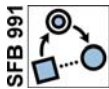


Frames as Informational Holograms

Towards an Integrating Theoretical Model of Syntax, Semantics, Utterance Meaning, and Context in Frame Theory

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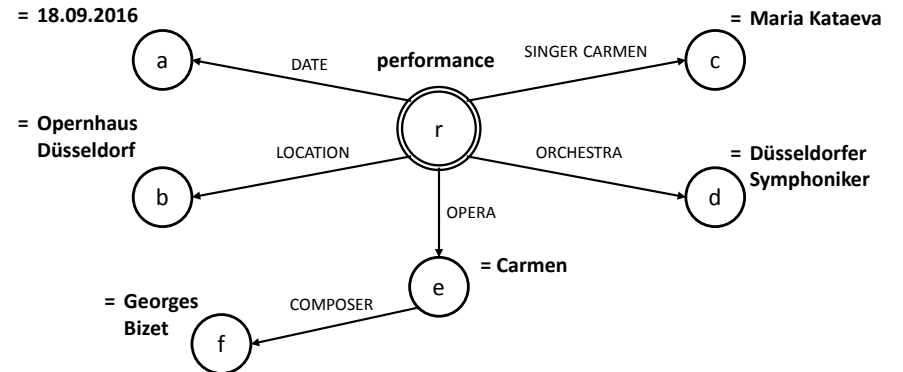
Workshop "Situations, Information, and Semantic Content"
LMU München, 16 – 18 December 2016



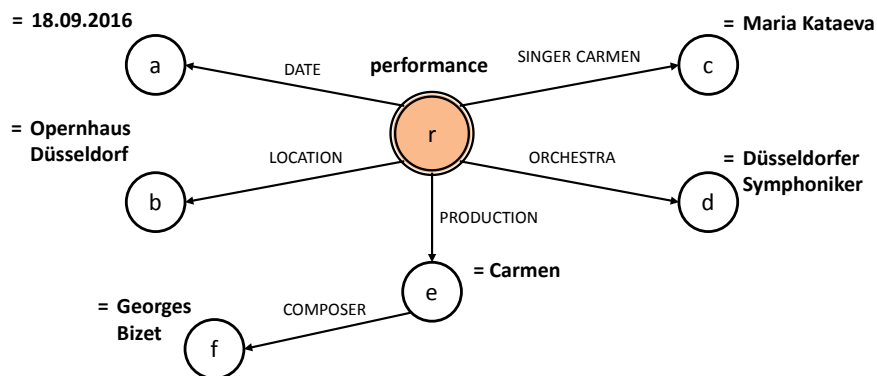
1. Frame content

Barsalou frames (in Düsseldorf guise):

= A network of nodes and attribute arcs with a distinguished node that represents the object of representation.



“(there is a) **performance** on 18.09.2016 [DATE], at the Opernhaus Düsseldorf [LOCATION] of “Carmen” [PRODUCTION], by Georges Bizet [COMPOSER], with Maria Kataeva singing Carmen [SINGER CARMEN], and the music being played by the Düsseldorfer Symphoniker [ORCHESTRA].



Translation into first order predicate logic

Canonical satisfaction¹ formula for the “Carmen” frame

FUNCTION CONSTANTS, **set/type terms**, individual variables, individual constants

$r \in \text{performance}$	
& DATE(r) = a	& $a = 18.09.2016$
& LOCATION(r) = b	& $b = \text{Opernhaus Düsseldorf}$
& SINGER_CARMEN(r) = c	& $c = \text{Maria Kataeva}$
& ORCHESTRA(r) = d	& $d = \text{Düsseldorfer Symphoniker}$
& PRODUCTION(r) = e	& $e = \text{opera "Carmen"}$
& COMPOSER(e) = f	& $f = \text{Georges Bizet}$

¹ See Löhnner, to appear, for a formal definition

Satisfaction type for a node in a given frame

A frame provides type information about what it represents.
The type information is expressed in the satisfaction formula.

Satisfaction type² for the node r in the “Carmen” frame

$$\text{SatTyp}(r, f_{\text{Carmen}}) = \{ r : \exists a \exists b \exists c \exists d \exists e \exists f$$

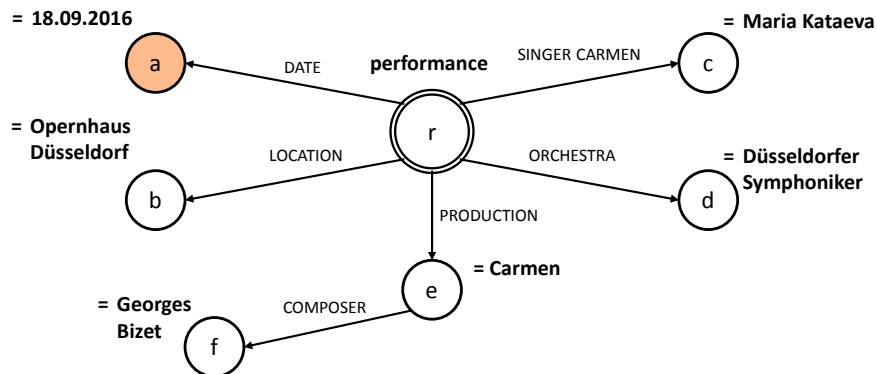
DATE(r) = a	& a = 18.09.2016
& LOCATION(r) = b	& b = Opernhaus Düsseldorf
& SINGER_CARMEN(r) = c	& c = Maria Kataeva
& ORCHESTRA(r) = d	& d = Düsseldorfer Symph.
& PRODUCTION(r) = e	& e = opera "Carmen"
& COMPOSER(e) = f	& f = Georges Bizet }

² See Löbner, to appear, for a formal definition

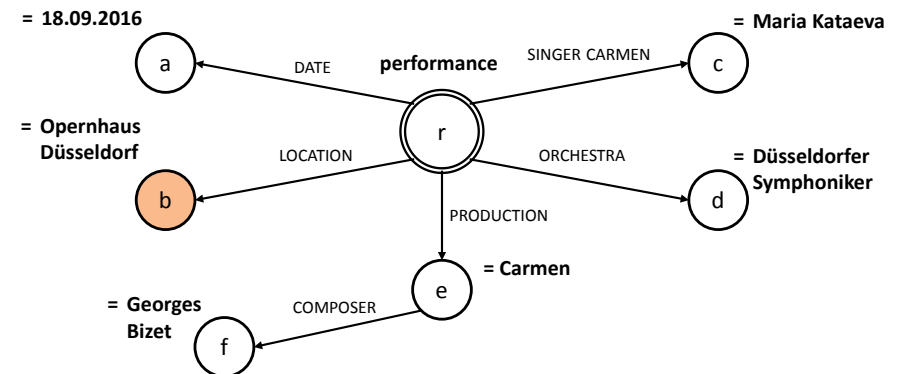
2. Frames are holograms

- ➔ They represent information not only about the distinguished node.
- ➔ They invest every node with the same information, although from its respective perspective.
- ➔ **The total information bears on every node.**

“on 18.09.2016,
there is a performance at the Opernhaus Düsseldorf of “Carmen”, by
Georges Bizet, with Maria Kataeva singing Carmen, and the music played
by the Düsseldorfer Symphoniker.”

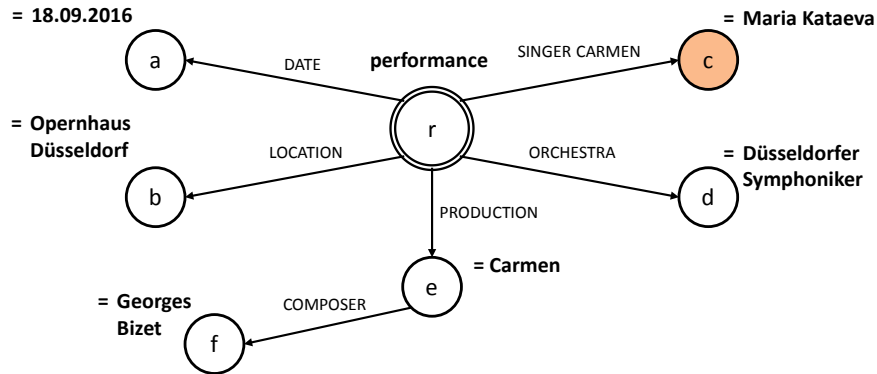


“at the Opernhaus Düsseldorf,
there is a performance on 18.09.2016 of “Carmen”, by Georges Bizet, with
Maria Kataeva singing Carmen, and the music played by the Düsseldorfer
Symphoniker.”



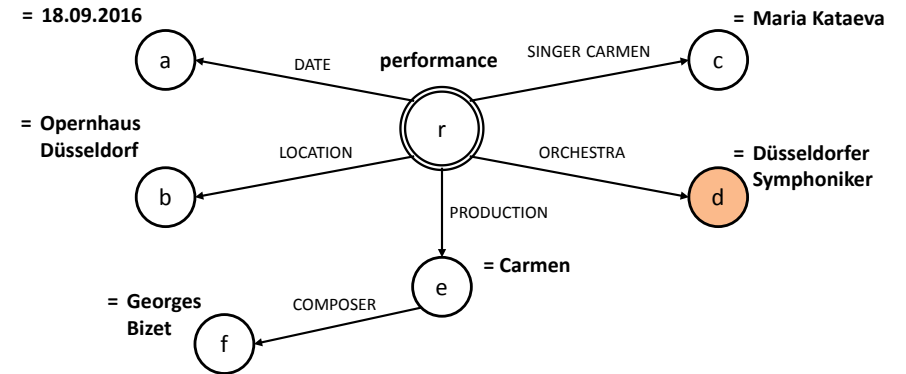
“Maria Kataeva

is singing Carmen in a performance on 18.09.2016 at the Opernhaus Düsseldorf of “Carmen”, by Georges Bizet; the music is played by the Düsseldorfer Symphoniker.”



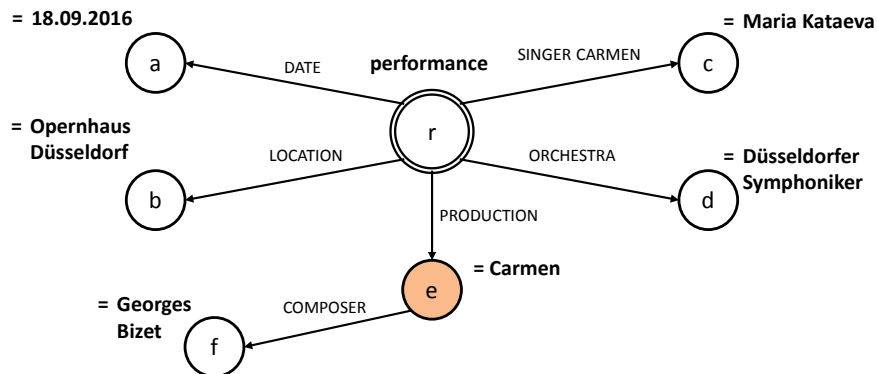
“The Düsseldorfer Symphoniker

is playing the music in a performance on 18.09.2016 at the Opernhaus Düsseldorf of “Carmen”, by Georges Bizet; Maria Kataeva sings Carmen”



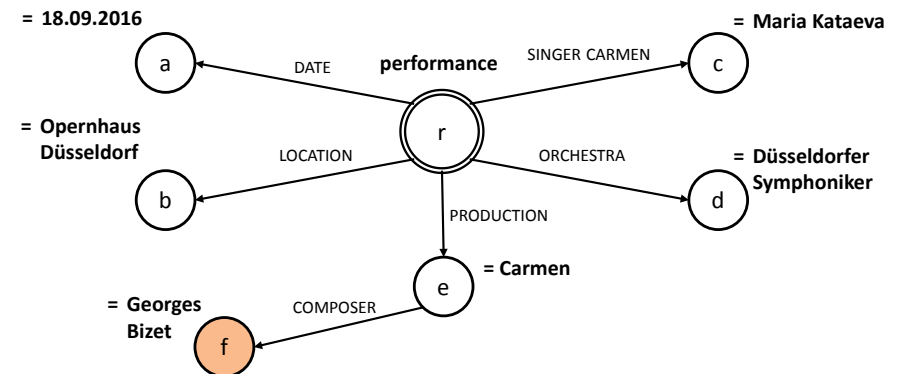
“the opera “Carmen”,

composed by Georges Bizet, is performed on 18.09.2016 at the Opernhaus Düsseldorf, with Maria Kataeva singing Carmen, and the music played by the Düsseldorfer Symphoniker.”



“Georges Bizet,

composed the opera “Carmen”, which is performed on 18.09.2016 at the Opernhaus Düsseldorf, with Maria Kataeva singing Carmen, and the music played by the Düsseldorfer Symphoniker.”



Satisfaction type for the node *date*

$$\text{SatTyp}(a, f_{\text{Carmen}}) = \{ a : \exists b \exists c \exists d \exists e \exists f \exists r$$

$r \in \text{performance}$

& DATE(r) = a & LOCATION(r) = b & SINGER_CARMEN(r) = c & ORCHESTRA(r) = d & PRODUCTION(r) = e & COMPOSER(e) = f	& $a = 18.09.2016$ & $b = \text{Opernhaus Düsseldorf}$ & $c = \text{Maria Kataeva}$ & $d = \text{Düsseldorfer Symph.}$ & $e = \text{opera "Carmen"}$ & $f = \text{Georges Bizet}$
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Metonymy

essentially, is just a shift of perspective in a given frame.

Ex.:

The opera [literal] "*Carmen*" is performed on Sunday
 at the *Düsseldorf opera* [metonymic: location of opera performances];
 the *opera* [metonymic: staging] starts at 19:30.

Note

- Metonymy is just one way of exploiting the hologram property of frames.
- Metonymy is restricted; it cannot shift the perspective to any arbitrary node in a frame.

Immediate consequences of the hologram property

In terms of conceptual content / **intension** assigned to a node:

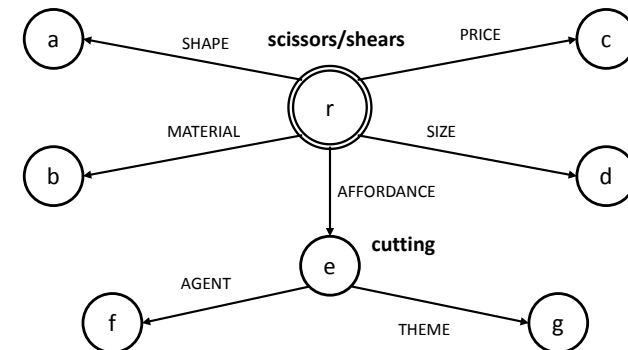
- The information on every node in a frame **enriches the information** on every other node.

In terms of the **extension** of the single node:

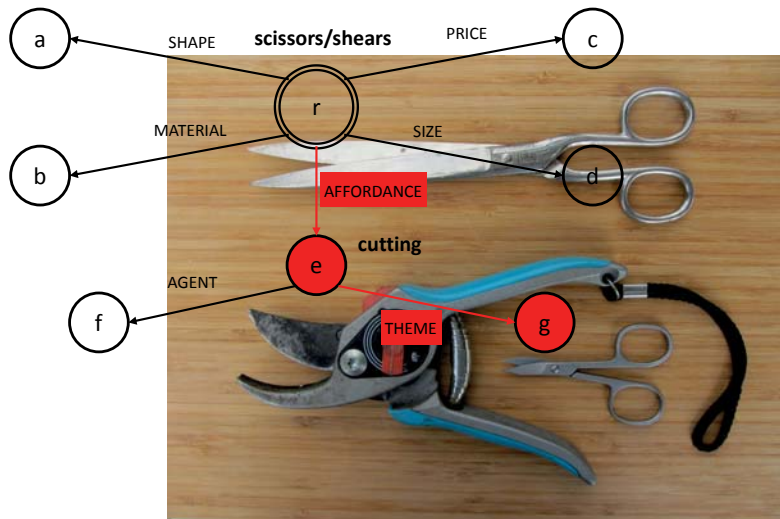
- The information on every node in a frame **constrains the extension** of every other node.

Illustration: scissors

- Fixing one feature of an artefact will affect many other features.
- The design of artefacts reflects content of the artefact concept.



Dominant feature: value of the THEME attribute of the cutting AFFORDANCE



Dominant feature: value of the AGENT attribute of cutting AFFORDANCE = 'kids'



Dominant feature: value of the PRICE attribute = 'low price'

Observation

Terms for special types of scissors are often compound expressions where the modifier specifies the **dominant feature**

type	attribute: value
<i>nail scissors</i>	AFFORDANCE: [cut]. OBJECT: nails
<i>pruning shears</i>	AFFORDANCE: pruning . [OBJECT: twigs]
<i>paper scissors</i>	AFFORDANCE: [cut]. OBJECT: paper
<i>kids scissors</i>	AFFORDANCE: [cut]. AGENT: kid

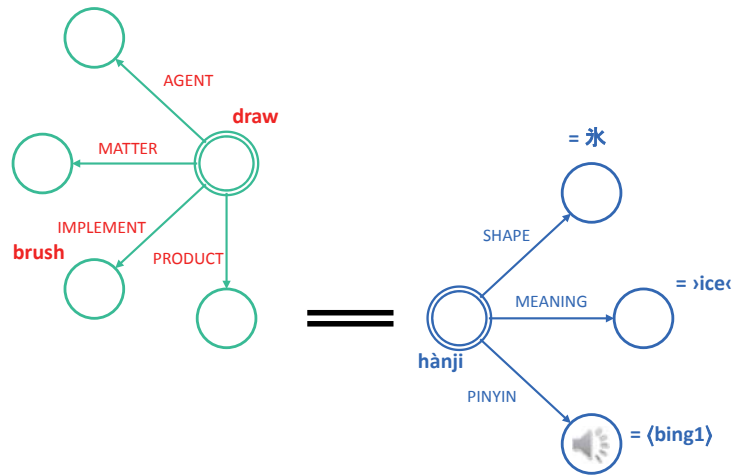
3. Frames in composition

3.1 Composition by unification

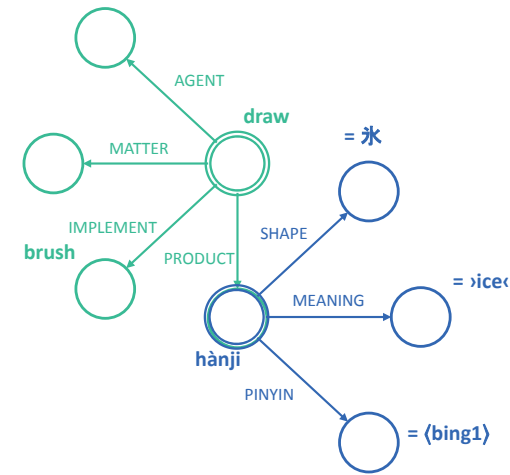
In a frame-theoretic approach to semantic composition, the basic mechanism is unification of two frames:

- Connecting two frames A and B by unifying two nodes, x in A and y in B, into one node x=y,
- thereby integrating two frames into one larger frame
- that unites the content of A and B.
- By the unification, the information originally carried by node x in A **enriches** the information, and constrains the extension, originally linked to node y in B, and vice versa.

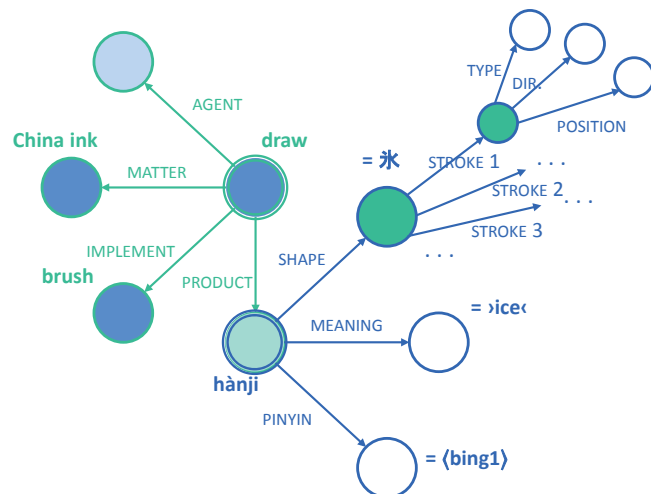
3.2 'draw' and 'hànzì 水' (context: traditional writing)



'draw the hánzì 水': unification of verb frame and object frame



'draw the hánzì 水': degrees of enrichment



3.3 Cocomposition

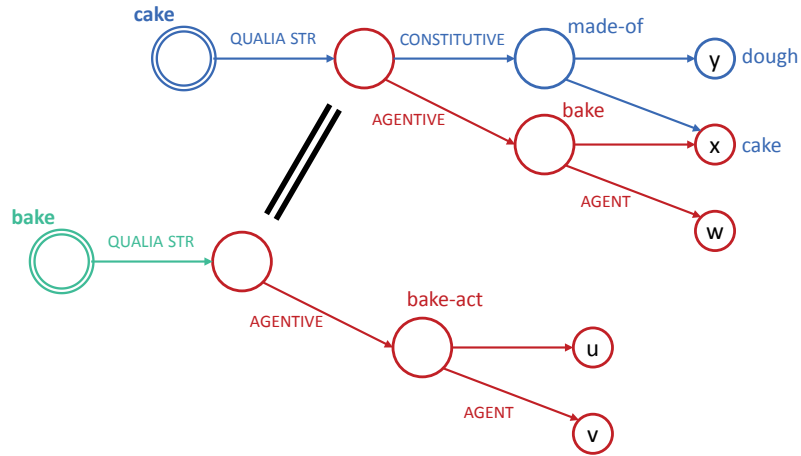
Pustejovsky (1991, 1995, 2011)

bake a potato vs. *bake a cake*

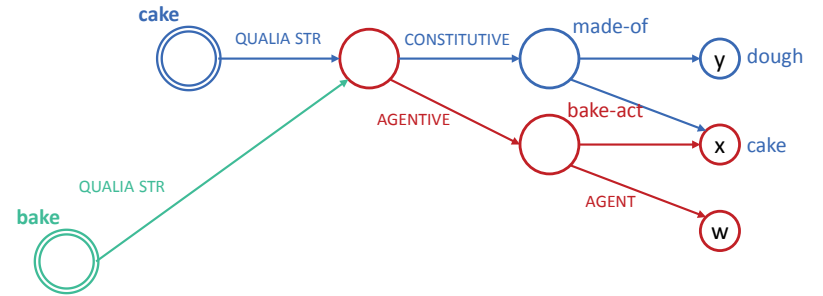
process vs. creation

"The change in meaning [from the process to the creation sense of *bake*, S.L.] comes not from the semantics of *bake*, but rather in composition with the complement of the verb, at the level of the entire verb phrase. The "creation" sense arises from the semantic role of *cake* that specifies it is an artifact" (Pustejovsky 1991, 423).

[bake] and [cake]



[bake and cake]



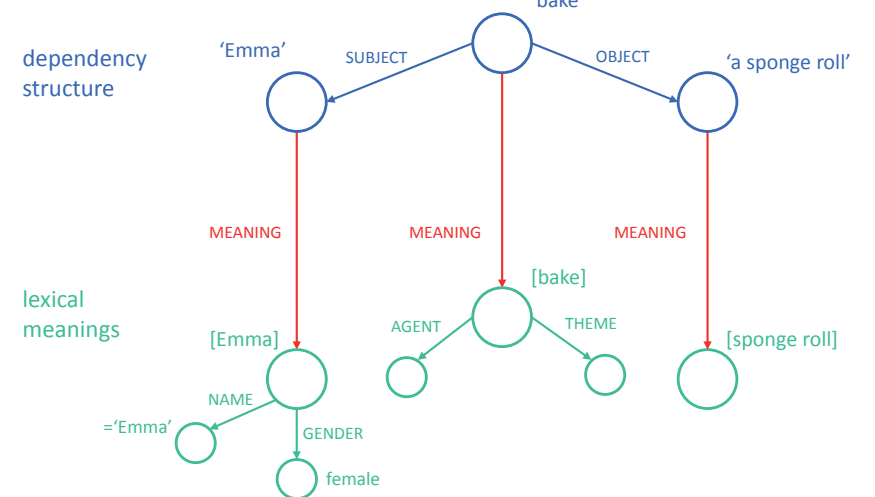
- The *bake* frame gets nested with the CONSTITUTIVE attribute [=quale] of the *cake* frame, yielding the 'creation' sense of *bake*.

Hologram effect

All composition is cocomposition.

3.4 Linking expressions and their meanings [see Löbner 2014]

'Emma bake[.] [a] sponge roll'

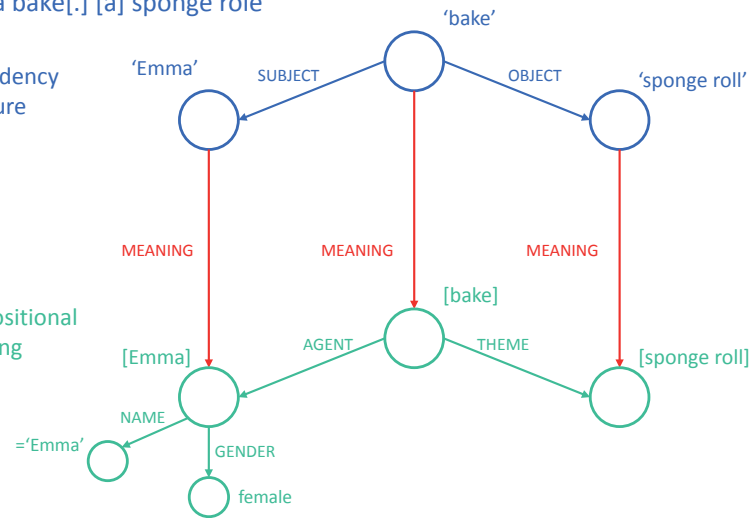


3.4 Linking expressions and their meanings

'Emma bake[.] [a] sponge roll'

dependency
structure

compositional
meaning



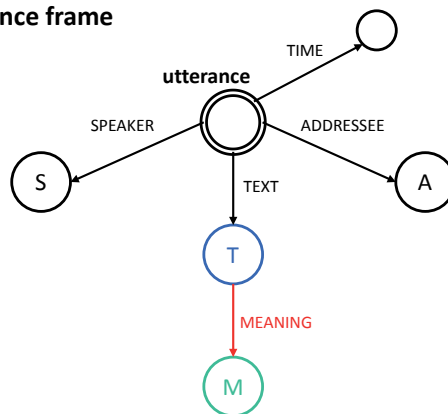
3.4 Linking expressions and their meanings

Hologram effects

- Meaning nodes are enriched with information on the expressions used to produce these senses;
- Expression nodes are enriched with information on their meaning in the given syntactic context;
- These frames enable the modeling of the interpretation of expressions that involve both levels, e.g. quotation, direct speech, 'de dicto' construal;
- they enable the modeling of notions such as synonymy or homonymy.

4 Utterances

4.1 The utterance frame



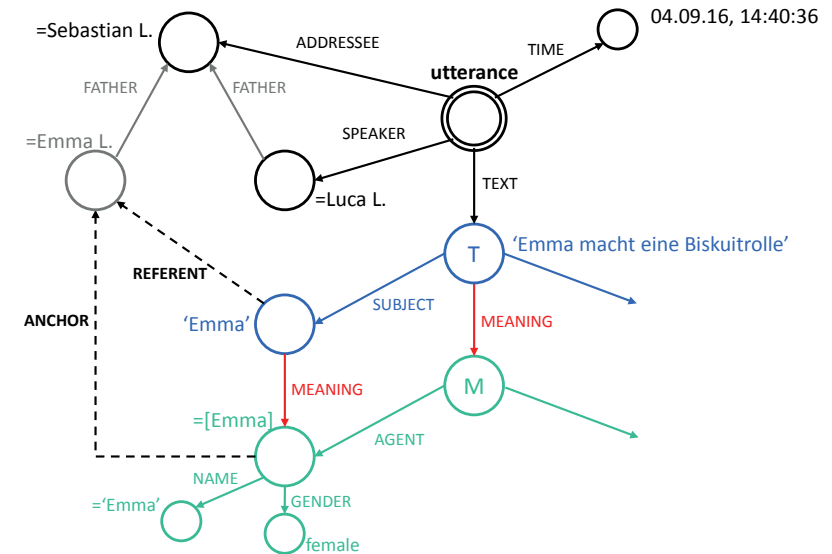
Hologram effects

- Expression nodes are enriched with the information as to who said this (and how) to whom
- Meaning nodes can be connected to either speaker or addressee (MEANING can be modeled as a two-place attribute).
- Expression nodes become to represent tokens of expressions.
- Meaning nodes become to represent tokens of meanings.
- The nodes in the utterance frame provide anchors for indexicals.

4.2 Reference



4.2 Reference: Embedding an utterance into a world frame



Hologram effects

A complete utterance frame is integrated into the world frame.

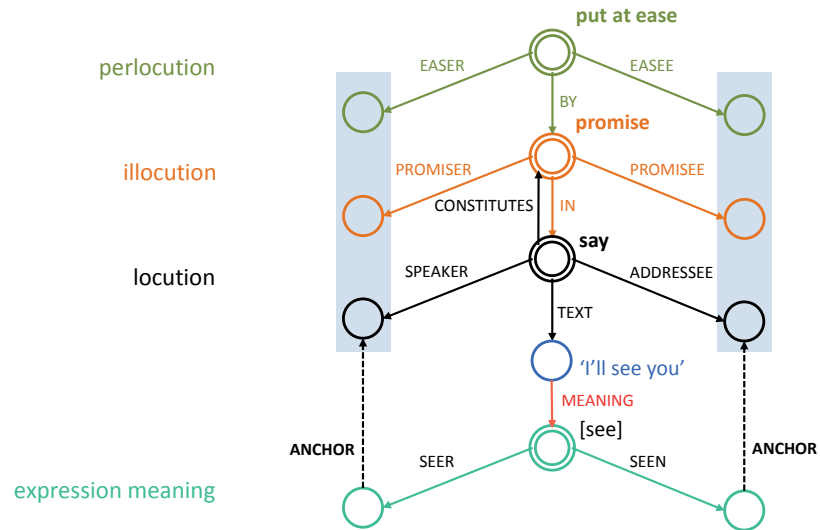
Meaning nodes for referential elements in the text are anchored in the world frame.

- By unification with pre-established nodes in the world frame, the information in the semantic frame is enriched with “world knowledge” – a process known as **pragmatic enrichment**.
- By embedding the whole proposition into the facts represented in the world frame – if embeddable – the world frame is enriched: the utterance becomes **information about the world**.
- Semantics along these lines is – full-scale – **dynamic semantics**.

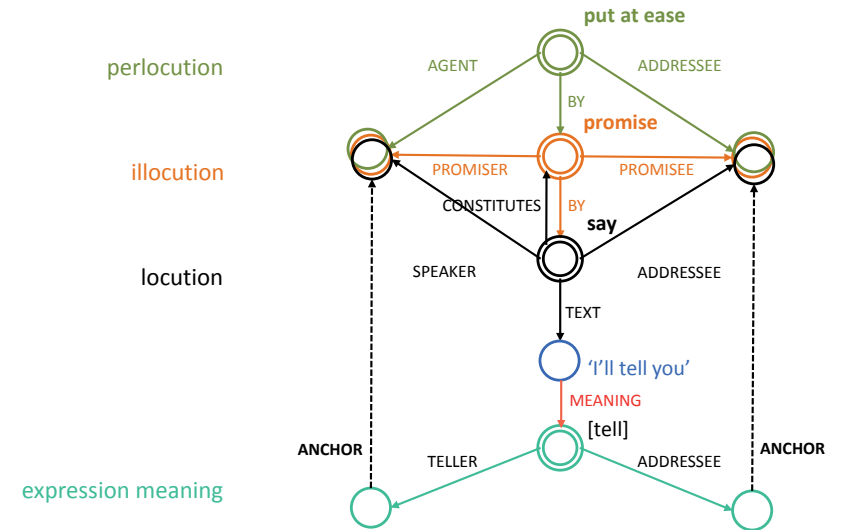
Two views on composition

- (1) **Offline process:** The view of linguistic semantics
Semantic composition as a (hypothetical) model of the construal of linguistic meaning from context-independent input: morpho-syntactic material, lexical meaning, general productive lexical operations such as conceptual shifts.
- (2) **Online process:** The view of actual speech processing
The construal of the meaning_in_context of an uttered text under realistic conditions of processing:
linguistic material
+ circumstantial knowledge
+ background knowledge
Probably **stepwise** inclusion of non-linguistic knowledge during composition.

4.3 Austin's speech act theory: a cascade of embedding



Austin's speech act theory: a cascade of embedding



Conclusions

- All nodes in a frame are interconnected – Every node provides information about every other node.
- Nodes in a frame are essentially foci used in organizing information.
- Connected frames yield mutual information about each other.
- **Using the frame approach allows us to integrate levels of description that are traditionally analyzed separately.**
- **It allows us to embed the use and meaning of linguistic gestures into wider pragmatic and social contexts.**

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