Chapter 16

Argument structure and mapping theory

Jamie Y. Findlay
University of Oslo

Roxanne Taylor
University of Huddersfield

Anna Kibort
Trinity College Library

This chapter presents the LFG view of two closely related areas of inquiry: argument structure, a level of structure which represents the syntactically realisable arguments of a predicate, and mapping theory, the theory of how those arguments are linked to grammatical functions at f-structure, as well as of alternations in this linking brought about by processes like passivisation. After introducing some preliminary concepts, the chapter explores various approaches within LFG: the earliest work using lexical rules to explain argument alternations, the "classical" version of Lexical Mapping Theory (LMT) developed in the late '80s and early '90s, and various subsequent modifications, extensions, and reimaginings of LMT, including contemporary work focussing on the formal status of argument structure and mapping theory, and their connection to the rest of the grammar.

1 Introduction

Predicates have both syntactic and semantic arguments, and the two are not always aligned. For instance, expletives, as shown in (1), are syntactic but not semantic arguments of their verbal governors:

(1) a. *It* is snowing.
b. *There* seems to be a problem.

Jamie Y. Findlay, Roxanne Taylor & Anna Kibort. 2023. Argument structure and mapping theory. In Mary Dalrymple (ed.), *Handbook of Lexical Functional Grammar*, 699–778. Berlin: Language Science Press. DOI: 10.5281/zenodo.10185966

On the other hand, there are verbs like *saddle*: conceptually, a saddling event involves three entities, the saddler, the saddled (usually a horse), and the saddle itself, but only the first two are expressible in the syntax (cf. Bresnan 1980). Similarly, there are clear patterns regarding which kinds of semantic arguments are realised by which kinds of grammatical functions – in general, more Agent-like arguments are more likely to be subjects than more Patient-like arguments, which are more likely to be objects – but there are also exceptions. There are, for example, verbs which seem to express the same type of event but to realise the semantic participants differently in the syntax (Rappaport 2006 [1983]: 132):

(2) a. Fred fears the prospect of failure.
    b. The prospect of failure frightens Fred.

(3) a. I like a job well done.
    b. A job well done pleases me.

Due to these kinds of mismatches, neither syntactic nor semantic arguments can be reduced to the other, and instead we need some intervening level of representation that can mediate the relationship between them. This is what is known as ARGUMENT STRUCTURE, and in LFG is often taken to constitute a separate module of the grammar called a-structure. Although it sits between syntax and (lexical) semantics, argument structure itself is often taken to be a specifically syntactic level of representation (Alsina 2001),[1] whose primary purpose is to explain a predicate's syntactic valency patterns – while acknowledging that at least some of these explanations are to be found in lexical semantic properties. The arguments represented at argument structure are therefore those which can or must be realised syntactically.

Explaining how exactly these arguments are realised is the purview of MAPPING THEORY. Such a theory seeks generalisations in the mapping between argument structure and syntax proper, and to explain any alternations which are possible (such as passivisation, causativisation, detransitivisation, etc.). In LFG, this means determining what GRAMMATICAL FUNCTION (GF) the argument will instantiate – overt phrasal realisation is then handled by the language-specific phrase-structure rules or case-marking system which determines how particular GFs surface (see Belyaev 2023a,b [this volume] for more on LFG's view of grammatical functions and their relation to phrasal syntax).

[1]Indeed, in the Minimalist tradition, argument structure is often represented in the phrasal syntax itself – see Harley (2011) and references therein for an overview.

As part of this LFG handbook, the present chapter focusses on providing a survey of work on argument structure and mapping theory which takes a Lexical-Functional approach.[2] The structure of the chapter is as follows: we begin, in Section 2, with a brief high-level introduction to some of the questions and phenomena which we will return to throughout the chapter. Section 3 then looks at the earliest work on these problems in LFG, which used LEXICAL RULES to account for argument alternations. Section 4, the largest of the chapter, presents the still-canonical theory of argument structure and mapping developed in the late 1980s and early 1990s, known as LEXICAL MAPPING THEORY (LMT). Section 5 examines a different version of LMT, that of Kibort (2007, *i.a.*) which, among other things, is designed to extend the empirical coverage of the mapping theory to so-called morphosemantic alternations. Section 6 delves more deeply into some formal issues and alternative proposals, before Section 7 concludes.

2 Background and basic concepts

2.1 From semantics to syntax

There are regularities in the ways that semantic participants of predicates are realised syntactically. For example, in a nominative-accusative language like English, when a verb describes an event that has a volitional Agent and a Theme or Patient affected by the event, the Agent will be realised as the active voice subject and the Theme/Patient as the object:

(4) a. Your dog is chasing my rabbit!
(cf. # My rabbit is chasing your dog![3])

b. The engineers will build the bridge there.
(cf. # The bridge will build the engineers there.)

c. The teacher opened the cupboard.
(cf. # The cupboard opened the teacher.)

[2]For general introductions as well as critical overviews of work in other traditions, the reader is directed to Grimshaw (1990), Comrie (1993), Levin & Rappaport Hovav (2005), Ramchand (2014), Williams (2015). For a different perspective on the LFG literature, see Dalrymple et al. (2019: ch. 9).

[3]The point of these anomalous alternatives is to illustrate that the (prototypical) situations presented are expressed via the (a) encodings, where the Agent is a subject and the Theme/Patient an object, rather than the *a priori* equally plausible (b) encodings, where the pairings of semantic and syntactic roles are reversed. The (b) sentences are of course perfectly grammatical strings of English, but they describe situations which are at odds with our real-world knowledge or expectations, precisely because the subjects in each case are interpreted as Agents.

Similarly, if the sentence expresses an Instrument used to perform the action described, along with the Theme/Patient, then the Instrument is the subject and the Theme/Patient the object:

(5) a. The key opened the cupboard.
(cf. # The cupboard opened the key.)

But if the Agent is also included, then *it* is the subject:

(6) The teacher opened the cupboard with the key.

This generalisation goes back to Fillmore (1968: 33), who expresses it as follows:

(7) If there is an A [= Agent], it becomes the subject; otherwise, if there is an I [= Instrument], it becomes the subject; otherwise, the subject is the O [= objective, i.e. Theme/Patient].

This is a productive rule (at least in English), as can be seen from the fact that invented words will also follow the same pattern. Alsina (1996: 5–6), for instance, imagines a verb *obliquate*, meaning 'build or place in an oblique position or direction', and notes the clear intuition that, if such a verb existed, we would say things like (8a), but not like (8b):

(8) a. Jim obliquated the door of the closet.
b. # The door of the closet obliquated Jim.

All this goes to illustrate a key explanandum: the semantic relationship which an argument bears to its verb is also implicated in determining its syntactic relationship, but in what way precisely? Mapping theory is interested in discovering the nature of this connection, and in finding generalisations over the links between semantic and syntactic relationships.

The observation in (7) induces a ranking of semantic/thematic roles,[4] where the highest available argument becomes the subject:

(9) A > I > O

This can be seen as a precursor to the well-known THEMATIC HIERARCHY (Jackendoff 1972: 43), of which there have been many versions. The one which has been most influential in LFG comes from Bresnan & Kanerva (1989: 23), and is shown in (10):

[4]We will use these two terms interchangeably in this chapter, drawing no theoretical distinction between them.

(10) *The Thematic Hierarchy:*
Agent > Beneficiary > Recipient/Experiencer
> Instrument > Theme/Patient > Location

Arguments which are more thematically "prominent" on this hierarchy tend to be realised by more grammatically "prominent" GFs, e.g. as defined by the Keenan-Comrie hierarchy (Keenan & Comrie 1977; see also Belyaev 2023b [this volume]) – in particular, the SUBJ function is usually taken by the the argument highest on the thematic hierarchy (Grimshaw 1990, Speas 1990). This insight is often at the core of mapping theories, and so the thematic hierarchy figures centrally in the standard version of Lexical Mapping Theory, which we explore in Section 4, as well as in other approaches discussed below.

The use of thematic hierarchies has also been challenged, however. For one thing, a consistent list of roles and definitions has proved elusive, and classification of arguments can therefore be problematic and open to disagreement (Gawron 1983, Dowty 1991, Ackerman & Moore 2001, Davis 2011). For another, even when a set of roles is agreed on, the question of their relative ordering has not been settled, and different hierarchies have been proposed for different phenomena, or even for the same phenomenon (Newmeyer 2002: 65ff. Levin & Rappaport Hovav 2005: ch. 6; Rappaport Hovav & Levin 2007). While it is clearly possible that different orderings could be relevant for different things, the extent of the variability in the literature, even with respect to one and the same phenomenon, stands in stark contrast to the putative appeal of a unifying thematic hierarchy where a fixed set of roles is used in order to abstract away from predicate-specific semantic entailments. Because of these concerns, some recent work in LFG's mapping theory, most notably that of Kibort (2007, *i.a.*), has attempted to do without thematic roles altogether. We discuss Kibort's work in Section 5.

Some questions of mapping depend not on the semantic relationship between an argument and its verb, but rather on lexical semantic properties of the verb itself. For example, *break* and *hit* both take Agent and Patient arguments, but *break* has an intransitive alternant, where the Patient appears as the subject, which is impossible with *hit*:

(11) a. The teacher broke the ruler.
b. The ruler broke.

(12) a. The teacher hit the ruler.
b. * The ruler hit.

Fillmore (1970) observes that this contrast is not a lexical idiosyncrasy of these two verbs, but actually applies to two large classes of semantically-related verbs, as shown in (13–14):

(13) a. The teacher {bent / folded / shattered / cracked / …} the ruler.
b. The ruler {bent / folded / shattered / cracked / …}.

(14) a. The teacher {slapped / struck / bumped / stroked / …} the ruler.
b. * The ruler {slapped / struck / bumped / stroked / …}.

Once again, we can see that this is a productive generalisation if we examine our intuitions about invented forms. For example, let us imagine a verb *jellate*, meaning 'to turn to jelly'. It is clear that this verb could appear in the same constructions as *break*.

(15) a. The wizard jellated the box.
b. The box jellated.

But if we invent a word like *coude*, meaning 'to touch with one's elbow', it is just as clear that it will pattern with *hit*:

(16) a. I couded the wall.
b. * The wall couded.

We do not want to simply stipulate the possibilities for each new verb, since then we fail to capture the regularity and productivity of our intuitions.

A mapping theory ought to give an account of these patterns. To do this, it must have access to detailed lexical semantic information, such as event structure. For example, a hitting event does not necessarily result in a change of state in the affected entity, whereas a breaking event does; that is, the structure of a hitting event does not contain a result state, in Ramchand's (2008) terms. Now, this may be expressed in the semantic role assigned to the affected entity – in some theories, the difference between Patient and Theme is that the former undergoes a change of state while the latter does not. But often such nuances are not captured by a simple semantic role analysis – for example, the thematic hierarchy in (10) collapses Theme and Patient into a single position – and it is certainly not apparent that there are any principled limits on what kinds of lexical semantic information can be relevant for questions of mapping, so it is quite possible that mapping theory needs access to a very rich representation of lexical semantics. In general, argument structure proposals in LFG have not taken up this challenge,

instead treating this level of representation as relatively informationally impoverished (it is often no more than a list of arguments and their associated thematic roles). Nevertheless, there have been, and continue to be a growing number of, exceptions, which we examine in Section 6.1.

2.2 Argument alternations

Accounting for the syntactic realisation of semantic arguments means also addressing the fact that a single predicate may permit multiple ways of expressing its arguments (including not expressing some of them at all) – that is, the existence of ARGUMENT ALTERNATIONS, such as that between the transitive and the inchoative illustrated in (11), above. Perhaps the most famous and well-studied of these is the active-passive alternation, a typologically common pattern whereby a transitive verb alternates with an intransitive in which the subject argument of the transitive form is either unexpressed or expressed as a non-core, oblique grammatical function instead:

(17) a. *Active:*
The dog chased the rabbit.

b. *Passive:*
The rabbit was chased (by the dog).

One important property of the active-passive alternation is that it does not involve any change in lexical semantics. That is, the situations described by (17a) and (the long version of) (17b) are truth-conditionally equivalent, and so this alternation is described as MEANING-PRESERVING (cf. Sadler & Spencer 1998). This label is slightly infelicitous, however, since once we look beyond mere truth conditions there are of course changes to other aspects of "meaning", writ large: for instance, the information-structural Topic is the dog in (17a) but the rabbit in (17b). This is not at all surprising, since language abhors true synonymy (Cruse 1986, Goldberg 2019), and variation of whatever kind is inevitably operationalised for communicative purposes (Clark 1987, Eckert 2018) – but it does mean that the term "meaning-preserving" must be understood in a suitably narrow sense.

Such meaning-preserving alternations are known as MORPHOSYNTACTIC, since they are morphological operations which alter the syntactic alignment of participants; this is in contradistinction to MORPHOSEMANTIC alternations, which involve changes in (truth-conditional) lexical meaning. Another example of a morphosyntactic alternation is locative inversion, illustrated in (18) for Chichewa (Bresnan & Kanerva 1989: 2). In this alternation (also found in English, as indicated by the translations below – see Bresnan 1994), a locative phrase which

normally appears as an oblique can surface as a subject, demoting the subject of the non-inverted form to object:[5]

(18) a. Chi-tsîme chi-li ku-mu-dzi.
7-well 7-be 17-3-village
'The well is in the village.'

b. Ku-mu-dzi ku-li chi-tsîme.
17-3-village 17-be 7-well
'In the village is a well.'

Once again, this affects certain properties of a sentence's information structure, for instance changing what is available for contrastive focus (Bresnan & Kanerva 1989: 35, Bresnan 1994: 86–87), but it does not alter the truth-conditional meaning.

Morphosemantic alternations, on the other hand, change the lexical meaning of a predicate – a change which may then have syntactic effects, though these are in a sense only incidental, merely following as automatic consequences of the lexical semantic changes (Kibort 2004: 374). Examples include many of the alternations listed in Levin (1993), such as the *spray/load* alternation shown in (19) or the dative shift alternation shown in (20):

(19) a. Carly loaded the wagon with barrels.
b. Carly loaded barrels onto the wagon.

(20) a. Julian brought Elim the message.
b. Julian brought the message to Elim.

In (19a), the Goal/Location *the wagon* is realised as the object, and in this case there is a "holistic" interpretation (Levin 1993: 50), whereby the Goal/Location is understood to be fully affected by the action (i.e. the wagon is filled up with barrels). This entailment is absent from the sentence in (19b), where the Theme is realised as the object instead. Similarly, in (20a), there is an entailment that the dative-shifted Goal object is animate (Goldberg 1995: 146–147), but this same constraint does not hold of the Goal argument in the prepositional variant (20b), as illustrated by the following contrast:

(21) a. # Julian brought Elim's study the message.
b. Julian brought the message to Elim's study.

[5]Numbers indicate noun classes: this is in part how we can tell that the locative is the subject in (18b), since the verb now agrees with it in this respect.

Both of these alternations involve differing syntactic realisations of the same arguments, but unlike the morphosyntactic alternations shown above, they also change certain properties of the truth-conditional meanings expressed by their governing verbs. Other morphosemantic alternations, such as the causative, also introduce *new* arguments, rather than simply rearranging existing arguments. The causative introduces a new Causer argument, which brings about the event described by the predicate. Here is a classic example from Turkish (Comrie 1974: 5):

(22) a. Hasan öl-dü.
Hasan die-PST
'Hasan died.'

b. Ali Hasan-ı öl-dür-dü.
Ali Hasan-OBJ die-CAUS-PST
'Ali killed Hasan.' (lit. 'Ali made Hasan die.')

As can be seen, this also has syntactic effects, since causativisation increases the valency of the predicate. Here an intransitive becomes a transitive, and the previous subject is demoted to object.

The world's languages are replete with a wide and varied selection of argument alternations, both meaning-preserving as well as meaning-altering, many of which are highly productive. Any mapping theory must therefore be capable of giving an account of such alternations in general, and this has been a major focus of research, as we will see below.

3 Lexical rules

Argument alternations have been at the heart of work in LFG since the very beginning. The seeds of LFG as a framework can be found in Bresnan's (1978) work on the psychological plausibility of transformational grammars, illustrating how the passive can be profitably viewed as an operation on lexical representations, rather than on phrase-level syntactic structures. Bresnan (1980) presents this analysis in a more recognisably LFG-like form, and extends the approach to the formation of intransitives and middles in English. In this and much other early work in LFG, argument alternations are treated as involving LEXICAL RULES, which systematically relate the different alternants of the same verb (e.g. active and passive). In this section, we give a brief overview of this approach, and highlight some of the reasons why it has fallen out of favour in recent work.

In Bresnan (1980), lexical items are assumed to possess abstract predicate-argument structures, which characterise "those arguments of a semantic predicate that are open to grammatical interpretation" (Bresnan 1980: 100). Such argument positions are then associated with grammatical functions by various (undiscussed) lexical processes, with the result being a LEXICAL FORM – recognisable as what would become in LFG the SEMANTIC FORM value of a PRED attribute (Belyaev 2023a [this volume]). For example, the lexical form for transitive *read*, as in *John read my letter*, is given in (23) (Bresnan 1980: 116):

(23) *read* ⟨ (SUBJ) (OBJ) ⟩

Here the first argument, corresponding to the reader, is linked to SUBJ, and the second argument, the thing read, is linked to OBJ. The exact nature of this initial linking of arguments to GFs is not spelled out explicitly, and is generally taken to follow from some intrinsic pairings of roles and syntactic functions. What is more, in this early work, the specific role of each argument is not labelled in the representation, and must be inferred from the combination of their ordering and lexical idiosyncrasies of meaning. In other work (e.g. Baker 2006 [1983]), lexical forms are shown with semantic roles alongside their associated GFs, thus highlighting both sides of the linking question explicitly in the representation. For the sake of clarity, we will follow this convention for the rest of this section; thus instead of (23), we will write (24) for the lexical form of *read*:

(24) *read* ⟨ Agent Theme ⟩
(SUBJ) (OBJ)

However such structures are represented, once the links between arguments and GFs are in place, other rules can then apply to manipulate them, capturing the effect of various argument alternations. For example, intransitivisation is achieved by the following lexical rule (Bresnan 1980: 116):

(25) *Intransitivisation:*
(OBJ) ↦ ∅

Here the argument previously linked to OBJ is instead assigned the special null GF ∅, which indicates that the argument is existentially bound in the semantics, and is not expressed overtly in the syntax. The application of (25) to (24) results in the lexical form in (26), corresponding to the intransitive form of *read*, as in *John read all night*.

(26) *read* ⟨ Agent Theme ⟩
(SUBJ) ∅

It is clear to see how this approach can be extended to other, more complex alternations. Bresnan (1982), for instance, proposes the following lexical rule for passivisation:[6]

(27) *Passivisation:*
$(\text{SUBJ}) \mapsto \emptyset/(\text{OBL}_{\text{AGENT}})$
$(\text{OBJ}) \mapsto (\text{SUBJ})$

This demotes the subject to either the unexpressed null GF (as in the English short, Agent-less passive), or an oblique (as in the English long, *by*-passive), and promotes the object to subject.

One important strength of such lexical rules is that they manipulate grammatical functions, rather than surface constituent structures; that is, (27) promotes the OBJ, rather than, say, moving the post-verbal NP to the specifier position of IP. This means that the same rule can be used across the languages of the world, with language-specific variations falling out from the rules for c- to f-structure mapping in those languages (Belyaev 2023a [this volume]).[7] Such an approach is a corollary of the claim that argument alternations operate at the level of argument structure, and not directly on the phrasal syntax.

Lexical rules in LFG are taken to be REDUNDANCY RULES (Bresnan 1990: 638): they are not applied on-line in the process of parsing, but instead describe regular relations between items in the lexicon. In other words, the existence of a lexical form like (28a) implies the existence of a corresponding passive form like (28b), because of the existence of rule (27):[8]

(28) a. *read* ⟨ Agent Theme ⟩
(SUBJ) (OBJ)

b. *read* ⟨ Agent Theme ⟩
$(\text{OBL}_{\text{AGENT}})$ (SUBJ)

Such a restriction follows from Bresnan's (1980: 118) claim that "structures which are analyzed by lexical rules must be lexical structures, and cannot be syntactically derived". Bresnan (1982: 6) goes further, and proposes that alterations of

[6] Bresnan (1982) is in fact the *locus classicus* of the lexicalist approach to the passive in general. In the paper, Bresnan makes a compelling case against the prevailing wisdom that passivisation should be treated as a transformation, i.e. something that takes places in the phrasal syntax. Instead, she shows that it must be treated as a process occurring inside the lexicon. Bresnan et al. (2016: ch. 3) provide a contemporary presentation of the relevant arguments.

[7] This insight originates from work in Relational Grammar (e.g. Perlmutter & Postal 1977).

[8] Bresnan (1980, 1982) presents such rules as directional, so that the active maps to the passive, but they can also be seen as bidirectional, so that the existence of either kind of entry implies the other – this is how it is presented in Bresnan (1990), for example.

argument-to-GF assignments can *only* take place in the lexicon, via lexical rules, and cannot be effected on-line by syntactic rules – she refers to this as the principle of DIRECT SYNTACTIC ENCODING. Although contemporary LFG makes much less (or no) use of lexical rules, it continues to maintain the first part of this principle, and treats all argument alternations as applying in the lexicon, not in the syntax.

While lexical forms, which appear at f-structure as the value of PRED attributes, are obtained by augmenting a predicate-argument structure with linkings to GFs, at this stage in the development of LFG the formal status of the predicate-argument structures themselves is not made explicit. They are certainly not a separate level of representation, akin to c- and f-structure (i.e. there is no a-structure). Indeed, it is not until Butt et al. (1997) that the formal position of argument structure in the LFG architecture is tackled head on – we will have more to say about this in Section 6.1.

A more urgent shortcoming of the early lexical rule approach is that there is no account of how the original assignment of GFs to arguments is accomplished – that is, as Falk (2001b: 96) observes, early LFG has a theory of *re*mapping, via lexical rules, but no theory of the initial mapping. Bresnan (1980: 112) briefly suggests some principles for default assignments, but this is not developed more fully. Since, as we observed in Section 2.1, the initial mapping is also amenable to systematic study, and exhibits a number of clear generalisations, this lacuna is therefore a significant one.

There is also the question of appropriately constraining lexical rules. Clearly the rule of intransitivisation given in (25) cannot apply freely to any verb with an object, otherwise we would expect examples like (29b) to be grammatical, contrary to fact:

(29) a. Naomi told the story to Jim.
b. * Naomi told to Jim.

Lexical rules must be assigned syntactic, semantic, and morphological conditions in order to constrain their application. Even then, it remains a fact that lexical rules are very powerful formal devices: there are no in-principle constraints on what kinds of alternations can be described, which means that any remapping can be represented, including some which are most unnatural in the world's languages (Bresnan 1980: 639ff.).[9]

[9]Of course, we may not expect formalism to constrain theory in this way (cf. Pollard 1997), and in that case this objection is of less concern.

The unconstrained expressive power of lexical rules arises from the fact that they are not MONOTONIC (Bresnan 1990): since such rules *overwrite* the original assignments of GFs to arguments, they are are not information-preserving.[10] Aside from the possibility of expressing unnatural alternations, another reason why non-monotonicity may be problematic has to do with processing. Arbitrary rewrite rules render a system intractable (cf. Peters & Ritchie 1973), and this is at odds with the LFG desideratum of psychological plausibility (Kaplan & Bresnan 1982: 173–174). However, this objection only carries weight insofar as the rules are applied during on-line processing; if they only apply in the lexicon, their computational power is irrelevant, since lexical entries are stored in memory. The discovery that complex predicates necessitate an analysis whereby argument structures can be assembled in the syntax (Butt 1995, Alsina 1996; Section 4.2.4 below) challenges this solution, however. Another way to neutralise the processing objection is by formally implementing lexical rules in such a way as to make them tractable, such as by treating two lexical entries related by lexical rule as a single lexical entry containing disjunctive specifications (cf. fn. 10). This might result in quite a gap between theoretical LFG and computational implementations (which again runs counter to the Competence Hypothesis of Kaplan & Bresnan 1982), but it does at least avoid intractability.

Although none of these objections may be insurmountable, lexical rules have nevertheless fallen out of favour in LFG. Lexical Mapping Theory has offered a fruitful alternative that avoids the formal and conceptual issues of lexical rules, and also goes further, by providing an account of the initial linking of arguments and GFs. Lexical rules have not entirely disappeared, however, and are still sometimes invoked to capture certain generalisations over the lexicon – see e.g. Bresnan et al.'s (2016: 315–319) analysis of possessors and gerundives. However, such generalisations can also be captured by using TEMPLATES (Dalrymple et al. 2004, Asudeh et al. 2013, Belyaev 2023a [this volume]), providing the possibility of doing away with lexical rules altogether.

[10] Note that this is not an inherent property of lexical rules *per se*; as a reviewer notes, in XLE (the computational implementation of LFG – Kaplan & Newman 1997, Crouch et al. 2011), lexical rules are implemented as disjunctions of functional descriptions, thereby restoring monotonicity. This approach has also been taken in some theoretical work in LFG, starting with Butt et al. (1997) – see Section 6.2 below. HPSG takes a different approach to lexical rules again, treating them as unary-branching rules in the type hierarchy (see e.g. Davis & Koenig 2021: 155ff.).

4 Classical LMT

Lexical Mapping Theory (LMT) arose in part as a result of dissatisfaction with the shortcomings and unconstrained nature of lexical rules (Bresnan 1990). LMT therefore attempts to offer a more principled and constrained theory of both argument alternations and initial argument-GF mappings. Since the foundational work in LMT (Levin 1986, Bresnan & Kanerva 1989, Bresnan & Zaenen 1990), the theory has undergone many alterations and extensions; some of these build on one other, some offer competing perspectives, and some are simply different ways of saying the same thing. In addition, some are mere extensions or minor tweaks, while others involve rebuilding the theory from the ground up. We feel it would be both convoluted and unilluminating to trace every divergent strand of research in the LMT tradition, and so in this section we try to present a single coherent version of the theory, which we call Classical LMT. In order to maintain this coherence, we will adapt and update analyses where necessary, provided this does not detract from the main goals of the work in question.

Classical LMT represents what many take to be the "canonical" version of mapping theory in LFG, and is the variety which often appears in textbook presentations of the framework (as in e.g. Dalrymple 2001: 202ff. Falk 2001b: ch. 4, Bresnan 2001: ch. 14, Bresnan et al. 2016: ch. 14, and Börjars et al. 2019: ch. 8; see also Butt 2006: pp. 117ff.). However, it has long since been recognised that the name "*Lexical* Mapping Theory" is inappropriate, since "the theory cannot apply exclusively to individual words" (Dalrymple 2001: 212): for example, complex predicates which are formed analytically nonetheless contribute a single (complex) argument structure, despite the fact they contain multiple lexemes (Mohanan 1994, Butt 1995, Alsina 1996; Section 4.2.4 below). For this reason, alternative names have been proposed for the theory, including Mapping Theory *tout court* (as in e.g. Kibort & Maling 2015), Functional Mapping Theory (Alsina 1996), and Linking Theory (Butt et al. 1997). We use "Classical LMT" as a cover term, and for consistency with the large body of literature that uses the moniker "LMT", but we do not thereby intend to deny the importance of the work on complex predicates which shows that LMT cannot apply exclusively in the lexicon.

Our presentation of Classical LMT in this section has two parts: in Section 4.1, we present the basic formal tools and theoretical assumptions which characterise Classical LMT, while in Section 4.2 we discuss several case studies which illustrate the application of the theory to some empirical challenges, some of which necessitate (minor) changes to the theory.

Table 1: Feature decomposition of grammatical functions

	$-r$	$+r$
$-o$	SUBJ	OBL_θ
$+o$	OBJ	OBJ_θ

4.1 The framework

In this section, we present the theoretical and formal tools which are used in Classical LMT. We begin in Section 4.1.1 by introducing the idea of decomposing grammatical functions by means of binary features, which underpins the LMT approach to mapping. In Section 4.1.2, we address the question of the initial (unmarked) mapping of arguments to GFs, something that was ignored in the lexical rule approach. Lastly, Section 4.1.3 discusses the Classical LMT approach to argument alternations.

4.1.1 Feature decomposition

In the theoretical world described above in Section 3, arguments are associated with GFs in the lexicon. If those arguments are realised by different GFs as the result of some alternation, like the passive, the original assignments have to be overwritten. As discussed, this means that argument alternations involve non-monotonic re-writing rules. The key innovation of Classical LMT allowing it to avoid this unhappy conclusion is to underspecify the mappings between arguments and GFs, by grouping GFs into natural classes. Each argument can then be associated with one of these natural classes, rather than a specific GF, thereby constraining but not totally determining its ultimate realisation. And since the groupings of GFs are supposed to be natural, this also answers the complaint of unconstrainedness levelled at the lexical rule approach: no longer can we replace a GF with any other; instead, the choice of GFs available to an argument is limited to a natural class.

To achieve this cross-classification, Classical LMT decomposes the GFs using two binary-valued features, $[\pm r]$ and $[\pm o]$ (Bresnan & Kanerva 1989: 24–25). The first, $[\pm r]$, refers to whether a GF is thematically restricted or not: OBJ_θ and OBL_θ are; SUBJ and OBJ are not. The second, $[\pm o]$, refers to whether a GF is objective or not: OBJ and OBJ_θ are; SUBJ and OBL_θ are not. This is illustrated in Table 1. Grammatical functions can now be described in terms of two features: SUBJ is $[-r, -o]$,

OBJ is $[-r, +o]$, OBL_θ is $[+r, -o]$, and OBJ_θ is $[+r, +o]$.[11] Each individual feature can also be used to describe a pair of GFs, as seen in each of the two rows and two columns of Table 1. This is what enables the association of an argument with a limited natural class of GFs: in Classical LMT, arguments are linked to a single feature (by means to be explored in the next section), and thereby made compatible with two GFs. This is more permissive than the original LFG approach, where an argument is linked to a specific GF, but still limited: argument alternations can only map the argument to the *other* GF, not to any arbitrarily different GF.

Bresnan & Kanerva (1989: 25) claim that the pairings induced by the feature decomposition just described are natural classes. This is a large part of the explanatory appeal of Classical LMT, so it is worth dwelling on momentarily. In fact, this is an area where Classical LMT has received some criticism. Alsina (1996), for example, observes that the standard feature decomposition fails in both directions: it describes an unnatural class and also fails to capture an important natural one. The pair of GFs described by $[+r]$, namely OBJ_θ and OBL_θ, does not seem to form a natural class, in that there are no instances where arguments alternate between them. At the same time, the division between terms/direct GFs and nonterms/obliques has a number of linguistic reflexes (Dalrymple et al. 2019: 15–17), yet no single feature can pick out the terms, i.e. SUBJ, OBJ, and OBJ_θ, or the nonterms, i.e. OBL_θ (Alsina 1996: 29, fn. 9). For this reason, Alsina (1996: 19–20) suggests a different decomposition, according to the features [±subj] and [±obl].

On a related note, Findlay (2020: 130) and Asudeh (2021: 32) object to the "suspiciously circular" (*ibid.*) definition of $[\pm o]$. While it might be relatively clear what independent content $[\pm r]$ could have (being semantically restricted makes sense outside of the context of grammatical functions), it is much less clear what independent content $[\pm o]$ could possess: it identifies a GF as belonging or not to the set $\{\text{OBJ}, \text{OBJ}_\theta\}$, but by virtue of no other property than membership of that set.

Despite these qualms, the cleavages induced by the $[r]$ and $[o]$ features remain in common usage, even if their interpretation is reimagined (e.g. Kibort 2014: 266 views $[+o]$ as picking out the complements from the non-complements, and $[-r]$ as picking out the core arguments from the non-core – see Section 5). The most

[11] If we take this feature decomposition literally, then grammatical functions are no longer primitives in the theory; instead, the features are. Butt (1995: 31) makes this claim explicitly. However, it is also possible to avoid this conclusion, and retain the primitive status of grammatical functions in LFG, by viewing such feature decomposition as merely descriptive, so that it cross-classifies the GFs but does not formally break them down (Butt et al. 1997, Findlay 2016: 298ff.; see Section 6.2 below).

significant reason for this is ultimately their success: the cross-classification in Table 1 has proved incredibly useful in describing a variety of argument structure phenomena in a diverse selection of languages – we will see some examples of this later in this section and especially in Section 4.2.

One potential immediate issue is that using two binary-valued features enables us to describe a four-way classification, but LFG's inventory of grammatical functions has more than four members. Of course, it is no problem that we omit ADJ and XADJ from consideration, since adjuncts are not involved directly in argument structure and mapping, being unable (by definition) to be selected by a predicate.[12] However, the two clausal GFs COMP and XCOMP, both argument GFs, are also missing from Table 1. In fact, and despite some countervailing voices (Dalrymple & Lødrup 2000, Lødrup 2012), many researchers have advocated for eliminating these GFs by assimilating them to one or more of the other complement GFs, *viz.* OBJ, OBJ_θ, and OBL_θ (Zaenen & Engdahl 1994: 197–198, Alsina 1996, Alsina et al. 2005, Forst 2006, Berman 2007, Patejuk & Przepiórkowski 2016, Szűcs 2018). In that case, the omission of COMP and XCOMP from Table 1 is not a problem. Even if the clausal GFs are not eliminated entirely, it seems possible that the distinction between them and the other complement GFs could still be neutralised at the level of specificity required of mapping theory. We can therefore continue to assume that the four GFs in Table 1 are the only ones relevant for mapping.

Besides dividing up the GFs, the $[r]$ and $[o]$ features can also be used to order them. Bresnan & Zaenen (1990: 49) claim that the features indicate markedness of GFs, so that those which possess more negative-valued features are less marked than those which possess more positive-valued ones. This leads to the partial ordering known as the MARKEDNESS HIERARCHY:

(30) *The Markedness Hierarchy:*
$\text{SUBJ} > \text{OBJ}, \text{OBL}_\theta > \text{OBJ}_\theta$

[12] In fact, it has been argued that there are such things as "obligatory adjuncts", given the existence of contrasts like the following, where the omission of the parenthetical material leads to ungrammaticality on the intended reading of the verb:

(i) a. Cat behaves *(badly).
b. Lister lives *(in space).
c. This book reads *(well).

See Przepiórkowski (2016: 262–263) and references therein for further discussion and exemplification.

SUBJ, bearing a negative value for both features, is the least marked GF, at the top of the hierarchy; OBJ_θ, with two positive values, is the most highly marked, at the bottom. Since OBJ and OBL_θ both have one negative- and one positive-valued feature, they sit in the middle, and are not ordered with respect to one another.[13] This hierarchy of GFs is important for the principles which Classical LMT uses to determine the ultimate mapping of arguments to GFs, to which we now turn.

4.1.2 Initial classification and mapping of arguments

Just as in Section 3, we assume that predicates are equipped with an argument structure that lists their syntactically-realisable arguments. (31) shows a simple example for *kick*:

(31) *kick* ⟨ Agent Patient ⟩

Although Classical LMT still offers no formal consensus on its status or position in the architecture of LFG, such a list now starts to be referred to as A-STRUCTURE, as if it were a separate level of the parallel projection architecture (see Falk 2001b: 97–106 for some discussion). Arguments within a-structure are ordered according to their thematic role, following the thematic hierarchy introduced in (10), and repeated in (32) (Bresnan & Kanerva 1989: 23):

(32) *The Thematic Hierarchy:*
Agent > Beneficiary > Recipient/Experiencer
> Instrument > Theme/Patient > Location

The most important function of this ranking in Classical LMT is simply to identify the most highly ranked argument, which we refer to as $\hat{\theta}$.[14] This is because of the observation that the most "prominent" thematic role often aligns with the

[13] Note that the order of GFs in this hierarchy differs from the typologically-motivated Functional Hierarchy, which Dalrymple et al. (2019: 11) present as the standard in LFG (based on the Accessibility Hierarchy of Keenan & Comrie 1977):

(i) *The Functional Hierarchy:*
SUBJ > OBJ > OBJ_θ (> XCOMP, COMP) > OBL_θ (> XADJ, ADJ)

Notably, OBJ_θ outranks OBL_θ in (i), while the opposite is true in (30).

[14] This is also sometimes called the THEMATIC SUBJECT or A-STRUCTURE SUBJECT, and has also been equated with the concept of LOGICAL SUBJECT. Such a notion of "most thematically prominent argument" has been shown to play a role outside of mapping theory as well, such as in determining the antecedent of a reflexive (Dalrymple 1993, Joshi 1993, Mohanan 1994, Manning & Sag 1999).

most "prominent" GF, i.e. SUBJ (Fillmore 1968, Grimshaw 1990, Speas 1990). We will see how this is cashed out in Classical LMT below.

Whereas arguments were previously associated with a specific GF in the lexicon, in Classical LMT they are associated with a single $[\pm o/r]$ feature instead (i.e. with a *pair* of GFs). In early versions of LMT, such as Bresnan & Kanerva (1989: 25–26) or Bresnan & Moshi (1990), this is achieved by intrinsic connections between specific named thematic roles and features, as in (33), from Bresnan & Moshi (1990: 168):

(33) *Intrinsic classifications:*

Agent	Theme/Patient	Location
$[-o]$	$[-r]$	$[-o]$

This is based on typological observations about common realisations of various thematic roles across languages: cross-linguistically, for instance, Themes/Patients canonically alternate between the unrestricted GFs, i.e. subject and object, while other roles like Agent and Location canonically alternate between the non-object functions, i.e. subject and oblique (Bresnan & Kanerva 1989: 26). There is no principled limit on which roles might receive intrinsic classifications like this.

In subsequent work in Classical LMT, this open-endedness is rejected, and the initial classification principles are reduced to three (Bresnan & Zaenen 1990: 49; cf. also Her 2003, 2013; and see Bresnan et al. 2016: 331 for a contemporary textbook presentation), claimed to be general across languages:[15]

(34) *Intrinsic classifications (general):*

patientlike roles:	secondary patientlike roles:	other roles:
θ	θ	θ
$[-r]$	$[+o]$	$[-o]$

While this is an improvement in terms of theoretical parsimony, there is a cost in terms of explicitness. Asudeh (2021: 32), for instance, complains that the notion of being "patientlike" is "obscure", noting that "it's not clear what the conditions are for meeting the criterion of being 'like' a patient".

Let us assume, however, that it is clear enough when a role is patientlike or not. What of the secondary patientlike roles? Where verbs have more than one patientlike argument, as in ditransitives, one of the two may be "secondary" in

[15] "θ" is used to stand for any thematic role, since these principles no longer refer to specific roles.

the sense of Dryer (1986), and this argument will be marked as [+*o*]. Such languages are called ASYMMETRICAL OBJECT LANGUAGES, in contrast with SYMMETRICAL OBJECT LANGUAGES, which permit multiple patientlike roles to be marked [−*r*] (see Bresnan & Moshi 1990 and Section 4.2.3 below). Even within asymmetrical object languages, there is variation in which of the two arguments counts as primary or secondary – indeed, a single language can permit both possibilities (see discussion of English *give* below).

Given these basic assignments, the a-structure of our simple transitive verb *kick* will be as follows:

(35) *kick* ⟨ Agent Patient ⟩
[−*o*] [−*r*]

There is one patientlike role, namely the Patient itself, so this is marked [−*r*]; the one other role is marked [−*o*], according to the third, "elsewhere" principle in (34).

To resolve these single features to fully-specified GFs, Classical LMT makes use of two MAPPING PRINCIPLES:[16]

(36) *Mapping Principles*:
a. Subject roles:
i. $\underset{[-o]}{\hat{\theta}}$ is mapped onto SUBJ when initial in the a-structure;
otherwise:
ii. $\underset{[-r]}{\theta}$ is mapped onto SUBJ.
b. Other roles are mapped onto the lowest featurally compatible function on the Markedness Hierarchy in (30).

As mentioned, the most thematically prominent argument, $\hat{\theta}$, is strongly associated with the SUBJ position; Mapping Principle (a-i) captures this, and requires that a non-patientlike $\hat{\theta}$ maps to SUBJ where possible. The constraint that $\hat{\theta}$ be leftmost in the a-structure is to account for the presence of non-thematic arguments which might take precedence in mapping to SUBJ. For example, the a-structure of a raising verb like *seem* is as shown in (37) (Zaenen & Engdahl 1994: 200):

(37) *seem* $\underset{[-r]}{\_\_}$ ⟨ Proposition ⟩
[−*o*]

[16]We follow the formulation of Bresnan et al. (2016: 334); for the first appearance of these principles, see Bresnan & Zaenen (1990: 51).

Although *seem* only takes a single semantic argument, the Proposition it embeds, this argument cannot surface as the subject, and the verb instead takes a non-thematic, expletive subject:[17]

(38) a. * That Kira smiled seemed.
b. It seemed that Kira smiled.

For this reason, (37) contains two argument slots, although one is devoid of semantic content and is therefore marked as $[-r]$, since a non-thematic argument, by definition, cannot be semantically restricted. The highest thematic role, $\hat{\theta}$, is still the Proposition, and it is marked $[-o]$, but because it is no longer initial in the a-structure, it is not mapped to SUBJ by Mapping Principle (a-i), leaving the expletive argument available to map to SUBJ by Principle (a-ii).

In addition to the Mapping Principles in (36), there are two other well-formedness conditions on mapping, FUNCTION-ARGUMENT BIUNIQUENESS (Bresnan 1980: 112), and the SUBJECT CONDITION (Baker 2006 [1983], Bresnan & Kanerva 1989: 28):[18]

(39) *Function-Argument Biuniqueness:*
Each a-structure role must be associated with a unique function, and vice versa.

(40) *The Subject Condition:*
Every predicator must have a subject.

The first condition ensures that a predicate cannot select for multiple of the same GF, and that a single argument cannot be realised by multiple GFs of the same predicate.[19] The second represents a supposed language universal, that all predicates possess subjects – even when these are not overtly expressed. There have been some doubts about the universality of this claim (see e.g. Bresnan & Kanerva 1989: 28, fn. 37, Bresnan et al. 2016: 334, fn. 9, Kibort 2006, and references therein), so it may be more appropriate to see this as a parameter which varies by language.[20]

[17] Of course, there is also the "raised" alternative *Kira seemed to smile*. See Zaenen & Engdahl (1994) and Dalrymple et al. (2019: ch. 15) for the treatment of raising in LFG.

[18] Once again, we take the specific wording from Bresnan et al. (2016: 334).

[19] The first part of this is already barred by the f-structure well-formedness condition called Consistency (Dalrymple et al. 2019: 53–54), which follows from the functional nature of f-structure: each attribute at f-structure, such as a GF like SUBJ or OBJ, can only have a single value.

[20] Kibort (2004: 358–359) reworks the Classical LMT Mapping Principles in such a way that she can do without the Subject Condition altogether – see Section 5 for more details.

Note that these well-formedness conditions are more important in early LMT work, such as Bresnan & Kanerva (1989), since this version of the theory does not include explicit Mapping Principles like (36). Instead, through a richer theory of intrinsic and default assignment of features to arguments, a number of mappings are made possible, which are then filtered down to the unique solution by Function-Argument Biuniqueness and the Subject Condition (Bresnan & Kanerva 1989: 28ff.). In the sense that this involves positing fewer rules, it is a simpler theory – but the rules it does include are more specific (i.e. referring to particular thematic roles by name), making it less general overall.

Let us return now to the example of a simple transitive predicate like *kick* and see how the Mapping Principles apply in practice. Since Agent outranks Patient on the Thematic Hierarchy, the Agent is identified as $\hat{\theta}$; since this argument is also initial in the a-structure, it is therefore mapped to SUBJ. The remaining argument, the $[-r]$ Patient, then maps to the lowest compatible GF on the Markedness Hierarchy: the lowest $[-r]$ GF is OBJ. This correctly gives us the active voice mapping whereby the Agent is realised as the subject, and the Patient as the object:

(41) *kick* ⟨ Agent Patient ⟩
$[-o]$ $[-r]$
| |
SUBJ OBJ

What of other predicate types?[21] Intransitives should have their single argument mapped to SUBJ. The initial feature assignment to this argument will depend on whether the predicate is unaccusative or unergative (Perlmutter 1978):

[21]We consider only verbal predicates in this chapter. This footnote offers a selection of references for the reader interested in learning more about argument structure and mapping phenomena within the nominal domain. The most prominent idea, proposed by Rappaport (2006 [1983]), is that nominals derived from verbs inherit that verb's argument structure, but that the possibilities for mapping are more constrained within the noun phrase – for example, the functions SUBJ and OBJ are not available to the dependents of nouns (cf. *Luke destroyed the Death Star* and *Luke's destruction of the Death Star*). This perspective remains the dominant one – see e.g. Laczkó (2000, 2003, 2007), Kelling (2003), Chisarik & Payne (2001, 2003) – but some have instead argued that nominals either don't have argument structures, or that, where they do, they can differ from the corresponding verbal ones (Ramchand 1997, Lowe 2017, Taylor 2023). Börjars & Lowe (2023) [this volume] provide a useful contemporary summary of the issues.

A wide range of languages have been studied in LFG with respect to nominal argument structures and their mapping possibilities: see Saiki (1987) on Japanese, Markantonatou (1995) on Modern Greek, Laczkó (2000, 2003, 2004, 2010) on Hungarian, Falk (2001a) on Modern Hebrew, Kelling (2003) on French, Sulger (2013) on Hindi-Urdu, Lowe (2017) on Sanskrit and other early Indo-Aryan languages, and Taylor (2023) on Old English.

since the single argument of an unaccusative is patientlike, it will be assigned $[-r]$; unergatives, on the other hand, have more agentlike arguments, which will therefore be assigned $[-o]$. However, in both cases this will result in the correct mapping (in the simple, active case): for the unaccusative verb, (42), Mapping Principle (a-ii) applies, while for the unergative (43), Principle (a-i) does the job.

(42) *fall* ⟨ Patient ⟩
$[-r]$
|
SUBJ

(43) *run* ⟨ Agent ⟩
$[-o]$
|
SUBJ

Ditransitives like *give* are slightly more complicated. They of course have three arguments in their a-structure:

(44) *give* ⟨ Agent Beneficiary/Recipient Theme ⟩

Following the usual initial classifications, the Theme, as a patientlike argument, is linked to $[-r]$, and the Beneficiary/Recipient and Agent both receive the "elsewhere" $[-o]$ feature. As per the Mapping Principles, the Agent, an a-structure-initial, $[-o]$-valued, $\hat{\theta}$ argument, is mapped to SUBJ. The Beneficiary/Recipient maps to the lowest $[-o]$ GF, which is OBL_θ, while the Theme maps to the lowest $[-r]$ GF, OBJ. This gives us one correct mapping for *give*, illustrated in a sentence like *Peter gave a present to Harriet*.

(45) *give* ⟨ Agent Beneficiary/Recipient Theme ⟩

Agent	Beneficiary/Recipient	Theme
$[-o]$	$[-o]$	$[-r]$
SUBJ	OBL_θ	OBJ

But of course there is another way of realising the arguments of a ditransitive like *give*: the dative-shifted version, illustrated in *Peter gave Harriet a present*. Since this involves the same thematic roles, this alternation cannot be derived in Classical LMT without some further stipulation (Kibort 2008: 314). It seems that we can choose to view the Beneficiary/Recipient as patientlike (cf. Toivonen 2013), in which case it is assigned $[-r]$ by the intrinsic classification rules

(Bresnan 2003: 14–15; cf. also Bresnan et al. 2016: 337–340). Now, English is an asymmetrical object language, which means it does not permit the presence of two $[-r]$ arguments at a-structure (see Section 4.2.3), and so the (lower-ranked) Theme must instead be marked $[+o]$, as a secondary patientlike argument, per (34). The Agent receives the "elsewhere" $[-o]$ specification as usual, giving us the following a-structure and GF-mapping:

(46)

give ⟨	Agent	Beneficiary/Recipient	Theme ⟩
	$[-o]$	$[-r]$	$[+o]$
	|	|	|
	SUBJ	OBJ	OBJ_θ

This is the double object version of *give*: the Agent is mapped to SUBJ as usual, then the other arguments are mapped to the lowest compatible GFs, in this case OBJ for the Beneficiary/Recipient (the lowest $[-r]$ GF) and OBJ_θ for the Theme (the lowest $[+o]$ GF). So, Classical LMT can account for the dative shift alternation, but only with the initial stipulation that the Beneficiary/Recipient can be viewed as patientlike, and hence assigned $[-r]$ at a-structure. Indeed, morphosemantic alternations in general are problematic for Classical LMT, a shortcoming which Kibort (2007, 2014) attempts to rectify, and which we will examine in more detail in Section 5. For now, though, we consider the well-developed Classical LMT account of (morphosyntactic) alternations.

4.1.3 Argument alternations

Argument alternations in Classical LMT are handled by adding extra specifications to arguments – in this way information is only added, not removed, meaning that "the computational requirement of monotonicity can be met even in the domain of relation changes" (Bresnan 1990: 650).

One common mechanism is that of SUPPRESSION, illustrated schematically in (47):

(47)

$$\begin{array}{c} \theta \\ | \\ \emptyset \end{array}$$

This prevents an argument from being mapped to a GF at f-structure, and existentially quantifies over the argument in the semantics (though it does allow the possibility of the argument being realised by an adjunct, like the English *by*-phrase

which can express the Agent of a passive, so this quantification only applies if the argument remains unexpressed). Suppression is restricted to unmarked arguments, i.e. those pre-specified with a negatively-valued feature at a-structure (Alsina 1999; see also Bresnan et al. 2016: 338–340 for a relevant example), a principle known as Recoverability of Suppresion (Bresnan et al. 2016: 333).

Lexical rules involving deletion can be recast in terms of suppression. For example, instead of deleting an obj, as in (25), intransitivisation involves suppression of a Theme/Patient argument:

(48) Intransitivisation: Theme/Patient
|
∅

And rather than deleting or re-writing the subj and changing an obj to a subj, as in (27), passivisation simply involves a single process, *viz.* the suppression of the highest thematic role:

(49) Passivisation: $\hat{\theta}$
|
∅

This simplified analysis of passivisation works because of the general system of mapping assumed in Classical LMT. In a standard two-place predicate like *kick*, the highest, Agent argument will be $[-o]$, while the next, Patient argument will be $[-r]$. If the Agent argument is suppressed, Mapping Principle (a-i) will not apply, and instead Principle (a-ii), which maps a $[-r]$ argument to subj, will step in, correctly promoting the Patient argument, without any need for further stipulation:[22]

[22]The way the Mapping Principles are written, it seems to us that argument suppression should lead to a contradiction. Assuming the Principles are intended to be declarative rather than procedural, then (50) would seem to violate Mapping Principle (a-i), since it is not true that a $[-o]$, a-structure-initial $\hat{\theta}$ is mapped onto subj: instead, it is not mapped to anything; and the same goes for intransitivisation: the suppressed Theme/Patient argument in a transitive will not be mapped to the lowest featurally compatible function on the Markedness Hierarchy, contrary to Principle (b). Perhaps suppression removes an argument from consideration at a-structure altogether, but in that case it would not be monotonic. One solution would simply be to add the rider "unless suppressed" to each of the Mapping Principles, but this seems far from parsimonious.

(50) *kicked*$_{\text{PASSIVE}}$ ⟨ Agent Patient ⟩

[−*o*]	[−*r*]
∅	SUBJ

Passivisation also correctly applies to ditransitives in both their a-structure realisations. For example, suppressing the Agent in the non-shifted version, repeated in (51), results in the Theme being promoted to SUBJ, by Mapping Principle (a-ii), since it is a [−*r*] argument.

(51) *give* ⟨ Agent Beneficiary/Recipient Theme ⟩

[−*o*]	[−*o*]	[−*r*]
∅	OBL$_\theta$	SUBJ

This gives us the correct alternation, illustrated in (52), where the Beneficiary/Recipient remains an OBL$_\theta$ (since this is still the most marked [−*o*] GF):

(52) a. Peter gave a present to Harriet.
b. A present was given to Harriet (by Peter).

On the other hand, when the Agent is suppressed in the dative-shifted version, the Beneficiary/Recipient is promoted instead, since it is now the [−*r*] argument, while the Theme remains an OBJ$_\theta$ (since this is still the most marked [+*o*] GF):

(53) *give* ⟨ Agent Beneficiary/Recipient Theme ⟩

[−*o*]	[−*r*]	[+*o*]
∅	SUBJ	OBJ$_\theta$

This again accords with the facts:[23]

(54) Peter gave Harriet a present.

(55) Harriet was given a present (by Peter).

[23]For those dialects where *%A present was given Harriet (by Peter)* is grammatical, something more needs to be said, of course. It is possible the Asymmetrical Object Parameter (Bresnan & Moshi 1990) is not in force in these varieties of English (see Section 4.2.3 for more on the AOP).

Notice that because Mapping Principle (b) requires that an argument be mapped to the *lowest* compatible GF on the hierarchy, the [+*o*] argument of such double object verbs remains an OBJ$_\theta$ in the passive, and is not, for example, "promoted" to OBJ. That this is the correct result is not at all obvious from English data alone: the usual test for OBJ-hood is the possibility of promotion through passivisation, but we cannot passivise a passive. In the absence of any morphological marking of the distinction between OBJ and OBJ$_\theta$, there is no obvious way to tell which of these two GFs *a present* bears in example (55).

Data from other languages, however, such as the Bantu language Chichewa, support the Classical LMT analysis. Ditransitive verbs can be formed in Chichewa by applicativisation, and when the applied argument is a Beneficiary, it is assigned a [−*r*] classification at a-structure, while the Theme is assigned [+*o*], exactly as in the English double object construction, and resulting in the same GF assignments as we saw above (Alsina & Mchombo 1993: 28). In such Chichewa applicatives, only the OBJ (the Beneficiary) can be indexed by an object marker on the verb, while the OBJ$_\theta$ (the Theme) cannot (Bresnan & Moshi 1990; Alsina & Mchombo 1993: 22):[24]

(56) a. Chi-tsîru chi-na-wá-gúl-ir-á m-phâtso (a-tsíkāna).
7-fool 7S-PST-2O-buy-APPL-FV 9-gift 2-girls
'The fool bought a gift for them (the girls).'

b. * Chi-tsîru chi-na-í-gúl-ir-á a-tsíkāna (m-phâtso).
7-fool 7S-PST-9O-buy-APPL-FV 2-girls 9-gift

Now, given the a-structure assignments, we also observe the same passivisation pattern for Chichewa applicatives as for the English double object construction, with the Beneficiary OBJ being promoted to SUBJ (Alsina & Mchombo 1993: 29):

(57) Atsíkāna a-na-phík-ír-idw-á nyêmba.
2-girls 2S-PST-cook-APPL-PASS-FV 10-beans
'The girls were cooked beans.'

Crucially, we now have a diagnostic to identify the GF of the remaining Theme argument: if it is promoted to OBJ, it should be compatible with the presence of an agreeing object marker on the verb; if it remains an OBJ$_\theta$, then the use of the object marker will not be possible. In fact, use of the object marker in this construction is ungrammatical (Alsina & Mchombo 1993: 30):

[24] Object NPs indexed on the verb can be omitted, indicated here by parentheses. Numbers signify noun classes; S = subject marker; O = object marker; FV = final vowel.

(58) * Atsíkāna a-na-zí-phík-ír-idw-á (nyêmba).
2-girls 2S-PST-10O-cook-APPL-PASS-FV 10-beans
'The girls were cooked beans.'

This incompatibility shows that the Beneficiary argument here must still be an OBJ_θ, not an OBJ, and this therefore motivates Mapping Principle (b), where arguments are linked to the *most* marked compatible GF (though the empirical landscape may not be quite so straightforward as this single data point would suggest: see Kibort 2008 for some discussion of the complexities).

Along with suppression, argument alternations can involve adding new arguments to an a-structure, as in the Bantu applicative (Bresnan & Moshi 1990), or the English benefactive (Toivonen 2013). For example, Toivonen (2013: 514) gives the rule in (60) for the benefactive in English, which takes a transitive verb into a ditransitive, as in (59):

(59) a. I'll pack some sandwiches.
b. I'll pack the children some sandwiches.

(60) English benefactive: $\langle \quad \hat{\theta} \quad \overset{\emptyset}{\downarrow} \text{Beneficiary/Recipient} \quad \text{Theme} \quad \rangle$
$[-o] \qquad [-r] \qquad [+o]$

Note that the symbol ∅ is used differently here from above, where it represented argument suppression. Here it captures the fact that the Beneficiary/Recipient is added to an a-structure which otherwise contains only a Theme and a $\hat{\theta}$, whatever role that may play; i.e. (60) adds the Beneficiary/Recipient where previously there was no argument.

As well as adding or suppressing arguments, alternations can also involve constraining the mapping possibilities of arguments. This is what happens in locative inversion, for example. The relevant examples from Chichewa are repeated in (61):

(61) a. Chi-tsîme chi-li ku-mu-dzi.
7-well 7-be 17-3-village
'The well is in the village.'
b. Ku-mu-dzi ku-li chi-tsîme.
17-3-village 17-be 7-well
'In the village is a well.'

Bresnan & Kanerva (1989: 27) analyse the relevant process in the following terms:

(62) Locative inversion: ⟨ Theme … Location ⟩
[−r]

That is, when a Location appears in the same a-structure as a Theme, assign it the specification [−r] in addition to whatever its intrinsic feature assignment is. Let us see how this provides the contrast in (61).

In the relevant sense, the verb *-li* 'be' takes a Theme and a Location argument; as per the intrinsic specifications of (34), the patientlike Theme is assigned [−r] and the other role is assigned [−o]. All things being equal, this will provide the mapping instantiated by (61a), where the Theme maps to SUBJ, by Mapping Principle (a-ii), and the Location maps to OBL_θ, the lowest [−o] GF.

(63) *-li* ⟨ Theme Location ⟩
[−r] [−o]
| |
SUBJ OBL_θ

When we apply the additional assignment in (62), however, things change:

(64) *-li* ⟨ Theme Location ⟩
[−r] [−o]
[−r]
| |
OBJ SUBJ

Here, the Location argument is fully specified as a SUBJ, meaning that the Theme is prevented from also being mapped to SUBJ, owing to Function-Argument Biuniqueness. Instead, it must map to the lowest available GF on the Markedness Hierarchy, namely OBJ. This gives us the mapping instantiated by (61b).

This section has served to provide a sampling of the different approaches to argument alternations in Classical LMT. By suppressing, adding, or further specifying arguments, the theory can give succinct accounts of a variety of different phenomena. To the extent that these simple descriptions make the correct predictions in conjunction with the underlying theory, this also serves as a vindication of the latter. Of course, we have hardly been able to do justice to such a rich literature in a handful of pages, but we hope to have illustrated the key technical points. In the following section, we provide a few more case studies, further showcasing areas where Classical LMT has provided elegant and illuminating analyses.

4.2 Case studies and extensions

The framework of Classical LMT has been shown to offer an elegant solution to many thorny empirical issues, but it has also sometimes been necessary to expand or modify the theory in the face of empirical deficiencies or theoretical shortcomings. In this section, we discuss various topics which showcase the workings of Classical LMT.

4.2.1 Resultatives

As first observed by Simpson (2006 [1983]), resultative predicates in English can be applied to the objects of transitives or to the subjects of their corresponding passives, as shown in (65), and to the subjects of unaccusative intransitives but not of unergatives, as shown in (66) (examples from Bresnan & Zaenen 1990: 46):

(65) a. We pounded the metal flat.
b. The metal was pounded flat.

(66) a. The river froze solid.
b. * The dog barked hoarse.

The question then arises: how should we characterise all and only the arguments which can have resultatives predicated of them?

The generalisation cannot be based on surface grammatical function. For one thing, the data above show that both subjects and objects can take resultative predicates. What is more, only some subjects are implicated: (66b) is ungrammatical, and (65a) would be too if it were intended to mean that we pounded the metal until *we* were flat.

Given the contrast between unaccusative and unergative predicates, we might think instead to appeal to the thematic role of the arguments in question: perhaps resultatives can be applied to Themes, and not to Agents? This would account for the data in (65–66), but unfortunately there are other data which invalidate such a generalisation. Resultatives can also be applied to non-thematic arguments such as "fake reflexives", illustrated in (67), or "non-subcategorised objects" which do not stand in a direct semantic relation to the main verb, illustrated in (68) (examples from Bresnan & Zaenen 1990: 47):

(67) a. The dog barked itself hoarse.
b. We ran ourselves ragged.

(68) a. The dog barked us awake.
b. We ran the soles right off our shoes.

The tools of Classical LMT offer a straightforward solution to this descriptive challenge: the arguments in question are simply those which are assigned $[-r]$ as their initial feature value at a-structure. For the Themes in (65–66), this follows from their being patientlike, while for the problematic arguments in (67–68) this follows from their being non-thematic (and so by definition semantically unrestricted). The more agentive subjects of transitive and unergative verbs will instead by classified as $[-o]$ by the "elsewhere" condition, which sets them apart.

4.2.2 Proto-roles and unaccusativity

Another area where intrinsic classification of argument positions at a-structure has proved a more useful discriminator than other notions is in Zaenen's (1993) analysis of unaccusativity in Dutch. Before we consider the data, however, we first introduce Zaenen's innovative approach to intrinsic feature specification.

Rather than having to decide impressionistically whether an argument is "patientlike" or not, in order to decide whether it should be assigned $[-r]$ or $[-o]$ as its initial feature specification at a-structure, Zaenen (1993: 146–154) proposes to operationalise Dowty's (1991) notion of semantic PROTO-ROLE.

Dowty (1991: 571–575) envisages semantic roles as prototypes: arguments can possess a number of both proto-agent and proto-patient properties, with their behaviour depending on the balance between the two groups. This allows a fuzzier notion of semantic role, and avoids some of the definitional challenges of using named roles. Proto-agentivity and proto-patientivity are determined by a number of lexical entailments, including volition, change of state, and movement, which describe aspects of the relationship between participant and event (Dowty 1991: 572):

(69) *Proto-agent entailments:*

- volitional involvement in the event or state
- sentience (and/or perception)
- causing an event or change of state in another participant
- movement (relative to the position of another participant)
- exists independently of the event named by the verb

(70) *Proto-patient entailments:*

- undergoes change of state
- incremental theme[25]
- causally affected by another participant
- stationary relative to movement of another participant
- does not exist independently of the event, or not at all

Dowty (1991: 576) uses these proto-properties to determine the assignment of the subject and object GFs to arguments (the argument with more proto-agent properties becomes the subject, while the argument with more proto-agent properties becomes the object), but Zaenen (1993: 149) instead uses them to determine the intrinsic feature specification of an argument at a-structure: those that have more proto-agent properties will be classified as $[-o]$, while those that have more proto-patient properties will be classified as $[-r]$. This therefore captures the same general intuition as the Classical LMT intrinsic assignment principles in (34), namely that patientlike arguments are $[-r]$ and others are $[-o]$, but does so in a way which makes it more explicit what criteria an argument has to satisfy to count as patientlike. (Of course, determining whether an argument satisfies the proto-properties can also sometimes be rather impressionistic, but many are clear-cut enough to at least afford one an analytical toehold.)

A problem arises when an argument possesses an equal number of proto-agent and proto-patient properties (including zero). Dowty (1991: 576) proposes that in this situation both mappings are available. Zaenen (1993: 150) instead assumes that in such a case the argument is assigned $[-r]$. This is somewhat self-serving in that it gives her the correct results for Dutch (see below), but, as she observes, it does not seem unreasonable that it is precisely in areas such as this, where the distinctions are less clear-cut, that languages vary, and so perhaps a degree of arbitrariness is unavoidable.

Let us now turn to the Dutch data which Zaenen (1993) uses these tools to analyse. Intransitive verbs in Dutch take different auxiliaries in the compound past tense depending on whether they are unaccusative or unergative. The unergatives take *hebben* 'have' and the unaccusatives take *zijn* 'be':

[25]Dowty (1991: 588) defines an incremental theme as "an NP that can determine the aspect of the sentence […]; the event is 'complete' only if all parts of the NP referent are affected (or effected)". For example, in *Chrisjen ate a pistachio*, the eating event is only complete once all (edible) parts of the pistachio are eaten.

(71) **Unergative verbs:**

a. Hij heeft/*is gelopen.
he has/is run
'He has run.'

b. Ze heeft/*is getelefoneerd.
she has/is telephoned
'She has telephoned.'

(72) **Unaccusative verbs:**

a. Ze is/*heeft overleden.
she is/has died
'She has died.'

b. Hij is/*heeft gevallen.
he is/has fallen
'He has fallen.'

This also correlates with another contrast: the possibility of using the past participle as a pre-nominal modifier. This is impossible with the unergative, *hebben*-taking verbs, but perfectly productive with the unaccusative, *zijn*-taking verbs:

(73) a. * de gelopen/getelefoneerd man
the run/telephoned man

b. de overleden/gevallen vrouw
the deceased/fallen woman
'the deceased/fallen woman'

Now, if the intransitives were the only verbs we had to consider here, then a semantic explanation would be possible. For one thing, the single argument of an unaccusative is generally Theme/Patient-like. Zaenen (1993: 132–136) also discusses other semantic criteria which distinguish the two classes of verbs. However, a class of transitive verbs (those with an experiencer argument) also exhibit the same syntactic split, despite having different semantics. Firstly, some take *hebben* and some take *zijn* in the compound past tense:

(74) a. Dat is/*heeft me jarenlang goed bevallen.
that is/has me for.years well pleased
'That has pleased me well for years.'

b. Hij heeft/*is me jarenlang geïrriteerd.
he has/is me for.years irritated
'He has irritated me for years.'

And this distinction once again maps onto a difference in the use of the past participle as a pre-nominal modifier. When the past participles of those verbs that take *zijn* are used pre-nominally, their head noun can be understood as the equivalent of their active voice subject, whereas this is not the case for those that take *hebben*:

(75) het hem goed bevallen boek
the him well pleased book
'the book that pleased him well'

(76) a. de geïrriteerde jongen
the irritated boy
'the irritated boy'

b. # de geïrriteerde fouten
the irritated mistakes
'the mistakes that were irritated', not 'the mistakes that caused irritation'

But here the semantic explanation is not available: the subject of a verb like *bevallen* 'please/suit' is not a Theme/Patient, but rather a Stimulus or equivalent. And Zaenen (1993: 144) notes that "if there are any semantic properties that distinguish the two classes of experiencer verbs under consideration, they are not the same as the ones distinguishing the two classes of intransitives".

In fact, once again the solution is to look at intrinsic assignment of features at a-structure. The subjects of verbs like *bevallen* do not, in Zaenen's (1993: 149) view, possess any proto-agent or proto-patient entailments; in the event of a tie, Zaenen (1993: 150) assumes that the argument is assigned [−*r*], and so these arguments are treated as being patientlike. We now have an explanation for the shared unaccusative/unergative split across intransitives and transitives. Just as with resultatives, the presence of a [−*r*] argument is the significant factor: verbs in which the intrinsically [−*r*]-marked argument becomes subject take the auxiliary *zijn* (otherwise verbs take *hebben*), and the head noun of the pre-nominal participle corresponds to the [−*r*] argument – this makes such participial uses simply impossible for unergative intransitives, which have no [−*r*] argument, and means that the head noun corresponds to the "logical object" of transitives.

4.2.3 Double object constructions

The world's languages are divided in how they treat ditransitive predicates. For some, both objects of a ditransitive are treated equally: for example, either can be promoted to subject by passivisation, flagged by object marking on the verb, etc. As mentioned above, these languages are called symmetrical object languages. Other languages, called asymmetrical object languages, exhibit strong differences between "primary" and "secondary" objects, whereby only one object is eligible for promotion by passivisation, flagging by object marking on the verb, etc. This distinction was first drawn as a result of work on the Bantu languages (e.g. Gary & Keenan 1977, Kisseberth & Abasheikh 1977, Baker 1988), where the divide is particularly clear: since these languages have a productive process of applicativisation, ditransitive predicates are very frequent, and a number of grammatical features are sensitive to objecthood.

To illustrate the contrast between symmetrical and asymmetrical object languages, we consider two languages from the Bantu family: Kichaga and Chichewa. Kichaga is a symmetrical object language, and so either of the post-verbal arguments in the active can be promoted to subject by passivisation (Bresnan & Moshi 1990: 150):

(77) a. N-ǻ-ĭ-lyì-í-à m̀-kà k-élyà
FOC-1S-PRS-eat-APPL-FV 1-wife 7-food
'He is eating food for/on his wife.'

b. M̀-kà n-ǻ-ĭ-lyì-í-ò k-élyâ
1-wife FOC-1S-PRS-eat-APPL-PASS 7-food
'The wife is being eaten food for/on.'
(i.e. 'The wife is being benefitted/adversely affected by someone eating food.')

c. K-élyà k-ĭ-lyì-í-ò m̀-kà
7-food 7S-PRS-eat-APPL-PASS 1-wife
'The food is being eaten for/on the wife.'

Chichewa, on the other hand, is an asymmetrical object language. Here, only the immediately post-verbal argument in the active can be promoted to subject in the passive (Baker 1988: 248):

(78) a. Kalulu a-na-gul-ir-a mbidzi nsapato.
hare S-PST-buy-APPL-ASP zebras shoes
'The hare bought shoes for the zebras.'

b. Mbidzi zi-na-gul-ir-idw-a nsapato (ndi kalulu).
zebras s-PST-buy-APPL-PASS-ASP shoes by hare
'The zebras were bought shoes (by the hare).'

c. * Nsapato zi-na-gul-ir-idw-a mbidzi (ndi kalulu).
shoes s-PST-buy-APPL-PASS-ASP zebras by hare
'Shoes were bought for the zebras (by the hare).'

There are a number of other properties which correlate with the passivisation facts (Bresnan & Moshi 1990: 150–153). Either or both post-verbal arguments in Kichaga can be omitted if they are encoded on the verb by an object marker, for instance, while in Chicheŵa, only the immediately post-verbal Beneficiary argument can be encoded/omitted this way; Kichaga allows unspecified object deletion of the Patient in a ditransitive where Chicheŵa does not; Kichaga allows the Patient argument to be eliminated by reciprocal marking on the verb in the presence of any applied object, while this is not the case in Chicheŵa; and all of these properties can interact in different ways.

These patterns receive an elegant explanation in Classical LMT, by way of the Asymmetrical Object Parameter (AOP; Alsina & Mchombo 1990, Bresnan & Moshi 1990: 172). This is a well-formedness constraint on a-structures, parametrised so that some languages apply it (i.e. asymmetrical object languages) and others do not (i.e. symmetrical object languages).

(79) *Asymmetrical Object Parameter*

$$* \quad \underset{[-r]}{\theta} \quad \ldots \quad \underset{[-r]}{\theta}$$

The AOP prohibits the presence of two intrinsically classified $[-r]$ arguments in the same a-structure: when it is in force, secondary patientlike arguments are assigned $[+o]$ by the intrinsic linking principles introduced in Section 4.1.2; when it is not, we permit multiple patientlike arguments to be assigned $[-r]$ instead. Let us consider how this can explain the passivisation facts shown in (77) and (78).

Chicheŵa is an asymmetrical object language, so the AOP is active. The a-structure for an applicative verb like we see in (78a) is therefore as follows:

(80) *gulira* 'buy-for' ⟨ Agent Beneficiary Theme ⟩

[−*o*]	[−*r*]	[+*o*]
SUBJ	OBJ	OBJ_θ

Just as with the English ditransitive above, we interpret the Beneficiary as patientlike, and so assign it the intrinsic feature [−*r*]. By the AOP, the second patientlike argument cannot also be marked [−*r*], so it is instead classified as [+*o*]. This leads to the (correct) mapping shown in (80).

In the passive, only the Beneficiary is eligible for promotion to SUBJ when the Agent is suppressed, since the [+*o*] Theme is featurally incompatible. This explains the contrast between (78b) and (78c).

(81) *guliridwa* 'buy-for$_{\text{PASSIVE}}$' ⟨ Agent Beneficiary Theme ⟩

[−*o*]	[−*r*]	[+*o*]
∅	SUBJ	OBJ_θ

Now consider Kichaga. Since it is a symmetrical object language, we are free to ignore the AOP ban on having two intrinsically [−*r*]-marked arguments. However, if we do, then we run into trouble in the active:

(82) *lyìíà* 'eat-for' ⟨ Agent Beneficiary Patient ⟩

[−*o*]	[−*r*]	[−*r*]
SUBJ	OBJ	*

Since the Agent will be mapped to SUBJ, we are left with only one remaining [−*r*] GF to share between two arguments. So here Kichaga must take the same option as Chichewa of assigning the non-Beneficiary argument [+*o*] instead:

(83) *lyìíà* 'eat-for' ⟨ Agent Beneficiary Patient ⟩

[−*o*]	[−*r*]	[+*o*]
SUBJ	OBJ	OBJ_θ

However, in the passive, things are different. Now that the Agent is not mapped to any GF, there are still two [−*r*] GFs available. This means the unrestricted intrinsic mapping of two arguments to [−*r*] is possible, and will in fact lead to two possible final mappings:

(84) *lyìíò* 'eat-for$_{\text{PASSIVE}}$' ⟨ Agent Beneficiary Patient ⟩

	[−*o*]	[−*r*]	[−*r*]
	∅	SUBJ/OBJ	OBJ/SUBJ

This is exactly the right prediction, since both (77b) and (77c) are grammatical.

The other properties can also be made to follow from the possibility of having multiple [−*r*] arguments or not. Recall that the argument structure operation of suppression is limited to unmarked arguments (those that possess negatively-valued intrinsic features) – it then follows that e.g. unspecified object deletion applies more freely in symmetrical object languages, which can have more arguments with negatively-valued features than asymmetrical object languages.

4.2.4 Complex predicates

Complex predicates are predicates which syntactically head single clauses, but whose meanings incorporate multiple semantic heads and which therefore have complex argument structures. They have been at the centre of LFG work on argument structure and mapping theory since the earliest days, and have consistently drawn a great deal of attention in the literature (e.g. Ishikawa 1985, Alsina 1992, 1996, Butt 1995, 2014, Mohanan 1994, Matsumoto 1992, 1996, Andrews & Manning 1999, Lowe 2016, Lovestrand 2020, among many, many others; see also Dalrymple et al. 2019: 351–352 for an overview of the range of cross-linguistic work on complex predicates carried out in LFG).[26] As one might expect, therefore, this work has also led to various innovations and extensions of Classical LMT. In this section, we discuss two of these: the idea that one a-structure can be embedded inside another, with appropriate fusion of overlapping arguments, and the claim that this a-structure composition can take place in the syntax proper, not just in the lexicon, thus putting paid to the "lexical" aspect of Lexical Mapping Theory.

The first of these points can be seen by considering causatives in Chicheŵa (Alsina 1992). Verbs containing the causative suffix *-ítsa* add an additional Causer argument which, in the active, surfaces as the subject, with the previous subject being demoted, either to object or oblique status (Alsina 1992: 518):

[26]There has also been extensive work on computational grammars for LFG that can handle complex predicates, with a particular focus on Hindi-Urdu: see Butt et al. (2003, 2012), Butt & King (2007), Bögel et al. (2009), Sulger (2013).

Another strand of research worth highlighting studies the consequences of complex predicates for the syntax-semantics interface: see Dalrymple, Hinrichs, et al. (1993), Kaplan & Wedekind (1993), Andrews & Manning (1999), Andrews (2007), Homola & Coler (2013), Lowe (2015).

(85) Nŭngu i-na-phík-íts-a kadzidzi maûngu.
9.porcupine 9s-PST-cook-CAUS-FV 1a.owl 6.pumpkins
'The porcupine made the owl cook the pumpkins.'

(86) Nŭngu i-na-phík-íts-a maûngu (kwá kádzīdzi).
9.porcupine 9s-PST-cook-CAUS-FV 6.pumpkins to 1a.owl
'The porcupine had the pumpkins cooked by the owl.'

Now, we might imagine that such causative forms have a simple a-structure, containing three argument positions for the Causer, Causee, and original Patient (here *maûngu*, 'pumpkins'). Instead, Alsina (1992: 521) suggests they have a complex argument structure, formed by embedding the base verb's a-structure into the a-structure of the CAUSE predicate, whose Patient is then merged with one of the arguments of the base predicate:

(87) CAUSE ⟨ Agent Patient PRED ⟨ … θ … ⟩ ⟩
caused event

Where the base predicate has more than one argument, this means there are multiple possibilities for this ARGUMENT FUSION: for instance, the causative's Patient argument may fuse with either the Agent or Patient of *phīka* 'cook'. Alsina (1992: 523–524) claims that this is precisely the difference between the two realisations in (85) and (86). In (85), the causative Patient is combined with the embedded verb's Agent, meaning the Causer's goal was to make the owl carry out the cooking; this sentence, but not (86), is therefore a possible answer to the question "What did the porcupine do to the owl?". In (86), however, the causative Patient is fused with the embedded verb's Patient, meaning the Causer merely intended for the pumpkins to get cooked, but did not especially care whether the owl did it; this sentence, but not (85), is therefore a possible answer to the question "What did the porcupine do to the pumpkins?".

The fact that an argument of the base predicate is the Patient of the causative morpheme itself has a number of effects. For instance, although the verb *phīka* 'cook' normally allows deletion of its object, in its causative form this is not possible, showing that in this respect the object behaves like an argument of the causative morpheme, rather than of the base predicate (Alsina 1992: 524–525):

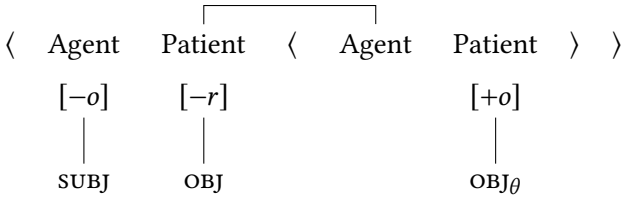
(88) Kadzīdzi a-na-phík-a (maûngu).
1a.owl 1s-PST-cook-FV 6.pumpkins
'The owl cooked (the pumpkins).'

(89) Nŭngu i-na-phík-îts-a *(maûngu) (kwá kádzīdzi).
9.porcupine 9S-PST-cook-CAUS-FV 6.pumpkins to 1a.owl
'The porcupine had the pumpkins/something cooked (by the owl).'

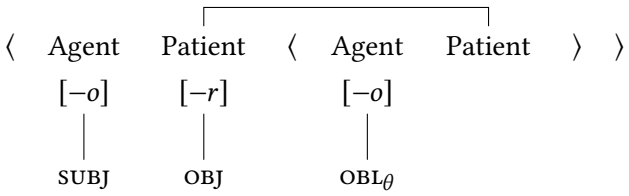
At the same time, the fused argument is also sensitive to its thematic role within the embedded predicate – for example, if it is an Agent in the base predicate it cannot be extracted (e.g. by relativisation), whereas if it is a Patient then it can (Alsina 1992: 529–530). This mixed behaviour motivates the idea that two argument positions are fused in the a-structure of these complex predicates.

The assumption of argument fusion also allows a straightforward Classical LMT account of the mapping possibilities open to causatives in Chichewa. The alternation between (85) and (86), for example, follows naturally if we assume that when two arguments fuse it is only the higher one which receives its intrinsic feature assignment:[27]

(90) a. *phikītsa* 'cause to cook'



b. *phikītsa* 'cause to cook'



When the causative Patient is fused with the embedded Agent, the embedded Patient is marked [+*o*] as a secondary patientlike argument (the higher Patient taking priority owing to its ranking in the a-structure). When it is fused with the embedded Patient instead, the embedded Agent now receives a [−*o*] specification, but since the higher Agent is leftmost in the a-structure, it will map to SUBJ, leaving this lower Agent to map to OBL_θ instead.

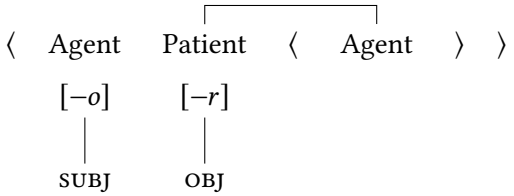
We can also see why the causatives of intransitives do not exhibit this same alternation – their Causee can only surface as an OBJ, never as an OBL_θ:

[27] We diverge somewhat from Alsina's (1992) proposal here – albeit only in detail and not in spirit – in order to harmonise with the approach to mapping we introduced earlier.

(91) Chatsalĭra a-ku-nám-íts-á (* kwá) mwãina.
1.Chatsalira 1S-PRS-lie-CAUS-FV to 1.child
'Chatsalira is making the child tell lies.'

This follows naturally from the argument structure facts: since the embedded predicate only has a single argument, that will necessarily be the argument that fuses with the causative Patient, and so it is mapped to OBJ, not to OBL_θ:

(92) *namĭtsa* 'cause to lie'



Chichewa forms causatives morphologically, and so the processes of a-structure composition and argument fusion can be thought of as taking place in the lexicon. However, some complex predicates are made up of multiple words, and so their argument structures must be built in the syntax rather than in the lexicon. Butt (1995), studying Hindi-Urdu permissive and aspectual constructions, and Alsina (1996), studying Romance causatives, were among the first to make this observation. We will illustrate the phenomenon with Hindi-Urdu data.

In Hindi-Urdu, complex predicates can be formed from a combination of a main verb and a light verb. In the case of so-called permissive complex predicates, the light verb in question is *de* 'let', homophonous with the lexical verb meaning 'give' (Butt 1995: 35). As with the causative morpheme, the light verb contributes its own arguments, which are added to and overlap with the arguments of the main predicate. For example, in (93), *saddaf=ko* is at once the "lettee" argument of the light verb *diyaa* and the "maker" argument of *banaane* 'make' (other arguments belong to only one verb: *anjum=ne* is only an argument of *diyaa* – she is the the one giving permission – and *haar* 'necklace' is only an argument of *banaane* – it is the thing being made).

(93) anjum=ne saddaf=ko haar banaa-ne
Anjum.F=ERG Saddaf.F=DAT necklace.M.NOM make-INF.OBL
di-yaa.
give-PERF.M.SG
'Anjum let Saddaf make a necklace.'

The light verb and main predicate do not have to be adjacent or form a constituent at c-structure, so there is no sense in which they can be analysed as a single, morphologically complex word (Butt 1995: 46):

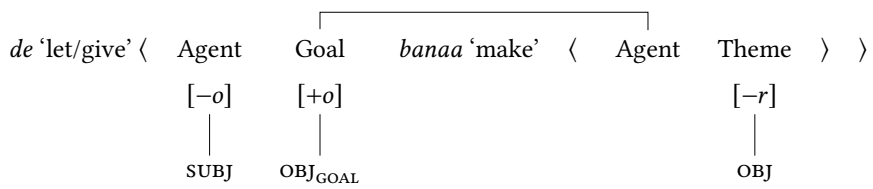
(94) a. anjum=ne saddaf=ko haar [**banaa-ne di-yaa**].
b. anjum=ne **di-yaa** saddaf=ko [haar **banaa-ne**].
c. anjum=ne [haar **banaa-ne**] saddaf=ko **di-yaa**.

Nevertheless, these sentences do not involve clausal embedding: with respect to agreement, anaphora, and control, they behave monoclausally (see Butt 1995: 36–43 for detailed evidence of this). That is, they have a flat f-structure, shown in (95):[28]

(95)
$$\begin{bmatrix} \textsc{pred} & \text{`}\textsc{let-make}\langle \textsc{subj},\textsc{obj},\textsc{obj}_{\textsc{goal}} \rangle \\ \textsc{subj} & \left[\textsc{pred} \text{ `}\textsc{Anjum}\text{'}\right] \\ \textsc{obj}_{\textsc{goal}} & \left[\textsc{pred} \text{ `}\textsc{Saddaf}\text{'}\right] \\ \textsc{obj} & \left[\textsc{pred} \text{ `}\textsc{necklace}\text{'}\right] \end{bmatrix}$$

This means the complex predicate must also have a single, composite a-structure:

(96)



But this a-structure cannot be the property of any one word in the lexicon, since it combines information from two words, and the light verb can freely combine with various predicates. What is more, complex predicates can be recursively embedded – Butt et al. (2010) give an example involving four levels of embedding, for instance:

(97) taaraa-ne amu-ko (bacce-se) haathii pinc kar-vaa
Tara-ERG Amu-DAT child.OBL-INS elephant.M.SG.NOM pinch do-CAUS
le-ne dii-yaa.
take-INF.OBL give-PRF.M.SG
'Tara let Amu have the elephant pinched (by the child) (completely).'

[28]The question of how the composite PRED value emerges here is an unanswered one – see Lowe (2016: sec. 2) for a sceptical review, and see Asudeh & Rad (2023: sec. 4) for a technical solution.

The core meaning here is the noun-verb complex predicate made up of *pinc* 'pinch' and *kar* 'do'. This is then embedded under a causative predicate, which is hosted morphologically on this same light verb. Then we have a "completive" light verb *le* (with the lexical meaning 'take'). Finally, this whole complex is embedded under the permissive light verb *de*, which we saw above.

The conclusion such data must lead us to is that complex predicate formation is a productive, syntactic process, which means that we need to be able to combine a-structures on-line, outside of the lexicon. Apart from anything else, this means that the name "Lexical Mapping Theory" is a misnomer, since the theory must not apply only to individual words, but also to complex predicate-argument structures built up syntactically.

5 Kibort MT: incorporating morphosemantic alternations

We've now seen a sampling of the successes of and challenges for Classical LMT. In this section, we turn to a rather different view of LMT, that developed by Kibort over a series of papers (Kibort 2001, 2007, 2008, 2009, 2013, 2014, Kibort & Maling 2015), which purports to improve on Classical LMT in a number of respects, not least of which being its ability to handle morphosemantic alternations. We will refer to this theory as Kibort MT.

As we saw in Section 4.1.2, the dative shift alternation poses a challenge for Classical LMT, in that the theory must assume two distinct initial assignments of features to arguments in order to be able to derive the two alternants. Other morphosemantic alternations are even more challenging. Consider again the *spray/load* alternation (Levin 1993: 50–51), illustrated in (98):

(98) a. Adam sprayed the paint on the wall.
b. Adam sprayed the wall with the paint.

This is morphosemantic insofar as the entailments of the alternants differ: in each case, the participant corresponding to the OBJ is completely affected – i.e. in (98a) the paint is fully used up, while in (98b) the wall is totally covered. Once again, both alternants involve the same thematic roles, and so the basic Classical LMT a-structure will be the same for both:

(99) *spray* ⟨ Agent Goal Theme ⟩

We would expect the Theme, being patientlike, to be assigned $[-r]$, and the other arguments to receive the default $[-o]$ assignment; this correctly produces the alternant in (98a), where the Theme surfaces as OBJ, and the Goal as an OBL_θ:

(100) *spray* ⟨ Agent Goal Theme ⟩
[−*o*] [−*o*] [−*r*]
| | |
SUBJ OBL$_\theta$ OBJ

Producing the other alternant, in (98b), is much more difficult, however. Compared to (98a), we need the Goal and Theme to switch GFs: the former now surfaces as an OBJ, and the latter as an OBL$_\theta$. We could try the same trick as we did for ditransitive *give*, and say that the Goal argument counts as patientlike: this will allow us to classify it as [−*r*], so that it can map to OBJ. But now the Theme will receive a [+*o*] assignment as a secondary patientlike argument, which is incompatible with the [−*o*] GF OBL$_\theta$. Indeed, patientlike arguments can only be classified as [−*r*] or [+*o*] by the intrinsic assignments in (34), which is precisely the opposite of what is needed to be compatible with the [+*r*, −*o*] specification of OBL$_\theta$.

In Kibort's view, the problem arises because Classical LMT conflates syntactic arguments and semantic participants, representing both simultaneously in the list of arguments-*cum*-thematic roles. She proposes therefore to expand the domain of a-structure and mapping theory to include not only ARGUMENT-FUNCTION MAPPING, i.e. what we have been considering as the domain of mapping theory up to now, but also ARGUMENT-PARTICIPANT MAPPING.[29] This is illustrated in Figure 1, representing the typical active voice realisation of the Polish double object verb *dać* 'give' (cf. Kibort 2014: 265).[30]

semantic participants	Agent	Theme	Recipient	SEMANTIC VALENCY
	|	|	|	
arguments of the predicate	⟨ arg$_1$	arg$_2$	arg$_3$ ⟩	LEXICAL VALENCY
	|	|	|	
grammatical functions	SUBJ	OBJ	OBJ$_\theta$	FUNCTIONAL SUBCATEGORISATION

Figure 1: The separation of levels in Kibort MT

Before providing the Kibort MT solution to the *spray/load* puzzle, we first introduce the theory in more detail.

[29] In other works by Kibort, these are referred to as "argument-**to**-function/participant mapping", but since the connections are intended to be bidirectional, we omit the preposition here to minimise the procedural implications.

[30] As Kibort (2007: 252) points out, separating argument positions from semantic participants in fact goes back to early LFG work (such as Bresnan 1982), and has been argued for by others such as Grimshaw (1988: 1), Mohanan (1990), Ackerman (1991: 12, 1992: 57ff), Mohanan (1994: 15ff), Joshi (1993), Alsina (1996: 37), Falk (2001b: 105), and Ackerman & Moore (2013: 40ff).

Kibort retains the Classical LMT mapping features [±*r*] and [±*o*], but, in keeping with the separation of syntax and semantics shown in Figure 1, she reinterprets them in purely syntactic terms, according to two traditional classifications of verbal dependents (Kibort 2014: 266):[31]

(101)

	[−*o*]	non-complements	(the "external" argument and oblique arguments)
	[+*o*]	complements	("internal arguments" of the predicate)
	[−*r*]	core arguments	(subject and object only)
	[+*r*]	non-core arguments	(all arguments except subject and object)

These features are associated with positions in a universally available lexical valency frame, from which predicates select a subset of argument positions:

(102)

⟨	arg_1	arg_2	arg_3	...	arg_4	...	⟩
	[−*o*]/[−*r*]	[−*r*]	[+*o*]	[+*o*]	[−*o*]	[−*o*]	

The ordering and feature assignment in (102) is based on the standard LFG Functional Hierarchy, repeated in (103):

(103) *The Functional Hierarchy:*
SUBJ > OBJ > OBJ_θ (> XCOMP, COMP) > OBL_θ (> XADJ, ADJ) .

The first position in (102), called mnemonically arg_1, corresponds to the canonical subject, and is associated with one of the two features which describe the SUBJ function (it is marked [−*o*] in unergative predicates, emphasising its non-complement status, and [−*r*] in unaccusative ones, emphasising its core status).[32] The second position, arg_2, corresponds to the canonical direct object, and is marked [−*r*] (core). The next position, arg_3, corresponds to the restricted object, and is marked [+*o*] (complement). Lastly, arg_4, corresponds to a canonical oblique argument, and is marked [−*o*] (non-complement). Predicates can select any number of arguments from this frame, but, as indicated, they can only choose one arg_1 and arg_2, though they can select multiple arg_3s and arg_4s – this corresponds to the fact that a predicate can subcategorise for only a single SUBJ and

[31] At least two other LFG linguists have proposed LMT feature sets which make no reference to semantic/thematic restrictions: Alsina (1996) and Hemmings (2012).

[32] Although the unergative/unaccusative distinction was originally applied only to intransitive predicates (Perlmutter 1978), subsequent work has extended it to predicates of all valencies: see Kibort (2004: 74–75) for discussion, and cf. the Dutch experiencer verbs discussed in Section 4.2.2, which exhibited the same syntactic split as intransitive unergatives/unaccusatives.

OBJ, whereas multiple OBJ_θs and OBL_θs are permitted, being individuated by their subscripts (e.g. $\text{OBJ}_{\text{THEME}}$ vs. OBJ_{BEN}).[33]

What we have considered as mapping so far in this chapter corresponds to "argument-function mapping" in Kibort MT, i.e. the linking of argument positions and GFs. As in Classical LMT, arguments in Kibort MT are associated with a feature specification that makes them compatible with two different GFs, and mapping therefore consists in determining which of the two (if either) will realise the argument syntactically. Kibort MT diverges from Classical LMT, however, in only having a single Mapping Principle (Kibort 2014: 267; cf. Her 2013):

(104) *Mapping Principle (Kibort MT):*
The ordered arguments are mapped in turn onto the highest (i.e. *least* marked) compatible grammatical function on the Markedness Hierarchy.

This inverts Mapping Principle (b) of Classical LMT, which maps arguments to the lowest, i.e. *most* marked, compatible GF, and in so doing removes the need for Mapping Principle (a), along with the Subject Condition, as we shall see. This is clearly a huge gain in parsimony, though it is not without cost, as we discuss below.

By way of illustration, consider again the simple transitive (and unergative) verb *kick*. This has the following Kibort MT a-structure:

(105) *kick* $\langle$ $\begin{matrix}\text{arg}_1 \\ [-o]\end{matrix}$ $\begin{matrix}\text{arg}_2 \\ [-r]\end{matrix}$ $\rangle$

By the Mapping Principle, we first map the highest argument, arg_1, onto the highest compatible GF: in this case, the highest $[-o]$ GF is SUBJ, so this is what we choose. Next, arg_2 is mapped onto the highest $[-r]$ GF available: since SUBJ is already taken, this is OBJ.[34] Note that despite the procedural talk here and in the Mapping Principle itself (arguments are mapped "in turn"), this process is intended to be understood declaratively. It can be seen as optimising the alignment between two hierarchies: are the highest arguments linked to the highest

[33] While these functions are often indexed by thematic roles, this can be understood purely for distinctiveness, having no semantic content: instead of $\text{OBJ}_{\text{THEME}}$ and OBJ_{BEN} we could use other mnemonic labels such as cases (e.g. OBJ_{ACC} vs. OBJ_{DAT}, etc.) or preposition names (e.g. OBL_{TO} vs. OBL_{ON}, etc.), or purely arbitrary labels such as OBJ_1 and OBJ_2. Thus, the retention of the GFs OBJ_θ and OBL_θ does not diminish the syntactically-motivated characterisation of GFs in Kibort MT.

[34] Function-Argument Biuniqueness still applies in Kibort MT, although it may not be necessary to stipulate it as a separate principle – see fn. 19.

GFs? This can then be solved using various constraint-based tools such as those of Optimality Theory (Prince & Smolensky 1993, 2004; cf. also Asudeh 2001 for an application of OT to mapping in an LFG context).

Morphosyntactic argument alternations interfere with the default argument-function mapping. As in Classical LMT, this is achieved monotonically, by further specifying the mapping possibility of an argument. However, Kibort MT goes even further in this respect, eschewing the use of suppression altogether, and thus sidestepping the issues mentioned in fn. 22. For instance, Kibort (2001: 170) treats passivisation as a further specification of arg_1 as $[+r]$, illustrated in (106) for passive *kicked* (cf. (50) above):

(106) $\textit{kicked}_{\text{PASSIVE}}$ $\langle$ $\begin{matrix}\text{arg}_1\\ [-o]\\ [+r]\end{matrix}$ $\begin{matrix}\text{arg}_2\\ [-r]\end{matrix}$ $\rangle$

The argument which by default would map to SUBJ is instead fully specified as an OBL_θ, and, as a result, the arg_2, if there is one, becomes the SUBJ. Note that this gives the correct result for the English long passive, where the Agent is expressed as an oblique *by*-phrase, but in the short passive the Agent is not expressed grammatically at all. Kibort (e.g. 2004: 29) refers to such obliques as "optional", but it is not clear what determines this – it cannot be the case that OBL_θs are always optional, for instance, since there are certainly cases of obligatory obliques, as in *I gave the book *(to my friend).*

In general, morphosyntactic operations are assumed to involve making arguments more marked, by adding additional +-valued specifications:

(107) a. adding the $[+r]$ specification to a $[-o]$ argument (e.g. passivisation)
b. adding the $[+r]$ specification to a $[+o]$ argument (e.g. secondary object preservation – Kibort 2007: 268)
c. adding the $[+o]$ specification to a $[-r]$ argument (e.g. locative inversion – Kibort 2004: 364–367)

One thing to note about argument-function mapping in Kibort MT is that the Subject Condition of Classical LMT is absent. The motivation for this is that genuinely subjectless predicates are quite common in the world's languages (see Kibort 2006 and Lowe et al. 2021 for discussion). For instance, Polish intransitives can be passivised, resulting in a subjectless sentence (Kibort 2006: 304–307):

(108) Było codziennie sprzątane (przez firmę).
was.3SG.N every-day clean.PART.SG.N (by company)
'There was cleaning every day (by a company).'

This follows quite naturally in Kibort MT, where the verb will have the following a-structure, resulting in the first and only argument being mapped to OBL_θ, rather than SUBJ:

(109) *sprzątać*$_{\text{PASSIVE}}$ ⟨ $\begin{matrix}\text{arg}_1\\ [-o]\\ [+r]\end{matrix}$ ⟩

The strong cross-linguistic preference for subjects is captured in the Mapping Principle: since arguments are mapped to the highest available GF on the Markedness Hierarchy, and since SUBJ is at the top of that hierarchy, SUBJ will always be the most preferred GF, meaning *something* will usually map to it. But by making this a strong preference rather than a principle of the grammar, Kibort MT also allows for the possibility of subjectless predicates in marked circumstances – such as the passivisation of an intransitive.

One negative side effect of this choice, however, is that Kibort MT apparently makes the wrong predictions about the passive of double object verbs. As mentioned above in Section 4.1.3, when a double object verb is passivised, and so the primary object is promoted to SUBJ, it is apparently *not* the case that the secondary object is promoted to primary object – but this is exactly what Kibort MT predicts should happen, since the $[+o]$-valued arg_3 of a secondary object argument is compatible with OBJ, and OBJ is less marked than OBJ_θ (though see Kibort 2008).

The Kibort MT approach to argument-function mapping offers a different perspective from Classical LMT, and perhaps represents an advancement in certain areas, in particular with respect to theoretical parsimony. However, the real advantage of the theory is in the fact that argument-*participant* mapping can interact in interesting ways with argument-function mapping. Let us return now to the question of the *spray/load* alternation. The verb *spray* in this sense will have the following a-structure and argument-function mappings:

(110) *spray* ⟨ $\begin{matrix}\text{arg}_1 & \text{arg}_2 & \text{arg}_4\\ [-o] & [-r] & [-o]\\ | & | & |\\ \text{SUBJ} & \text{OBJ} & \text{OBL}_\theta\end{matrix}$ ⟩

In fact, these GFs are the same ones which appear in both alternants – the only difference is which participants map to which GFs. Because Kibort MT posits a separate level of semantic participants, the mapping between those participants and the argument positions – and so, indirectly, the GFs – can be allowed to vary.

(111) a. Adam sprayed the wall with the paint.

b.

		Agent	Goal	Theme	
spray	⟨	arg_1	arg_2	arg_4	⟩
		[−*o*]	[−*r*]	[−*o*]	
		SUBJ	OBJ	OBL_θ	

(112) a. Adam sprayed the paint on the wall.

b.

		Agent	Goal	Theme	
spray	⟨	arg_1	arg_2	arg_4	⟩
		[−*o*]	[−*r*]	[−*o*]	
		SUBJ	OBJ	OBL_θ	

Although for a human reader it may be easier to track the re-aligned participants in diagrams like (111b) and (112b) if they are represented by thematic role labels, Kibort MT takes the criticisms of thematic roles mentioned in Section 2.1 to heart, and so they play no role in the theory. Furthermore, Kibort (2014) argues that neither Dowty-style proto-roles nor feature decomposition attempts are adequate either. In the absence of an adequate and complete representation of lexical knowledge, Kibort MT instead adopts a very minimal representation of semantic participants. In this system, semantic participants are labelled by numbers which identify which arg positions they can map to (Kibort 2014: 275ff.). For example, the a-structure of *spray* would be augmented as follows:

(113)

		1	24_{TH}	24_{GO}	
spray	⟨	arg_1	arg_2	arg_4	⟩
		[−*o*]	[−*r*]	[−*o*]	

The first semantic participant is labelled 1 since it can only be linked to the arg_1 position, but the other two are labelled 24 since they can be linked to either the arg_2 or the arg_4 position. The subscripts on the semantic participants are purely

for distinctness, to individuate the two participants with identical labels, and have no semantic content.

Argument-participant mapping has no principles beyond stating that participants with label *n* can be linked to argument arg_n; arguments whose labels contain multiple numbers, like the Theme and Goal in (113), are assumed to bear multiple labels, i.e. each of the Theme and Goal in (113) simultaneously has the label 2 and the label 4. In cases where multiple mappings are possible, Kibort MT predicts that neither is more basic than the other, since there is no preference ranking encoded in the argument-participant mapping. This is certainly right for the *spray/load* alternation, since there does not seem any reason to assume that one alternant is derived from the other or that one is more basic than the other, especially given that this alternation is unmarked in English (i.e. there is no morphological or syntactic marker in either version).[35]

Kibort MT thus draws a clear formal distinction between morphosyntactic (meaning-preserving) and morphosemantic (meaning-altering) alternations: the former affect the argument-function mapping, using techniques very similar to those of Classical LMT; the latter affect the argument-participant mapping, something made possible by separating out these two levels of representation.

In sum, Kibort MT offers a mapping theory that on the one hand simplifies, and on the other hand elaborates on Classical LMT. It is simpler in that there is a universal valency frame, a single Mapping Principle, and no mention of thematic roles, but it is more complex in that it separates out the notion of argument from semantic participant. This does, however, offer the possibility of straightforwardly representing the effects of meaning-altering, morphosemantic alternations, something that was not always possible in Classical LMT.

6 Formal issues and recent developments

Aside from Kibort's focus on expanding the empirical coverage of LMT, another major thread in contemporary work on argument structure and mapping theory has been an increased interest in questions of formalisation. In this section, we address three areas in this vein: the formal status of a-structure, the nature of mapping, and the integration of mapping theory and compositional semantics.

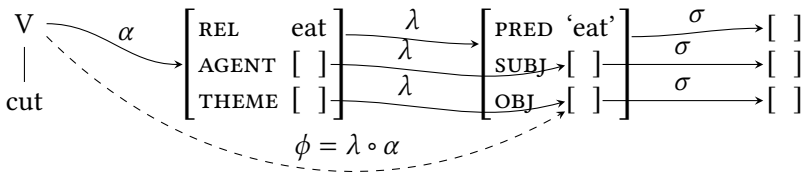
[35] It may be possible to argue that one of the variants is more basic on non-linguistic grounds, e.g. by reference to the relative prominence of cognitive concepts like Figure and Ground (Talmy 1978; see also Schätzle 2018 for an implementation of these concepts within LFG's mapping theory), but a strength of Kibort MT is that such a move is not *necessary*, even if it may sometimes be independently motivated.

6.1 The position and nature of a-structure

In Kibort MT, Classical LMT, and earlier work, the position of argument structure in the architecture of the grammar is left vague or unmentioned. Sometimes, it is (implicitly) assumed to be situated inside f-structure, as (part of) the value of PRED, but otherwise the question does not arise.

Butt et al. (1997: 1) are the first to address this formal deficiency head on, and propose that argument structure forms its own level of representation, a-structure, situated in the LFG projection architecture between c-structure and f-structure:

(114)



(Butt et al. 1997: 1, their ex. (1))

This positioning is motivated by the complex predicate facts discussed in Section 4.2.4. Since complex a-structures can correspond to simplex (monoclausal) f-structures, and since the projection functions, as functions, can be many-to-one but not one-to-many, a-structure must be mapped to f-structure, and not vice versa. On the other hand, since complex a-structures can be built from discontinuous pieces in the syntax, and are not necessarily generated in the lexicon, a-structure must be positioned after c-structure, so that information can be passed from the latter to the former.

One immediate effect of this positioning is to break up the traditional ϕ mapping from c- to f-structure: it is now the composition of two functions, the α function from c- to a-structure, and the λ function from a- to f-structure, i.e. $\lambda \circ \alpha$.[36] Some have seen this as undesirable: for example, Asudeh & Giorgolo (2012) propose a change to the architecture (to be discussed shortly), one of the effects of which is to restore ϕ to its atomic status, and they claim this as an advantage of their proposal (Asudeh & Giorgolo 2012: 71) – but if this is an advantage, we do not see how it can be anything other than an aesthetic one.

Unlike in most earlier approaches, for Butt et al. (1997), a-structures are not simply lists of arguments, but are instead AVMs. This allows for a richer internal structure: for example, complex predicates have nested a-structures (Butt et al.

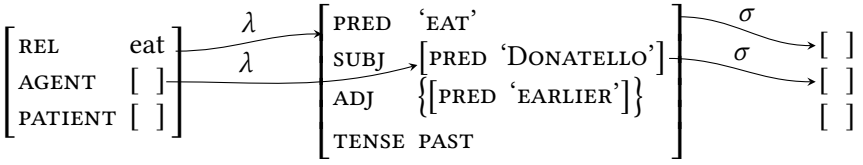
[36] Butt et al. (1997: 1) identify ϕ with $\alpha \circ \lambda$ (rather than $\lambda \circ \alpha$), but this must be an error, since α has to be applied before λ, given their architecture.

1997: 12). Each a-structure contains a REL attribute that names the semantic relation it encodes, and attributes labelled with thematic role names corresponding to argument positions. Nothing further is said about the value of these attributes, and they are represented as empty AVMs in Butt et al. (1997). These must be shorthand for more complete structures, however, since otherwise, under a standard set-theoretic interpretation of AVMs, all the "empty" AVMs would in fact be one and the same.[37]

Asudeh & Giorgolo (2012) criticise Butt et al.'s (1997) architecture and propose an alternative which has since proven influential. They do so on the basis of verbs which take optional objects, like *eat* in English:

(115) a. Donatello ate a pizza earlier.
b. Donatello ate earlier.

Although the Patient argument does not need to be expressed in the syntax, it must still be present in the a-structure, since it remains part of the core relation expressed by the verb (eating events involve something being eaten), and must also be represented at s-structure, since it is interpreted semantically: the truth of *Donatello ate* implies the truth of *Donatello ate something*. This poses a problem for the Butt et al. (1997) architecture, since there is no route through the projection architecture from the a-structure PATIENT to its corresponding s-structure without going via its f-structure representation, and it appears not to have one:

(116)


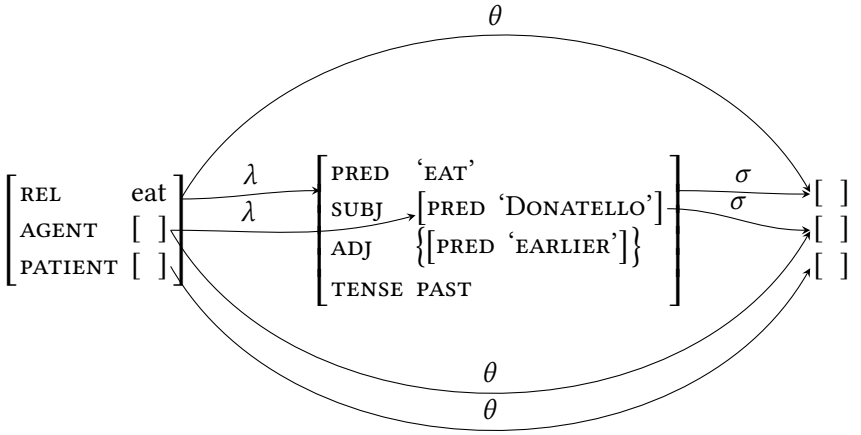
One might therefore be tempted to posit an unpronounced OBJ attribute at f-structure corresponding to the Patient, but there is empirical evidence against this (Asudeh & Giorgolo 2012: 71). For example, this putative null pronoun cannot antecede another, subsequent pronoun:

(117) a. Donatello ate a pizza, but it turned out to be Raphael's.
b. * Donatello ate, but it turned out to be Raphael's.

[37] For discussion of a similar problem, this time with regard to s-structure, see Findlay (2021: 348–353).

Given this, we are forced to propose a new function which projects directly from a-structure to s-structure (i.e. it is not simply the composition of σ and λ); Asudeh & Giorgolo (2012: 70) call this the θ projection. (118) shows this new situation.

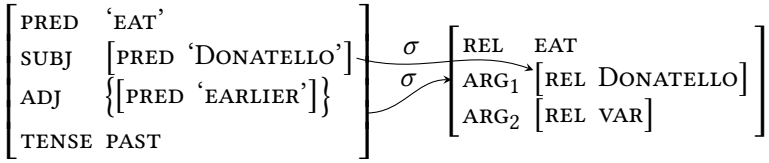
(118)



This move adds formal complexity to the grammar (a whole new projection function) and also adds indeterminacy: when an element of a-structure *is* expressed at f-structure, there are now two ways of reaching its s-structure – one via $\sigma \circ \lambda$ and one via θ directly. Even if this solves the problem of unexpressed arguments, it is a formally unhappy scenario to be forced into.

Asudeh & Giorgolo's (2012) solution is to do away with a-structure as a separate level of representation, and to replace it with a new, connected version of s-structure – that is, rather than the s-structures for the arguments being separate from the s-structure for the clause (and from each other), they are instead embedded inside it. This makes this new conception of s-structure very similar to Butt et al.'s (1997) a-structures. An example is shown in (119):

(119)



Ultimately, it is a fairly arbitrary choice whether we call this new connected structure s-structure or a-structure. Asudeh & Giorgolo (2012) call it s-structure since they continue to use it as part of the linear logic component of Glue Semantics meaning constructors, but it has a lot in common with Butt et al.'s (1997) a-structure as well, being internally structured/connected and expressing the

predicate-argument structure of the clause. What is more, later developments have sought to imbue this new structure with additional information about tense, aspect, and event structure (see e.g. Lowe 2014, Lovestrand 2018, 2020, Findlay 2021), thereby incorporating some information which is also present in Butt's (1995) "elaborated" a-structures (on which see below). For consistency with other work, however, we will continue to call these s-structures here.

The exact content of these s-structures is subject to ongoing research, but they are assumed to at least include a REL attribute identifying the semantic relation expressed (cf. Asudeh et al. 2013: 24), and potentially several numbered ARG attributes, e.g. ARG_1, ARG_2, for each of that relation's arguments. Asudeh & Giorgolo (2012) use REL only for predicates, and leave argument s-structures as "empty" AVMs, just like Butt et al. (1997). Lovestrand (2018: ch. 8.3) and Findlay (2020: 135f.), however, generalise the presence of REL to argument as well as predicate s-structures, and Findlay (2020: 144) proposes to use "var" as the REL value for unexpressed/suppressed arguments.

The numbered ARG attributes are used instead of Butt et al.'s (1997) thematic role labels in part because Asudeh & Giorgolo (2012) make use of a neo-Davidsonian meaning language (Parsons 1990) such that thematic role information is expressed directly in the semantics – i.e. instead of (120a), the meaning of *eat* is expressed by (120b) – and so it would be redundant to also encode this information in s-structure.

(120) a. $\lambda x \lambda y \lambda e.\mathbf{eat}(e, x, y)$
b. $\lambda x \lambda y \lambda e.\mathbf{eat}(e) \wedge \mathbf{agent}(e, x) \wedge \mathbf{theme}(e, y)$

This has the additional benefit of relegating thematic roles to the meaning language rather than making them part of the meta-language of the grammar itself. There they can be treated as abbreviations for whatever sets of semantic entailments we take them to encode (*à la* Dowty 1991), with whatever level of granularity is required, leaving the grammar itself free of the nebulous notion of thematic role.

The significance, or lack thereof, of the ARG labels has been the subject of disagreement, however. They were originally intended as arbitrary labels merely to achieve distinctness at s-structure, but Findlay (2016) imbues them with meaning, identifying them with the numbered arg positions of Kibort MT (see Section 5), as part of an implementation of that theory within the new architecture. This view has been adopted by others (e.g. Asudeh et al. 2014, Lowe 2016, Lovestrand 2018, 2020), but Findlay (2020) argues for a return to the *status quo ante*, where these labels have no significance in and of themselves, and shows that the same implementation of Kibort MT can be achieved while avoiding reifying the s-structure attribute names.

The title of Findlay (2016) is "Mapping theory without argument structure", but this is in many respects a mischaracterisation of the research programme inspired by Asudeh & Giorgolo's (2012) architectural proposal. Rather than doing away with argument structure, this work has served more as a rationalisation of the LFG architecture: instead of having two levels, a-structure and s-structure, the latter of which is rather informationally impoverished, we have a single level of representation which shares properties of both.[38]

As mentioned above, some researchers have imbued this new structure with additional information about lexical semantics and event structure (e.g. Lowe 2014, Lovestrand 2018). But suggestions to add this kind of information to a-structure are not new. Butt (1995) develops what she calls an ELABORATED A-STRUCTURE (Butt 1995: 133), which includes much more structure and much more semantic information than Classical LMT's minimalist a-structures. This elaborated a-structure is based on Jackendoff's (1990) LEXICAL CONCEPTUAL STRUCTURES (LCSs), but only includes the concepts relevant to linking and semantic case marking (Butt 1995: 143). An example of the elaborated a-structure for the Urdu main verb *de* 'give' is shown in (121):

(121)
$$\left[\begin{array}{l} \text{de 'give'} \\ \left[\begin{array}{l} \text{CS}([\alpha], \text{GO}_{Poss}([\ \ ], \text{TO}[\ \ ])) \\ \text{AFF}([\ \ ]^{\alpha}, \ ) \\ \text{ASP}(\_\ \_\ \_) \end{array}\right]_{E} \end{array}\right]$$

The inner box is the actual a-structure, and contains three levels. The first two are borrowed from Jackendoff's LCSs: the THEMATIC TIER and the ACTION TIER.

[38]The observant reader may be entertaining an architectural concern at this point: earlier, we motivated the Butt et al. (1997) architecture by drawing on the facts of complex predicates: a complex a-structure can correspond to a simplex (monoclausal) f-structure, and so we need the former to precede the latter in the projection architecture in order to retain the functional nature of the projection relations. However, in the new architecture, the connected s-structure which represents predicate-argument structure comes after f-structure, so we appear to be in trouble. Two solutions to this puzzle have been proposed. Lowe (2016) gives the first analysis of complex predicates in this new framework, and argues that they should be given a flat s-structure (in contrast to the articulated a-structures usually assumed), representing their complexity in the meaning language instead. This avoids any problems arising from having a flat f-structure, since it is no longer required to subsequently project a more articulated s-structure. Alternatively, Lovestrand (2020) proposes to give complex predicates articulated f-structures after all, which means a complex s-structure is also possible without losing the functional nature of σ. There are empirical shortcomings with both of these approaches, but they fare no worse than existing, alternative approaches, and serve to illustrate how the apparent monoclausality of complex predicates does not force us to assume an articulated a-structure which precedes f-structure in the projection architecture.

The former, the Thematic Tier, describes the lexical meaning of the verb in decompositional terms – here that one entity *causes* (CS) *possession* of another to *go* (GO_{Poss}) *to* a third entity (TO). The latter, the Action Tier, describes the relationship between Actor, Patient, and Beneficiary roles – in other words those roles which usually receive structural case. As Butt (1995: 137) points out, it can also be thought of as encoding an analogue of Dowty's (1991) proto-roles. Here the argument labelled α, i.e. the "giver" (the one causing the transfer of possession) is indicated to be *affecting* (AFF) something else. The second slot of the function AFF is left empty, indicating that there is no true Patient or Beneficiary here (Butt treats the recipient as a simple Goal instead of a Beneficiary). There are also subtypes of the AFF function which provide information about volitionality or conscious choice.

The final tier is the Aspect Tier. This is not borrowed from Jackendovian LCSs, but is an innovation by Butt. It represents aspectual information: specifically, whether a verb is positively or negatively specified for inception, duration, and/or completion (Butt 1995: 142). The function ASP contains three slots, one for each of these properties, and each can be specified positively, with a '1', negatively, with a '0', or left unspecified, indicated by a '_'. In (121), all three slots are empty, showing that this verb is unspecified for this aspectual information.

Clearly, this conception of argument structure is far more complex than the ordered lists used in Classical LMT, and more informationally rich than either of the structures discussed already in this section.[39] Butt argues that this complexity is motivated by its capacity to offer an elegant account of complex predicates. For one thing, the elaborated a-structures expose more lexical semantic content to the grammar, enabling appropriately fine-grained constraints to be placed on complex predicate formation (see e.g. Butt 1995: 147–155 for examples). For another, they add articulation and structure, and, as we saw in Section 4.2.4, the proper treatment of complex predicates necessitates assuming a more articulated a-structure than is standard in Classical LMT – at least one capable of recursive embedding.

On Butt's (1995) approach, the light verbs which are used in complex predicates have a-structures which themselves have argument slots for *other a-struc-*

[39]Indeed, one reviewer suggests that the level of representation proposed by Butt (1995) is not argument structure at all, but rather some kind of "event structure" or "semantic structure". To the extent that the additional information is necessary to handle argument structure phenomena like complex predicate formation, and given that these structures also do everything else we would want from an argument structure (see e.g. Butt 1995: ch. 6 on mapping), it is hard to know what to make of this complaint. Perhaps a more minimal a-structure would in fact be sufficient, but if so that is a matter to be demonstrated empirically, rather than settled by definitional fiat.

tures, labelled as TRANSPARENT EVENTS (E_T), since the light verbs that host them can "see into" their internal structure. This visibility allows different kinds of argument fusion to take place, whereby participants of the embedded event are identified with participants of the event described by the light verb (as discussed in Section 4.2.4). We omit the full details here – see Butt (1995: ch. 5) for more information. By way of illustration, the a-structure for the Urdu permissive light verb *de-* 'let' is given in (122) (Butt 1995: 156):

(122)
$$\left[\begin{array}{l}\text{de- 'let'}\\ \left[\begin{array}{l}\text{CS}([\alpha], \text{GO}_{Poss}(\{\ \}_{E_T}, \text{TO}[\ ]))\\ \text{AFF}([\ ]^{\alpha},\ )\\ \text{ASP}(\_\ \_\ \_)\end{array}\right]_{E}\end{array}\right]$$

This is very similar to the a-structure in (121), the only difference being that the first argument of GO_{Poss} has been replaced by a transparent event (indicated by the curly braces and subscript E_T). The "letting" event expressed by this light verb is viewed metaphorically as a transfer event, where the thing transferred is the permitted event. This gives some explanation to the fact that both verbs share the same form in Urdu, for example, and shows how the embedded verb contributes to the overall interpretation of the complex predicate. It also allows for the recursive construction of complex predicates which are embedded under more than one light verb.[40]

A more contemporary approach to expanding the coverage of a-structure, but without assuming the Asudeh & Giorgolo (2012) architecture, is that of Schätzle (2018: ch. 6). She assumes a richly multidimensional version of Kibort MT's a-structure, where each argument can be annotated with a variety of non-standard semantic information, such as whether it is a FIGURE or GROUND (Talmy 1978), and which kind of event participant it is in the typology of Ramchand's (2008) FIRST-PHASE SYNTAX. This, Schätzle (2018: 202) claims, enables a more "semantically realistic" account of mapping and of argument alternations, a goal shared by other recent work – see Section 6.3.

[40] Other work on complex predicates and LMT, including Butt's own later work, has tended to eschew these more complex a-structures in favour of the simpler, ordered list representations of Classical MT (e.g. Alsina 1996, 1997, Butt 2014). But this leads to enormous difficulty in appropriately formalising the process of PREDICATE FUSION: see Lowe (2016: sec. 2) for critical discussion.

6.2 Mapping as co-description

The relationship between different levels of structure, such as a-structure and f-structure, has been approached in two different ways in LFG: CO-DESCRIPTION and DESCRIPTION BY ANALYSIS (Kaplan 1995, Dalrymple et al. 2019: 267–270). In co-description, multiple levels of structure are described simultaneously – for example, LFG's annotated phrase-structure rules simultaneously describe both c-structure and f-structure. This is the most commonly used approach in LFG. The alternative, description by analysis, involves determining the description of one structure by inspecting and analysing another. This was used in early LFG proposals for semantic analysis (e.g. Halvorsen 1983). Findlay (2021: 344–345) discusses various shortcomings of the description by analysis approach: notably, it ignores the possibility of mismatches between levels, and fails to meet the desideratum of constraint-based grammars laid down by Pollard & Sag (1994: 13) that they be "process neutral": description by analysis inevitably introduces directionality into parsing, which co-description does not. Co-description therefore "most directly captures the spirit of the constraint-based approach to linguistic analysis" (Findlay 2021: 344), which may explain why it has come to dominate in LFG analyses – indeed, while description by analysis was prominent in early accounts of semantics in LFG, those approaches have since been replaced by Glue Semantics (Dalrymple, Lamping & Saraswat 1993, Dalrymple 1999, Asudeh 2022), which employs co-description.

Classical LMT, though, is very much in the spirit of description by analysis: GF assignments at f-structure are determined by inspecting a-structure, and by analysing it using the Mapping Principle(s). This state of affairs meant that LFG work on argument structure and mapping was out of sync with the theoretical mainstream, where co-description was the norm. Once again, Butt et al. (1997: 6) were the first to tackle this formal issue, treating mapping as co-description of both a- and f-structure.

For example, to say that a predicate's Agent argument is expressed as its SUBJ GF, we could include the following piece of functional description in its lexical entry (where $*$ refers to the c-structure node bearing the annotation, and $\hat{*}$ to its mother node):

(123) $(\hat{*}_{\alpha}\ \textsc{agent})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{subj})$

The expression $\hat{*}_{\alpha}$ refers to the lexical item's a-structure, via the α projection from c- to a-structure, while the expression $\hat{*}_{\alpha\lambda}$ refers to the lexical item's f-structure (the equivalent of the more familiar ↑). This constraint therefore picks out the f-structure corresponding to the a-structure AGENT, and identifies it with the verb's f-structure SUBJ.

But, of course, we generally don't want to associate an argument with only a single GF. Instead, Classical LMT associates it with a feature which describes a *pair* of GFs. Butt et al. (1997: 6) make this disjunctive meaning of the features explicit: instead of associating an argument with a feature, a disjunction of mapping equations like (123) is given, as in (124) or (125):

(124) *AGENT links to* $[-o]$*:*
$(\hat{*}_{\alpha}\ \textsc{agent})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{subj}) \vee$
$(\hat{*}_{\alpha}\ \textsc{agent})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{obl}_{\textsc{agent}})$

(125) *THEME links to* $[-r] \vee [+o]$*:*
$(\hat{*}_{\alpha}\ \textsc{theme})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{subj}) \vee$
$(\hat{*}_{\alpha}\ \textsc{theme})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{obj}) \vee$
$(\hat{*}_{\alpha}\ \textsc{theme})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \textsc{obj}_{\textsc{theme}})$

Butt et al. (1997: 6) suggest that these intrinsic specifications can be universal, like (124) for AGENTs and (125) for THEMEs, or they can be parameterised on a language-by-language basis, as is the case for other roles like LOCATION, GOAL, or INSTRUMENT.

Of course, these specifications alone do not determine the final mapping. In fact, Butt et al. (1997: 6) propose an important theoretical break from Classical LMT in this respect:

> Our approach departs most radically from the LMT literature in that we do not assume that a-structure roles are deterministically and uniquely linked to grammatical functions via a set of default principles. Instead, we propose a set of preference constraints which impose an ordering on the available linking possibilities; the most preferred possibility or possibilities are chosen.

In essence, their approach rejects the mechanistic, rule-driven approach of Classical LMT, and instead proposes that there is a hierarchy of GFs, and that those

mappings which realise more highly ranked GFs are preferred. The hierarchy they propose is as follows:[41]

(126) SUBJ > OBJ > OBL_θ, OBJ_θ

That is, SUBJ outranks OBJ, which in turn outranks OBL_θ and OBJ_θ, which have the same rank as each other. This means, for each argument, that it is preferable for it to be realised as a SUBJ, or, failing that, as an OBJ, or, lastly, as either an OBL_θ or an OBJ_θ. The argument will therefore be linked to the highest GF on this hierarchy with which it is compatible, given the disjunctive specifications provided in its intrinsic classification.[42] This gives us a much more dynamic system than in Classical LMT: there are no explicit Mapping Principles, and arguments simply compete for the highest available GFs. In a nod to Mapping Principle (a-i) of Classical LMT (see Section 4.1.2), Butt et al. (1997: 6) do include a preference for the SUBJ to be linked to the highest available argument on the thematic hierarchy, but crucially this is just a preference, and so is not inviolable.

The final mapping chosen is the one deemed "optimal" in terms of realising the highest number of the most highly ranked GFs, and in terms of satisfying any other preference constraints, such as the subject preference just mentioned (as well as not violating Function-Argument Biuniqueness or the Subject Condition). Butt et al. (1997: 7) use a numerical system to express the relative weightings of

[41]Butt et al. (1997: 7) claim that the hierarchy in (126) can be recast as a preference for negative-valued features in the classic $[\pm o/r]$ schema:

(i) a. $[-r] > [+r]$
b. $[-o] > [+o]$

But the expressions in (i), which is their (15), do not match the authors' prose description, which only applies (i-b) within the $[-r]$ GFs. If we simply take (i) as expressing two independent preference rankings, we get the Markedness Hierarchy of Classical LMT (see Section 4.1.1):

(ii) SUBJ > OBJ, OBL_θ > OBJ_θ

Alternatively, if we see (i-a) as taking precedence over (i-b), then we obtain another ranking, this time a total ordering:

(iii) SUBJ > OBJ > OBL_θ > OBJ_θ

It is of course an empirical matter which of these rankings (if any) is correct.

[42]Just like Kibort MT's Mapping Principle (see Section 5), this reverses the Classical LMT mapping principle where GFs *lower* down the hierarchy are preferred. This means that Butt et al.'s (1997) proposal shares the weakness of Kibort MT that it makes the wrong prediction about the passives of ditransitives – see Section 4.1.3.

different GFs and of other constraints, but this is not a crucial component of the theory, and any appropriate means of ranking different solutions in terms of a set of preferences could be used – for example, the authors speculate (p. 7) that the proposal could be reformulated in terms of Optimality Theory (Prince & Smolensky 1993, 2004, *et seq.*).

By way of illustration, consider a simple transitive like *kick* again. For every argument, the most preferred GF is SUBJ. But is each compatible with SUBJ? According to the disjunctions in (124) and (125), assuming that the intrinsic classification for Theme also applies to Patients, SUBJ is a possible realisation of both arguments. But we cannot map both to SUBJ, or we fall foul of Function-Argument Biuniqueness, so we must decide which one to map to SUBJ, and which to map to the next most highly ranked compatible GF. Since, following the thematic hierarchy, the Agent argument of *kick* outranks its Patient argument, the subject preference will be satisfied if we map the Agent to SUBJ but not if we map the Patient to SUBJ, so the former mapping is preferred; the next highest GF compatible with the Patient intrinsic specification is OBJ, and so we end up with the correct outcome whereby the Agent is linked to SUBJ and the Patient to OBJ.

The theoretically most interesting consequence of the Butt et al. (1997) approach to mapping is that certain constructions may have more than one optimal linking. Butt et al. (1997: 8ff.) argue that this in fact characterises alternations which are motivated by semantic/pragmatic constraints (such as the dative shift) and not by morphosyntactic ones (such as the passive).[43] This offers a more natural account of the dative shift alternation than the Classical LMT analysis, which requires two different initial assignments of features to the arguments. In the Butt et al. (1997) framework, both realisations of the dative shift alternation in English are made available automatically, since they have equivalent preference rankings:

(127) [Garak] gave [the datarod] [to Sisko].
SUBJ OBJ OBL_{GOAL}

(128) [Garak] gave [Sisko] [the datarod].
SUBJ OBJ $\text{OBJ}_{\text{THEME}}$

[43] However, their distinction does not seem to perfectly match that between meaning-preserving (morphosyntactic) and meaning-altering (morphosemantic) alternations, since they consider the locative inversion to be grouped with the dative shift (as being explained by the presence of more than one optimal linking) and distinct from the passive, when the locative inversion is no more meaning altering than the passive (neither alternation affects truth-conditional semantics, but only alters the information structural prominence of its arguments).

Both involve a SUBJ (linked to the highest argument) and an OBJ, and since OBJ_θ and OBL_θ are equally ranked, the different realisations of the third argument make no odds when it comes to the relative weightings of the two mappings. Therefore both mappings are made available by the grammar, and the choice between them must be determined by other factors, such as lexical preference (the shifted variant is impossible with verbs of Latinate origin, for example) or semantic/pragmatic considerations (see Bresnan 2007 and Bresnan et al. 2007 for usage-based/probabilistic accounts of the alternation, and Goldberg 1995: ch. 6 on the special meanings associated with the double object construction in English).

Work which assumes the Asudeh & Giorgolo (2012) architecture also makes use of co-description to express mapping possibilities, although here the directionality is changed: we are mapping from f-structure to s-structure, rather than from a-structure to f-structure. The equivalent of (123), assuming ARG_1 corresponds to the Agent (see Section 6.3), is (129):

(129) $(\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma \text{ARG}_1)$

As in Butt et al. (1997), feature decomposition is replaced by explicit disjunctions over GFs. Findlay (2016: 299) uses abbreviations to describe the (supposedly) natural classes captured by the traditional features:

(130) a. $\text{MINUSO} \equiv \{\text{SUBJ}|\text{OBL}_\theta\}$
b. $\text{PLUSO} \equiv \{\text{OBJ}|\text{OBJ}_\theta\}$
c. $\text{MINUSR} \equiv \{\text{SUBJ}|\text{OBJ}\}$
d. $\text{PLUSR} \equiv \{\text{OBL}_\theta|\text{OBJ}_\theta\}$

This gives us (131) as the equivalent of (124):

(131) $(\uparrow \text{MINUSO})_\sigma = (\uparrow_\sigma \text{ARG}_1)$

In fact, since arguments may not be realised by any GF – for example, the Agent argument of a short passive – we also need a description which says that the argument in question does not correspond to any GF at f-structure. We achieve this by stating that the inverse of the σ mapping from f- to s-structure is empty when applied to that argument, as in (132):

(132) $(\uparrow_\sigma \text{ARG}_1)_{\sigma^{-1}} = \emptyset$

This says that the s-structure ARG_1 has no f-structure correspondent, i.e. that this argument is not realised syntactically.

Findlay (2016: 319, 321) proposes to use templates to abbreviate these mapping equations and make them more readable:[44]

(133) $\textsc{Map}(\mathrm{D}, \mathrm{A}) \equiv (\uparrow \mathrm{D})_{\sigma} = (\uparrow_{\sigma} \mathrm{A})$

(134) $\textsc{NoMap}(\mathrm{A}) \equiv (\uparrow_{\sigma} \mathrm{A})_{\sigma^{-1}} = \emptyset$

The first of these, (133), says that the GF or disjunction of GFs D is mapped to the s-structure argument A, while (134) says that the s-structure argument A has no GF correspondent at f-structure.[45] These templates can then be combined, so that e.g. the correct expression to capture the mapping possibilities of an Agent assigned to $\textsc{arg}_1$ is the following:

(135) $\{@\textsc{Map}(\textsc{minuso}, \textsc{arg}_1) \mid @\textsc{NoMap}(\textsc{arg}_1)\}$

That is, either this argument is mapped to one of the two MINUSO GFs (SUBJ or $\textsc{obl}_{\theta}$), or it is not expressed syntactically at all.

Using disjunctions over GFs like MINUSO or PLUSR instead of assuming features like $[-o]$ and $[+r]$ sidesteps any formal issues arising from seeing GFs as decomposable into features (as discussed in Section 4.1.1), and simply represents the most significant empirical claim of the feature-based approach – that GFs can be grouped into natural classes (whether the $[\pm o/r]$ classification is the correct way of grouping them is orthogonal). It has been objected that this use of disjunctions makes the approach somehow more arbitrary or less well motivated than earlier incarnations of LMT, since we could just as easily have written a different set of disjunctions in (130). Such an objection is misplaced for two important reasons. Firstly, it purports to contrast the arbitrariness of the disjunctive approach with the theoretical motivation of the feature-decomposition approach. But this is only true to the extent that the features used in the latter have independent motivations. While a case could be made for $[\pm r]$ on these grounds (one could imagine an independent criterion for determining semantic restrictedness), as we mentioned in Section 4.1.1, this seems not to be the case for $[\pm o]$, which has no content other than identifying the two object functions OBJ and $\textsc{obj}_{\theta}$, and whose definition is therefore circular. Given this situation, we take the use of the explicitly "arbitrary" mechanism of disjunction to in fact be an advantage

[44] On templates, see Dalrymple et al. (2004), Crouch et al. (2011), Asudeh et al. (2013) and Belyaev (2023a: §5.1 [this volume]).

[45] One problem with the NOMAP template is that in the event an argument is not expressed syntactically, nothing will ensure its presence at s-structure. Findlay (2020: 135–136) argues therefore that existential constraints must accompany the introduction of each argument.

over the classical approach, since it wears its arbitrariness on its sleeve rather than concealing it behind a veneer of theoretical motivation.

Secondly, and much more significantly, such an objection misses the crucial distinction between formalism and theory. The formalism *itself* need not be expected to say anything about what natural groupings of GFs occur in the world's languages. Rather, the formalism gives us tools for making explicit claims about such things – and it is those claims which constitute the theory. As Pollard (1997: 9) puts it, "it is the theory that imposes the constraints, not the language in which the theory is expressed". So, although we could've written different disjunctions in (130), it is precisely in writing one set of expressions rather than another that we make a theoretical claim. This claim may turn out to be true or false, but if it is false, we would prefer to be able to use the same familiar tools to express a different, revised hypothesis, rather than have to throw away our tools entirely because they have been over-engineered to fit one particular view of reality. Once again, therefore, we see this property as being an advantage of the disjunctive approach. As an example, consider the objection by Alsina (1996: 29, fn. 9), noted in Section 4.1.1, that the traditional $[\pm o/r]$ features cannot be used to describe the natural class of terms, or direct GFs, i.e. SUBJ, OBJ, and OBJ_θ. He instead proposes a different classification using the features [±subj/obl], where [−obl] describes the terms (Alsina 1996: 27–30). In the traditional view, this approach and the Classical LMT approach are simply incommensurable: they represent two different formalisms which contain different primitive elements. But in the view we are considering, both can be expresed in the *same* terms – compare (130) and (136) – thereby highlighting their status as competing theoretical claims rather than totally distinct formal approaches.

(136) a. $\text{MINUSSUBJ} \equiv \{\text{OBJ}|\text{OBJ}_\theta|\text{OBL}_\theta\}$
b. $\text{PLUSSUBJ} \equiv \text{SUBJ}$
c. $\text{MINUSOBL} \equiv \{\text{SUBJ}|\text{OBJ}|\text{OBJ}_\theta\}$
d. $\text{PLUSOBL} \equiv \text{OBL}_\theta$

It is an empirical matter which of these analyses is correct, and we should not generally expect the formalism to adjudicate on empirical matters. Rather, the theory which we develop in using that formalism is what we expect to align with the facts.

6.3 Connection to semantics

While the most influential research in Classical LMT was being conducted, there was no canonical theory of the syntax-semantics interface in LFG to appeal to. With the acceptance of Glue Semantics (Glue) into the LFG mainstream around the turn of the millennium, this changed.[46] One of the most important goals of recent work on mapping theory has therefore been to integrate the theory into a Glue-based analysis of the syntax-semantics interface. In particular, this strand of research assumes that Glue's concept of resource sensitivity (Asudeh 2012: ch. 5) subsumes the traditional LFG principles of Completeness and Coherence, so that pred features at f-structure no longer contain an argument list. That is, instead of (137a), we have (137b):[47]

(137) a. $\left[\text{PRED } \text{`EAT}\langle\text{SUBJ, OBJ}\rangle\text{'}\right]$
b. $\left[\text{PRED } \text{`EAT'}\right]$

This creates greater flexibility when it comes to argument realisation, since one and the same pred value can correspond to different syntactic realisations of its arguments. In the previous conception, each argument array required a separate pred value (and therefore a separate lexical entry), since pred values cannot be manipulated in the syntax (cf. the principle of Direct Syntactic Encoding introduced in Section 3, and discussed further in Kaplan & Bresnan 1982, Bresnan et al. 2016: sec. 5.2, and Dalrymple et al. 2019: 329).

[46] Although Glue first appeared in the early '90s (Dalrymple, Lamping & Saraswat 1993), it was still not well established in the LFG community by the time much of the the work discussed in the earlier sections of this chapter was carried out. The first major collection of Glue work connected to LFG was Dalrymple (1999), and the theory later appeared in Dalrymple's (2001) handbook-style presentation of LFG, as well as the latest reference guide to LFG, Dalrymple et al. (2019: ch, 8.5). We cannot include an introduction to Glue Semantics in this chapter for reasons of space, but see the references just cited, along with Asudeh (2022) and Asudeh (2023) [this volume] for further information.

[47] The idea of using linear logic's resource sensitivity to account for Completeness and Coherence goes back to the very first Glue paper (Dalrymple, Lamping & Saraswat 1993), and was noted again by Dalrymple et al. (1999), Kuhn (2001), and Asudeh (2012: 112ff.), though it didn't find its way into more mainstream LFG work until the research programme initiated by Asudeh & Giorgolo (2012).

One oft-noted (potential) problem with viewing Completeness and Coherence as reducible to semantic resource sensitivity is expletive arguments, i.e. syntactic arguments which do not correspond to semantic ones. Since, by hypothesis, they make no semantic contribution, they will not be required by constraints of semantic resource sensitivity, even though they *are* required for grammaticality. As Asudeh (2012: 113) points out, however, this is far from an insurmountable problem, and there are a number of potential solutions (including rejecting the idea that expletive arguments are semantically empty in the first place – see Bolinger 1977).

A typical lexical entry in this strand of work is given in (138):

(138) *kick* V $(\uparrow \textsc{pred}) = \text{`kick'}$
$(\uparrow_\sigma \textsc{rel}) = \text{kick}$

$\{@\textsc{Map}(\textsc{minuso}, \textsc{arg}_1) \mid @\textsc{NoMap}(\textsc{arg}_1)\}$
$\{@\textsc{Map}(\textsc{minusr}, \textsc{arg}_2) \mid @\textsc{NoMap}(\textsc{arg}_2)\}$

$\lambda x \lambda y \lambda e.\mathbf{kick}(e) \wedge \mathbf{agent}(e, x) \wedge \mathbf{patient}(e, y)$:
$(\uparrow_\sigma \textsc{arg}_1) \multimap (\uparrow_\sigma \textsc{arg}_2) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

The first two lines provide the PRED value along with a value for REL at s-structure.[48] The next two lines provide the mapping information, using the technique explained in the previous section: either the arguments map to one of a pair of GFs, or they are not realised syntactically. This corresponds to argument-function mapping in Kibort MT (see Section 5). The crucial advantage of incorporating a theory of the syntax-semantics interface is that we can also express the equivalent of Kibort MT's argument-participant mapping, via the meaning constructor in the final line. Here the variable x is identified as the Agent of the kicking event, and connected via the linear logic term to $\textsc{arg}_1$ at s-structure; similarly, y is identified as the Patient, and connected to $\textsc{arg}_2$. That is, the link between GFs and semantic participants, a key part of any mapping theory, is mediated by the intervening level of s-structure, here playing the same role as Kibort MT's lexical valency frame. And just like in Kibort MT, this setup allows for the realignment of participants to argument positions – see Findlay (2016: 328–332) for an example of this with the English benefactive.

By bringing together information about mapping and about semantics, which are just the same kind of object in this approach, *viz.* pieces of functional description, it becomes far easier to express semantic constraints on, and semantic consequences of, argument alternations and other argument structure operations (cf. also the discussion of Butt's 1995 enhanced a-structures above). Asudeh (2021: 32–39) shows the potential of this approach in his analysis of the English "non-agentive dynamic intransitive", and contrasts it with what he calls the "low resolution" of Classical LMT, which only has access to very spartan semantic information (usually just the thematic roles of arguments).

[48]The current status of PRED and REL in LFG is not settled: many if not all of the important functions of PRED have been taken over by Glue Semantics (Andrews 2008), and REL really has no substantive role in the theory (Lovestrand 2018: 169ff. although see Lowe 2014). They also seem to both express the same information in (138), which adds a degree of redundancy to the grammar. Nevertheless, they at least serve to help distinguish different f- and s-structures, as well as making the representations more readable.

One promising area of research made possible by this "joined up" approach to mapping is the idea of incrementally bundling up semantic and mapping information into more and more complex valency templates (as employed in e.g. Asudeh & Giorgolo 2012, Asudeh et al. 2014, Findlay 2020), which, coupled with the notion of an inclusion hierarchy between templates (see especially Asudeh et al. 2013: 17–20), could lead to a mapping theory based purely on a richly structured and hierarchical lexicon, along the lines of Davis & Koenig (2000). This potential has yet to be fully explored, though Przepiórkowski (2017) has pointed the way.

7 Conclusion

New approaches to argument structure and mapping theory phenomena were at the heart of what gave rise to LFG as a separate approach to linguistic theory in the first place: Bresnan's (1980, 1982) observations about the lexical character of argument alternations and the benefits afforded by separating out lexical predicate-argument structures from surface syntactic structures were what laid the foundations for LFG's lexicalist, modular view of the grammar. The advent of Lexical Mapping Theory (LMT) helped to constrain the theory of argument alternations, and also offered new explanatory tools which proved successful in characterising a number of linguistic phenomena across a fairly typologically diverse range of languages. Recent developments in both theory and formalism show that the field is ripe for a renaissance, and that while great strides have been made, many important questions still remain unanswered. This chapter has attempted to give a broad and expository overview of the status quo, along with a little of how we got here, with the hope that by drawing together different theoretical perspectives we can both encourage dialogue among experienced researchers, and bring new scholars up to speed, so that both can be in the best position to contribute to a field which remains full of untapped potential.

Acknowledgements

We would like to thank in the strongest possible terms the four anonymous reviewers whose extremely detailed comments have vastly improved the quality of this chapter. Jamie Findlay also gratefully acknowledges the financial support of Research Council of Norway grant number 300495, "Universal Natural Language Understanding".

References

Ackerman, Farrell. 1991. Locative alternation vs. locative inversion. In Aaron Halpern (ed.), *Proceedings of the 9th West Coast Conference on Formal Linguistics*, 1–13. Stanford: CSLI Publications.

Ackerman, Farrell. 1992. Complex predicates and morpholexical relatedness: Locative alternation in Hungarian. In Ivan A. Sag & Anna Szabolcsi (eds.), *Lexical matters* (CSLI Lecture Notes), 55–83. Stanford: CSLI Publications.

Ackerman, Farrell & John Moore. 2001. *Proto-properties and grammatical encoding*. Stanford: CSLI Publications.

Ackerman, Farrell & John Moore. 2013. Proto-properties in a comprehensive theory of argument realization. In Tracy Holloway King & Valeria de Paiva (eds.), *From quirky case to representing space: Papers in honor of Annie Zaenen*, 9–20. Stanford: CSLI Publications.

Alsina, Alex. 1992. On the argument structure of causatives. *Linguistic Inquiry* 23. 517–555.

Alsina, Alex. 1996. *The role of argument structure in grammar: Evidence from Romance* (CSLI Lecture Notes). Stanford: CSLI Publications.

Alsina, Alex. 1997. Causatives in Bantu and Romance. In Alex Alsina, Joan Bresnan & Peter Sells (eds.), *Complex predicates*, 203–246. Stanford: CSLI Publications.

Alsina, Alex. 1999. Where's the mirror principle? *The Linguistic Review* 16. 1–42. DOI: 10.1515/tlir.1999.16.1.1.

Alsina, Alex. 2001. On the nonsemantic nature of argument structure. *Language Sciences* 23(4–5). 355–389. DOI: 10.1016/s0388-0001(00)00030-9.

Alsina, Alex & Sam A. Mchombo. 1990. The syntax of applicatives in Chichewa: Problems for a theta theoretic asymmetry. *Natural Language & Linguistic Theory* 8(4). 493–506. DOI: 10.1007/bf00133691.

Alsina, Alex & Sam A. Mchombo. 1993. Object asymmetries and the Chichewa applicative construction. In Sam A. Mchombo (ed.), *Theoretical aspects of Bantu grammar 1*, 17–45. Stanford: CSLI Publications.

Alsina, Alex, K. P. Mohanan & Tara Mohanan. 2005. How to get rid of the COMP. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '05 conference*, 21–41. Stanford: CSLI Publications.

Andrews, Avery D. 2007. Projections and glue for clause-union complex predicates. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '07 conference*, 44–65. Stanford: CSLI Publications.

Andrews, Avery D. 2008. The role of PRED in LFG+Glue. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '08 conference*, 46–67. Stanford: CSLI Publications.

Andrews, Avery D. & Christopher D. Manning. 1999. *Complex predicates and information spreading in LFG*. Stanford: CSLI Publications.

Asudeh, Ash. 2001. Linking, optionality, and ambiguity in Marathi. In Peter Sells (ed.), *Formal and empirical issues in Optimality Theoretic Syntax*, 257–312. Stanford: CSLI Publications.

Asudeh, Ash. 2012. *The logic of pronominal resumption* (Oxford Studies in Theoretical Linguistics). Oxford: Oxford University Press. DOI: 10.1093/acprof:oso/9780199206421.001.0001.

Asudeh, Ash. 2021. The unrealized and the unheard. In I Wayan Arka, Ash Asudeh & Tracy Holloway King (eds.), *Modular design of grammar: Linguistics on the edge*, 22–44. Oxford: Oxford University Press. DOI: 10.1093/oso/9780192844842.003.0003.

Asudeh, Ash. 2022. Glue semantics. *Annual Review of Linguistics* 8. 321–341. DOI: 10.1146/annurev-linguistics-032521-053835.

Asudeh, Ash. 2023. Glue semantics. In Mary Dalrymple (ed.), *Handbook of Lexical Functional Grammar*, 651–697. Berlin: Language Science Press. DOI: 10.5281/zenodo.10185964.

Asudeh, Ash, Mary Dalrymple & Ida Toivonen. 2013. Constructions with Lexical Integrity. *Journal of Language Modelling* 1(1). 1–54. DOI: 10.15398/jlm.v1i1.56.

Asudeh, Ash & Gianluca Giorgolo. 2012. Flexible composition for optional and derived arguments. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '12 conference*, 64–84. Stanford: CSLI Publications.

Asudeh, Ash, Gianluca Giorgolo & Ida Toivonen. 2014. Meaning and valency. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '14 conference*, 68–88. Stanford: CSLI Publications.

Asudeh, Ash & Siavash Rafiee Rad. 2023. Persian perception verbs. In Miriam Butt, Jamie Y. Findlay & Ida Toivonen (eds.), *Proceedings of the LFG '23 conference*. Konstanz: PubliKon.

Baker, Mark C. 1988. *Incorporation: A theory of grammatical function changing*. Chicago: University of Chicago Press.

Baker, Mark C. 2006 [1983]. Objects, themes and lexical rules in Italian. In Miriam Butt & Tracy Holloway King (eds.), *Lexical semantics in LFG*, 11–57. Stanford: CSLI Publications. Originally published as Levin, Rappaport & Zaenen (1983: 1–45).

Belyaev, Oleg. 2023a. Core concepts of LFG. In Mary Dalrymple (ed.), *Handbook of Lexical Functional Grammar*, 23–96. Berlin: Language Science Press. DOI: 10.5281/zenodo.10185936.

Belyaev, Oleg. 2023b. Grammatical functions in LFG. In Mary Dalrymple (ed.), *Handbook of Lexical Functional Grammar*, 97–161. Berlin: Language Science Press. DOI: 10.5281/zenodo.10185938.

Berman, Judith. 2007. Functional identification of complement clauses in German and the specification of COMP. In Annie Zaenen, Jane Simpson, Tracy Holloway King, Jane Grimshaw, Joan Maling & Chris Manning (eds.), *Architectures, rules, and preferences: Variations on themes by Joan W. Bresnan*, 69–83. Stanford: CSLI Publications.

Bögel, Tina, Miriam Butt, Annette Hautli & Sebastian Sulger. 2009. Urdu and the modular architecture of ParGram. In *Proceedings of the Conference on Language and Technology 2009 (CLT09)*, 1–7. Lahore: Center for Research in Urdu Language Processing (CRULP).

Bolinger, Dwight. 1977. *Meaning and form*. London: Longman.

Börjars, Kersti & John J. Lowe. 2023. Noun phrases in LFG. In Mary Dalrymple (ed.), *Handbook of Lexical Functional Grammar*, 523–561. Berlin: Language Science Press. DOI: 10.5281/zenodo.10185958.

Börjars, Kersti, Rachel Nordlinger & Louisa Sadler. 2019. *Lexical-Functional Grammar: An introduction*. Cambridge, UK: Cambridge University Press. DOI: 10.1017/9781316756584.

Bresnan, Joan. 1978. A realistic transformational grammar. In Morris Halle, Joan Bresnan & George A. Miller (eds.), *Linguistic theory and psychological reality*, 1–59. Cambridge, MA: The MIT Press.

Bresnan, Joan. 1980. Polyadicity: Part I of a theory of lexical rules and representations. In Teun Hoekstra, Harry van der Hulst & Michael Moortgat (eds.), *Lexical grammar*, 97–121. Dordrecht: Foris Publications.

Bresnan, Joan. 1982. The passive in lexical theory. In Joan Bresnan (ed.), *The mental representation of grammatical relations*, 3–86. Cambridge, MA: The MIT Press.

Bresnan, Joan. 1990. Monotonicity and the theory of relation-changes in LFG. *Language Research* 26(4). 637–652.

Bresnan, Joan. 1994. Locative inversion and the architecture of Universal Grammar. *Language* 70(1). 72–131. DOI: 10.2307/416741.

Bresnan, Joan. 2001. *Lexical-Functional Syntax*. Oxford: Blackwell.

Bresnan, Joan. 2003. Lexical syntax 25 years later: A retrospective and prospective look at the dative alternation in LFG. Handout of paper given at the LFG03

conference, University at Albany, State University of New York. https://web.stanford.edu/~bresnan/slides-lfg03.pdf.

Bresnan, Joan. 2007. Is syntactic knowledge probabilistic? Experiments with the English dative alternation. In Sam Featherston & Wolfgang Sternefeld (eds.), *Roots: Linguistics in search of its evidential base* (Studies in Generative Grammar), 77–96. Berlin: Mouton de Gruyter.

Bresnan, Joan, Ash Asudeh, Ida Toivonen & Stephen Wechsler. 2016. *Lexical-Functional Syntax*. 2nd edn. (Blackwell Textbooks in Linguistics 16). Malden, MA: Wiley-Blackwell.

Bresnan, Joan, Anna Cueni, Tatiana Nikitina & R. Harald Baayen. 2007. Predicting the dative alternation. In Gerlof Bouma, Irene Krämer & Joost Zwarts (eds.), *Cognitive foundations of interpretation*, 69–94. KNAW.

Bresnan, Joan & Jonni M. Kanerva. 1989. Locative inversion in Chichewa: A case study of factorization in grammar. *Linguistic Inquiry* 20(1). 1–50.

Bresnan, Joan & Lioba Moshi. 1990. Object asymmetries in comparative Bantu syntax. *Linguistic Inquiry* 21. 147–186.

Bresnan, Joan & Annie Zaenen. 1990. Deep unaccusativity in LFG. In Katazyna Dziwirek, Patrick Farrell & Errapel Mejías-Bikandi (eds.), *Grammatical relations: A cross-theoretical perspective*, 45–57. Stanford: CSLI Publications.

Butt, Miriam. 1995. *The structure of complex predicates in Urdu* (Dissertations in Linguistics). Stanford: CSLI Publications.

Butt, Miriam. 2006. *Theories of case*. Cambridge, UK: Cambridge University Press. DOI: 10.1017/cbo9781139164696.

Butt, Miriam. 2014. Control vs. complex predication: Identifying non-finite complements. *Natural Language & Linguistic Theory* 32. 165–190. DOI: 10.1007/s11049-013-9217-5.

Butt, Miriam, Tina Bögel, Annette Hautli, Sebastian Sulger & Tafseer Ahmed. 2012. Identifying Urdu complex predication via bigram extraction. In *Proceedings of the 24th international conference on computational linguistics (coling 12)*, 409–424. Mumbai, India: The COLING 2012 Organizing Committee. https://aclanthology.org/C12-1026.

Butt, Miriam, Mary Dalrymple & Anette Frank. 1997. An architecture for linking theory in LFG. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '97 conference*, 1–16. Stanford: CSLI Publications.

Butt, Miriam & Tracy Holloway King. 2007. Urdu in a parallel grammar development environment. *Language Resources and Evaluation* 41(2). Special Issue on Asian Language Processing: State of the Art Resources and Processing, 191–207. DOI: 10.1007/s10579-007-9042-8.

Butt, Miriam, Tracy Holloway King & John T. III Maxwell. 2003. Complex predication via restriction. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '03 conference*, 92–104. Stanford: CSLI Publications. http://cslipublications.stanford.edu/LFG/8/pdfs/lfg03buttetal.pdf.

Butt, Miriam, Tracy Holloway King & Gillian Ramchand. 2010. Complex predication: Who made the child pinch the elephant? In Linda Ann Uyechi & Lian-Hee Wee (eds.), *Reality exploration and discovery: Pattern interaction in language and life*, 231–256. Stanford: CSLI Publications.

Chisarik, Erika & John R. Payne. 2001. Modelling possessor constructions in LFG: English and Hungarian. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '01 conference*, 33–46. Stanford: CSLI Publications.

Chisarik, Erika & John R. Payne. 2003. Modelling possessor constructions in LFG: English and Hungarian. In Miriam Butt & Tracy Holloway King (eds.), *Nominals: Inside and out*, 181–199. Stanford: CSLI Publications.

Clark, Eve V. 1987. The principle of contrast: A constraint on language acquisition. In Brian MacWhinney (ed.), *Mechanisms of language acquisitions*, 1–33. Lawrence Erlbaum Associates.

Comrie, Bernard. 1974. Causatives and Universal Grammar. *Transactions of the Philological Society* 73(1). 1–32. DOI: 10.1111/j.1467-968X.1974.tb01155.x.

Comrie, Bernard. 1993. Argument structure. In Joachim Jacobs, Arnim von Stechow, Wolfgang Sternefeld & Theo Vennemann (eds.), *Syntax: An international handbook of contemporary research*, vol. 1, 903–914. Berlin: Walter de Gruyter.

Crouch, Richard, Mary Dalrymple, Ronald M. Kaplan, Tracy Holloway King, John T. III Maxwell & Paula S. Newman. 2011. *XLE Documentation*. Xerox Palo Alto Research Center. Palo Alto, CA. https://ling.sprachwiss.uni-konstanz.de/pages/xle/doc/xle_toc.html.

Cruse, D. Alan. 1986. *Lexical semantics*. Cambridge University Press.

Dalrymple, Mary. 1993. *The syntax of anaphoric binding*. Stanford: CSLI Publications.

Dalrymple, Mary (ed.). 1999. *Semantics and syntax in Lexical Functional Grammar: The resource logic approach* (Language, Speech, and Communication). Cambridge, MA: The MIT Press. DOI: 10.7551/mitpress/6169.001.0001.

Dalrymple, Mary. 2001. *Lexical Functional Grammar* (Syntax and Semantics 34). New York: Academic Press. DOI: 10.1163/9781849500104.

Dalrymple, Mary, Angie Hinrichs, John Lamping & Vijay Saraswat. 1993. The resource logic of complex predicate interpretation. In *Proceedings of ROCLING 1993*, 3–21. http://www.aclclp.org.tw/rocling/1993/K01.pdf.

Dalrymple, Mary, Ronald M. Kaplan & Tracy Holloway King. 2004. Linguistic generalizations over descriptions. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '04 conference*, 199–208. Stanford: CSLI Publications.

Dalrymple, Mary, Ronald M. Kaplan, John T. III Maxwell & Annie Zaenen (eds.). 1995. *Formal issues in Lexical-Functional Grammar*. Stanford: CSLI Publications.

Dalrymple, Mary, John Lamping, Fernando Pereira & Vijay Saraswat. 1999. Overview and introduction. In Mary Dalrymple (ed.), *Semantics and syntax in Lexical Functional Grammar: The resource logic approach*. Cambridge, MA: The MIT Press.

Dalrymple, Mary, John Lamping & Vijay Saraswat. 1993. LFG semantics via constraints. In *Proceedings of the 6th conference of the European chapter of the ACL (EACL 1993)*, 97–105. Association for Computational Linguistics. DOI: 10.3115/976744.976757.

Dalrymple, Mary & Helge Lødrup. 2000. The grammatical functions of complement clauses. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '00 conference*, 104–121. Stanford: CSLI Publications.

Dalrymple, Mary, John J. Lowe & Louise Mycock. 2019. *The Oxford reference guide to Lexical Functional Grammar*. Oxford: Oxford University Press. DOI: 10.1093/oso/9780198733300.001.0001.

Davis, Anthony R. 2011. Thematic roles. In Claudia Maienborn, Klaus von Heusinger & Paul Portner (eds.), *Semantics: An international handbook of natural language meaning*, vol. 1, 399–420. Berlin: De Gruyter Mouton.

Davis, Anthony R. & Jean-Pierre Koenig. 2000. Linking as constraints on word classes in a hierarchical lexicon. *Language* 6(1). 59–91. DOI: 10.1353/lan.2000.0068.

Davis, Anthony R. & Jean-Pierre Koenig. 2021. The nature and role of the lexicon in HPSG. In Stefan Müller, Anne Abeillé, Robert D. Borsley & Jean-Pierre Koenig (eds.), *Head-Driven Phrase Structure Grammar: The handbook* (Empirically Oriented Theoretical Morphology and Syntax), 125–176. Berlin: Language Science Press. DOI: 10.5281/zenodo.5599824.

Dowty, David R. 1991. Thematic proto-roles and argument selection. *Language* 67. 547–619. DOI: 10.2307/415037.

Dryer, Matthew S. 1986. Primary objects, secondary objects, and antidative. *Language* 62(4). 808–845. DOI: 10.2307/415173.

Eckert, Penelope. 2018. *Meaning and linguistic variation: The third wave in sociolinguistics*. Cambridge University Press. DOI: 10.1017/9781316403242.

Falk, Yehuda N. 2001a. Constituent structure and grammatical functions in the Hebrew action nominal. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '01 conference*, 83–103. Stanford: CSLI Publications.

Falk, Yehuda N. 2001b. *Lexical-Functional Grammar: An introduction to parallel constraint-based syntax*. Stanford: CSLI Publications.

Fillmore, Charles J. 1968. The case for case. In Emmon W. Bach & Robert T. Harms (eds.), *Universals in linguistic theory*, 1–88. New York: Holt, Rinehart & Winston.

Fillmore, Charles J. 1970. The grammar of hitting and breaking. In Roderick A. Jacobs & Peter S. Rosenbaum (eds.), *Readings in English transformational grammar*, 120–133. Waltham, MA: Ginn.

Findlay, Jamie Y. 2016. Mapping theory without argument structure. *Journal of Language Modelling* 4(2). 293–338. DOI: 10.15398/jlm.v4i2.171.

Findlay, Jamie Y. 2020. Mapping Theory and the anatomy of a verbal lexical entry. In Miriam Butt & Ida Toivonen (eds.), *Proceedings of the LFG '20 conference*, 127–147. Stanford: CSLI Publications.

Findlay, Jamie Y. 2021. Meaning in LFG. In I Wayan Arka, Ash Asudeh & Tracy Holloway King (eds.), *Modular design of grammar: Linguistics on the edge*, 340–374. Oxford: Oxford University Press. DOI: 10.1093/oso/9780192844842.003.0020.

Forst, Martin. 2006. COMP in (parallel) grammar writing. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '06 conference*, 222–239. Stanford: CSLI Publications.

Gary, Judith Olmsted & Edward L. Keenan. 1977. On collapsing grammatical relations in universal grammar. In Peter Cole & Jerrold M. Sadock (eds.), *Grammatical relations* (Syntax and Semantics 8), 83–120. New York: Academic Press.

Gawron, Jean Mark. 1983. *Lexical representations and the semantics of complementation*. University of California, Berkeley. (Doctoral dissertation).

Goldberg, Adele E. 1995. *Constructions: A Construction Grammar approach to argument structure*. Chicago: University of Chicago Press.

Goldberg, Adele E. 2019. *Explain me this: Creativity, competition, and the partial productivity of constructions*. Princeton: Princeton University Press.

Grimshaw, Jane. 1988. Adjuncts and argument structure. *Occasional Paper* 36.

Grimshaw, Jane. 1990. *Argument structure*. Cambridge, MA: The MIT Press.

Halvorsen, Per-Kristian. 1983. Semantics for Lexical-Functional Grammar. *Linguistic Inquiry* 14. 567–615.

Harley, Heidi. 2011. A Minimalist approach to argument structure. In Cedric Boeckx (ed.), *The Oxford handbook of linguistic Minimalism*, 427–448. Oxford: Oxford University Press. DOI: 10.1093/oxfordhb/9780199549368.013.0019.

Hemmings, Charlotte. 2012. *Causatives and applicatives: The case of polysemy in Javanese*. London: School of Oriental & African Studies. (M.Sc. thesis).

Her, One-Soon. 2003. Chinese inversion constructions within a simplified LMT. *Journal of Chinese Linguistics Monograph Series* (19). 1–31.

Her, One-Soon. 2013. Lexical mapping theory revisited. In Tracy Holloway King & Valeria de Paiva (eds.), *From quirky case to representing space: Papers in honor of Annie Zaenen*, 47–60. Stanford: CSLI Publications.

Homola, Petr & Matt Coler. 2013. Causatives as complex predicates without the restriction operator. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '13 conference*, 316–334. Stanford: CSLI Publications.

Ishikawa, Akira. 1985. *Complex predicates and lexical operations in Japanese*. Stanford: Stanford University. (Doctoral dissertation).

Jackendoff, Ray. 1972. *Semantic interpretation in generative grammar*. Cambridge, MA: The MIT Press.

Jackendoff, Ray. 1990. *Semantic structures*. Cambridge, MA: The MIT Press.

Joshi, Smita. 1993. *Selection of grammatical and logical functions in Marathi*. Stanford: Stanford University. (Doctoral dissertation).

Kaplan, Ronald M. 1989. The formal architecture of Lexical-Functional Grammar. *Journal of Information Science and Engineering* 5. 305–322. Revised version published as Kaplan (1995).

Kaplan, Ronald M. 1995. The formal architecture of Lexical-Functional Grammar. In Mary Dalrymple, Ronald M. Kaplan, John T. III Maxwell & Annie Zaenen (eds.), *Formal issues in Lexical-Functional Grammar*, 7–27. Stanford: CSLI Publications. Earlier version published as Kaplan (1989).

Kaplan, Ronald M. & Joan Bresnan. 1982. Lexical-Functional Grammar: A formal system for grammatical representation. In Joan Bresnan (ed.), *The mental representation of grammatical relations*, 173–281. Cambridge, MA: The MIT Press. Reprinted in Dalrymple, Kaplan, Maxwell & Zaenen (1995: 29–130).

Kaplan, Ronald M. & Paula S. Newman. 1997. Lexical resource reconciliation in the Xerox Linguistic Environment. In *Proceedings of the ACL workshop on Computational Environments for Grammar Development and Engineering*. Association for Computational Linguistics.

Kaplan, Ronald M. & Jürgen Wedekind. 1993. Restriction and correspondence-based translation. In *Proceedings of the 6th conference of the European chapter of the ACL (EACL 1993)*, 193–202. Association for Computational Linguistics. DOI: 10.3115/976744.976768.

Keenan, Edward L. & Bernard Comrie. 1977. Noun phrase accessibility and universal grammar. *Linguistic Inquiry* 8(1). 63–99.

Kelling, Carmen. 2003. French psych verbs and derived nouns. In Miriam Butt & Tracy Holloway King (eds.), *Nominals inside and out*, 151–180. Stanford: CSLI Publications.

Kibort, Anna. 2001. The Polish passive and impersonal in Lexical Mapping Theory. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '01 conference*, 163–183. Stanford: CSLI Publications.

Kibort, Anna. 2004. *Passive and passive-like constructions in English and Polish*. Cambridge, UK: University of Cambridge. (Doctoral dissertation).

Kibort, Anna. 2006. On three different types of subjectlessness and how to model them in LFG. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '06 conference*, 289–309. Stanford: CSLI Publications.

Kibort, Anna. 2007. Extending the applicability of Lexical Mapping Theory. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '07 conference*, 250–270. Stanford: CSLI Publications.

Kibort, Anna. 2008. On the syntax of ditransitive constructions. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '08 conference*, 312–332. Stanford: CSLI Publications.

Kibort, Anna. 2009. Intermediary agents and unexpressed pronouns. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '09 conference*, 378–398. Stanford: CSLI Publications.

Kibort, Anna. 2013. Objects and lexical mapping theory. Presented at the 18th International Lexical Functional Grammar Conference, University of Debrecen. Extended abstract available at https://csli-publications.stanford.edu/LFG/18/abstracts/lfg13abs-kibort.html.

Kibort, Anna. 2014. Mapping out a construction inventory with (Lexical) Mapping Theory. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '14 conference*, 262–282. Stanford: CSLI Publications.

Kibort, Anna & Joan Maling. 2015. Modelling the syntactic ambiguity of the active vs. passive impersonal in LFG. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '15 conference*, 145–165. Stanford: CSLI Publications.

Kisseberth, Charles W. & M. I. Abasheikh. 1977. The object relationship in Chi-Mwi:ni, a Bantu language. In Peter Cole & Jerrold M. Sadock (eds.), *Grammatical relations* (Syntax and Semantics 8). New York: Academic Press.

Kuhn, Jonas. 2001. Resource sensitivity in the syntax-semantics interface: Evidence from the German split NP construction. In W. Detmar Meurers & Tibor Kiss (eds.), *Constraint-based approaches to Germanic syntax* (Studies in Constraint-Based Lexicalism), 177–216. Stanford: CSLI Publications.

Laczkó, Tibor. 2000. Derived nominals, possessors, and lexical mapping theory in Hungarian DPs. In Miriam Butt & Tracy Holloway King (eds.), *Argument realization*, 189–227. Stanford: CSLI Publications.

Laczkó, Tibor. 2003. On oblique arguments and adjuncts in Hungarian event nominals. In Miriam Butt & Tracy Holloway King (eds.), *Nominals: Inside and out*, 201–234. Stanford: CSLI Publications.

Laczkó, Tibor. 2004. Grammatical functions, LMT, and control in the Hungarian DP revisited. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '04 conference*, 313–333. Stanford: CSLI Publications.

Laczkó, Tibor. 2007. Revisiting possessors in Hungarian DPs: A new perspective. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '07 conference*, 343–362. Stanford: CSLI Publications.

Laczkó, Tibor. 2010. A new account of possessors and event nominals in Hungarian. In Artemis Alexiadou & Monika Rathert (eds.), *The semantics of nominalizations across languages and frameworks*, 81–106. Berlin: Mouton de Gruyter. DOI: 10.1515/9783110226546.83.

Levin, Beth. 1993. *English verb classes and alternations*. Chicago: University of Chicago Press.

Levin, Beth & Malka Rappaport Hovav. 2005. *Argument realization* (Research Surveys in Linguistics). Cambridge, UK: Cambridge University Press. DOI: 10.1017/cbo9780511610479.

Levin, Lori S. 1986. *Operations on lexical forms: Unaccusative rules in Germanic languages*. Cambridge, MA: Massachussetts Institute of Technology. (Doctoral dissertation).

Levin, Lori S., Malka Rappaport & Annie Zaenen (eds.). 1983. *Papers in Lexical-Functional Grammar*. Bloomington, IN: Indiana University Linguistics Club.

Lødrup, Helge. 2012. In search of a nominal COMP. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '12 conference*, 383–404. Stanford: CSLI Publications.

Lovestrand, Joseph. 2018. *Serial verb constructions in Barayin: Typology, description and Lexical Functional Grammar*. Oxford: University of Oxford. (D.Phil. Thesis). https://ora.ox.ac.uk/objects/uuid:39406562-02d3-46f5-abf3-180d22225925.

Lovestrand, Joseph. 2020. F-structure and s-structure of Urdu complex predicates. In Miriam Butt & Ida Toivonen (eds.), *Proceedings of the LFG '20 conference*, 232–249. Stanford: CSLI Publications.

Lowe, John J. 2014. Gluing meanings and semantic structures. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '14 conference*, 387–407. Stanford: CSLI Publications.

Lowe, John J. 2015. Degrees of degrammaticalization: A lexical sharing approach to the English possessive. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '15 conference*, 208–228. Stanford: CSLI Publications.

Lowe, John J. 2016. Complex predicates: An LFG+glue analysis. *Journal of Language Modelling* 3. 413–462. DOI: 10.15398/jlm.v3i2.125.

Lowe, John J. 2017. *Transitive nouns and adjectives: Evidence from Early Indo-Aryan*. Oxford: Oxford University Press.

Lowe, John J., Adriana Molina-Muñoz & Antonia Ruppel. 2021. Raising and passive in Sanskrit. In Miriam Butt, Jamie Y. Findlay & Ida Toivonen (eds.), *Proceedings of the LFG '21 conference*, 243–263. https://csli-publications.stanford.edu/LFG/LFG-2021/lfg2021-lmr.pdf.

Manning, Christopher D. & Ivan A. Sag. 1999. Dissociations between argument structure and grammatical relations. In Gert Webelhuth, Jean-Pierre Koenig & Andreas Kathol (eds.), *Lexical and constructional aspects of linguistic explanation*, 63–77. Stanford: Stanford University Press.

Markantonatou, Stella. 1995. Modern Greek deverbal nominals: An LMT approach. *Journal of Linguistics* 31(2). 55–58. DOI: 10.1017/s0022226700015619.

Matsumoto, Yo. 1992. *On the wordhood of complex predicates in Japanese*. Stanford: Stanford University. (Doctoral dissertation).

Matsumoto, Yo. 1996. *Complex predicates in Japanese: A syntactic and semantic study of the notion 'word'*. Stanford: CSLI Publications.

Mohanan, Tara. 1990. *Arguments in Hindi*. Stanford: Stanford University. (Doctoral dissertation).

Mohanan, Tara. 1994. *Argument structure in Hindi* (Dissertations in Linguistics). Stanford: CSLI Publications.

Newmeyer, Frederick J. 2002. Optimality and functionality: A critique of functionally-based optimality-theoretic syntax. *Natural Language & Linguistic Theory* 20(1). 43–80. DOI: 10.1023/A:1014290005775.

Parsons, Terence. 1990. *Events in the semantics of English: A study in subatomic semantics* (Current Studies in Linguistics 19). Cambridge, MA: The MIT Press.

Patejuk, Agnieszka & Adam Przepiórkowski. 2016. Reducing grammatical functions in LFG. In Doug Arnold, Miriam Butt, Berthold Crysmann, Tracy Holloway King & Stefan Müller (eds.), *Proceedings of the joint 2016 conference on Head-Driven Phrase Structure Grammar and Lexical Functional Grammar*, 541–559. Stanford: CSLI Publications.

Perlmutter, David M. 1978. Impersonal passives and the unaccusative hypothesis. In Jeri J. Jaeger, Anthony C. Woodbury, Farrell Ackerman, et al. (eds.), *Proceedings of the 4th annual meeting of the Berkeley Linguistics Society*, 157–189. Berkeley: Berkeley Linguistics Society. DOI: 10.3765/bls.v4i0.2198.

Perlmutter, David M. & Paul M. Postal. 1977. Toward a universal characterization of passivization. In Kenneth Whistler, Robert Van Valin Jr., Chris Chiarello, Jeri J. Jaeger, Miriam Petruck, Henry Thompson, Ronya Javkin & Anthony Woodbury (eds.), *Proceedings of the 3rd annual meeting of the Berkeley Linguistics Society*, 394–417. Berkeley: Berkeley Linguistics Society. DOI: 10.3765/bls.v3i0.2266.

Peters, Stanley & R. W. Ritchie. 1973. On the generative power of transformational grammars. *Information Sciences* 6. 49–83. DOI: 10.1016/0020-0255(73)90027-3.

Pollard, Carl. 1997. The nature of constraint-based grammar. *Linguistic Research* 15. 1–18. http://isli.khu.ac.kr/journal/content/data/15/1.pdf.

Pollard, Carl & Ivan A. Sag. 1994. *Head-Driven Phrase Structure Grammar*. Chicago: University of Chicago Press & CSLI Publications.

Prince, Alan & Paul Smolensky. 1993. *Optimality Theory: Constraint interaction in Generative Grammar*. Tech. rep. 2. New Brunswick, NJ: Rutgers University Center for Cognitive Science. Published as Prince & Smolensky (2004).

Prince, Alan & Paul Smolensky. 2004. *Optimality theory: Constraint interaction in Generative Grammar*. Oxford/Malden: Blackwell. DOI: 10.1002/9780470759400.

Przepiórkowski, Adam. 2016. How *not* to distinguish arguments from adjuncts in LFG. In Doug Arnold, Miriam Butt, Berthold Crysmann, Tracy Holloway King & Stefan Müller (eds.), *Proceedings of the joint 2016 conference on Head-Driven Phrase Structure Grammar and Lexical Functional Grammar*, 560–580. Stanford: CSLI Publications.

Przepiórkowski, Adam. 2017. A full-fledged hierarchical lexicon in LFG: The FrameNet approach. In Victoria Rosén & Koenraad De Smedt (eds.), *The very model of a modern linguist – In honor of Helge Dyvik*, 202–219. Bergen: Bergen Language & Linguistics Studies (BeLLS). DOI: 10.15845/bells.v8i1.1336.

Ramchand, Gillian. 1997. *Aspect and predication*. Oxford: Oxford University Press.

Ramchand, Gillian. 2008. *Verb meaning and the lexicon: A first phase syntax*. Cambridge, UK: Cambridge University Press. DOI: 10.1017/cbo9780511486319.

Ramchand, Gillian. 2014. Argument structure and argument structure alternations. In Marcel den Dikken (ed.), *The Cambridge handbook of generative syntax*, 265–321. Cambridge, UK: Cambridge University Press.

Rappaport, Malka. 2006 [1983]. On the nature of derived nominals. In Miriam Butt & Tracy Holloway King (eds.), *Lexical semantics in LFG*, 121–148. Stanford: CSLI Publications. Originally published as Levin, Rappaport & Zaenen (1983: 113–142).

Rappaport Hovav, Malka & Beth Levin. 2007. Deconstructing thematic hierarchies. In Annie Zaenen, Jane Simpson, Tracy Holloway King, Jane Grimshaw,

Joan Maling & Chris Manning (eds.), *Architectures, rules, and preferences: Variations on themes by Joan W. Bresnan*, 385–402. Stanford: CSLI Publications.

Sadler, Louisa & Andrew Spencer. 1998. Morphology and argument structure. In Andrew Spencer & Arnold M. Zwicky (eds.), *The handbook of morphology*, 206–236. Oxford: Blackwell. DOI: 10.1002/9781405166348.ch10.

Saiki, Mariko. 1987. *On the manifestations of grammatical functions in the syntax of Japanese nominals*. Stanford: Stanford University. (Doctoral dissertation).

Schätzle, Christin. 2018. *Dative subjects: Historical change visualized*. Konstanz: University of Konstanz. (Doctoral dissertation).

Simpson, Jane. 2006 [1983]. Resultatives. In Miriam Butt & Tracy Holloway King (eds.), *Lexical semantics in LFG*, 149–161. Stanford: CSLI Publications. Originally published as Levin, Rappaport & Zaenen (1983: 143–157).

Speas, Margaret. 1990. *Phrase structure in natural language*. Dordrecht: Kluwer Academic Publishers. DOI: 10.1007/978-94-009-2045-3.

Sulger, Sebastian. 2013. Nominal argument structure and the stage/indiviual-level contrast in Hindi-Urdu. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '12 conference*, 582–602. Stanford: CSLI Publications.

Szűcs, Péter. 2018. A COMP-less approach to Hungarian complement clauses. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '18 conference*, 325–342. Stanford: CSLI Publications.

Talmy, Leonard. 1978. Figure and ground in complex sentences. In Joseph H. Greenberg (ed.), *Universals of human language*, vol. 4, 625–649. Stanford: Stanford University Press.

Taylor, Roxanne. 2023. *Argument realisation and argument structure in the Old English eventive noun phrase*. University of Manchester. (Doctoral dissertation).

Toivonen, Ida. 2013. English benefactive NPs. In Miriam Butt & Tracy Holloway King (eds.), *Proceedings of the LFG '13 conference*, 503–523. Stanford: CSLI Publications.

Williams, Alexander. 2015. *Arguments in syntax and semantics* (Key Topics in Syntax). Cambridge, UK: Cambridge University Press. DOI: 10.1017/cbo9781139042864.

Zaenen, Annie. 1993. Unaccusativity in Dutch: Integrating syntax and lexical semantics. In James Pustejovsky (ed.), *Semantics and the lexicon*, 129–161. Dordrecht: Kluwer Academic Publishers. DOI: 10.1007/978-94-011-1972-6_9.

Zaenen, Annie & Elisabet Engdahl. 1994. Descriptive and theoretical syntax in the lexicon. In Beryl T. S. Atkins & Antonio Zampolli (eds.), *Computational approaches to the lexicon*, 181–212. Oxford: Clarendon Press.