

Semantic Supersenses for English Possessives

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Abstract

We adapt an approach to annotating the semantics of adpositions to also include English possessives, showing that the supersense inventory of Schneider et al. (2017) works for the genitive **'s** clitic and possessive pronouns as well as prepositional **of**. By comprehensively annotating such possessives in an English corpus of web reviews, we demonstrate that the existing supersense categories are readily applicable to possessives. Our corpus will facilitate empirical study of the semantics of the genitive alternation and the development of semantic disambiguation systems.

Keywords: Genitive, Possessive, Supersense, Lexical Semantics

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**, **SOCIALREL**, 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.

Supersense	's+PRP\$ %	of %	Supersense	's+PRP\$ %	of %	Supersense	's+PRP\$ %	of %
Agent	11.2	0.4	Identity		5.5	SocialRel	19.5	0.8
Beneficiary	0.9		Instrument		0.2	Species		7.7
Causer	0.4	0.4	Locus	0.1	1.6	Stimulus		2.4
Characteristic		1.4	Manner		0.2	Stuff		3.3
ComparisonRef		0.2	OrgRole	2.9	1.0	Theme	1.1	3.1
Cost		0.6	Originator	6.9	0.2	Time	0.3	0.6
Duration	0.2		Possession		0.6	Topic		6.3
Experiencer	7.7	0.4	Possessor	34.2		Whole	6.0	12.2
Extent		0.4	Quantity		36.9			
Gestalt	7.7	13.8	Recipient	1.0		# tokens	1104	509

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.

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 the **of** 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 κ 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

CONFIGURATION subtypes. The most prototypical possessive scenarios are stative relationships between entities. Excluding relations of place and time (which may apply to static or dynamic scenes), these fall under the **CONFIGURATION** portion of the supersense hierarchy. Together,

¹Specifically: 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.

²Most 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).

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*

“NP₁ **of** NP₂”, where NP₁ refers to an entity and NP₂ 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*

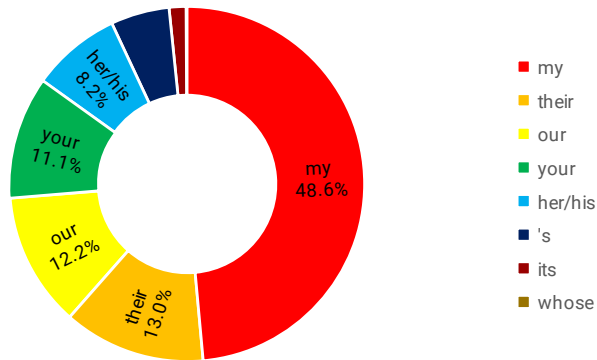


Figure 1: Distribution of s-genitive forms with supersense labels. Nonstandard spellings like *ur* have been normalized.

STUFF: *the piece **of** metal*

WHOLE: *judge a book by **its** cover, the inside **of** my car*

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),

Supersense	's %	PRP\$ %
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
# tokens	59	1045

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

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 ' \$ 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 my order*: The noun *order* can denote a command or request (where the possessive construction is marked as **ORIGINATOR**) or, by metonymy, an

A1 / A2	AGENT	BENEFICIARY	CHARACTERISTIC	EXPERIENCER	GESTALT	ORGRROLE	ORIGINATOR	PART/POROTION	POSSESSION	POSSESSOR	RECIPIENT	SOCIALREL	SOURCE	THEME	WHOLE
AGENT	9		1				3			2				1	
BENEFICIARY				1											
EXPERIENCER				4										1	
GESTALT					2							2			
ORIGINATOR					1		8								
POSSESSOR		1	2	1	2		1	2	22						
SOCIALREL	1				1	1	1	1	3	1	21				
THEME										1					
WHOLE															12

Table 3: Interannotator confusion matrix for s-genitives.

item which had been requested (in which case the possessive marking on the orderer is labeled **POSSESSOR**). Annotators should judge by context.

Table 3 provides a confusion matrix between the two annotators. Annotator 1 was more prone to using prototypical possessive supersenses while Annotator 2 was more willing to use **PARTICIPANT** subtypes. As examples of disagreement:

- *my home team* was labeled **SOCIALREL** by A1 and **GESTALT** by A2—a distinction in whether the team has an interpersonal relationship with or is a property of the speaker;
- in *This one won't be getting my business*, **my** was labeled **AGENT** by A1 and **ORIGINATOR** by A2—a distinction in whether business is considered an action or something transferred;
- in *I have many fond memories of my college evenings*, **my** was labeled **POSSESSOR** by A1 and **EXPERIENCER** by A2—a distinction in whether evenings are thought to be possessed or experienced.

Recent improvements to the guidelines have sought to address some of these sources of disagreement.

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).

5. Discussion

5.1. Distribution: s-genitives vs. of-genitives

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**, **ORGRROLE**, **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, hereafter “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

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	a place of beauty
ComparisonRef			the opposite of QuikTrip
Cost	Extent	Measure	a price of \$160
Duration	Extent	Temporal	a year's worth of dirty clothes
Experiencer	Mental Experiencer	Experiencer	our needs
Extent	Extent	Extent	a production increase of 10%
Gestalt	Attribute	Property	Her flexibility and accessibility
Identity		Hypernymy	the city of Dallas
Instrument		Means	usage of product barcodes
Locus	Location	Location/Space	Miami's best beach
Manner			reeks of old cigarette smoke
OrgRole	Member's Collection	Associated With, Source/From	his firm, prime minister of Japan
Originator	Producer's Product	Make/Produce	his advice
Possession		Possession	the owner of a new car
Possessor	Controller/Owner/User	Possession	her dog
Quantity		Measure	plenty of parking
Recipient	Recipient	Recipient	my delivery
SocialRel	Kinship, Member's Collection, Other Relational Noun	Kinship	her brother, her family her friend
Species			that kind of behavior
Stimulus		Stimulus	a fear of snakes
Stuff			the piece of metal
Theme	Objective	Theme, Accompaniment, Result	my next haircut, "solution of the problem" B., "result of the review" B.
Time	Temporal	Temporal	today's tough times
Topic		Topic, Depiction-Depicted	apprised of status, a picture of the moon
Whole	Partitive	Part-Whole	the inside of my car
(idiom)	Adjective Determined, Possessive Coumpound, Other		Ben's Chili Bowl, "his fellow brit" T.
N/A	Other	Other	"state of emergency" B., "your lordship" T.

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.

could be useful for making inferences about the related NPs. BM distinguishes direction with a suffix 'R' for reversed relations—e.g. 'Possession' vs. 'PossessionR'.

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>.

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