Semantic Supersenses for English Possessives

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1. Introduction

Possessive constructions can be used to express a wide variety of semantic relations. English has two canonical constructions for attributive possession. The first uses the clitic 's or a possessive pronoun and is known as the s-genitive (or Saxon genitive): e.g., the car's/its windshield. The second uses the preposition of and is known as the of-genitive: the windshield of the car. Both constructions are highly polysemous as to the nature of the relation between the two noun phrases. A few of the semantic relations associated with possessives include:

- Alienable possession: John's computer.
- Kinship: My sister was surprisingly late.
- Part–whole relations: The car's windshield.
- Thematic roles: The boy's murder was never reported. (This is actually ambiguous: The role that the boy fills with respect to the predicate murder could be either agent or patient, depending on whether he was the victim or perpetrator.)

Previous work on annotating the semantics of possessive constructions has taken a sense disambiguation perspective, with semantic categories specific to relations between nominals (Badulescu and Moldovan, 2009) or s-genitives (Tratz and Hovy, 2013). In this paper, we show that a tagset for broad-coverage semantic annotation of prepositions and postpositions can be applied—mostly as is—to English possessive constructions.

We use the adposition supersense inventory (Schneider et al., 2015, 2016, 2017), which was designed with adpositions (including of) in mind, to annotate all of-genitive and s-genitive tokens in a 55,000 word corpus of English web reviews (§3). In so doing, we demonstrate that the existing supersense categories are readily applicable to English possessives.

The latest version consists of 50 general supersense categories including thematic role labels (AGENT, THEME, RECIPIENT, etc.) and relations that hold between entities (POSSESSOR, WHOLE, SOCIAL, REL, etc.). §4 describes the supersenses that proved useful for possessive constructions. In §5 we examine their distribution in the corpus and their relationship to categories from prior work.

Our corpus will facilitate the development of semantic disambiguation systems, as well as the empirical study of the semantics of the English genitive alternation (i.e., what factors influence the choice of 's vs. of), building on the work of Rosenbach (2002) and Shih et al. (2012). As the latest version of the supersense inventory was designed to be cross-linguistically applicable, we anticipate that this approach will eventually accommodate possessives and genitives in other languages, yielding similar analyses of supersense coverage and distribution to the analysis in this paper. It has been investigated for adpositions in English, Korean, Hebrew, and Hindi thus far (Schneider et al., 2017; Hwang et al., 2017).

2. Related work

Linguistic study has shown that possessive constructions in English and other languages can denote a number of semantic relations (Taylor, 1996; Nikiforidou, 1991; Rosenbach, 2002; Heine, 2006), in particular described as prototypical forms of possession (legal ownership, kinship, body parts, part-whole relations) and non-prototypical possession (other semantic relations) (Rosenbach, 2002; Wolk et al., 2013). Nikiforidou (1991) shows that possession in classical Greek can denote a comparison relation (“better than Plato”). Stefanowitsch (2003) shows that s-genitive and of-genitive are not interchangeable, and further the genitive alternation is not fully predictable from animacy, givenness, or syntactic weight. S-genitive and of-genitive are each polysemous but not interchangeable. We will discuss their semantic differences further in §5.

The computational linguistics community has seen a few studies of relations between nominals—including possessive constructions—and their automatic disambiguation (e.g., Badulescu and Moldovan, 2009; Tratz and Hovy, 2013). In §5.2, we compare the adposition supersense scheme to previous proposals for English possessives that were based on noun-noun relations. We explore whether the English preposition system, by contrast, is a useful departure point for characterizing the semantics of genitives.
3. Corpus annotation

For this work, 2 linguists annotated a 55,000 word corpus of English web reviews. We annotate a total of 1,613 possessive constructions with 28 attested supersense labels (out of 50 total). Their lexical distribution is given in figure 1. One annotator labeled all genitive case tokens from scratch. The other annotator revised all genitive case tokens from Schneider et al.’s (2016) supersenses to reflect the inventory of Schneider et al. (2017). From this data, 100 sentences containing s-genitives were randomly sampled and independently labeled by both annotators.\(^1\) 109 s-genitive tokens are in this sample. In our study, each s-genitive or of-genitive token was assigned a single label. (See Hwang et al. (2017); Schneider et al. (2018) for a strategy of representing construal with two supersense labels.)

The 2 annotators agreed 72% of the time; Cohen’s \(k\) was 0.66, falling into a range which has been said to indicate “substantial” agreement (Viera et al., 2005). Disagreements are discussed in §4.2 below.

4. Supersense inventory for possessives

4.1. Categories

Of the 50 supersenses in Schneider et al.’s (2017) inventory, 28 appear to be relevant to English possessive constructions. Their distribution in our corpus appears in table 1. We exemplify and discuss these categories below.\(^2\)

| Supersense | ‘s+PRP$ % of | Supersense | ‘s+PRP$ % of | Supersense | ‘s+PRP$ % of |
|------------|-------------|------------|-------------|------------|-------------|
| Agent      | 11.2        | Identity   | 5.5         | SocialRel  | 19.5        |
| Beneficiary| 0.9         | Instrument | 0.2         | Species    | 7.7         |
| Causer     | 0.4         | Locus      | 0.1         | Stimulus   | 2.4         |
| Characteristic | 1.4     | Manner     | 0.2         | Stuff      | 3.3         |
| ComparisonRef | 0.2      | OrgRole    | 2.9         | Theme      | 3.1         |
| Cost       | 0.6         | Originator | 6.9         | Time       | 0.3         |
| Duration   | 0.2         | Possession | 0.6         | Topic      | 6.3         |
| Experiencer| 7.7         | Possessor  | 34.2        | Whole      | 6.0         |
| Extent     | 0.4         | Quantity   | 36.9        |           |             |
| Gestalt    | 7.7         | Recipient  | 1.0         |           |             |
|            |             |            |             | # tokens   | 1104        |

Table 1: Token distribution of supersenses: of-PP vs. genitive case (’s and possessive pronouns). The percentages in each column sum to 100%. In addition, there were 11 s-genitive tokens that were used in idioms.

These account for 83.3% of the of tokens and 70.3% of the s-genitive tokens in our corpus.

**CHARACTERISTIC:** a place of beauty

“NP\(_1\) of NP\(_2\)”, where NP\(_1\) refers to an entity and NP\(_2\) to a quality of that entity (also: a person of honor); seems to be a rare construction that does not admit an ’s paraphrase.

**COMPARISONREF:** the opposite of cheap

This category exists primarily for than, like, as, and similar prepositions that can be used in various statements of comparison, contrast, similarity, or differentiation. Occasionally, a predicate like opposite uses of to mark such a role.

**GESTALT:** Her flexibility and accessibility, Quality of work

Gestalt is the inverse of Characteristic: it is the holder of a property.

**IDENTITY:** a neat gem of a restaurant

This label is used for constructions that establish some sort of equation between the two noun phrases. With of, the head noun is a category being ascribed to the dependent. The above example can be paraphrased as a restaurant that is a neat gem.

**ORGROLE:** his firm, a customer of this store

The dependent NP is an organization/institution with which somebody (denoted by the head NP) has an association.

**POSSESSION:** the owner of a new car

For of-genitives and s-genitives, this is restricted to arguments of a predicate of ownership. In a way, the example above is also a Theme. With the car’s owner, the labels Possession and Gestalt both seem to apply (because the owner is a piece of information typically associated with cars).

**POSSESSOR:** her dog

Strikingly, there were no clear of-Possessors in our corpus—for the most prototypical forms of possession (human ownership of a nonhuman entity), English speakers exhibit a strong preference for the s-genitive, though the dog of hers is a valid paraphrase of her dog.

**QUANTITY:** plenty of parking

The preposition of is frequently used in various expressions of quantity which cannot be paraphrased with the s-genitive.

**SOCIALREL:** her brother, a friend of mine

This category covers relationships between persons, including kinship, friendship, and business or other social associations (e.g., my teacher). The s-genitive is far more popular than of for this relation in our corpus.

**SPECIES:** that kind of behavior

\(^1\)Specifically: Annotator A annotated all genitive case markers in the corpus, and selected examples for discussion with Annotator B. After the discussion, A revised the original annotations and B annotated the random sample of 100 sentences. So as not to skew the results, B skipped 6 tokens that B recalled specifically from the discussion. For the tokens in the sample, A applied 9 distinct supersenses while B found use for a superset of 15 supersenses.

\(^2\)Most examples are drawn or adapted from our corpus. Where the names of the categories are conventional, we do not provide a definition. Further definitions and guidelines on applying these categories appear in Schneider et al. (2018).
PARTICIPANT subtypes. Nominalization and other processes result in the realization of participant roles with possessive marking. In our data, these account for 13.9% of of tokens and 29.2% of s-genitives.

AGENT: her help, the fault of the parts supplier

BENEFICIARY: children 's clothes

CAUSER: the fire 's damage, victim of adversity

COST: a tax bill of $6,000

EXPERIENCER: will exceed your expectations, a favorite of our family

INSTRUMENT: Usage of product barcodes

ORIGINATOR: his advice, in the words of my son

ORIGINATOR is defined as “animate who is the initial possessor or creator/producer of something, including the speaker/communicator of information” (Schneider et al., 2017, p. 17).

RECIPIENT: my delivery

STIMULUS: a fear of snakes

THEME: my next haircut, spraying of pesticides, a dish full of filler vegetables

TOPIC: kept me apprised of status

AGENT, EXPERIENCER, and ORIGINATOR are not infrequently expressed with the s-genitive. STIMULUS, THEME, and TOPIC are not infrequently expressed with of. The rest are rarely observed in possessive constructions.

CIRCUMSTANCE subtypes. Rarely expressed with possessive constructions, these comprise 2.8% of of tokens and 0.5% of s-genitives.

DURATION: a year 's worth of dirty clothes

EXTENT: a production increase of 10%

LOCUS: Miami 's best beach, I am just south of Walnut

LOCUS is used for concrete as well as abstract locations, including states and values.

MANNER: My room reeks of old cigarette smoke.

TIME: today 's tough times, March of 2010

4.2. Further conventions

Multiword expressions and idioms. Schneider et al. (2014) had already annotated the online reviews corpus for multiword expressions (Baldwin and Kim, 2010), including proper names and idioms. We did not apply supersenses to possessives used within a completely fixed phrase, such as the proper name Ben 's Chili Bowl or the shorter ‘local genitive’: Ben 's is a great restaurant (Quirk and Greenbaum, 1973, pp. 329–330).

In addition, various idioms license a noun phrase constituent that is required to be possessively marked (but the NP itself is not fixed). These include possessed idioms, where the pronoun in the possessive slot agrees with an NP in another syntactic position (Bond et al., 2013, 2015): e.g., try [one] 's best (which can be instantiated as I tried my best, not *I tried Mary 's best or *I tried her best); be quick on [one] 's feet; and be on [one] 's own. Other idioms with a possessive slot do not enforce agreement: e.g., [one] 's hour/time of need (I helped in Mary 's hour of need). If the 's clitic was used, it was annotated as a fixed part of the idiom, so we did not assign it a label. In labeling possessive pronouns used in idioms, our policy was to assign a semantic label only if the possessive relationship was compositional, and a special label `s otherwise (11 tokens). 4 of these were the generic pronoun your in the expression your average/typical/usual NP.

Borderline cases. As is par for the course in broad-coverage semantic annotation, many constructions in our corpus could be considered to fit into more than one supersense, or a different supersense depending on context or interpretation. We give two examples:

1. Jane 's knowledge of the subject matter: Possessive nominals modifying knowledge, like the example above, can plausibly be interpreted as POSSESSOR, EXPERIENCER, GESTALT, and possibly others. Speakers can disagree in how they interpret knowledge with respect to these different perspectives. For the sake of annotation, it is helpful to have a clear and consistent convention. We annotate Jane 's knowledge as EXPERIENCER.

2. I put in my order vs. I picked up your order: The noun order can denote a command or request (where the possessive construction is marked as ORIGINATOR) or, by metonymy, an

| Supersense | `s % | PRPS % |
|------------|------|--------|
| Agent      | 8.5  | 11.4   |
| Beneficiary | 3.4  | 0.8    |
| Causer     | 0.0  | 0.4    |
| Duration   | 3.4  | 0.0    |
| Experiencer | 6.8  | 7.8    |
| Gestalt    | 15.3 | 7.3    |
| Locus      | 1.7  | 0.0    |
| OrgRole    | 5.1  | 2.8    |
| Originator | 10.2 | 6.7    |
| Possessor  | 25.4 | 34.7   |
| Recipient  | 0.0  | 1.1    |
| SocialRel  | 10.2 | 20.0   |
| Theme      | 1.7  | 1.1    |
| Time       | 5.1  | 0.0    |
| Whole      | 3.4  | 6.1    |

Table 2: Token distribution of supersenses: `s vs. possessive pronouns. The percentages in each column sum to 100%.

Figure 1: Distribution of s-genitive forms with supersense labels. Nonstandard spellings like ur have been normalized.

STUFF: the piece of metal
WHOLE: judge a book by its cover, the inside of my car
As table 1 shows, there are noticeable differences in distribution of supersenses between of and genitive case markers (‘s and possessive pronouns). The distribution of ‘s is roughly similar to that of possessive pronouns, though there are only 59 tokens of the former. See table 2.) The differences are stark. Supersenses that are only attested for of include Characteristic, Identity, Quantity, Species, Stimulus, Stuff, and Topic. Supersenses that are only attested for ‘s and possessive prepositions include Beneficiary, OrgRole, Recipient, and perhaps most interestingly Possessor.

Semantic differences in distribution are known to play a role in English’s genitive alternation studied in previous work (Shih et al., 2012; Wolk et al., 2013). Many other factors have been established as well. Our data augments the empirical record.

5.2. Comparison to previous schemes

Previous annotation schemes for English possessive constructions have been based on attempts to characterize relations between nominals. Badulescu and Moldovan (2009, herafter “BM”) adapted one such set of 35 semantic categories (from Moldovan et al., 2004), resulting in 22 labels for English possessive constructions. Tratz and Hovy (2013, “TH”), building on prior work by BM and others, developed a set of 18 semantic categories specific to the s-genitive. They did so iteratively, adjusting the categories as needed to reduce disagreements between annotators. TH’s study and inventory were limited to the s-genitive (‘s and possessive pronouns).

Our approach, by contrast, uses an adposition annotation scheme as the point of departure. We find that indeed, many of the semantic relations expressed with prepositions like in, with, etc. can also be conveyed with of and ‘s (the man in/with a coat vs. the man’s coat; the financial markets in/of the largest European capitals). While ‘s was not considered as a preposition in the development of the supersenses, we find that nearly all its usages in a corpus are covered by the supersense categories (rare exceptions are due to idioms). A direct comparison between the schemes is given in table 4. Overall, the supersense scheme is slightly finer-grained than the others, which is not surprising as it has more labels (29, including the idiom category, versus 18 for TH and 22 for BM). Most of the supersenses have a counterpart in at least the BM scheme, which covers both kinds of genitive constructions. A notable difference is that certain supersenses distinguish directionality where the corresponding TH labels do not—e.g. Gestalt is distinguished from Characteristic, and Possessor from Possession, which

| A1 / A2 | Agent | Beneficiary | Characteristic | Experiencer | OrgRole | Originator | Possession | Recipient | Social Rel | Theme | Whole |
|---------|-------|-------------|----------------|-------------|---------|------------|------------|-----------|------------|-------|-------|
| Agent   | 9     | 1           | 3              | 2           | 1       |            |            |           |            |       |       |
| Beneficiary | 1     |             |                |             |         |            |            |           |            |       |       |
| Experiencer | 4     |             |                |             |         |            |            |           |            |       |       |
| Gestalt  | 2     |             |                |             |         |            |            |           |            |       |       |
| Originator | 1     | 1           |                |             |         |            |            |           |            |       |       |
| Possessor | 1     | 2           | 1              | 2           | 22      |            |            |           |            |       |       |
| Social Rel | 1     | 1           | 1              | 1           | 3       | 21         |            |           |            |       |       |
| Theme    | 1     |             |                |             |         |            |            |           |            |       |       |
| Whole    | 1     |             |                |             |         |            |            |           |            |       | 12    |

Table 3: Interannotator confusion matrix for s-genitives.

Apart from occasional disagreements about the semantic boundaries of categories, we have noticed that annotating the s-genitive can feel counterintuitive: it is easy to accidentally focus on the role of the head noun and apply the inverse label, e.g. Possession instead of Possessor or Characteristic instead of Gestalt. Annotators should therefore be vigilant about s-genitives, and a warning should be generated if an unlikely s-genitive supersense is applied (for instance, Possession or Characteristic, neither of which is attested for any s-genitives in our data).
could be useful for making inferences about the related NPs. BM distinguishes direction with a suffix ‘\R’ for reversed relations—e.g. ‘Possession’ vs. ‘Possession\R’.

The supersense schema aims to be applicable to adpositional constructions in other languages. Based on our findings, we speculate that it will be applicable to other language’s possessive constructions as well, though this will need to be tested in future work. Our data is a step toward future work comparing genitive constructions across languages.

6. Conclusion

We have shown that an existing broad-coverage semantic annotation scheme for adpositions can be applied to English possessive constructions. Annotation reveals major distributional differences between prepositional of and genitive case marking (the s-genitive). Our policies for s-genitives have been incorporated into the latest version of the English annotation guidelines for adposition and case supersenses (Schneider et al., 2018). Our annotated corpus is available for download at https://github.com/nert-gu/streusle/releases/tag/v4.0.

Table 4: Mappings between possessive categories. Quoted examples followed by B. are attributed to Badulescu and Moldovan (2009) and ones ending in T. are from Tratz and Hovy (2013). Tratz and Hovy’s (2013) labels only apply to s-genitives.

| Supersense | (Tratz and Hovy, 2013) | (Badulescu and Moldovan, 2009) | example |
|------------|------------------------|---------------------------------|---------|
| Agent | Subjective | Agent | her help |
| Beneficiary | Recipient | Recipient | children’s clothes |
| Causer | Producer’s Product | Cause | victim of hard times |
| Characteristic | Property | Property | a place of beauty |
| ComparisonRef | Extent | Measure | the opposite of QuikTrip |
| Cost | Duration | Experiencer | a year’s worth of dirty clothes |
| Duration | Experience | Extent | a production increase of 10% |
| Experience | Experiencer | Extent | Her flexibility and accessibility |
| Extent | Gestalt | Attribute | the city of Dallas |
| Gestalt | Identity | Property | usage of product barcodes |
| Identity | Instrument | Hypernity | Miami’s best beach |
| Instrument | Locus | Means | reeks of old cigarette smoke |
| Locus | Manner | | |
| OrgRole | Member’s Collection | Associated With, Source/From | |
| Originator | Producer’s Product | Make/Produce | |
| Possession | Possessor | Possession | |
| Possessor | Quantity | Measure | |
| Quantity | Recipient | Recipient | |
| Recipient | SocialRel | Kinship | |
| SocialRel | Species | Other Relational Noun | |
| Species | Stimulus | Stimulus | |
| Stimulus | Stuff | | |
| Stuff | Theme | Objective | |
| Theme | Time | Temporal | |
| Time | Topic | Part-Whole | |
| Topic | Whole | Part-Whole | |
| Whole | (idiom) | Adjective Determined, Possessive Compound, Other | |
| (idiom) | N/A | Other | |
| N/A | Other | Other | |

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References

Badulescu, Adriana and Moldovan, Dan (2009). A Semantic Scattering model for the automatic interpretation of English genitives. *Natural Language Engineering*, 15(2):215–239.

Baldwin, Timothy and Kim, Su Nam (2010). Multiword expressions. In Indurkhya, Nitin and Damerau, Fred J., editors, *Handbook of Natural Language Processing, Second Edition*, pages 267–292. CRC Press, Taylor and Francis Group, Boca Raton, FL.

Bond, Francis, Ho, Jia Qian, and Flickinger, Daniel (2015). Feeling our way to an analysis of English possessed idioms. In *Proc. of HPSG*, pages 61–74. Singapore.

Bond, Francis, Sameha, Sheefa Samara, and Flickinger, Dan (2013). Making English possessed idioms our own. In *Proc. of HPSG*. Berlin, Germany.

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Heine, Bernd (2006). *Possession: Cognitive Sources, Forces, and Grammaticalization*. Cambridge University Press, Cambridge, UK.

Hwang, Jena D., Bhatia, Archna, Han, Na-Rae, O’Gorman, Tim, Srikrumar, Vivek, and Schneider, Nathan (2017). Double trouble: the problem of construal in semantic annotation of adpositions. In *Proc. of *SEM, pages 178–188. Vancouver, Canada.

Moldovan, Dan, Badulescu, Adriana, Tatu, Marta, Antohe, Daniel, and Girju, Roxana (2004). Models for the semantic classification of noun phrases. In *Proceedings of the HLT-NAACL Workshop on Computational Lexical Semantics*, pages 60–67. Association for Computational Linguistics.

Nikiforidou, Kiki (1991). The meanings of the genitive: a case study in semantic structure and semantic change. *Cognitive Linguistics*, 2(2):149–205.

Quirk, Randolph and Greenbaum, Sidney (1973). *A concise grammar of contemporary English*. Harcourt School.

Rosenbach, Anette (2002). *Genitive Variation in English: Conceptual Factors in Synchronic and Diachronic Studies*. Walter de Gruyter.

Schneider, Nathan, Hwang, Jena D., Bhatia, Archna, Han, Na-Rae, Srikrumar, Vivek, O’Gorman, Tim, and Abend, Omri (2017). Adposition Supersenses v2. arXiv preprint: http://arxiv.org/abs/1704.02134v1.

Schneider, Nathan, Hwang, Jena D., Bhatia, Archna, Han, Na-Rae, Srikrumar, Vivek, O’Gorman, Tim, Moeller, Sarah R., Abend, Omri, Blodgett, Austin, and Prange, Jakob (2018). Adposition and Case Supersenses v2: Guidelines for English. arXiv preprint: https://arxiv.org/abs/1704.02134.

Schneider, Nathan, Hwang, Jena D., Srikrumar, Vivek, Green, Meredith, Suresh, Abhijit, Conger, Kathryn, O’Gorman, Tim, and Palmer, Martha (2016). A corpus of preposition supersenses. In *Proc. of LAW X – the 10th Linguistic Annotation Workshop*, pages 99–109. Berlin, Germany.

Schneider, Nathan, Onuffer, Spencer, Kazour, Nora, Danchik, Emily, Mordowanec, Michael T., Conrad, Henrietta, and Smith, Noah A. (2014). Comprehensive annotation of multiword expressions in a social web corpus. In Calzolari, Nicoletta, Choukri, Khalid, Declerck, Thierry, Loftsson, Hrafn, Maegaard, Bente, Mariani, Joseph, Moreno, Asuncion, Odijk, Jan, and Piperidis, Stelios, editors, *Proc. of LREC*, pages 455–461. Reykjavík, Iceland.

Schneider, Nathan, Srikrumar, Vivek, Hwang, Jena D., and Palmer, Martha (2015). A hierarchy with, of, and for preposition supersenses. In *Proc. of The 9th Linguistic Annotation Workshop*, pages 112–123. Denver, Colorado, USA.

Shih, Stephanie, Grafmiller, Jason, Futrell, Richard, and Bresnan, Joan (2012). Rhythm’s role in genitive construction choice in spoken English.

Stefanowitsch, Anatol (2003). Constructional semantics as a limit to grammatical alternation: The two genitives of English. *Topics in English Linguistics*, 43:413–444.

Taylor, John R. (1996). *Possessives in English: An Exploration in Cognitive Grammar*. Clarendon Press, Oxford, UK.

Tratz, Stephen and Hovy, Eduard (2013). Automatic interpretation of the English possessive. In *Proc. of ACL*, pages 372–381. Sofia, Bulgaria.

Viera, Anthony J., Garrett, Joanne M., et al. (2005). Understanding interobserver agreement: the kappa statistic. *Fam Med*, 37(5):360–363.

Wolk, Christoph, Bresnan, Joan, Rosenbach, Anette, and Szmrecsanyi, Benedikt (2013). Dative and genitive variability in Late Modern English: Exploring cross-constructional variation and change. *Diachronica*, 30(3):382–419.