Identifying Participation of Individual Verbs or VerbNet Classes in the Causative Alternation

Esther Seyffarth (esther.seyffarth@hhu.de)
Heinrich Heine University, Düsseldorf

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HEINRICH HEINE UNIVERSITÄT DÜSSELDORF

The Causative Alternation

- Verbs in the causative alternation have a **causative**/**inchoative** meaning:
  - (1) You open the door. *causative: ACTOR = you, THEME = door*
  - (2) The door opens. *inchoative: ACTOR = ∅, THEME = door*
- Verbs in the object-drop alternation have no inchoative interpretation:
  - (3) You read the letter. *transitive: ACTOR = you, THEME = letter*
  - (4) You read. *intransitive: ACTOR = you, THEME = implied*
- Verb alternations are **interesting** from a computational linguistics point of view: The events should be modeled differently.
- This paper presents 8 approaches to the **automatic identification** of verbs in the causative alternation.
- Existing resources (used here as gold data): **Levin (1993) verb classes, VerbNet classes (Kipper et al., 2000)**

Task Description

- **Predict:** Does a given verb participate in the causative alternation or not?
- **Use:** BNC corpus, Stanford CoreNLP Dependency Parser, word2vec
- **Test conditions:** 1) **all** verbs listed in the gold data, 2) only the 300 most **freq**uent verbs, 3) a **balanced** set of 150 verbs from each class
- **Different indicators:**
  - $v' \in C$: What can we observe about other verbs in the same VerbNet class as the current verb?
  - $\sum_{v' \in C} c(v')$: How many instances of verbs in this VerbNet class are attested in the corpus?
  - $c(v_{trans}), c(v_{intrans})$: How often does a verb occur (in)transitively?
  - $\cos(\overrightarrow{objects}, \overrightarrow{intr-subjects})$: Are the possible objects of the verb close to its possible intransitive subjects in vector space?
  - $|avg\_\_acc(v_{trans}) - avg\_\_acc(v_{intrans})|$: Does the average acceptability of transitive usages of the verb differ a lot from that of intransitive usages?

Classification: Does this verb participate in the Causative Alternation or not?

$a_1(v \in C) = 1$ iff $\forall v' \in C : c(v'_{trans}) > 0 \wedge c(v'_{intrans}) > 0$

$a_3(v \in C) = \frac{\sum_{v' \in C} \min(c(v'_{trans}), c(v'_{intrans}))}{\sum_{v' \in C} c(v')}$

$a_5(v) = \frac{c(v_{trans})}{c(v_{intrans})}$

$a_7(v) = a_6(v) - \cos(\overrightarrow{tr-subjects}, \overrightarrow{intr-subjects})$

	Causative Alternation vs. Other						*Causative vs. Obj-Drop*		
	Levin			**VerbNet**			**Levin**		
	all	**freq**	**balanced**	**all**	**freq**	**balanced**	**all**	**freq**	**balanced**
Random Baseline	0.51	0.54	0.52	0.53	0.47	0.56	0.48	0.50	0.49
VNType	0.20	0.31	0.32	0.10	0.18	0.17	0.19	0.30	0.30
VNRank	0.67	0.63	0.52	0.60	0.42	0.52	**0.79**	0.67	0.68
VNToken	0.61	0.59	0.50	**0.83**	0.68	0.71	0.61	0.51	0.51
SCFFlag	**0.71**	**0.74**	**0.67**	0.59	0.63	0.67	0.64	0.66	0.67
SCFRatio	**0.71**	0.72	0.65	0.68	0.57	0.60	0.68	**0.73**	**0.75**
CentroidDistance	0.62	0.60	0.62	0.64	0.78	**0.79**	0.53	0.55	0.55
CentroidSubjVsObj	0.63	0.63	0.57	0.64	**0.79**	**0.79**	0.59	0.61	0.61
RNN-LM	0.66	0.69	0.59	0.66	0.78	**0.79**	0.58	0.63	0.63

Tab. 1: F1 scores for the classification of verbs that do/don't participate in the causative alternation (left) and verbs that participate in the causative/object-drop alternation (right)

$a_2(v \in C) = \frac{|\{v' \in C : c(v'_{trans}) > 0 \wedge c(v'_{intrans}) > 0\}|}{|C|}$

$a_4(v) = 1$ iff $c(v_{trans}) > 0 \wedge c(v_{intrans}) > 0$

$a_6(v) = \cos(\overrightarrow{objects}, \overrightarrow{intr-subjects})$

$a_8(v) = \frac{1}{|avg\_\_acc(v_{trans}) - avg\_\_acc(v_{intrans})|}$

Discussion

- **SCFFlag and SCFRatio** outperform the other systems most consistently.
- Verbs in the causative alternation occurred in transitive/intransitive SCFs with very **dissimilar frequencies**. Verbs with more **similar frequencies** were predicted to participate in the object-drop alternation.
- Vector-based systems are **surprisingly bad** at distinguishing the causative alternation from the object-drop alternation. This might be due to overlapping selectional preferences for different role slots.
- **Vector-based** approaches achieve better scores on VerbNet test data: Vectors are good at predicting VerbNet-like clusters.
- **Unattested or infrequent** verbs are classified as "not alternating" by most of our systems. *Is this the best idea?*

Fun Facts!

- **Acceptability scores** (used in RNN-LM) were generally higher for transitive SCFs than intransitive ones, independent of the verb!
  - "John sleeps him" was *more* acceptable than "John sleeps"!
- Verbs with noun or adjective **homographs** were rarely annotated correctly by the dependency parser!
  - Difficult to classify *circle* (V), *drip* (V), *yellow* (V), *awake* (V)!
- Qualitative analysis shows that the parser is likely to incorrectly predict a **transitive structure** for complex sentences!
- Future work: Transfer experiments on **Spanish and/or Russian data**!
- **SOTA = ???** (*Ask me!*)

References (Selection)

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