

Formal Approaches to The Interface of Syntax and Information Structure

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Outline

- Day 1: Background on Information Structure
- Day 2: Lexical-Functional Grammar (LFG) approaches
- Day 3: Combinatory Categorical Grammar (CCG) approaches
- Day 4: Head-Driven Phrase Structure Grammar (HPSG) approaches
- Day 5: Comparison, Open Issues, Outlook

General Remarks

- We'd like to get to know who you are! Please write down:
 - Name
 - Affiliation, Country
 - Research area/interests
- The **reader** is a collection of representative articles. For copyright reasons, the reader is not on the ESLLI CD and will not be available in the net.
- We'll distribute **handouts** with 4up-copies of the slides.
- Don't hesitate to ask **questions**:
 - At ESLLI, during the lectures, during the breaks, . . . anytime!
 - After ESLLI, send emails to continue the discussion.

Background on Information Structure

- Introduction: What is information structure and basic notions
- Historical development of information structure approaches (largely based on von Stechow 1999, ch. 3)
 - The Beginnings of Information Structure
 - The Prague School
 - Halliday and the American structuralism
 - Information Packaging
 - Information Structure in Generative Grammar
- The Semantics of Information Structure
 - Structured Meaning
 - Alternative Semantics
- Intonation and Information Structure
- Word order and Information Structure

There is more than just syntax and semantics

A simple sentence can be used in many different context, conveying different kinds of information.

- (1) Tim bought a new car.
- (2) a. There is a brand-new Mercedes outside. Did anybody buy a new car?
b. TIM bought a new car.
- (3) a. Tim looks so happy these days. What did he do?
b. Tim bought a new CAR.
- (4) a. What did Tim do after his old car broke down? Did he lease a new car?
b. No, Tim BOUGHT a new car.

The primitives of information structure

The terminology describing information structure is diverse and sometimes confusing, but most theories make one of the following distinctions:

- A **focus/background** distinction between what is new, i.e., that advances the discourse, and what is already known, i.e., that part of the utterance that relates it to the discourse.
- A **topic/comment** (theme/rheme) distinction between what the utterance is about and what the speaker has to say about it.

Sometimes a further distinction is made:

- A **background/contrast** distinction, between parts of the utterance which contribute to distinguishing its actual content from alternatives the context makes available.

What is information structure?

- The non-truth-conditional meaning of a sentence which depends on the context in which the sentence is uttered has been studied in pragmatics under the name information structuring.
- The **information structure** encodes which part of an utterance is informative in which way, given a particular context.
- Different approaches exist with respect to the question what should be regarded as the primitives of the information structure.
- There are two main views about what should be the central aspect:
 - i) the new, information-bearing part of the sentence, or
 - ii) the theme of a sentence

The Focus/Background distinction

- A sentence can be structured into two units according to their informativeness, i.e., which part is informative/new with respect to the discourse (the focus) and which part is uninformative/known (the background).
- The typical test for the focus unit of a sentence is the constituent question:
 - (5) a. Q: Who did Sue introduce to Bill?
A: Sue introduced [John]_F to Bill.
 - b. Q: Who did Sue introduce to Bill?
A: Sue introduced [the woman with the red SCARF]_F to Bill.
 - c. Q: What happened?
A: [Sue introduced John to Bill]_F
- The focus part of a sentence can be one word, a phrase, or the whole sentence.
- The background part of the sentence is usually derived from the focus part, i.e., it is that part of the utterance that is not the focus.

The Focus/Background distinction (cont.)

- Linguistic means of marking such an information structuring are, for example, word order, morphology and prosody.
- English and German are so called intonation languages, i.e., they use pitch accents to highlight informational units of the utterance in a particular way.
- The intonationally highlighted part is associated with the most informative part, i.e., the focus, while the remainder of the sentence contains mainly background knowledge, i.e., information that is already available in the discourse.
- A focused unit in English must contain a pitch accent.

Semantic effects

A sign in the London underground reads (Halliday 1967):

(8) Dogs must be carried.

This sentence can be read in two different ways:

- (9) a. Dogs must be **CARRIED**.
b. **DOGS** must be carried.

There is a difference in meaning:

- (10) a. If you have a dog, you must carry it.
b. What you must do is carry a dog.

(11) Shoes must be worn.

The Topic/Comment distinction

- In the topic-comment structure, topic refers to what the utterance is about and comment what the speaker says about it. Thus, the topic is discourse established; the comment gives new information with respect to the topic.
- The topical element can be associated with the question: *What about X?*
- In English, topic, as well as focus, is marked by a pitch accent, but of a different movement: The focus accent is a typical falling movement while the topic accent is realized as a fall-rise.

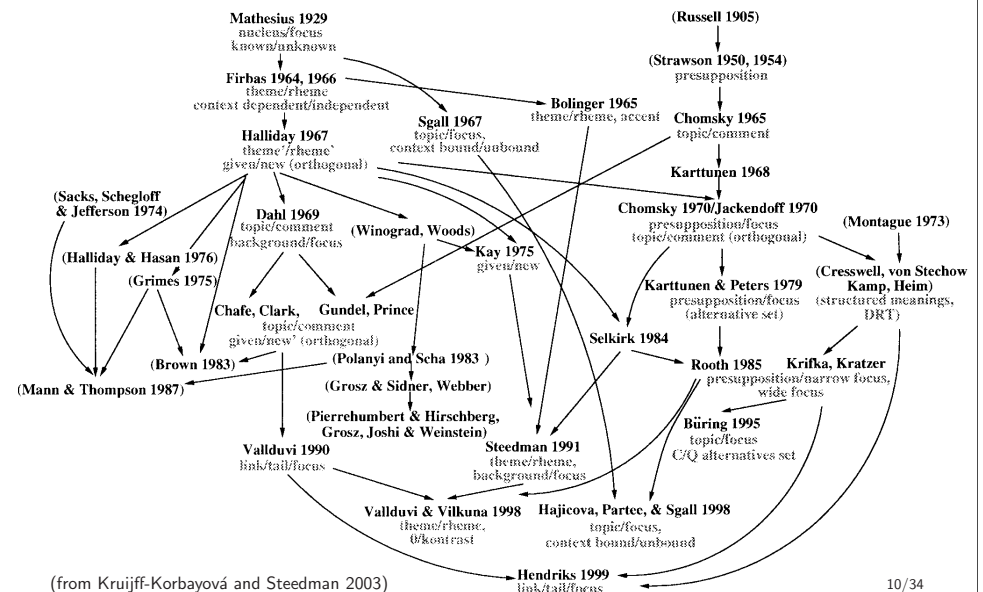
(6) Q: Well, what about **FRED**? What did **HE** eat?

A: **FRED** ate the **BEANS**.
topic focus

(7) Q: Well, what about the **BEANS**? Who ate **THEM**?

A: **FRED** ate the **BEANS**.
focus topic

Historical development of information structure approaches



The beginnings of information structure

- In the course of the 19th century it became obvious that the syntactic description of the sentence does not cover all aspects of sentence meaning. Differences in the presentation of the sentence content were attributed to an underlying psychological structure.
- One important movement in psychology, the so-called **Gestalt theory**, assumed that perception functions as a whole gestalt and not by constructing something out of small units. The gestalt perception includes two different parts: **figure** and **ground**.
- The figure is recognized only against the ground. This is the principle behind many optical illusions, as illustrated below, where one and the same stimulus (the line) is perceived differently depending on the ground.



The communicative function of language

- At the beginning of the 20th century, the interest in the communicative function of language increased.
- In order to distinguish between the grammatical structure of the sentence, the psychological structure of concepts or ideas, and the informational structure, Ammann (1928) introduces a new pair of terms: **theme** and **rheme**.
- Mathesius (1929) used these terms for describing word order phenomena in Czech and other Slavic languages.
- The Prague School integrated the distinction between theme and rheme into the grammatical system.

Gestalt and language

- Related to the Gestalt theory in psychology, the idea of a dichotomy of the sentence organization was developed, which inherited the terms figure and ground.
- The figure represents the prominent or highlighted part, while the ground represents the given or less informative material of the sentence.

The Prague School

- The most characteristic feature of the Prague structuralists, in contrast to other structuralists, is the functional perspective:
 - Language is understood as a tool for communication and the information structure is important for both the system of language and the process of communication.
 - Firbas (1964) argues that information structure is not a dichotomy but rather a whole scale, or hierarchy, or what he calls communicative dynamism.
 - Daneš (1970) extends the thematic relation of the sentence to one of a text.
 - The newer Prague School (cf., e.g., Sgall et al. 1973, 1986) uses the contrast of **topic** and **focus** and give an account of how to integrate this structure into a grammatical model.

Halliday and the American structuralists

- Halliday (1967) introduced the Praguean distinction of theme and rheme into American structuralist linguistics.
- He is the first who uses the term **information structure** and establishes an independent concept of it. He assumes that an utterance is organized into "information units", which do not correspond to constituent structure.
- Information structure is realized phonologically, i.e., the utterance is divided into different tone groups (intermediate phrases). These phrases exhibit an internal structure.
- Analogously, Halliday assumes two structural aspects of information structure:
 - the informational partition of the utterance, the **thematic structure** (theme-rheme), organizes the linear ordering of the informational units.
 - the internal organization of each informational unit, the **givenness**, elements are marked with respect to their discourse anchoring.

Historical development of information structure approaches

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Information Packaging

- Chafe (1976) is interested in the way discourse is structure, and he introduces the term **information packaging**.
- The idea of information packaging was further developed by Vallduví (1990).
- He assumes an information structure that consists of three parts merging the most prominent aspects of information structure into one: focus/background and topic/comment.

(12) What about John? What does he drink?

(13) John drinks BEER.

- (14) a. [John]_{Topic} [drinks BEER]_{Comment}.
 b. [John drinks]_{Ground} [BEER]_{Focus}.

Historical development of information structure approaches

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Halliday's system of intonation and information structure

*	*	
// Mary //	always goes to town on Sundays //	pitch accent
[Mary]	[always goes to town on Sundays]	phrasing
Mary	town	theme-rheme ("aboutness")
Mary	town	information focus
	always goes to on Sundays	new ("discourse anchoring")
		given

Historical development of information structure approaches

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Information Structure in Generative Grammar

- Chomsky (1971) assumes a **focus/presupposition** distinction. The function of focus is to determine the relation of the utterance to responses, to utterances to which it is a possible response, and to other sentences in the discourse.
 - Focus is defined as the phrase containing the intonation center.
 - Presupposition is described as that part of the sentence that is conveyed independently of the speech act or the negation made in the sentence.
- For example, (16) is a proper answer to (15a) since they share the same presupposition that John writes poetry at some place.
 - (15) a. Does John write poetry in his STUDY?
 b. John doesn't write poetry in his STUDY.
 - (16) No, John writes poetry in the GARDEN.
 - (17) [the place where John writes poetry]_{Presupposition} [is in the garden]_{Focus}
- On this basis, Jackendoff (1972) developed an approach which is the basis for a number of semantic theories of focus.

Historical development of information structure approaches

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The semantics of information structure

- Information structure plays an essential role in several aspects of meaning:
 - Information structure is essential for
 - * the construction and the coherence of a discourse,
 - * the choice of anaphoric elements, and
 - * the interpretation of the adequate speech act.
 - Information structure is necessary for the interpretation of sentences with focus-sensitive particles (e.g., *only, also, too*), or adverbs of quantification (e.g., *always, sometimes*).
- (18) a. John only introduced [Bill]_F to Sue.
b. John only introduced Bill to [Sue]_F .
c. John only introduced [Bill]_F to [Sue]_F .

Focus induced interpretations (cont.)

- The focus induces the presupposition that the set of values which verify the p-skeleton is under discussion. E.g., (20) is the focal presupposition of (19a):
(20) $\{d \in D : \text{John introduced } d \text{ to Sue}\}$ is under discussion.
- The sentence is taken to assert that the denotation of the focus is a member of this set. For example, (21) is the assertion of (19a):
(21) $\text{Bill} \in \{d \in D : \text{John introduced } d \text{ to Sue}\}$
- Based on the insights of Jackendoff (1972), in the 1980's two strands of semantic theories of focus were developed:
 - Structured meaning approach
 - Alternative semantics

Focus induced interpretations

- Current formal theories of the semantics of focus associate with each sentence a model-theoretic entity which directly reflects its focal structure. This entity is often called the **focus-induced interpretation**.
 - The value of the focus, i.e., the ordinary denotation of the focused expression, is part of the **set of alternatives**, the **p(resuppositional)-set**.
 - The rest of the sentence corresponds to a semantic structure that is called **p-skeleton**. It is formed by substituting the focused expressions with appropriate variables, for example:
- (19) a. John introduced [Bill]_F to Sue.
p-skeleton: John introduced x to Sue.
b. John introduced Bill to [Sue]_F .
p-skeleton: John introduced Bill to y.

Structured meaning

- The structured meaning theory of focus was developed by Stechow (1981), Stechow and Cresswell (1983), Jacobs (1983), and Krifka (1992).
 - The focus-induced interpretation of a sentence is an ordered sequence, the **structured meaning**, whose members are
 - the property obtained by λ -abstracting on the focus/foci, and
 - the ordinary semantic interpretation(s) of the focus/foci.
- As an example, consider the structured meaning representation of the repeated examples in (19):
- (19) a. John introduced [Bill]_F to Sue.
 $\langle \llbracket \lambda x [\text{introduce}(\text{john}', x, \text{sue}')] \rrbracket, \text{bill}' \rangle$
b. John introduced Bill to [Sue]_F .
 $\langle \llbracket \lambda x [\text{introduce}(\text{john}', \text{bill}', y)] \rrbracket, \text{sue}' \rangle$

Alternative semantics

- The alternative semantics theory of focus was proposed in Rooth (1985).
- Each sentence receives two distinct model-theoretic interpretations:
 - an ordinary semantic value (written as $\llbracket \cdot \rrbracket^o$), and
 - a separate focus-induced interpretation called the p-set or the **focus-semantic value** (written as $\llbracket \cdot \rrbracket^f$), which is the set of all propositions obtainable by replacing each focus with an alternative of the same type.

The focus semantic value of (19a), i.e., $\llbracket \text{John introduced [Bill]}_F \text{ to Sue.} \rrbracket^f$ is shown in (22a). In (22b), it is spelled out assuming that the only individuals in D are John, Bill, Sue, and Mary.

- (22) a. {the proposition that John introduced d to Sue : $d \in D$ }
- b. $\left\{ \begin{array}{l} \llbracket \text{John introduced John to Sue} \rrbracket^o, \llbracket \text{John introduced Bill to Sue} \rrbracket^o, \\ \llbracket \text{John introduced Sue to Sue} \rrbracket^o, \llbracket \text{John introduced Mary to Sue} \rrbracket^o \end{array} \right\}$

Characterizing intonation

- Intonation patterns consist of intonation features or subsystems of various kinds and names.
- The terms **intonational contour (tune)**, **prominence (stress)**, **intonational phrasing**, and **pitch range** are used to refer to these features.
 - The **contour** indicates the movement of pitch. For example, the intonation pattern of an assertion has a distinct contour from that of a question.
 - **Intonational phrasing** divides the sequence of words into intonational units, the intonational (or prosodic) phrases. Phrase boundaries are marked by pauses, boundary tones and duration patterns.
 - **Pitch range** controls the limits in which the contours are realized.

How information structure is represented in a language

- Languages differ with respect to how the information structure of an utterance is represented.
- Linguistic means of marking information structure are, for example: word order, morphology and prosody.
- English and German are a so-called **intonation languages**:
 - Information structuring is signaled by the intonation (contour) of an utterance, including pitch accents.
 - The absence or presence of an accent thus is an indicator of the discourse function of a particular constituent in a sentence.

Autosegmental-metrical approaches to intonation

- Pierrehumbert (1980) proposes a description of intonation that consists of three parts:
 - the grammar of phrasal tunes, consisting of L and H tones, which are instantiated as pitch accents, phrase accents and boundary tones.
 - the metrical representation of the text
 - rules for lining up the tune with the text
- Phonological tones
 - Each phrase requires at least one pitch accent (for English: H^*, L^* , or bitonal as H^*+L , $H+L^*$, L^*+H , $L+H^*$ and H^*+H)
 - Each phrase receives a phrase accent (H^- , L^-) at the end of the word that is associated with the last pitch accent
 - Each phrase ends with a boundary tone ($H\%$, $L\%$).

Intonational phrases and intermediate phrases

- The original partition into pitch accents, phrase accents and boundary tones was modified by Beckman and Pierrehumbert (1986), who assume two kinds of boundary tones:
 - one marking the end of the **intonational phrase (IP)**, and
 - another kind signaling the end of the smaller **intermediate phrase (ip)**
- Besides the boundary tone (the old phrase accent), the intermediate phrase contains at least one pitch accent.
- Phonological tones for English (Beckman and Pierrehumbert (1986))
 - H^* , L^* (or bitonals as H^*+L , $H+L^*$, L^*+H , $L+H^*$ and H^*+H)
 - $H\%$, $L\%$ boundary (or edge) tones, namely H_{IP} , L_{IP} for intonational phrases or H_{ip} , L_{ip} for intermediate phrases

Discourse function of pitch accents

- In languages like English and German, pitch accents can have different shapes allowing them to signal different functions in the discourse.
- For example, Beckman and Pierrehumbert (1986) assume seven different pitch accents for English: H^* , L^* and bitonals H^*+L , $H+L^*$, L^*+H , $L+H^*$, H^*+H .
- The H^* pitch accents are often assumed to signal focus, i.e., new material.
- A more precise mapping of each possible pitch accent to its discourse function (i.e., information structure role) is needed.

Intonational meaning

- There are two main questions with respect to intonational meaning:
 - What are the meaningful units of intonation?
 - What kind of meanings are associated with these units?
- Domains of intonational patterns: tune, phrasing, and pitch accent
- Meaning types that are associated with each of the domains:
 - Tune is often correlated with speech acts
 - phrasing is mostly associated with information structure.
 - The pitch accent is linked with the notion of focus.

Discourse function of pitch accents (cont.)

- For example for German, Féry (1993) describes the so called hat pattern, consisting of a L^*+H accent and a H^*+L accent, which signals a topic-comment structure.

(23) Q: Habt ihr gut geschlafen? / Did you sleep well?

L^*+H H^*+L

A: GESCHLAFEN hat KEINER von uns (aber unterhalten haben wir uns).

slept has no-one of us but talked have we ourselves

'None of us slept, but we talked.'

Focus projection

- The description of accent patterns involves two complementary aspects:
 - which part of the utterance is the focus/topic, and
 - how this focus/topic is conveyed by a pitch accent.
- The phonologically marked word and the extension of the focus are related to each other by rules of **focus projection**.

(24) Mary bought a book about BATS.

- (25) a. Q: What did Mary buy a book about?
A: Mary bought a book about [BATS.]_F
- b. Q: What did Mary buy?
A: Mary bought [a book about BATS.]_F
- c. Q: What did Mary do?
A: Mary [bought a book about BATS.]_F
- d. Q: What happened?
A: [Mary bought a book about BATS.]_F

Word order and information structure

- So-called configurational languages mark information structure through word order. Among such languages are Russian, Hungarian, Czech, Catalan, Turkish.
- But even intonational languages like English and German combine intonation and word order in order to mark certain information structurings.

– Topicalization in English

- (29) Q: Who did you meet in Germany?
A: In Germany, I met a lot of old friends.
- (30) Q: You look so happy, what happened?
A: # In Germany, I met a lot of old friends.

Focus projection (cont.)

- The focus projection rules determine the focus projection potential of accent placement dependent on the syntactic surface structure.

For example, no focus projection is available for the examples (26) and (27).

(26) Q: Who bought a book about bats?

A: [MARY]_F bought a book about bats.

(27) Q: What related to bats did Mary buy?

A: Mary bought a BOOK_F about bats.

- A rarely noted fact is that the focus resulting from one pitch accent does not always correspond to a constituent, as shown by the German (28) (Höhle 1982).

(28) Q: Was hat das Kind erlebt? / What did the child experience?

A: [Karl]_F hat dem Kind [das BUCH geschenkt]_F .
Karl has the child the book given
'Karl gave the child the book as a present.'

Word order and information structure (cont.)

- Scrambling in German

(31) Wo sollte gestern der Spion den Kurier treffen? / Where was the spy supposed to meet the courier yesterday?

- a. Gestern sollte der Spion den Kurier in Frankfurt treffen.
yesterday should the spy the courier in Frankfurt meet
- b. # Gestern sollte in Frankfurt der Spion den Kurier treffen.
yesterday should in Frankfurt the spy the courier meet
'Yesterday, the spy was supposed to meet the courier in Frankfurt.'

(32) Wen sollte der Spion gestern in Frankfurt treffen? / Who was the spy supposed to meet in Frankfurt?

- a. Gestern sollte in Frankfurt der Spion den Kurier treffen.
yesterday should in Frankfurt the spy the courier meet
'Yesterday, the spy was supposed to meet the courier in Frankfurt.'

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