Frames as Informational Holograms
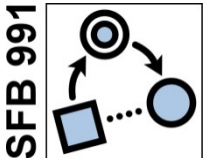## Sebastian Löbner

International Conference "Cognitive Structures" CoSt'16
Düsseldorf, 15 – 17 September 2016

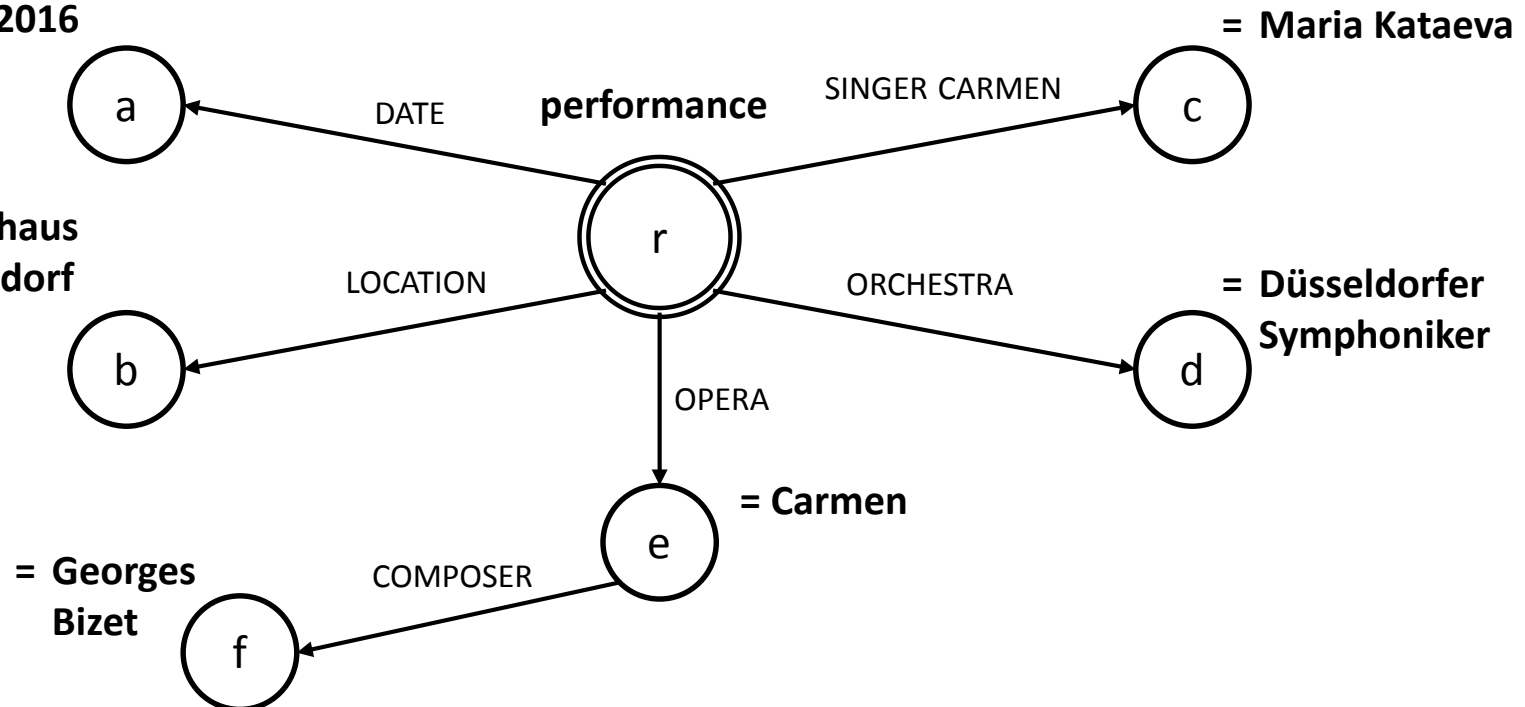SFB 991

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF
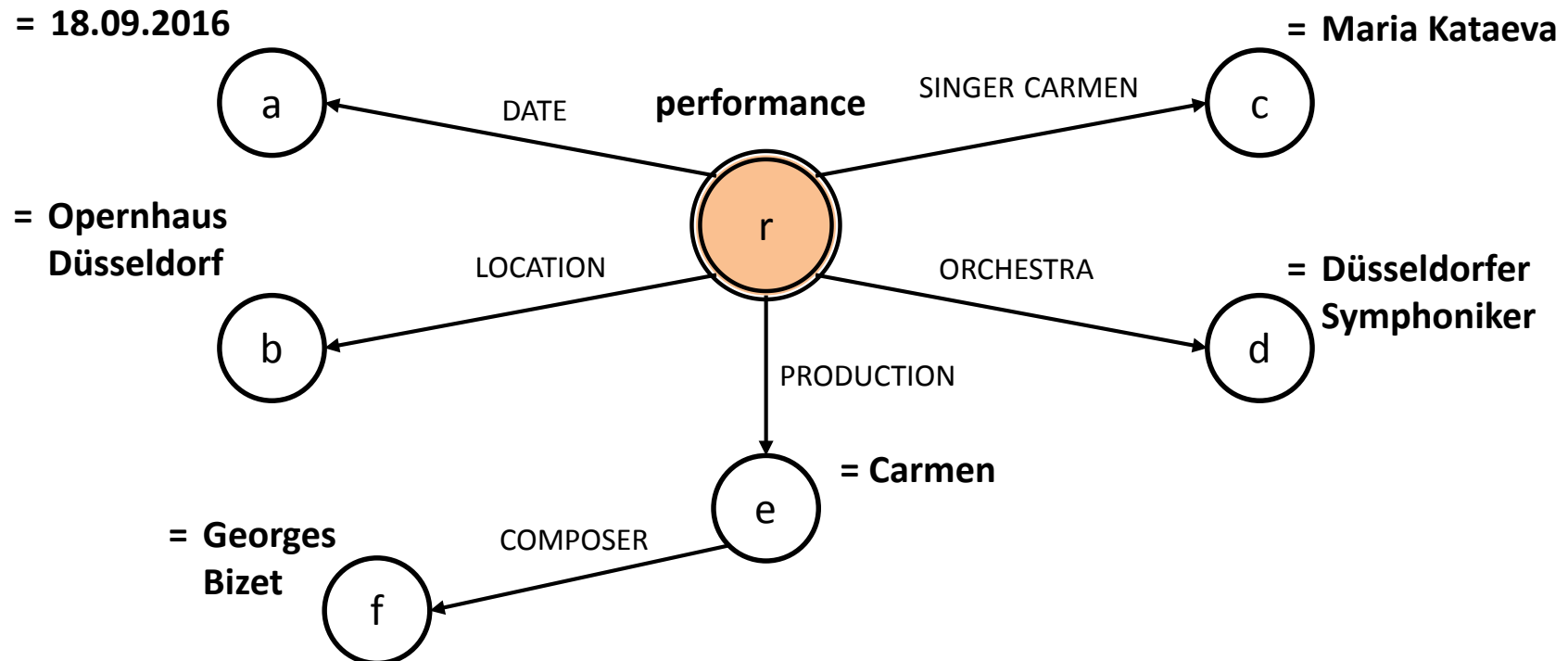
1. Frame content

Barsalou frames (in Düsseldorf guise):

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

= 18.09.2016

= Maria Kataeva

= Opernhaus Düsseldorf

= Düsseldorfer Symphoniker

= Carmen

= Georges Bizet

performance

DATE   SINGER CARMEN   LOCATION   ORCHESTRA   OPERA   COMPOSER
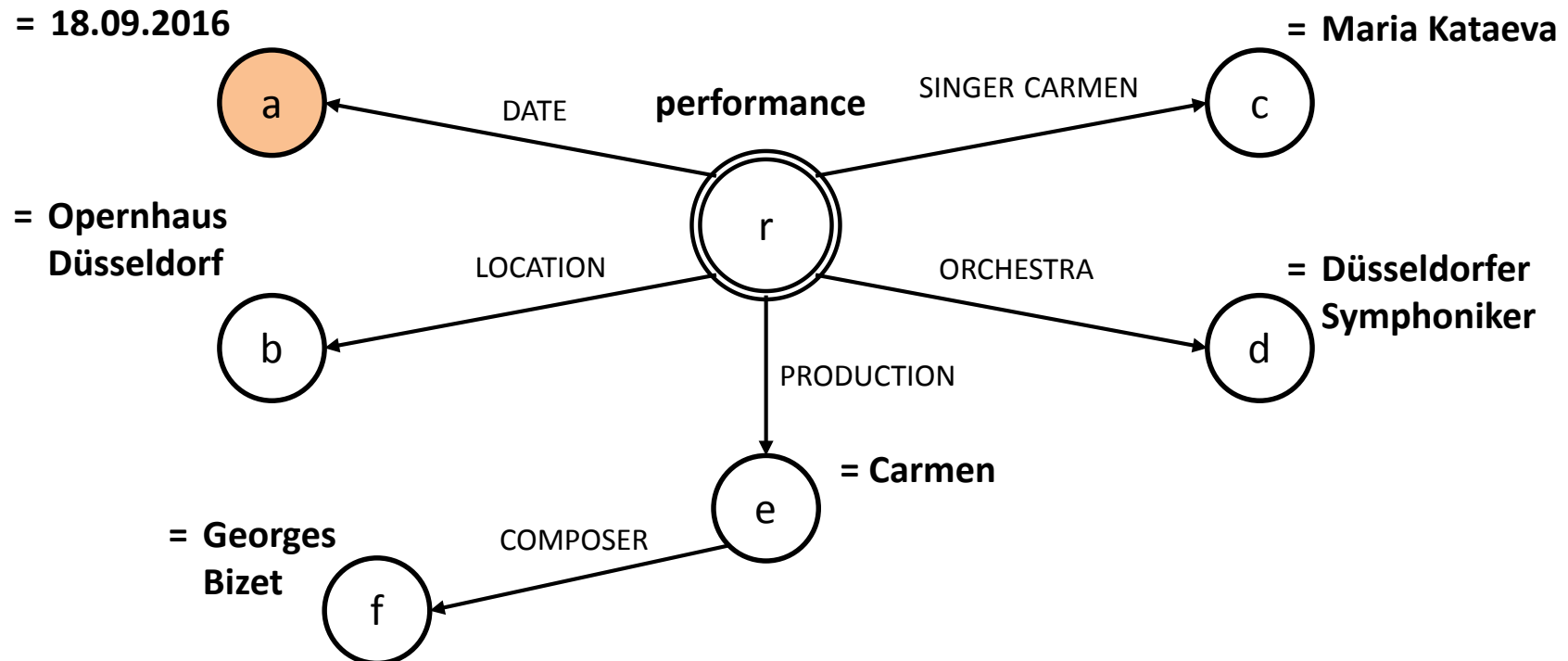
a   c   r   b   d   e   f

"(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] .
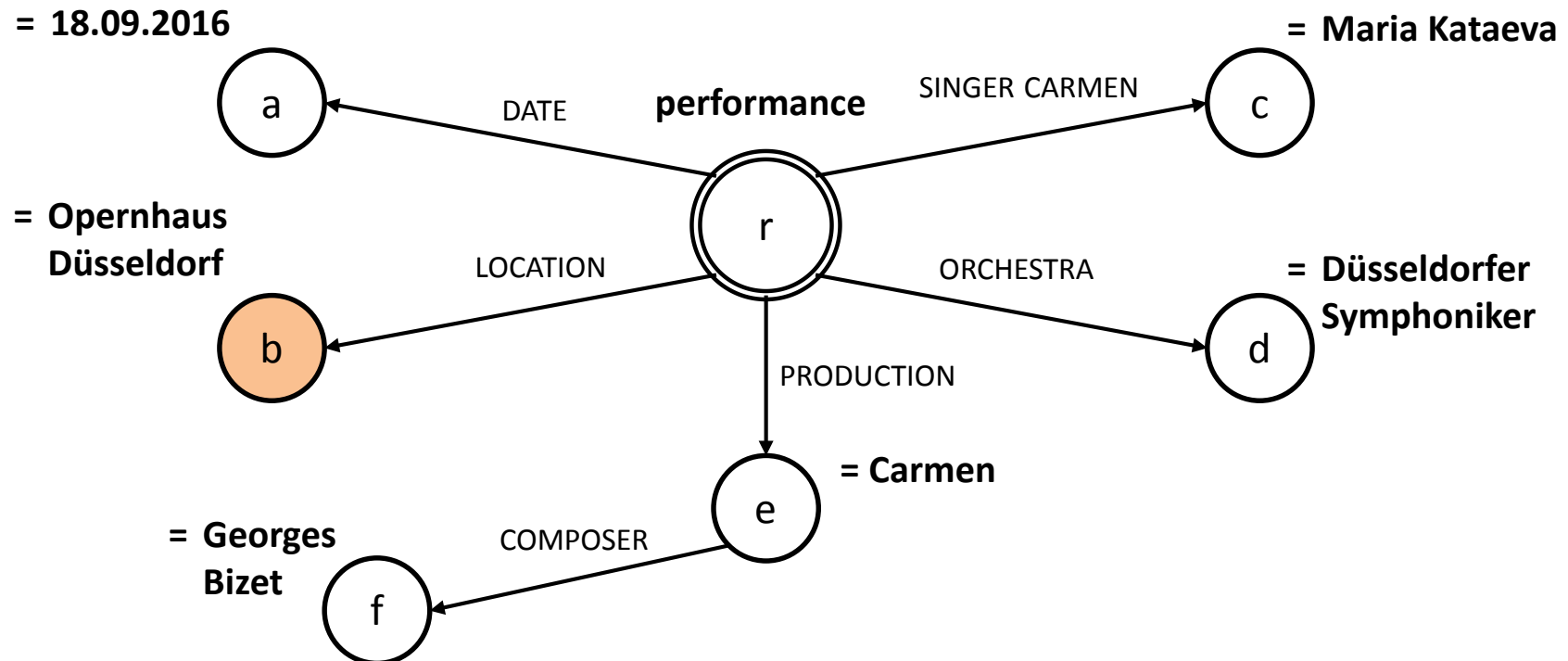
= **18.09.2016**

= **Maria Kataeva**

= **Opernhaus Düsseldorf**

= **Düsseldorfer Symphoniker**

= **Carmen**

= **Georges Bizet**

performance

DATE

SINGER CARMEN

LOCATION

ORCHESTRA

PRODUCTION

COMPOSER

a   b   c   d   e   f   r

2. Frames are holograms

➡ They represent information not only about the distinguished node.

➡ They provide essentially the same information about every node in the frame.

➡ **Complete information bears on every node in a frame.**

"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
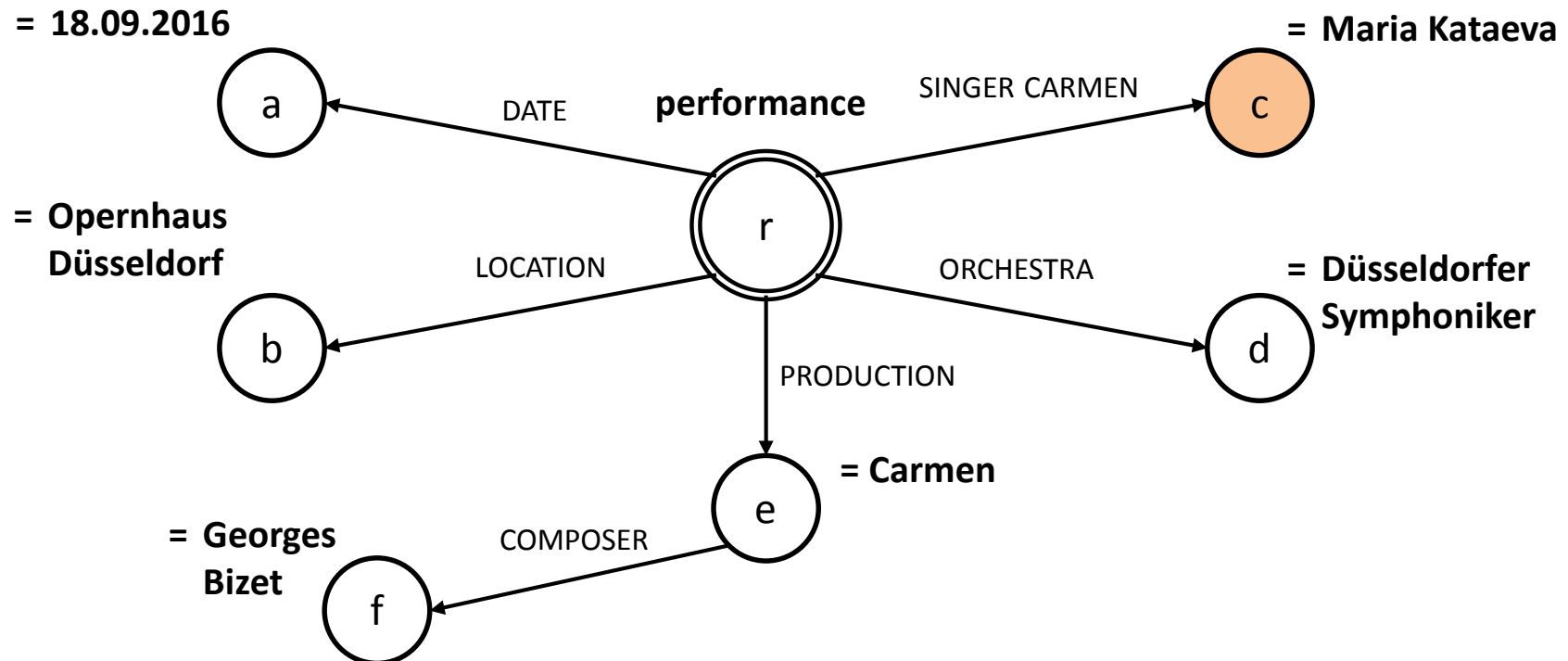by the Düsseldorfer Symphoniker."

= 18.09.2016

= Maria Kataeva

**= Opernhaus
Düsseldorf**

**= Düsseldorfer
Symphoniker**

**= Georges
Bizet**

= Carmen

DATE   **performance**   SINGER CARMEN

LOCATION   ORCHESTRA

PRODUCTION

COMPOSER

a   b   c   d   e   f   r

"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."
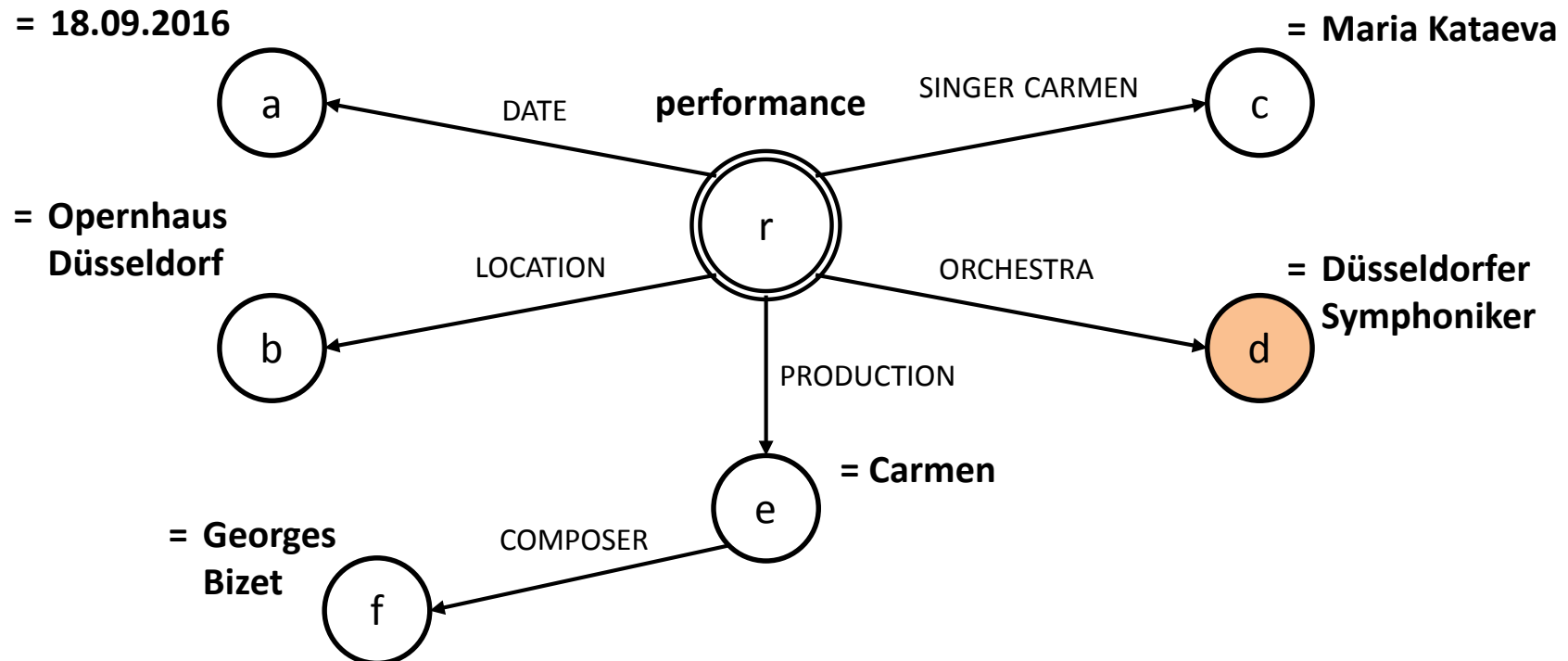
= 18.09.2016

= Maria Kataeva

= Opernhaus Düsseldorf

= Düsseldorfer Symphoniker

SINGER CARMEN

DATE   **performance**

LOCATION

ORCHESTRA

PRODUCTION

= Carmen

= Georges Bizet

COMPOSER

a   r   c   b   d   e   f

"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."

= 18.09.2016

= Maria Kataeva

a

DATE   **performance**   SINGER CARMEN   c

= Opernhaus
Düsseldorf

r

LOCATION   ORCHESTRA   = Düsseldorfer
Symphoniker

b

PRODUCTION   d
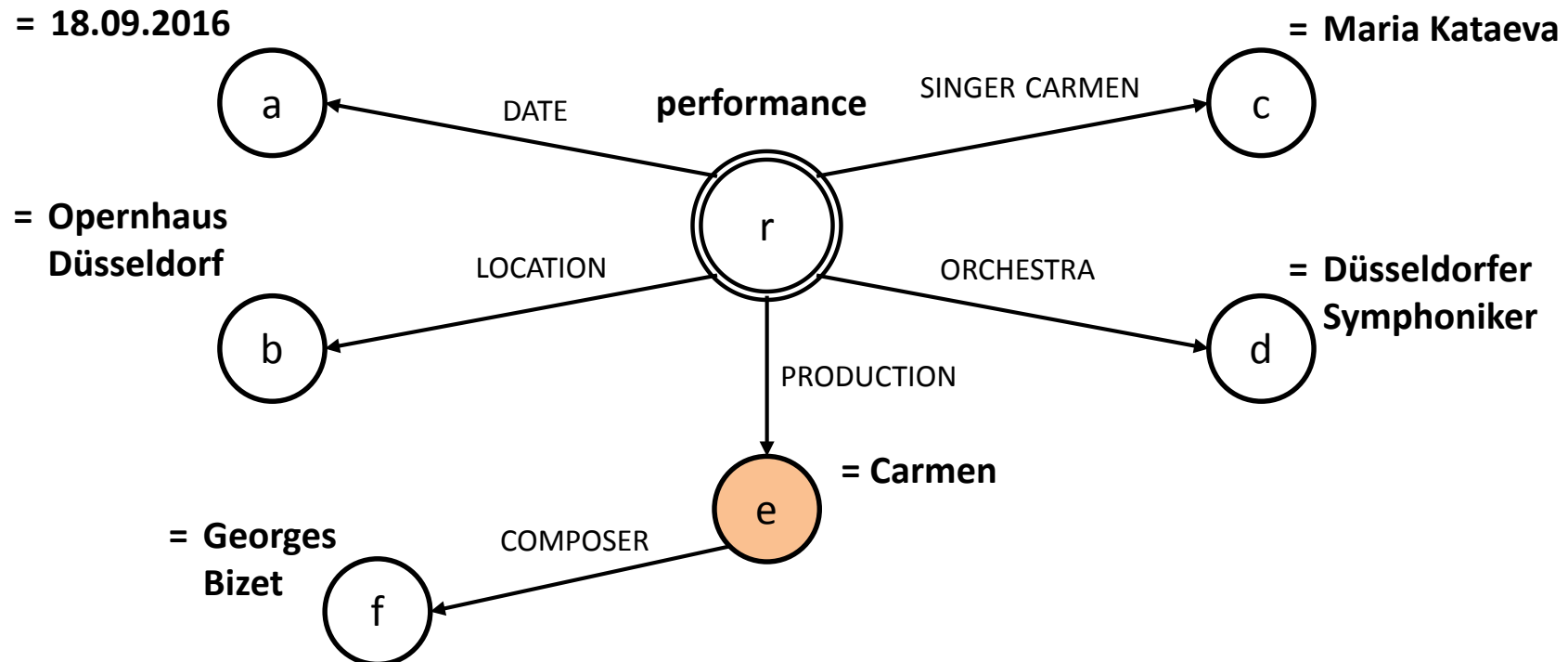
= Carmen

e

= Georges
Bizet   COMPOSER
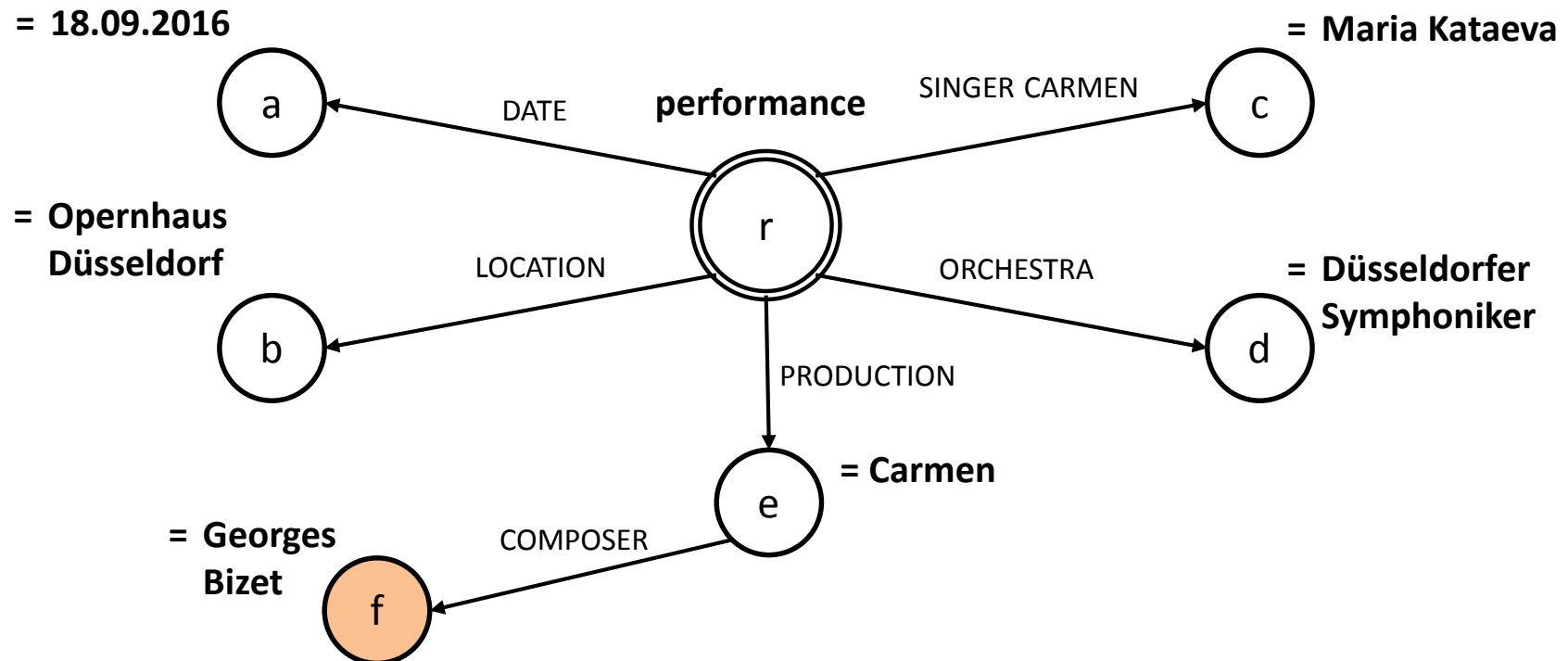
f

"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 Kataevea 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 Kataevea singing Carmen, and the music
played by the Düsseldorfer Symphoniker."

= 18.09.2016

= Maria Kataeva

SINGER CARMEN

performance

a

DATE

c

= Opernhaus Düsseldorf

r

LOCATION

ORCHESTRA

= Düsseldorfer Symphoniker

b

PRODUCTION

d

= Carmen

e

= Georges Bizet

COMPOSER

f

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
nail scissors	AFFORDANCE: [cut]. OBJECT: **nails**
pruning shears	AFFORDANCE: **pruning**. [OBJECT: twigs]
paper scissors	AFFORDANCE: [cut]. OBJECT: **paper**
kids scissors	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.
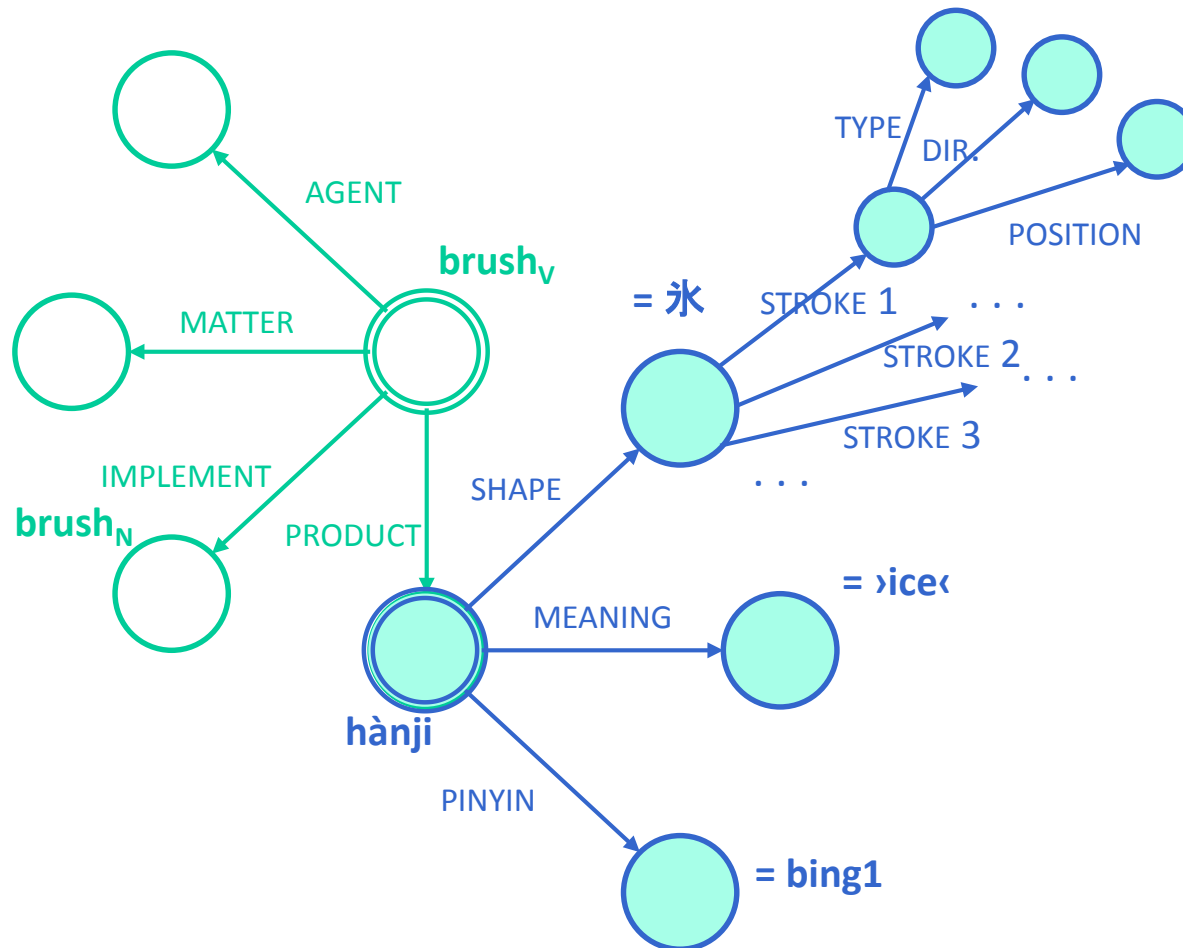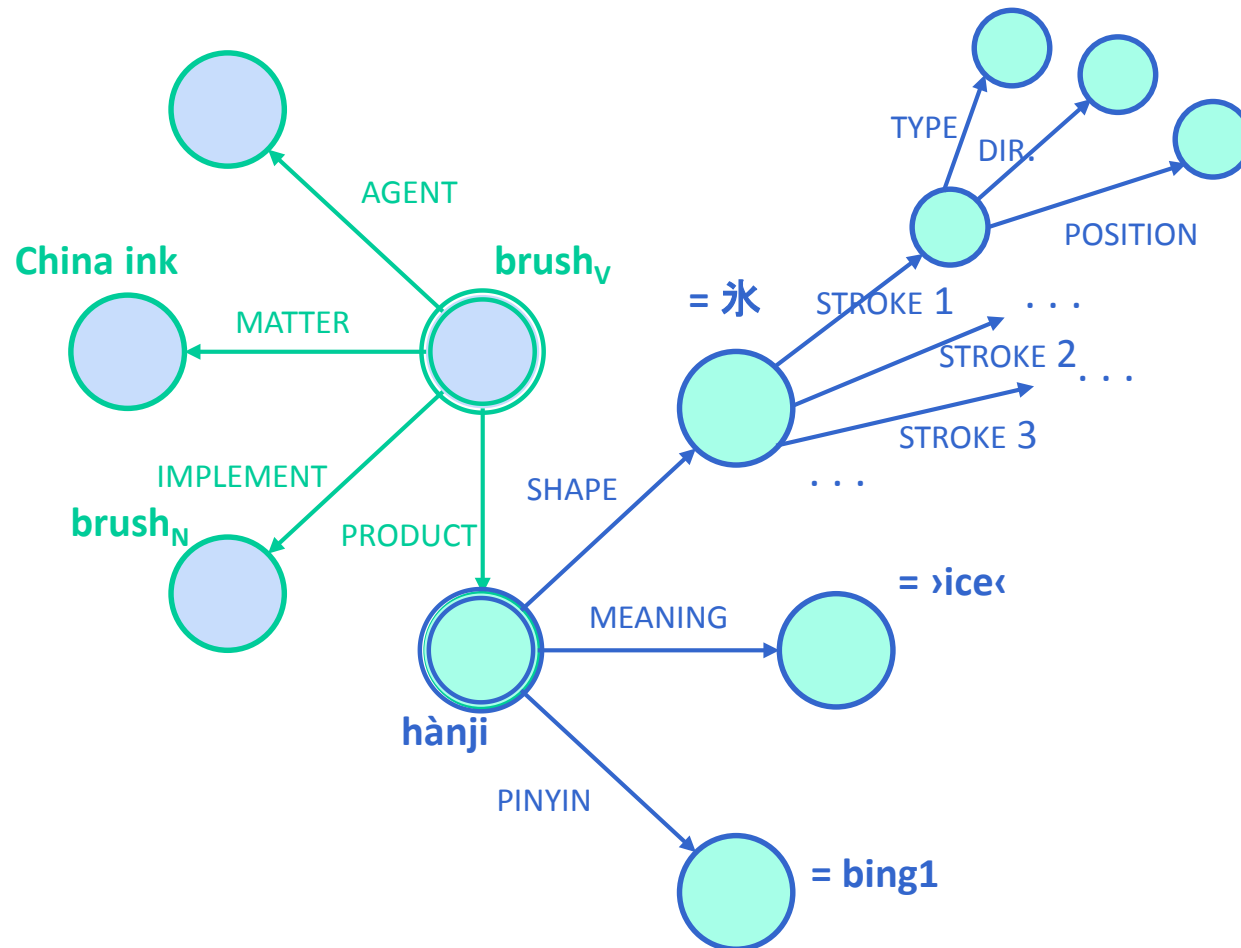
3.2   'brush' and 'hànzi 氷'
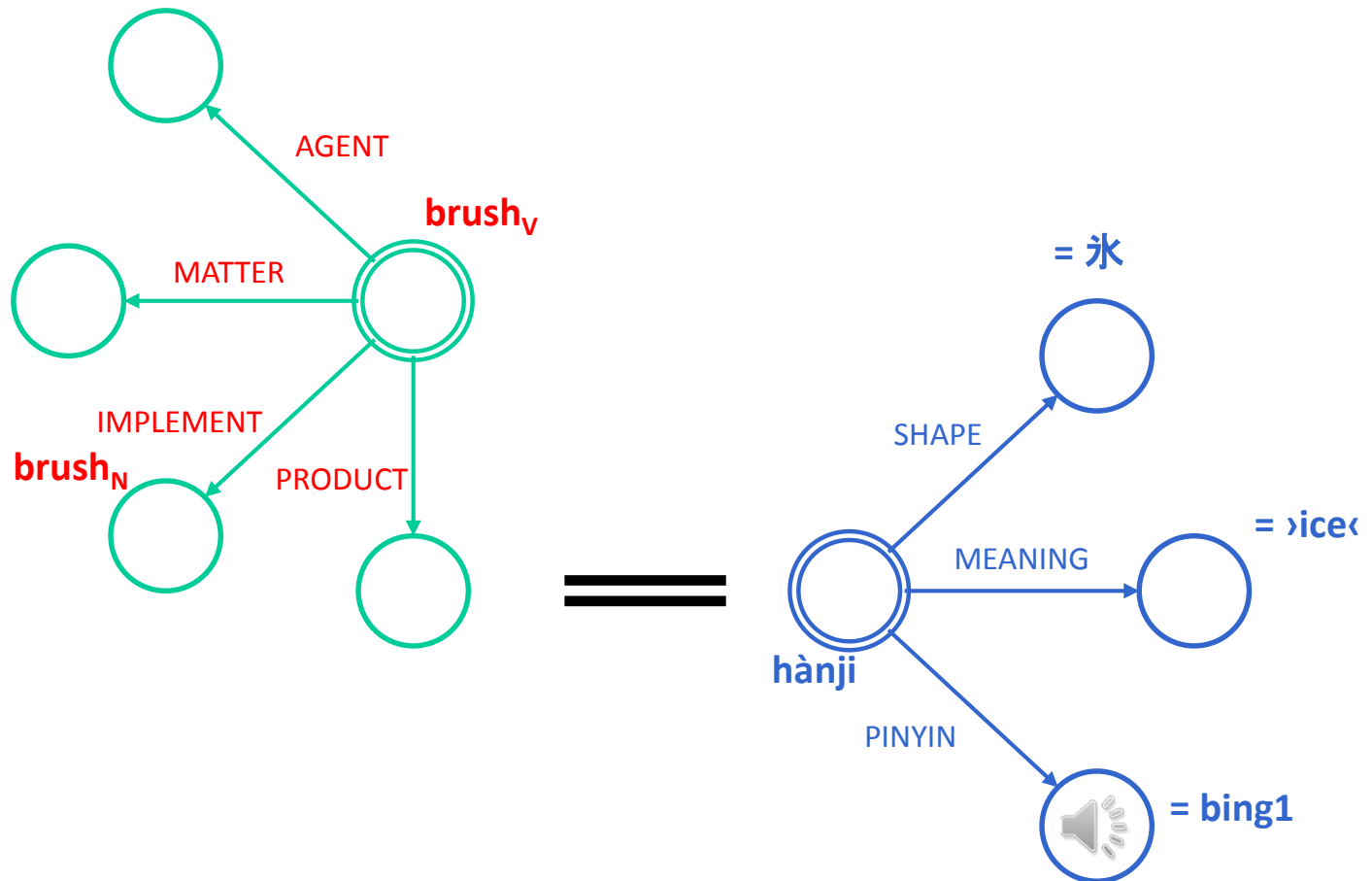
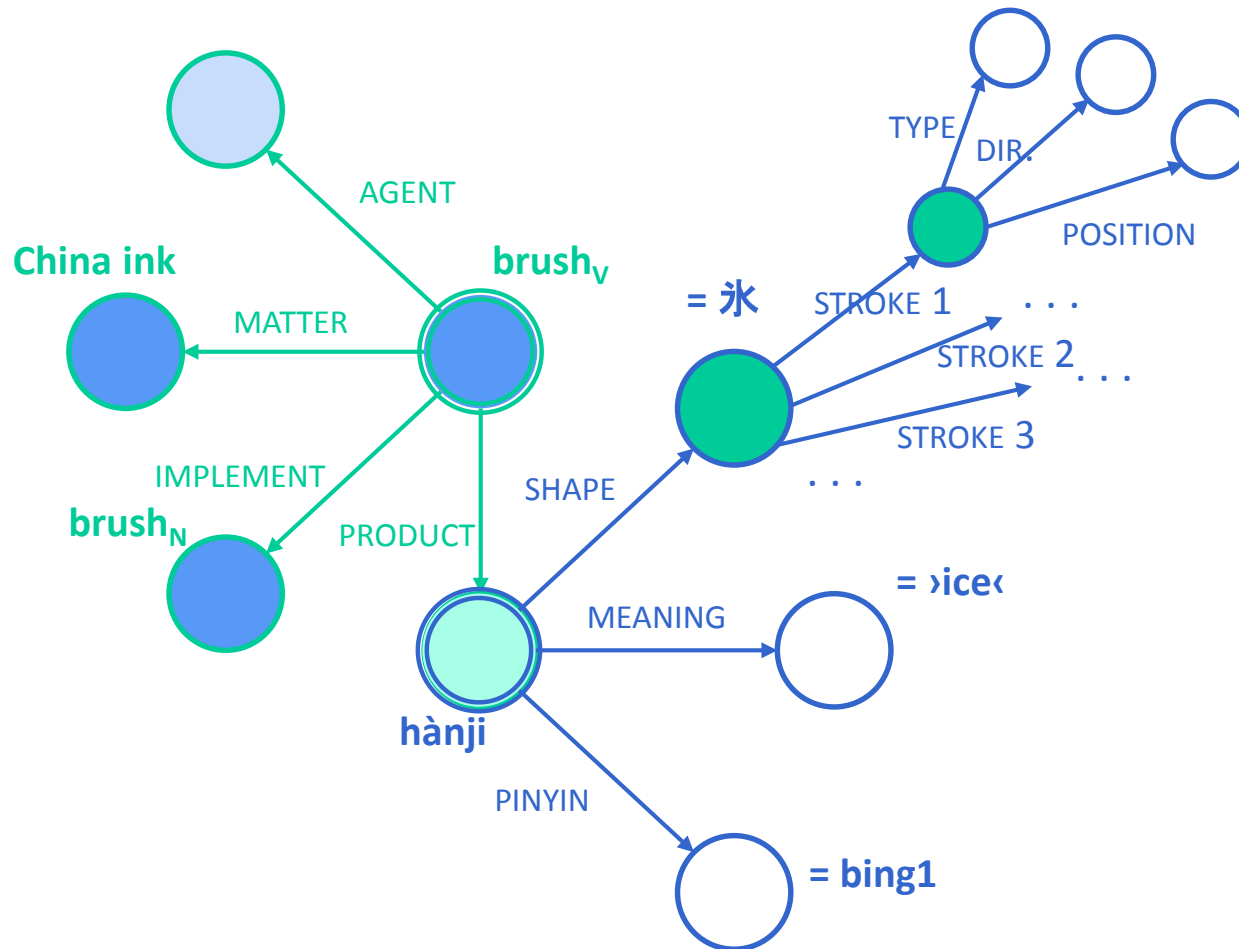'brush the hànzi 氷': unification of verb frame and object frame
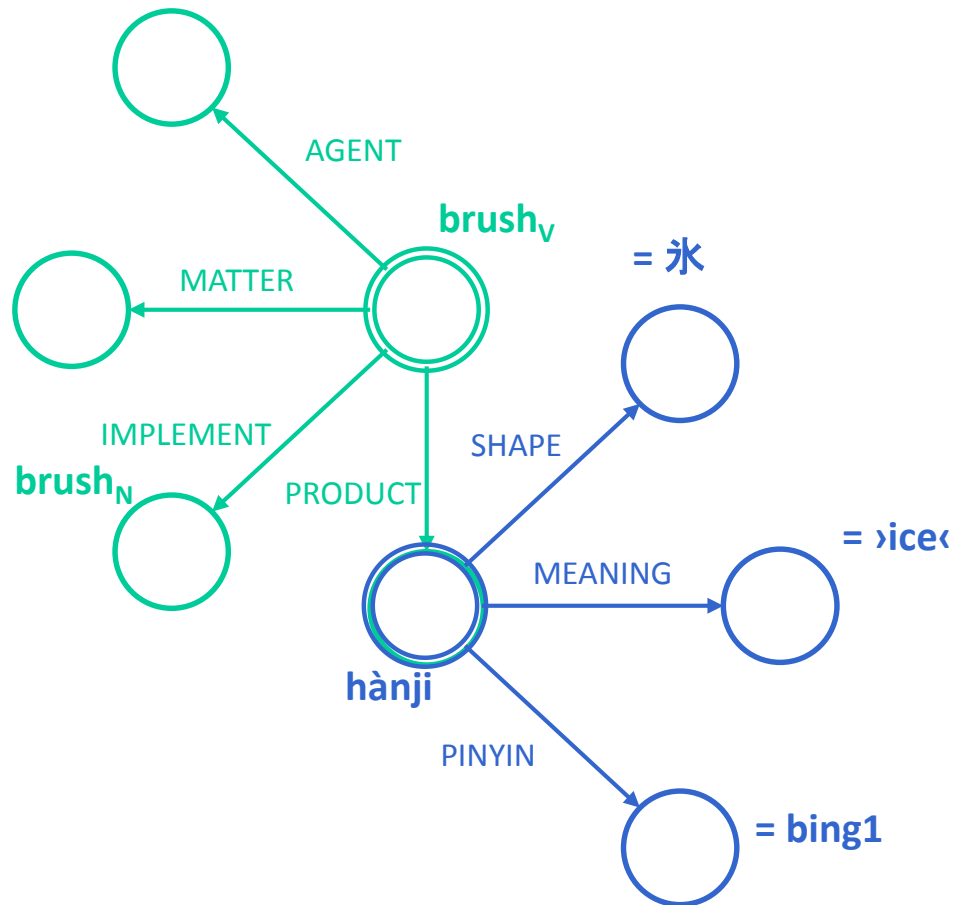
'brush the hànzi 氷': enrichment of the object frame by the verb frame

AGENT

brush_V

MATTER

= 氷

STROKE 1

STROKE 2

STROKE 3

. . .

. . .

. . .

TYPE

DIR.

POSITION

IMPLEMENT

brush_N

PRODUCT

SHAPE

MEANING

= ›ice‹

hànji

PINYIN

= bing1

‘brush the hànzi 氷’: mutual enrichment of verb frame and object frame

'brush the hànzi 氷': degrees of enrichment
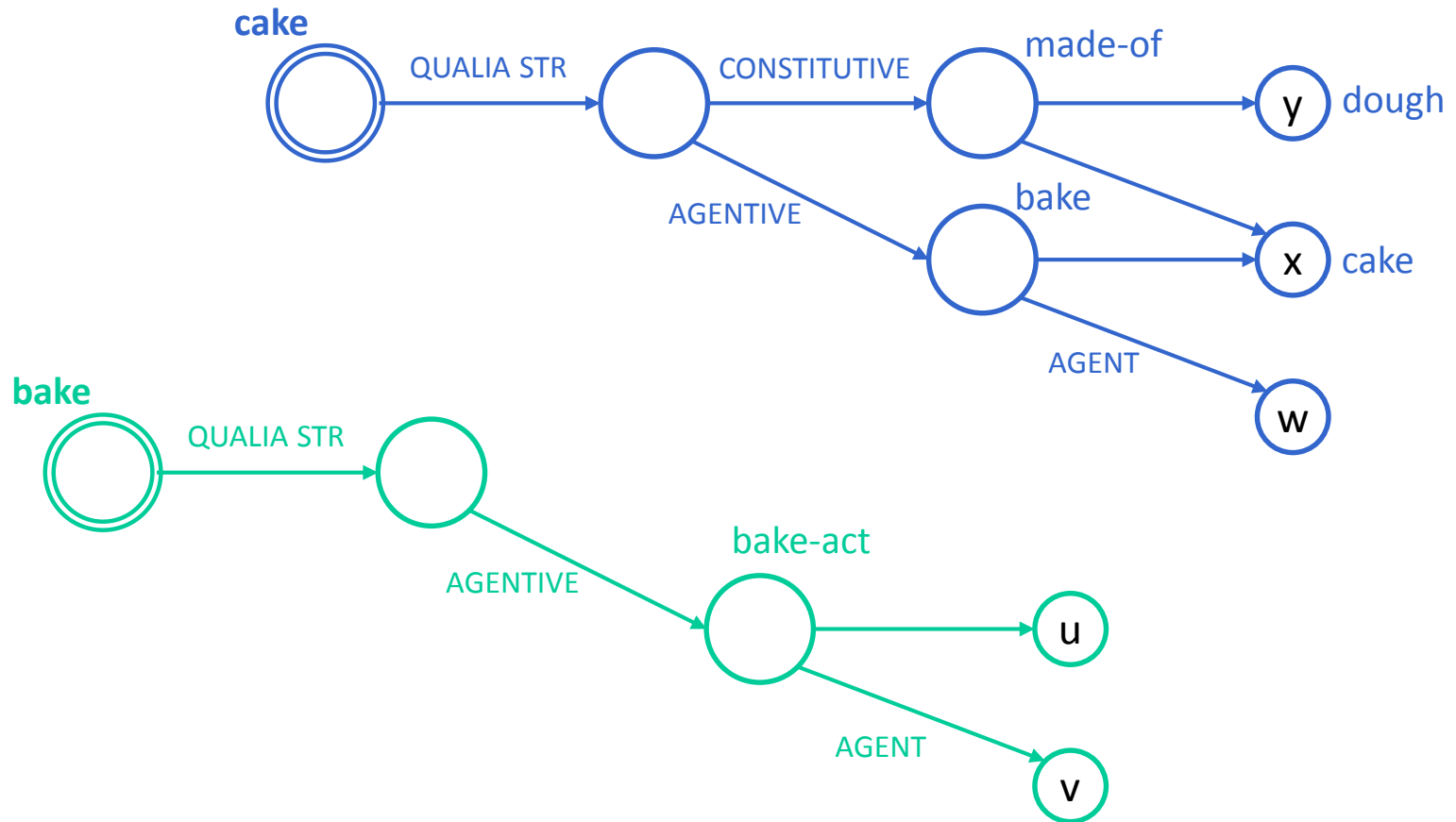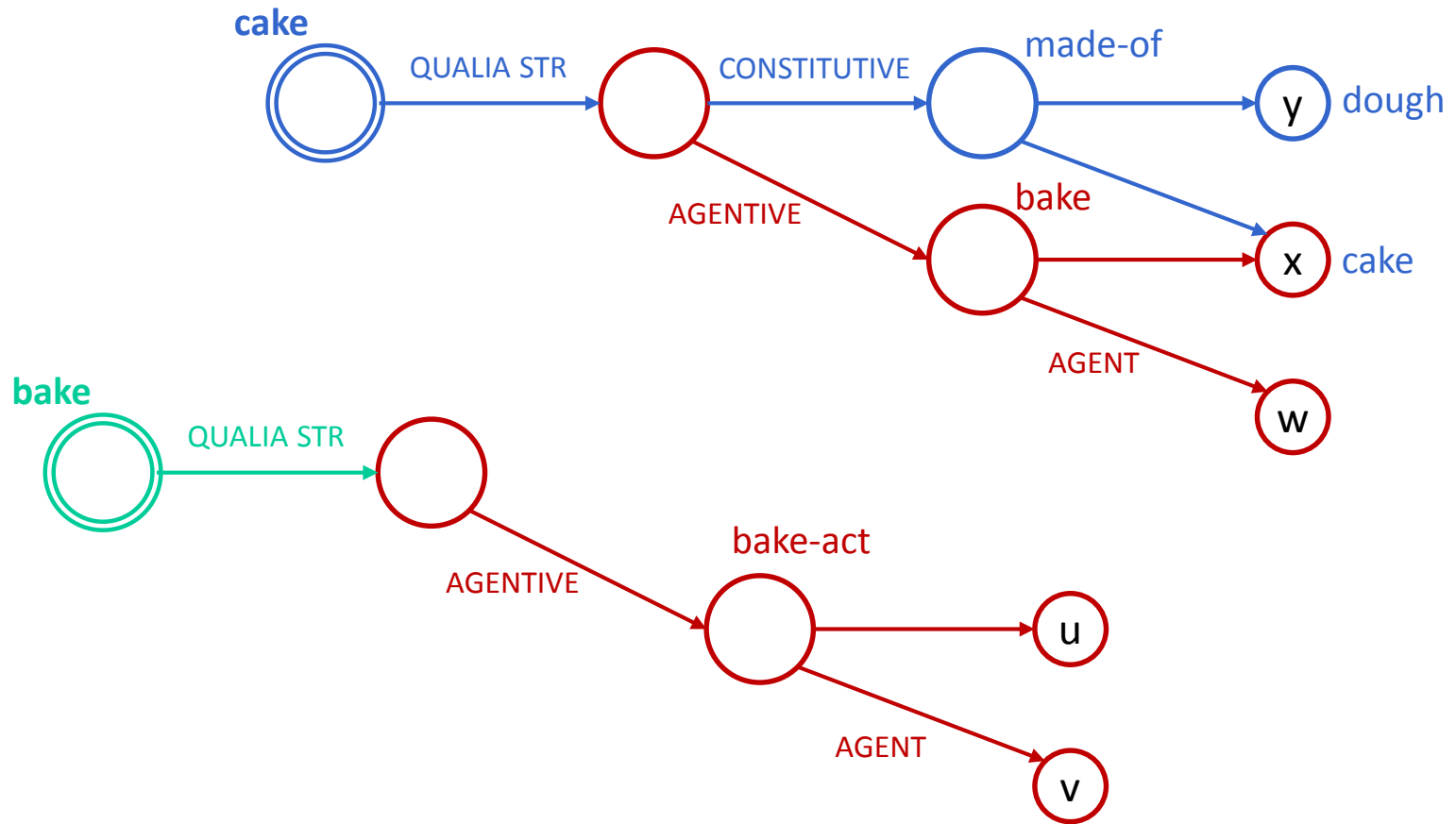
3.3   Cocomposition

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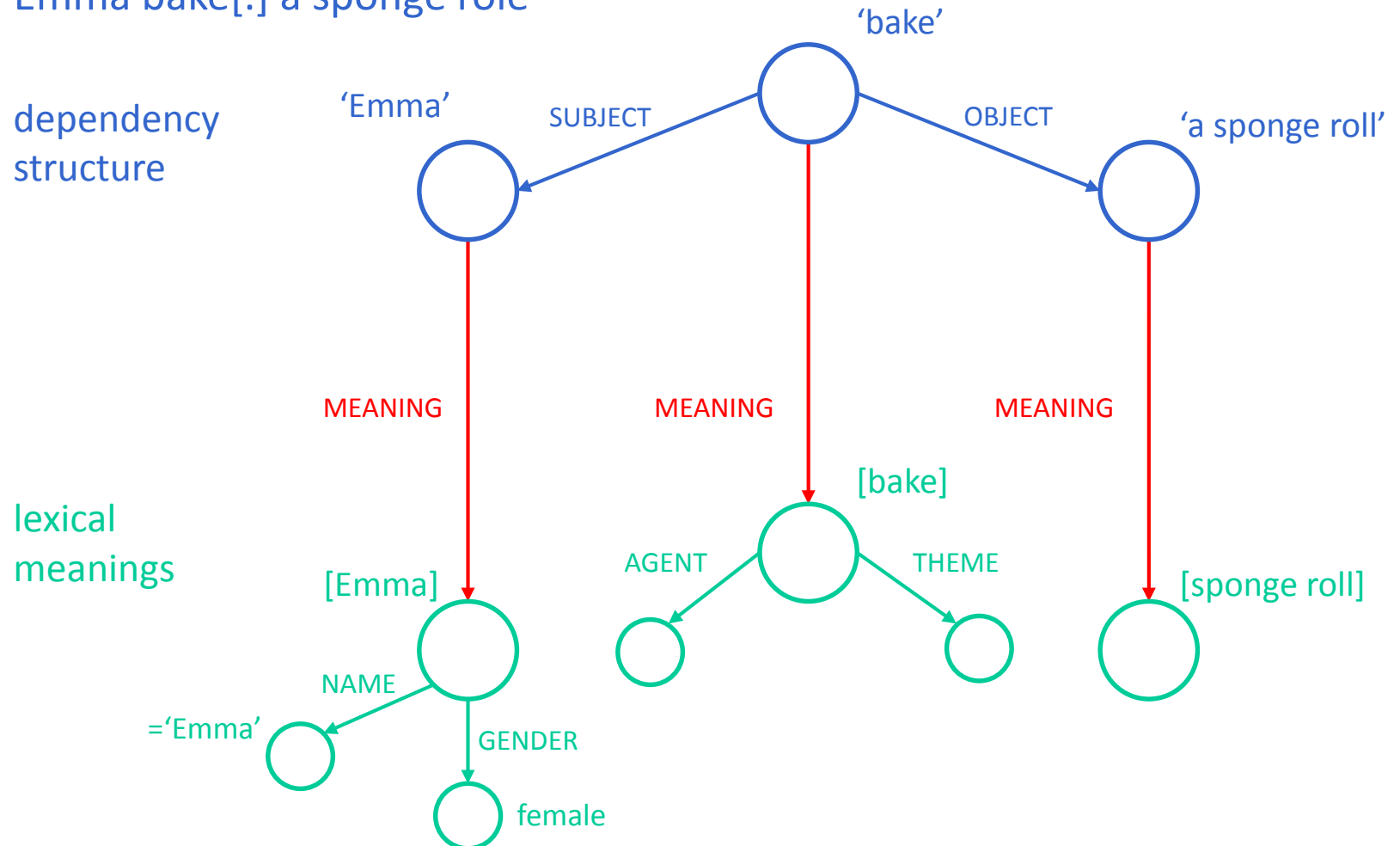
[bake and cake]
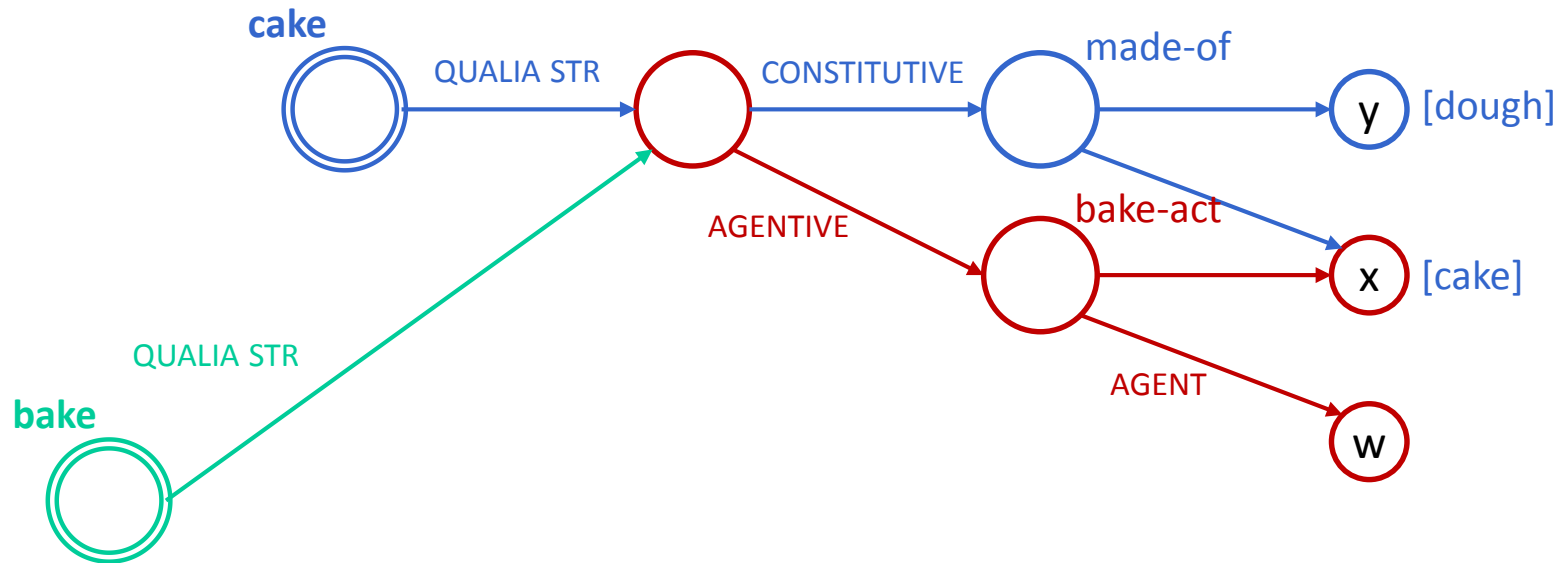
- The *bake* frame gets nested with the CONSTITUTIVE attribute [=quale] of the *cake* frame, yielding the 'creation' sense of *bake.*
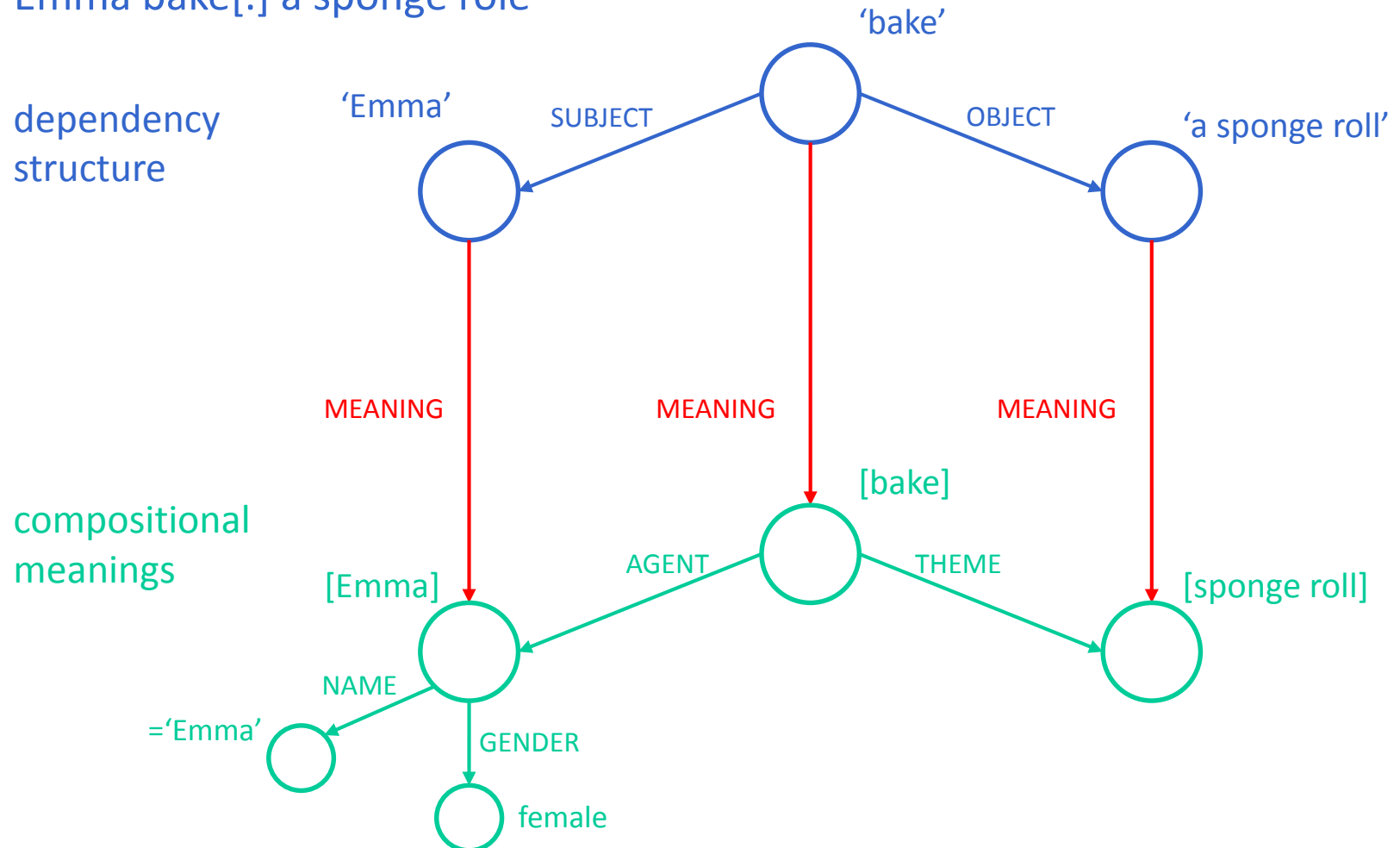
Hologram effect

All composition is cocomposition.

3.4   Linking expressions and their meanings

'Emma bake[.] a sponge role'

dependency
structure

lexical
meanings

3.4   Linking expressions and their meanings

'Emma bake[.] a sponge role'

dependency
structure

'Emma'   'bake'   'a sponge roll'

SUBJECT   OBJECT

MEANING   MEANING   MEANING

[bake]

compositional
meanings

[Emma]   AGENT   THEME   [sponge roll]

NAME

='Emma'   GENDER

female

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
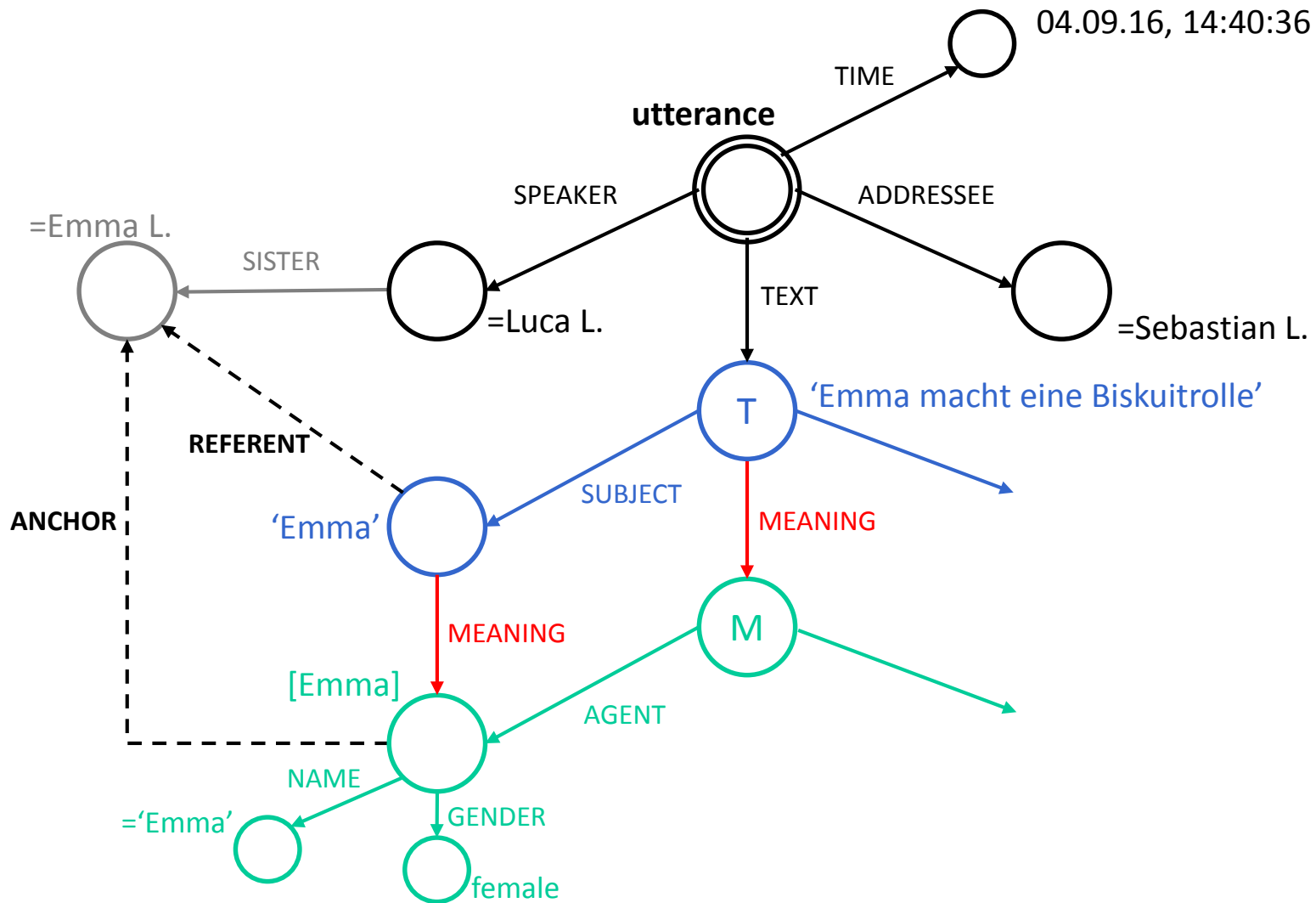
4.1   The utterance frame
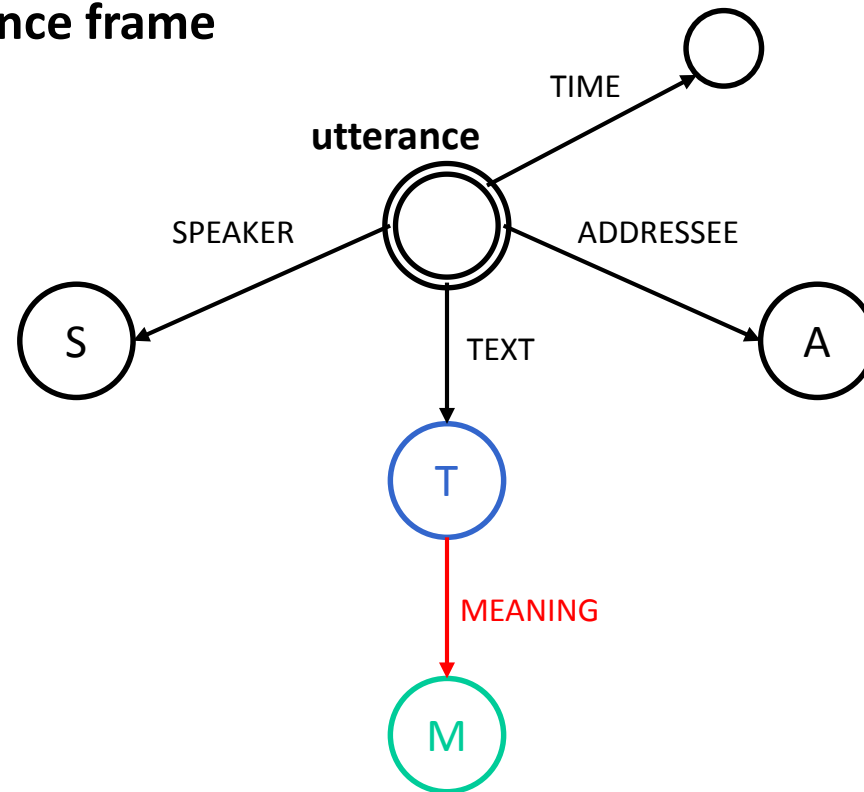
Hologram effects

- 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, the world frame is enriched: the utterance becomes **information about the world**.

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 further cascade of embedding
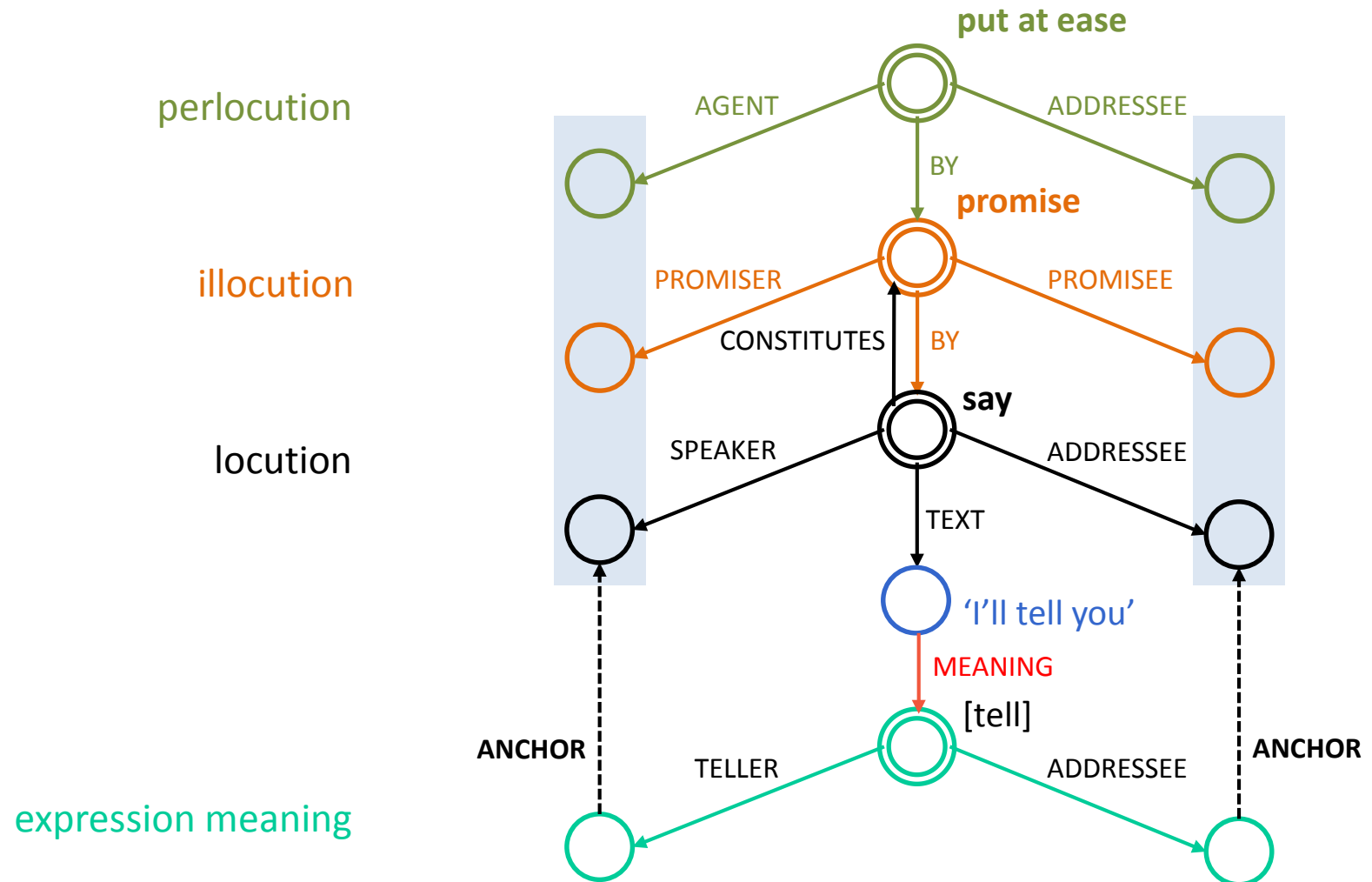
Austin's speech act theory: a further cascade of embedding
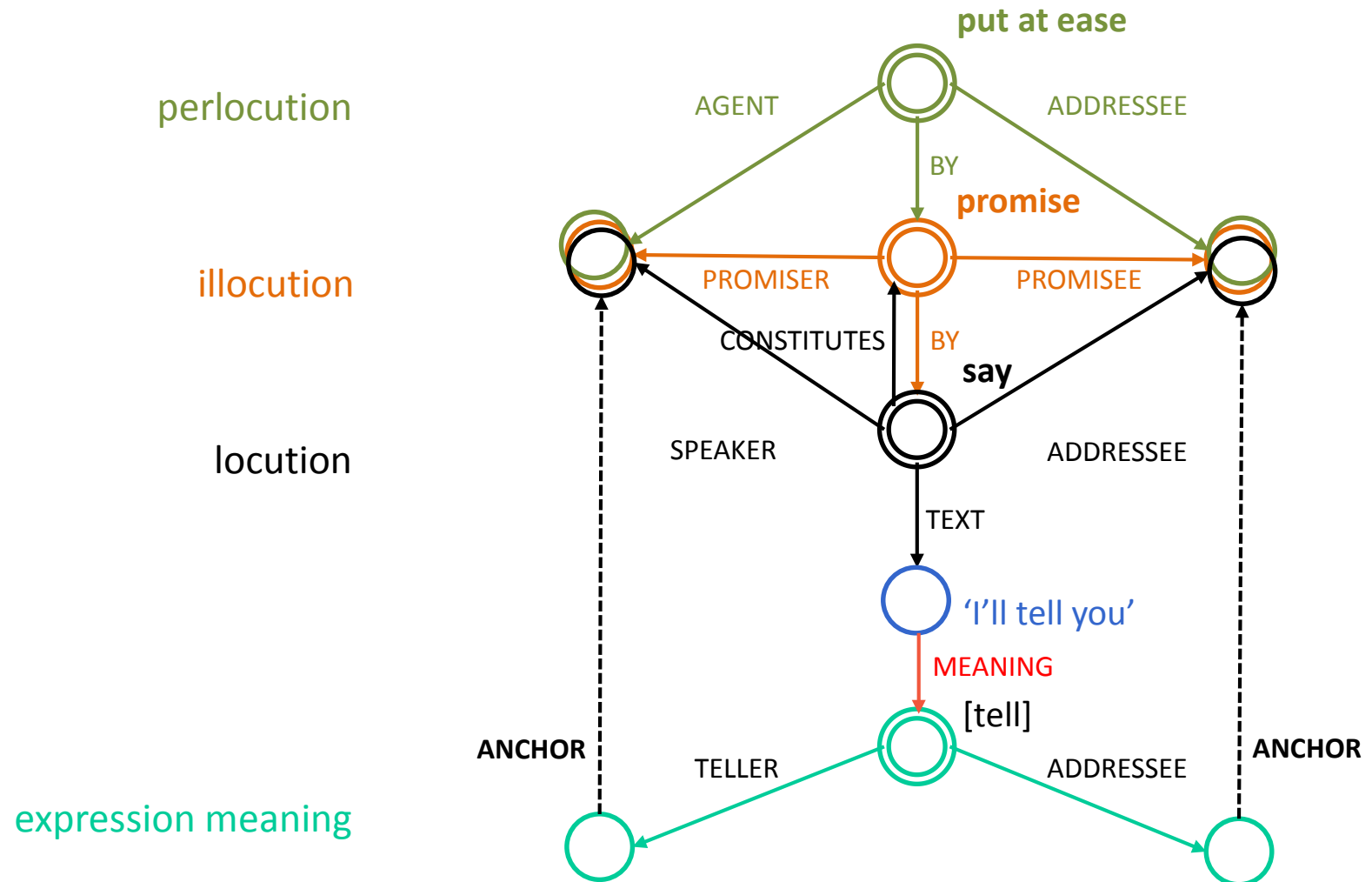
Conclusions

- 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.

Selected references

Austin, J. L. (1962) *How to Do Things with Words.* Oxford University Press, London.

Barsalou, L. W. (1992) Frames, concepts, and conceptual fields. In A. Lehrer and E. F. Kittay (eds.) *Frames, fields, and contrasts: New essays in semantic and lexical organization*. Lawrence Erlbaum Associate, Hillsdale, NJ.

Barsalou, L. W. (1999) Perceptual symbol systems. *Behavioral and Brain Sciences* 22

Löbner, S. (2014) Evidence for frames from human language. In T. Gamerschlag et al. (eds.) Frames and Concept Types. Springer, Heidelberg

Petersen, W. (2007) Representation of concepts as frames. In: Skilters, J. et al. (eds.) *Complex cognition and qualitative science.* The Baltic International Yearbook of Cognition, Logic and Communication 2. University of Latvia, Riga (2007)

Pustejovsky, J. (1991) The Generative Lexicon. *Computational Linguistics* 17.

Pustejovsky, J. (1995) *The Generative Lexicon.* MIT Press, Cambridge MA.