Automatic Classification of Communicative Functions of Definiteness

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Abstract

Definiteness expresses a constellation of semantic, pragmatic, and discourse properties (the communicative functions) of an NP. Our supervised classifier for English NPs uses lexical, morphological, and syntactic features to predict the communicative functions in terms of a language-universal classification scheme and establishes strong baselines for future work. Additionally, analysis of the features and learned parameters in the model provides insight into the grammaticalization of definiteness in English, not all of which is obvious a priori.

Classification Model

We use an in-house implementation of a multiclass logistic regression classifier.

Feature function:

$$\mathbf{f}(x, y) = \boldsymbol{\phi}(x) \times \tilde{\boldsymbol{\omega}}(y)$$

Feature weight vector:

$$\hat{\boldsymbol{\theta}} = \arg\max_{\boldsymbol{\theta}} -\lambda||\boldsymbol{\theta}||_2^2 + \sum_{\langle x,y\rangle \in \mathscr{D}} \log \frac{\exp \boldsymbol{\theta}^\top \mathbf{f}(x, y)}{\sum_{y' \in \mathscr{Y}} \exp\left(\boldsymbol{\theta}^\top \mathbf{f}(x, y')\right)}$$

Features

Words of Interest Head of the NP, its dependents, its governor (external to NP), its first ancestor verb — token, lemma, POS tag, dependency relation, a binary indicator of plurality on the head N, first_dependent, last_dependent, auxiliaries of the first ancestral verb, first ancestral verb with a negative particle as dependent.

Structural — path length to the root, path length to the first ancestral verb, number of dependents, number of dependency relations that link non-neighbors.

Positional — token length of the NP, NP's location in the sentence (first or second half), the first ancestral verb's position relative to the head (left or right), POS & lemma of the left and the right neighbors of the head, governor, and the first ancestral verb.

Above features of NPs in Following NP-NP relation Types immediate parent, immediate child, immediate precedent, immediate successor, the nearest preceding coreferent mention.

Communicative Functions of Definiteness

Nonanaphora [-A,-B]	**999**
- Unique [+U]	**287**
∗**Unique_Hearer_Old** [+F,-G,+S]	**251**
Unique_Physical_Copresence [+R]	13
Unique_Larger_Situation [+R]	237
Unique_Predicative_Identity [+P]	1
∗Unique_Hearer_New [-F]	36
- Nonunique [-U]	**581**
∗**Nonunique_Hearer_Old** [+F]	**169**
Nonunique_Physical_Copresence [-G,+R,+S]	39
Nonunique_Larger_Situation [-G,+R,+S]	117
Nonunique_Predicative_Identity [+P]	13
∗Nonunique_Hearer_New_Spec [-F,-G,+R,+S]	231
∗Nonunique_Nonspec [-G,-S]	181
- Generic [+G,-R]	**131**
∗Generic_Kind_Level	0
∗Generic_Individual_Level	131

Anaphora [+A]	**1574**
- Basic_Anaphora [-B,+F]	**795**
∗Same_Head	556
∗Different_Head	329
- Extended_Anaphora [+B]	**779**
∗Bridging_Nominal [-G,+R,+S]	43
∗Bridging_Event [+R,+S]	10
∗Bridging_Restrictive_Modifier [-G,+S]	614
∗Bridging_Subtype_Instance [-G]	0
∗Bridging_Other_Context [+F]	112

Miscellaneous [-R]	**732**
- Pleonastic [-B,-P]	53
- Quantified	248
- Predicative_Equative_Role [-B,+P]	58
- Part_Of_Noncompositional_MWE	100
- Measure_Nonreferential	125
- Other_Nonreferential	148

Examples for Communicative Functions

CFD Label	Example
Unique_Physical_Copresence	**John** here is an investment banker.
Unique_Larger_Situation	In the days since **Hillary Clinton** unburdened herself in an interview with The Atlantic's Jeffrey Goldberg ...
Unique_Predicative_Identity	Clark Kent is **Superman**.
Unique_Hearer_New	a restaurant chain named **Shoney's**
Nonunique_Physical_Copresence	**The podium** is too high.
Nonunique_Larger_Situation	**the chair** (at a conference) / **today**
Nonunique_Predicative_Identity	He is **the manager**.
Nonunique_Hearer_New_Specific	I am looking for **a nurse**. Her name is Sara.
Nonunique_Nonspec	I am looking for **a nurse** [any nurse would do].
Generic_Kind_Level	**Dinosaurs** are extinct.
Generic_Individual_Level	**Cats** have fur.
Basic_Same_Head	I'm going to tell you a quick story. It's **a true story**.
Basic_Different_Head	I adopted a cat this weekend. **The animal** is so cute.
Extended_Bridging_Nominal	I looked at an apartment yesterday. **The kitchen** was really large.
Extended_Bridging_Event	My friend's son got married this weekend. **The bride** looked beautiful.
Extended_Bridging_Restrictive_Modifier	**the house** next door/ John's **daughter**
Extended_Subtype_Instance	I collect coins. I have **a 1943 steel penny**.
Extended_Other_Context	I want to focus on what many of you have said you would like me to elaborate on. What can you do about **the climate crisis**?
Pleonastic	**It is raining.**
Quantified	**All the people** / **no motorcade**
Predicative_Equative_Role	He's **a teacher**. / This is **an opportunity**.
Part_of_Noncompositional_MWE	Ole' Charlie kicked **the bucket** today.
Measure_Nonreferential	**hours** later / **miles** away
Other_Nonreferential	**global warming** / **concern** / the topic of **energy**

Accuracy

Condition	Params #	ExactMatch %	SoftMatch %
Majority baseline	—	12.1	47.8
Log-linear			
+ attributes	473,064	38.7	77.1
+ labels	413,931	40.8	73.6
+ attributes, labels	926,417	43.7	**78.2**
Random forest	20,363	**49.7**	77.5

Analysis

Confirmation of known facts: Specificity

High '+' weights	High '-' weights
+ the definite article "the"	- the indefinite article "a"
+ possessives (PRP$)	
+ proper nouns (NNP)	
+ 2nd person pronouns	
+ NPs with "the" as the first dependent	

Hypotheses to test: Specificity

High '+' weights	High '-' weights
+ objects of "from"	- NPS with comparative adjectives (JJR)
+ NPs with NNP as their last dependent	
+ NPs with possessive pronouns	

Communicative Function Label Accuracy

CFD label	Instances	CFD label	Instances	F1
Bridging_Restrictive_Modifier	552	Bridging_Restrictive_Modifier	552	68
Same_Head	452	Same_Head	452	41
Different_Head	271	Different_Head	271	32
Quantified	213	Quantified	213	57
Nonunique_Hearer_New_Specific	190	Nonunique_Hearer_New_Specific	190	40
Nonunique_Nonspec	173	Nonunique_Nonspec	173	13
Other_Nonreferential	134	Other_Nonreferential	134	37
Generic_Individual_Level	113	Generic_Individual_Level	113	13
Measure_Nonreferential	98	Measure_Nonreferential	98	40
Unique_Larger_Situation	97	Unique_Larger_Situation	97	55
Nonunique_Larger_Situation	97	Nonunique_Larger_Situation	97	27
Bridging_Other_Context	96	Bridging_Other_Context	96	11
Part_of_Noncompositional_MWE	88	Part_of_Noncompositional_MWE	88	18
Predicative_Nonidentity	57	Predicative_Nonidentity	57	—
Pleonastic	44	Pleonastic	44	88
Nonunique_Physical_Copresence	36	Nonunique_Physical_Copresence	36	—
Bridging_Nominal	33	Bridging_Nominal	33	15
Unique_Hearer_New	26	Unique_Hearer_New	26	—
Nonunique_Predicative_Identity	10	Nonunique_Predicative_Identity	10	—
Bridging_Event	9	Bridging_Event	9	—

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