Sense and Simplicity:
Bidirectionality in Differential Case Marking

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1 Introduction

In recent years a number of different models of bidirectional optimization have been introduced in which productive and interpretive optimization are interdependent in one way or another. One of the reasons for this interest in bidirectionality is the fact that there is a range of phenomena such as ambiguity and (partial) blocking which cannot be straightforwardly accounted for with standard unidirectional optimization. Instead, they seem to require the integration of the hearer’s and the speaker’s perspective. At the same time, it has been shown that even though both OT syntax and OT semantics are complete theories about the relation between form and meaning the independent combination of the two theories does not yield a model that assigns a consistent relation between form and meaning (Zeevat 2000; Beaver and Lee 2004). That is, it is possible that one does not end up with the meaning one started with when OT syntax and semantics are applied successively. To overcome these problems different models of bidirectional optimization have been proposed in which OT syntax and semantics are dependent on one another: the outcome of one direction of optimization constrains the outcome of the other direction. Among them we can distinguish two main types. On the one hand, there are asymmetric models in which either interpretive optimization is constrained by productive optimization (Zeevat 2000) or productive optimization is constrained by interpretive optimization (Wilson 2001). On the other hand, there are symmetric models in which interpretive and productive optimization constrain each other simultaneously (Blutner 2000). It seems that the latter type of model is currently the favoured one.

In this paper I discuss a set of case-marking facts which receive a straightforward analysis using a bidirectional model. However, I will not argue in favour of a symmetric model, but rather in favour of an asymmetrical one. In fact, I will propose a new variant of asymmetrical bidirectional optimization
in which productive optimization is constrained by interpretive optimization. In contrast to existing models this new approach will be able to handle the data under discussion. The facts central to the discussion will come from languages in which the differential case marking of direct objects is based on recoverability of grammatical function. In these languages overt marking of objects is only required in cases of actual ambiguity. This motivation behind differential object marking will be shown to exist next to the well-known markedness considerations as discussed by Aissen (2003). I will argue that both types of systems can be modeled in the bidirectional architecture proposed in this paper. As such, this paper further develops the modeling of differential object marking in Optimality Theory.

The structure of the paper is as follows: in the next section I introduce the relevant case-marking facts. These will be modeled in section 3 where I also outline the new asymmetric model of bidirectional optimization. In section 4 the proposed model will be compared to existing models of Bidirectional Optimality Theory, after which conclusions will be reached in section 5.

2 Case Distinguishability

Case marking is an extremely effective mechanism to ensure recoverability of grammatical relations, as it marks the grammatical function directly on the argument. Indeed, in the functional-typological literature one of the main functions ascribed to case marking is a distinguishing one (Comrie 1989, see Song 2001 for discussion). Under this view, case marking is used to distinguish the core arguments in transitive sentences. This function is often taken to explain the fact that the majority of languages with overt case marking leave one of the arguments in a transitive sentence unmarked. That is, most languages follow a nominative/accusative or an ergative/absolutive system in which the subject receives unmarked nominative or the object unmarked absolutive case respectively. This falls out from the distinguishing function in combination with economy considerations, as it suffices to mark one argument overtly to assess the grammatical functions of both arguments of a transitive sentence (cf. Dixon 1979).

In recent years the distinguishing function of case regained a lot of attention due to a surge of interest in the phenomenon of differential object marking, initiated by Aissen (2003; see also de Swart 2003; de Hoop and Narasimhan 2005; de Hoop and Malchukov 2007; de Swart 2007; de Hoop and Malchukov 2008; Malchukov 2006, 2008). In a differential object marking system only a subset of direct objects is marked overtly depending on certain features, most notably animacy and definiteness. Following Aissen
such systems can be analyzed as exhibiting an extremely economical application of the distinguishing function of case by marking only those objects which are most in need of disambiguation with respect to subjects. In this section, I will show that the distinguishing function of case does not apply in a uniform way to differential object marking systems and that in fact two types of distinguishability (local and global) should be acknowledged. For some languages these two types can even be shown to be at work simultaneously (see also de Swart 2003, 2007; Malchukov 2008). In the next section I will demonstrate how these two types of distinguishability correspond to different types of optimization.

The most common characterization of differential object marking (DOM) is that it generally only applies to objects which are high in prominence (Aissen 2003; de Hoop and Narasimhan 2005; de Hoop and Malchukov 2008; de Swart 2007; Malchukov 2008). Thus, in the Papuan language Imonda all and only human direct objects are obligatorily marked. This is illustrated by the contrast between the human object in (1) and the animate one in (2):

1

(1) aial edel-m ue-ne-wōl fe-f
    father human-OBJ CL-eat-PL do-PRS
    ‘Her father habitually eats humans.’

(2) ne ka-ne malhu ōm uōn-ue-ne-na-ba
    2SG 1SG-POS pig yesterday AC-CL/eat-PST-TOP
    ‘because you ate my pig with them yesterday’

Aissen (2003; cf. also Comrie 1989 and Bossong 1991), argues that the marking patterns found in DOM systems can be understood in terms of markedness reversal, i.e., what is marked for a subject is unmarked for an object and vice versa. If we consider features such as animacy and definiteness, she claims that it is unmarked for a transitive subject and marked for a direct object to be animate and definite. On the other hand, it is unmarked for an object and marked for a subject to be inanimate and indefinite. In this view, objects that resemble prototypical subjects are in need of disambiguation with respect to those subjects and hence will receive overt (case) marking.

1In the examples the following abbreviations are used: AC-accompanier, ACC-accusative, CL-classifier, F-feminine, FAC-factive, IMP-imperfect, OBJ-object marker, PF-perfect, PL-plural, POS-possessive,PRS-present, PST-past, Q-question marker, SG-singular, TOP-topic.

2Aissen’s characterization of unmarked objects is not uncontroversial (see Næss 2004; de Swart 2007 for discussion). However, when one interprets markedness as frequency, Aissen’s argumentation can be maintained. Given that animate objects are less frequent than inanimate ones, case is used to signal deviations from this frequency distribution.
In other words, marked objects have concomitant marked forms, whereas unmarked objects are formally unmarked as well. This can be interpreted as a manifestation of the iconicity principle, which states that markedness of form goes hand in hand with markedness of meaning (cf. Horn’s principle of the division of pragmatic labor).

This analysis in terms of markedness reversal makes use of the distinguishing function of case in a generalized way (Aissen 2003; de Swart 2003; Malchukov 2008). That is, it determines the need for overt case marking of an object on the basis of comparison not to the actual subject, but rather to a prototypical subject. In order to determine the use of case marking it only has to take into account the features of the direct object in the sentence. This type of disambiguation can be labelled local distinguishability (cf. Silverstein 1976). As a result, a DOM system based on local distinguishability also marks objects when there is no actual ambiguity. Such a situation is, for instance, found in the Dravidian language Malayalam, as the following example illustrates:

MALAYALAM (Dravidian; Asher and Kumari 1997:203)
(3) \(\text{Avan oru pafuvin-e vayyi.}\)
\(\text{he a cow-ACC buy.PST}\)
‘He bought a cow.’

In Malayalam, only animate, but generally not inanimate objects are marked with accusative case. As the example in (3) shows this even holds in cases when there is no potential ambiguity. It is highly unlikely that (3) can be assigned a reverse interpretation.\(^3\)

In terms of the optimization model to be discussed in the next section local distinguishability can be shown to be the result of purely productive optimization. That is, whenever there is an object of a certain type, e.g. animate or definite, in the input it has to be assigned overt case irrespective of other features of the clause. DOM systems based on local distinguishability can be opposed to those based on global distinguishability (de Swart 2003, 2007; Malchukov 2008). In the latter systems occurrence of overt object marking is determined by a comparison between the features of the subject and the object. Such systems use case as a real-time recoverability mechanism which helps the speaker to convey the meaning he intended to express in an unambiguous way. In the next section I will show how global distinguisha-

\(^3\)It should be noted, however, that due to the fact that Malayalam is a verb-final language, there may be a temporal ambiguity with respect to which of the two preverbal NPs is the subject and which one the object. Accusative case helps to overcome this temporal ambiguity.
bility can be modelled in terms of the interplay between the speaker’s and the hearer’s perspective. That is, it involves both productive and interpretative optimization.

A clear example of a language in which object marking depends on global distinguishability is Awtuw. In this Papuan language, the interpretation of sentences is dependent on the relative ranking of the arguments in the animacy hierarchy (human > animate > inanimate) and the use of overt object marking (Feldman 1986). In the absence of object marking, the argument which ranks highest in the animacy hierarchy is interpreted as the subject, cf. (4). When the two arguments are equal in animacy they are interpreted as a conjoined subject, cf. (5).

\begin{language} {Awtuw (Papuan; Feldman 1986:110)}
\begin{languageexample} {4} {4}
\begin{languageitem} {Tey \textit{tale} yaw \textit{d-æl-i}.} {3.F.SG woman pig FAC-bite-PST}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {4}
\begin{languageitem} {‘The woman bit the pig.’ \textbf{not}: ‘The pig bit the woman.’} {4}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {5} {5}
\begin{languageitem} {Piyren \textit{yaw di-k-æl-iy}.} {dog pig FAC-IMP-bite-IMP}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {5}
\begin{languageitem} {‘The dog and the pig bite.’ \textbf{not}: ‘The dog is biting the pig/The pig is biting the dog.’} {5}
\end{languageitem}
\end{languageexample}
\end{language}

These default interpretations can be overruled by the use of case marking, as illustrated in (6) and (7):

\begin{language} {Awtuw (Papuan; Feldman 1986:110)}
\begin{languageexample} {6} {6}
\begin{languageitem} {Tey \textit{tale-re} yaw \textit{d-æl-i}.} {3.F.SG woman-OBJ pig FAC-bite-PST}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {6}
\begin{languageitem} {‘The pig bit the woman.’} {6}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {7} {7}
\begin{languageitem} {Piyren-re \textit{yaw di-k-æl-iy}.} {dog-OBJ pig FAC-IMP-bite-IMP}
\end{languageitem}
\end{languageexample}
\begin{languageexample} {7}
\begin{languageitem} {‘The pig is biting the dog.’} {7}
\end{languageitem}
\end{languageexample}
\end{language}

By marking ‘woman’ in (6) with the object suffix it has to be interpreted as the object of the sentence, which goes against the interpretive hierarchy at work in (4). Use of the object marker in (7) makes it impossible for the two arguments to be interpreted as a conjoined subject. Instead, the argument ‘dog’ has to be interpreted as the object. Thus, case marking in Awtuw is used in tandem with an interpretive constraint based on the animacy hierarchy. Case is used only in those situations where absence of overt marking would result in a different interpretation due to this hierarchy.\footnote{The Papuan language Fore (Scott 1978; Donohue 1999), exhibits differential subject}
As such, case represents a robust mechanism which ensures that the meaning intended by the speaker is recoverable for the hearer.

The hierarchy-based case marking found in Awtuw represents a rather standardized way in which global distinguishability can manifest itself. We also find languages exhibiting object marking based on global distinguishability, which does not depend on a hierarchy. For instance, Gerner (2008) argues that the Tibeto-Burman language Yongren Lolo has a DOM system based exclusively on ambiguity avoidance. In this language the multifunctional marker \( t^{h}ie^{21} \) is obligatorily used in clauses which are ambiguous due to their combination of predicate and arguments (here and in later examples from Yongren Lolo superscript numbers indicate tones). This requirement pertains to sentences with animate and inanimate arguments alike. The need for formal object identification in these cases is high due to the fact that preverbal word order is free. The example in (8) shows that absence of the object marker would result in an ambiguous structure, which is avoided in the language. This ambiguity is absent in the second example (9) where the object marking disambiguates towards an SOV order. Moreover, the presence of the object marker results in freedom of word order such that subject and object can be reversed.

Yongren Lolo
(Tibeto-Burman; Gerner 2008:299)

(8) \( yo^{33} ce^{33} mo^{33} tso^{33} zi^{33} \)
1SG snake follow go
‘I follow the snake.’ or ‘The snake follows me.’

(9) \( yo^{33} ce^{33} mo^{33} t^{h}ie^{21} tso^{33} zi^{33} \)
1SG snake OBJ follow go
‘I follow the snake.’

In clauses without an inherently ambiguous predicational structure the object marker is typically absent. Gerner (2008) even reports the total absence of this marker in such unambiguous cases from his textual materials. He nevertheless shows that in elicited sentences the marker can be used in such contexts when it acquires a contrastive function. The following example marking under nearly identical conditions to those found in Awtuw. This is not unexpected from the viewpoint of global distinguishability, given that marking of either the subject or the object suffices to distinguish the two arguments of a transitive sentence from one another, cf. the abundance of accusative and ergative alignment patterns. Differential subject marking based on global distinguishability seems to be less frequent than differential object marking. As such, it mirrors the skewed distribution between accusative and ergative alignment systems, where the former is much more frequent than the latter. There may be a principled explanation for the correlation between these two observations (see Malchukov 2006, 2008 for discussion).
shows an unambiguous sentence without the object marker:

Yongren Lolo (Tibeto-Burman; Gerner 2008:301)

(10) \[ ni^{\text{33}} mi^{\text{33}} mo^{\text{21}} y^{\text{21}} m\epsilon^{\text{22}}  \varepsilon^{\text{21}} ? \]

2PL earth plough want Q

‘Do you want to plough the earth?’

Due to the lexical meaning of the verb ‘to plough’ only the noun referring to the earth can be the object and therefore overt object marking is not necessary to make the meaning of the sentence uniquely recoverable.

In the above discussion I have shown that two different notions of distinguishability underlie DOM cross-linguistically. These two patterns of local and global distinguishability can also occur in one single language. For instance, in Imonda, already discussed above, animates may be and often are marked when they interact with other animals. One such example is given in (11):

Imonda (Papuan; Seiler 1985:165)

(11) \[ tin^{\text{bi}} ha^{\text{m}} ue-ne-fan \]

python snake-OBJ CL-eat-PF

‘The python has swallowed the snake.’

This example shows a marked animate object and as such contrasts with the unmarked animate object in (2) above. The examples differ on another important point. Whereas the subject in (2) was human, the subject in (11) is animate. This shows that the animacy feature of the subject influences the case marking of the object. Hence, the pattern in (11) should be interpreted in terms of global distinguishability. These kinds of patterns are common in languages with an otherwise local DOM system. In Malayalam, normally only animate objects are marked, cf. (3) above, but case marking does occur on inanimate objects in those situations where ambiguity may otherwise arise (Asher and Kumari 1997; de Swart 2007). Such seemingly optional patterns of DOM can only be explained when both local and global distinguishability are taken into account.

In sum, I have shown that DOM languages exhibit an economical case system as they limit the use of case to situations of ambiguity. Some languages follow a strategy of local distinguishability in which case is dependent on certain features of arguments and only related to ambiguity in a generalized way. Most of the attention in the next section will, however, go to the global distinguishability systems as found in Awtuw and Yongren Lolo. In these languages case marking is used only in those situations where otherwise actual ambiguity will arise or where the intended meaning is overruled.
by other interpretive mechanisms. Below, I demonstrate that such case systems can be analyzed in terms of a bidirectional model in which both the hearer’s and the speaker’s perspective are taken into account. The systems based on local distinguishability will be shown to naturally fit into this model even though they rely solely on the speaker’s perspective.

3 Recoverability as Bidirectionality

Restricting the use of overt case marking to those situations in which the intended meaning may not be recoverable implies that the speakers of the languages with a DOM system based on global distinguishability take into account the hearer’s perspective as well. That is, in order to determine whether or not to use overt case they have to consider whether the absence of case results in the intended interpretation. As such, the case systems discussed above are prime candidates for an analysis in terms of Bidirectional Optimality Theory, an extension of regular (unidirectional) Optimality Theory as developed by Prince and Smolensky (1993/2004).

In standard Optimality Theory (OT) a distinction is made between OT syntax and OT semantics. The former concerns productive optimization from meaning to form, and the latter interpretive optimization from form to meaning. Both OT syntax and OT semantics are complete theories about the relation between form and meaning. However, it has been argued that the independent combination of the two theories does not yield a model that assigns a consistent relation between form and meaning (Zeevat 2000; Beaver and Lee 2004). That is, it is possible that one does not end up with the meaning one started with when OT syntax and semantics are applied successively. To overcome this problem different models of bidirectional optimization have been proposed in recent years in which OT syntax and semantics are dependent on one another, as the outcome of one direction of optimization constrains the outcome of the other direction. Several of these models have been applied to account for phenomena involving recoverability similar to the one discussed here (cf. Donohue 1999; Lee 2001; Aissen 2004). Nevertheless, I will adopt a new version of Bidirectional Optimality Theory for reasons to be discussed in section 4.

In order to describe the DOM systems based on global distinguishability, I introduce here an asymmetric version of bidirectional OT similar in spirit to earlier work (Smolensky 1998; Donohue 1999; Zeevat 2000; Wilson 2001) (see section 4 for a comparison of these different approaches; cf. also Beaver and Lee 2004). In this model the outcome of the production component is constrained by the interpretational component, but not (necessarily) vice
versa. More specifically, I propose that a form \( f \) is bidirectionally optimal for a given meaning \( m \) iff the meaning \( m \) is uniquely recoverable from that form \( f \) and there is no form \( f' \) which is less marked than \( f \), i.e. a better form from the viewpoint of productive optimization, and from which \( m \) is uniquely recoverable. A meaning \( m \) is uniquely recoverable from a form \( f \) iff it is the unique optimal candidate in the interpretive optimization of \( f \). In this model a form which is optimal from the production perspective can be rejected as the output candidate when it results in the wrong interpretation, i.e. an interpretation different from the one intended. As a result, a candidate which is suboptimal from the production perspective can become bidirectionally optimal (given that it does express the intended meaning).

In the proposed model the speaker is constantly monitoring himself to ensure that what he wants to convey is said in the right way. Under this interpretation (asymmetric) bidirectionally is thus not (necessarily) about speaker-altruism but rather about speaker-egoism. It is the need of the speaker to make sure that the hearer understands him in order to achieve his own (communicative) goals (see Blutner and Strigin, this volume, for further discussion and a slightly different view).

Before showing how this model applies to the data discussed above, let me first introduce the constraints involved. In my analysis I will only employ constraints that have already been proposed by other authors. The first is a general economy constraint on case marking. As noted above, economy considerations are often invoked in order to explain why in a majority of languages with case marking only one of the arguments of a transitive sentence is overtly marked. Therefore, I take the following constraint to hold: \(^5\)

\[(12) \quad \text{Case-Economy: avoid the use of overt case marking.}\]

This production constraint reflects the idea that case is used economically in differential object marking languages (cf. Aissen 2003). It is violated by the use of overt case marking and as such favors unmarked objects over marked ones.

On the interpretation side I employ three constraints. I follow Zeevat (2000; see also Zeevat and Jäger 2002) in using the general constraint \( \text{FAITHINT} \) which requires hearers to interpret everything the speaker has said. In the presence of overt morphology this constraint guides the hearer to the right interpretation:

\(^5\)An economy constraint on case marking can be found in one formulation or the other in many approaches of different theoretical persuasions. See Malchukov and de Swart (2008) for discussion and references.
(13) **FAITHINT**: make use of all available morphosyntactic information.

This constraint is violated by any interpretation in conflict with the provided morphosyntactic information. An example of such a violation is assignment of the subject function to an argument marked with accusative case. Following de Hoop and Lamers (2006) this constraint may be viewed as a family of constraints each related to a different formal distinguishability mechanism such as case and word order, which may be in conflict with one another in certain languages. Given that this is not the case in the data I discuss in this paper I use **FAITHINT** as a shorthand notation. This constraint is (potentially) in conflict with constraints which promote the interpretation of sentences exclusively on the basis of semantic information.

The first semantic constraint used in the analysis is **SELECTION** (cf. de Hoop and Lamers 2006):

(14) **SELECTION**: obey the selectional restrictions of the verb.

As was shown in the previous section, the argument structure of a given verb may be a crucial guide in interpretation. This is reflected in this constraint which is violated by any interpretation that goes against such restrictions. The other semantic constraint incorporates the influence of animacy on interpretation (cf. de Hoop and Lamers 2006):

(15) **PROMINENCE**: the argument highest in animacy is the subject.

This constraint is violated by interpretations in which the object ranks higher in the animacy hierarchy than the subject. It was shown to play an important role in the interpretation of Awtuw sentences. In this language **PROMINENCE** has a clear grammatical effect. This does not hold for every language, however. For instance, Gerner (2008) does not provide any evidence for the relevance of this constraint in Yongren Lolo. Nevertheless, it should be noted that there is robust psycholinguistic evidence for the influence of animacy information on the interpretation of sentences even in languages in which it may not be grammatically visible (see Lamers and de Hoop 2005; de Hoop and Lamers 2006; Grewe et al. 2007). This may also turn out to hold for Yongren Lolo when the relevant experiments are conducted. As it is, I will assume that the constraint **PROMINENCE** is very low-ranked in Yongren Lolo and therefore virtually inactive, i.e. without much effect on the optimization outcome. Accordingly, I will not include this constraint in the tableaux when discussing Yongren Lolo. Alternatively, under a stochastic interpretation of OT (Boersma 1998; Jäger 2003) the variation in strength of **PROMINENCE** across languages may be interpreted as the reflection of the adage ‘soft con-
strains mirror hard constraints’ (Bresnan et al. 2001; Hawkins 2004).6

With the relevant constraints in place, let me show how my bidirectional model can account for the case-marking patterns discussed above. Tableaux 1 and 2 show the bidirectional evaluation of the Awtuw examples (4) and (6), respectively. They should be read in the following way. The top parts of the tableaux show the productive optimization (PROD) of a given input, specified in the top left cell, and list the relevant output candidate forms. These candidates are then submitted to interpretive optimization (INT) in the lower part of the tableaux where again only the relevant interpretation candidates are listed. Candidates which are optimal from a unidirectional perspective are preceded by ‘□’ and those which are bidirectionally optimal by ‘□’. Grey shading indicates the candidates which are suboptimal from a bidirectional perspective. The ranking of the constraint FaithInt over Prominence and Selection reflects the observation that morphosyntactic information is a stronger cue in determining grammatical functions of arguments than semantic information.7

Tableau 1 gives the bidirectional optimization of the meaning that ‘the woman bit the pig’. The two relevant output candidates are one with an unmarked object (candidate a) and one with an overtly marked object (candidate b). The latter candidate is suboptimal from the production perspective due to a violation of the constraint Case-Economy resulting from the use of case. As a result, the candidate with the caseless object, which does not violate this constraint, is optimal from the production perspective. However, in order to find out whether it is also bidirectionally optimal we have to submit the candidates to the interpretive component as well. Consider first the interpretive optimization of candidate a (INT_a). Neither candidate interpretation violates the interpretation constraint FaithInt. The two interpretations do differ on the second highest constraint Prominence. Only interpretation (ii) violates it due to the fact that it has an animate subject and a human object. Given that interpretation (i) does not violate this constraint, it comes

6 It is not easy to predict when Prominence will be a hard or soft constraint. One may expect a correlation between grammatical relevance of animacy information and the presence of unambiguous morphosyntactic coding of grammatical functions. That is, in languages which encode grammatical functions by means of word order or case on all arguments animacy is not likely to show up as grammatically relevant, i.e. a hard constraint. The reverse situation is expected in languages in which such robust coding of grammatical functions is absent. Yongren Lolo would present a violation to the second expectation and shows that further research in this area is needed.

7 I have ranked the constraint Prominence above Selection. Unfortunately, Feldman’s grammar does not provide the crucial data to determine this ranking and it may therefore turn out to be the other way around if more data become available. This would however not affect the proposed analysis in any significant way.
**Tableau 1**: Evaluation of example (4)

<table>
<thead>
<tr>
<th>Production</th>
<th>Econ</th>
<th>Int$_a$: woman pig bit</th>
<th>FaithInt</th>
<th>Prom</th>
<th>Sel</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit(woman, pig)</td>
<td></td>
<td>a. woman pig bit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. woman pig-obj bit</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int$_b$: woman pig-obj bit</td>
<td>FaithInt</td>
<td>Prom</td>
<td>Sel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i) bit(woman, pig)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) bit(pig, woman)</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

out as the unique optimal interpretation for production candidate $a$. Hence, this output candidate makes the intended meaning uniquely recoverable and is bidirectionally optimal, indicated by ‘$\neq$’. As a result, production candidate $a$ is produced by the grammar as the output form for the intended meaning. The fact that candidate $b$ also makes the intended meaning uniquely recoverable as can be seen from the tableau – the alternative interpretation (ii) violates two high-ranked interpretation constraints – does not alter this. Given that candidate $a$ is optimal from the production perspective, it is the preferred output candidate. Thus, Tableau 1 shows a situation in which the candidate which is optimal from the production perspective is bidirectionally optimal as well.

Now consider Tableau 2 which shows how a candidate which is suboptimal from the production perspective can become bidirectionally optimal due to the fact that the production-optimal candidate is not (uniquely) recoverable. This tableau visualizes the evaluation of the reversed meaning that ‘the pig bit the woman’. As in the previous tableau, candidate $a$ with the unmarked object comes out as optimal from the production perspective due to a violation of Case-Economy by the overtly marked object of the $b$-candidate. This time, however, this candidate is not bidirectionally optimal as it does not uniquely recover the intended meaning. Int$_a$ shows that interpretation (i) is the optimal interpretation for candidate $a$ as it performs better on the interpretation constraints than does the reverse interpretation (ii). Crucially, only the latter interpretation violates the constraint Prominence for the same reason as in the previous example. As a result, candidate $a$ does not make the intended meaning uniquely recoverable – in fact, it does not make
PROD: bit(pig, woman) | ECON

| $\mathcal{P}$ | a. pig woman bit | ECON |
| $\mathcal{E}$ | b. pig woman-OBJ bit | *! |

INT$_a$: pig woman bit | FAITH | PROM | SEL

| $\mathcal{P}$ | (i) bit(woman, pig) | FAITH |
| $\mathcal{E}$ | (ii) bit(pig, woman) | *! |

INT$_b$: pig woman-OBJ bit | FAITH | PROM | SEL

| (i) bit(woman, pig) | FAITH |
| (ii) bit(pig, woman) | * |

Tableau 2: Evaluation of example (6)

it recoverable at all–, and therefore cannot be bidirectionally optimal. What about candidate $b$? Here the intended meaning, interpretation (ii), does come out as the optimal one due to the fact that in contrast to interpretation (i) it does not violate the highest ranked constraint FAITH$_{INT}$. Interpretation (i) violates this constraint as it assigns the subject function to the argument overtly marked as the object. Even though it violates the constraint PROMINENCE, interpretation (ii) is the optimal one for candidate $b$ and hence this candidate makes the intended meaning uniquely recoverable. Given that candidate $a$ fails to make the intended meaning recoverable, candidate $b$ comes out as bidirectionally optimal. These tableaux show how my bidirectional approach can model the flexible use of case marking in Awtuw. By taking into account the interpretation perspective, a speaker can determine whether the sentence he wants to utter is likely to result in an interpretation different from the one he intended. If this is the case, he will mark the object with overt case, otherwise he will refrain from using overt case marking.

This analysis can straightforwardly be transferred to the DOM system of Yongren Lolo. Let me show this for an ambiguous context, depicted in Tableau 3. As should be familiar by now, the candidate with overt object marking is suboptimal from the production perspective due to a violation of CASE-ECONOMY. However, when we take into account the interpretation perspective as well, it does come out as bidirectionally optimal. Consider first the interpretive optimization of candidate $a$ (INT$_a$). Neither interpretation violates the interpretation constraints FAITH$_{INT}$ and SELECTION, and therefore they show exactly the same violation pattern. This means that both the interpretation (i) and interpretation (ii) come out as optimal. As a result, the
intended meaning is not uniquely recoverable from candidate $a$ and hence this candidate cannot be bidirectionally optimal, indicated by the grey shading. Candidate $b$, by contrast, does make the intended meaning uniquely recoverable, as shown by $\text{INT}_b$. Here the intended meaning (i) comes out as the sole optimal interpretation due to a violation of the constraint $\text{FAITH}_{\text{INT}}$ by the reverse interpretation (ii). This violation results from the fact that ‘snake’ is interpreted as the subject even though it is overtly marked as the object. Because candidate $b$ makes the intended meaning uniquely recoverable, and candidate $a$ does not, the former is bidirectionally optimal and produced as the output form for the intended meaning. Thus, Tableau 3 again shows how a candidate which is suboptimal from the production perspective can become bidirectionally optimal due to the fact that the other candidate is not uniquely recoverable.

Although this bidirectional analysis gives a straightforward account of DOM based on global distinguishability, it does not carry over to systems of local distinguishability in which animate objects are case marked independently of ambiguity, as was discussed for Malayalam above. The present model would predict the absence of case on such objects when the intended meaning is uniquely recoverable from the sentence as a whole. Hence, the obligatory use of case marking irrespective of actual ambiguity does not fit in the bidirectional model defended above. This becomes even more apparent when one considers languages with differential object marking in which the occurrence of overt case is determined by features other than animacy. For instance, in Hebrew the occurrence of overt case marking correlates with the definiteness of the object: only definite objects are marked with accusative
case (Danon 2001, 2006). Unlike animacy, definiteness cannot be related to recoverability, as it does not provide information about an argument’s role in the eventuality described by the predicate (see de Swart 2007 for further discussion). Instead, the obligatory marking of definite and animate direct objects is independently required by the grammars of these languages. In particular, it follows from a constraint which forces the marking of prominent objects, i.e., animate, definite, specific ones (cf. Aissen 2003; de Hoop and Narasimhan 2005; Malchukov 2008). Here I will restrict myself to animacy by means of the following constraint:

(16) \text{Anim} \rightarrow \text{Case}: \text{case mark animate objects.}

By incorporating this constraint into my bidirectional model, I can explain the obligatory use of case on animates irrespective of ambiguity, as in example (3) above. In Tableau 4 the production constraint \text{Anim} \rightarrow \text{Acc} requires accusative marking of animate objects. It shows that candidate b, even though it violates \text{Case}-\text{Economy}, is optimal from the production perspective because candidate a violates the higher-ranked \text{Anim} \rightarrow \text{Acc}. \text{INT}_b shows that it also makes the intended meaning (i), which violates none of the interpretation constraints, uniquely recoverable whereas the reverse interpretation (ii) violates both \text{FaithInt} by assigning the accusative-marked NP the function of subject, and \text{Selection} as a cow does not qualify as the instigator of a buying event. Because candidate b is optimal from the production perspective and makes the intended interpretation uniquely recoverable, it comes out as bidirectionally optimal. The importance of \text{Anim} \rightarrow \text{Acc} in this analysis can be seen from the fact that candidate a, even though it makes the intended meaning recoverable, is not bidirectionally optimal, due to a violation of this constraint, which makes it suboptimal from the production perspective. This shows that DOM based on local distinguishability essentially is a production-driven phenomenon. In fact, a unidirectional optimization model only taking production into account (cf. Aissen 2003) gives the same results as the present bidirectional model which demonstrates the irrelevance of the hearer’s perspective for this kind of DOM systems.\footnote{It is of course very well possible that the hearer’s perspective did play an important role in the historical development of such DOM systems. See Zeevat and Jäger (2002), Jäger (2003), Morimoto and de Swart (2006), and de Swart (2007) for discussion.}

In this section I have shown how the patterns found in DOM systems based on local and global distinguishability can be integrated and accounted for in an asymmetric model of bidirectional optimization. Under this approach local and global distinguishability fall out from different modes of optimization. More particular, global distinguishability is interpreted as an
interplay between the speaker’s and hearer’s perspective in which interpretive optimization constrains the outcome of productive optimization. Local distinguishability, by contrast, is analyzed as a marking strategy exclusively based on productive optimization. A clear advantage of the present approach is that recoverability results from the optimization mechanism itself instead of being stipulated as a separate constraint. As a result, I can do without a constraint like DISTINGUISHABILITY proposed in earlier work (de Swart 2006; Malchukov 2008; de Hoop and Malchukov 2008), which explicitly requires the use of overt case marking in case of ambiguity. As such, I consider the present bidirectional model more parsimonious than those previous accounts.

4 The Landscape of Bidirectionality

The asymmetric bidirectional model introduced in the previous section does not stand on its own. In the past few years a number of different bidirectional models have been introduced in order to accommodate the insight that productive optimization and interpretive optimization must be connected in one way or the other in order to account for a range of otherwise unexplained facts. The present model combines these two directions of optimization in one of the simplest ways possible by leaving both intact and applying one after the other. Up to now I have remained silent about the way in which this approach relates to other models of bidirectionality. I will use this section to determine the position of the present model in the landscape of bidirection-
ality by comparing it to other approaches around. It will turn out that the present model unites the properties of various other models with the result that it inherits not only their positive but sometimes also their problematic features. In my discussion I will focus primarily on how the different models can account for the data discussed in the present paper. For a comprehensive comparison of the different bidirectional models on the basis of a wide variety of phenomena the reader is referred to Beaver and Lee (2004).

The model proposed in the previous section is a variant of the model of comprehension-directed bidirectional optimization proposed by Smolensky (1998) to account for ineffability, and later adopted by Donohue (1999) to describe a case system similar to the ones discussed in section 2. In this model a form can only be bidirectionally optimal if it leads back to the intended meaning:

(17) Comprehension-directed bidirectional optimization (Smolensky 1998; Donohue 1999):

a. \( m \rightarrow f \rightarrow m' \).

b. if \( m = m' \), then \( m \) is expressible; if \( m \) is not expressible, it is ineffable.

As in the present model, a meaning is first sent through productive optimization to determine its optimal expression after which this expression is sent through interpretive optimization to determine its optimal interpretation. When this latter interpretation equals the one the speaker started out with, the meaning is expressible, otherwise it is ineffable. Comprehension-directed bidirectional optimization differs from the present model in that it only considers as potential outputs forms that are optimal from the production perspective. As was shown in the previous section, the present model crucially relies on the employment of suboptimal production candidates when the optimal production candidate does not lead back to the intended meaning. Given that comprehension-directed bidirectional optimization only takes into account optimal production candidates, it cannot handle the case data discussed in this paper as it would predict a uniform use of case marking depending on the ranking of constraints. That is, when economy is the most important constraint we would never find overt case marking, when economy is outranked by a constraint forcing use of case we would always observe overt case marking, and when these two constraints are equally ranked we would find truly optional use of case. Thus, under this approach the use of case is not constrained by interpretation contra to what I have argued for the systems discussed in section 2. Nevertheless, the interpretation perspective may have effects on the output forms in a given language – in particular
those without overt case marking— not by forcing overt case in situations of ambiguity but by making certain meanings ineffable instead. Although comprehension-directed bidirectional optimization cannot handle the data discussed in the present paper it does have a clear handle on ineffability, something which is much less straightforwardly modeled in the present approach. It thus seems that by winning some, i.e., the analysis of case marking, the present model loses something as well, i.e., ineffability, with respect to its alternative and vice versa—a recurrent conclusion when comparing different models of bidirectionality (cf. Beaver and Lee 2004).

Comprehension-directed bidirectional optimization differs in another respect from the present model. Whereas the first uses the same constraints in both productive and interpretive optimization, the latter one makes a clear distinction between production and interpretation constraints, without excluding potential overlap between the two. In this respect, the present model is on the same line as the proposal by Zeevat (2000) who advocates a strong split between production and comprehension. He presents an asymmetric model of bidirectional optimization in which the meaning associated with a form is constrained by productive optimization. In his approach a meaning can only be optimal for a given form, when this form is an optimal output for that meaning in productive optimization. This means that the candidate set in interpretive optimization, i.e., the competing meanings, is constrained by productive optimization. Zeevat’s model is extremely well-designed to handle and allow for cases of ambiguity (like the rad/rat problem), which are generally hard to model in Bidirectional Optimality Theory. Ambiguity arises in his model when in productive optimization two meanings share an optimal form and they perform equally well under interpretive optimization of that form. The model proposed here does not tolerate any ambiguity, something which is well understood given that it was developed in the first place to deal with cases in which ambiguity is indeed totally excluded. It is, however, not the fact that Zeevat’s model in principle allows for ambiguity that makes it unsuitable for the data discussed in section 2. Instead, it is the fact that whereas the model constrains interpretive optimization by means of productive optimization, it leaves productive optimization itself unconstrained. As a result, Zeevat’s approach suffers from the same problem as discussed above for comprehension-directed bidirectional optimization. That is, depending on the ranking of constraints, the model will generate languages in which case is always used, never used, or truly optional and this is not what we observe.

Wilson (2001) presents an asymmetric bidirectional model which is the mirror image of the one proposed by Zeevat (2000). He leaves interpretive optimization unaffected, but constrains the candidate set of productive opti-
mization using interpretive optimization. Wilson’s model is hence very similar in spirit to the one presented in the previous section as both constrain the outcome of productive optimization by interpretive optimization. They differ most notably in the way they implement this. The first restricts the set of potential output candidates before productive optimization applies, whereas the second does not restrict the set of potential output candidates and applies interpretive optimization after productive optimization. Due to the fact that interpretive optimization is applied before productive optimization, Wilson’s model faces the same problem described above for comprehension-directed bidirectional optimization and Zeevat’s asymmetric model. Thus, suppose that in Wilson’s approach two different forms, \( f_1 \) without case and \( f_2 \) with case, result in the same optimal meaning \( m_1 \) under interpretive optimization. This means that in the productive optimization of \( m_1 \) both forms compete for expression. Then, again, depending on the ranking of constraints one of them will come out as the optimal form (or both under equal ranking of constraints) in the language under discussion. Thus, even though Wilson uses interpretive optimization to constrain productive optimization applies, the moment at which this is implemented makes that his model cannot account for the data discussed in this paper.

It should be noted that Wilson allows interpretation constraints not only to play a role in interpretive optimization but also in productive optimization, which amounts to a dual application of interpretive optimization once before and once after productive optimization. As a result, it may be possible to model the data discussed here in Wilson’s approach, in particular when one adopts a constraint like DISTINGUISHABILITY which forces overt case in ambiguous situations (cf. de Swart 2006; Malchukov 2008; de Hoop and Malchukov 2008). However, as shown in the previous section, these data can be accounted for without taking recourse to such a constraint or to dual application of interpretive optimization. In fact, the model proposed here shows that application of interpretive optimization before productive optimization is redundant in order to account for these case systems. Therefore, I consider the present model to be more parsimonious.

In the discussion so far I have concentrated on existing asymmetric models of bidirectional optimization and I have shown that they cannot account for the data discussed in the present paper due to the fact that they do not (properly) constrain productive optimization by means of interpretive optimization. In the final part of the comparison, I want to oppose the present approach to the symmetric models of strong and weak bidirectionality as proposed by Blutner (2000). I will show that even though both models explicitly incorporate interpretation as a constraint on production (and vice versa), they cannot account for the data discussed in section 2.
Let me start with strong bidirectional optimization, a definition of which is given below (where ‘≻’ should be read as ‘more harmonic than’):

\[(18)\] Strong bidirectionality (Blutner 2000):
\[\langle f, m \rangle \in \text{GEN}\] is strong bidirectionally optimal iff:
\[a. \text{ There is no } \langle f', m \rangle \in \text{GEN} \text{ such that } \langle f', m \rangle \succ \langle f, m \rangle, \text{ and} \]
\[b. \text{ There is no } \langle f, m' \rangle \in \text{GEN} \text{ such that } \langle f, m' \rangle \succ \langle f, m \rangle.\]

In the case systems central to this paper, for the expression of a meaning \(m_1\), a choice has to be made between two forms, \(f_1\) without case and \(f_2\) with case, where \(f_1\) is also associated with the reverse interpretation \(m_2\). Let’s run this situation through the model of strong bidirectionality. Starting with clause (18a), the meaning \(m_1\) will be paired with the form \(f_1\) as this is a more economical form than \(f_2\) due to violation of Case-Economy by the latter, and hence \(f_1\) blocks \(f_2\). In order to determine whether the pair \(\langle f_1, m_1 \rangle\) is strong bidirectionally optimal we also have to consider clause (18b): there should not be a more harmonic meaning than \(m_1\) that is associated with \(f_1\). Given that this is not the case, the pair \(\langle f_1, m_1 \rangle\) comes out as bidirectionally optimal.

However, in the present example there is an alternative meaning \(m_2\) which is the reverse of \(m_1\). In case we are dealing with a symmetric predication in which both participants have equal status it will be hard to argue that \(m_2\) is more, or less, harmonic than \(m_1\). For instance, it is hard to argue that \(\text{John saw Bill}\) is a more harmonic meaning than \(\text{Bill saw John}\). Instead they are of equal harmony. As a result, neither meaning can block the other and also the pair \(\langle f_1, m_2 \rangle\) will come out as strong bidirectionally optimal. This means that this system would predict ambiguity of the form \(f_1\) and this is exactly what the languages under discussion avoid. In case we are dealing with an asymmetric predication in which the two participants do not have equal status it will be easier to argue that \(m_2\) is more, or less, harmonic than \(m_1\). For instance, we could state that \(\text{The man bit the pig}\) is a more harmonic meaning than \(\text{The pig bit the man}\) due the fact that the latter violates the constraint Prominence. In this case only \(\langle f_1, m_1 \rangle\) will come out as strong bidirectionally optimal. Furthermore, the expression of meaning \(m_2\) will be blocked because the better form \(f_1\) is already taken and hence this meaning will become ineffable.\(^9\) Again this is an undesired result.

These problems may be remedied to a certain extent by having \(f_2\) – the case marked form – as the most harmonic form, e.g. by demoting Case-Economy at the benefit of a constraint favouring overt case. The result is

\(^9\)The same would happen to \(m_2\) when we would be able to identify a constraint which could distinguish between the two meanings in case of a symmetric predication.
obligatory marking of all objects and absence of ambiguity and ineffability. However, this still would not bring us the desired result as the case systems under discussion are characterized by not having obligatory case marking for all objects. This shows that strong bidirectionality suffers from the same problem as the three models discussed above. Depending on the ranking of constraints, it will predict a consistent case-marking pattern in which objects are always marked, never marked or optionally marked. When the first pattern comes out as production optimal, this may result in ambiguity together with ineffability. It should be clear from the above discussion that strong bidirectionality cannot account for the data central to this paper.

What about weak bidirectionality (weak BiOT) which in contrast to the strong variant allows for more than one bidirectionally optimal pair? In weak BiOT a candidate suboptimal in one direction of optimization can become bidirectionally optimal through association with a candidate suboptimal in the other direction of optimization. This results in Horn’s division of pragmatic labour in which unmarked forms go with unmarked meanings and marked forms with marked meanings. This is schematically depicted in (20) (where \(f_1 \succ f_2, m_1 \succ m_2\), and arrows indicate relations of relative preference between form-meaning pairs), the result of the application of the definition in (19):

\[
\begin{align*}
(19) & \quad \text{Weak bidirectionality (Blutner 2000):} \\
& \quad \langle f, m \rangle \in \text{GEN is weak bidirectionally optimal iff:} \\
& \quad a. \quad \text{There is no weak bidirectionally optimal } \langle f', m \rangle \in \text{GEN such that} \\
& \quad \quad \langle f', m \rangle \succ \langle f, m \rangle, \text{ and} \\
& \quad b. \quad \text{There is no weak bidirectionally optimal } \langle f, m' \rangle \in \text{GEN such that} \\
& \quad \quad \langle f, m' \rangle \succ \langle f, m \rangle.
\end{align*}
\]

\[
\begin{array}{cccc}
\hline
f_1 & \Downarrow & f_2 \\
& \Leftarrow & \Uparrow & \Uparrow \\
& \Downarrow & \Leftarrow & \Uparrow \\
m_1 & \leftarrow & m_2
\end{array}
\]

The model proposed in this paper shares with weak BiOT the property that it can revive a candidate which is suboptimal from the unidirectional production perspective as a grammatical output. However, where the present model will select the suboptimal form instead of the optimal one to express the intended meaning, weak BiOT will associate each form with a separate meaning, cf. (20). That is, in the case systems central to our discussion, when there are two separate forms \(f_1\) and \(f_2\) (where \(f_1 \succ f_2\)) for meaning \(m_1\) and \(f_1\) is paired with \(m_1\) then weak BiOT predicts \(f_2\) to occur with a meaning \(m_2\), such that \(m_1 \succ m_2\). This is clearly the wrong prediction, as \(f_2\) will sim-
ply not occur in the language. This overgeneration of form-meaning pairs is a well-known property of weak BiOT (cf. Beaver 2004; Beaver and Lee 2004) and is strengthened by the fact that weak BiOT also allows to revive candidates suboptimal from the unidirectional interpretation perspective. As such, it differs from the present model, which only overgenerates in the sense that it in principle would predict every meaning to be expressible. At the same time, it is this property that makes weak BiOT a successful model of partial blocking phenomena, e.g. where the association of ‘kill’ with direct causation makes that ‘cause to die’ gets associated with indirect causation. This can only be accounted for in the present model when the association between ‘kill’ and direct causation has been established on independent grounds. As a consequence, the present model allows for a less natural interpretation of Horn’s division of pragmatic labour.

In sum, I have shown in this section that existing models of Bidirectional Optimality Theory cannot account for the data discussed in section 2. This is mainly due to the fact that these models do not let interpretive optimization constrain productive optimization in a proper way. Given that these data require a bidirectional analysis, the introduction of the new model outlined in the previous section is warranted.

5 Conclusions

In this paper I have shown that two different motivations drive the differential case marking of direct objects cross-linguistically. On the one hand, direct objects can be marked to signal their markedness with respect to certain semantic features, a strategy dubbed local distinguishability. Opposed to this we find systems where overt object marking is dependent on global distinguishability and is only applied in cases of actual ambiguity or comparison between subject and object features. In some DOM systems we even find both strategies at work. I have argued that these two strategies correspond to different modes of optimization. Whereas local DOM systems can be modeled by referring only to productive optimization, global systems require a model in which interpretive optimization plays a role as well. I have introduced an asymmetric model of bidirectional optimization in which the outcome of production is constrained by interpretation. This model was shown to provide a straightforward analysis of different DOM patterns. Moreover, by showing that existing models of bidirectional optimization do not suffice for the data under discussion, I demonstrated that the introduction of this new model is warranted.

However, this new bidirectional architecture also has its limitations. There
seems to exist a general consensus that there is a number of linguistic phenomena which can be best analyzed in terms of a bidirectional model. The present model can account for one of these phenomena, but its full empirical scope awaits further examination. It is nevertheless clear that there are some phenomena which it cannot deal with, the most straightforward one being the existence of ambiguity. Thus, the present model seems to behave like any other bidirectional model proposed so far: by accounting for one phenomenon there is at least one other phenomenon it cannot account for. As of yet, there is no bidirectional model which can account for all the phenomena in which bidirectionality seems to be involved. I believe the construction of such a model to be a daunting task for future research on bidirectionality in language.

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