Offset vectors and affix meaning in English nominalizations

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Offset vectors

vector of derivative			vector of base	= **offset vector**
inclusiveness	(4 3 1)	−	**inclusive** (2 1 4)	= (2 2 -3)
inclusivity	(3 4 1)	−	**inclusive** (2 1 4)	= (1 3 -3)

Introduction

- Shafaei-Bajestan et al. (2024, p. 381), on English plural inflection: "the semantics of shift vectors is changing in close association with the semantics of the singular and plural words."
- Schäfer (2025), on the English *-ity*/*-ness* affix rivalry: the distributional vectors of adjectival bases successfully predict the affix choice.

Introduction

- Shafaei-Bajestan et al. (2024, p. 381), on English plural inflection: "the semantics of shift vectors is changing in close association with the semantics of the singular and plural words."
- Schäfer (2025), on the English *-ity*/*-ness* affix rivalry: the distributional vectors of adjectival bases successfully predict the affix choice.

My research questions:

1. Are the offset vectors of *-ity* base-derivative pairs distinct from the *-ness* pairs?
2. Are there further patterns associated with specific subsets of bases within the offset vectors?

The *-ity* and *-ness* affix rivalry:

(1) *-ity*

a. insular: insularity
b. eatable: eatability
c. sentimental: sentimentality

(2) *-ness*

a. red: redness
b. messy: messiness
c. pleasant: pleasantness

`Note: the study is restricted to adjectival bases used in Schäfer 2024b, data etc. at Schäfer 2024a`

Study 1: *-ity/-ness* offset vectors [methods]

- adj/*-ity/-ness* derivatives:
  tagged ukWaC corpus ∩ fastText vectorsets
- 1 million item fastText vectors **WITHOUT** subword information
- no doublets

→ set of 3014 base-derivative pairs

`ukWaC corpus: Baroni et al. (2009); fastText vectorsets: Mikolov, Grave, et al. (2017)`

Study 1: *-ity/-ness* offset vectors [methods]

- offset vectors
- downstream-analysis:
  - t-SNE for visualization
  - Linear Discriminant Analysis (LDA) for statistical corroboration

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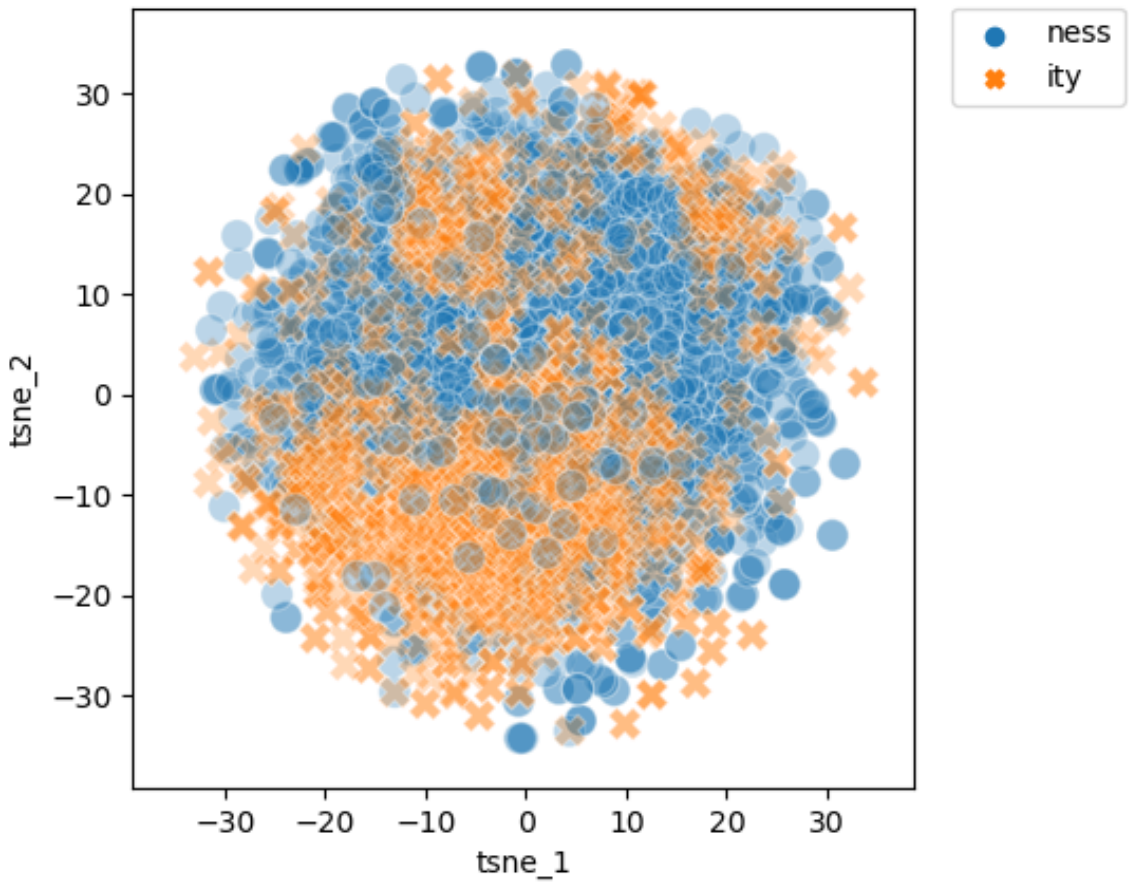
= same downstream analysis as Shafaei-Bajestan et al.
(2024) and Schäfer (2025).
```

Study 1: *-ity*/*-ness* offset vectors [results]



`average weighted F1 score: 0.838 (0.019 std)`
`[baseline classifier 0.395]`

Study 1: *-ity/-ness* offset vectors [discussion]

- clear difference, contrasting with results for French deadjectival derivations in Guzmán Naranjo and Bonami (2023)
- F1 score comparable to score for the bases
- no categorical difference, considerable variation, similar to results by Shafaei-Bajestan et al. (2024)

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Open issues:

- link to genre or text type
- possible frequency effects

Study 2: inside the *-ity*/*-ness* offset vectors

- both sets of offset vectors display considerable variation
- an obvious question is whether this variation is patterned in non-random ways even within the form pairs
- semantics of bases?

Study 2: inside the *-ity*/*-ness* offset vectors [Methods]

- Analogy task of Mikolov, Chen, et al. (2013)
- When adding the average offset vector to the base vector, is the target vector, that is, the actual *-ness* or *-ity* form associated with the base vector, contained in the nearest neighbors of the synthetic vector?

Study 2: inside the *-ity*/*-ness* offset vectors [Methods]

- Analogy task of Mikolov, Chen, et al. (2013)
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`[average -`*`ness`*` offset-vector ] + [vector of `*`smooth`*`] =`
`[synthetic vector for `*`smoothness`*`]`

How close is this synthetic vector to the actual vector for *smoothness*?

Study 2: inside the *-ity*/*-ness* offset vectors [Methods]

(3) five average vectors

a. **all**: average offset vector across all pairs
b. **ity**: average offset vector across all *-ity* pairs
c. **ness**: average offset vector across all *-ness* pairs
d. **ble**: average offset vector across all 547 *-ble* bases that take only *-ity*
e. **ed**: average offset vector across all 173 *-ed* bases

Study 2: inside the *-ity*/*-ness* offset vectors [Methods]

(4) four test sets:

a. **other *-ity***: 25 bases with no discernable morphological pattern that have only *-ity* derivatives (*sublime*, *secure*).

b. **other *-ness***: 25 bases of the same type that have only *-ness* derivatives (*harsh*, *smart*).

c. ***-ble* [*-ity*-only]**: 25 *-ble* bases that only have *-ity* derivatives (*lovable*, *notable*).

d. ***-ed* [*-ness*-only]**: 25 *-ed* bases that only have *-ness* derivatives (*directed*, *guarded*)

Study 2: inside the *-ity*/*-ness* offset vectors [results]

Table 1: test set (a), **other *-ity***

Rank	all	ity	ness	ble	ed
Rank 2	6	4	9	5	8
Rank 3	5	3	4	3	5
Rank 4	4	4	4	6	2
Rank 5	2	3	0	1	1
Rank 6-10	3	3	3	3	3
Rank 11-50	3	6	2	5	3
Rank >50	2	2	3	2	3

Study 2: inside the *-ity*/*-ness* offset vectors [results]

Table 2: test set (b), **other *-ness***

Rank	all	ity	ness	ble	ed
Rank 2	7	6	10	6	8
Rank 3	4	2	1	2	3
Rank 4	1	2	2	3	2
Rank 5	3	3	2	2	2
Rank 6-10	3	2	4	3	4
Rank 11-50	2	4	1	3	1
Rank >50	5	6	5	6	5

Study 2: inside the *-ity*/*-ness* offset vectors [results]

Table 3: test set (c), ***-ble* [*-ity* only]**

Rank	all	ity	ness	ble	ed
Rank 2	16	16	17	16	16
Rank 3	1	1	1	3	2
Rank 4	2	0	3	0	1
Rank 5	1	1	1	1	3
Rank 6-10	4	4	2	4	2
Rank 11-50	0	2	1	1	0
Rank >50	1	1	0	0	1

Study 2: inside the *-ity*/*-ness* offset vectors [results]

Table 4: test set (d), ***-ed* [-ness only]**

Rank	all	ity	ness	ble	ed
Rank 2	5	4	6	4	7
Rank 3	3	1	4	2	3
Rank 4	2	3	1	2	2
Rank 5	2	2	3	2	2
Rank 6-10	2	3	2	4	2
Rank 11-50	5	5	3	5	4
Rank >50	6	7	6	6	5

Study 2: inside the *-ity*/*-ness* offset vectors [discussion]

different test sets:

- ***ble* [only *ity*]** vs ***-ed* [only *-ness*]**
  - ***-ble* [*-ity* only]** test set: perhaps prototypical bases, in line with them forming the largest distinct subgroup of bases
  - ***-ed* [only *-ness*]**: perhaps different types of properties (less abstract?)

$\rightarrow$ systematic differences between different types of bases

Study 2: inside the *-ity*/*-ness* offset vectors [discussion]

different composed vectors:

- clear differences between *-ity* and *-ness*
- overall better performance of the *-ness* related average vectors can perhaps be linked to its greater productivity and its less distinct lexicalization effects (Bauer, Lieber, and Plag, 2013)
- ***-ble* [*-ity* only]** and ***-ed*** average vectors: optimized for their respective bases

Study 2: inside the *-ity*/*-ness* offset vectors [discussion]

Other:

- for some items clear evidence of lexicalization effects: lowest ranked examples (always across all 5 probes): *minority*, *otherness*, and *signedness*
- bad performance in comparison to Shafaei-Bajestan et al. (2024); plausible explanation: the less stable nature of derivational vs inflectional relationship, see Bonami and Paperno (2018).

Conclusion

(1) Are the offset vectors across the *ity/ness* non-doublet bases distinct from each other or not?

- clear but non-categorical differences

Conclusion

(2) Are there sub-regularities within the offset vectors of both affixes?

- (difference between the **ity** and **ness** vectors)
- sub-regularities based on morphological properties of the bases
  - ***-ble*** **[only *-ity*]** test set maximally different from the ***-ed*** **[*-ness* only]** test set
  - corresponding average vectors always performing best in the corresponding test sets
  - plausibly linked to prototypicality and semantic differences

Other possibilities

- Other operations between vectors
- Other conceptualizations of affixation (Marelli and Baroni, 2015): affix as matrix, affixation as matrix multiplication

Thank you!

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