Input, Output Candidates, Markedness Constraints, and Ineffability in OT-LFG

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Abstract: This paper tries to clarify the concepts of inputs, output candidates, faithfulness constraints, and markedness constraints in Optimality-Theoretic syntax in the context of the multidimensional architecture in Lexical Functional Grammar, and to explore the consequences of the clarification of these concepts to the problem of ineffability. We propose that multidimensional markedness constraints expressing the correspondences between syntactic and semantic representations correctly derive at least some instances of ineffability without appealing to bi-directional optimization.

1 Introduction

The central ingredients of O(ptimality) T(heory) (Prince and Smolensky 1993) are (i) representations of inputs and (optimal) output candidates, (ii) expressive (meaning-to-form) and interpretive (form-to-meaning) optimization; and (iii) universal constraints (universally inviolable *GEN* constraints, violable *faithfulness* constraints that express the default correspondence between input and output candidates, and violable *markedness* constraints that express recurrent cross-linguistic patterns) and their language-particular ranking. The purpose of this paper is to try to clarify the concepts of input, output candidates, and markedness constraints in OT syntax in the context of the idea of multidimensional structure in Lexical Functional Grammar, and of the notion of 'constructions', and to explore the consequences of the clarification of these concepts to the problem of ineffability.

Three ideas play a crucial role in our exploration, and in addressing the problem of ineffability. The first is the assumption of computational monotonicity in the relation between inputs and output candidates, which translates in OT as the Prohibition of Structure Change, and can be stated as: Structure change is prohibited in the process of optimization. The substance of this prohibition is assumed in both LFG (Bresnan 2001) and OT syntax (Grimshaw 1997). The second assumption is that output candidates are representations of constructions rather than of linguistic signs. By constructions, we mean complex multi-dimensional representational units covering both meaning and form, acting as a locus of universal constraints. Examples of constructions would include such linguistic units as the 'active', 'passive', 'causative', 'applicative', 'cleft', '*wh*-question', 'relative clause', 'complex predicate', 'noun incorporation', and so on. Third, markedness constraints express not only regularities within a dimension of structure but also correspondences across dimensions. The second and third of these ideas, though not explicitly stated in the literature, are implicit in OT analyses, including OT-LFG.

Within OT, the phenomenon of ineffability has been viewed as a problem. An OT grammar only picks winning outputs, and must always pick a winning output. The problem is that there are instances of inputs that yield no acceptable output. (Pesetsky 1997) Solutions to the problem of ineffability have typically been based on bi-directional optimization (Legendre et al. 1998, Legendre 2001, Smolensky 1998). Having assumed that the representation of meaning in the input need not be preserved in the representation of meaning in the optimal output, these solutions permit unfaithful meanings. This, however, runs counter to the Prohibition of Structure Change, which is fundamental to any non-derivational/non-transformational model of linguistic theory. Combining the ideas of constructions and cross-dimensional markedness constraints may allow us to derive most instances of ineffability from multidimensional markedness constraints, without violating computational monotonicity.

The paper is structured as follows. Section 2 clarifies the nature of inputs and output candidates, and section 3 looks at the relation between them. Sections 4-7 explore the consequences of the multidimensional LFG architecture for the concepts of inputs, output candidates, faithfulness constraints, and markedness constraints in OT-LFG. Section 8 examines the problem of ineffability within this perspective, and proposes that markedness constraints expressing the correspondences between syntactic and semantic representations correctly derive at least some instances of ineffability without appealing to bi-directional optimization.

2 Inputs and output candidates

There are two intuitions about inputs and output candidates. One is based on performance, that is, the processes of language production and language comprehension. If we take this view, an input in expressive optimization is the pre-linguistic message in the mind of a speaker, and the output is the waveform that the speaker produces, with a production procedure deriving the output from the input. In interpretive optimization, the input would be the waveform, and the output, the message that a listener receives, a comprehension procedure deriving the output from the input. This would be the maximally global notion of input and output.

The other intuition, which we adopt in this paper, is based on competence, neutral to production and comprehension. Within the competence perspective, an input would be one aspect, or 'slice', of language structure, and the output would be another 'slice' that one can infer from the input. For the situations in which we take semantic representations as the input and syntactic representations as the output, there are two possible ways to view inputs:

(**1**) a. Given two linguistic signs (words, sentences, or texts) whose meanings are distinct within or across languages, their input representations must be distinct.

b. Given two constructions (classes of linguistic signs with shared form and meaning) whose meanings are distinct within or across languages, their input representations, must be distinct.

The examples in (2) bring out the difference in the implications of choosing between (1a) and (1b):

(**2**) a.	i.	Jay baked a shrimp.	ii.	Jay broiled a shrimp.	iii.	Jay bought a shrimp.
b.	i.	Jay baked a prawn.	ii.	Jay broiled a prawn.	iii.	Jay bought a prawn.
c.	i.	Jay baked a cow.	ii.	Jay broiled a cow.	iii.	Jay bought a cow.
d.	i.	Jay baked some/*a beef.	ii.	Jay broiled some/*a beef.	iii.	Jay bought some/*a beef.

In the above examples, the significant difference across the rows lies in the object: *shrimp*/*prawn*/*cow* vs. *beef*. The difference across the columns lies in the verb: *bake*, *broil*, and *buy*. Some of these differences, for instance, that between *bake* and *broil*, and between *shrimp* and *prawn*, are important for distinguishing between entities/events in the world, but not between different structures of the grammar. On the other hand, the meaning contrast between *bake* and *buy* is important also for distinguishing between different structures. For instance, *bake* and *broil*, unlike *buy*, allow resultatives.

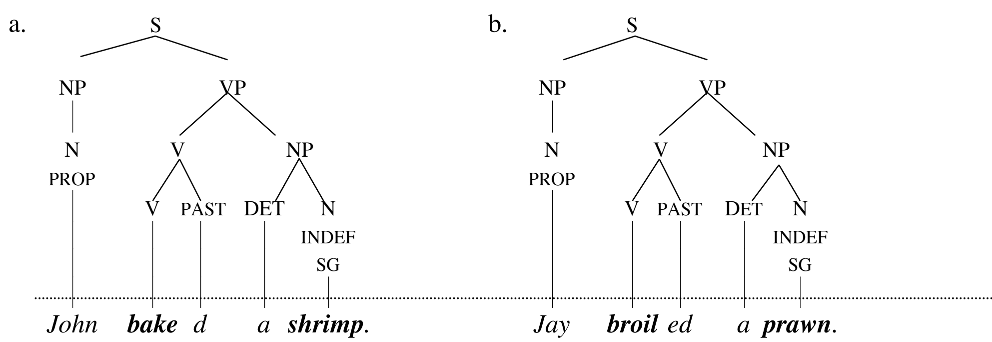
The position in (1a) would demand distinct semantic inputs for each of the examples in (2). In contrast, (1b) would assign the same input to (2ai, ii; bi, ii), as they do not express structurally distinct meanings. Based on the assumption that the grammatically relevant event structure of *bake* and *broil* is distinct from that of *buy*, (1b) would distinguish the input for (2ai, ii; bi, ii) from the input for (2aiii, biii). Likewise, since *shrimp*, *prawn*, and *cow* in (2a-c) are countable, unlike *beef* in (2d), (1b) would distinguish the input for (2a-c) from that for (2d).[1]

If two sentences have distinct meanings, the source of their difference may lie either in their structural meanings or their purely lexical meanings that are not structurally relevant. If two constructions have distinct meanings, the source of their difference must lie in their structural meanings. The choice of (1b), therefore, requires that structurally distinct meanings be represented in the semantic input, but not purely lexical meanings.

Adopting (1a) would entail inventing a universal set of semantic atoms capable of representing the meaning contrasts expressed by all the morphemes/words in all the human languages of all times. This demand is clearly too ambitious if not unrealistic. We therefore adopt the more modest version in (1b), which demands a universal set of semantic atoms capable of representing the meaning contrasts expressed by the grammatical constructions in all the human languages of all times.

Turning to output candidates, note that parallel remarks apply to them as well: the structural representations of (2ai, ii) and (2bi, ii) are non-distinct at the morphological and phrasal levels in terms of c-structure. Take (2ai) and (2bii) for illustration:

(**3**)



[1] Whether or not (2c) should be distinguished from (2a, b), i.e., whether or not *shrimp*/*prawn* are structurally distinct from *cow*, is an open question, which we will not address here.

(3a) and (3b) are non-distinct in terms of a-structure and f-structure as well. Thus, *John baked a shrimp* and *Jay broiled a prawn* have identical inputs, and identical optimal outputs. Distinctions in the material below the dotted line in (3) do not make for distinct output candidates.[2]

Now, if we accept position (1b), we must conclude that inputs and output candidates not linguistic signs; they are linguistic structures, each structure being instantiable by a number of linguistic signs. In other words, a linguistic structure may be thought of as representing a class of linguistic signs. When such a linguistic structure is multidimensional, and forms a unit that represents a class of linguistic signs, we refer to it as a construction.

While units like segment, syllable, foot, lexical category phrasal category, grammatical function, clause, semantic role, and event are representational units on a single dimension of representation, we view a construction as a representational unit that spans more than one dimension of representation. Intuitively, we may say that a construction is a complex unit that includes semantics and morpho-syntax, and can in principle include phonology as well. Terms like passive, noun incorporation, and cleft refer to categories of such units. From this point of view, we may say that mono-dimensional representational units like prepositional phrase and clause are constructional fragments. Like other complex representational units, the well-formedness of a construction is governed by constraints on linguistic representations. [3]

3 The input-output relation

Having said that inputs and output candidates are linguistic structures, we must ask: what is the relation between input and output representations? When trying to answer the question, however, it is important to also ask: "input and output for what purpose?" The output in OT phonology, for instance, would include phonological distinctive features, but the output in OT syntax has no need for phonological distinctive features. Likewise, inputs and outputs of OT pragmatics, OT sociolinguistics, and OT stylistics would differ from those of OT syntax.

The optimality-theoretic conception of grammar is that of the optimal pairing of meaning and form. Given this position, two alternative characterizations of output representations, as stated below, are possible:

(4) a. An output candidate in both expressive and interpretive optimization is a representation of both meaning and form.

b. An output candidate in expressive optimization is a representation of form alone, and in interpretive optimization is that of meaning alone.

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2 This means that inputs and outputs in OT syntax do not contain the structurally irrelevant content of lexical morphs.

3 This notion of 'construction' is perhaps closest to that in Croft's (2001) radical construction grammar, even though embedded in a very different kind of syntactic theory. As we see it, the notion of construction in construction grammar (Fillmore et al. 1988, Goldberg 1995, Kay and Fillmore 1999, among others) is a way of welding together the general and the idiomatic (exceptional) in a seamless way. This conception includes language particular constructions such as the *let alone* and *What's X doing Y* constructions, and seems to be distinct from our notion, unless it includes universal constructions such as passive, causative, cleft, noun incorporation, and so on.

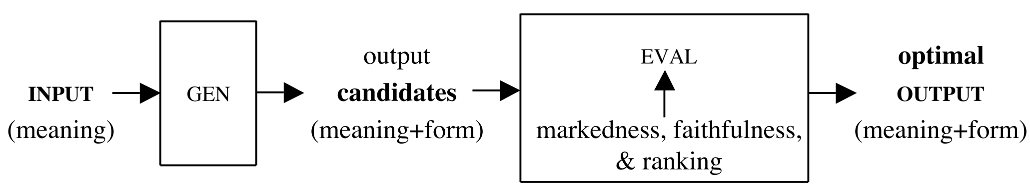
Taking expressive optimization as inferring form from meaning, and interpretive optimization as inferring meaning from form, we can schematize the pairing of form and meaning in (4a) and (4b) as (5a) and (5b) respectively:

(**5**)		input		output
a.	Expressive optimization (inferring form from meaning):	meaning	→	meaning | form
	Interpretive optimization (inferring form from meaning):	form	→	meaning | form
b.	Expressive optimization (inferring form from meaning):	meaning	→	form
	Interpretive optimization (inferring form from meaning):	form	→	meaning

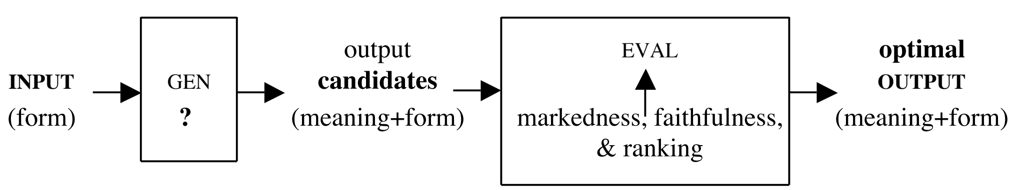
In (5a), an output candidate in expressive as well as interpretive optimization is a representation of both meaning and form. This is the conception of the relation between inputs and ouput candidates in OT-LFG (Bresnan 2000, Sells 2001a, b, Kuhn 2003). This view is also consistent with the Principle of Containment in OT phonology (McCarthy and Prince 2001), which states that an input representation is a proper subset of the output representation. Most analyses in phonology, however, adopt (5b) in practice, assuming that underlying representations are not contained in the output representations (in expressive optimization).

The idea that a grammar is a pairing between form and meaning is present in almost all models of generative grammar. But the architecture of the pairing varies from theory to theory. Given that the input is retained in the output in OT-LFG, the model that emerges from (5a) can be articulated as (6):

(**6**) a. Expressive optimization



b. Interpretive optimization



Given this model, *ineffability* can be characterized as the absence of an optimal output in expressive optimization, and *uninterpretability* as its counterpart, namely, the absence of an optimal output in interpretive optimization. In the same vein, *free variation* would be the presence of multiple optimal outputs for the same input in expressive optimization, and *ambiguity* the presence of multiple optimal outputs for the same input in interpretive optimization. *Optionality* then is simply a special form of free variation in which an element of representation in one optimal output is optionally absent in the other.

4 Multidimensionality of structure

Given (6), an input is a partial representation of a multidimensional structure, and an output candidate a fuller representation. This position allows us to view OT constraints as expressing a set of relations between different parts of an output representation (cf. HPSG: Pollard and Sag 1993). Now, what is the consequence of combining this idea with the idea of multidimensional (co-present) structures in the LFG architecture?

The major (not necessarily exhaustive) dimensions of information in grammar relevant for the pairing of form and meaning are the different aspects of form (PF) (including phonetic representation, underlying representation, morphs, word internal c-structure, and sentence level c-structure); the 'syntax' that mediates between form and meaning (including f-structure and a-structure); and the different aspects of meaning (LF) (including word internal semantics, sentence level semantics, discourse meanings). The table below summarizes these dimensions of structure:

(**7**) Multidimensionality of the structure of linguistic signs in LFG:

word/sentence/text	phonology	phonetic representation underlying representation
	syntax	c-structure f-structure a-structure
	semantics	sem-structure

The dimensions in (7) yield the following input-output relations in OT-LFG:

(**8**)

Input		Output		
lexical sem-structure	→	a-structure	+	lexical sem-structure
a-structure	→	a-structure	+	lexical sem-structure
a-structure	→	a-structure	+	f-structure
f-structure	→	a-structure	+	f-structure
f-structure	→	f-structure	+	phrasal sem-structure
phrasal sem-structure	→	f-structure	+	phrasal sem-structure
f-structure	→	f-structure	+	c-structure
c-structure	→	f-structure	+	c-structure

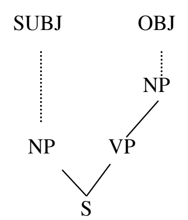
Implicit in (8) is the assumption that given any two dimensions of structure □ and □, we can take a to be the input and □+□ the output. The output representation includes the part contained in the input, as well as additional specifications.

In (8), the output representations contain multidimensional information, and the input-output relations involve a correspondence relation between two dimensions. Another possible relation between inputs and output candidates is one in which the input is an underspecified representation along the same dimension of representation as the fully specified output candidate. The examples in (9) illustrate the two kinds of input-output relations:

(**9**) a. Along the same dimension:

	input		output	
i)	[+nasal]	→	[+nasal, +son, +voice]	phonology
ii)	P, NP	→	P > NP	c-structure

b. Across dimensions:

i)	ARG_1, ARG_{-2}	→	ARG-1 ⋮ SUBJ ARG-2 ⋮ OBJ	a-structure / f-structure
ii)	SUBJ, OBJ	→		f-structure / c-structure

5 Choice of relevant candidates for a given semantic input

We have so far assumed that the input in global expressive optimization is the representation of meaning. Given a semantic input, how do we identify the competing output candidates that the analysis must consider? We suggest that these competing output candidates are the equivalent grammatical constructions provided by universal grammar as alternative expressive options that share the same core meaning. As an illustration, consider an analysis of the sentence in (10):

(10) *Jan sent Sue Eric Schlosser's 'Fast Food Nation.'*

Suppose we take the semantic structure in (11) as a core (but incomplete) input for (10) for the meaning-form mapping.

(**11**) Input representation for (10):

[x CAUSE [y MOVE-TOWARDS z]]

Given the representation in (11), we must consider at the least the following representations as output candidates. (In the examples in the right hand column, we use the abbreviation *FFN* for *Eric Schlosser's 'Fast Food Nation'* for convenience):

(**12**) Output candidates — Examples

a.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBJ$_Z$]
[NP$_X$ > VERB > NP$_Z$ > NP$_Y$] — (*Jan sent Sue FFN*.)

b.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBL$_Z$]
[NP$_X$ > VERB > NP$_Y$ > P > NP$_Z$] — (*Jan sent FFN to Sue*.)

c.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBL$_Z$]
[NP$_X$ > VERB > P > NP$_Z$ > NP$_Y$] — (*Jan sent to Sue FFN*.)

d.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBL$_Z$]
[NP$_Y$ > NP$_X$ > VERB > P > NP$_Z$] — (*FFN Jan sent to Sue*.)

e.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBL$_Z$]
[NP > BE > NP$_Y$ > [NP$_X$ > VERB > P > NP$_Z$]] — (*It was FFN that Jan sent to Sue*.)

f.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBL$_Z$]
[NP$_{-wh}$ > NP$_X$ > VERB > P > NP$_Z$] > BE > NP$_Y$] — (*What Jan sent to Sue was FFN*.)

g.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[ADJCT$_X$ PRED SUBJ$_Y$ OBL$_Z$]
[NP$_Y$ > VERB > P > NP$_Z$ > P > NP$_X$] — (*FFN was sent to Sue by Jan*.)

h.
[x CAUSE [y MOVE-TOWARDS z]]
[ARG$_X$ PRED ARG$_Y$ ARG$_Z$]
[SUBJ$_X$ PRED OBJ$_Y$ OBJ$_Z$]
[NP$_X$ > VERB > NP$_Y$ > NP$_Z$] — (* *Jan sent FFN Sue*.)

i. [x CAUSE [y MOVE-TOWARDS z]]
[ARG_X PRED ARG_Y ARG_Z]
[$SUBJ_X$ PRED OBJ_Y OBJ_Z]
[NP_X > NP_Y > NP_Z > VERB] (* *Jan FFN Sue sent*.)

j. [x CAUSE [y MOVE-TOWARDS z]]
[ARG_X PRED ARG_Y ARG_Z]
[$SUBJ_X$ PRED OBJ_Y OBJ_Z]
[NP_X > NP_Z > NP_Y > VERB] (* *Jan Sue FFN sent*.)

Of these, English selects options in (a–g) as optimal candidates, disallowing those in (h-j). Given that the input in (11) corresponds to multiple optimal outputs (12a-g), if (11) were a complete input, (12a-g) must be free variants. However, we know that the meanings of these candidates are structurally distinct. Hence, they must be conditioned by additional semantic, pragmatic, or discourse specifications in the input.

If we accept this position, we must look for a systematic explanation for when each of these candidates gets chosen as the optimal output in an OT analysis. This naturally involves adding further specifications to the core meaning in (11), in order to narrow down the set of optimal candidates. Take, for instance, the addition of 'TOPIC' and 'FOCUS' to (11), yielding (13a) and (13b), which would then also be part of the output representation:

(**13**)	Input	Illustration for optimal output
a.	x CAUSE [y_{TOP} MOVE-TOWARDS z]	*FFN Jan sent to Sue*.
b.	x CAUSE [y_{FOC} MOVE-TOWARDS z]	*It was FFN that Jan sent to Sue*.

Given (13a), the optimal candidate would be (12d), and given (13b), the optimal candidates would be (12e) and (12f). To distinguish between (12e) and (12f), we need to identify the semantic distinction between clefts and pseudo-clefts. Suppose we use the diacritics FOCUS-C and FOCUS-P to distinguish between the meaning of clefts and that of pseudo-clefts, and distinguish their respective inputs as in (14):

(**14**) a. x CAUSE [$y_{FOC\text{-}C}$ MOVE-TOWARDS z] *It was FFN that Jan sent to Sue*.

b. x CAUSE [$y_{FOC\text{-}P}$ MOVE-TOWARDS z] *What Jan sent to Sue was FFN*.

Assuming that *wh-* questions also involve FOCUS, the input in (14a) does not distinguish between clefted and unclefted *wh*-questions. A possible solution would be to assume the input in (15a) for *wh*-questions (unclefted), and that in (15b) for clefted *wh*-questions. Needless to say, the semantic substance of the diacritic features FOCUS-C, FOCUS-P, and FOCUS-WH would need to be spelt out in a theory of grammatical semantics:

(**15**) a. x CAUSE [y MOVE-TOWARDS z] *What did Jan send to Sue?*
FOC- WH

b. x CAUSE [y MOVE-TOWARDS z] *What was it that Jan sent to Sue?*
FOC- C-WH

If we assume that actives and passives are distinct at the level of sentence or discourse semantics in that, say, the passive has the feature □, more fully specified input representations would be those in (16):

(**16**) a. x CAUSE [y MOVE-TOWARDS z] *FFN was sent to Sue (by Jan).*
□

b. x CAUSE [y MOVE-TOWARDS z] *Sue was sent FFN (by Jan).*
□

If the agent is truly optional in the passive, the meanings of the passive with and without an overt agent would be identical. If the two passives are not free variants, they call for further input specifications. We would need a similar strategy of further input specification to make distinctions such as that between theme-passive and goal-passive, between dative and non-dative, and so on. If the theory does not permit free variation, we would need to find a semantic distinction between datives with and without heavy NP shift as well.

To summarize, the discussion above shows the competing output candidates that must be considered in an OT analysis of a sentence in expressive optimization are the equivalent grammatical constructions provided by universal grammar as alternative options that express the core meaning of the sentence. Given (11) as the core meaning of *Jan sent 'FFN' to Sue*, the competing alternatives would include (12a-j). Adding further specifications to the core meaning of the input narrows down the set of optimal output(s).

6 Representing syntactic input in expressive optimization

We have said that if two competing constructions have distinct meanings, they are not free variants, as they have distinct semantic, discourse, or pragmatic inputs. What would be the nature of inputs in expressive optimization for two competing constructions which are free variants, in a theory that permits free variation?

For the purposes of illustration, let us assume that the dative shift construction does not involve a meaning contrast. If so, the input in (11), repeated as (17), yields as free variants (18a) with a goal-OBJ, and (18b) with a goal-OBL:

(**17**) [x CAUSE [y MOVE-TOWARDS z]]

(**18**) a. [x CAUSE [y MOVE-TOWARDS z]]
[ARG_X PRED ARG_Y ARG_Z]
[$SUBJ_X$ PRED OBJ_Y OBJ_Z]
Jan sent FFN to Sue.

b. [x CAUSE [y MOVE-TOWARDS z]]
[ARG_X PRED ARG_Y ARG_Z]
[$SUBJ_X$ PRED OBJ_Y OBL_Z]
Jan sent Sue FFN.

The input in (17) yields (18a, b) as optimal outputs in the mapping from sem-str to f-str. We take it that (18a) and (18b) are now the more articulated inputs in the mapping from f-str to c-str; they determine the choice between (12a) and (12b). This implies a chain of local input-output relations internal to the grammar, as illustrated in (19):

(**19**)

input		output	input		output
sem-structure a-structure	→	sem-structure a-structure f-structure	sem-structure a-structure f-structure	→	sem-structure a-structure f-structure c-structure

Even if the constructions exemplified by *Jan sent Sue FFN*, and *Jan sent FFN to Sue* were free variants in the a-structure to f-structure mapping, they are not free variants in the f-structure to c-structure mapping.

In the examples in (11)-(19), we abstracted away the specifics of the instantiation of grammatical constructions from the specifics of the lexical items. Thus, (12a) is instantiated not only by *Jan sent Sue FFN*, but also by (20a-d).

(**20**) a. *Mary bought Sue a bunch of flowers.*
b. *Mary bought Sue a bunch of roses.*
c. *Ella bought Lee a bunch of pink flowers.*
d. *Ella bought Lee a bunch of purple flowers.*

While it may be possible to develop a universal framework of semantic representations and a set of constraints to choose between competing constructions instantiated by [*x give y to z*], [*x send y to z*], and [*x buy y for z*], trying to develop a theory of semantic representations and constraints to choose between (20c) and (20d) would be an unrealistic goal.

If we think of language as providing a set of options for the expression of meanings, we may distinguish two kinds of options as in (21), namely, lexical options and grammatical options. Among grammatical options, there are those offered by grammatical morphs on the one hand ('morphic' in the table), and by grammatical structures on the other. Structural options could be either paradigmatic or constructional.

(**21**)

Options provided by a language	lexical			e.g., *pink* vs. *purple*
	grammatical	‘morphic’		e.g., *to* vs. *from*
		structural	paradigmatic	e.g., PAST vs. PRES
			constructional	e.g., cleft vs. non-cleft

Except for grammatical items (e.g. *to* vs. *for, -ed* vs. *–es*, *may* vs. *can*), a grammar is concerned with types (classes), not tokens (instantiations of the classes). This means that the aspect of semantics relevant for OT syntax is grammatical semantics, not truth conditional semantics. To exemplify, clefts and non-clefts are distinct in grammatical semantics, but not necessarily so in truth-conditional semantics. Conversely, (20c) and (20d) are distinct in truth-conditional semantics, but not in grammatical semantics.

7 Faithfulness, markedness, and cross-dimensional correspondences

Recall that the input-output relation can be viewed either as in (5a), where the input representation is contained in the output representations, or as (5b), where the input and output representations are distinct. As illustrated in (9a, b), constraints may hold either on a single dimension of representation, or on the mapping between two (or more) dimensions. Given the OT-LFG position in (5a), and the multidimensional structure of output candidates sketched in the preceding sections, we are now ready to ask: what is the nature of faithfulness and markedness constraints in OT-LFG?

Faithfulness constraints are conventionally assumed to hold between input and output representations. However, given that input representations are part of the output representations ((5a)), this is not necessary: faithfulness constraints may be viewed as expressing default correspondences between different dimensions of language structure within output representations. The consequence of this result, as also suggested by Vikner (2001), is that the concept of input representations is redundant in the theoretical model: it is only a convenient descriptive term useful for the exigencies of computation.

As for markedness constraints, it is clear that at least some of them hold on a single dimension. The question then is, can markedness constraints also be multidimensional? Standard OT phonology, taking the position in (5b), disallows multidimensional markedness constraints, allowing only faithfulness to constrain the pairing between underlying and phonetic representations. However, versions of OT syntax that subscribe to (5a) do not forbid markedness constraints holding on the correspondence between different structural dimensions. Yet, even in these versions of OT syntax, the problematization of ineffability appears to imply a prohibition against multidimensional markedness constraints.

Interestingly, multidimensional constraints are present in classical LFG. Some of them may be viewed as GEN constraints in OT-LFG, while others will have to be treated as markedness constraints. Take, for instance, consistency and function-argument bi-uniqueness conditions that express the correspondences between a-structure and f-structure. These are generally taken to be inviolable constraints, and hence would be GEN constraints. In contrast, annotation constraints that express the correspondences between f-structure and c-structure, if taken as universal constraints, are necessarily violable in that the f-structure/c-structure pairings obeyed in one language need not hold in another. In classical LFG, annotations are assumed to be part of language-particular phrase structure rules. Since OT-LFG disallows language particular rules, the substance of annotations must be expressed as markedness constraints holding on the relation between f-structure and c-structure.

If both faithfulness and markedness constraints are violable, and markedness constraints may be either unidimensional or multidimensional, faithfulness constraints become a special kind of multidimensional markedness constraints — those that express context-free, default corres-pondences between two dimensions of representation.

8 Ineffability

We are now ready to address the so-called ineffability problem. Ineffability is the phenomenon of a meaning expressible in one language being inexpressible (ineffable) in another. It is a problem in OT because of the assumption that given any input, there must be a winning candidate. To address this problem, it would be useful to begin by clarifying the nature of the problem.

Notice that ineffability is a problem only in the context of an expectation of effability:

(**22**) The meaning expressed by every linguistic sign in one language is expressible by a sign in every language.

That the meaning expressed by a word in a particular language can be expressed in another by using a sentence (with multiple embedding), or that the meaning expressed by a single clause in one language can be expressed in another by a paragraph, is not an interesting claim. The question is: is the claim of effability tenable if formulated as in (23)?

(**23**) The meaning expressed by a linguistic sign in one language is expressible by an **equivalent** sign in every language.

To see if this expectation is tenable, we must clarify the concept of equivalent signs. Let us say that two signs are equivalent if they belong to the same level in the hierarchy of units. Thus, two affixes are equivalent, but not an affix and a poly-morphemic word. Two words are equivalent, but not a word and a sentence, or a phrase and a paragraph. A single clause is not equivalent to a multi-clausal sentence. Going back to the typology of the expressive options outlined in (21), we may break up the substance of (23) as follows:

(**24**) a. Effability of content morphemes: the meaning expressed by a content morpheme in one language is expressible by a content morpheme in every language.

b. Effability of grammatical morphemes: the meaning expressed by a grammatical morpheme in one language is expressible by a grammatical morpheme in every language.

c. Paradigmatic effability: the meaning expressed by a member of a paradigm in one language is expressible by the member of a paradigm in every language.

d. Constructional effability: the meaning expressed by a grammatical construction in one language is expressible by a grammatical construction in every language.

Each of these claims is false. Take the trivial case of the effability of content morphemes. English expresses a lexical contrast between the concepts of red vs. orange, mass vs. weight, and phonology vs. phonetics; Malayalam does not. English has morphemes that express the concepts of quark, monotonic, and gene; Malayalam does not. That this type of ineffability exists is uncontroversial. Clearly then, the claim in (24a) is false. It is also uninteresting.

What about the effability of grammatical morphemes? Malayalam expresses a contrast between two kinds of reflexives. One, *taan* 'self', is non-clause-bounded, and requires the antecedent to be a logophoric center. The other, *swa-* 'self', is clause-bounded (except in the subject position), and has no logophoricity effects. They also express distinct meanings as possessors. This contrast between reflexives is ineffable in English. English has a prefix *re-* (e.g., *rearrange)* that expresses the meaning of an EVENT resulting in a STATE, a distinct token of which (state) existed prior to the event. Malayalam does not have such an affix. Hence, the claim in (24b) is also false.

As for paradigmatic effability, we observe that Malayalam expresses a three-way tense contrast, PAST, PRESENT, and FUTURE, in terms of three distinct verbal affixes, while English distinguishes only between PAST and NON-PAST in terms of verbal affixes, not FUTURE. Such examples show that (24c) is also false.

Finally, take constructional ineffability. The semantic distinction expressed by clefts and pseudo-clefts in English is not available in Malayalam. Conversely, the meaning of *I know the boy who$_i$ Mary was reading a book when —$_i$ came in.* is expressible as a relative clause in Malayalam and Hindi, but not in English. Hence, (24d) is false as well.

The essence of the problem of ineffability in OT is that the expectation of constructional effability does not hold. Is constructional ineffability a design problem that calls for bi-directional optimization, or is it a pseudo-problem, a phenomenon that can be readily captured in terms of multidimensional markedness constraints in expressive optimization? To address this question, let us look at some more examples from the perspective of constructional effability.

As shown by the alternation between *The jar broke,* and *Max broke the jar,* a verb in English can express the meaning: [x CAUS [y GO TO STATE]]:

(**25**) a. [y GO TO STATE] b. [x CAUS [y GO TO STATE]] sem-structure

VERB	VERB	c-structure

However, a verb in English cannot express the meaning: [x CAUSE [y ACT ON z]], unlike verbs in many other languages:

(**26**) a. [y GO TO STATE] b. [x CAUS [y ACT ON z]] sem-structure

VERB	VERB	c-structure

Furthermore, a single verb in English or in Malayalam cannot be associated with a bi-clausal f-structure, unlike in languages like Japanese:

(**27**) a. [… PRED …] b. [… PRED … [… PRED …]] f-structure

VERB	VERB	c-structure

(28) and (29) below give examples from Malayalam and Japanese respectively of verbs in these languages that express the meaning in (26b). A Japanese example instantiating (27b) is given in (29bii) below:

(**28**) a. (i)

ani	*swantam*	*uuññaalil*	*aaTi.*
Ani-N	self's	swing-L	swing-PAST

Ani$_k$ swung in self's$_k$ swing. (self = Ani/*someone else)

(ii)

uma	*aniye*	*swantam*	*uuññaalil*	*aaTTi.*
Uma-N	Ani-A	self's	swing-L	swing-CAUS-PAST

Uma$_j$ swung Ani$_k$ in self's$_{j/*k}$ swing. (self = Uma/*Ani/*someone else)

(iii)

amma	*umayekkoNTə*	*aniye*	*swantam*	*uuññaalil*	*aaTTiccu.*
mother-N	Uma-INST	Ani-A	self's	swing-L	swing-CAUS-CAUS-PAST

Mother$_i$ made Uma$_j$ swing Ani$_k$ in self's$_{i/*j}$ swing.

(self = Mother/*Uma/*Ani/*someone else)

b. (i)

ani	*awaLe*	*nuLLi.*
Ani-N	she-A	pinch-PAST

Ani$_k$ pinched her$*_k$. (her = someone else/*Ani)

(ii)

uma	*aniyekkoNTə*	*awaLe*	*nuLLiccu.*
Uma-N	Ani-INST	she-A	pinch-CAUS-PAST

Uma$_i$ made Ani$_j$ pinch her$_{*i/*j}$. (her = someone else /*Uma/*Ani)

Evidence from disjoint reference, reflexive binding, and control above shows that causatives in Malayalam are mono-clausal in f-structure (K P Mohanan 1983, T Mohanan 1988). Evidence from disjoint reference and reflexive binding below shows that causatives in Japanese are bi-clausal in f-structure (Kuno 1973, Farmer 1980, Dalrymple 1982), while evidence from scrambling and the double *–o* constraint shows that they are mono-clausal in c-structure (i.e., associated with a single S/IP node):

(**29**) a. (i) *John-ga* *zibun-o* *tsuner-ta.*
John-NOM self-ACC pinch- PAST
$John_j$ pinched $self_j$. (self = John/*someone else)

(ii) *Bill-ga* *John-ni* *zibun-o* *tsuner-ase-ta.*
Bill-NOM John-DAT self-ACC pinch-CAUS-PAST
$Bill_i$ made $John_j$ pinch $self_{i/j}$. (self = John/Bill/*someone else)

b. (i) *John-ga* *kare-o* *tsuner-ta.*
John-NOM he/she-ACC pinch- PAST
$John_j$ pinch him_{*j}. (him = someone else/*John)

(ii) *Bill-ga* *John-ni* *kare-o* *tsuner-ase-ta.*
Bill-NOM John-DAT he/she-ACC pinch-CAUS-PAST
$Bill_i$ made $John_j$ pinch $him_{*i/*j}$. (him = someone else/*John/*Bill)

In the light of the examples in (28)-(29), we can restate the generalizations about (23)-(25) as (30):

(**30**) a. The meaning of [x CAUSE [y ACT UPON z]] is expressible as a morphological causative construction with a mono-clausal c-structure in Malayalam and Japanese, but not in English.

b. The meaning of [x CAUSE [y ACT UPON z]] is expressible as a morphological causative construction with a bi-clausal f-structure in Japanese, but not in Malayalam or English.

The generalizations in (30) call for the multidimensional constraints in (31): [4]

(**31**) a. Lexical Causative-transitive Constraint: * [x CAUSE [y ACT ON z]] sem-str
|
VERB c-str

b. Lexical Bi-clausality Constraint: * [… PRED …[… PRED …]] f-str
|
VERB c-str

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[4] These constraints are similar in spirit to the LCS/c-structure isomorphism and f-structure/c-structure isomorphism constraints in Broadwell (2003).

Constraint (31a) is violated in Malayalam and Japanese, but not in English; constraint (31b) is violated in Japanese, but not in English and Malayalam. These effects would follow from the ranking of these constraints as in (32):

(32)	Constraint ranking:	English:	(39a), (39b) >> Faith-CAUS
		Malayalam:	(39b) >> Faith-CAUS >> (39a)
		Japanese:	Faith-CAUS >> (39a), (39b)

These rankings correctly predict that a verb that expresses the causative of a transitive should be impossible in English, and so should a verb that is associated with a bi-clausal f-structure. The latter should be impossible in Malayalam. Both such verbs are permitted in Japanese.

To summarize, the ineffability effects in (30) follow from the multidimensional markedness constraints in (31), and their ranking in (32). In short, at least some instances of constructional ineffability can be derived without bi-directional optimization, if the theory permits markedness constraints to constrain the pairing between syntactic structure and semantic structure.

9 Concluding remarks

In this paper, we have examined input and output representations, and faithfulness and markedness constraints in OT from the perspective of the multidimensional architecture of LFG, in order to look for a solution to the problem of ineffability. There are at least three alternative assumptions about the representation of global inputs in expressive optimization in OT-LFG:

(**33**) a. underspecified f-structure with an a-structure skeleton (Bresnan 2000, Sells 2001a, b, Kuhn 2003), corresponding to an underspecified d-structure in GB/Minimalism (Grimshaw 1997, Legendre et al 1998);

b. fully specified semantic representation sufficiently detailed to express the semantic contrasts among lexical items (morphemes) (corresponding to deep structure in generative semantics).

c. underspecified semantic representation carrying the semantic information that interacts with syntax and morphology, but not detailed enough to express the semantic contrasts among lexical items, corresponding to the combination of underspecified lexical semantics and LF without the traces in GB/Minimalism, and to Grammatical Semantics (Mohanan and Wee 1999, and the references therein).

We have adopted (33c) in our discussion in this paper. By a way of additional support for (33c), notice that (33a) fails to express the typological variation in the syntactic realization of core meanings. Take the semantic (event structure) information [X CAUS [Y CAUS [Z BECOME OPEN]]] (e.g., *Ann made May open the door*.) In a language like Malayalam, it is realized syntactically as a single f-structure predicate with x, y and z as co-arguments ((26)). The English counterpart has two f-structure predicates, with x as an argument of the matrix predicate, and y and z as arguments of the embedded predicate. Unlike Malayalam, English does not allow a single f-structure predicate associated with two units of CAUSE ((31b)). If input representations in expressive optimization are to encode the meanings that underlie typological distinctions in syntactic realizations, then (33a) is inadequate. (33b) is overambitious. If input information is represented in terms of a universal inventory, a framework of semantic representations rich enough to express the meaning contrasts even in a restricted semantic domain, say, the names of flowers, would be an unrealistic goal.

Accepting (33c) has a number of interesting consequences for OT-LFG. First, consider the following assumption in OT:

(**34**) Given an input, universal constraints and their language particular ranking yield the optimal output.

If we accept (33c), then (34) leads to the conclusion that the output candidates in OT-LFG are not *sentences* with their lexical items, but *constructions* of which sentences are tokens: we cannot deduce the lexical items in a sentence from an abstract grammatical semantic representation that does not carry the semantic contrasts necessary to distinguish one lexical item from another, whether within or across languages.

Second, the output constructions (the candidates) that OT-LFG grammars evaluate are multidimensional structures. The constraints on the output would then contain *wellformedness constraints* internal to a given dimension of representation, and *correspondence constraints* that express the relations between different dimensions of representation in a construction. Given this position, faithfulness constraints may be viewed as a special type of markedness constraints.

Third, (33c) commits OT-LFG to developing a framework of grammatical semantic representations to account for the choice from among competing constructions such as those in (12a-j).

Finally, OT-LFG is committed to providing an account of grammatical ineffability, but not lexical ineffability. If we allow markedness constraints on the correspondence between semantic and syntactic representations, as in (31a, b), grammatical ineffability can be accounted for without appealing to bi-directional optimization that involves structure change of meanings in the course of optimization.

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