry-dominance construction in Lao fish trap descriptions”, *Semiotica* 149, 57-123.
- Erteschik-Shir, Naomi. 1997. *The dynamics of focus structure*. Oxford U P.
- Fadiga, Luciano & Laila Craighero (2006), “Hand actions and speech representation in Broca's area”, *Cortex* 42, 486-490.
- Faurie, Charlotte & Michel Raymond (2004), “Handedness frequency over more than ten thousand years”, *Proc. R. Soc.Lond. B (Suppl)* 271. 43-45.
- Firbas, Jan. 1964. “On defining the theme in functional sentence analysis.” *Travaux Linguistique de Prague* 1. 267-280.
- Frey, Werner. “A medial topic position for German.” *Linguistische Berichte* 198. 153-190.
- Gee, James Paul & Judy Kegl (1983), “Narrative/story structure, pausing, and American Sign Language”, *Discourse Processes* 6, 243-258
- Guiard, Yves. 1987. “Asymmetric division of labor in human skilled bimanual action: The kinematic chain as a model.” *Journal of Motor Behavior* 19. 486-517.
- Gundel, Jeanette K. 1988. “Universals of topic-comment structure.” *Studies in Syntactic Typology*. Eds. Hammond, Michael Edith Moravcsik, Jessica Wirth. Amsterdam: Benjamins. 209-239.
- Halliday, M. A. K. 1967. *Intonation and Grammar in British English*. The Hague: Mouton.
- Halliday, M. A. K. 1970. *A course in spoken English: Intonation*. Oxf.: OUP.
- Hauser, M. D., N. Chomsky & W. T. Fitch (2002), “The faculty of language: What is it, who has it, and how did it evolve?”, *Science* 298, 1569-1579.
- Hockett, Charles. 1958. *Two models of grammatical description*. Readings in Linguistics. Chicago: University of Chicago Press.
- Hockett, Charles. 1960. “The origin of speech.” *Scientific Am.* 203. 88-106.
- Hopkins, William D. et al. 2005. “The distribution and development of handedness for manual gestures in captive chimpanzees (*Pan troglodytes*).” *Psychological Science* 16. 487-493.
- Jacobs, Joachim. 2001. “The dimensions of topic-comment.” *Linguistics* 39. 641-681.
- Jäger, Gerhard. 1996. *Topics in Dynamic Semantics*. Ph.D. thesis, Humboldt University Berlin. CIS-Bericht 96-92, Centrum für Informations- und Sprachverarbeitung, Universität München.
- Kamp, Hans. 1981. “A theory of truth and semantic representation.” *Formal Methods in the Study of Language*. Eds. Groenendijk e.a., Amsterdam: Mathematical Centre Tracts 135. 277-322.
- Knecht, S. & e.a. 2000. “Handedness and hemispheric language dominance in healthy humans.” *Brain* 123. 2512-2518.
- Kuroda, S.-Y. 1972. “The categorical and thethetic judgment, Evidence from Japanese syntax” Ed. 153-185.
- Lambrecht, Knud. 1994. *Information structure and sentence form. Topic, focus, and the mental representation of discourse referents*. Cambridge: Cambridge University Press.
- Leesan, Lorraine, and John I. Saeed. 2002. “Windowing of attention in simultaneous constructions in Irish Sign Language (ISL)” Ed. Cameron, Terry. Albuquerque: University of New Mexico.
- Li, Charles N. & Sandra A. Thompson. “Subject and Topic: A new typology of language”, in Ch. Li (ed.), *Subject and Topic*. New York: Acad. Press.
- Lidell, Scott K. (2003), *Grammar, Gesture, and Meaning in American Sign Language*, Cambridge University Press, Cambridge.
- Marty, Anton. 1884. “Über subjektlose Sätze und das Verhältnis der Grammatik zu Logik und Psychologie.” *Vierteljahresschrift für wissenschaftliche Philosophie*
- MacNeilage, Peter F. 1984 “Implications of primate functional asymmetries for the evolution of cerebral hemispheric specialization.” Eds. Ward, J.P & W.D. Hopkins. Heidelberg, New York: Springer.
- MacNeilage, Peter F. 1986. “Bimanual coordination and the beginnings of speech.” Eds. Lindblom, Björn & Rolf Zetterstrom, *Precursors of Early Speech*, New York: Stockton Press.
- MacNeilage, Peter F. 1990. *Grasping in modern primates: The evolutionary context*. Norwood: Ablex.
- Macneilage, Peter F. (1998), “The frame/content theory of evolution of speech production”, *Behavioral and Brain Sciences* 21, 499-546.
- MacNeilage, Peter F. et al. 1984. “Functional precursors to language and its lateralization.” *American Journal of Physiology (Regulatory, Integrative and Comparative Physiology)* 15. R912-R914.
- McManus, Chris (2003), *Right hand, left hand. The origins of asymmetry in brains, bodies, atoms and cultures*, Phoenix House.
- McNeill, David (2005), *Gesture and thought*, University of Chicago Press.
- Nehaniv, Christopher L. 2000. “The making of meaning in societies: Semiotic & information-theoretic background to the evolution of communication.” *Society for the Study of Artificial Intelligence and Adaptive Behavior*. 73-84.
- Palmer, A. Richard. 2002. “Chimpanzee Right-Handedness reconsidered: Evaluating the evidence with funnel plots.” *American Journal of Physical Anthropology* 118. 191-199.
- Paul, Hermann. 1880. *Prinzipien der Sprachgeschichte*. Leipzig.
- Portner, Paul & Katsuhiko Yabushita. 1998. “The semantics and pragmatics of topic phrases.” *Linguistics and Philosophy* 21. 117-157.
- Rasmussen, t. & B. Milner. 1977. “The role of early left-brain injury in determining lateralization of speech functions.” *Annals of the New York Academy of Sciences* 299. 355-369.
- Reinhart, Tanja. 1982. “Pragmatics and linguistics: An analysis of sentence topics.” Bloomington, Indiana University Linguistics Club.
- Rizzolatti, Giacomo & Michael Arbib (1998), “Language within our grasp”, *Trends in Neurosciences* 21, 188-194.
- Rooth, Mats (1992), “A theory of focus interpretation”, *Natural Language Semantics* 1, 75-116.
- Sandler, Wendy. 2005. “Phonology, phonetics and the nondominant hand.” *LabPhon* 8. See also [http://www.ling.yale.edu:16080/labphon8/Talk\\_Abstracts/Sandler.html](http://www.ling.yale.edu:16080/labphon8/Talk_Abstracts/Sandler.html)
- Sasse, H.-J. 1987. “Thethetic/categorical distinction revisited” *Linguistics* 511-580.
- Sgall, Petr et al. 1987. *The meaning of the sentence and its semantic and pragmatic aspects*. Dordrecht: Reidel.
- Stalnaker, Robert. 1974. “Pragmatic presuppositions.” *Semantics and Philosophy*. Eds. Munitz, Milton K. & Peter K. Unger. New York: New York University Press. 197-214.
- Strawson, P. 1964. *Identifying reference and truth value*. In D. Steinberg & A. Jakobovitz (eds.), *Semantics. An interdisciplinary reader*. Cambridge University Press.
- Tomasello, Michael & Zuberbühler. 2002. “Primate Vocal and Gestural Communication.” Eds. Bekoff, Marc Colin Allen, Gordon M. Burghardt, *The Cognitive Animal*, MIT Press.
- Wilson, Frank R. (1998), *The hand. How its use shapes the brain, language, and human culture*, Pantheon Books,
- von der Gabelentz, H. Georg. 1869. “Ideen zu einer vergleichenden Syntax.” *Zeitschrift für Völkerpsychologie und Sprachwissenschaft* 6. 376-384.
- von Stechow, Arnim (1990), “Focusing and backgrounding operators”, in Werner Abraham, *Discourse particles*, Amsterdam, J Benjamins, 37-84.
- Zubizarreta, Maria Luisa. 1998. *Prosody, focus and word order*. Cambridge, Mass.: MIT Press.