



# Centering Theory in natural text: a large-scale corpus study

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## Centering Theory (CT): transition types

Grosz et al. (1995)

$U$  = utterance  
 $CB$  = backward-looking center  
 $CP$  = preferred center

$CB(U_i) = undef.$	NoCB
$CB(U_{i-1}) = undef$ and $CB(U_i) = def.$	ESTABLISH

	Coherence $CB(U_i) = CB(U_{i-1})$	$\neg$ Coherence $CB(U_i) \neq CB(U_{i-1})$
Salience $CB(U_i) = CP(U_i)$	CONTINUE	SMOOTH-SHIFT
$\neg$ Salience $CB(U_i) \neq CP(U_i)$	RETAIN	ROUGH-SHIFT

Our parameter settings:

- ▶ **utterance** = sentence
- ▶ **ranking of centers** within an utterance: *grammatical function* (*subj* > *obj* > *other*) and *surface order* for disambiguation, nouns modifying other nouns ranked below their head.

← **entites** mentioned in the text  
CP, CB

Julia owns a cat and a dog. — ESTABLISHMENT  
 She likes the dog better. ← CONTINUE  
 She thinks the cat is crazy. ← RETAIN  
 John likes Julia a lot. ← SMOOTH SHIFT  
 He feeds the cat when Julia is on vacation. ← ROUGH SHIFT  
 The dog usually travels with Julia. ← NOCB  
 John doesn't mind the cat. ← NOCB

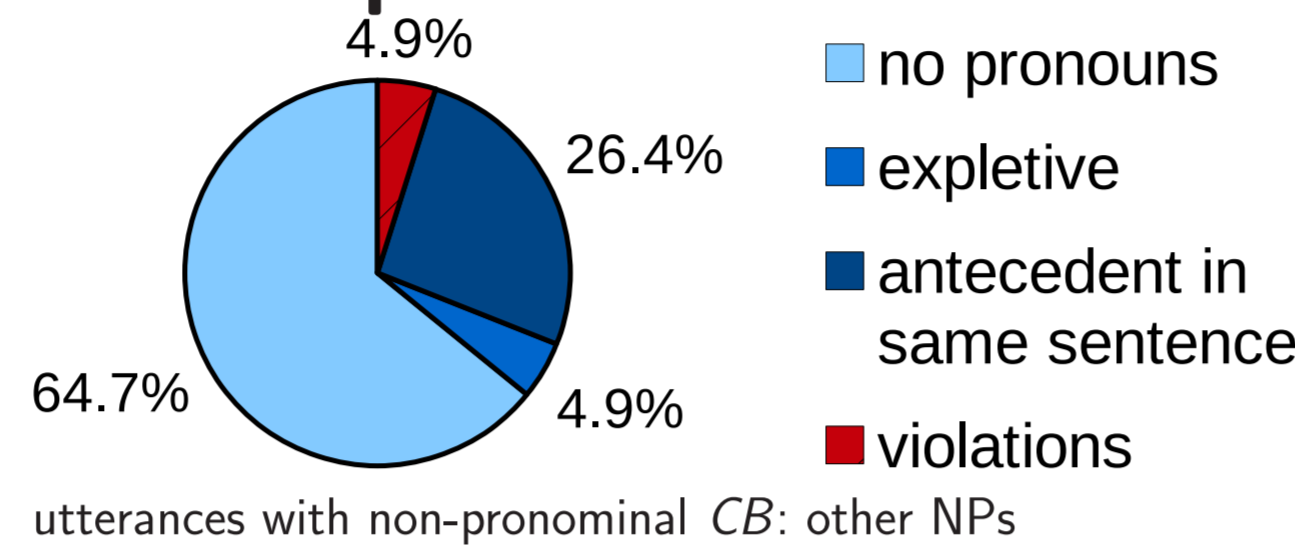
## Data: OntoNotes 4.0 (WSJ portion)

documents (total)	535
news (479), essay (41), letters (15)	
sentences (total)	14,096
paragraphs (total)	5,605
avg. # of sentences per par.	3.02
all CT transitions	13,561
transitions within paragraphs	8,491

- ▶ gold **parses** from PTB → dependency relations
- ▶ gold **coreference** annotation + same lemma heuristic

## CT applicability: collections of text

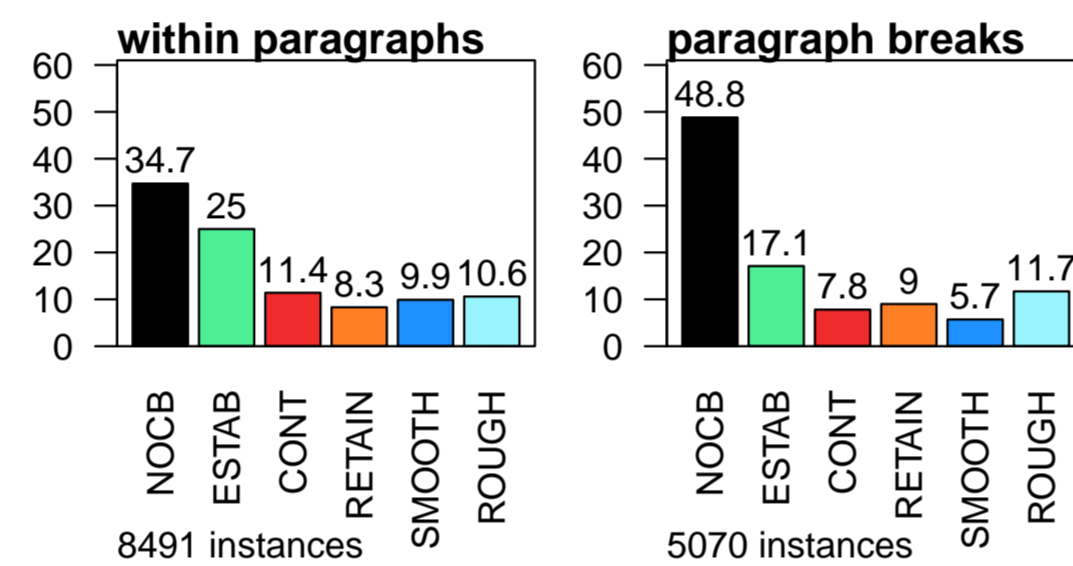
### Rule 1: pronominalization ✓



**Rule 1:** if CB is not pronominalized, neither should any other entity in the sentence be.  
⇒ strong support.

### Preferences for transition types: % in text ✗

Brennan (1987): degree of coherence: CONT > RET > SMOOTH > ROUGH

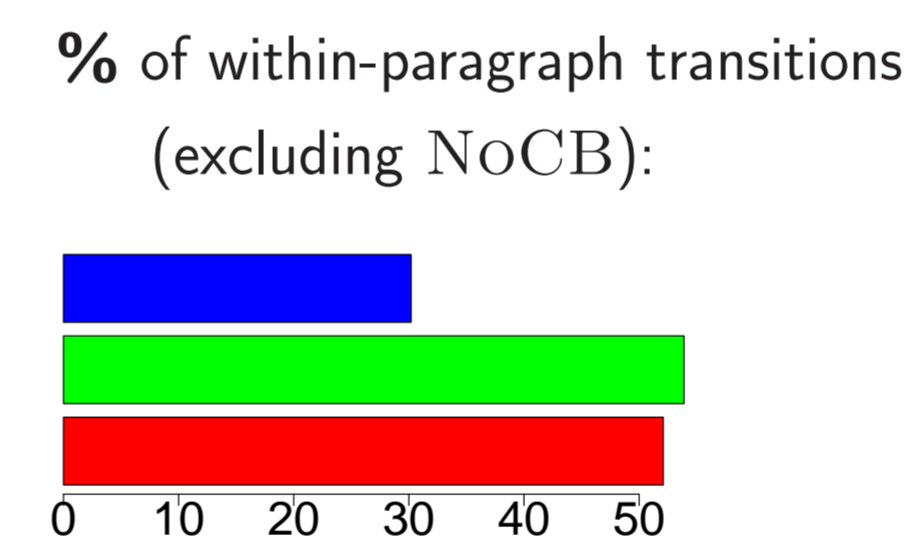


Transitions assumed to be more coherent are not in fact used more often (in coherent texts).  
New paragraphs: change focus, but refer to previous centers.

### Kibble (2001): reformulation of rule 2 ✓

coherence ranking of transitions using several criteria:

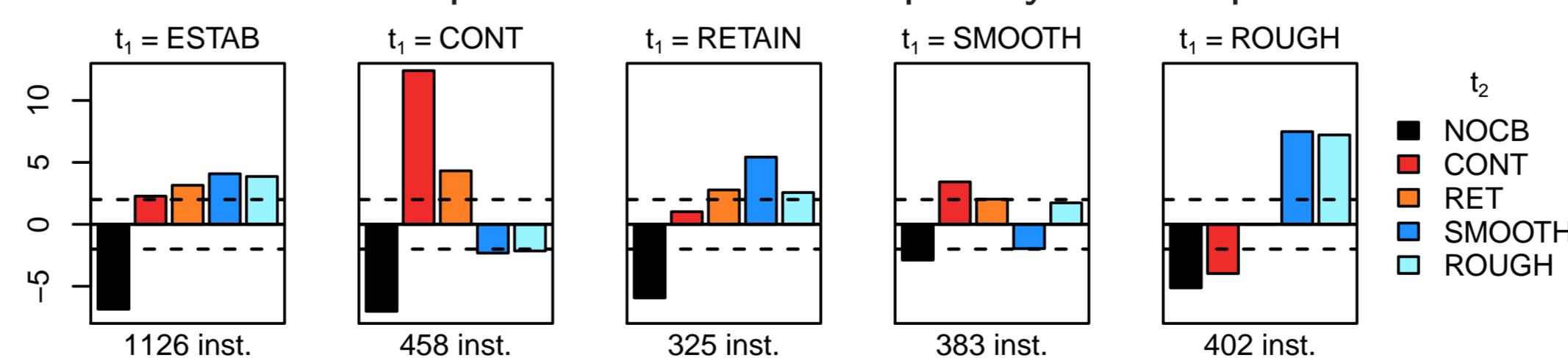
- ▶ *cohesion*:  $CP(U_i) = CP(U_{i-1})$
- ▶ *cheapness*:  $CB(U_i) = CP(U_{i-1})$
- ▶ *salience*:  $CB(U_i) = CP(U_i)$



“importance”: *salience* > *cheapness* > *cohesion*  
Kibble's predictions are supported.

### Transition bigram distributions ✓

Residuals of  $\chi^2$ -test, comparison of  $P(t_2|t_1)$  and  $P(t_2)$ :  
do some transition pairs occur more frequently than expected?



Negative residuals for NOCB: entity-coherent portions of text.  
More SMOOTH after RETAIN: supports RETAIN-SHIFT pattern.  
Pairs with large residuals → *cheap* pairs of Strube & Hahn (1999).

## CT applicability: coherence rating

### Information ordering experiments:

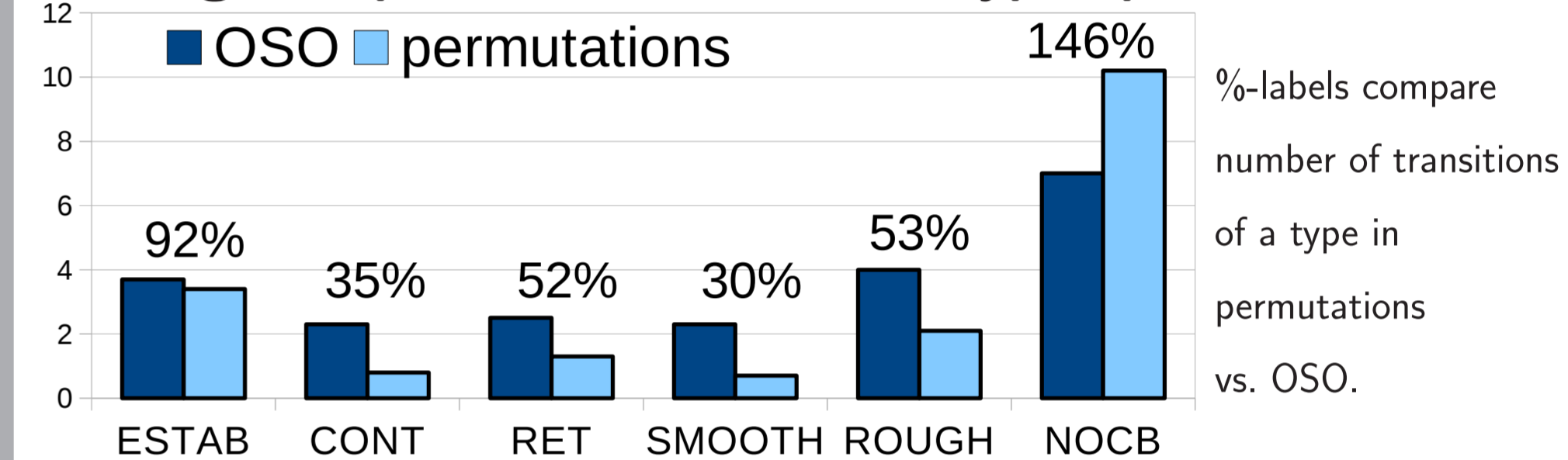
- original sentence order (OSO) should be scored higher than random permutation of sentences.
- ▶ Previous work (Karamanis et al. 2009): CT-based coherence metrics did not improve over simple baseline. **WHY?**

Classification error rates

METRIC	Our corpus	Karamanis
M.KP	0.219	0.561
<b>M.NoCB</b>	<b>0.226</b>	<b>0.217</b>
M.CHEAP	0.265	0.698
M.BFP	0.285	0.280
documents	535	542
sentences	14,096	4,380

M.KP and M.NoCB do **not** differ significantly ( $p < 0.01$ ).

### Average frequencies of transition types per document:



Major difference between OSO and permutations: percentage of NOCB transitions. All other types decrease, but not in relation to their assumed coherence. → assumption of metrics is wrong.

## Discussion & Conclusion

- ▶ CT **correctly** predicts patterns of entity mentions when analysing **collections of text**. → in line with previous, smaller studies (e.g. Hurewitz (1998), Poesio et al. (2004), Strube & Hahn (1999))
- ▶ CT's linguistic patterns suffer from **sparseness** when considering **single texts**. → explanation for why NOCB-based metric outperforms all other metrics (e.g. Karamanis (2009))
- ▶ Shifting centers may be what makes a text interesting to readers.
- ▶ NOCB transitions are not necessarily incoherent → need to consider other coherence devices (e.g. discourse relations).

- (a) Competition has glutted the market with both skins and coats, driving prices down.
- (b) The animal-rights movement hasn't helped sales. (NOCB)
- (c) Warm winters over the past two years have trimmed demand, too, furriers complain. (NOCB) (*wsj1586*)

