

# Form-Meaning Asymmetries and Bidirectional Optimization

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**Abstract.** This paper discusses architectural aspects of various versions of bidirectional OT so far proposed, and their treatments of blocking and other phenomena involving asymmetric relationships between form and meaning. The models to be studied here are the strong and weak bidirectional OT of Blutner (2000), and the asymmetric OT model of Wilson (2001). We show that each of these models provides at best a partial solution to the problems of form-meaning asymmetries. We argue that some of the problems of existing OT models can be eliminated using a variant of system which performs only one iteration of the Weak OT process.

## 1. Introduction

Bidirectional Optimality Theory allows us to see a wide range of problems which would previously have been considered unrelated from a new perspective, the perspective of asymmetric relationships between input and output. For interpretation, the input is a form and the output a meaning, and for production the input is a meaning and the output is a form. A mismatch is any case where there is no isomorphism between the space of meanings and the space of forms, say because one form has no meaning, or multiple meanings, or because a meaning is inexpressible, or may be expressed in multiple ways. From this perspective, we can understand the phenomenon of blocking as a process which prevents or removes form-meaning asymmetries.

In this paper, we study how various versions of OT handle mismatches, concentrating on the phenomenon of blocking. In section 2 we will be considering simpler, relatively standard OT architectures. The first two of these are unidirectional. What we will term *naive OT production* is the approach seen in most OT syntax papers, and is close to the model that is used in OT phonology. Naive OT production starts with some representation of meaning as input, and a set of candidate outputs provided by a function referred to as GEN. A set of linearly ranked constraints is then used to select between candidate surface forms. The second unidirectional approach, not surprisingly, works the other way: we will term it *naive OT comprehension*, although Hendriks and de Hoop (2001) term it *OT semantics*. The input is a surface form, GEN offers a set of candidate meanings, and the linearly ranked constraint set is used to find the best meaning for the given form.

Some OT architectures provide grammars that cannot be reduced to a set of meaning-form pairs. One of these, which we will term *naive back-and-forth OT*, consists of an obvious combination of naive OT production and comprehension: the first is used for production only, and the second for comprehension only, an architecture discussed by Hendriks and de Hoop (2001). Note that even if the constraints used in each direction are the same, this model may not assign a consistent relation between meanings and forms. In particular for some choices of constraints, if you take a meaning, apply naive OT production to get a form, and then apply naive OT comprehension, you may not get back to the original meaning.

In addition to the three *naive* models, we will also consider four more sophisticated variants, sophisticated in the sense that they have been specifically designed to target some of the mismatch phenomena we will be discussing. The four other models to be studied are the *strong bidirectional OT* and *weak bidirectional OT* of Blutner (2000), the *asymmetric OT* model of Wilson (2001) and a model we will term *medium strength OT*, developed by Beaver (to appear). We will introduce these models individually later in the paper.

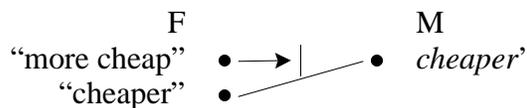
## 2. Blocking in Unidirectional Optimization Models

In this section we will consider blocking, which is the focus of this paper, and discuss the significance of this phenomenon for naive OT architectures.‡

### *Total Blocking*

One of the classic cases of blocking is where the existence of a lexical form produced by productive morphology blocks a phrasal form. For instance, consider English comparative and superlative adjectival inflections: the existence of “cheaper” can be said to block “more cheap”, whereas the absence of “expensiver” means that “more expensive” is available (Poser 1992; Bresnan 2001):

- (1) a. cheaper/cheapest, ?more/?most cheap  
 b. \*expensiver/\*expensivest, more/most expensive



We can also understand cases involving alternative binding possibilities for pro-forms in terms of blocking of meaning (Levinson 2000). In Marathi, for example, a preference for more local anaphora resolution prevents resolution outside of the clause, as in (2a); resolution outside the clause is possible only when there is no blocking, as in (2b) (Dalrymple 1993:19–20):

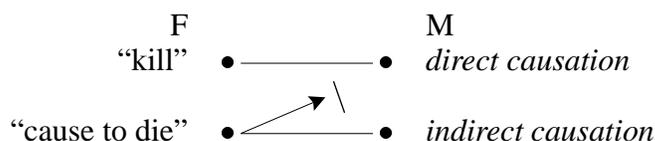
- (2) a. Tom<sub>i</sub> mhanat hota [ki Sue<sub>j</sub> ni swataahlaa<sub>\*i/j</sub> maarle]. [Marathi]  
 Tom said that Sue ERG ANAPHOR-ACC hit  
 ‘Tom said that Sue hit herself/\*him.’  
 b. Jane<sub>i</sub> mhanaali [ki [swataaci<sub>i</sub> parikshaa] sampli].  
 Jane said that ANAPHOR-GEN test finished  
 ‘Jane said that her test was over.’

The existence of blocked meanings is not modelled by naive production OT, since it makes no prediction about which interpretation of the same form should be preferred. Similarly, blocking of forms is not predicted, if we take the interpretation perspective alone.

‡ The discussion in the present paper closely follows the exposition given in Beaver and Lee (to appear), in which more extensive reviews of OT models are presented.

### *Partial Blocking*

Blocking can leave a form unemployed, but the unemployed form may soon find a new job, generally expressing something closely related to but subtly different from the canonical interpretation that one might have expected. This is partial blocking: an asymmetry is eliminated, but removal of a link creates a new form-meaning pair. An example from McCawley (1978) is that of causatives. The observation is that the existence of a lexical causative “kill” blocks “cause to die” from having its canonical meaning. “Cause to die” comes to denote a non-canonical killing, for instance one where the chain of causation is unusually long or unforeseeable.



Similarly, it has been often argued that the existence of a conventionalized, lexicalized irregular form blocks a form produced by regular morphological processes (e.g., affixation) from a canonical interpretation that one might have expected. An example from Kiparsky (1983) is the interpretation of “cutter”, a nominalization involving application of a regular and productive rule (“-er” addition). The observation is that when someone refers to “a cutter” they could not ordinarily be referring to an object for which a standard idiosyncratic expression exists, like “scissors” or “a bread knife”. So “a cutter” is interpreted as a non-canonical instrument used for cutting. As was the case for total blocking, partial blocking is not modelled by naive OT models.

Recently a class of bidirectional OT models have been proposed to handle shortcomings in naive OT models. We will now consider the *strong bidirectional* OT and *weak bidirectional* OT of Blutner (2000), the *asymmetric* OT model of Wilson (2001). We will show that each of these models provides at best a partial solution to the the problem of blocking. We will consider application of *medium strength* OT to the same problems.

### **3. Strong Bidirectional Optimization**

Besides the blocking phenomena we discuss here,§ arguments for bidirectional optimization have come from various sources. These include the production/comprehension asymmetry in child grammar (Smolensky 1996), decidability in computational processing (Kuhn 2001) and learning algorithms (Jäger, to appear). Given that production-based and interpretation-based optimization are both well motivated, a question immediately arises as to how the two directions of optimization can be combined into a coherent theory of language structure and interpretation. One option is to combine them conjunctively, producing a model which Blutner (2000) calls the *strong bidirectional* OT model. The idea is that in order to be grammatical, a form-meaning pair  $\langle f, m \rangle$  has to be optimal in both directions of optimization. That is, a form-meaning pair is strong OT optimal iff the form produces the meaning in Interpretation OT and the meaning produces the form in Production OT.

Strong OT offers a treatment of total blocking. Suppose that we are analyzing two forms  $f_1$  and  $f_2$  which are semantically equivalent and that we have some meaning  $m_1$  that is optimal for both forms. In interpretation optimization, the two forms would not belong to the same candidate set and thus would both be grammatical. In the Strong OT model,  $f_2$ , even if optimal

§ For applications of bidirectional OT to other cases of form-meaning asymmetries, see Smolensky (1998), Zeevat (2000), Asudeh (2001), Lee (2001), Vogel (to appear), among others.

in the interpretation-based optimization, may be blocked by the more economical alternative form  $f_1$ . Hence, the form-meaning pair  $\langle f_2, m_1 \rangle$  is removed from the set of the language generated by the Strong OT system.

Strong OT also opens up a simple way of modeling blocking of meaning. Consider the Marathi example in (2a) above. This sentence has the form  $[A_i \dots [\delta B_j \dots \text{anaphor} \dots ]]$ , in which A and B are potential antecedents for the anaphor and  $\delta$  is the domain in which the anaphor must have an antecedent (the minimal finite clause that contains the anaphor). Parsing this sentence will result in two classes of analyses: one in which the binding relation is local (i.e.,  $\text{anaphor} = j$ ) and one in which the binding relation is non-local (i.e.,  $\text{anaphor} = i$ ). In production-based optimization, the two interpretations do not compete with each other and thus the sentence is grammatical for both interpretations. In interpretation-based optimization, the former interpretation is preferred to the latter interpretation by a locality constraint on binding. As a result, anaphora resolution outside the clause is blocked by local anaphora resolution and hence removed from the set of interpretations generated by the Strong OT system. Taking together the two directions of optimization, we correctly predict not only that (2) is interpreted as  $\text{say}(\text{Tom}, \text{hit}(\text{Sue}, \text{Sue}))$ , but that it is the preferred way of expressing this meaning.

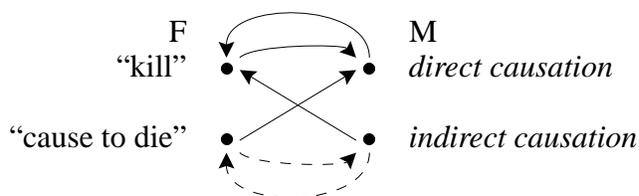
However, Strong OT fails to predict partial blocking. For example, strong OT predicts that “cause to die”, since it is blocked by the lexicalized “kill”, should be uninterpretable. But in fact it is only partially blocked, and comes to have an application in situations where “kill” would be deemed inappropriate. We now turn to Blutner’s proposed solution to this problem.

#### 4. Weak Bidirectional Optimization

Blutner’s *weak* notion of optimality, which we refer to simply as Weak OT, is an iterated variant of Strong OT that produces partial blocking instead of strict blocking. In Weak OT, sub-optimal candidates in a strong bidirectional competition can become winners in a second or later round of optimization.

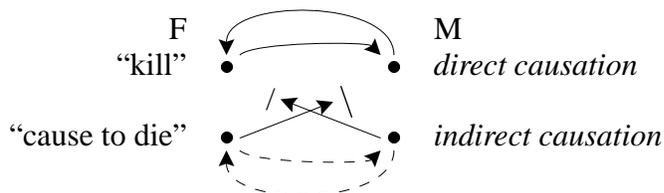
We illustrate how Weak OT predicts partial blocking using the example of lexical and periphrastic causatives “kill”/“cause to die” which we assume are matched on the meaning side by two possible interpretations, direct causation (canonical killing) and indirect causation (non-canonical killing). The following three diagrams, illustrate three phases of weak optimization. In the first diagram, all the unidirectionally optimal links are shown. In addition to the optimal links, two links are shown with dashed lines. Both of these links are unidirectionally sub-optimal at this stage, beaten by other candidates.

PHASE 1 — NAIVE INTERPRETATION AND PRODUCTION:



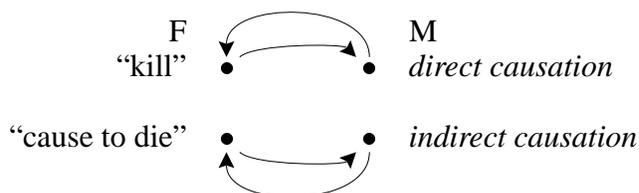
In phase 2 of Weak optimization, two unidirectionally optimal links are blocked, leaving a single bidirectionally optimal link, that between the form “kill” and the meaning corresponding to direct causation.

PHASE 2 — PRUNING:



Now we graft the originally sub-optimal links between “cause to die” and the indirect causation meaning back into the picture, since the candidates which originally beat them have been removed by blocking. This gives us two bidirectionally optimal links. In the resulting happy picture, all the candidate meanings are uniquely expressible and all the candidate forms are uniquely interpretable:

PHASE 3 — GRAFTING:



Blutner (2000) argues that Weak OT captures the essence of the pragmatic generalization that “unmarked forms tend to be used for unmarked situations and marked forms for marked situations” (Horn 1984:26). As Beaver and Lee (to appear) point out, however, Weak OT suffers from a serious problem of over-generation. Specifically, the process of adding extra links will eventually provide links for every form (if there are at least as many forms as meanings), or every meaning (if there are at least as many meanings as forms).

The problem of over-generation just mentioned obviously affects accounts of other phenomena involving form-meaning asymmetries. First, note that Weak OT fails to predict total blocking. While in the first phase of optimization the successful Strong OT predictions appear to be reproduced, in latter stages peculiar new form-meaning pairs will emerge as winners. Provided the set of candidate meanings is large, Weak OT never predicts total blocking: all blocking is partial. So a form like “more cheap”, for example, would presumably be the correct expression of some meaning in Strong OT.

Furthermore, Weak OT does not predict the existence of ineffable meanings and uninterpretable forms. For example, in Italian, multiple wh-questions are infelicitous for most speakers (Legendre, Smolensky and Wilson (1998)). Yet in this case Weak OT predicts that a multiple question is expressible since the grafting stage of Weak OT can add links to make it expressible. Uninterpretability is not predicted either since an uninterpretable form can be linked to a meaning by the grafting process.

## 5. Asymmetric Bidirectional Optimization

Wilson (2001) discusses a model in which interpretation precedes production. We refer to this as Asymmetric OT. (For discussion of different asymmetric models, see Zeevat (2000) and Vogel (to appear).) In more detail, the idea of Asymmetric OT is as follows: (i) Interpretation: Given any form-meaning pair  $\langle f, m \rangle$ , find the most harmonic semantic interpretation of  $f$ . (ii) Production: Given input meaning  $m$ , take as candidate outputs the set of forms  $f$  such that  $\langle f, m \rangle$  is optimal in stage one, and perform standard OT production optimization with this restricted candidate set. Note that the set of optimal form-meaning pairs in production is

a subset of the optimal form-meaning pairs in interpretation. The set of meanings which are in some optimal pair is the same in interpretation and production, although the number of forms would, for constraint sets which are of interest, be smaller in production than in comprehension. It is the reduced set of forms in production, those which result from the two stage process, which are to be considered grammatical, even though there are others which are interpretable.

Wilson (2001) uses this version of OT to model partial blocking involving relativized minimality (see the examples in (2)) and referential economy in anaphor binding. An example of a referential economy effect is provided by the following contrast between the Icelandic third-person pronoun *hann* and the anaphor *sig*:

(3) Referential economy in Icelandic (Maling 1984: 212)

- a. Haraldur<sub>i</sub> skipaði mér að raka \*hann<sub>i</sub>/sig<sub>i</sub>.  
Harold ordered me to shave him/ANAPHOR  
'Harold ordered me to shave him.'
- b. Jón<sub>i</sub> veit að María elskar hann<sub>i</sub>/\*sig<sub>i</sub>.  
Jon knows that Maria loves him/ANAPHOR  
'Jon knows that Maria loves him.'

In (3a), the matrix subject *Haraldur* can grammatically bind the anaphor but not the pronoun. In (3b), in contrast, the pronoun is grammatical. According to Wilson, contrasts like the one in (3) follow from an interaction of two constraints: the LOC(AL) ANT(ECEDENT) constraint, which is a locality requirement on anaphor binding, and the REF(ERENTIAL) ECON(OMY) constraint, which requires a bound element to be an anaphor.

For the anaphora data above, the consequence of Asymmetric OT is as follows: for the interpretation optimization based on the string containing an anaphor, REFECON has no effect, since all candidates contain a bound anaphor. Thus, LOCANT gives us a local binding interpretation as the winner. In the interpretation optimization with the string containing a pronoun as the input, both local and nonlocal binding interpretations have the same constraint profile for REFECON and LOCANT, so both are selected as winners. The production optimization which takes nonlocal binding as input (Tableau 1), however, does not include the form containing an anaphor in the candidate set, since nonlocal binding loses in the interpretation competition with this form as input. As a result, the candidate with a pronoun wins trivially, and the more marked meaning, i.e., nonlocal binding, is predicted to be realized as a more marked (less economical) form. Note that the production tableau for local binding interpretation (Tableau 2) contains both forms, so this meaning is still realized as a form containing an anaphor:

Tableau 1. Production I (Asymmetric OT)

	REFECON	LOCANT
Input: nonlocal binding ( $m_2$ )		
☞ b. [ $A_i[\delta B_j \dots \text{pronoun}_i]$ ] ( $\langle f_2, m_2 \rangle$ )	*	

Tableau 2. Production II (Asymmetric OT)

	REFECON	LOCANT
Input: local binding ( $m_1$ )		
☞ a. [ $A_i[\delta B_j \dots \text{anaphor}_j]$ ] ( $\langle f_1, m_1 \rangle$ )		
b. [ $A_i[\delta B_j \dots \text{pronoun}_i]$ ] ( $\langle f_2, m_1 \rangle$ )	*	

So far we have looked at the Asymmetric OT analysis of partial blocking in anaphor binding. Asymmetric OT, however, fails to model the standard cases of partial blocking discussed earlier. What distinguishes Wilson’s anaphora data is that the pair of a marked form and an unmarked meaning ( $\langle f_2, m_1 \rangle$  in the above tableaux) and the pair of a marked form and a marked meaning ( $\langle f_2, m_2 \rangle$  in the above tableaux) have the same constraint profile for the constraint favoring a less marked meaning (see the tableaux above). As noted above, the LOCANT constraint, preferring local binding over nonlocal binding, targets only an anaphor ( $f_1$ ) but not a pronoun ( $f_2$ ). As a result, the pairs  $\langle f_2, m_1 \rangle$  and  $\langle f_2, m_2 \rangle$  both survive in interpretation. Now when we come to realize  $m_1$ , we don’t choose  $f_2$  but instead choose  $f_1$ . In other words, in production, as illustrated in the tableaux above, the pair  $\langle f_1, m_1 \rangle$  blocks  $\langle f_2, m_1 \rangle$ , making  $\langle f_2, m_2 \rangle$  available.

The standard cases of partial blocking differ in that the two pairs  $\langle \text{marked form}, \text{unmarked meaning} \rangle$  and  $\langle \text{marked form}, \text{marked meaning} \rangle$  do not have the same constraint profile (In Tableau 3, ECONOMY is a formal markedness constraint (a preference for short forms), and CANON is a semantic markedness constraint (a preference for the canonical mode of causation)):

Tableau 3. Interpretation (Asymmetric OT)

	ECONOMY	CANON
Input: <i>cause to die</i>		
☞ a. $\langle \text{cause to die}, \text{direct causation} \rangle$	*	
b. $\langle \text{cause to die}, \text{indirect causation} \rangle$	*	*

Asymmetric OT, while successfully modelling total blocking and certain cases of partial blocking that are interpretation-driven, fails to predict the full “division of pragmatic labor” whereby more marked forms are associated with more marked meanings. The constraints above yield a preferred interpretation of “cause to die” as involving canonical direct causation. Therefore, in the production competition with indirectly caused death as input meaning, “cause to die” is not even amongst the candidate outputs, and cannot be the winner.

We can see the difference between the two cases, and how they are treated, graphically. Diagrams (i–v), below, show both production and interpretation relations. The first two diagrams represent direct applications of naive back-and-forth OT. the first illustrates standard partial blocking cases yielding marked meanings for marked forms such as “cutter” and “cause to die”. The second diagram represents the situation Wilson describes for Icelandic anaphora. The only difference is an extra arrow from the marked form to the marked meaning in the second diagram.

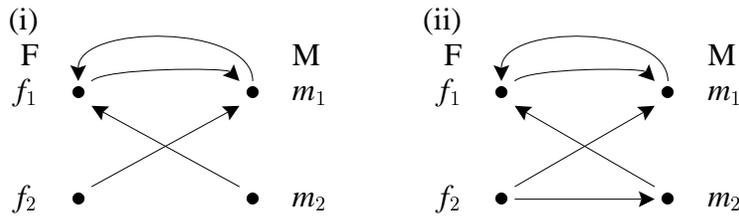
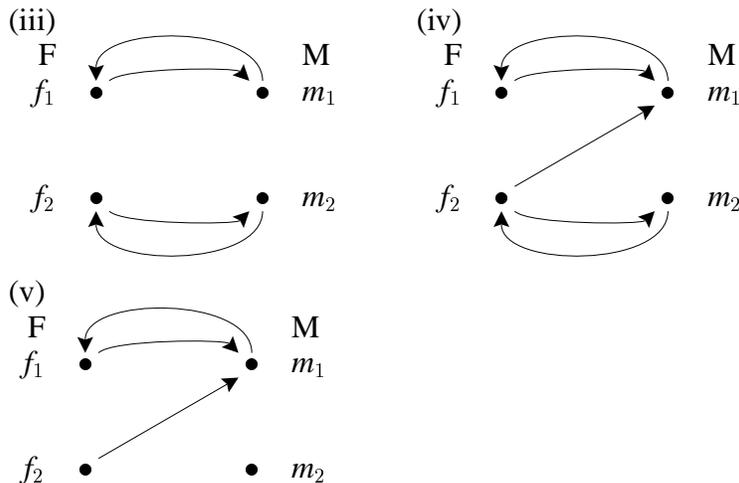


Diagram (iii) shows the results of applying Weak OT to either the situation in (i) or that in (ii): the marked form becomes uniquely associated with the marked meaning in both directions of optimization, while the unmarked form and unmarked meaning continue to be a bidirectionally optimal pair as they were in the original cases. Asymmetric OT does not achieve the harmonious situation depicted in (iii) for either of the situations given by (i) and (ii). What it does achieve is represented in (iv) and (v). Diagram (iv) shows the results of applying Asymmetric OT (IP) to the Icelandic anaphora case in (ii). Here we see that the division of labor depicted in (iii) is almost achieved, except that there remains the possibility of interpreting the marked form as the unmarked meaning. This is a result of the fact that Wilson’s proposal does not innovate above naive back-and-forth OT as regards interpretation. When Asymmetric OT is applied to the classic “cause to die” situation in (i), what results is (v). Wilson’s system does not succeed in creating any link between the marked form and the marked meaning, so we can see that it does not provide a very general model of partial blocking. In these cases we might better describe what it does as “almost blocking”.



## 6. Medium Strength Optimization

It was noted above that Weak OT suffers from a serious problem of over-generation, as well as providing a problematic solution to total blocking. Could a variant of Weak OT maintain the analysis of partial blocking without such great over-generation? The possibility we will consider here is the variant of Weak OT discussed by Beaver (to appear). This variant system, which we refer to as Medium Strength OT, performs only one iteration of the Weak OT process, pruning once and grafting once. As a result, it maintains some of the properties of Weak OT, but lacks Weak OT’s “everyone’s a winner” profligacy.

In more detail, Medium Strength OT operates as follows. (i) starting with a set of production links and a set of interpretation links, find strong bidirection optimal form-meaning pairs. (ii) mark form-meaning pairs that have identical form or meaning to a bidirectionally optimal pair, but worse constraint violations. (iii) recalculate production and interpretation

links for the remainder to get a new set of strong bidirection optimal pairs. The set of medium strength winners is just the union of the winning sets from each round.

Stage (ii) corresponds loosely to the pruning phase (phase 2) of Weak OT. In Medium Strength OT, the recoverability condition on optimality (Smolensky 1998) is implemented into the model as a meta-linguistic constraint that acts as a blocking mechanism in the pruning phase. Let us term this **\*BLOCK**, defined as follows:

- (4) **\*BLOCK**: A form-meaning pair may not be dominated by (i.e., loses out to) a bidirectionally optimal candidate in either direction of optimization in the tableau consisting of all constraints except **\*BLOCK**.

We illustrate how Medium Strength OT predicts partial blocking using the example of the Icelandic anaphora discussed in section 5. Consider first the following bidirectional tableau, in which the **\*BLOCK** column is blank, but other constraint violations are marked. Candidate (a), with a locally bound anaphor, emerges immediately as a bidirectionally optimal form-meaning pair:

Tableau 4. Partial blocking in Medium OT I

	*BLOCK	REFECON	LOCANT
↗ a. [A <sub>i</sub> [δ B <sub>j</sub> ... anaphor <sub>j</sub> ]] (⟨f <sub>1</sub> , m <sub>1</sub> ⟩)			
b. [A <sub>i</sub> [δ B <sub>j</sub> ... pronoun <sub>j</sub> ]] (⟨f <sub>2</sub> , m <sub>1</sub> ⟩)		*	
c. [A <sub>i</sub> [δ B <sub>j</sub> ... anaphor <sub>i</sub> ]] (⟨f <sub>1</sub> , m <sub>2</sub> ⟩)			*
↘ d. [A <sub>i</sub> [δ B <sub>j</sub> ... pronoun <sub>i</sub> ]] (⟨f <sub>2</sub> , m <sub>2</sub> ⟩)		*	

Now let us consider how violations of **\*BLOCK** are evaluated. Of the three candidates that are originally non-optimal, candidates (b) and (c) have identical form or meaning to the bidirectionally optimal candidate (candidate (a)), but worse violations of the standard constraints. Hence they are marked with a star in the **\*BLOCK** column, as shown in Tableau 5:

Tableau 5. Partial blocking in Medium OT II

	*BLOCK	REFECON	LOCANT
↗ a. [A <sub>i</sub> [δ B <sub>j</sub> ... anaphor <sub>j</sub> ]] (⟨f <sub>1</sub> , m <sub>1</sub> ⟩)			
b. [A <sub>i</sub> [δ B <sub>j</sub> ... pronoun <sub>j</sub> ]] (⟨f <sub>2</sub> , m <sub>1</sub> ⟩)	*	*	
c. [A <sub>i</sub> [δ B <sub>j</sub> ... anaphor <sub>i</sub> ]] (⟨f <sub>1</sub> , m <sub>2</sub> ⟩)	*		*
↘ d. [A <sub>i</sub> [δ B <sub>j</sub> ... pronoun <sub>i</sub> ]] (⟨f <sub>2</sub> , m <sub>2</sub> ⟩)		*	

Thus Medium Strength OT produces two bidirectionally optimal candidates, ⟨f<sub>1</sub>, m<sub>1</sub>⟩ and ⟨f<sub>2</sub>, m<sub>2</sub>⟩, so we can see that it successfully predicts the full ‘division of pragmatic labor’ whereby more marked forms are associated with more marked meanings. The same result occurs with the standard cases of partial blocking, so no tableau will be shown here.

Although we will not provide detailed analyses here, it should be obvious that Medium Strength OT can model ineffability and uninterpretability: the one extra round of optimization produces some new pairs, but it does not produce anything as weird as “colorless green ideas” or “frodlsnoop”, and it need not produce a short way of expressing multiple questions like “Who ate what?” in Italian.

## 7. Conclusion

Most previous bidirectional OT models have failed to model the full range of blocking phenomena. The one system which does model the full range, Blutner’s Weak system, does so only at the expense of massive over-generation, making it untenable as a model of online interpretation or production. The Medium Strength system is a compromise between Weak and Strong OT. The compromise can be understood in terms of the following restatement of these three notions of optimality:

**Strong** The set  $S$  of strongly optimal form-meaning pairs is the largest set (of form-meaning pairs) which are undominated in interpretation and undominated in production.

**Weak** The set  $W$  of weakly optimal form-meaning pairs is the largest set which is undominated by other weakly optimal form-meaning pairs in interpretation and undominated by other weakly optimal form-meaning pairs in production.

**Medium** The set  $M$  of medium-strength optimal form-meaning pairs is the largest set which is undominated by other strongly optimal form-meaning pairs in interpretation and undominated by other strongly optimal form-meaning pairs in production.

By these definitions it is clear that  $S \subseteq M \subseteq W$ . Strong OT, like Asymmetric OT, does not produce enough form-meaning pairs to account adequately for partial blocking. Weak OT produces enough for partial blocking, but also produces many form-meaning pairs which have no linguistic significance. So the question is, does Medium Strength OT yield enough pairs, and does it yield too many pairs. This is an empirical question.

Suppose that form-meaning pairs created as a result of partial blocking were known synchronically to cause yet further partial blocking. A hypothetical case would be if use of “cause X to die” to refer to indirectly caused death prevented “lead to the death of X” from having this meaning, and caused the latter locution to have yet another interpretation. Such a chain of partial blocking would constitute a counterexample to Medium Strength OT and force us to move further along the hierarchy towards Weak Bidirectional OT. However, we are not currently aware of any attested counter-examples of this sort. Thus we offer Medium Strength OT as a working hypothesis as to how interpretation and production interact to co-determine what is optimal in human language.

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