Multi-source projection of coreference chains

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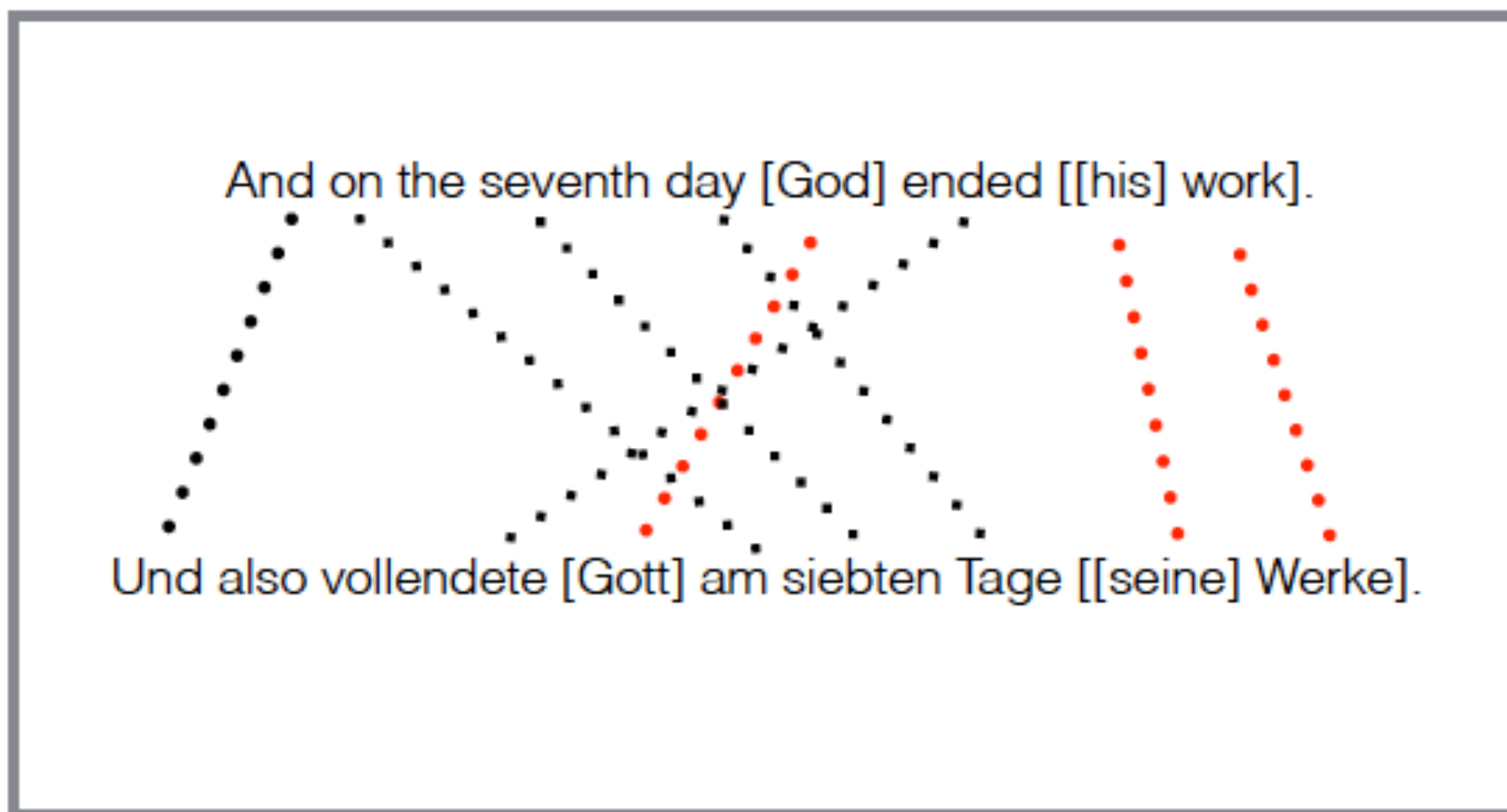
Outline

(I) idea

(II) strategies

(III) results

(IV) error analysis

(V) outcomes

(1) Idea & Methodology

Annotation projection

- **automatically transfer annotations from source to target**

And on the seventh day [God] ended [[his] work].

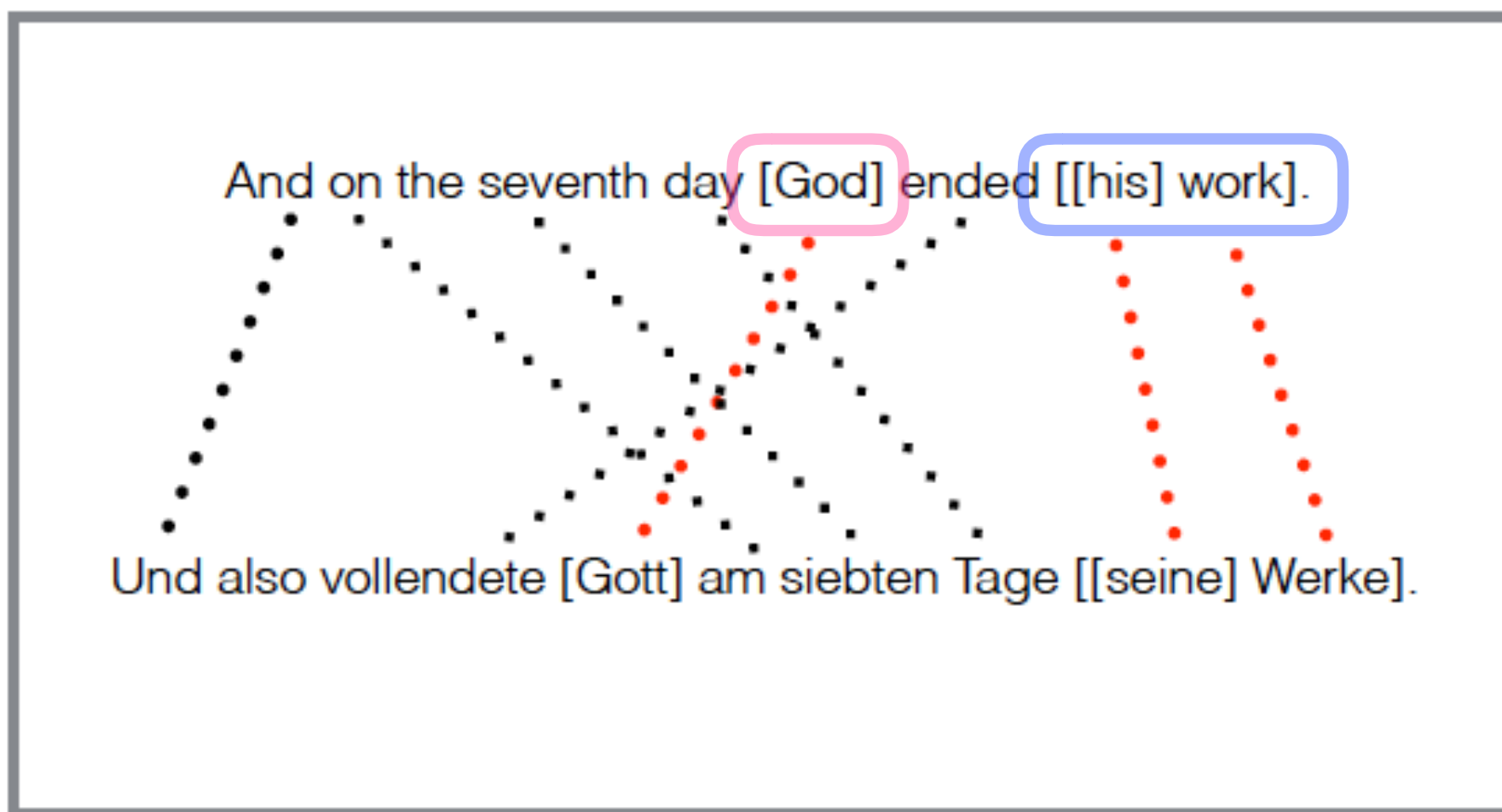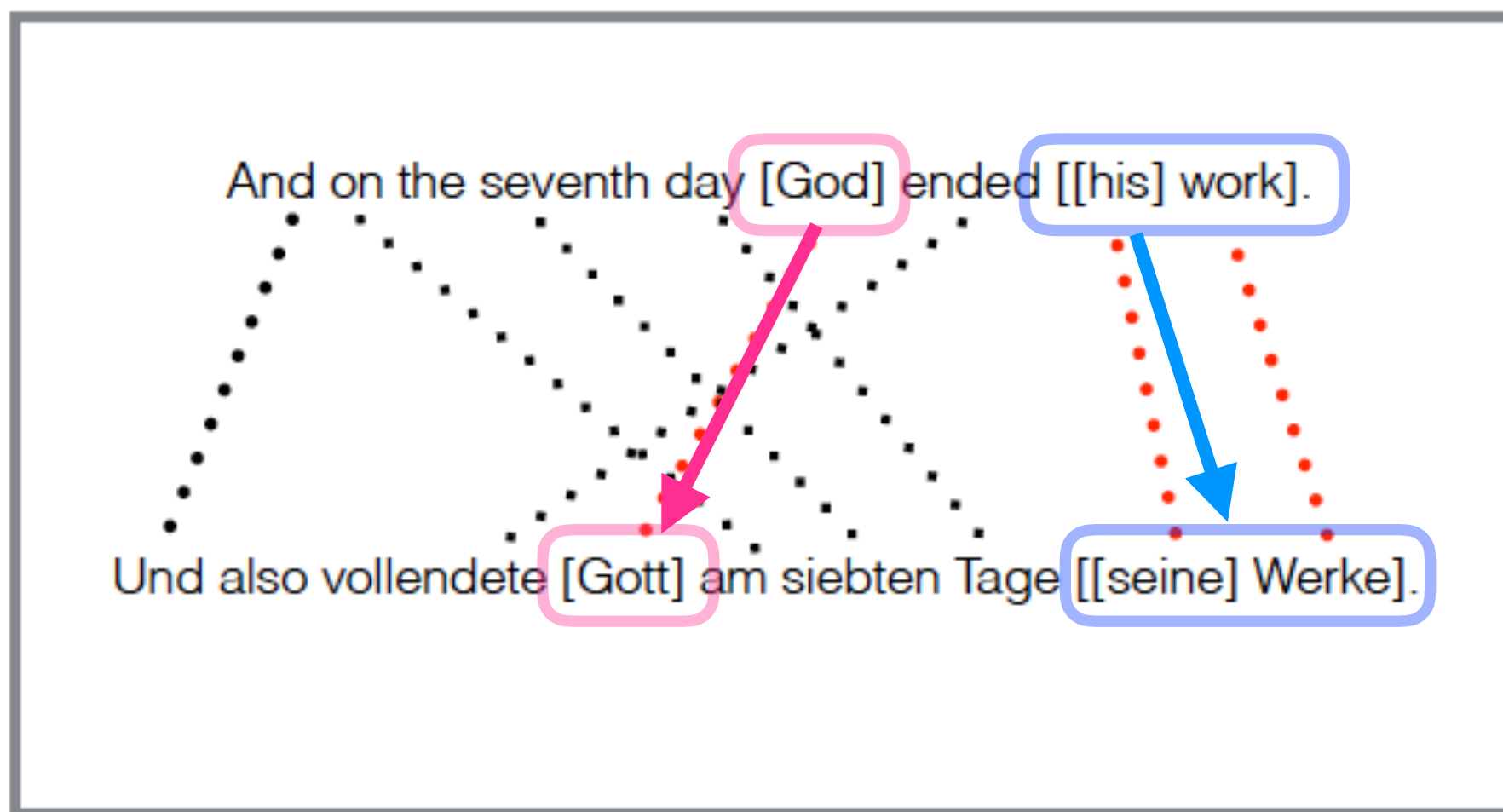Und also vollendete [Gott] am siebten Tage [[seine] Werke].

Annotation projection

- **automatically transfer annotations from source to target**

Annotation projection

- **automatically transfer annotations from source to target**

New: multi-src projection

- (Yarowski et al., 2001): multiple translations of Bible

- (Agic et al., 2016): POS tags

- (Rasooli and Collins, 2015; Johannsen et al., 2016): dependency trees

- .. coreference?

The parallel corpus

- 38 parallel texts

- 3 languages: English, German, Russian

- 3 text genres: newswire[1], narratives[2], medicine instruction leaflets[3] (only EN-DE)

[1] multilingual newswire agency Project Syndicate (www.project-syndicate.org)

[2] short narratives for second language acquisition Daisy stories (http://www.lonweb.org)

[3] EMEA subcorpus of the OPUS collection of parallel corpora (Tiedemann, 2009)

The parallel corpus

- sentence-aligned

- extracted sentences aligned in the three languages (reduced sentences by 5% and coref. chains by 6% as compared to (Grishina & Stede, 2015))

- word alignment using GIZA++ (Och & Ney, 2003)

Annotation

- common coreference annotation guidelines

- uniform annotations in 3 languages

- identity relation

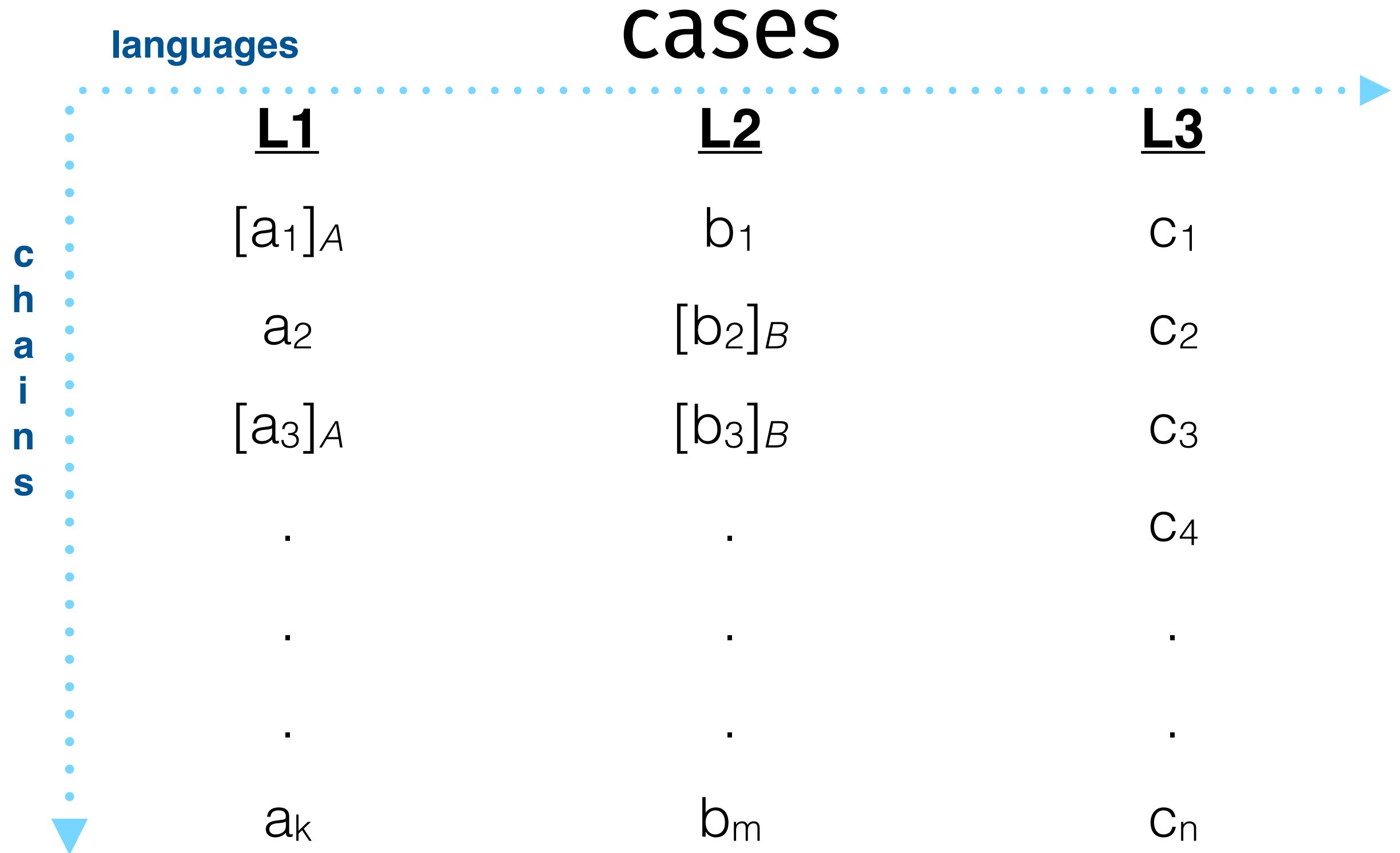- see (Grishina & Stede, 2016)

Annotation guidelines

- NP coreference: full NPs, proper names, pronouns

- no generic NPs annotated

- no singletons annotated

The parallel corpus

	Newswire			Narratives			Total		
	EN	DE	RU	EN	DE	RU	EN	DE	RU
Tokens	5903	6268	5763	2619	2642	2343	*8522*	*8910*	*8106*
Sentences	239	252	239	190	186	192	*429*	*438*	*431*
REs	558	589	606	470	497	479	*1028*	*1086*	*1085*
Chains	124	140	140	45	45	48	*169*	*185*	*188*
REs/Chains (%)	4.5	4.2	4.3	*10.4*	*11.0*	*10.0*	*6.1*	*5.9*	*5.8*
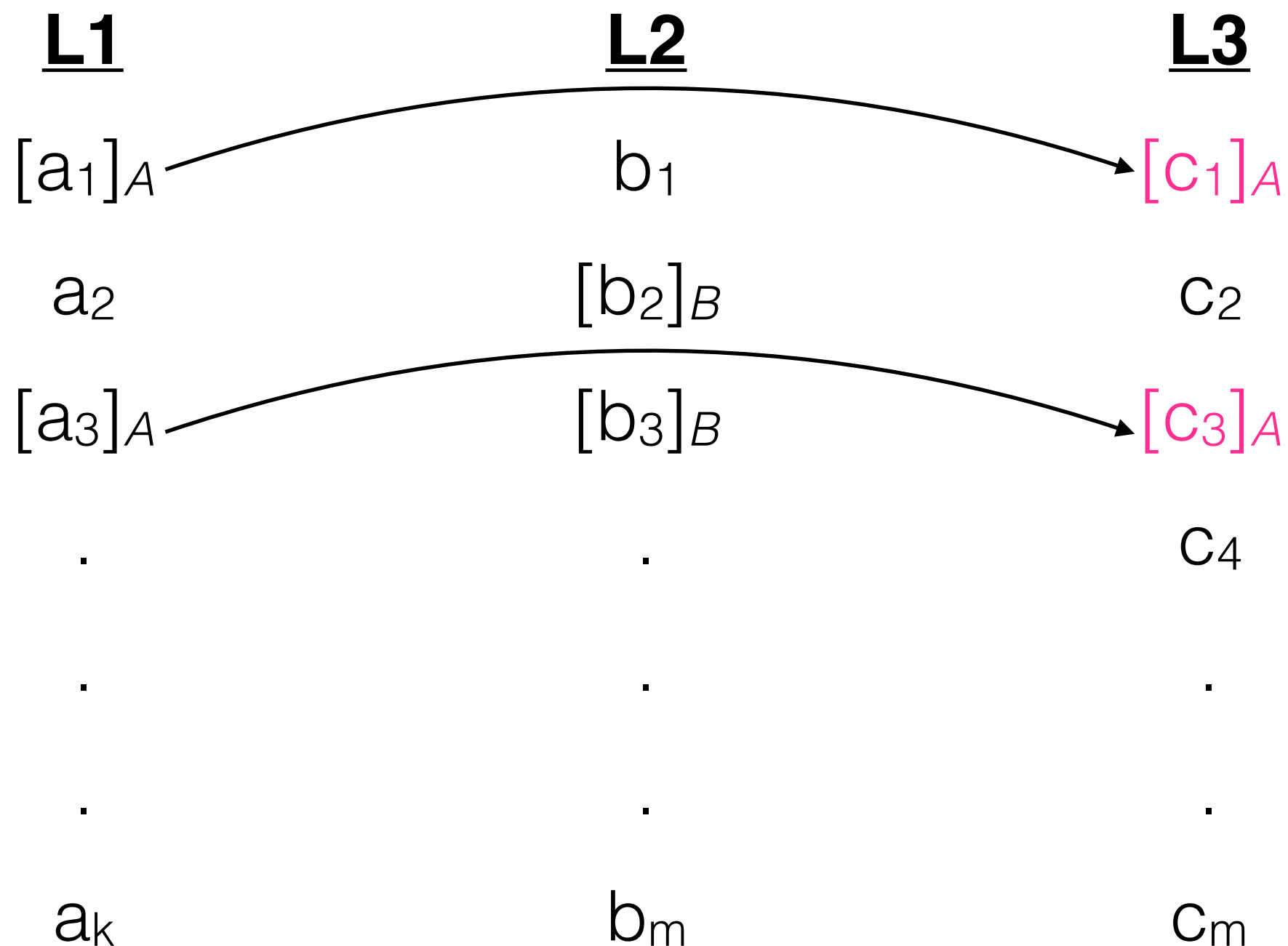
(Grishina and Stede, 2015), (Grishina, 2016)

(2) Strategies

Multi-src projection: cases

<u>L1</u>   **<u>L2</u>**   **<u>L3</u>**

c h a i n s

L1	L2	L3
$[a_1]_A$	b_1	c_1
a_2	$[b_2]_B$	c_2
$[a_3]_A$	$[b_3]_B$	c_3
.	.	c_4
.	.	.
.	.	.
a_k	b_m	c_n

Multi-src projection: trivial case

L1	**L2**	**L3**
$[a_1]_A$	b_1	$[c_1]_A$
a_2	$[b_2]_B$	c_2
$[a_3]_A$	$[b_3]_B$	$[c_3]_A$
.	.	c_4
.	.	.
.	.	.
a_k	b_m	c_m

Multi-src projection: trivial case

L1 **L2** **L3**

$[a_1]_A$ b_1 $[c_1]_{AB}$

a_2 $[b_2]_B$ c_2

$[a_3]_A$ $[b_3]_B$ $[c_3]_{AB}$

. . c_4

. . .

. . .

a_k b_m c_n

Multi-src projection: trivial case

L1 　 **L2** 　 **L3**

$[a_1]_A$ 　 b_1 　 **$[c_1]_{AB}$**

a_2 　 $[b_2]_B$ 　 c_2

$[a_3]_A$ 　 $[b_3]_B$ 　 **$[c_3]_{AB}$**

. 　 . 　 c_4

identical chains

. 　 . 　 .

. 　 . 　 .

a_k 　 b_m 　 c_n

Multi-src projection: simple case

L1	**L2**	**L3**
$[a_1]_A$	b_1	$[c_1]_A$
a_2	$[b_2]_B$	c_2
$[a_3]_A$	$[b_3]_B$	$[c_3]_A$
.	.	c_4
.	.	.
.	.	.
a_k	b_m	c_n

Multi-src projection: simple case

L1   **L2**   **L3**

$[a_1]_A$ b_1 $[c_1]_A$

a_2 $[b_2]_B$ $[c_2]_B$

$[a_3]_A$ $[b_3]_B$ $[c_3]_A$

$[c_4]_B$

.   .   .

.   .   .

.   .   .

a_k b_m c_n

Multi-src projection: simple case

L1   **L2**   **L3**

$[a_1]_A$ b_1 $[c_1]_A$

a_2 $[b_2]_B$ $\longrightarrow$ $[c_2]_B$

$[a_3]_A$ $[b_3]_B$ $[c_3]_A$

$[c_4]_B$

.   .

disjoint chains

.   .   .

.   .   .

a_k b_m c_n

Multi-src projection: typical case

L1	**L2**	**L3**
$[a_1]_A$	b_1	$[c_1]_A$
a_2	$[b_2]_B$	c_2
$[a_3]_A$	$[b_3]_B$	$[c_3]_A$
.	.	c_4
.	.	.
.	.	.
a_k	b_m	c_n

Multi-src projection: typical case

L1	**L2**	**L3**
$[a_1]_A$	b_1	$[c_1]_A$
a_2	$[b_2]_B$	$[c_2]_B$
$[a_3]_A$	$[b_3]_B$	$[c_3]_?$
.	.	c_4
.	.	.
.	.	.
a_k	b_m	c_n

Multi-src projection: typical case

L1 **L2** **L3**

$[a_1]_A$ b_1 $[c_1]_A$

a_2 $[b_2]_B$ $[c_2]_B$

$[a_3]_A$ $[b_3]_B$ $[c_3]_?$ ***A or B?***

. . c_4

overlapping chains

. . .

. . .

a_k b_m c_n
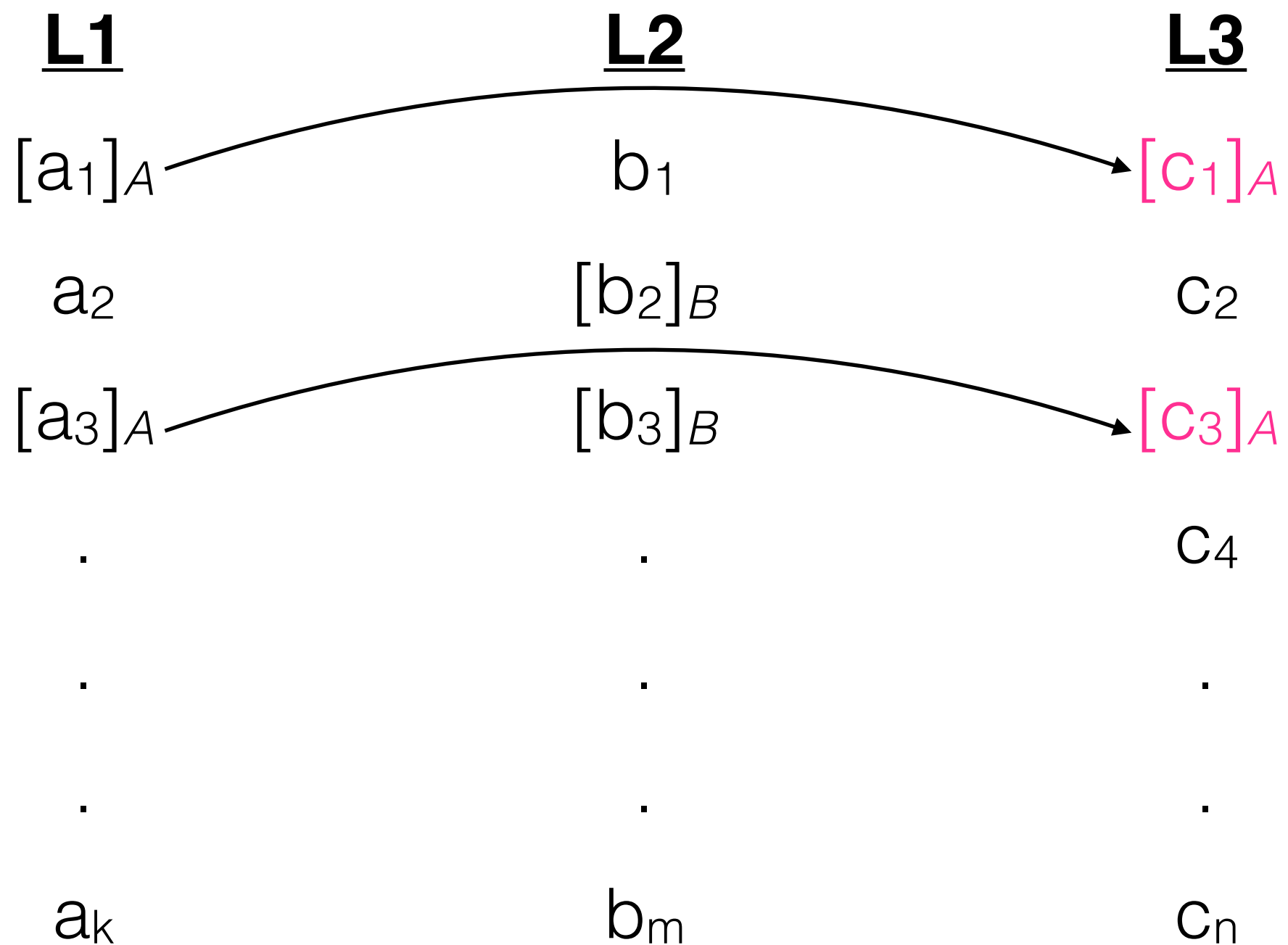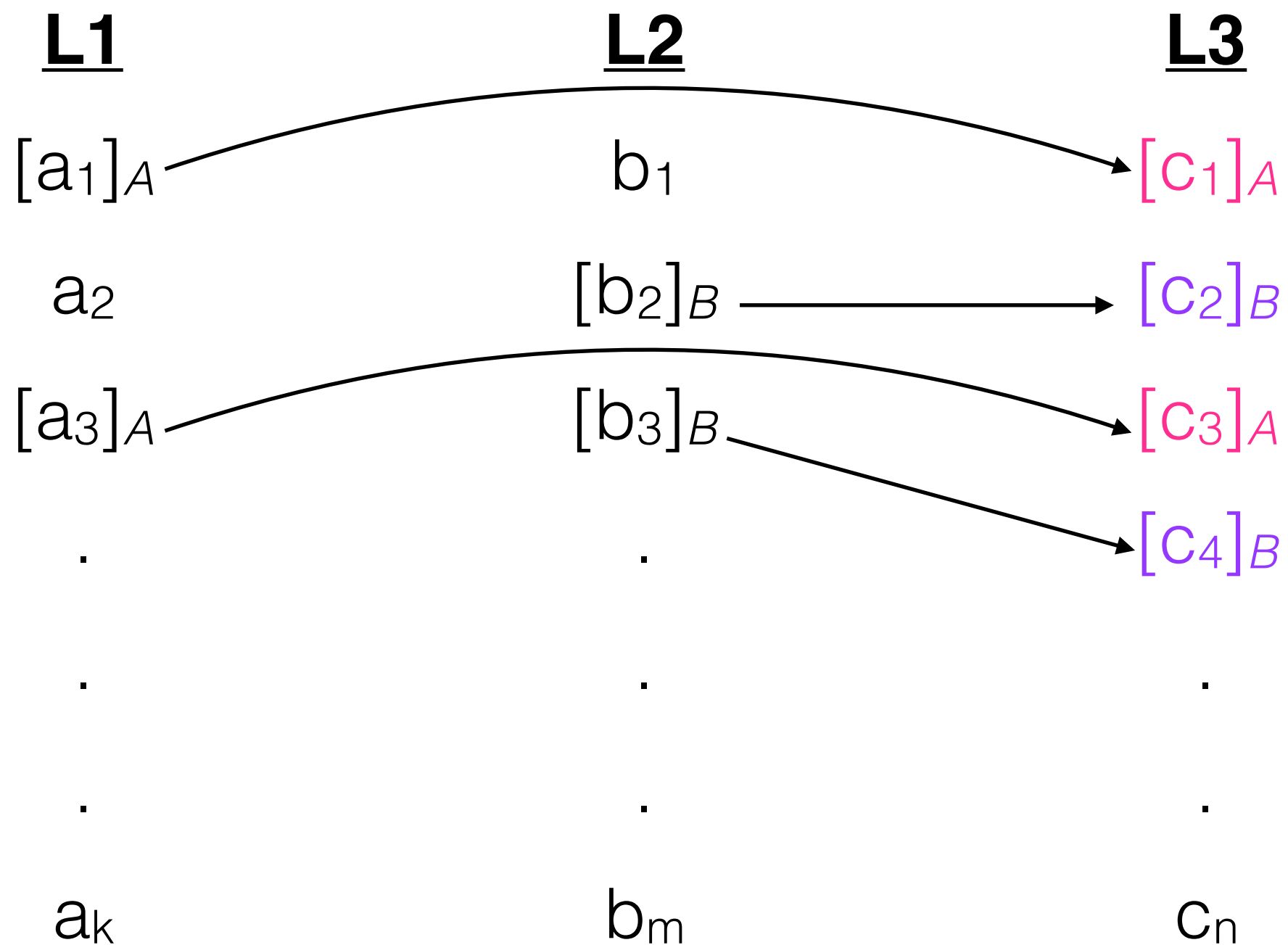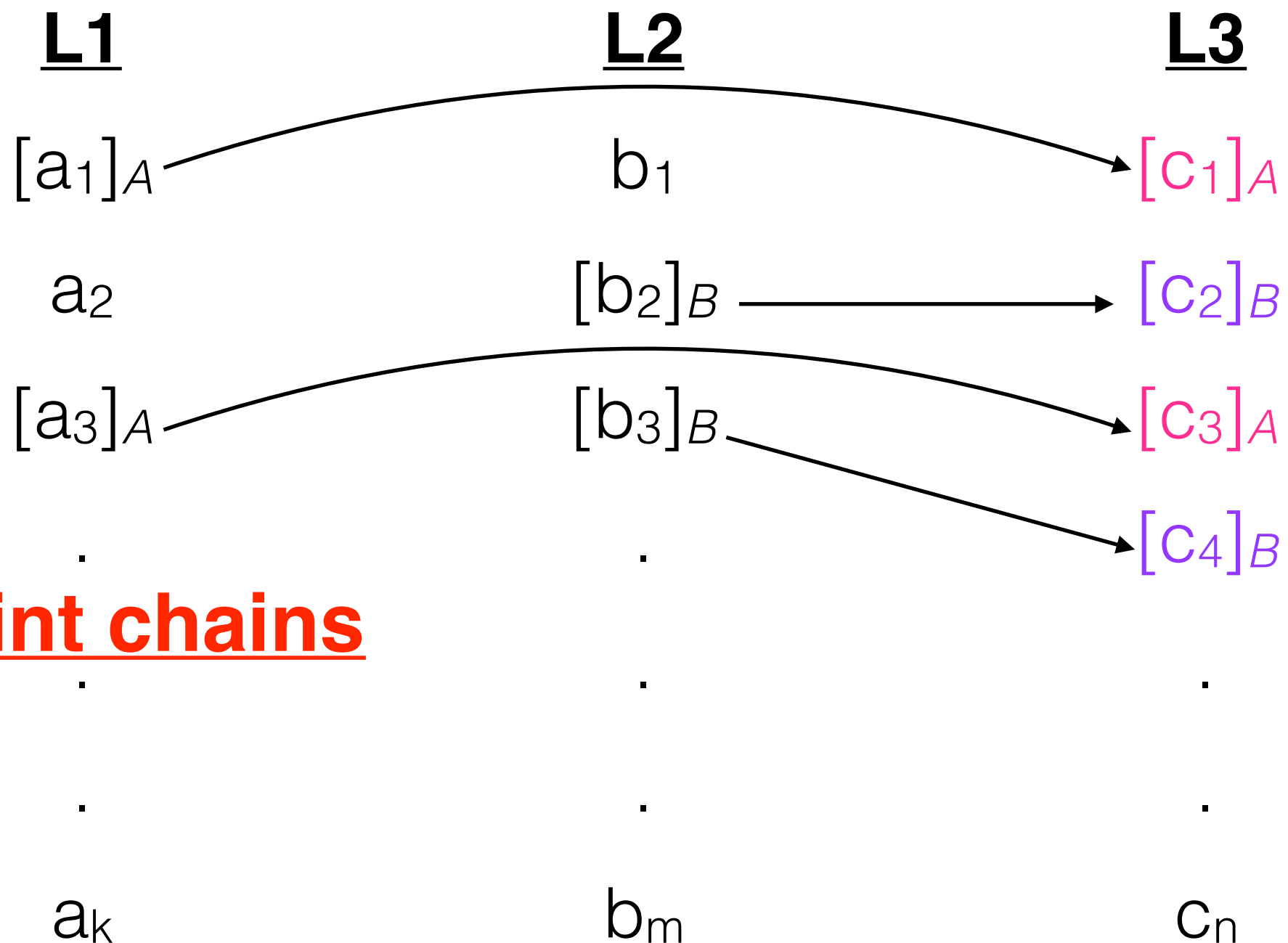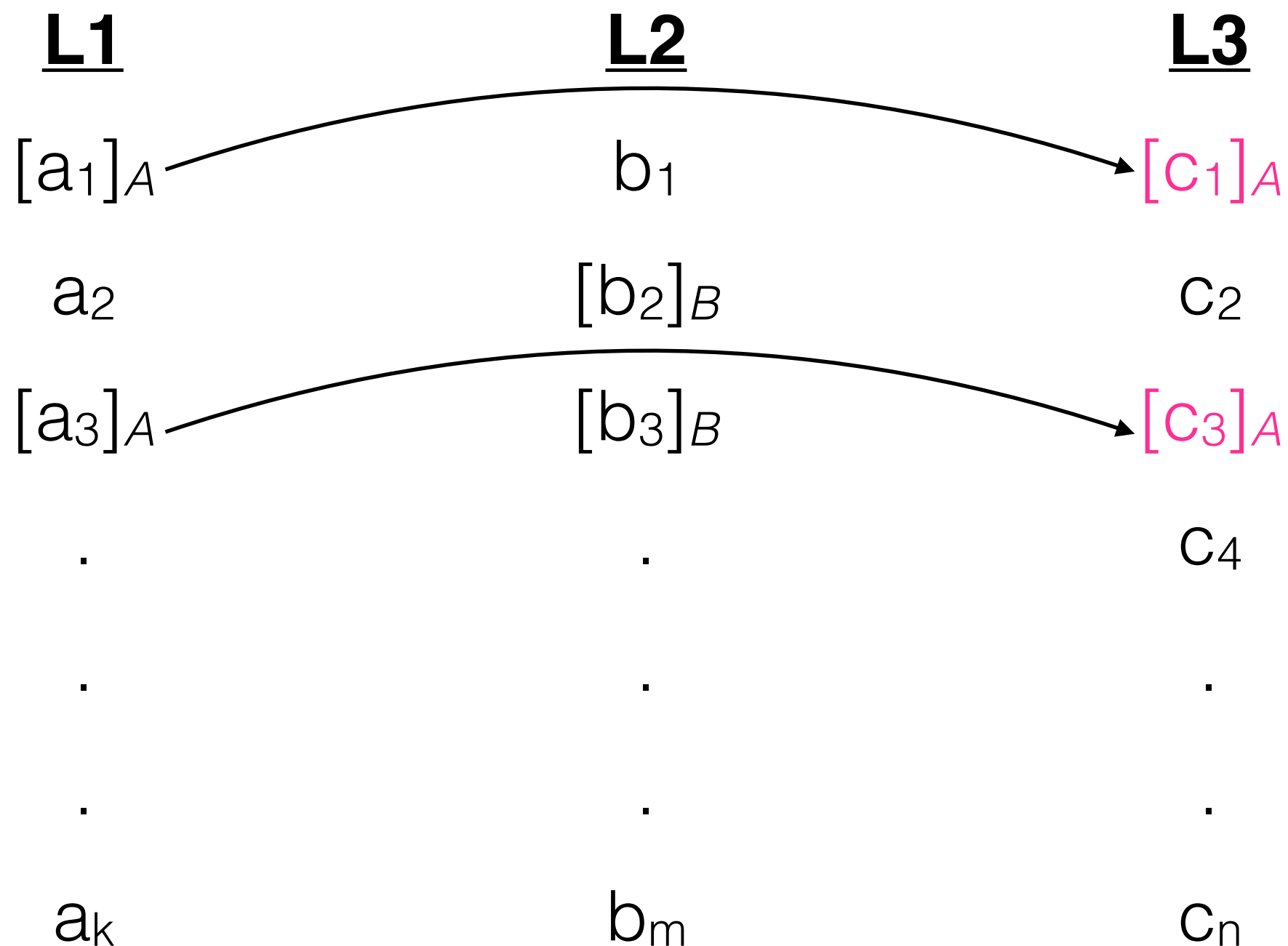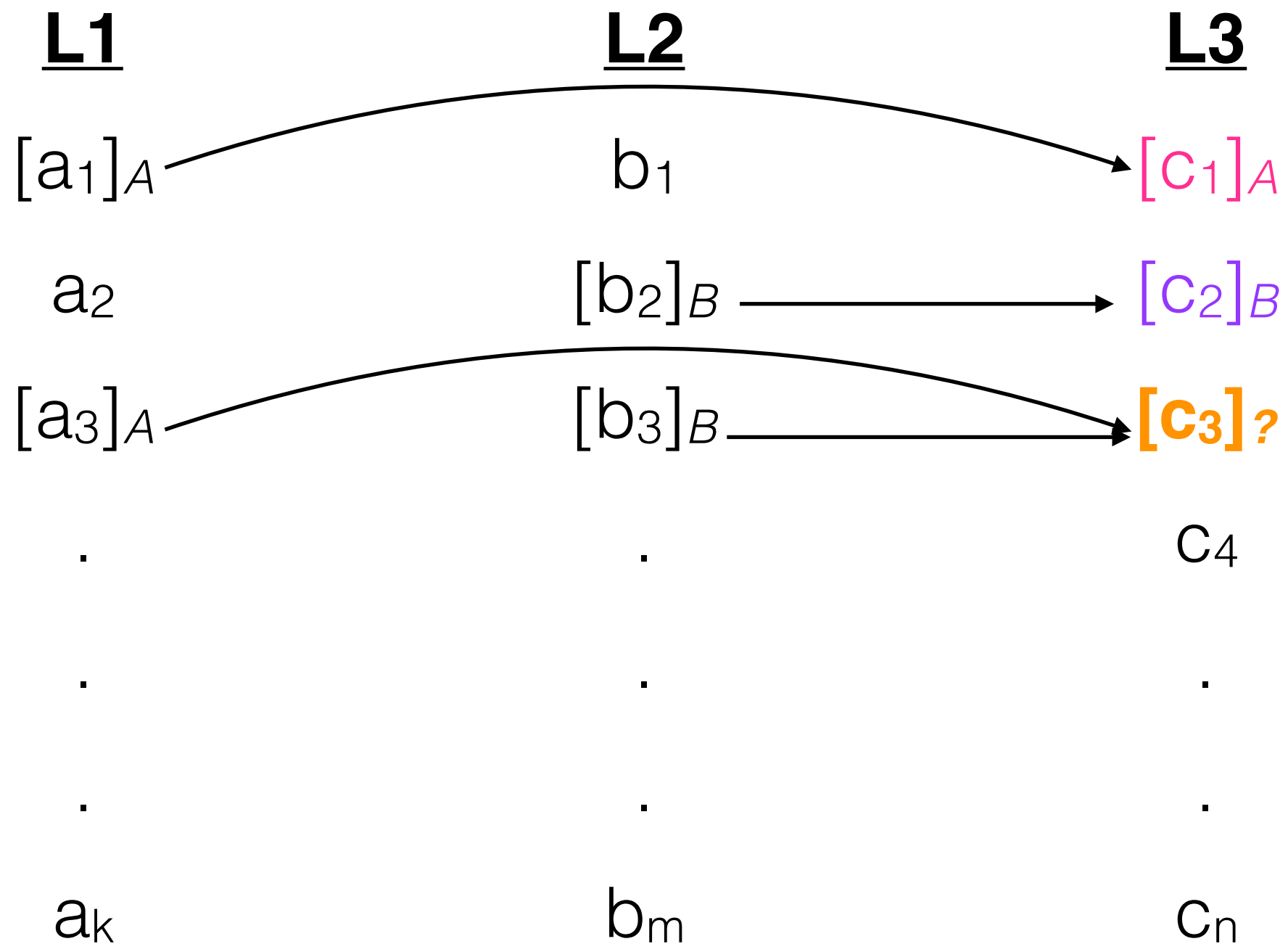
Strategies
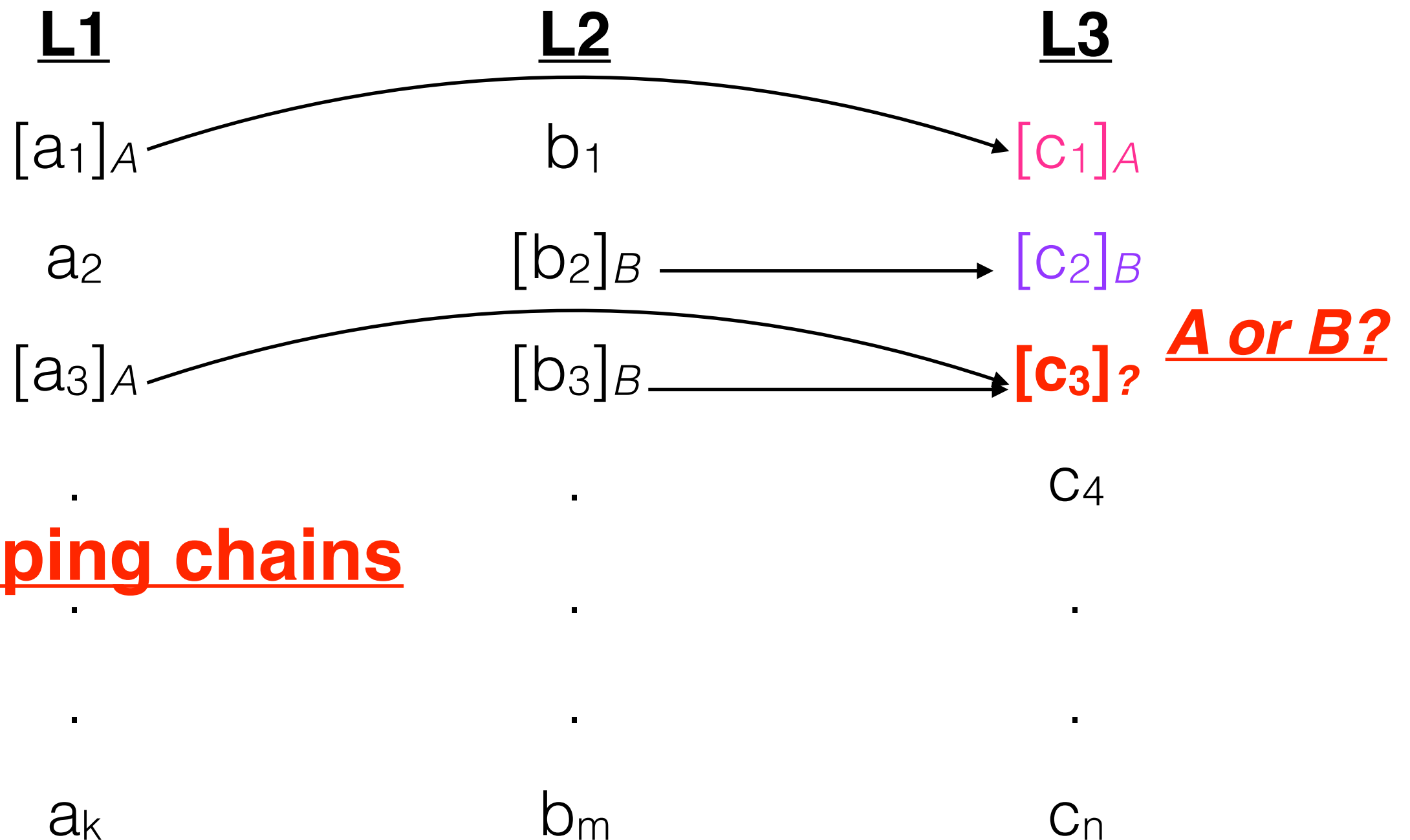
concatenation
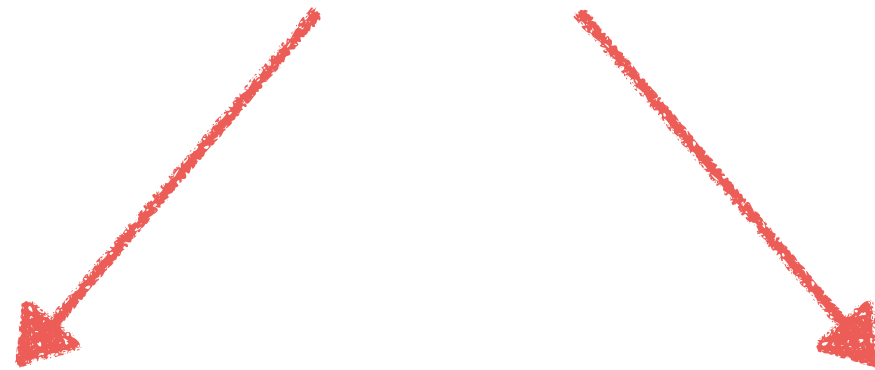
voting, intersection

add: disjoint chains from one lang are added to the other languages
concatenate: overlapping chains merged together

intersect: intersection of mentions for overlapping chains

A real example

EN: [A fat lady] [who] wore a fur around [her] neck came in. [She] said that [she] needs [Daisy's] help and does not know what to do.

DE: [Eine dicke Dame mit einer Pelzstola] kam rein. [Sie] hat gesagt, dass [sie] [Daisys] Hilfe braucht und dass [sie] nicht weiß, was [sie] tun soll.

RU: Вошла [полная дама, носившая мех вокруг шеи]. [Она] сказала, что [ей] необходима помощь [Дэйзи] и что [она] не знает, что [ей] делать.

A real example

EN: [A fat lady] [who] wore a fur around [her] neck came in. [She] said that

[she] needs [Daisy's] help and does not know what to do.

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[sie] [Daisys] Hilfe braucht und dass [sie] nicht weiß, was [sie] tun soll.

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A real example

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[ей] необходима помощь [Дэйзи] и что [она] не знает, что [ей] делать.

(3) Results

Results

	EN,RU->DE	+ment	EN,DE->RU	+ment
add	46.6	52.6	56.9	57.3
concatenate	49.6	57.0	58.6	59.0
intersect	35.7	40.3	40.7	40.8

Results

	EN,RU->DE	+ment	EN,DE->RU	+ment
add	46.6	52.6 +6.0	56.9	57.3 +0.4
concatenate	49.6	57.0 +7.4	58.6	59.0 +0.4
intersect	35.7	40.3 +4.6	40.7	40.8 +0.1

Results: baselines

	P	R	F1
EN-DE	55.3	43.8	48.7
RU-DE	40.9	26.7	31.9
EN,RU-DE-con	53.3	**46.5**	**49.6**
EN,RU-DE-int	**63.0**	25.7	35.7
EN-RU	68.0	51.6	58.5
DE-RU	54.4	28.9	37.3
EN,DE-RU-con	67.2	**52.2**	**58.6**
EN,DE-RU-int	**78.0**	28.1	40.7

Results: baselines + ment

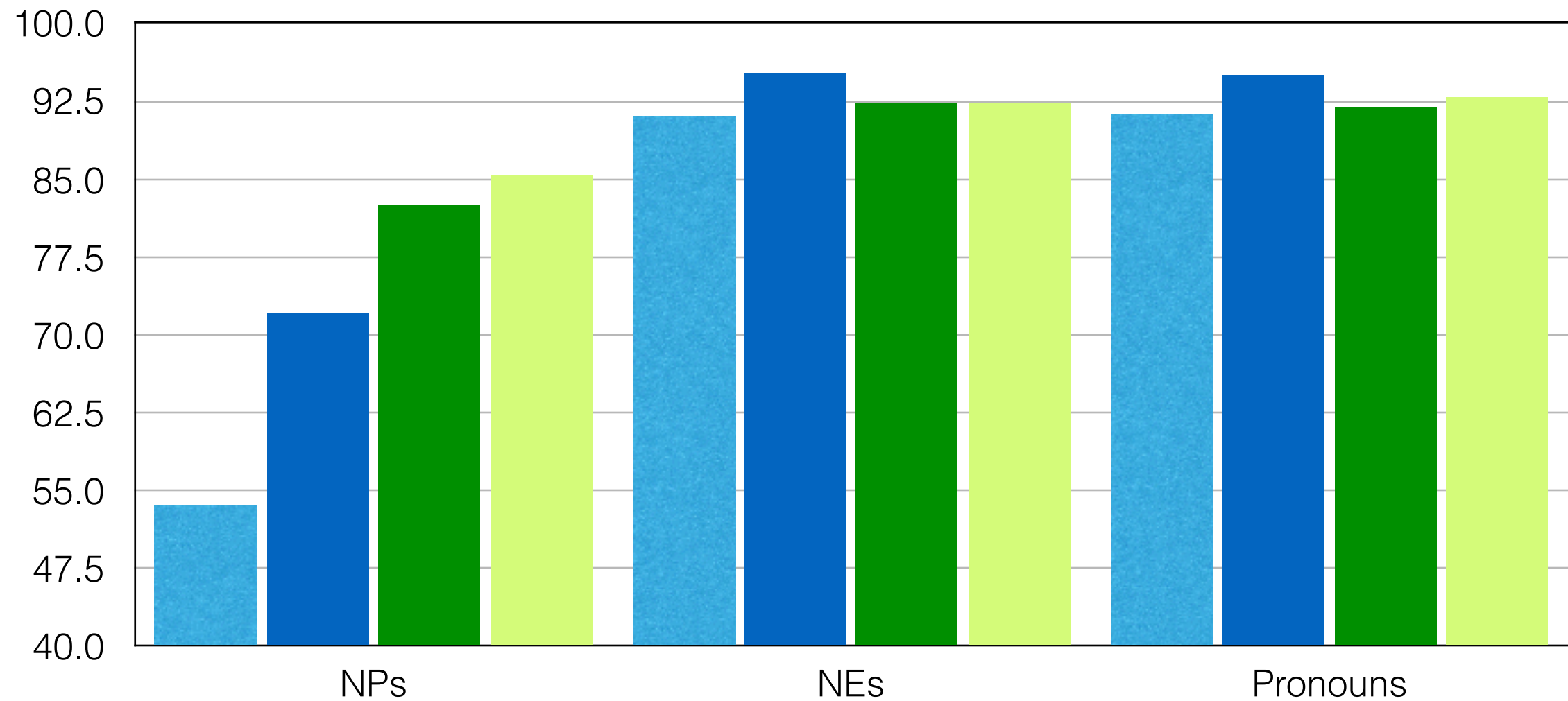|	P	R	F1
EN-DE	63.2	50.0	55.7
RU-DE	41.7	27.0	32.3
EN,RU-DE-con	62.3	**52.7**	**57.0**
EN,RU-DE-int	**71.8**	29.1	40.3
EN-RU	68.4	52.4	58.8
DE-RU	54.9	29.0	37.6
EN,DE-RU-con	67.7	**52.5**	**59.0**
EN,DE-RU-int	**79.1**	28.1	40.8

(4) Error analysis

Projected markables by type
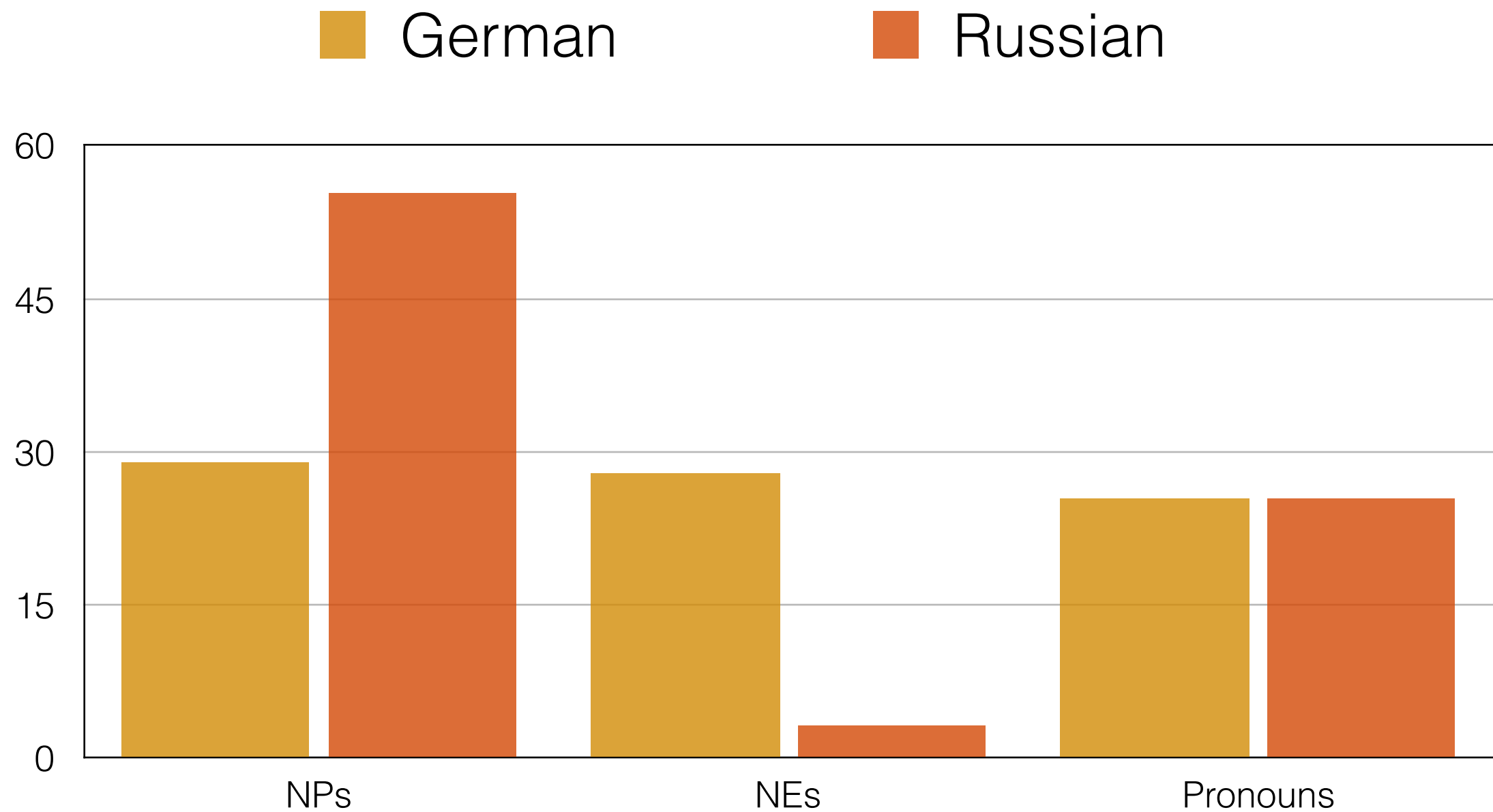
Markable accuracy by type
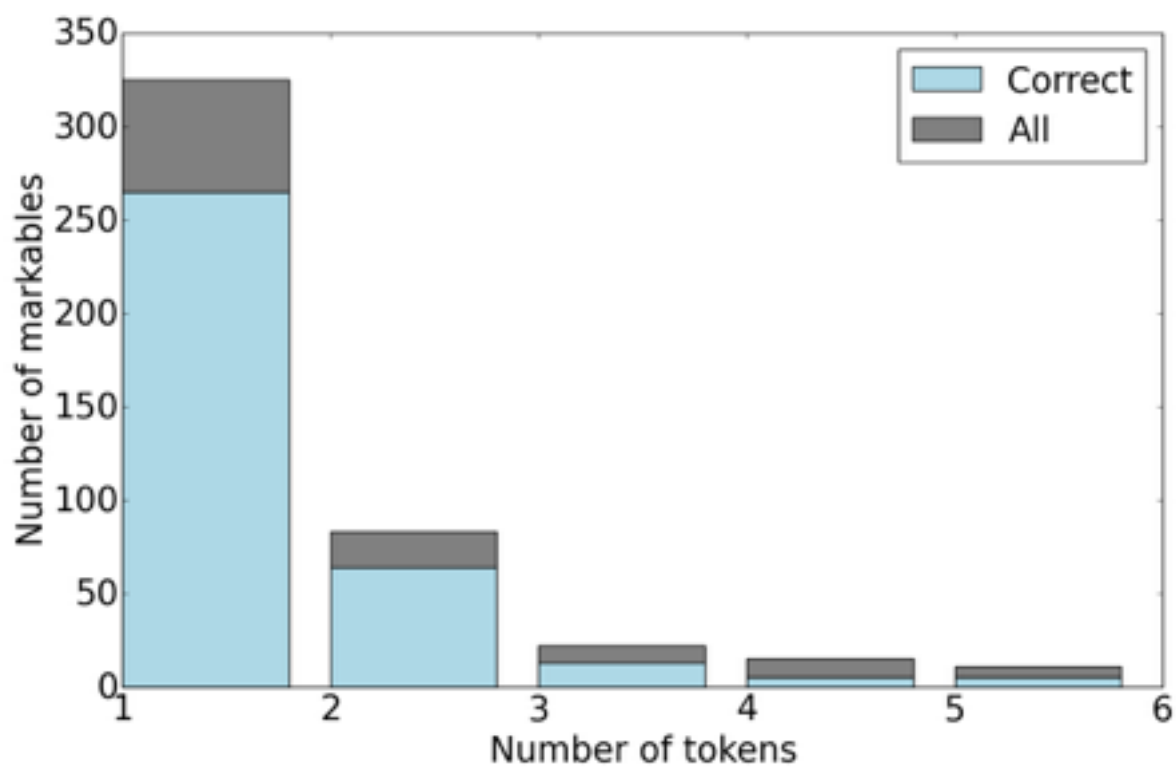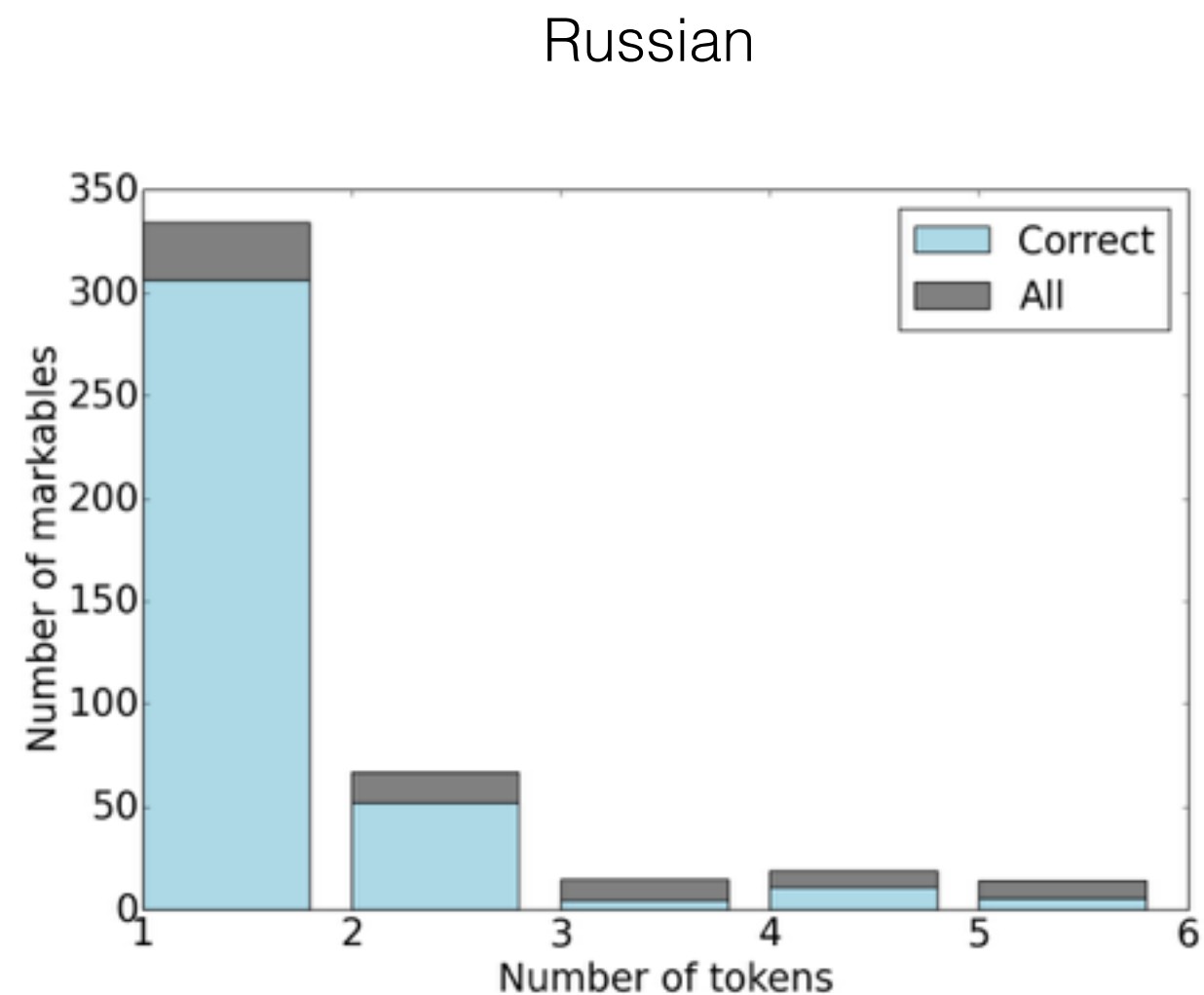
Markable accuracy by type
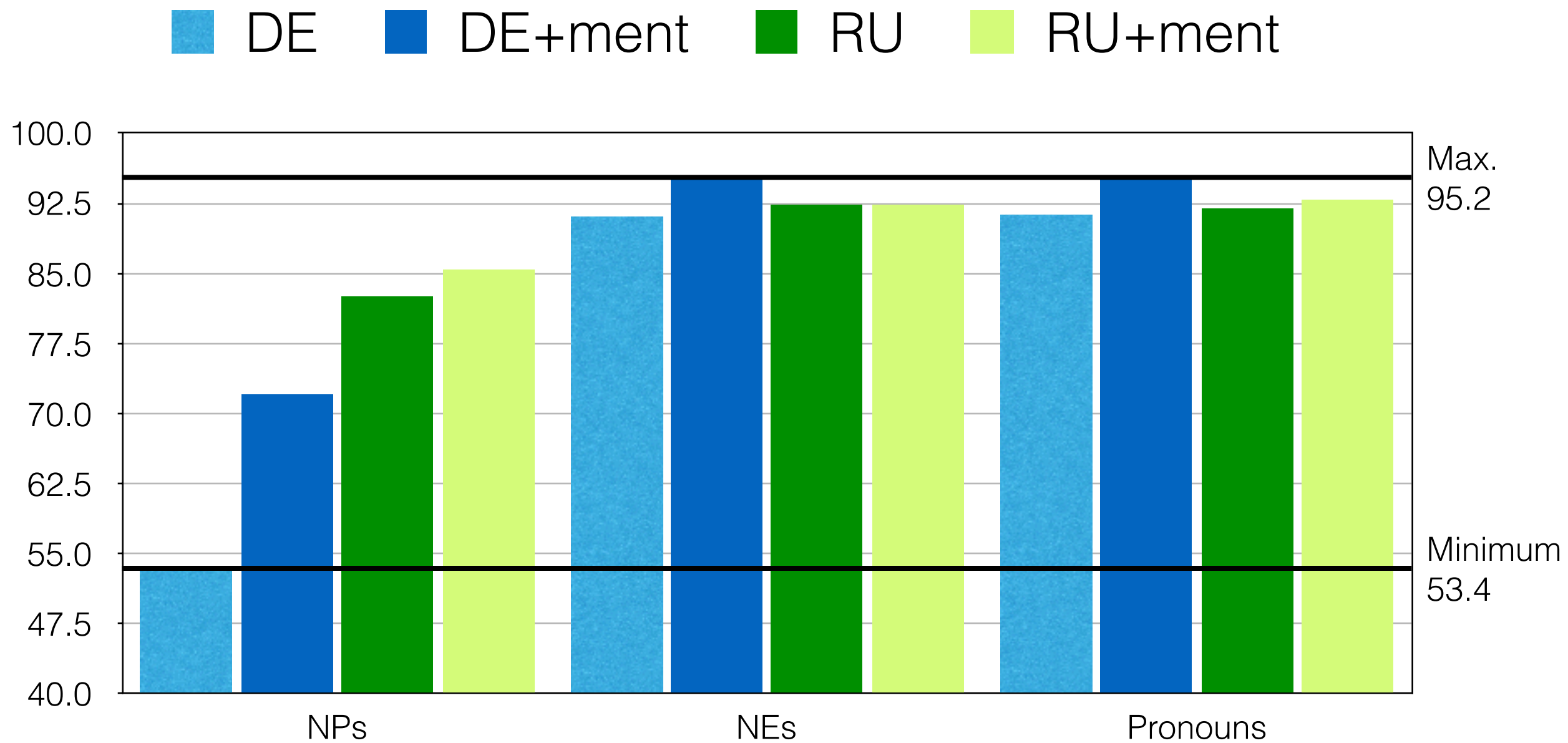
Markable accuracy by
of tokens

German

Russian

(5) Outcomes

Outcomes

- comparable results for both languages: the highest Precision of 78.0/79.1 for German/Russian and the highest Recall of 52.7 for both;

- outperforms single-source projection in terms of Precision and Recall; overall results are only slightly higher;

- different directions of projection are not equally good.

Conclusions

- for the first time implemented multi-source projection for coreference and tested several strategies

- it outperforms P&R scores as compared to single source & achieves slightly better overall scores

- NPs are more challenging for the projection than pronouns; automatic mention extraction supports mention recovery for German.

Future work

- experimenting with more sophisticated strategies based upon this study

- projection with more than two source languages

- projection of automatic annotations & system training

thank you!