

# Variation, Ambiguity, and Noun Classes in English<sup>1</sup>

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## Abstract

This paper explores a theory of the meaning-form relation based on ranked and violable constraints (Prince and Smolensky, 1993), using the English genitive construction as a testing ground. Our main thesis is that partially ordered optimality-theoretic grammars allow us to relate four apparently independent empirical phenomena: (i) categorical grammaticality contrasts; (ii) variation and preferences in expression; (iii) ambiguity and preferences in interpretation; (iv) lexical organization.

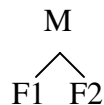
## 1. Introduction

English possessives have been studied in generative linguistics since the early days (Lees, 1960; Chomsky, 1970; and many others). In this paper, we will approach this topic from a somewhat unusual angle: by studying patterns of VARIATION and AMBIGUITY in possessive constructions. By variation we mean one-to-many mapping between meaning and form, e.g. *my parents' house* ~ *the house of my parents* ('the house owned by my parents'); by ambiguity we mean one-to-many mapping between form and meaning, e.g. *the performance of Aida* ('Aida performed something' versus 'Someone performed Aida'). Variation and ambiguity can be profitably studied together as they are converses of each other:<sup>2</sup>

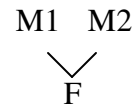
a. One meaning, one form



b. Variation



c. Ambiguity



Let us first state why we think this is an interesting thing to study. The patterns of variation and ambiguity in English possessives are pervasive and systematic. They lie very much in the core grammar and cannot be relegated to the periphery as exceptions. Particularly intriguing are the noticeable and systematic PREFERENCES, both in the direction of expression as well as in the direction of interpretation. Such preferences are rarely studied in detail, partly because of the very real methodological difficulties involved, partly because most linguistic theories are unable

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<sup>2</sup> We owe these diagrams to Anttila (1989).

to explicitly interpret such facts. It thus seems that exploring this area might well reveal something new. It also seems reasonable to hope that the correct approach to variation, ambiguity and preferences, once found, would automatically provide new solutions to more traditional problems as well.

We have two main goals. First, we demonstrate how variation and ambiguity, including preferences in expression and preferences in interpretation, can be derived from the interaction of ranked and violable constraints, i.e. Optimality Theory (Prince and Smolensky, 1993). We believe that it is precisely in the domain of variation and ambiguity that OT can provide genuinely new insights and derive results that are difficult to achieve in other frameworks. Our approach draws upon earlier work on OT syntax (e.g. Legendre et al., 1993; Bresnan, 1997, 2001; Grimshaw, 1997; Aissen, 1999; Müller, 1999; Asudeh, 2001). Second, once the theory of variation and ambiguity is in place, we show that it generalizes to an apparently unrelated empirical domain: the lexical organization of nouns. We show that the theory correctly delimits the space of possible noun classes and accounts for various observed subregularities in expression and interpretation within the English nominal lexicon.

To facilitate the discussion, we adopt the following terminological conventions. We will say *Pat* is in the Specifier position in *Pat's picture*, and in the Complement position in *the picture of Pat*. We will say both phrases are instances of the genitive construction: we call *Pat's picture* the 's-genitive construction, and *the picture of Pat* the *of*-genitive construction.<sup>3</sup> In this paper, we will limit our attention to these two constructions only. In particular, double genitives (e.g. *a friend of Pat's*) and genitive compounds (e.g. *men's room*) remain beyond the scope of this paper.

## 2. The genitive construction

This section presents an overview of the basic facts to be addressed in this paper. We first give examples of variation and ambiguity, preferences in expression, and preferences in interpretation. We then point out that these patterns are not random and that in many cases neither variation nor ambiguity is possible.

### 2.1 Variation

Corpus examples demonstrating free variation between the 's-genitive and the *of*-genitive are not easy to find. This is because the two variants will almost never occur in exactly the same linguistic context. However, finding such examples is not impossible. Different versions of the same text, such as different translations of the Bible, turn out to be a good source of examples:

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<sup>3</sup> The term 'genitive' is intended as an innocuous label with no theoretical commitments. For different views on the historical development and current status of the two constructions, see e.g. Altenberg, 1982; Allen, 1997; Weerman and de Wit, 1999; Rosenbach, to appear; and references there. While our terminology may not be entirely successful, other terminological choices we could think of seemed no better. For example, 'possessive' is misleading in that many genitive constructions have nothing to do with the semantic notion of possession.

- (1) a. But the earth came to the help of the woman, and the earth opened its mouth and swallowed the river which the dragon had poured from his mouth. (Revelations 12: 16, Revised Standard Version)
- b. But the earth came to the woman's help: it opened its mouth and drank up the river which the Dragon had poured from his mouth. (Weymouth New Testament)

The examples of free variation in (2) are from Garretson, Skarabela and O'Connor (2002):

- |     |                            |   |                       |
|-----|----------------------------|---|-----------------------|
| (2) | the land of the dead man   | ~ | the dead man's land   |
|     | houses of settlers         | ~ | settlers' houses      |
|     | the son of a Scottish man  | ~ | a Scottish man's son  |
|     | the muzzle of the pistol   | ~ | the pistol's muzzle   |
|     | the ear of Mrs. Coolidge   | ~ | Mrs. Coolidge's ear   |
|     | the explosion of the rifle | ~ | the rifle's explosion |

Typically, however, the variation is not entirely free. In such cases of CONTEXTUAL ALTERNATION, both the 's-genitive and the *of*-genitive variants are found, but with subtle or not-so-subtle differences in meaning. The differences range from the obvious and predictable to the puzzling and idiosyncratic. Some examples are listed in (3).

- |     |    |  |                                   |
|-----|----|--|-----------------------------------|
| (3) | a. | Boston's Mr. and Mrs. Frank Stearns  | unique couple                     |
|     |    | Mr. and Mrs. Frank Stearns of Boston   | non-unique couple                 |
|     | b. | <u>his</u> thought   | subjective reading                |
|     |    | the thought of <u>him</u>  | objective reading                 |
|     | c. | We'll meet at <u>the house of Ann Smith</u> .  | new information                   |
|     |    | We'll meet at <u>Ann Smith's house</u> .   | old information (Deane, 1987)     |
|     | d. | Transactions of the Philological Society   | title page                        |
|     |    | Philological Society's Transactions  | back cover (Jespersen, 1949: 314) |
|     | e. | someone's head   | ?                                 |
|     |    | the head of someone  | ?                                 |
|     |    | "You cannot shave <u>the head of someone</u> when he is not there," he added. (Google <sup>4</sup> ) |                                   |
|     |    | It's not beyond science's reach to put <u>someone's head</u> on a new body. (Google <sup>5</sup> )   |                                   |

In (3a)–(3c), the meaning differences are relatively uncontroversial. In (3a), the 's-genitive carries the implication that there is a unique couple in Boston identifiable as Mr. and Mrs. Frank Stearns (see e.g. Barker, 1995: 78–83). The *of*-genitive carries no such implication. In (3b), *his thought* has the subjective reading (i.e. he is doing the thinking); *the thought of him* has the objective reading (i.e. he is the one being thought of). In (3c), the two sentences are felicitous in different discourse contexts. According to Deane (1987), the sentence with the *of*-genitive is felicitous if *Ann Smith* is new information; the sentence with the 's-genitive is felicitous if *Ann Smith* is old information.

In (3d)–(3e), it is less clear whether the two variants have different interpretations, and if so, what these interpretations might be. Jespersen (1949: 314) reports that the first variant of (3d)

<sup>4</sup> Google search result, <http://www.langues-vivantes.u-bordeaux2.fr/Interactive/P2/transplant2r.htm>

<sup>5</sup> Google search result, [http://www.unfpa.org/news/2002/features/ageing\\_book.htm](http://www.unfpa.org/news/2002/features/ageing_book.htm)

is found on the title page of the named publication, the second on the back cover. The difference between *someone's head* and *the head of someone* in (3e) is equally elusive. The two expressions seem to be in more or less free variation in the first context (*You cannot shave someone's head when he is not there*), but less so in the second (*?It's not beyond science's reach to put the head of someone on a new body*).<sup>6</sup>

## 2.2 Ambiguity

Examples of ambiguity are not hard to find. The example in (4) is cited in Jespersen, 1940: 67.

- (4) An attorney, not celebrated for his probity, was robbed one night on his way from Wicklow to Dublin. His father, meeting Baron O'Grady the next day, said: "My Lord, have you heard of my son's robbery?" "No indeed", replied the Baron, "pray whom did he rob?" (Hodgson, *Errors in the Use of English* 91)

In this paper, we will consider three types of ambiguity. In the first type, illustrated in (4), the ambiguity comes from a deverbal noun that inherits the argument structure of its verb, hence the ambiguity between the subjective versus the objective readings. Both the 's-genitive and the *of*-genitive are potentially ambiguous. More examples are given in (5).

- (5) a. We also have the duty to appraise realistically and honestly their performance.  
b. President Kennedy has expressed his dissatisfaction with its performance.  
c. Splendid, too, is the performance of Yuri Tolubeyev.  
d. The play was to be a benefit performance of the Octoroon.

The second type of ambiguity occurs with nouns whose lexical meaning entails two entities in a particular relation, also known as RELATIONAL NOUNS (see e.g. de Bruin and Scha, 1988; Barker and Dowty, 1993; Barker, 1995). For example, while the noun *person* denotes a set of entities, the noun *friend* is relational: it denotes the set of pairs  $\langle x, y \rangle$  such that  $x$  is the friend of  $y$ . Here the ambiguity is between the LEXICAL reading versus the non-lexical, or EXTRINSIC, reading. Examples are given in (6).

- (6) a. His pictures were roundly denounced as the most disgusting things one has ever seen in Vienna.  
b. Her creations in fashion are from many designers because she doesn't want a complete wardrobe from any one designer any more than she wants all of her pictures by one painter.

For example, in (6a) *his pictures* is ambiguous between the reading where the picture depicts him (the lexical reading) and the reading where the picture stands in some contextually determined relation to him, for example, the picture belongs to him, or was painted by him (the extrinsic

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<sup>6</sup> The meaning difference can also be fairly idiosyncratic: *The English of the king* varied widely at times from *the king's English* 'English spoken by the king' versus 'correct English'; *the Lord's Day* 'Sunday' versus *the Day of the Lord* 'Judgment Day' (Jespersen, 1949:314, 318).

reading). In this case, only the 's-genitive is potentially ambiguous; *the picture of him* only has the lexical reading.

In what follows, we will assume that both transitive deverbal nouns and relational nouns denote two-place predicates and we will treat them in a parallel fashion. We will use the term RELATIONAL NOUN to refer to both. To unify the terminology further, we will call objective/lexical readings INTERNAL readings, and subjective/extrinsic readings EXTERNAL readings.<sup>7</sup>

The third type of ambiguity has to do with uniqueness. As illustrated by *Boston's Mr. and Mrs. Frank Stearns* in (3a), the 's-genitive generally carries a uniqueness implication (see also Barker, 1995: 78). However, this implication is suspended in cases like (7) (from Taylor, 1996: 262–3): (7a) does not imply that I have a unique sister; neither can we infer from (7b) that the professor has exactly one PhD student.<sup>8</sup>

- (7) a. My sister is getting married next week.  
b. She is having problems with her PhD student.

### 2.3 Preferences in expression, preferences in interpretation

It is not uncommon to find cases of variation where there is no obvious difference in meaning, but one variant sounds better than the other. Consider the following examples (cf. Grimshaw, 1990: 87):

- (8) a. its removal ~ ?the removal of it  
b. ?the tree's removal ~ the removal of the tree

In the 's-genitive, a pronominal genitive phrase (*its*) sounds better than a non-pronominal genitive phrase (*the tree's*); in the *of*-genitive we have the reverse judgment. These intuitions can also be supported by corpus evidence. In the Brown Corpus, the noun *removal* shows a categorical pattern: of the 17 genitive constructions in the corpus, all the 's-genitives (3 tokens) are pronominal, all the *of*-genitives (14 tokens) non-pronominal. As we will see later, this tendency is robust and general. The generalization that pronouns are dispreferred in the Complement position of a noun is also cross-linguistically supported (see e.g. Giorgi and Longobardi, 1991; Cardinaletti and Starke, 1999; Babyonyshev, 2002).

Similar preferences are also found in interpretation. Examples like *Aida's performance* are at least four-ways ambiguous, as shown in (9). While all four readings seem possible, some of them are more easily accessible than others. Readers may want to record their own preferred readings for future reference.

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<sup>7</sup> The terms 'internal' and 'external' are familiar from the literature on predicate-argument structure (e.g. Williams, 1981). Because we treat relational nouns as well as transitive deverbal nouns as two-place predicates, both types of nouns are assumed to take an internal and an external argument. We further assume that non-relational nouns (e.g. *cat*) are one-place predicates, and do not take an internal argument. See also our discussion on the representations of relational versus non-relational nouns in (18) below.

<sup>8</sup> The suspension of uniqueness is common in predicatives, e.g. *Those are Harry's tools, and those are too* (Mandelbaum, 1994; cited in Barker, 2002). This was pointed out to us independently by Cathy O'Connor and Philippe Schlenker.

- (9) *Aida's performance*
- a. 'the performance by Aida' (external reading)
  - b. 'a performance by Aida' (external reading)
  - c. 'the performance of Aida' (internal reading)
  - d. 'a performance of Aida' (internal reading)

## 2.4 No variation, no ambiguity

Despite the abundance of variation and ambiguity in the genitive construction, there are cases where we find neither. In (10), variation is categorically excluded:

- (10)
- |    |                           |                      |
|----|---------------------------|----------------------|
| a. | *the hospitals of us      | our hospitals        |
| b. | the destruction of cities | *cities' destruction |
| c. | a ring of gold            | *gold's ring         |
| d. | most of the time          | *the time's most     |

Similar sharp judgments are found on the ambiguity side. For example, the ambiguous examples in (5) and (6) stand in clear contrast to the unambiguous (11) and (12).

- (11) I appreciate your contribution to the performance of it.  
(internal reading only, contrast (5))

- (12)
- a. Shakespeare gives us a vivid picture of Shylock.
  - b. This is a picture of her.  
(internal reading only, contrast (6))

## 2.5 Summary

Table I below displays the categorical and gradient patterns exhibited by the English genitive construction: variation/no variation, ambiguity/no ambiguity.

Table I: Summary

VARIATION <sup>9</sup>	NO VARIATION
<p>1a. <i>Pat's picture</i> ~ <i>the picture of Pat</i>                      1b. <i>my picture</i> ~ <i>the picture of me</i></p> <p>1c. <i>John's performance</i> ~ <i>the performance of John</i>                      1d. <i>the opera's performance</i> ~ <i>the performance of the opera</i>                      1e. <i>its performance</i> ~ <i>the performance of it</i></p> <p>1f. <i>God's love</i> ~ <i>the love of God</i></p> <p>1g. <i>?the tree's removal</i> ~ <i>the removal of the tree</i>                      1h. <i>its removal</i> ~ <i>?the removal of it</i></p> <p>1i. <i>Pat's cat</i> ~ <i>?the cat of Pat</i></p>	<p>2a. <i>some of my pictures</i> / <i>*my pictures'</i>  <i>some</i></p> <p>2b. <i>my cat</i> / <i>*the cat of me</i></p>

AMBIGUITY	NO AMBIGUITY
<p>3a. <i>Pat's picture</i>                      'picture representing Pat'                      'picture owned by Pat'</p> <p>3b. <i>the love of God</i>                      'God loves someone' (external)                      'someone loves God' (internal)</p> <p>3c. <i>Aida's performance</i>                      'performance by Aida' (external)                      'performance of Aida' (internal)</p> <p>3d. <i>the performance of Aida</i>                      'performance by Aida' (external)                      'performance of Aida' (internal)</p>	<p>4a. <i>the picture of Pat</i>                      'picture representing Pat'</p> <p>4b. <i>God's love</i>                      'God loves someone' (external)</p> <p>4c. <i>the performance of it</i>                      'performance of it' (internal)</p>

<sup>9</sup> The examples with a question mark may be marginal, but possible. Attested examples: (i) *The tree's removal has sparked a reaction on campus* (<http://www.dailyemerald.com/archive/v100/2/990222/tree.html>); (ii) *Since the hair is a woman's glory, then isn't the removal of it the removal of her glory?* (<http://www.antipas.org/magazine/editor/hdcover.html>); (iii) *Madre, the cat of John* (<http://waves.apple.com/people/jav/OPC.html>); *The cat of Mr. Leopold Bloom sipped without embellishment the inner juices of the bovine udder* (<http://www.geocities.com/benbulben.geo/badjoyce1st2000.html>) (the first line of a first prize essay in the Jameson Whiskey Bad Joyce Essay Competition 2000).

Three important observations are now in order. The first observation is that relational nouns (e.g. *picture*) and non-relational nouns (e.g. *cat*) behave differently. The empirical generalization is stated by Barker and Dowty (1993) as follows:

- (13) The Barker-Dowty Generalization: If a noun can take a genitive *of*-phrase and if the *of*-phrase can also be paraphrased by a prenominal possessive [*'s*-genitive] then we can generally assume that [the] noun has the appropriate relational sense.

In short, relational nouns allow *'s*-genitive ~ *of*-genitive variation, non-relational nouns do not.<sup>10</sup> This is easiest to observe with pronouns: *my picture* ~ *a picture of me* versus *my cat*/\**a cat of me*. However, interpreted as a syntactic test for relationality, (13) is both too loose and too strict. Many non-relational nouns show variation, e.g. *the office of the superintendent* ~ *the superintendent's office*, *the new firetruck of the fire department* ~ *the fire department's new firetruck*. Conversely, not all relational nouns show variation, e.g. *my picture* ~ *the picture of me*, but *my nose*/\**the nose of me* (only *'s*-genitive) and *the destruction of cities*/\**cities' destruction* (only *of*-genitive). There is clearly something right about the Barker-Dowty generalization, but as it stands, it is not a particularly good predictor of the actual distributions.

The second observation is that pronouns and non-pronouns behave differently. Recall the contrasts *its removal* ~ ?*the removal of it* and ?*the tree's removal* ~ *the removal of the tree*. The generalization can be stated as follows:

- (14) The Pronoun Generalization: Pronouns are preferred in the Specifier position and dispreferred in the Complement position. Non-pronouns show the reverse pattern.

The problem is that this generalization only surfaces as a quantitative tendency. Pronouns are clearly allowed in the Complement position, e.g. *the picture of me*, and non-pronouns in the Specifier position, e.g. *God's love*. Expressions like ?*the removal of it* and ?*the tree's removal* are clearly both acceptable, only dispreferred. In a grammatical theory that only recognizes qualitative distinctions, such gradient judgments and skewed distributions remain informal observations. This is despite the fact that they are otherwise just like their categorical counterparts: both are equally systematic and both depend on the same kind of grammatical information.

The third observation is that different relational nouns behave differently:

- (15) The Noun Class Observation: Different relational nouns show different ambiguity patterns.

For example, *Aida's performance* is ambiguous (external versus internal reading), but *God's love* is not (external reading only); *Clinton's picture* is ambiguous (external versus internal reading), but *Clinton's sketch* is not (external reading only). More examples are listed in (16).

- (16) E = external, I = internal
- |    |                               |       |                                    |       |
|----|-------------------------------|-------|------------------------------------|-------|
| a. | <i>Aida's performance</i>     | (E~I) | <i>the performance of Aida</i>     | (E~I) |
|    | <i>the tribe's discovery</i>  | (E~I) | <i>the discovery of the tribe</i>  | (E~I) |
|    | <i>the company's donation</i> | (E~I) | <i>the donation of the company</i> | (E~I) |

<sup>10</sup> The second implication is not entailed by (13), but it is implicit in the surrounding text.



b.	God's love	(E)	the love of God	(E~I)
	God's knowledge	(E)	the knowledge of God	(E~I)
	the enemy's fear	(E)	the fear of the enemy	(E~I)
c.	Clinton's picture	(E~I)	the picture of Clinton	(I)
	Clinton's portrait	(E~I)	the portrait of Clinton	(I)
	Clinton's statue	(E~I)	the statue of Clinton	(I)
d.	Clinton's sketch	(E)	the sketch of Clinton	(I)
	Clinton's painting	(E)	the painting of Clinton	(I)

What is striking about this lexical variation is its limited nature. While the nouns in (16a) allow both readings in both syntactic positions, the nouns in (16b-d) exclude readings selectively: in (16b) the 's-genitive only has the external reading; in (16c) the *of*-genitive only has the internal reading; in (16d), where there is no ambiguity, the 's-genitive has the external reading, the *of*-genitive the internal reading. To the best of our knowledge, English has no nouns that pattern as in (17). We use the hypothetical relational noun *quain* to illustrate:

(17) Nonexistent patterns

a.	Pat's quain	(I)	the quain of Pat	(E)
b.	Pat's quain	(I)	the quain of Pat	(E~I)
c.	Pat's quain	(E~I)	the quain of Pat	(E)

These three observations are empirical problems that invite an OT-type solution. The Barker-Dowty Generalization and the Pronoun Generalization are typical examples of regularities that are violable and quantitative. Intuitively, there is something right about them, but taken at face value, they are either empirically wrong or unhelpfully vague. The observation that different relational nouns behave differently is another aspect of the same problem; here we need a theory that explains the systematic restrictions, but at the same time accommodates the attested lexical diversity. In the rest of this paper, we will show how these three observations can be derived in Optimality Theory.

### 3. An approach to meaning-form mapping

#### 3.1 Questions

The above survey of English genitive constructions has shown that while variation and ambiguity abound, the occurrence of both is severely restricted by the grammar. In what follows, we will address two general questions:

- Why do we only find certain patterns of variation and ambiguity, but not others?
- To what extent can we explain quantitative preferences in variation and ambiguity?

#### 3.2 Inputs, outputs, constraints

An optimality-theoretic grammar defines a set of possible mappings between inputs (here, meanings) and outputs (here, forms). We assume that an input contains at least argument

structure and the relevant semantic features expressed in a suitable semantic metalanguage. In (18), we provide two sample semantic inputs: (18a) is the input underlying the external reading of *John's cat*; (18b) is the input underlying the internal reading of *John's child*. Our treatment of relational and non-relational nouns follows Barker (1995).<sup>11</sup>

- (18) a.  $\lambda x(\pi(\mathbf{john}, x) \wedge \mathbf{cat}_{[\text{specific}, \text{definite}]}(x))$  'the cat in some extrinsic relation with John'  
 b.  $\lambda x(\mathbf{child}_{[\text{specific}]}(\mathbf{john}, x))$  'a child of John'

Our task is to find a grammar that successfully maps a semantic input of this kind to the correct syntactic output(s). We assume that a syntactic output contains at least two kinds of material: (i) lexical items that correspond to the semantic predicates and constants, e.g. *cat*, *child*, *John*; (ii) grammatical morphemes that express functional information such as definiteness and specificity. Given the observation that possessives pattern like definites in several respects (see e.g. Woisetschlaeger, 1983; Barker, 1995: 78; Taylor, 1996: 187-204), we propose that the morphemes *the*, *my*, *your*, *his/hers/its*, *our*, *their*, and *'s* express the meaning [specific, definite], the morpheme *a(n)* expresses the meaning [specific], and that these expressions are associated with the entire phrase within which these items occur.<sup>12</sup> To illustrate, we display two types of output candidates in (19): the *'s*-genitive and the *of*-genitive.

- (19) a. *John's cat*<sub>[specific, definite]</sub> ('s-genitive)  
*John's child*<sub>[specific, definite]</sub>  
 b. *the cat of John*<sub>[specific, definite]</sub> (*of*-genitive)  
*a child of John*<sub>[specific]</sub>

Of course, there are other possible output candidates. Many of them never surface in actual English, e.g. *\*of the's John cat*<sub>[specific, definite]</sub>. Among the more plausible candidates is *a cat of John's*<sub>[specific]</sub> (double genitive) which surfaces under certain conditions. Here we will assume that candidates of the first type are ruled out by independent high-ranking constraints left unspecified here. Accounting for the distribution of candidates of the second type is left for future work.

Having now described inputs and outputs, we turn to constraints. In Optimality Theory, constraints are of two basic types: MARKEDNESS constraints that strive towards economy of expression, and FAITHFULNESS constraints that strive to express all and only the meanings present in the input (see e.g. Prince and Smolensky, 1993; Legendre, 2001 for general discussion). We first define two basic markedness constraints:

- (20) a. \*C: No Complement  
 b. \*S: No Specifier

In other words, \*C is violated if and only if the Complement position is filled; \*S is violated if and only if the Specifier position is filled.

<sup>11</sup> The features [specific] and [definite] could also be translated, but this would entail adopting a particular logical treatment of definiteness and specificity which is not our main concern here.

<sup>12</sup> As is well known, *a(n)* may be non-specific in examples like *I'm looking for a dictionary*. One possibility is to treat such cases as faithfulness violations where the presence of *a(n)* is forced for reasons independent of meaning. For a parallel example involving an indefinite use of *my*, see (39).

Next, we spell out the markedness constraints responsible for the Barker-Dowty Generalization (13) and the Pronoun Generalization (14). These generalizations refer to three properties of the genitive phrase: its expression type (Pronoun, Non-Pronoun), its argument status (External, Internal), and its structural position (Specifier, Complement). One possibility would be to simply stipulate constraints on the possible combinations of the three properties and rank them as required by the data. Here we will take a more principled approach. We start by defining the following universal prominence scales:

- (21) Universal prominence scales
- a. Animacy Hierarchy: Pronoun > Non-pronoun<sup>13</sup>
  - b. Argument Hierarchy: External > Internal (Grimshaw, 1990)
  - c. Structural Hierarchy: Specifier > Complement<sup>14</sup>

Next, we apply HARMONIC ALIGNMENT to the scales (21a) and (21c), and (21b) and (21c) (see Prince and Smolensky, 1993: 139 for details). The intuitive idea is that prominent elements combine well with other prominent elements, and non-prominent elements combine well with other non-prominent elements. Lexico-grammatical prominence hierarchies related to case, thematic roles, grammatical functions, definiteness, and animacy are known to play a role in word order phenomena (e.g. Uszkoreit, 1984; Choi, 2001; Lee, 2001); our proposal here is that such hierarchies also play a role in constituent ordering within NPs/DPs. For other applications of this idea in syntax, see Aissen, 1997; O'Connor, 1999a,b; Asudeh 2001. As a result of the harmonic alignment operation, we get the partially ranked constraint hierarchies shown in the rightmost columns of Tables II and III below.

Table II: Alignment of animacy and structural prominence

Scales	Harmonic Alignment	Constraint Alignment
Pronoun > Non-Pronoun	S/P > <sub>H</sub> S/NONP	$\left\{ \begin{array}{l} *C/P \\ *S/NONP \end{array} \right\} \gg \left\{ \begin{array}{l} *S/P \\ *C/NONP \end{array} \right\}$
Specifier > Complement	C/NONP > <sub>H</sub> C/P	

Table III: Alignment of argument structure and structural prominence

Scales	Harmonic Alignment	Constraint Alignment
External > Internal	S/E > <sub>H</sub> S/I	$\left\{ \begin{array}{l} *S/I \\ *C/E \end{array} \right\} \gg \left\{ \begin{array}{l} *S/E \\ *C/I \end{array} \right\}$
Specifier > Complement	C/I > <sub>H</sub> C/E	

This grammar fragment militates against prominence mismatches. The constraint hierarchy in Table II states that the combinations Complement/Pronoun (\*C/P) and Specifier/Non-pronoun (\*S/NONP) are worse than the combinations Specifier/Pronoun (\*S/P) and Complement/Non-pronoun (\*C/NONP). Similarly, the constraint hierarchy in Table III states that the combinations Specifier/Internal (\*S/I) and Complement/External (\*C/E) are worse than the combinations

<sup>13</sup> This is adapted from Silverstein's person/animacy hierarchy (in Aissen, 1999):

Local Person > Pronoun 3rd > Proper Noun 3rd > Human 3rd > Animate 3rd > Inanimate 3rd

<sup>14</sup> Here, prominence is defined by precedence and dominance relations at phrase structure.

Specifier/External (\*S/E) and Complement/Internal (\*C/I). Note that several constraint pairs remain unranked; these rankings will be fixed by language-specific empirical evidence.

In the actual analysis to be presented below, only the following three constraints ranked in the higher stratum will be active:

- (22) a. \*S/I No Specifier with an internal argument (see Koopman and Sportiche, 1991; Bernstein, 2001 and references therein)  
 b. \*C/P No Complement with a pronoun (see Giorgi and Longobardi, 1991; Cardinaletti and Starke, 1999; cf. also Babyonyshev, 2002)  
 c. \*S/NONP No Specifier with a non-pronoun.

We now turn to the faithfulness constraints. Following standard practice, we assume two basic constraints:

- (23) MAX Express meaning present in the input.  
 (24) DEP Do not express meaning not present in the input.

For example, expressing ‘the cat of John’ as *a cat of John*<sub>[specific]</sub> amounts to a MAX-violation because input definiteness does not have an expression in the output. Conversely, expressing ‘a child of John’ as *John’s child*<sub>[specific, definite]</sub> amounts to a DEP-violation because of the gratuitous expression of definiteness (= ‘s’) in the output. We argue that violations of this type are actually found in English: DEP is violated in cases like *My sister is getting married next week* where the phrase *my sister*<sub>[specific, definite]</sub> optionally expresses the meaning ‘a sister of mine’ (cf. the discussion in Woisetschlaeger, 1983; versus Jackendoff, 1968; Taylor, 1996; and Barker, 2002). We will return to this example shortly.

We are aware of two residual cases that the above constraints do not account for. We will simply mention them here and leave a more serious analysis for future work. First, partitive constructions categorically disallow the ‘s-genitive:

- |      |                                   |                              |
|------|-----------------------------------|------------------------------|
| (25) | some of us                        | *our some                    |
|      | some of my teachers               | *my teachers’ some           |
|      | most of the time                  | *the time’s most             |
|      | few of my friends                 | *my friends’ few             |
|      | the second of the five candidates | *the five candidates’ second |
|      | both of my cats                   | *my cats’ both               |
|      | the rest of the days              | *the days’ rest              |
|      | either of them                    | *their either                |

It is not clear to us why this restriction should hold and we will not be able to pursue the various possible syntactic and semantic explanations here. What is clear is that this constraint, whatever its nature, is never violated. At this stage in our analysis, we posit the descriptive constraint (26) and make it undominated.

- (26) PARTITIVE CONSTRUCTION (PC): In partitive constructions, the genitive phrase must be in the Complement position.

Second, the 's-genitive construction seems categorically impossible in examples like (27):

(27)	a ring of gold	*gold's ring
	a man of honor	*honor's man
	a state of shock	*shock's state
	a man of brooding suspicions	*brooding suspicions' man
	the goal of human dignity	*human dignity's goal

What these constructions seem to have in common is that the genitive phrase (e.g. *gold*, *brooding suspicions*) is non-specific (cf. Taylor 1996, Ch. 7). To describe this regularity, we posit the constraint in (28) and make it undominated:

(28) SPECIFICITY (SPEC): No non-specific specifiers.

Again, we believe that there is a deeper syntactic and/or semantic explanation behind this restriction, which awaits further investigation.<sup>15</sup>

### 3.3 Deriving patterns of variation

The next step in the analysis is to find informative data in order to figure out the constraint ranking. The constraints we have tentatively proposed are repeated in (29):

(29)	Constraints:	
	*C	No Complement
	*C/P	No Complement with a pronoun
	*S	No Specifier
	*S/I	No Specifier with an internal argument
	*S/NONP	No Specifier with a non-pronoun
	MAX	Express meaning present in the input
	DEP	Do not express meaning not present in the input
	SPEC	No non-specific specifiers
	PC	In partitives, the genitive phrase is in the Complement

In order to rank two constraints, we must find data where they conflict. This means that we must find a categorical well-formedness contrast such as *my cat*/\**the cat of me* that can then be used as evidence for the mutual ranking of the relevant constraint pair (see e.g. Tesar and Smolensky, 2000; McCarthy, 2002). The problem with English genitive constructions is that there are very few categorical contrasts to begin with, so it is exceedingly hard to make progress on this front. It is not particularly helpful to know that the 's-genitive and the *of*-genitive are more or less

---

<sup>15</sup> We put aside two further problems: (i) genitive compounds, e.g. *men's room*; (ii) generics, e.g. *women's rights*, *taxpayers' money*. The two are sometimes hard to tell apart (Taylor, 1996:194-5). Genitive compounds are clearly syntactically a class of their own. Among other things, they do not allow intervening adjectives (*\*men's respectable rooms* versus *Pat's large hats*), see Barker, 1995:37-9 and references there. As for generics, we simply stipulate that they do not violate the SPECIFICITY constraint. This probably means that the SPECIFICITY constraint must be reformulated once the real semantic generalization is better understood.

interchangeable in the same context because this just means that the constraints cannot be ranked either way. The abundance of such cases may initially seem to cast doubt on the entire optimality-theoretic approach. It is thus interesting to see whether anything worthwhile can be achieved in the near-absence of rankings.

Let us begin by identifying the constraints that are never violated. Once this is done, we can rank them at the top of the hierarchy and candidates that violate them can be safely ignored in subsequent tableaux. There are two such constraints: PARTITIVE CONSTRUCTION (PC) and SPECIFICITY (SPEC) which are responsible for the categorical contrasts *some of us*/\**our some* and *the ring of gold*/\**gold's ring*, respectively. In what follows, candidates that violate either of these two descriptive constraints will be suppressed.

Next, we turn to the interaction between pronouns and relational nouns. The four relevant input types are shown in (30). Sample outputs are given on the right.

- (30) a. Pronominal genitive phrase, non-relational noun (e.g. *my cat*)  
 b. Pronominal genitive phrase, relational noun (e.g. *a picture of him*)  
 c. Non-pronominal genitive phrase, non-relational noun (e.g. *Clinton's cat*)  
 d. Non-pronominal genitive phrase, relational noun (e.g. *a picture of Clinton*)

We will now walk through these cases one by one. First, consider pronouns combined with non-relational nouns. There are four active constraints: MAX, \*C/P, \*C and \*S. The violation pattern is shown in tableau (31). At this point, the constraints are still completely unranked.

- (31) 'the cat owned by me' → *my cat*

$\lambda x(\pi(\mathbf{I},x) \wedge \mathbf{cat}_{[\text{specific, definite}]}(x))$	MAX	*C/P	*C	*S
(a) → <i>my cat</i> <sub>[specific, definite]</sub>				*
(b) * <i>the cat of me</i> <sub>[specific, definite]</sub>		*	*	
(c) * <i>a cat of me</i> <sub>[specific]</sub>	*	*	*	

It is easy to see that candidate (a) *my cat* will always beat candidate (b) \**the cat of me* if we posit the ranking \*C/P >> \*S. Candidate (c) \**a cat of me* loses for an independent reason: it is HARMONICALLY BOUNDED by (b). This means that it incurs all the violations that (b) does, and more. The gratuitous MAX-violation proves fatal: there exists no ranking that would make (c) optimal.

Indeed, non-relational nouns with pronoun complements are generally no good:

- (32) You're my man.                   \*You're the man of me.  
 Get your timing right!           \*Get the timing of you right!  
 All he knows is his music.       \*All he knows is the music of him.  
 our hospitals                       \*the hospitals of us  
 Their flight was delayed.       \*The flight of them was delayed.

The striking unacceptability of the examples in (32) stands in clear contrast to the examples in (33), which sound perfectly natural:

- (33) Partitives: *some of us, many of us, several of them, most of them, each of us, both of us, one of them, two or three of us, a couple of us, dozens of them, a large number of them, either of them, any of them, the rest of us, neither of us, none of us.*  
Relational nouns: *pictures of me, the memory of him, a combination of them, through fear of him, in the forepart of him, the length of it, the sight of me, to the west of us, on the other side of him, the likes of me, the name of it*

We have already set aside partitives (cf. PARTITIVE CONSTRUCTION). Can we say something principled about relational nouns? Examples where a relational noun is followed by a pronoun complement are easy to find in corpora:

- (34) a. He could not recognize even long-familiar things upon seeing them again. Instead, he constantly became lost in parts and components of them.  
 b. The hen appeared to have no doubts as to her duties and was quick to settle down to the performance of them.  
 c. What is the real cause of them?

A crucial fact about relational nouns is that they allow variation: the *of*-phrase can be generally paraphrased by the 's-genitive. Thus, both *the picture of me* and *my picture* can express the meaning 'the picture representing me'. This is the Barker-Dowty Generalization. This is also what our grammar predicts. There are five active constraints, two of which are crucially ranked by earlier data (\*C/P >> \*S). To illustrate, we only display two totally ranked tableaux.

- (35) 'the picture representing me' → *my picture*  
 → *the picture of me*

$\lambda x(\text{picture}_{[\text{specific, definite}]}(\mathbf{I}, x))$	MAX	*S/I	*C/P	*C	*S
(a) <i>my picture</i> <sub>[specific, definite]</sub>		*!			*
(b) → <i>the picture of me</i> <sub>[specific, definite]</sub>			*	*	
(c) <i>a picture of me</i> <sub>[specific]</sub>	*!		*	*	
	MAX	*C/P	*S/I	*C	*S
(a) → <i>my picture</i> <sub>[specific, definite]</sub>			*		*
(b) <i>the picture of me</i> <sub>[specific, definite]</sub>		*!		*	
(c) <i>a picture of me</i> <sub>[specific]</sub>	*!	*		*	

These tableaux show that some total rankings compatible with \*C/P >> \*S predict *my picture*, others predict *the picture of me*. In other words, the grammar predicts variation. Candidate (c) is harmonically bounded.

In order to go beyond simple optionality we adopt the following QUANTITATIVE INTERPRETATION of OT grammars:

- (36) A quantitative interpretation of OT grammars (variation) (Anttila, 1997):  
 a. An output *O* is predicted by the grammar iff it wins by at least one total ranking compatible with the grammar.  
 b. If an output *O* wins by *n* total rankings and *t* is the number of total rankings compatible with the grammar, the probability of *O*'s occurrence is *n/t*.

By (36), the number of total rankings that generate each output is proportional to the probability of occurrence of this output. A simple computation shows that *my picture* is optimal by 80% and *the picture of me* by 20% of the total rankings compatible with  $*C/P \gg *S$ . This quantitative bias comes from the ranking  $*C/P \gg *S$  which prefers *my picture* over *the picture of me*. Recall that the same ranking resulted in a categorical contrast in *my cat*/*\*the cat of me*. This reveals a fundamental property of quantitatively interpreted optimality-theoretic grammars: the same ranking may yield both categorical and quantitative effects, depending on the input (Anttila, 1997, to appear; Anttila and Cho, 1998; Anttila and Fong, 2000; see Boersma and Hayes, 2001 for a somewhat different theory). The interpretation in (36) is an empirical hypothesis and as such possibly wrong. What makes it attractive is its simplicity. We will provisionally accept it here and go on to explore the predictions it derives.<sup>16</sup>

We have now dealt with two of the four cases: pronouns combined with both non-relational and relational nouns. Let us now turn to non-pronouns combined with non-relational nouns. This time, there are four active constraints. It suffices to inspect the two totally ranked tableaux in (37).

- (37) ‘the cat owned by Mr. Clinton’       $\rightarrow$  *Mr. Clinton’s cat*  
     $\rightarrow$  *the cat of Mr. Clinton*

$\lambda x(\pi(\mathbf{Mr. C}, x) \wedge \mathbf{cat}_{[\text{specific, definite}]}(x))$	MAX	*S/NONP	*C	*S
(a) <i>Mr. C’s cat</i> <sub>[specific, definite]</sub>		*!		*
(b) $\rightarrow$ <i>the cat of Mr. C</i> <sub>[specific, definite]</sub>			*	
(c) <i>a cat of Mr. C</i> <sub>[specific]</sub>	*!		*	
	MAX	*C	*S	*S/NONP
(a) $\rightarrow$ <i>Mr. C’s cat</i> <sub>[specific, definite]</sub>			*	*
(b) <i>the cat of Mr. C</i> <sub>[specific, definite]</sub>		*!		
(c) <i>a cat of Mr. C</i> <sub>[specific]</sub>	*!	*		

Again, the grammar correctly predicts variation, but the frequencies differ from the previous case: *Mr. Clinton’s cat* is optimal by 40% and *the cat of Mr. Clinton* by 60% of the total rankings. Candidate (c) is harmonically bounded.

Finally, consider non-pronouns combined with relational nouns. Now there are five active constraints. Again, the grammar correctly predicts variation, and again, the predicted frequencies differ from the previous cases. We only display two totally ranked tableaux to illustrate:

<sup>16</sup> The anonymous reviewer asks how grammars like this might be acquired. Some partially ordered grammars (stratifiable partial orderings) can be described as a special case of continuously ranking grammars with noisy evaluation, studied by e.g. Boersma and Hayes (2001), for which a learning algorithm has been developed. However, the present grammar does not belong to this class, and as far as we know, no non-exponential learning algorithm for the general class of partially ordered grammars has been developed (Boersma, 2001). Our reason for adopting partially ordered grammars is simply that we do not know how to derive our empirical results within a different system that we know to be learnable. If future empirical research continues to provide evidence for partial ordering (or something equivalent) as a genuine property of natural language grammars, more realistic learning algorithms must be developed to meet this challenge. At the very least, we do not know of any negative results demonstrating that a reasonable learning algorithm for partially ordered grammars could not exist.



- (38) ‘the picture representing Mr. Clinton’ → *Mr. Clinton’s picture*  
 → *the picture of Mr. Clinton*

$\lambda x(\text{picture}_{[\text{specific,definite}]}(\text{Mr. C}, x))$	MAX	*S/I	*S/NONP	*C	*S
(a) Mr. Clinton’s picture <sub>[specific,definite]</sub>		*!	*		*
(b) → the picture of Mr. Clinton <sub>[specific,definite]</sub>				*	
(c) a picture of Mr. Clinton <sub>[specific]</sub>	*!			*	
	MAX	*C	*S/I	*S/NONP	*S
(a) → Mr. Clinton’s picture <sub>[specific,definite]</sub>			*	*	*
(b) the picture of Mr. Clinton <sub>[specific,definite]</sub>		*!			
(c) a picture of Mr. Clinton <sub>[specific]</sub>	*!	*			

This time, *Mr. Clinton’s picture* is optimal by 29% and *the picture of Mr. Clinton* by 71% of the total rankings. Candidate (c) is harmonically bounded. For full quantitative predictions for all types of inputs, see the Appendix, Part I.

There is one remaining categorical fact that calls for our attention. The candidate *\*a cat of me* is unacceptable as an expression of ‘a cat owned by me’ where the cat is [specific] but not [definite]. What we get instead is *my cat*, e.g. *This is my cat*, apparently contradicting our assumption that possessive pronoun *my* is [definite].<sup>17</sup> The obvious hypothesis is that the unacceptability of *\*a cat of me* is directly responsible for the unexpected indefinite reading of *my cat*: since *\*a cat of me* is unavailable for independent reasons (‘No Complement with a pronoun’), *my cat* is pressed into service even at the expense of semantic unfaithfulness. This effect can be easily derived by adding a second ranking to our grammar: *\*C/P* >> *DEP*. The grammar now contains two binary rankings: *\*C/P* >> *\*S* and *\*C/P* >> *DEP*. To illustrate, we display one totally ranked tableau.

- (39) ‘a cat owned by me’ → *my cat*

$\lambda x(\pi(\mathbf{I}, x) \wedge \text{cat}_{[\text{specific}]}(x))$	*C/P	DEP	*C	*S
(a) → my cat <sub>[specific,definite]</sub>		*		*
(b) *a cat of me <sub>[specific]</sub>	*!		*	
(c) *the cat of me <sub>[specific,definite]</sub>	*!	*	*	

The remaining important question is whether the predictions of our grammar are anywhere near correct. In particular, one would like to know how our quantitative predictions fare when confronted with actual data. In order to find out, we conducted a mini-test. We first selected 17 relational nouns based on the examples in Barker and Dowty 1993 and extracted the relevant genitive constructions from the Brown Corpus.<sup>18</sup> The selected nouns were those that occurred at least 20 times in the relevant environments in the corpus. These nouns were: *hand, head, heart, leg, nose* (body part nouns); *friend, wife* (kinship nouns and the like); *color, length, shape* (function nouns); *corner, edge, middle, point, side, surface, top* (topological properties). This

<sup>17</sup> Another possible expression is *a cat of mine*. As noted earlier, we do not yet have an account of the distribution of double genitives and will have to leave this for future work.

<sup>18</sup> We used a version of the Brown Corpus tagged by the ENGCG parser (Karlsson, Voutilainen, Heikkilä and Anttila, 1995), courtesy of the Department of General Linguistics, University of Helsinki.

resulted in 1,116 tokens in all. We then selected 37 nouns that appeared to us non-relational and that were also among the most frequent nouns in the corpus. The nouns were: *body, boy, business, car, city, church, country, day, fact, field, god, law, life, line, man, moment, money, night, number, office, place, power, problem, program, public, school, system, thing, voice, war, water, week, woman, word, world, work, year*. This resulted in 1,147 tokens in all. Only definite noun phrases, e.g. *the street's corner* and *the corner of the street* were included in the count. The results are shown in (40).<sup>19</sup>

(40) Predictions and observations: Preliminary data from the Brown Corpus

	Predictions		Observations		N of tokens, total = 2,263
	Spec	Comp	Spec	Comp	
a. Non-relational noun + pronoun <i>my cat / *the cat of me</i>	100%	0%	100%	0%	611
b. Relational noun + pronoun <i>my picture ~ the picture of me</i>	80%	20%	97%	3%	624
c. Non-relational noun + non-pronoun <i>Mr. C's cat ~ the cat of Mr. C</i>	40%	60%	37%	63%	536
d. Relational noun + non-pronoun <i>Mr. C's picture ~ the picture of Mr C.</i>	29%	71%	18%	82%	492

The results of our mini-test suggest that the grammar is on the right track. We predict that (i) non-relational noun + pronoun should categorically exclude *of*-genitives, which is correct; (ii) relational noun + non-pronoun should show the highest number of *of*-genitives, which is correct; (iii) of the two intermediary cases, relational noun + pronoun should show a higher number of 's-genitives than non-relational noun + non-pronoun, which is also correct. In other words, the predicted ordering of environments holds true in the corpus. On the negative side, the numerical fit could be better. The quantitative discrepancies have at least three possible sources. First, the classification of corpus examples may be inaccurate; for a brief description of some methodological problems, see footnote 19. Second, the numbers were derived from an extremely simple grammar with only two binary rankings established on the basis of categorical judgments; no rankings were added to fine-tune the quantitative predictions. Third, our descriptive taxonomy is too coarse-grained; for example, relational nouns have been treated as a homogeneous group,

<sup>19</sup> We wish to emphasize that these data are preliminary. The following limitations should be noted: (i) Our grammar makes different predictions depending on whether the genitive phrase is an external or an internal argument and whether the head noun is definite or indefinite. Unfortunately, these differences are sometimes difficult to tease apart from an actual corpus example. For example, *her picture* may mean 'a/the picture of her' (internal reading, definite or indefinite) or 'a/the picture that she owns' (external reading, definite or indefinite), and this four-way ambiguity may persist even in context. Our practical decision was to classify all 's-genitives that occur with relational nouns as definite internal readings. This means that we may have overestimated the number of internal readings in the Specifier position. In other words, the observed percentages in the Spec column of (40b) and (40d) may be too high; (ii) Our classification of nouns into relational versus non-relational is not entirely uncontroversial. A particularly thorny problem is homonymy/polysemy. For example, we have classified *boy* and *number* as non-relational, but they also have relational senses, namely 'son' and 'amount', respectively, and we have not attempted to tease the two senses apart; (iii) We only extracted those 's-genitives where 's was adjacent to the noun, e.g. *John's friend*, ignoring examples like *John's best friend* where 's and *friend* are separated by an adjective; (iv) Examples with two genitive phrases, e.g. *my picture of John*, were systematically excluded from the present count. This is appropriate because in these cases different predictions are made. We will return to this issue shortly.

ignoring the systematic differences among them. In any case, the moderate quantitative success of our simple grammar is a reason for optimism.

We have now evaluated the predictions of our grammar in terms of corpus frequencies, exploiting the auxiliary hypothesis that the relative well-formedness of an expression is reflected in its usage frequency (see Boersma and Hayes, 2001 for some discussion of this issue). However, nothing keeps us from testing the predictions in terms of intuitions about well-formedness. For example, consider the judgments in (41) (from (8)), attributed to Kayne (1984) by Grimshaw (1990: 87):

(41)	EXPRESSION	COMPETITOR
	a. <u>its removal</u> by Mary	the removal of it
	b. ?? <u>the tree's removal</u> by Mary	the removal of the tree
	c. during the course of <u>its digestion</u> by worms	the digestion of it
	d. ??during the course of <u>the food's digestion</u> by worms.	the digestion of the food

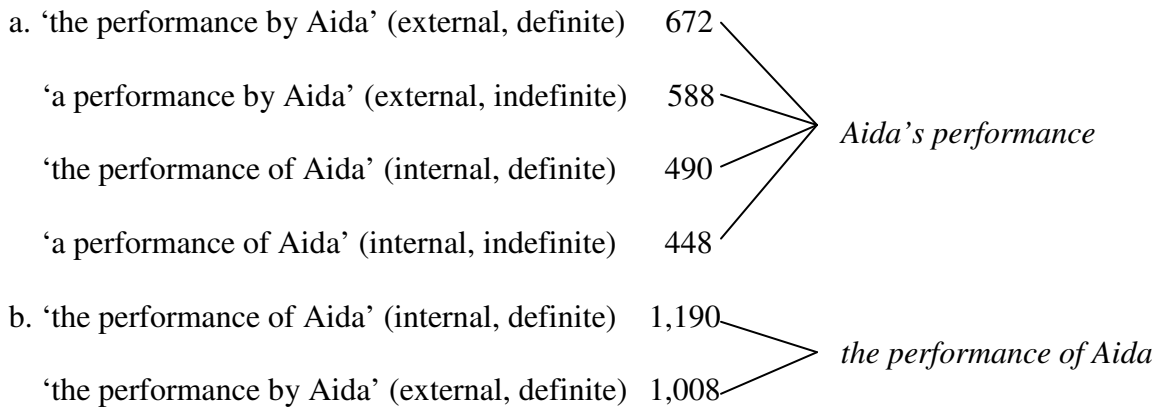
These examples involve a relational noun combined with a pronoun versus a non-pronoun (see tableaux (35) and (38)). Our grammar correctly predicts that (41a) should sound better than (41b) because *its removal* beats its competitor *the removal of it* in 80% of the competitions, whereas *the tree's removal* faces much more strenuous opposition from *the removal of the tree* and only wins in 29% of the competitions. The same applies to (41c) and (41d). The general point is that grammaticality is a comparative notion: an expression is excellent, good, poor, or unacceptable depending on the grammatical fitness of the alternative expressions for the same meaning.

### 3.4 Deriving patterns of ambiguity

An expression is ambiguous if it can be derived from two distinct inputs. For example, *the performance of Aida* can be derived from either 'Aida performed something' or 'Someone performed Aida'. Typically, there is a favored reading that jumps to mind immediately and one has to work harder to get the other readings. While it is clear that extragrammatical knowledge plays some role in ambiguity resolution, it is equally clear that grammatical knowledge is also involved in determining the preferred reading. This is problematic for a grammatical theory that only makes qualitative distinctions: the grammar will deliver a set of possible readings, but cannot provide any rationale for preferences among them, predicting that any preferences must be extragrammatical in nature. Different approaches to optimization of interpretation have been developed recently by Blutner (2000), de Hoop and de Swart (2000), Zeevat (2000), and Hendriks and de Hoop (2001), among others, but the problem of preferences has not been directly addressed in these works. It is therefore of some interest that the theory of variation explored here automatically provides a rationale for preferences in interpretation. This was first noted by Anttila and Fong (2000) who used this theory to derive preferences among the alternative readings of Finnish partitives.

Consider the expressions *Aida's performance* and *the performance of Aida*. Our grammar predicts that the former is four ways ambiguous and the latter two ways ambiguous, as shown in (42). Each interpretation is annotated by the number of total rankings that map this interpretation to this particular expression.

(42) Ambiguity

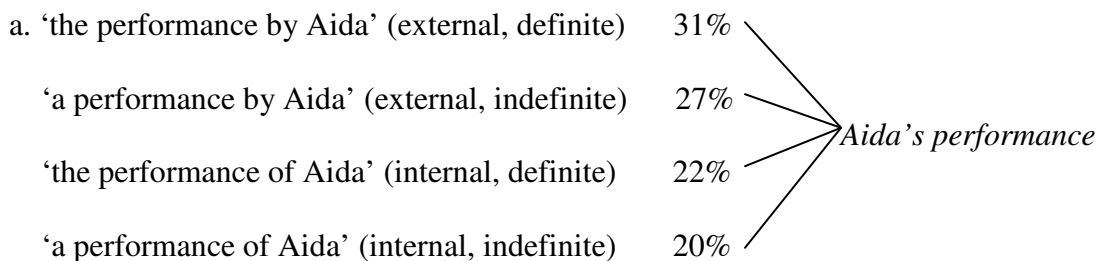


As the numbers indicate, the hearer's grammatical knowledge entails that (i) external readings are more likely to be mapped to the 's-genitive (*Aida's performance*) than internal readings (672, 588 > 490, 448); (ii) the definite reading is more likely to be mapped to the 's-genitive than the indefinite reading (672 > 588; 490 > 448); (iii) the internal reading is more likely to be mapped to the *of*-genitive (*the performance of Aida*) than the external reading (1,190 > 1,008). This seems to correspond to the intuitive judgments. The anonymous reviewer asks why *the performance of Aida* cannot be derived from an indefinite input. The reason is harmonic bounding: given an indefinite input, *the performance of Aida* is harmonically bounded by *a performance of Aida*: both violate \*C, but *the performance of Aida* violates DEP as well through the gratuitous insertion of [definite]. This predicts that there should be no language in which a definite determiner may express indefinite readings, all else being equal.

Building on these observations, we now define a quantitative interpretation for ambiguity that is exactly the mirror image of our quantitative interpretation for variation. The definition is given in (43). The predicted preferences are shown in (44). For full quantitative predictions for all types of outputs, see the Appendix, Part II.

- (43) A quantitative interpretation of OT grammars (ambiguity) (Anttila and Fong, 2000):
- An output *O* can be interpreted as input *I* iff there is at least one total ranking that maps *I* to *O*.
  - If *n* is the number of total rankings mapping *I* to *O* and *t'* is the number of total rankings that have *O* as their output, the probability that *O* is interpreted as *I* is  $n/t'$ .

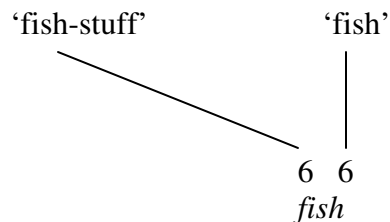
(44) Preferences in interpretation



- b. ‘the performance of Aida’ (internal, definite) 54%  
 ‘the performance by Aida’ (external, definite) 46%  $\searrow$  *the performance of Aida*

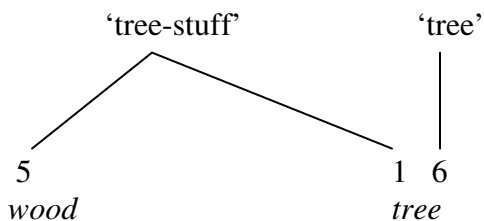
This quantitative interpretation of optimality-theoretic grammars, first proposed in Anttila and Fong, 2000, ties variation, ambiguity, preferences in expression, and preferences in interpretation together in a way that makes a number of unobvious empirical predictions. In particular, it yields a simple theory of BLOCKING (see e.g. Aronoff, 1976; Kiparsky, 1982; Briscoe et al., 1995; Copestake and Briscoe, 1995; Blutner, 2000). Consider the following familiar example. English productively converts count nouns into mass nouns, e.g. *This is a fish* versus *We had fish for dinner*, a phenomenon known as CONCEPTUAL GRINDING (see e.g. Pelletier and Schubert, 1989). While the grinding mechanism seems otherwise completely general, it is blocked in cases like *??This table is made of tree*, intuitively because there is an alternative expression *wood* that blocks the mass noun reading of *tree*. Assume a hypothetical grammar that consists of six total rankings. If this grammar maps both ‘fish-stuff’ and ‘fish’ to *fish*, and there is no variation in either mapping, (43) predicts that both readings of *fish* should be equally likely ( $6/12 = 50\%$ ). Neither reading is blocked.

(45) Ambiguity, no blocking



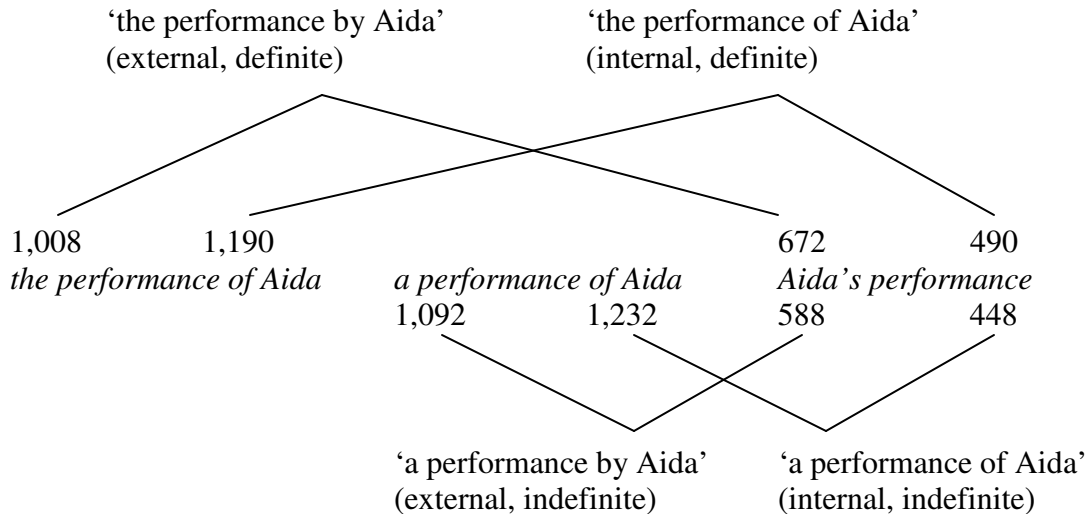
Now, if the grammar maps ‘tree’ to *tree*, and ‘tree-stuff’ to both *wood* and *tree*, with a 5-to-1 preference for *wood*, (43) predicts that *tree* has the preferred interpretation ‘tree’ ( $6/7 = 86\%$ ), and the dispreferred interpretation ‘tree-stuff’ ( $1/7 = 14\%$ ), whereas *wood* is unambiguously interpreted as ‘tree-stuff’ ( $5/5 = 100\%$ ). The oddity of *??This table is made of tree* thus follows from the existence of an alternative expression *wood* which reduces the number of paths between *tree* and ‘tree-stuff’ to one. This follows because the number of total rankings in the grammar ( $t$ ) is constant. This is an instance of quantitative blocking.

(46) Ambiguity, quantitative blocking



In (47), we see an actual prediction made by our grammar:

(47) Ambiguity, quantitative blocking



Consider the four ways ambiguous *Aida’s performance*. Its most likely interpretation is ‘the performance by Aida’ (external, definite) ( $672/2,198 = 31\%$ ); its least likely interpretation is ‘a performance of Aida’ (internal, indefinite) ( $448/2,198 = 20\%$ ). This is directly connected to the fact that the first meaning has the alternative expression *the performance of Aida* which only wins in  $1,008/1,680 = 60\%$  of the competitions, whereas the second has a better alternative expression *a performance of Aida* which wins in as many as  $1,232/1,680 = 73\%$  of the competitions. This is another instance of quantitative blocking: the weight of a reading depends on whether and how easily it can be expressed by alternative means. If a reading can be expressed in only one way, i.e. there is no variation, its weight will be  $t$  (= the number of total rankings in the grammar). If the reading has alternative expressions available, i.e. there is variation, its weight will be smaller than  $t$ . This is precisely why the preferences in interpretation come out the way they do in (42) and (44).

In sum, we have proposed that the same grammar that predicts variation probabilities also determines the relative weight of the different readings of an ambiguous expression. Of course, this is not the whole story. It is plainly obvious that extragrammatical knowledge plays some role in ambiguity resolution. However, it is equally clear that grammatical knowledge is also involved in determining the preferences among readings, and the present proposal is an attempt to formulate an explicit hypothesis about how such preferences might result from the interaction of grammatical principles, and how these preferences relate to other facts of language, in particular variation.

### 3.5 Summary

Let us now summarize what has been done. We started out by proposing a simple grammar to account for the categorial grammaticality judgments *my cat/\*the cat of me/\*a cat of me*. This was achieved by two binary rankings:

- (48) Rankings for English: \*C/P >> \*S  
 \*C/P >> DEP

We then noted that the proposed grammar lends itself to a simple quantitative interpretation and derived a set of variation probabilities that turned out to approximate the actual frequency facts in the Brown Corpus reasonably well. We further pointed out that the same grammar also provides a rationale for a theory of interpretational preferences and provided some preliminary motivation for it. The proposed theory thus explicitly ties together three empirical domains: categorical well-formedness judgments, variation frequencies, and interpretational preferences, predicting that evidence from all three sources should converge. Serious quantitative work is needed to verify this prediction.

#### 4. Deriving noun classes

##### 4.1 Lexical patterns

So far, we have been assuming a two-way distinction between relational nouns and non-relational nouns. However, this is clearly an idealization. As we pointed out earlier, relational nouns are not a homogeneous class. Recall the Noun Class Observation (15): different relational nouns show different ambiguity patterns. So far, we have found six distinct classes of relational nouns, which we display in (49). What we observe is that different noun classes exhibit different ways of linking their internal and external arguments to syntactic positions, and ambiguity arises when both arguments can be linked to the same syntactic position. More examples of each noun class are given in (50) below.

- (49) Classes of relational nouns

NOUN CLASS	GENITIVE PHRASE	'S-GENITIVE READINGS	OF-GENITIVE READINGS
<i>performance</i>	PRONOUN NON-PRONOUN	E~I <i>its performance</i> E~I <i>Aida's performance</i>	I <i>the performance of it</i> E~I <i>the performance of Aida</i>
<i>picture</i>	PRONOUN NON-PRONOUN	E~I <i>my picture</i> E~I <i>Clinton's picture</i>	I <i>the picture of me</i> I <i>the picture of Clinton</i>
<i>love</i>	PRONOUN NON-PRONOUN	E <i>her love</i> E <i>God's love</i>	I <i>the love of her</i> E~I <i>the love of God</i>
<i>expression</i>	PRONOUN NON-PRONOUN	E~I <i>its expression</i> E <i>Pat's expression</i>	I <i>the expression of it</i> I <i>the expression of anger</i>
<i>sketch</i>	PRONOUN NON-PRONOUN	E <i>my sketch</i> E <i>Clinton's sketch</i>	I <i>the sketch of me</i> I <i>the sketch of Clinton</i>
<i>brother</i>	PRONOUN NON-PRONOUN	E~I <i>my brother</i> E~I <i>Pat's brother</i>	∅ -- I <i>the brother of Clinton</i>

(50) More examples

- *performance*-nouns: performance, robbery, conquest, discovery, examination, donation, summary, write-up, declaration, review, destruction, promulgation
- *picture*-nouns: picture, photograph, portrait, statue, history, biography, story, draft, version, name, birthday
- *love*-nouns: love, fear, admiration, knowledge, ignorance, desire, survey, account, criticism, contribution, news, report, statement, most *-ing* forms
- *expression*-nouns: expression, avoidance
- *sketch*-nouns: sketch, tale, painting, part
- *brother*-nouns: brother, sister, wife, hand, nose, child, mother

How can we account for these lexical differences? The first thing that comes to mind is that these differences have something to do with lexical semantics, in particular thematic roles, aspectual structure, and the affectedness of arguments (e.g. Anderson, 1979; Grimshaw, 1990; Doron and Rappaport-Hovav, 1991; Taylor, 1996). The syntactic differences among noun classes would thus derive from the lexical meaning of nouns, in the same way that verb meaning has been assumed to determine the syntactic behavior of verbs (see e.g. Levin, 1993). This may well be so, and one could posit additional constraints to that effect. Of course, such constraints would have to generalize beyond the descriptive problem at hand and produce plausible cross-linguistic typologies. However, it is not always easy to see what such constraints might be. For example, what would be the universal semantic constraint responsible for the difference between *picture* and *nose*, or perhaps more puzzlingly, *picture* and *sketch*?<sup>20</sup> Indeed, the noun classes in (50) defy a simple semantic definition. For example, *performance*-nouns include many action nouns, such as *robbery* and *conquest*, where the agent performs an act that results in a substantial change in the state of the patient (Taylor, 1996: 152), but it also includes nouns like *discovery*, *examination*, *review*, and *donation* that do not have such semantic entailments. Most *picture*-nouns are representational, but we find some non-representational nouns as well (e.g. *name*, *birthday*). Many *love*-nouns (e.g. *fear*, *admiration*, *knowledge*, *ignorance*, *desire*) derive from cognitive verbs (Taylor, 1996: 152), but some do not (e.g. *criticism*, *contribution*). Morphology seems to play a role as well: for example, most *-ing* forms seem to belong to the *love*-noun class.<sup>21</sup> Yet another problem is that the same meanings pattern differently in different languages, showing that a purely semantic account is probably insufficient. Consider for example the English sentence (48a) and its Italian equivalent (48b) (Giorgi and Longobardi, 1991: 121-2):

- (51) (a) The description of Mary was inaccurate. (internal reading)  
(b) La descrizione di Maria non era accurata. (external or internal reading)

Observations like these suggest that we are dealing with facts that are semantically not completely arbitrary, but not completely predictable either. What we need is a theory that accommodates the attested diversity, both within a language as well as across languages, but also

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<sup>20</sup> Taylor (1996: 259) suggests that the difference between *portrait* and *sketch* depends on the informativity of represented objects. According to Taylor, *portrait*, *statue*, and *history* allow us to ‘draw quite reliable inferences as to the nature of the represented object’, whereas *sketch*, *painting*, and *story* ‘could be a representation of just about anything’. This semantic dichotomy would then explain the differences in ambiguity patterns in (49).

<sup>21</sup> However, cf. *my mother’s training* which admits the internal reading.



sets principled limits on lexical arbitrariness. In what follows, we will show how the theory of variation and ambiguity explored in this paper extends to the domain of lexical organization.

#### 4.2 A subregularity interpretation of OT grammars

In our analysis of the genitive construction, the grammar of English consists of 9 constraints and 2 binary rankings: \*C/P >> \*S, \*C/P >> DEP. These two binary rankings define a partial order that can be spelled out as 1,680 total rankings. By adding more binary rankings to this grammar, we can define various subsets of English. The resulting partial orders will each be increasingly specific, and will be compatible with fewer and fewer total orders.

To capture the lexical patterns in (49), we hypothesize that the partial ordering \*C/P >> \*S, \*C/P >> DEP defines the space of possible lexical variation in English. Following Anttila (2002), we propose a subregularity interpretation of OT grammars:

- (52) A subregularity interpretation of OT grammars (Anttila, 2002): Different lexical items may subscribe to different partial orders within the grammar of a language.

Given that the overall grammar space is rather large (1,680 total rankings), the question arises as to how many and what kinds of distinct lexical patterns the theory predicts. This is not too difficult to work out. First, we must consider the space of possible inputs. We note that (i) the head noun may be definite or indefinite; (ii) the genitive phrase may be pronominal or non-pronominal, an internal or external argument, specific or non-specific. This yields  $2^4 = 16$  possible combinations. Since English has no non-specific pronouns, we are left with 12 types of inputs. Next, for each input, we must consider every total ranking in the grammar, and figure out the possible outputs. We illustrate this by considering one randomly chosen ranking:

- (53) Sample ranking: \*S/I >> \*C/P >> DEP >> \*S/NONP >> \*C >> \*S >> MAX

	HEAD	GENITIVE PHRASE	OUTPUT
1.	definite	pronominal, specific, external	<i>X's Y</i>
2.	definite	pronominal, specific, internal	<i>Y of X</i>
3.	definite	non-pronominal, specific, external	<i>Y of X</i>
4.	definite	non-pronominal, specific, internal	<i>Y of X</i>
5.	definite	non-pronominal, non-specific, external	<i>Y of X</i>
6.	definite	non-pronominal, non-specific, internal	<i>Y of X</i>
7.	indefinite	pronominal, specific, external	<i>X's Y</i>
8.	indefinite	pronominal, specific, internal	<i>Y of X</i>
9.	indefinite	non-pronominal, specific, external	<i>Y of X</i>
10.	indefinite	non-pronominal, specific, internal	<i>Y of X</i>
11.	indefinite	non-pronominal, non-specific, external	<i>Y of X</i>
12.	indefinite	non-pronominal, non-specific, internal	<i>Y of X</i>

Of the 1,680 total rankings, we have now considered one; there are 1,679 total rankings left. Despite the apparently large number of possible grammars, the number of possible output patterns turns out to be quite small because many rankings yield the same output. In table (54),

we have grouped the 1,680 total rankings by the output pattern they generate; only eight distinct types I-VIII are found. The number N shows the number of total rankings in each type. The input types have been arranged in pairs such that each odd-numbered row contains an external reading and the immediately following even-numbered row contains the corresponding internal reading (cf. (53)).

(54) A typology of input-output mappings

		RANKING TYPES							
		I	II	III	IV	V	VI	VII	VIII
INPUT TYPES		N = 224	N = 98	N = 14	N = 42	N = 28	N = 448	N = 42	N = 784
	1.	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y
	2.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	X's Y	X's Y	X's Y	X's Y	X's Y
	3.	<b>Y of X</b>	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	<b>Y of X</b>
	4.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	X's Y	X's Y	<b>Y of X</b>
	5.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>
	6.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>
	7.	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y
	8.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	X's Y	X's Y	X's Y	X's Y	X's Y
	9.	<b>Y of X</b>	X's Y	<b>Y of X</b>	X's Y	<b>Y of X</b>	X's Y	<b>Y of X</b>	<b>Y of X</b>
	10.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	X's Y	<b>Y of X</b>	<b>Y of X</b>
	11.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>
12.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	

To see how the variation and ambiguity patterns can be read off the table in (54), consider the following example:

(55) Input 1: Head [definite], genitive phrase [pron, specific, external]

Input 2: Head [definite], genitive phrase [pron, specific, internal]

	I	II	III	IV	V	VI	VII	VIII
	224	98	14	42	28	448	42	784
1.	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y	X's Y
2.	<b>Y of X</b>	<b>Y of X</b>	<b>Y of X</b>	X's Y	X's Y	X's Y	X's Y	X's Y

Table (55) gives us three types of information. First, it shows the presence versus absence of variation: while input 1 is invariably expressed as *X's Y*, input 2 can be expressed variably as either *Y of X* or *X's Y*. Second, the table shows the presence versus absence of ambiguity: the expression *X's Y* is ambiguous because it can express either input 1 or input 2; the expression *Y of X* is unambiguous because it can only express input 2. Third, the table shows how the different total rankings differ in their output. In this case, the rankings I-III keep the two inputs syntactically distinct: input 1 is expressed as *X's Y*, input 2 as *Y of X*. In contrast, the rankings IV-VIII neutralize the syntactic distinction, expressing both inputs as *X's Y* where *X* is ambiguous. This indicates the presence of two distinct subregularities within the grammar of English.

By working out the remaining patterns for the remaining pairs of input types, the following general predictions emerge:

- (56) General predictions:
- (a) If there is no ambiguity, the internal argument is mapped to the complement, the external argument to the specifier.
  - (b) If the external argument can be mapped to the complement, so can the internal argument.
  - (c) If the internal argument can be mapped to the specifier, so can the external argument.

We now match the predictions of our model to the actually attested noun classes in (49). All in all, only six possible ambiguity patterns are predicted. As shown in (57), at least five of the predicted six patterns are attested. Note that each pattern is predicted to occur only with a particular kind of a genitive phrase.

(57) The predicted types of ambiguity

	SPEC	COMP	GENITIVE PHRASE	EXAMPLE
a.	E	I	specific	<i>Pat's sketch ~ a sketch of Pat</i>
b.	E~I	--	specific	<i>my brother ~ *the brother of me</i>
c.	--	E~I	non-pronominal	?
d.	E~I	I	specific	<i>Pat's picture ~ the picture of Pat</i>
e.	E	E~I	specific	<i>God's love ~ the love of God</i>
f.	E~I	E~I	specific, non-pron.	<i>Aida's performance ~ the performance of Aida</i>

Several logically possible ambiguity patterns are excluded, among them the patterns in (58). Again, we use the hypothetical relational noun *quain* to illustrate:

(58) Excluded patterns

a.	Pat's quain	(I)	the quain of Pat	(E)
b.	Pat's quain	(I)	the quain of Pat	(E~I)
c.	Pat's quain	(E~I)	the quain of Pat	(E)
d.	Pat's quain	(E)	the quain of Pat	(E)
e.	Pat's quain	(I)	the quain of Pat	(I)
f.	its quain	(E~I)	the quain of it	(E~I)

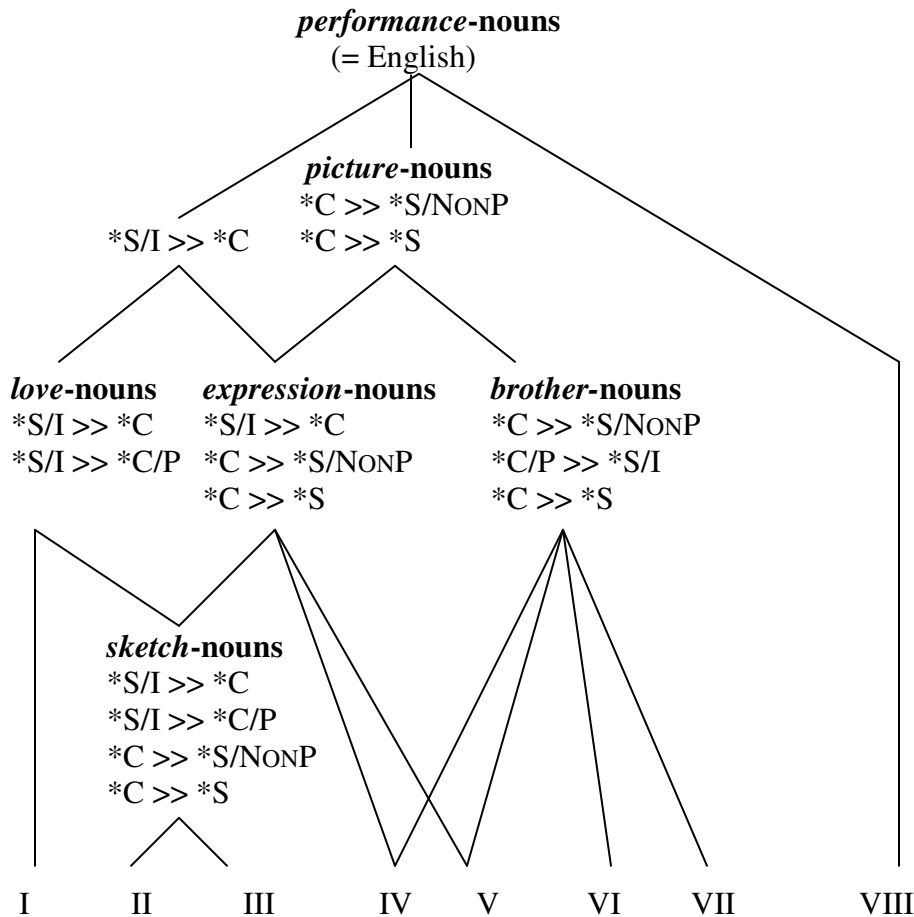
By hypothesis, the six observed noun classes can be paired with specific partial orders within the grammar of English. The required rankings for each noun class can be figured out by inspecting the tableaux in section 3.3. The results are presented in (59).

(59) Six noun classes with the corresponding partial orders

<i>performance</i>	English
<i>picture</i>	English $\cup$ { *C >> *S/NONP, *C >> *S }
<i>love</i>	English $\cup$ { *S/I >> *C, *S/I >> *C/P }
<i>expression</i>	English $\cup$ { *S/I >> *C, *C >> *S/NONP, *C >> *S }
<i>sketch</i>	English $\cup$ { *S/I >> *C, *C >> *S/NONP, *S/I >> *C/P, *C >> *S }
<i>brother</i>	English $\cup$ { *C/P >> *S/I, *C >> *S/NONP, *C >> *S }

The organization of the nominal lexicon is best displayed in terms of a lattice diagram. English is located at the root; the various classes of relational nouns are shown in order of increasing specificity.

(60) The organization of relational nouns (general rankings for English omitted)



The above diagram makes explicit the inclusion relations among noun classes. For example, *expression-nouns* have the rankings of *picture-nouns* plus one additional binary ranking that results in a more limited pattern: *\*his anger's expression* (I) versus *Clinton's picture* (I) (cf. Taylor, 1996: 153). An even stricter pattern is found in *sketch-nouns* that inhabit the intersection of *love-nouns* and *expression-nouns*. In this case, there is no ambiguity at all: *his sketch* (E), *the sketch of him* (I), *John's sketch* (E), *the sketch of John* (I). Finally, *brother-nouns* are a more limited version of *picture-nouns* as shown by the contrast *\*the brother of me* versus *the picture of me*, and *picture-nouns* are a special case of *performance-nouns*.<sup>22</sup>

<sup>22</sup> The anonymous reviewer notes: "The limit of this interpretation would be that there is a different ranking linked to each individual word, at which point it would no longer make sense to assume there is a grammar that underlies these patterns, since it would be equivalent to saying that the child just has to learn per word in which pattern it appears." We agree with the first observation, but not with the second. While individual words do have a certain degree of grammatical autonomy in choosing their linking patterns (cf. *picture* versus *sketch*), the possible choices are severely limited by the grammar, as shown in (57) and (58).

We conclude by pointing out two areas where the analysis needs further refinement. First, the nouns *concealment*, *disappointment*, *amusement*, and *exposure* are problematic as they appear to manifest the excluded (I, I) pattern (58e). For example, both *Pat's amusement* and *the amusement of Pat* get the internal reading; both are incompatible with the external reading, which is not predicted by our analysis. These nouns have other unexpected properties as well, for example, they do not permit the *X's Y of Z* expression at all, e.g. *\*the news's disappointment of the audience* (intended meaning: 'the news disappointed the audience') (Taylor, 1996: 156-7), cf. *Pat's performance of Aida*. Any analysis should connect these two facts (see e.g. Roeper, 1993; Pesetsky, 1995; Maling, 2001 for relevant discussion), but we have yet to incorporate this into our analysis.

Second, we have only considered cases where there is only one genitive phrase, e.g. *Aida's performance*, *the performance of Aida*. How about cases where there are two genitive phrases, such as *Pat's performance of Aida*? As it stands, the analysis works if both are either pronouns or non-pronouns, e.g. *my performance of it*, *Pat's performance of the play*, or if the external argument is a pronoun and the internal argument a non-pronoun, e.g. *its performance of Aida*. Here the analysis correctly predicts that the *'s*-genitive has the external reading and the *of*-genitive has the internal reading. However, if the external argument is a non-pronoun and the internal argument a pronoun, the analysis optionally permits the wrong linking pattern, e.g. 'the performance of it by Aida' comes out optionally as *its performance of Aida*, an incorrect prediction. This suggests that we must enrich our model with an independent constraint that prohibits the linking of an internal argument to a structurally higher position than the external argument (e.g. Williams, 1981; Grimshaw, 1990).

### 4.3 Summary

In this section, we have shown how the argument linking patterns in relational nouns can be derived from our theory of variation and ambiguity. The theory proposed here explicitly relates three empirical domains that may pre-theoretically seem quite different: (i) variation and quantitative preferences in expression; (ii) ambiguity and quantitative preferences in interpretation; (iii) the typology of argument linking in the nominal lexicon. All three aspects of the genitive problem follow from one simple optimality-theoretic grammar. It is no doubt possible to replicate parts of the analysis in alternative frameworks. What makes Optimality Theory attractive is that it provides a simple structure that allows one to derive all these regularities, including the quantitative regularities, from one and the same grammar.

### 5. Future directions

We have motivated and defended a general approach to variation, ambiguity, preferences, and lexical subregularities, using the English genitive construction as a test case. There remain several issues that have not been addressed. In this section, we will identify some issues we hope to pursue in future work.

First, our assumptions about lexical semantics have been minimal. We distinguished between non-relational and relational nouns, but we could have made subtler distinctions in terms of semantic relations (Hawkins, 1981; Pustejovsky, 1995; Borschev and Partee, 2002;

Jensen and Vikner, 2002), nominalization types (Grimshaw, 1990), animacy and referentiality (Altenberg, 1982; Rosenbach, to appear) and thematic roles. Instead, we pursued the idea that the grammar generates a limited space of possible subregularities and that different lexical items cluster around different points in this space creating subregularities like *love*-nouns, *picture*-nouns and *brother*-nouns. This was a natural move both theoretically and descriptively: theoretically because these subregularities are entailed by our theory of variation; descriptively because they allow us to accommodate semantically puzzling differences such as the *picture-sketch* difference while maintaining principled limits on possible subregularities. There is no inconsistency between these two approaches, and it seems reasonable to introduce more fine-grained semantic constraints into the analysis. Whether a given surface regularity derives from a universal semantic constraint, a language-specific subregularity, or perhaps neither of the two is a question that can only be settled by careful empirical work.

Second, we have not addressed the problem of discourse effects (see especially Deane, 1987; Anschutz, 1997; O'Connor, 1999a,b). The central question is whether constraints referring to notions like discourse new versus discourse old should be included in the grammar. If yes, do the correct typological and quantitative predictions follow? For example, can novelty sometimes override 'hard' syntactic constraints? Alternatively, should syntax only deliver the options by generating free variation, which an independent discourse module then exploits for its own purposes? If so, how exactly do syntax and discourse interact?

Third, it has often been claimed that 'light' constituents precede 'heavy' ones. The notion of grammatical weight (e.g. Wasow, 1997; Arnold, Wasow, Losongco and Ginstrom, 2000) is relevant to the ordering of constituents within the genitive construction, but has not been addressed in the present analysis.

## 6. Conclusion

In this paper, we have explored a theory of the meaning-form relation based on ranked and violable constraints, using the English genitive construction as a testing ground. Our main thesis is that partially ordered optimality-theoretic grammars allow us to relate four apparently independent empirical phenomena: (i) categorical grammaticality contrasts; (ii) variation and preferences in expression; (iii) ambiguity and preferences in interpretation; (iv) lexical organization. Perhaps the most unconventional aspect of the present proposal is that quantitative aspects of variation and ambiguity are treated as integral parts of the grammar. More specifically, we have defended three claims:

- The same grammatical constraints yield both categorical and gradient surface effects (Anttila, 1997; Boersma and Hayes, 2001).
- Variation and ambiguity are mutually dependent and follow from one and the same constraint system (Anttila and Fong, 2002).
- The limited lexical diversity in argument linking is yet another aspect of a grammar that derives variation and ambiguity.

We have also defended the view that grammaticality is a comparative notion: an expression is excellent, good, poor, or unacceptable depending on the grammatical fitness of alternative expressions for the same meaning.

## Appendix: Quantitative predictions

The quantitative predictions of our grammar are listed below. These predictions are based on the nine constraints and the two binary rankings posited for the general grammar of English; we are abstracting away from lexical differences among nouns. Both percentages and raw numbers of total rankings are given. Abbreviations: Subj = subjective reading, Obj = objective reading, Lex = lexical reading.

### Part I: Predicted patterns of variation

#### Non-relational nouns

‘the cat owned by me’	<i>my cat</i>	100%	[1,680]
‘the cat owned by Mr. Clinton’	<i>Mr. Clinton’s cat ~</i> <i>the cat of Mr. Clinton</i>	40% 60%	[672] [1,008]
‘the ring made of gold’	<i>the ring of gold</i>	100%	[1,680]
‘a cat owned by me’	<i>my cat</i>	100%	[1,680]
‘a cat owned by Mr. Clinton’	<i>Mr. Clinton’s cat ~</i> <i>a cat of Mr. Clinton</i>	35% 65%	[588] [1,092]
‘a ring made of gold’	<i>a ring of gold</i>	100%	[1,680]

#### Relational nouns, external reading

‘the performance by it’ (Subj)	<i>its performance</i>	100%	[1,680]
‘the performance by Aida’ (Subj)	<i>Aida’s performance ~</i> <i>the performance of Aida</i>	40% 60%	[672] [1,008]
‘the examination by doctors’ (Subj)	<i>the examination of doctors</i>	100%	[1,680]
‘a performance by it’ (Subj)	<i>its performance</i>	100%	[1,680]
‘a performance by Aida’ (Subj)	<i>Aida’s performance ~</i> <i>a performance of Aida</i>	35% 65%	[588] [1,092]
‘an examination by doctors’ (Subj)	<i>an examination of doctors</i>	100%	[1,680]

#### Relational nouns, internal reading

‘the performance of it’ (Obj)	<i>its performance ~</i> <i>the performance of it</i>	80% 20%	[1,344] [336]
‘the picture representing me’ (Lex)	<i>my picture ~</i> <i>the picture of me</i>	80% 20%	[1,344] [336]
‘the performance of Aida’ (Obj)	<i>Aida’s performance ~</i> <i>the performance of Aida</i>	29% 71%	[490] [1,190]
‘the picture representing Mr. Clinton’ (Lex)	<i>Mr. Clinton’s picture ~</i> <i>the picture of Clinton</i>	29% 71%	[490] [1,190]
‘the examination of doctors’ (Obj)	<i>the examination of doctors</i>	100%	[1,680]

‘the picture representing gold’ (Lex)	<i>the picture of gold</i>	100%	[1,680]
‘a performance of it’ (Obj)	<i>its performance ~</i> <i>a performance of it</i>	80%	[1,344]
‘a picture representing me’ (Lex)	<i>my picture ~</i> <i>a picture of me</i>	80%	[1,344]
‘a performance of Aida’ (Obj)	<i>Aida’s performance</i> <i>a performance of Aida ~</i>	27%	[448]
‘a picture representing Mr. Clinton’ (Lex)	<i>a picture of Mr. Clinton ~</i> <i>Mr. Clinton’s picture</i>	27%	[448]
‘an examination of doctors’ (Obj)	<i>an examination of doctors</i>	100%	[1,680]
‘a picture representing gold’ (Lex)	<i>a picture of gold</i>	100%	[1,680]

## Part II: Predicted patterns of ambiguity

### 4-way ambiguities

<i>my picture</i>	‘the picture owned by me’	28%	[1,680]
	‘a picture owned by me’	28%	[1,680]
	‘the picture representing me’ (Lex)	22%	[1,344]
	‘a picture representing me’ (Lex)	22%	[1,344]
<i>its performance</i>	‘the performance by it (Subj)’	28%	[1,680]
	‘a performance by it (Subj)’	28%	[1,680]
	‘the performance of it (Obj)’	22%	[1,344]
	‘a performance of it (Obj)’	22%	[1,344]
<i>Clinton’s picture</i>	‘the picture owned by C’	31%	[672]
	‘a picture owned by C’	27%	[588]
	‘the picture representing C’ (Lex)	22%	[490]
	‘a picture representing C’ (Lex)	20%	[448]
<i>Aida’s performance</i>	‘the performance by A (Subj)’	31%	[672]
	‘a performance by A (Subj)’	27%	[588]
	‘the performance of A (Obj)’	22%	[490]
	‘a performance of A (Obj)’	20%	[448]

### 2-way ambiguities

<i>my cat</i>	‘the cat owned by me’	50%	[1,680]
	‘a cat owned by me’	50%	[1,680]
<i>my reaction</i>	‘the reaction by me’	50%	[1,680]
	‘a reaction by me’	50%	[1,680]
<i>Clinton’s cat</i>	‘the cat owned by Clinton’	53%	[672]
	‘a cat owned by Clinton’	47%	[588]
<i>Clinton’s reaction</i>	‘the reaction by Clinton’	53%	[672]
	‘a reaction by Clinton’	47%	[588]



<i>the picture of Clinton</i>	‘the picture representing C’ (Lex)	54%	[1,190]
	‘the picture owned by C’	46%	[1,008]
<i>the performance of Aida</i>	‘the performance of Aida (Obj)’	54%	[1,190]
	‘the performance by Aida (Subj)’	46%	[1,008]
<i>a picture of Clinton</i>	‘a picture representing C’ (Lex)	53%	[1,232]
	‘a picture owned by C’	47%	[1,092]
<i>a performance of Aida</i>	‘a performance of Aida (Obj)’	53%	[1,232]
	‘a performance by Aida (Subj)’	47%	[1,092]
<i>the picture of gold</i>	‘the picture representing gold’ (Lex)	50%	[1,680]
	‘the picture made of gold’	50%	[1,680]
<i>the examination of doctors</i>	‘the examination of d (Obj)’	50%	[1,680]
	‘the examination by d (Subj)’	50%	[1,680]
<i>a picture of gold</i>	‘a picture representing gold’ (Lex)	50%	[1,680]
	‘a picture made of gold’	50%	[1,680]
<i>an examination of doctors</i>	‘an examination of d (Obj)’	50%	[1,680]
	‘an examination by d (Subj)’	50%	[1,680]

### One form, one meaning

<i>the cat of Clinton</i>	‘the cat owned by Clinton’	100%	[1,008]
<i>the reaction of Clinton</i>	‘the reaction by Clinton’	100%	[1,008]
<i>a cat of Clinton</i>	‘a cat owned by Clinton’	100%	[1,092]
<i>a reaction of Clinton</i>	‘a reaction by Clinton’	100%	[1,092]
<i>the ring of gold</i>	‘the ring made of gold’	100%	[1,680]
<i>a ring of gold</i>	‘a ring made of gold’	100%	[1,680]
<i>the picture of me</i>	‘the picture representing me’ (Lex)	100%	[336]
<i>the performance of it</i>	‘the performance of it (Obj)’	100%	[336]
<i>a picture of me</i>	‘a picture representing me’ (Lex)	100%	[336]
<i>a performance of it</i>	‘a performance of it (Obj)’	100%	[336]

### Forms without interpretation

<i>*gold’s ring,</i>	---
<i>*the cat of me, *the reaction of me</i>	---
<i>*a cat of me, *a reaction of me</i>	---
<i>*gold’s picture, *plays’ performance</i>	---

## References

- Aissen, J., 1997. On the syntax of obviation. *Language* 73, 705-750.
- Aissen, J. 1999. Markedness and subject choice in Optimality Theory. *Natural Language and Linguistic Theory* 17, 673-711.
- Allen, C., 1997. The origin of the 'group genitive' in English. *Transactions of the Philological Society* 95, 111-131.
- Altenberg, B., 1982. *The Genitive v. the of-construction: A Study of Syntactic Variation in 17th Century English*. Lund: CWK Gleerup.
- Anderson, M., 1979. *Noun Phrase Structure*. PhD thesis, University of Connecticut.
- Anttila, A., 1997. Deriving variation from grammar. In: Hinskens, F., van Hout, R., and Wetzels, W.L. (Eds.), *Variation and Change in Phonological Theory*. John Benjamins, Amsterdam, pp. 35-68.
- Anttila, A., 2002. Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20, 1-42.
- Anttila, A., to appear. Derived Environment Effects in Colloquial Helsinki Finnish. In: Inkelas, S. and Hanson, K. (Eds.), *The Nature of the Word: Essays in Honor of Paul Kiparsky*. MIT Press, Cambridge, MA.
- Anttila, A. and Cho, Y.Y. 1998. Variation and change in Optimality Theory. *Lingua* 104, 31-56.
- Anttila, A. and Fong, V., 2000. The partitive constraint in Optimality Theory. *Journal of Semantics* 17, 281-314.
- Anttila, R., 1989. *Historical and Comparative Linguistics*. John Benjamins, Amsterdam.
- Anschutz, A., 1997. How to choose a possessive noun phrase construction. *Studies in Language* 21, 1-35.
- Arnold, J.E., Wasow, T., Losongco, A., and Ginstrom, R., 2000. Heaviness versus newness: The effects of structural complexity and discourse status on constituent ordering. *Language* 76, 28-55.
- Aronoff, M., 1976. *Word Formation in Generative Grammar*. MIT Press, Cambridge, MA.
- Asudeh, A., 2001. Linking, optionality, and ambiguity in Marathi. In Sells, P. (Ed.), *Formal and Empirical Issues in Optimality Theoretic Syntax*. CSLI, Stanford, CA, pp. 257-312.
- Babyonyshev, M., 2002. Deriving the restrictions on pronominal complements of nouns. Paper presented at the Workshop on the Semantics/Syntax of Possessive Constructions, University of Massachusetts, Amherst.
- Barker, C., 1995. *Possessive Descriptions*. CSLI, Stanford, CA.
- Barker, C., 2002. Metadefinite possessives. Paper presented at the Workshop on the Semantics/Syntax of Possessive Constructions, University of Massachusetts, Amherst.
- Barker, C. and Dowty, D., 1993. Non-verbal thematic proto-roles. In Shafer, A. (Ed.), *Proceedings of NELS 23, Volume 1*. GLSA, Amherst, pp. 49-62.
- Bernstein, J.B., 2001. The DP hypothesis. In: Baltin, M. and Collins, C. (Eds.), *The Handbook of Contemporary Syntactic Theory*. Blackwell, Malden, MA, pp. 536-561.
- Blutner, R., 2000. Some aspects of optimality in natural language interpretation. *Journal of Semantics* 17, 189-216.
- Boersma, P. 2001. Review of Arto Anttila (1997) "Variation in Finnish Phonology and Morphology". *Glott International* 5.1, 33-40.
- Boersma, P. and Hayes, B., 2001. Empirical tests of the Gradual Learning Algorithm. *Linguistic Inquiry* 32, 45-86.

- Borschev, V. and Partee, B.H., 2002. Genitives, types and sorts. Paper presented at the Workshop on the Semantics/Syntax of Possessive Constructions, University of Massachusetts, Amherst.
- Bresnan, J., 1997. The emergence of the unmarked pronoun: Chichewa pronominals in Optimality Theory. BLS 23. Berkeley, California, Berkeley Linguistic Society.
- Bresnan, J., 2001. Explaining morphosyntactic competition. In Baltin, M. and Collins, C. (Eds.), *The Handbook of Contemporary Syntactic Theory*. Blackwell, Malden, MA, pp. 11-44.
- Briscoe, T., Copestake, A., and Lascarides, A., 1995. Blocking. In Saint-Dizier, P. and Viegas, E. (Eds.), *Computational Lexical Semantics*. Cambridge University Press, Cambridge, pp. 273-302.
- de Bruin, J. and Scha, R., 1988. The interpretation of relational nouns. *Proceedings of the 26th Annual Meeting of the Association for Computational Linguistics (Buffalo)*, pp. 25-32.
- Cardinaletti, A. and Starke, M., 1999. The typology of structural deficiency: A case study of the three classes of pronouns. In: van Riemsdijk, H. (Ed.), *Clitics in the Languages of Europe*. Mouton de Gruyter, Berlin.
- Choi, H., 2001. Phrase structure, information structure, and resolution of mismatch. In Sells, P. (Ed.), *Formal and Empirical Issues in Optimality Theoretic Syntax*. CSLI, Stanford, CA, pp. 17-62.
- Chomsky, N., 1970. Remarks on nominalization. In Jacobs, R.A. and Rosenbaum, P.S. (Eds.), *Readings in English Transformational Grammar*. Ginn and Company, Waltham, MA, pp. 184-221.
- Copestake, A. and Briscoe, T., 1995. Semi-productive polysemy and sense extension. *Journal of Semantics* 12, 15-67.
- Deane, P. 1987. English Possessives, Topicality, and the Silverstein Hierarchy. BLS 13. Berkeley, California, Berkeley Linguistic Society.
- Doron, E. and Rappaport Hovav, M., 1991. Affectedness and externalization. NELS 21. GLSA, Amherst, pp. 81-94.
- Francis, W.N. and Kučera, H., 1982. *Frequency Analysis of English Usage*. Houghton Mifflin, New York.
- Garretson, G., Skarabela, B., and O'Connor, C., 2002. Mapping out the English possessive: Using corpora to differentiate the senses of 'of'. Poster presented at ICAME 2002, *The Theory and Use of English Language Corpora*. Göteborg, Sweden.
- Giorgi, A. and Longobardi, G., 1991. *The Syntax of Noun Phrases*. Cambridge University Press, Cambridge.
- Grimshaw, J., 1990. *Argument Structure*. MIT Press, Cambridge, MA.
- Grimshaw, J., 1997. Projection, Heads, and Optimality. *Linguistic Inquiry* 28, 373-422.
- Hawkins, R., 1981. Towards an account of the possessive constructions: *NP's N* and *the N of NP*. *Journal of Linguistics* 17, 247-269.
- Hendriks, P. and de Hoop, H., 2001. Optimality Theoretic semantics. *Linguistics and Philosophy* 24, 1-32.
- de Hoop, H. and de Swart, H., 2000. Temporal adjunct clauses in Optimality Theory. *Rivista di Linguistica* 12, 107-127.
- Jackendoff, R., 1968. Possessives in English. In Anderson, S.R., Jackendoff, R.S., and Keyser, S.J. (Eds.), *Studies in Transformational Grammar and Related Topics*. Brandeis University, Department of English, Waltham, MA, pp. 25-51.

- Jensen, P.A. and Vikner, C., 2002. The English pronominal genitive and lexical semantics. Paper presented at the Workshop on the Semantics/Syntax of Possessive Constructions, University of Massachusetts, Amherst.
- Jespersen, O., 1940. A Modern English Grammar on Historical Principles, Part V. Ejnar Munksgaard, Copenhagen.
- Jespersen, O., 1949. A Modern English Grammar on Historical Principles, Part VII. Ejnar Munksgaard, Copenhagen.
- Karlsson, F., Voutilainen, A., Heikkilä, J., and Anttila, A. (Eds.), 1995. Constraint Grammar: A Language-Independent System for Parsing Running Text. Mouton de Gruyter, Berlin.
- Kayne, R., 1984. Connectedness and Binary Branching. Foris: Dordrecht.
- Kiparsky, P., 1982. Word-formation and the lexicon. In Ingeman F. (Ed.), Proceedings of the 1982 Mid-America Linguistic Conference.
- Koopman, H. and Sportiche, D., 1991. The Position of Subjects. *Lingua* 85, 211-256.
- Lee, H., 2001. Markedness and word order freezing. In Sells, P. (Ed.), Formal and Empirical Issues in Optimality Theoretic Syntax. CSLI, Stanford, CA.
- Lees, R., 1960. The Grammar of English Nominalizations. Mouton, The Hague.
- Legendre, G., 2001. An introduction to Optimality Theory in syntax. In Legendre, G., Grimshaw, J., and Vikner S. (Eds.), Optimality-Theoretic Syntax. MIT Press, Cambridge, MA.
- Legendre, G., Raymond, W., and Smolensky, P., 1993. An Optimality-Theoretic typology of case and grammatical voice systems. BLS 19. Berkeley Linguistic Society, Berkeley, CA.
- Levin, B., 1993. English Verb Classes and Alternations. University of Chicago Press, Chicago.
- Maling, J., 2001. Dative: The heterogeneity of the mapping among morphological case, grammatical functions, and thematic roles. *Lingua* 111, 419-464.
- McCarthy, J.J., 2002. A Thematic Guide to Optimality Theory. Cambridge University Press, Malden, MA.
- Müller, G., 1999. Optionality in Optimality-Theoretic syntax. *Glott International* 4.5, 3-8.
- O'Connor, M.C., 1999a. Harmonic alignment of the animacy hierarchy and the structure of possessive DPs in Northern Pomo. Paper presented at the Workshop on Native American Languages, LFG 99. University of Manchester.
- O'Connor, M.C., 1999b. An Optimality Theory account of possessive DPs in Northern Pomo. Paper presented at the Joint meeting of the NSF-funded Optimal Typology projects at Stanford University and U.C. Santa Cruz.
- Pelletier, F.J. and Schubert, L.K., 1989. Mass expressions. In Gabbay, D. and Guenther, F. (Eds.), *Handbook of Philosophical Logic, Vol. IV, Topics in the Philosophy of Language*. Reidel, Dordrecht.
- Pesetsky, D., 1995. *Zero Syntax: Experiencers and Cascades*. MIT Press, Cambridge, MA.
- Prince, A. and Smolensky, P., 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Rutgers University, New Brunswick, and University of Colorado, Boulder.
- Pustejovsky, J., 1995. *The Generative Lexicon*. MIT Press, Cambridge, MA.
- Roeper, T., 1993. Explicit syntax in the lexicon: The representation of nominalizations. In Pustejovsky, J. (Ed.), *Semantics and the Lexicon*. Kluwer, Dordrecht, pp. 185-222.
- Rosenbach, A., to appear. Aspects of iconicity and economy in the choice between the *s*-genitive and the *of*-genitive in English. In: Rohdenburg, G. and Mondorf, B. (Eds.), *Determinants of Grammatical Variation in English*. Mouton de Gruyter, Berlin/New York.
- Taylor, J.R., 1996. *Possessives in English*. Oxford University Press, Oxford.

- Tesar, B. and Smolensky, P., 2000. *Learnability in Optimality Theory*. MIT Press, Cambridge, MA.
- Uszkoreit, H., 1984. *Word Order and Constituent Structure in German*. PhD Thesis, University of Texas at Austin.
- Wasow, T., 1997. Remarks on grammatical weight. *Language Variation and Change* 9, 81-105.
- Weerman, F. and de Wit, P., 1999. The decline of the genitive in Dutch. *Linguistics* 37, 1155-1192.
- Williams, E., 1981. Argument structure and morphology. *Linguistic Review* 1, 81-114.
- Woisetschlaeger, E., 1983. On the question of definiteness in 'An old man's book'. *Linguistic Inquiry* 14, 137-154.
- Zeevat, H., 2000. The asymmetry of optimality theoretic syntax and semantics. *Journal of Semantics* 17, 243-262.

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