最適性理論を用いた形式意味論／語用論の研究

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自然言語の意味解釈に関わる問題は人間が生得的に持つ言語の知識と後天的に獲得する世界の有り様に関する知識の両方を使って処理される。特に、言語の知識としての文法が要求する解釈と、世の中の常識が要求する解釈が合わない場合、どのような判断が下されるかは構文や単語の選択等によって異なり複雑である。このような問題は、最適性理論(OT)を用いるとうまく説明できる可能性がある。しかし、OT の意味論・語用論への応用は幾つか問題を内在しているのも事実である。本研究では、まず、OT の理論的問題点を明らかにし、その上で、どのように自然言語の意味解釈に応用できるかを、具体的事例に基づき考察した。

初年度は、OT の基本的問題の１つである、随意性 optionality の問題を考察した。研究費交付決定が夏期休暇後であったため、十分な時間がなく、筆者が 1997 年に書いた "Three OT approaches to the optimality of complementizer"を再考することにした。この論文は未発表であるが、manuscript として流布し、Bakovic and Keer (2001) (Optimality-Theoretic Syntax, MIT Press に所収)等に引用されているので、参考文献のアップデート等内容に関わりない程度の修正を施し、本報告書に収めている。この論文では、Otani and Whitman (1991)で提案された日本語の動詞移動を前提にして、議論を構築しているが、1998 年ころから、彼らの分析に対する反論が出され、現在では、ほぼ、日本語に動詞移動を仮定する積極的な証拠は見いだせないという状況である。従って、動詞移動がないと仮定した場合どうなるかを、postscript として本報告書に収めている。基本的には、1997 年の論文の主張と同様、OT で随意性を扱うためには、「中和化 neutralization」というアプローチが経験的に優れていることを示した。

次年度は、OT のもう一つの問題である表現不可能性 ineffability の問題を扱った（論文タイトル：PARSE (wh) and the ineffability problem of multiple wh-questions)。これは、統語論と意味論の接点に関わる領域である。具体的には、英語とイタリア語の多重 wh 疑問文をとりあげ、Lgendre, Smolenky and Wilson (1998)で提案された PARSE(wh)という制約を用いた解決案が妥当でないことを、単方向的 OT 統語論と単方向的 OT 意味論、及び、双方向的 OT の観点から議論した。そして、イタリア語で非文として扱われてきた多重 wh 疑問文 *Chi ha detto cosa?* (who has said what?) は、主語が談話連結(D-linking)として解釈されれば文法的となり、この解釈が談話連結されない解釈を阻止しているという分析を提案した。また、英語の非文多重 wh 疑問文の一つである**Who left why?*は、等位接続を用いた *Who left and why?*が最適出力であると考えれば、PARSE(wh)を用いた場合の不自然な結果に比べて、直観的により妥当な文法形式・解釈の対が得られることを示した。

最終年度は、意味論と語用論の接点に関わる問題を扱った（論文タイトル：A pragmatic factor in the interpretations of donkey pronouns)。具体的には、いわゆるロバ文における代名詞の解釈を論じた。ロバ文代名詞は、普遍量化的に解釈される場合（強解釈）と存在量化的に解釈される場合（弱解釈）がある。そして、どちらの解釈が得られるかについて、これまで様々な意味論的考察がなされてきた。しかし、Chierchia (1995)は意味論ではどちらの解釈も生成できるようにしておいて、どちらの解釈が得られるかは語用論が決定すると主張した。この Chierchia の主張は、OT の枠組みを用いて形式化できる。意味論で生成された２つの解釈が候補となり、どちらがより好ましい解釈であるかは語用論的な要請を含む制約のランキングによって決定される。本論では、語用論制約の１つとして、文が記述する出来事の中で、目的を達成するための手段は最小でなければならないという「最小努力制約」を提案した。every で始まる関係節ロバ文や条件文ロバ文では、強解釈がデフォルトであるが、最小努力の要請が明示的な文脈では、弱解釈が優位的である。これは、「最小努力制約」が、デフォルト解釈を導く制約より上位にランクされていることから導かれる。

以上のように、この３年間で、OT に内在する問題を、統語論、統語論−意味論の接点、意味論−語用論の接点の３領域で研究した。残念ながら、語用論固有の問題を OT の枠組みで十分に研究することができなかった。これに関しては、今後の課題としたい。

研究組織

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Table of Contents

Three OT Approaches to the Optionality of Complementizers

1 Introduction

The present paper discusses how to account for optionality in the framework of OT with special reference to the optionality of complementizers as in (1).

(1) John thinks (that) Mary came to the party.

Three approaches have been proposed to this issue so far, as given in (2).

(2) a. Constraint Tie Approach: Pesetsky (1998)
b. "Free C" Approach: Grimshaw (1997), Vikner (2001)
c. Neutralization Approach: Keer and Bakovic (1997), Bakovic and Keer (2001)

The purpose of this paper is to provide empirical evidence for the neutralization approach in (2c) over the other two.

Discussion goes as follows. First I will argue that the set of constraints proposed by Pesetsky (1998) cannot account for the fact that the optionality of complementizers is observed in Tokyo Japanese only in the stacked complementizers configuration, and I will show that that fact strongly suggests that we need a constraint like Grimshaw's (1997) PURE-EP, which basically says that nothing can move to the highest head of an embedded clause. Then I will show that once we introduce a constraint like PURE-EP, only the approach based on neutralization can capture the fact that Kansai Dialect of Japanese allows the optionality of complementizers in spite of the fact that the dialect has V-to-I movement in complement clauses.

2 The optionality of complementizers in OT

In this section, I will overview the three approaches to the optionality of complementizers.

2.1 The constraint tie approach

Among the constraints proposed by Pesetsky (1998), those which are relevant to our discussion are as follows.

(3) a. LEFT EDGE (CP): The first pronounced word in CP is the complementizer that heads it.[1]

b. TELEGRAPH: Do not pronounce function words.

French, for example, does not allow complementizer-deletion as shown in (4), which is captured by ranking of LE(CP) over TEL. The competition is given in (5).

(4) a. Je crois [$_{CP}$ que Pierre a faim].
b. *Je crois [$_{CP}$ ~~que~~ Pierre a faim].
I believe that is hungry

(5) French: LE(CP) » TEL

	LE(CP)	TEL
☞(4a)		*
(4b)	*!	

The optionality of complementizers in English is accounted for by the idea of constraint tie, which is defined as in (6).

(6) Constraint Tie: The output of a set of tied constraints is the union of the outputs of every possible ranking of those constraints.
(Pesetsky 1998: 13)

The fact that (7a) and (7b) are both grammatical is accounted for by assuming that the constraints are tied with each other as illustrated in (8), where each candidate has only one violation of the tied constraints.

(7) a. I think [$_{CP}$ that Peter is hungry].
b. I think [$_{CP}$ ~~that~~ Peter is hungry].

(8) English: LE(CP) = TEL

	LE(CP)	TEL
(7a)		*
(7b)	*	

2.2 The "free C" approach

In Grimshaw (1997) and Vikner (2001), the optionality of complementizers is regarded as the CP/IP-alternation of embedded tensed clauses. As shown in (9b), if there is no complementizer, there is no CP projection.

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1 (3a) is the first version of his definition. The final version is given in (i).

(i) Left Edge (CP):
The first pronounced word in CP is a function word related to the main verb of that CP.

As we will see in section 3, it is not clear if the final version in (i) is applicable to the stacked C phenomenon in Tokyo Japanese, so that I adopt his first version of Left Edge (CP) in (3a).

(9) a. Mary thinks [$_{CP}$ that [$_{IP}$ John left]]
b. Mary thinks [$_{IP}$ John left]

The most important assumption in their approach is that input does not have a complementizer and the use of a complementizer itself violates no constraints. In other words, there is no constraint like "Do not use complementizer". This is why I refer to this approach as the "free C" approach. In this paper, I will follow Vikner's (2001) system rather than Grimshaw's (1997), but the choice between the two is not crucial.

Before going to how to get the CP/IP-alternation, two constraints must be introduced. Following Emonds (1978), Pollock (1989) and Chomsky (1995: Ch.2), Vikner (2001) assumes that in English the I head moves down to the V head as shown in (10a) while in French V moves up to I as shown in (10b).

(10) a. [$_{IP}$ the actor t_I (actually) [$_{VP}$ saw the film]].

b. [$_{IP}$ l'acteur voit (vraiment) [$_{VP}$ t_V le film]].

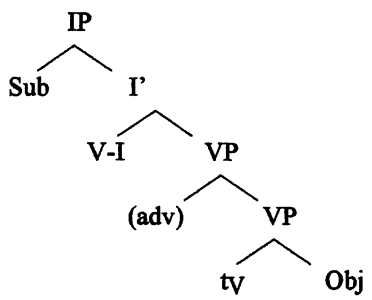
To capture the difference between English and French, Vikner adopts two constraints as in (11).

(11) LEXICAL MOVEMENT (LX-MV): A lexical head cannot move. (Grimshaw 1997)

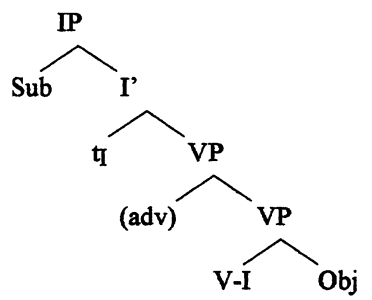
PROPER BINDING (PR-BD): Trace must be bound.
(May 1977, Fiengo 1977, Saito 1989)

LX-MV is violated if V moves as in (12a). Movement of I as in (12b) does not violate this constraint since I is not lexical by definition. PR-BD is violated by any downward movements. So, ranking of LX-MV » PR-BD gives us English-type I-lowering as in (13), while ranking of PR-BD » PR-BD forces French-type V-raising as shown in (14).[2]

(12) a.



b.



[2] I ignore the VP-internal subject and *do*-support for the sake of exposition.

(13) English: LX-MV » PR-BD

	LX-MV	PR-BD
(12a)	*	
☞ (12b)		*!

(14) French: PR-BD » LX-MV

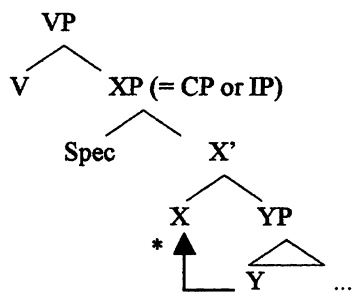
	PR-BD	LX-MV
☞ (12a)		*
(12b)	*!	

Now let us consider embedded clauses. A crucial constraint in Grimshaw-Vikner's approach is PURITY OF EXTENDED PROJECTION as in (15).

(15) PURITY OF EXTENDED PROJECTION (PURE-EP):
No movement into the head of a subordinate clause.
(Grimshaw 1997, McCloskey 1992)

The effect of PURE-EP is shown in (16). This constraint is violated in the following cases: (i) The topmost category of the embedded clause is CP, and something moves to the C head. (ii) The topmost category of the embedded clause is IP, and something moves into the I head. On the other hand, this is not violated if the topmost category of the embedded clause is CP and something moves to I head but not to the C head.

(16)



Given PURE-EP and the rankings in (13) and (14), it is predicted that in French there must be CP projection in embedded clauses while in English complementizers are optional. And this prediction is borne out, as we have already seen above. The competitions are given in (17) and (18).

(17) English complement tensed clauses

	LX-MV	PR-BD	PURE-EP
a. ☞V [IP sub tI (adv) V-I obj]		*	
b. ☞V [CP that [IP sub tI (adv) V-I obj]		*	
c. V [IP sub V-I (adv) tV obj]	*(!)		*(!)
d. V [CP that [IP sub V-I (adv) tV obj]]	*!		

(18) French complement tensed clauses

	PR-BD	LX-MV	PURE-EP
a. V [IP sub tI (adv) V-I obj]	*!		
b. V [CP que [IP sub tI (adv) V-I obj]	*!		
c. V [IP sub V-I (adv) tV obj]		*	*!
d. ☞ V [CP que [IP sub V-I (adv) tV obj]]		*	

2.3 The neutralization approach

The basic idea of the neutralization approach proposed by Bakovic and Keer (2001) and Keer and Bakovic (1997) is that an apparent optionality is actually not an optionality obtained from the unique input, but rather it obtains from different inputs. If a faithfulness-type constraint is ranked over a markedness constraint, apparent optionality obtains. On the other hand, ranking of a markedness-type constraint over a faithfulness-type constraint gives us obligatoriness.

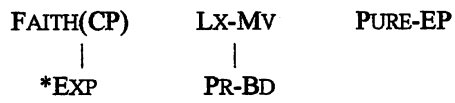
In addition to LX-MV, PR-BD and PURE-EP, we need the following constraints.

(19) FAITH(CP): Parse CP.
*EXP: Do not use expletives (e.g. complementizers).

The rankings in English and in French are given in (20), respectively.

(20) Rankings of relevant constraints

a. English



b. French

A crucial ranking is FAITH (CP) » *EXP in English, which guarantees that if an input has a complementizer, it had better be used, and if an input has no complementizer, it should not be used. French also has this ranking, but PURE-EP and PR-BD are also

ranked over *EXP, which means that even if an input has no complementizer, a complementizer should be used to "protect" V-to-I movement from the violation of PURE-EP. Competitions are given in (21)-(24). (21) is the English case, where the input has a complementizer, and the candidate which has a complementizer is the optimal output.

(21) English

Input: ...V[$_{CP}$ that ...	FAITH(CP)	*EXP	LX-MV	PR-BD	Pure-EP
a. ☞ V [$_{CP}$ that [$_{IP}$ t_V V-I		*		*	
b. V [$_{IP}$ t_V V-I	*!			*	
c. V [$_{CP}$ that [$_{IP}$ V-I t_V		*	*!		
d. V [$_{IP}$ V-I t_V	*!		*		*

In (22), the input has no complementizer. Therefore the candidate which does not have a complementizer is the optimal output.

(22) English

Input: ...V[$_{IP}$ ...	FAITH(CP)	*EXP	LX-MV	PR-BD	Pure-EP
a. V [$_{CP}$ that [$_{IP}$ t_I V-I		*!		*	
b. ☞V [$_{IP}$ t_I V-I				*	
c. V [$_{CP}$ that [$_{IP}$ V-I t_V		*!	*		
d. V [$_{IP}$ V-I t_V			*!		*

(23) and (24) are competitions of French, in which the complementizer is always forced.

(23) French

Input: ...V[$_{CP}$ que ...	PURE-EP	FAITH(CP)	PR-BD	*EXP	LX-MV
a. V [$_{CP}$ que [$_{IP}$ t_I V-I			*!	*	
b. V [$_{IP}$ t_I V-I		*(!)	*(!)		
c.☞ V [$_{CP}$ que [$_{IP}$ V-I t_V				*	*
d. V [$_{IP}$ V-I t_V	*(!)	*(!)			*

(24) French

Input: ...V[IP ...	PURE-EP	FAITH(CP)	PR-BD	*EXP	LX-MV
a. V [CP que [IP tI V-I			*!	*	
b. V [IP tI V-I			*!		
c. ☞ V [CP que [IP V-I tV				*	*
d. V [IP V-I tV	*!				*

3 The necessity of PURE-EP: Evidence from Tokyo Japanese

Pesetsky's system differs from the other two systems in a very crucial way. It does not have a constraint corresponding to PURE-EP, which relates the head-movement in an embedded clause and the existence/absence of the complementizer. In this section, I will claim that we need a constraint like PURE-EP, showing a piece of evidence from Tokyo Japanese.

Complementizers are not optional in Tokyo Japanese as in (25).

(25) John-wa [Mary-ga deteit-ta *(to)] omot-ta.
-Top -Nom leave-Past Comp think-Past
'John thought that Mary left.'

How about V-to-I movement? It is not easy to provide syntactic evidence for V-to-I movement in the language since it is strictly head-final, although it is so assumed implicitly in many papers on Japanese syntax. I will give two pieces of theory-independent evidence proposed in the literature, as in (26).

(26) a. Holmberg's Generalization: Object shift (≈ scrambling) is contingent on V-raising. (cf. Chomsky's equidistance)
b. Otani and Whitman's (1991) observation of sloppy readings.

Holmberg's generalization in (26a) says that cross-linguistically object shift, or scrambling, is possible only when V moves to I. Since scrambling is possible in embedded clauses (as well as in matrix clauses) in Japanese, it is indicated that the language has V-to-I movement.[3] (26b) is a more empirical study. Otani and Whitman (1991) point out that the interpretation of the second sentence in (27) is the same as the interpretation available in English VP-ellipsis. So, they claim that the second sentence in (27) is actually the case of VP-ellipsis and the reason why the V-head is not elided is that it raises to I out of the VP.

[3] At this moment, I have no idea how to get the generalization in the framework of OT.

(27) John-wa zibun-no tegami-o sute-ta.
-Top self-Gen letter-Acc discard-Past
'John threw out his letters.'

Bill-mo [$_{VP}$ ø t_V] sute$_V$-ta.
-also discard-Past
'Bill did, too.' (i) Bill threw out Bill's letters, too.
(ii) Bill threw out John's letters, too.

Tokyo Japanese is very much like French in that it has V-to-I movement and the complementizer is obligatory. So, constraint-ranking for Tokyo Japanese is the same as that for French (as far as the relevant facts are concerned). Unlike French, however, Tokyo Japanese (or Japanese in general) allows a [-wh] complementizer *to* to follow a [+wh] complementizer (or Q-marker) *ka*, as shown in (28), and interestingly enough, the upper complementizer *to* becomes optional in this configuration.[4]

(28) a. Coronbo-wa [[dare-ga kono heya-ni haire-ta
-Top who-Nom this room-to enter.can-Past
ka] (to)] kangaekon-da.
Q Comp think.seriously-Past
'Columbo seriously considered who could enter this room.'

b. Mary-wa kagami-ni mukat-te
-Top mirror-to face-Gerund
[[dare-ga zibun-yori utukusi-i ka] (to) tazune-ta.
who-Nom self-than beautiful-Pres Q Comp ask-Past
'Mary asked the mirror who was more beautiful than her.'

This fact is a direct result of the effect of PURE-EP. The lower complementizer *ka* functions as a "shelter" for V-to-I movement not to violate PURE-EP. So, the higher complementizer *to* plays no role with respect to PURE-EP.

Incidentally note that the V-I complex does not move to the *ka*-position. This is important because if the V-I complex moved to C, it would be expected that the higher complementizer *to* in (28) should be obligatory due to PURE-EP. This is not the case, so that the V-I complex should not move to C. There is evidence for non-I-to-C movement, which comes from sluicing in the language, as given in (29).

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4 It is well-known that Spanish also has "stacked C's", where the higher C is optional.

(i) Pepe preguntó (que) cuántos países habíamos recorrido.
asked:3s that how many countries had:1p visited
'Pepe asked how many countries we had visited.'

But the effect of Pure-EP is not clear in the language since it seems that *habíamos* moves to the C even if *que* is absent.

(29) John-wa [Mary-ga nanika-o kat-ta to] it-ta.
-Top -Nom something-Acc buy-Past Comp say-Past
Sikasi, baku-wa [nani-o ka] sir-ana-i.
but I-Top what-Acc Q know-Neg-Pres
'John said that Mary bought something. But I don't know [what (she bought)].'

The complement clause of *sir-ana-i* 'not know' in the second sentence consists only of a *wh*-phrase and the question marker *ka*. How to derive sluicing constructions varies from author to author (cf. Takahashi (1994) and Nishiyama, et. al (1996), among others), but the important point for our discussion is that the [+wh] complementizer *ka* stands alone, which shows that the V-I complex does not move to C.

The optionality of the higher complementizer of the stacked complementizers configuration can be accounted for by the "free C" approach or the neutralization approach without any change. Since the [+wh] complementizer *ka* functions as a "shelter", V-to-I movement in the embedded clause does not violate PURE-EP. The optionality obtains because the use of C is free under the "free C" approach or because {FAITH(CP), PURE-EP} » *EXP under the neutralization approach.

But this fact cannot be accounted for by Pesetsky's system. In order to capture the optionality in (28), RT(CP) must be tied with TEL.

(30) Right Edge (CP) = TEL
RT(CP): The final pronounced word in CP is the complementizer that heads it.

But these tied constraints cannot account for the obligatoriness of complementizers observed in (25). Clearly, this problem comes from the fact that Pesetsky's system does not say anything about the relation between V-to-I movement and the presence/absence of complementizers, and this strongly suggests that we need PURE-EP.

Notice that the fact in (28) is not a counterargument against the constraint tie approach. The facts in (25) and (28) are accounted for by (30) plus some version of PURE-EP as in (31).[5]

(31) Pesetsky's system augmented with some version of PURE-EP
Tokyo Japanese: PURE-EP » RT(CP) = TEL

Relevant competitions are given in (32) and (33).

(32) Single C

	PURE-EP	RT(CP)	TEL
a. ☞ t_V V-I $_{IP}$] to $_{CP}$] matrix-V			*
b. t_V V-I $_{IP}$] ~~to~~ $_{CP}$] matrix-V	*!	*	

[5] Since Pesetsky does not regard the optionality of complementizers as CP/IP-alternation, the original version of PURE-EP cannot be adopted as it is. In order to make it work, the constraint must be revised as in (i).

(i) The highest pronounced head of a subordinate clause cannot be a head of a chain.

(33) Stacked C's

	PURE-EP	RT(CP)	TEL
a. t_V V-I $_{IP}$] ka $_{CP}$] to $_{CP}$] matrix-V			*
b. t_V V-I $_{IP}$] ka $_{CP}$] ~~to~~ $_{CP}$] matrix-V		*	

To sum up: the stacked C phenomenon in Tokyo Japanese provides evidence for the necessity of PURE-EP. We have seen that the set of constraints in Pesetsky (1998) cannot account for this fact, but the failure does not come from the idea of constraint tie but from the fact that his system does not have a constraint like PURE-EP. So, if we introduce some version of PURE-EP into his system, then it works.

4 An argument for the neutralization approach: Evidence from Kansai Japanese

We have seen that no matter which approach is taken, PURE-EP is necessary. In this section I will show that the existence of PURE-EP becomes a problem both for the constraint tie approach and for the "free C" approach, but not for the neutralization approach to account for the optionality of complementizer observed in Kansai Japanese.

As Saito (1983) points out, complementizers are optional in Kansai Japanese when they are adjacent to verbs like *iw* 'say' or *omow* 'think'. This fact is extremely interesting in our current context since the dialect has V-to-I movement in embedded clauses. In (34), scrambling takes place in the embedded clause, and the complementizer *te* is optional.

(34) a. Anta, [Junko-ga Mayumi-ni ni-te-ru (te)] omo-te-n no?
you -Nom -Dat look.like-Prog-Pres Comp think-Prog-Pres Q
'Do you think (that) Junko looks like Mayumi?'

b. Anta, [Mayumi-ni Junko-ga ni-te-r (te)]omo-te-n no?
you -Dat -Nom look.like-Prog-Pres Comp think-Prog-Pres Q
'lit.: Do you think (that), Mayumi, Junko looks like?'

An example with VP-ellipsis is given in (35). The second sentence of the example is ambiguous as shown in the translation, and this ambiguity is the same as the one available in VP-ellipsis in English. So, if Otani and Whitman are correct, (35) is also the case of VP-ellipsis and the V in the embedded clause must raise to I.

(35) Ken-ga zibun-no sidookyookan nagut-ta rasii yan.
-Nom self-Gen adviser hit-Past Hearsay Prt
'I heard that Ken hit his adviser.'

Yoko-wa [Kazuo-mo [$_{VP}$ ø t_V] nagut$_V$-ta (te)] yuu-te-ta de.
-Top -also hit-Past Comp say-Prog-Past Prt
'Yoko said (that) Kazuo did, too.'
(i) Yoko said that Kazuo hit Kazuo's adviser, too.
(ii) Yoko said that Kazuo hit Ken's adviser, too.

Now let us consider how to capture the fact that Kansai Japanese has V-to-I movement and the optionality of complementizers. Clearly neither Pesetsky's

approach augmented with some version of PURE-EP or the "free C" approach can capture the optionality of complementizers in the dialect. The competition under Pesetsky's approach is given in (36), where it is obvious that only one of the two candidates can be optimal, no matter how the constraints are ranked or no matter which constraints are tied.

(36) Pesetsky's system augmented with some version of PURE-EP

	PURE-EP	RT(CP)	TEL
a. ?? t_V V-I $_{IP}$] te $_{CP}$] V			*
b. ?? t_V V-I $_{IP}$] ~~te~~ $_{CP}$] V	*	*	

In the case of the "free C" approach, only the candidate with a complementizer can be optional, no matter where PURE-EP is ranked, as shown in (37).

(37) The "free C" approach

	...	PURE-EP	...
a. only ☞ t_V V-I $_{IP}$] te $_{CP}$] V	...		...
b. t_V V-I $_{IP}$] V	...	*!	...

As illustrated in (38) and (39), on the other hand, the neutralization approach elegantly accounts for the fact in Kansai Japanese by re-ranking the constraints. (38) is the competition where the input has a complementizer and (39) is the one where the input has no complementizer. The crucial ranking is that Faith(CP) » *EXP » PURE-EP.

(38) The neutralization approach

Input: ... te $_{CP}$]V...	FAITH(CP)	*EXP	PR-BD	LX-MV	PURE-EP
a. V-I t_I $_{IP}$] te $_{CP}$] V		*	*!	*	
b. V-I t_I $_{IP}$] V	*!		*		
c.☞ t_V V-I $_{IP}$] te $_{CP}$] V		*		*	
d. t_V V-I $_{IP}$] V	*!			*	*

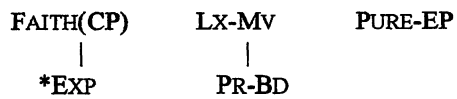
(39) The neutralization approach

Input: ... $_{IP}$]V...	FAITH(CP)	*EXP	PR-BD	LX-MV	PURE-EP
a. V-I t_I $_{IP}$] te $_{CP}$] V		*!	*	*	
b. V-I t_I $_{IP}$] V			*!		
c. t_V V-I $_{IP}$] te $_{CP}$] V		*!		*	
d.☞ t_V V-I $_{IP}$] V				*	*

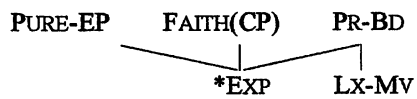
Rankings of relevant constraints for the four languages are given in (40).

(40) Rankings of relevant constraints

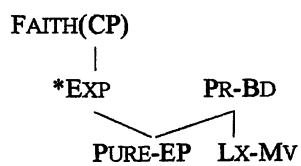
a. English



b. French/Tokyo Japanese



c. Kansai Japanese



5 Conclusion

In this paper, we have compared the three OT approaches to the optionality of complementizers. We first established that we need PURE-EP to account for the optionality of complementizers in the stacked complementizers configuration in Tokyo Japanese. We also pointed out that in order to account for this fact Pesetsky's constraint tie approach must be augmented with PURE-EP. We showed, then, that once we introduce PURE-EP into the set of constraints, neither Pesetsky's system augmented with PURE-EP or the "Free C" approach can account for the optionality of complementizers in Kansai Japanese, where IP complementation is possible with V-to-I movement in that IP. The neutralization approach, on the other hand, can account for the fact by re-ranking relevant constraints, which leads us to the conclusion that empirically the neutralization approach is superior to the other two approaches.

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Postscript: Complementizer Deletion in Japanese Revisited without V-to-I Movement

The analysis I proposed in "Three OT Approaches to the optionality of complementizers" (henceforth 3OT-paper) crucially depended on the assumption that both Tokyo and Kansai Japanese have V-to-I movement, following Otani and Whitman's (1991) analysis of a sentence like (27) (example numbers used here correspond to those in 3OT-paper).

After I wrote 3OT-paper in 1997, however, Otani and Whitman's was criticized by several syntacticians. For instance, Hoji (1998) and Tomioka (1998) convincingly argue that sentences like (27) should be analyzed as having a null object, and if so, we cannot use the data given by Otani and Whitman as evidence for V-to-I movement in Tokyo/Kansai Japanese. Recently Koizumi (2000) proposed an analysis of VP-coordination with verb raising in Japanese, but Fukui and Sakai (2003) argue against it, claiming that there is no evidence for V-to-I movement in the language. It is thus worthwhile reconsidering the three OT approaches to complementizer deletion discussed in 3OT-paper without assuming V-to-I movement. I will show that the neutralization approach is still superior to the other two approaches.

Before going to the discussion, an apparent question should be noted: Does I lowering to V exist in Japanese? Since downward movement is not allowed in the minimalist approach, the above mentioned authors do not consider this possibility. To the best of my knowledge, there is no evidence that supports for the existence of I lowering to V in Japanese, so I will assume that there is no such movement either, and the V-I complex behaves like a word, being the head of V at least in overt syntax.

• The Constraint Tie Approach

Without verb raising, the optionality of complementizers in Kasai Japanese can be treated as the same as that in English. What should be discussed is the fact that the complementizer *to* becomes optional in the stacked C's configuration in Tokyo Japanese. In 3OT-paper, it is argued that the fact in Tokyo Japanese is not problematic for Pesetsky's constraint tie approach. However if Tokyo Japanese lacks V-to-I movement and consequently a constraint like PURE-EP becomes irrelevant, then it turns out to be problematic. As in (25), the complementizer *to* cannot be deleted in a usual situation. This fact is captured by the constraint ranking RE(CP) » TEL as shown in Tableau 1.

Tableau 1: Single C in Tokyo Japanese

	RT(CP)	TEL
a. ☞ V-I $_{VP}$] to $_{CP}$] matrix-V		*
b. V-I $_{VP}$] ~~to~~ $_{CP}$] matrix-V	*	

Once this ranking is stated, however, the optionality of *to* in the stacked C's cases cannot be obtained. In order to capture the optionality, we have to add two more constraints, one tied with RT(CP), the other tied with TEL, as given in Tableau 2, but this is very stipulative.

Tableau 2: Stacked C's in Tokyo Japanese

	C1 RT(CP)	C2 TEL
a. V-I $_{VP}$] ka $_{CP}$] to $_{CP}$] matrix-V	*	*
b. V-I $_{VP}$] ka $_{CP}$] ~~to~~ $_{CP}$] matrix-V	*	*

• The "Free C" Approach

The "free C" approach does not say anything about the obligatoriness of complementizer in languages without V-raising nor I-lowering, so that the obligarotiness of C in Tokyo Japanese given in (25) cannot be accounted for by this approach. Incidentally note that we cannot add a constraint like TEL or *EXP to the set of constraints used in the "free C" approach, for such a constraint makes optionality impossible under this approach.

• The Neutralization Approach

The facts in Tokyo can easily accounted for by the neutralization approach. Constraint ranking FAITH(CP) » *EXP makes the candidate which is the most faithful to the input the winner of the competition. I give the case of stacked C's as Tableaux 3 and 4, and the same logic applies to cases like (25).

Tableau 3: Stacked C's in Tokyo Japanese

Input: ...V-I $_{VP}$] ka $_{CP}$] to $_{CP}$] matrix-V	FAITH(CP)	*EXP
a. ☞ V-I $_{VP}$] ka $_{CP}$] to $_{CP}$] matrix-V		*
b. V-I $_{VP}$] ka $_{CP}$] ~~to~~ $_{CP}$] matrix-V	*	

Tableau 4: Stacked C's in Tokyo Japanese

Input: .....V-I $_{VP}$] ka $_{CP}$] matrix-V	FAITH(CP)	*EXP
a V-I $_{VP}$] ka $_{CP}$] to $_{CP}$] matrix-V		*
b. ☞ V-I $_{VP}$] ka $_{CP}$] matrix-V		

Only the neutralization approach can thus give a natural account for the optionality of *to* in the stacked C's case in Tokyo Japanese.

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PARSE(wh) and the Ineffability Problem of Multiple Wh-Questions

1. Introduction

One of the tasks of modern linguistic theory is to explain the reason of impossible forms and interpretations. In the traditional generative syntax, the way of ruling out ungrammatical sentences is quite simple: if sentence S violates any syntactic principle, S is regarded as ungrammatical. In this view, principles are inviolable, and violation of a principle makes the sentence violating it ungrammatical. In the early 90's, the Minimalist Program (Chomsky 1995) started, and the notion of economy was introduced in syntax and many interesting analyses have been proposed. With this notion, sentence S, which does not violate any principle per se, is regarded as ungrammatical if there is another sentence S' that is "better than" S. In this approach, grammaticality is determined by competition between two expressions or more. The Minimalist Program still assumes, however, that principles are inviolable, and not all syntactic phenomena can be accounted for based on the notion of economy or competition.

Optimality Theory (OT) proposed by Prince and Smolensky 1993 is different from the Minimalist Program, taking the radical view that constraints are violable and (totally) ordered, and an expression which satisfies a higher ranked constraint is regarded as optimal, hence, grammatical, even if it has many violations of lower ranked constraints. In other words, ungrammatical forms/interpretations are necessarily blocked by grammatical forms/interpretations.

This OT approach faces an interesting problem when we consider ungrammatical cases which seem not to have grammatical counterparts. This is called the ineffability problem. In this paper, I will discuss two particular ineffable cases as follows.

(1) English ineffable multiple wh-question
*Who left why?

(2) Italian ineffable multiple wh-question
*Chi ha detto cosa?
who has said what

In the principles-and-parameters approach (cf. Chomsky 1981), the ungrammaticality of (1) was extensively discussed and it was claimed that (1) violates the Empty Category Principle (ECP). What is important is that the ECP is an inviolable principle so that the violation of it causes the ungrammaticality. In OT, however, we have to say that (1) is blocked by another "better" expression. The question is, then, what it is. Incidentally, the ungrammaticality of (1) cannot be due to the semantic ill-formedness, since, for example, the Japanese counterpart *dare-ga naze deteitta no* 'who left why' is perfectly fine. To the best of my knowledge, the ungrammaticality

of the Italian ineffable multiple wh-question (2) has never been discussed in the principles-and-parameters approach or the Minimalist Program. In OT, again, the ungrammaticality of (2) has to be accounted for by claiming that there is another "better" expression than it.

This paper discusses how OT should account for the ineffability problems in (1) and (2), with special attention to Legendre, Smolensky and Collins's 1998 approach using PARSE(wh). Their analysis will be discussed in unidirectional (traditional) OT syntax and semantics, and in bidirectional OT recently proposed by Blutner 2000. The empirical and theoretical difficulties caused by PARSE(wh) will be pointed out, and alternative analyses will be suggested.

2. Unidirectional OT Syntax and Semantics

In OT syntax, it is widely assumed that the input has the complete semantic information, and the job of OT syntax is to determine the optimal syntactic form to realize the semantic information given in the input. For example, Grimshaw 1997 assumes that the input contains argument structure, indices for references and scope, and semantic features such as [+Q] and [+focus] (see also Samek-Lodovic 1996). What OT syntax does, thus, can be regarded as production optimization.

In the case of the ineffable multiple wh-question (2), the input should be something like (3).

(3) a. semantic representation:
?x?ysaid(x, y)
(cf. $\lambda p[\exists x \exists y\ [person(x)\ \&\ thing(y)\ \&\ p = \lambda w[said_W(y)(x)]]\ ]$

b. conventional structure-like representation:
$Q_i\ Q_j$ [who_i ... $what_j$]

(3a) is a simplified semantic representation of question, the Karttunen/Hamblin semantics of which is given below it. (3b) is a more structured representation, where the bracket stands for clause and Qs represent the scope of the co-indexed wh-phrases. (3a) and (3b) have the same value.

There have been several proposals made to the ineffability problem. Prince and Smolensky 1993 propose Null Parse, which roughly says that a candidate in which nothing is pursed wins the competition. The idea that the candidate with no phonological realization can be a winner does not work in syntax in general, however. An easy example is that, the null parse necessarily has more serious violations than candidates whose elements are partially unparsed (cf. Ackema and Neeleman 1998), which suggests that it not be easy to make the null parse win.

Legendre, Smolensky and Wilson 1998 claim that syntactic features of a word can be partially unparsed, arguing that PARSE(wh), which requires that the [wh] feature of a wh-phrase be parsed, is violable and if it is unparsed, the rest of the feature bundle is phonologically realized as an indefinite NP. Let me review their account. The other relevant constraints that they assume are; *Q: No empty question operator, and *ABSORB: No absorption strategy. In Italian, PARSE(wh) is outranked by *Q and *ABSORB. The competition is shown in Tableau 1 (I use English words just for convenience).

Tableau 1: Multiple Wh-Questions in Italian

Input: Q_i Q_j [who_i ... $what_j$]	*Q	*ABSORB	PARSE(wh)
a. $who_{i[j]}$ [t_i ... $what_{[j]}$]		*!	
b. ☞ who_i <Q_j>[t_i ... <$what_j$>]			*
c. <Q_i><Q_j>[<who_i> ... <$what_j$>]			**!

*Q requires a wh-phrase to be in [Spec, CP]. Candidate a satisfies this constraint. Candidate b and c satisfies this constraint vacuously since the Qs in these candidates are unparsed, represented with angle brackets. *ABSORB is the ban on absorption. Absorption is a strategy by which a wh-in-situ is interpreted depending on the moved wh-phrase. This strategy is represented by a bracketed index [j]. In this competition, candidate a uses this strategy, so that it violates *ABSORB. Unparsed whs are represented with angle brackets. Candidate b has one violation of PARSE(wh) while candidate c has two. The multiple wh-question in (2), thus, loses to candidate b, whose output form is *Chi ha detto qualcosa?* (Who has said something?).

Using PARSE(wh) seems to work well, but it is not enough. Let us consider the English case in (1). What is the output which wins over *who left why*? To get a grammatical output like *who said what*, we need the ranking PARSE(wh) >> {*Q, *ABSORB } for English, as shown in Tableau 2.

Tableau 2: Multiple Wh-Questions in English

Input: Q_i Q_j [who_i ... $what_j$]	PARSE(wh)	*Q	*ABSORB
a. ☞ $who_{i[j]}$ [t_i ... $what_{[j]}$]			*
b. who_i <Q_j>[t_i ... <$what_j$>]	*!		
c. <Q_i><Q_j>[<who_i> ... <$what_j$>]	*!*		

But clearly, this doesn't work for (1). This ranking incorrectly makes *who left why* the optimal output. One might suggest the possibility to add an constraint like *wh-adv in-situ, which says "wh-adverbs such as *why* or *how* may not be in-situ." If this constrain is ranked above PARSE(wh), then the candidate *who left why* violates it, as shown in Tableau 3.

Tableau 3: *Who left why* in English (questionable result)

Input: Q_i Q_j [who_i ... why_j]	*wh-adv-in-situ	PARSE(wh)	*Q	*ABSORB
a. $who_{i[j]}$ [t_i ... $why_{[j]}$]	*!			*
b. ☞ who_i <Q_j>[t_i ... <why_j>]		*		
c. <Q_i><Q_j>[<who_i> ... <why_j>]		**!		

Interestingly enough, the winner in this competition is candidate b, where the [+wh] feature of *why* is unparsed. But what is the phonological form of it? The adjunct *why* does not have its indefinite NP counterpart. An apparent close expression for the adjunct *why* is the PP *for some reason*, but this PP expression should be regarded as the indefinite counterpart to *for what reason*. Furthermore, using the PP *for some reason*

causes the violation of FAITHFULNESS type constraints since the input does not have the preposition *for* and the noun *reason*. So, the approach with PARSE(wh) does not work to resolve the ineffability problem.

Now let us consider the ineffable multiple wh-quesitons from the OT semantics view point. OT semantics deals with how a given syntactic form is interpreted. Here again, we have an interesting theoretical question just like OT syntax, or OT in general. That is, how rich is the input form in OT semantics? What is being done in the OT semantics literature is as follows. For example, suppose we have a sentence [...A...[...B...[...C...]]], where C is an anaphoric expression. Then one of the semantics jobs is to choose the optimal antecedent for C (cf. Hendriks and de Hoop 2000). In OT semantics, by using the tableau as follows, the optimal interpretation is determined.

Tableau 4: Usual OT semantics format (a case of anaphoric relation)

Input: [...A ...[...B ...[...C ...]]]	C1	C2	C3	...
a. [...A_i ...[...B_j ...[...C_i ...]]]				
b. [...A_i ...[...B_j ...[...C_j ...]]]				
c. [...A_i ...[...B_j ...[...C_k ...]]]				
⋮				

The point is this: the sentence form [...A...[...B...[...C...]]] serves as an input, and importantly, there is no index assigned, which means no anaphoric relation is given in the input. Instead, possible anaphoric relations are represented in each candidate, and the constraint ranking determines the optimal interpretation.

It is interesting to consider how the Italian wh-question *Who has said something*, which is the optimal output of *who said what*, is interpreted. Here I would like to discuss the competition between two candidates, given in (4), where each candidate is expressed with an LF-syntactic representation and a simplified logical expression.

(4) Input: who has said something (Italian)

a. LF: who_i $[+Q]_i$ has said something
Interpretation: ?x ∃ ysaid(x, y)

b. LF: who_i $[+Q]_i$ has said $something_i$
Interpretation: ?x?ysaid(x, y)

In candidate a, the object is existentially quantified and the sentence-initial wh-phrase is correctly interpreted as a question, being bound by the [+Q] feature, which is assumed to be in the C-head. In candidate b, the object is bound by the Q as well as the subject, so that the resulting interpretation is *who has said what*. This is the absorption strategy discussed in Tableau 1. Notice that nothing is wrong with the object in b having the index i, since this is the job of OT semantics as discussed above. Candidate b violates *ABSORB, which candidate a does not. A potential constraint that candidate a violates is the extra use of the existential quantifier, which is not in the input, but if the ban on the use of the existential quantifier is ranked lower than *ABSORB, we can make candidate a the winner as desired.

To sum up so far: To resolve the ineffability problem concerning multiple

wh-questions in Italian, Legendre et al. 1998 propose that the wh-feature can be unparsed, and we have seen that the resulting output like *who has said something* is correctly interpreted in OT semantics by using the same constraint ranking. We have also seen that the unparsing strategy do not work well for the English ineffable case in (1).

3. Bidirectional OT

The models of OT syntax and OT semantics we have assumed so far is unidirectional; from forms to interpretations or from interpretations to forms. Blutner 2000 proposes a new OT model, which is called Bidrectional OT (BiOT). The idea of this model is based on pragmatics or discourse semantics. As is well-known, pragmatic principles such as Gricean conversational maxims have OT flavor. For example, the maxim of quantity says, "Do not say less than is required, and do not say more than is required." The quantity of information to be conveyed is not absolute. Rather the maxim requires that it largely be dependent on the hearer' need. This kind of situation is not easy to formalize with a set of inviolable principles, but an approach with a set of violable constraints can capture such context-flexibility. Grice's original maxims are seen as the requirement to the speaker. But the hearer is also expected to use the same maxims the other way around. So the maxims are used from two perspectives. From the speaker's perspective, the maxims require the speaker to make the optimal form (the production perspective), and from the hearer's perspective, they force the hearer to choose the optimal meaning (the interpretation perspective). These two perspectives correspond to what OT syntax and semantics do, respectively. This means that pragmatic principles such as the Gricean maxims can be formalized with OT syntax and semantics.

In recent semantics/pragmatic such as dynamic semantics (cf. Groenendijk and Stokhof 1991 among others), the meaning M (of the semantic form, i.e. LF) of the form F is regarded as its context change potential. The (semantic form of the) form F updates the current context σ and gives a new context M. This is represented as in (5).

(5) $[sem(F)](\sigma) = M$
(in the dynamic semantics notion, $\sigma[sem(F)] = M$)

Based on (5), Blutner 2000 formalizes the OT generator Gen as in (6).

(6) $Gen_\sigma = \{<F, M>: \sigma[sem(F)]M\}$

A form-meaning pair, or an input-output pair, <F, M> is such that M is a potential result of updating σ with sem(F). Blutner then defines the optimal <F, M> as in (7), where $\succ$ means "more harmonic than."

(7) Bidirectional OT (strong version)

(Q) <F, M> satisfies the Q-principle iff <F, M> $\in Gen_\sigma$ and there is no other pair <F', M> such that <F', M> $\succ$ <F, M>.

(I) <F, M > satisfies the I-principle iff <F, M> $\in Gen_\sigma$ and there is no other pair <F, M'> such that <F, M'> $\succ$ <F, M>.

<F, M> is called optimal iff it satisfies both the Q-principle and the I-principle.

The Q-principle in (7) seeks the optimal form for the given meaning, and the I-principle chooses the optimal interpretation for the given form. BiOT in (7) requires both principles to be satisfied.

BiOT makes an interesting account for the Italian ungrammatical sentence **who has said what*. For the ease of explanation, let me use the diagrams used in Beaver and Lee 2004 as in (8), which are very instructive to understand the BiOT algorithm.

(8) a. Form Production Optimization Meaning

who has said what ?x?ysaid(x, y)

who has said something ?x∃ysaid(x, y)

b. Form Comprehension Optimization Meaning

who has said what ?x?ysaid(x, y)

who has said something ?x∃ysaid(x, y)

c. Form Bidirectional Optimization Meaning

who has said what ?x?ysaid(x, y)

who has said something ?x∃ysaid(x, y)

(8a) is the diagram for the Q-principle. Suppose <F, M> = <*who has said something*, ?x?ysaid(x, y)>. We have to check whether this pair satisfies the Q-principle. The relevant competitor is the pair <*who has said what*, ?x?ysaid(x, y)>, and given the constraint ranking *ABSORB >> PARSE(wh) in Italian, this competitor is less harmonic than the other. So, the pair <*who has said something*, ?x?ysaid(x, y)> satisfies the Q-principle. This is illustrated by the arrow from '?x?ysaid(x, y)' to *who has said something*. By the same token, no pair is more harmonic than <*who has said something*, ?x∃ysaid(x, y)>, when the input is '?x∃ysaid(x, y).' The satisfaction of the I-principle is given in (8b). As seen in OT semantics above, for the input *who has said something*, the optimal interpretation is '?x∃ysaid(x, y),' so, the pair <*who has said something*, ?x∃ysaid(x, y)> is more harmonic than anything else and satisfies the I-principle. Notice that the form *who has said what* has no arrow. This is because this form is not generated, and therefore it never functions as an input.

It is very clear from (8a, b) that the pair which satisfies both the Q- and the I-principles is <*who has said something*, ?x∃ysaid(x, y)>, as shown in (8c). This diagram also means that in BiOT only this pair is the optimal output and the other pairs lose to it. In (8c), thus, the arrow from '?x?ysaid(x, y)' to *who has said something* is blocked, which Beaver and Lee call pruning.

This result is very important. Remember that to resolve the ineffability problem, Legendre, et. al. 1998 propose that the [+wh] feature of *what* can be unparsed and interpreted as an indefinite like *something*. Theoretically this technique is very wise, but intuitively it sounds a little bit unnatural. Once the BiOT approach is taken, however, the pair <*who has said something*, ?x?ysaid(x, y)> is never regarded as

optimal, which amounts to saying that there is no output for the meaning '?x?ysaid(x, y)' in Italian. This accounts for the ineffability in the intuitively convincing way, but a new question arises; Is PARSE(wh) necessary at all? I will come back to this point later.

Blutner 2000 also proposes a weak version of BiOT as follows.

(9) Bidirectional OT (weak version)

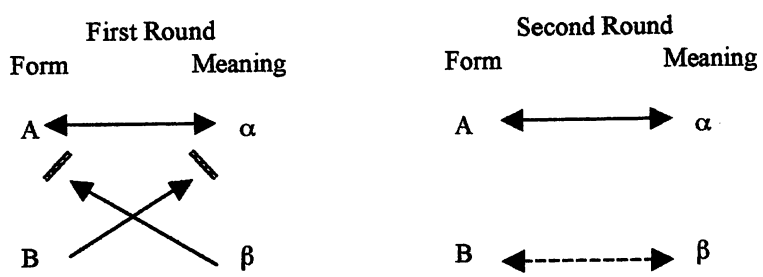
(Q) <F, M> satisfies the Q-principle iff <F, M> $\in$ Gen_{σ} and there is no other pair <F', M> satisfying the I-principle such that <F', M> $\succ$ <F, M>.

(I) <F, M > satisfies the I-principle iff <F, M> $\in$ Gen_{σ} and there is no other pair <F, M'> satisfying the Q-principle such that <F, M'> $\succ$ <F, M>.

<F, M> is called super-optimal iff it satisfies both the Q-principle and the I-principle.

The most salient difference between the strong and weak versions is that in weak BiOT, the super-optimal form-meaning pair is computed recursively. Let us see the Q-principle first. A form-meaning pair <A, B> can satisfy the Q-principle even if there is another pair <A', B> which is more harmonic with respect to the Q-principle. The point is that the existence of the pair <A', B> which satisfies the I-principle prevents <A, B> from satisfying the Q-principle. The same algorithm applies to the satisfaction of the I-principle, too. Weak BiOT works for the case called partial blocking, diagramed as in (10).

(10)



Since weak BiOT applies iteratively, more than one optimization is computed. In (10), the first round competition chooses <A, α> as the optimal. This pair excludes every pair which has either A or α. In this example, <B, α> and <A, β> are excluded (pruning). In the second round, the optimal one is chosen among the remaining pairs. In (10), since <B, β> does not compete against <A, α>, and therefore satisfies both the Q-principle and the I-principle, it is the optimal pair, represented by the dashed arrow, which Beaver and Lee call grafting.

In the case of Italian ineffable multiple wh-questions, the result given by weak BiOT is the same as the one by strong BiOT. The pair <*who has said something*, ?x?ysaid(x, y)> does not satisfy the Q-principle, since another pair <*who has said something*, ?x $\exists$ysaid(x, y)> satisfies the I-principle and more harmonic than it. If we check more candidate pairs, we will get other optimal pairs by recursive application of the weak BiOT algorithm. But it is enough for us to find that the pair <*who has said something*, ?x?ysaid(x, y)> is never chosen. See Beaver and Lee 2004 for the detailed analysis and the problem with weak BiOT.

4. Alternative Analyses

The discussion so far gives rise to the following question: Do we really need PARSE(wh) to resolve the problem with the ineffable wh-questions? This constraint has both empirical and theoretical problems. Empirically, it is not clear what form blocks the ungrammatical English multiple wh-question **who left why*. Without adding any other constraint, the constraint ranking in English PARSE(wh) >> {*Q, *ABSORB} predicts that *who left why* is grammatical. If we add a new constraint like *wh-adjunct in-situ, which says "wh-adjunct such as *why* or *how* may not be in-situ," then the optimal output will be the one in which the [wh] feature of *why* is unparsed, but it is not clear what is the phonetic realization of it. Theoretically, the status of the output to which PARSE(wh) crucially applies is questionable, in particular, under the BiOT approach. In the standard unidirectional OT syntax with PARSE(wh), the optimal form of the input '?x?ysaid(x, y)' in Italian is *who has said something*, where the [wh] feature of the object wh-phrase is unparsed, but in BiOT, the form-meaning pair <*who has said something*, ?x?ysaid(x, y)> cannot win any competition, as shown in the previous section. Since the input '?x?ysaid(x, y)' is never realized as *who has said something*, the theoretical status of PARSE(wh) is really questionable.

In this section, I would like to propose an alternative to PARSE(wh). Let me begin with the Italian case. Vieri Samek-Lodovic (personal communication) informed me that (2), repeated as (11), is actually acceptable if the subject is interpreted as D-linked.

(11) Chi ha detto cosa? (D-linked interpretation on *chi*)
who has said what

If this judgment is correct, the Italian constraint ranking concerning wh-movement is pretty much like the English one. The minimal difference between Italian and English multiple wh-questions is that in the former the first wh-phrase must be D-linked while in the latter such requirement is not imposed. The fact that in English the first wh-phrase does not have to be D-linked is shown in (12) where the subject wh-phrase is used with the aggressively non-D-linked expression *the hell* (see Pesetsky 1987 for the detail).

(12) Who the hell ate what?

The difference between the two languages concerning multiple wh-questions can be captured by the following constraints.

(13)	D-LEFT:	The leftmost wh-phrase in multiple wh-question must be D-linked.
	*[D]:	Do not use the D-linking feature [D].
	PARSE[D]:	Parse the D-linking feature [D].

In Italian, these constraints are ranked as D-LEFT >> *[D] >> PARSE[D], and the English ranking is PARSE[D] >> *[D] >> D-LEFT. In Tableau 5 the input does not have the D-linking feature [D], and Tableau 6 is the case where only the object has that feature.

Tableau 5: Multiple Wh-Questions in Italian (no [D] in the input)

Input: Q_i Q_j [who$_i$ ... what$_j$]	D-LEFT	*[D]	PARSE[D]
a. who$_{i[j]}$ [t_i ... what$_{[j]}$]	*!		
b. ☞ who[D]$_{i[j]}$ [t_i ... what$_{[j]}$]		*	
c. who$_{i[j]}$ [t_i ... what[D]$_{[j]}$]	*!	*	

Tableau 6:
Multiple Wh-Questions in Italian (the object with [D] in the input)

Input: Q_i Q_j [who$_i$ ... what[D]$_j$]	D-LEFT	*[D]	PARSE[D]
a. who$_{i[j]}$ [t_i ... what[D]$_{[j]}$].	*!		
b. ☞ who[D]$_{i[j]}$ [t_i ... what~~[D]~~$_{[j]}$]		*	*
c. who[D]$_{i[j]}$ [t_i ... what[D]$_{[j]}$]		**!	

As shown in Tableau 5, even if the input has no [D] feature, the candidate in which the subject has the [D] feature wins the competition. In English, on the other hand, the candidate most faithful to the input is the optimal output, as in Tableaux 7 and 8.

Tableau 7: Multiple Wh-Questions in English (no [D] in the input)

Input: Q_i Q_j [who$_i$ ... what$_j$]	PARSE[D]	*[D]	D-LEFT
a. ☞ who$_{i[j]}$ [t_i ... what$_{[j]}$]			*
b. who[D]$_{i[j]}$ [t_i ... what$_{[j]}$]		*!	
c. who$_{i[j]}$ [t_i ... what[D]$_{[j]}$]		*!	*

Tableau 8:
Multiple Wh-Questions in English (the object with [D] in the input)

Input: Q_i Q_j [who$_i$ ... what[D]$_j$]	PARSE[D]	*[D]	D-LEFT
a. who$_{i[j]}$ [t_i ... what~~[D]~~[[j]]	*!		*
a. who[D]$_{i[j]}$ [t_i ... what~~[D]~~$_{[j]}$]	*!	*	
b. ☞ who$_{i[j]}$ [t_i ... what[D]$_{[j]}$]		*	*

The crucial difference between the PARSE(wh) approach and my proposal is that in the former, the sequence *who has said what* does not serve as an input in OT semantics while, in my approach, it does. If the Italian form *who has said what* is the OT semantics input, then the constraint ranking given above chooses '?x?ysaid(x, y): x[D]' as the optimal interpretation. This means that the pair <*who has said what*, ?x?ysaid(x, y): x[D]> is bidirectionally optimal. So, the unnatural result that the PARSE(wh) approach reaches never takes place.

Finally, let us discuss the English ineffable case in (1). The semantic representation of the input that we have to consider should be something like (14).

(14) ?x?y ∃ e[e = left(x) & y = reason(e)]

This semantic representation can be roughly paraphrased as: what are x and y such that there is an event e in which x left and y is the reason of e. This formula contains two propositions in the nucleus scope and they are conjoined, so in a more colloquial style it can be read as "Who left and why?" I would like to claim that the sequence *who left and why?* is actually the optimal form which makes *who left why* ineffable. The competition and relevant constraints are given below.

(15) *wh-adv-in-situ : Wh-adverbs (such as *why* or *how*) may not be in-situ.
*FCat: Do not use a functional category.

Tableau 9: Multiple Wh-Questions in English (with wh-adverb)

Input: Q_i Q_j [who$_i$ ... why$_j$]	*wh-adv-in-situ	*FCat	*ABSORB
a. who$_{i[j]}$ [t_i ... why$_{[j]}$]	*!		*
b. ☞ [who$_i$ [t_i ...]] and [why$_{[j]}$]		**...	

Candidate b has the conjunction *and*, which the input does not have. So, this candidate violates *FCat. I assume that there are two CPs conjoined in candidate b and *why* is in the second [Spec, CP]. This structure thus satisfies *wh-adv-in-situ, but at the same time using an additional CP causes the violation of *FCat. The precise clause structure of the second CP of candidate b is not clear, but if it has a complete structure like [$_{CP}$ [$_{IP}$ ...]], then *FCat is violated more times. In English, however, *FCat is outranked by *wh-adv-in-situ, so candidate b wins the competition.

5. Conclusion and Remaining Problems

In this paper, I have discussed the two cases of ineffable multiple wh-questions; **who left why?* in English and **chi ha detto cosa?* (who has said what?) in Italian, focusing on Legendre, Smolensky and Wilson's 1998 approach with PARSE(wh). I have claimed that PARSE(wh) does not work well, pointing out the following two problems. (i) It is not clear what is the phonological realization of *why* with the [wh] feature unparsed. An apparent candidate is *for some reason*, but this should be considered to be the unparsed counterpart to *for what reason*. (ii) In Italian, *who has said something* is regarded as the optimal form for the input '?x?ysaid(x, y),' but if the bidirectial OT approach is taken, the form-meaning pair <*who has said something*, ?x?ysaid(x, y)> never win the competition. This result gives rise to the question of whether PARSE(wh) is necessary.

I have suggested alternative analyses of these two ineffable cases without PARSE(wh). In the case of Italian, the multiple wh-question in question is actually grammatical if the subject is interpreted as D-linked. I then proposed a set of constraints and their ranking, according to which the candidate whose subject is interpreted as D-linked wins the competition even if it is not D-linked in the input. In the case of **who left why*, I proposed that this loses to *who left and why?*, which is semantically more faithful to the intended interpretation Q_i Q_j [who$_i$ ... why$_j$] than the candidate where the [wh] feature of *why* is unparsed.

There are remaining problems, though. For example, the case of wh-extraction out of a relative clause is ineffable, as in (16).

(16) *Who did John buy the book [that t wrote]?

The Japanese counterpart to (16) is OK, so we cannot reject (16) on the semantic basis. With PARSE(wh), the optimal output will be *John bought the book that someone wrote*. The constraints and the ranking that I proposed do not say anything about a sentence like (16), as they are. My suggestion is that the grammatical form to which (16) loses could be something like *John bought a book and who wrote it?* or *who wrote the book that John bought?* In any case, the input 'Q_i John bought the book that [who$_i$ wrote]' must be radically restructured, violating FAITHFULNESS type constraints many times. Likewise, wh-extraction from adjunct clauses or from coordinate constructions will face the same kind of problem. I leave these issues open.

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A Pragmatic Factor in the Interpretations of Donkey Pronouns

1. Introduction

Pronouns in relative clause donkey sentences and in conditional donkey sentences have been noted to have two readings: strong readings (-readings/universal readings) and weak readings (-readings/existential readings). The strong reading is obtained when donkey pronouns and their indefinite NP antecedents are both universally quantified. By contrast, if indefinite NPs are existentially quantified, the weak reading is obtained. There have been various proposals in the literature concerning what factor(s) determine(s) the choice between the two readings. Chierchia 1995 claims that semantics generates both readings and pragmatics chooses the appropriate reading. His idea can be formalized in the format of Optimality Theory (OT). An input is a donkey sentence, and semantics generates possible interpretations as candidates, and the best interpretation is chosen among the candidates by constraints interaction including pragmatic principles. In this paper I will propose a pragmatic principle, Effort Minimization, which roughly says, 'Make a necessary and sufficient effort to accomplish the purpose', and show that this pragmatic principle plays a very crucial role in determining the best interpretation of a donkey sentence.

2. Strong/Weak Readings and Chierchia's 1995 Dual Approach

Typical relative clause donkey sentences like (1a) and conditional donkey sentences like (1b) favor the strong reading. A possible paraphrase for both (1a) and (1b) is 'every farmer who owns a donkey beats every donkey he owns', where the indefinite NP *a donkey* is provided universal quantificational force.

(1) a. Every farmer who owns a donkeyi beats iti.
    b. If a farmerj owns a donkeyi, hej beats iti.

The weak reading is observed in sentences as follows.

(2) a. Everyone who has a donkey must donate its service for one day during the festival. (Schubert and Pelletier 1989: 200)
    b. If I have a quarter in my pocket, I will put it in the parking meter. (ibid.)
    c. Every man who owns a donkey will ride it to town tomorrow. (ibid.: 201)

In (2b), for example, the speaker does not have to put in the parking meter all of the quarters that she has in her pocket. Putting just one quarter in the meter makes the sentence true. That is, the indefinite NP is interpreted as existentially quantified. Furthermore, as argued by Chierchia (1995: 64), even the sentences in (1) get the weak reading if they are uttered in the context like (3).

(3) The farmers of Ithaca, N.Y., are stressed out. They fight constantly with each other. Eventually, they decide to go to the local psychotherapist. Her recommendation is that every farmer who has a donkey should beat it, and channel his/her aggressiveness in a way, which still morally questionable, is arguably less dangerous from a social point of view. The farmers of Ithaca follow this recommendation and things indeed improve.

Under the scenario in (3), every farmer's beating at least one of the donkeys he owns makes the sentences true. So Chierchia argues that the strong reading and the weak reading are always available in donkey sentences and semantic theory should generate both of the readings.

In Chierchia 1995, it is argued that the two readings are obtained by two semantic devices: the strong reading is obtained via an E-type strategy whereas dynamic binding gives the weak reading. In the E-type strategy, donkey pronouns are interpreted as functions from individuals into individuals. In (1a), the pronoun is interpreted as a function from farmers into the donkey(s) that they own, as represented in (4). Thus, if farmer A has three donkeys, he beats all three donkeys.

(4) $\forall x[\text{farmer}'(x) \wedge \exists y\ [\text{donkey}'(y) \wedge \text{own}'(y)(x)] \rightarrow [\text{beat}'(f(x))(x)]]$
f: a function from farmers into the donkey(s) they own.

Putting the formalization aside, in dynamic binding, the scope of an existential quantifier extends across sentence boundaries and binds a variable in the subsequent sentence, as given in (5), and by conservativity (every(A)(B) = every(A)(A and B)) (1a) is interpreted as in (6a), where the pronoun is dynamically bound by the existential quantifier introduced with *a donkey* as in (6b).

(5) $\exists\ [p] \text{ and } [q] \quad = \exists\ [p \text{ and } q]$

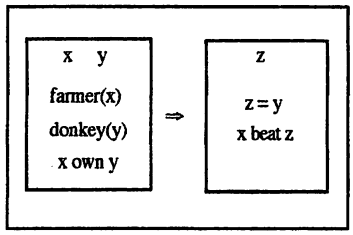
(6) a. every farmer who owns a donkey is a farmer who owns <u>a donkey</u> and beats <u>it</u>.
b. $\forall x[\text{farmer}'(x) \wedge \exists y\ [\text{donkey}'(y) \wedge \text{own}'(y)(x)] \rightarrow \exists y[\text{donkey}'(y) \wedge \text{own}'(y)(x) \wedge \text{beat}'(y)(x)]]$

3. More Data and Approaches to the Two Readings

There have been many proposals to donkey pronouns in the semantic literature, and to the best of my knowledge every approach but Chierchia's accounts for donkey pronouns by a single mechanism (either dynamic binding or the E-type approach, or others), and tries to derive the strong/weak distinction from some semantic factors. In what follows, I will outline some of the other approaches with respect to how to capture the two interpretations.

The classical Discourse Representation Theory as in Kamp 1981 and Heim 1982 cannot capture the weak readings of donkey pronouns because it was originally designed to account for the fact that the indefinite NPs in donkey sentences are interpreted as universal. For example, (1a) is represented as in (7).

(7)



Informally the Discourse Representation Structure in (7) is true iff for every way of finding values for a pair of x and y, x a farmer, y a donkey and x owns y, there is z, z equals to y and x beats z. This is equivalent to $\forall xy[[farmer'(x) \wedge donkey'(y) \wedge own'(y)(x)] \rightarrow beat'(y)(x)]$. The point is that the indefinite NP *a donkey* has no quantificational force of its own, and in this configuration the universal quantificational force is inevitably assigned to the variable introduced by the indefinite NP. This is an empirical problem with the 80's Discourse Representation Theory.

The recent theories of donkey pronouns are all designed to be able to represent the two readings (see Kamp and Reyle 1993, Groenendijk and Stokhof 1991, Schubert and Pelletier 1989 among many others). Moreover, there are some approaches that try to spell out determining factors of preferred readings. For example, Rooth 1987 observes that donkey sentences with upward entailing determiners such as *every* favor the strong reading while those with downward entailing determiners like *no* favor the weak one. The latter example is given in (8), where the existence of a parent who lent the car to one of his sons makes the sentence false.

(8) No parent with a son still in high school has ever lent him the car on a weeknight. (Rooth 1987: 256)

Developing Rooth's observation, Kanazawa 1993 also claims that there is a tight connection between monotonicity of the determiners of donkey sentences and the default interpretation of the pronouns. In particular, he shows that monotonicity of the first argument and that of the second argument are relevant to determining the readings of donkey pronouns. The relation between determiners' monotonicity and the interpretation of donkey pronouns is summarized in (9), where ↑MON stands for the first argument's upward monotonicity and MON↑ for the second argument's, and likewise the down arrows stand for downward monotonicity. The first argument of *most* is neither upward nor downward.

(9)

	Interpretation	Determiners
↑MON↑	Weak reading only	*a, some, several, at least n, many*
↑MON↓	Strong reading preferred?	*not every, not all*
↓MON↑	Strong reading preferred	*every, all, FC any*
↓MON↓	Weak reading only	*no, few, at most n*
MON↓	Both	*most*

cited from Kanazawa (1993: 120)

Kanazawa proposes not only a formal system of getting the two readings in a dynamic setting but also a formal mechanism to derive the preferred readings in (9) based on logical inference. What is necessary for the purpose of the present paper is the generalization that if the monotonicity in the first argument and that in the second argument are the same, represented as ↑MON↑ and ↓MON↓ in (9), only the weak reading is available.

Another kind of approach to the strong and weak readings pays attention to the meaning of the predicate of nuclear scope, rather than determiners. Yoon 1996 classifies predicates into two types, total predicates and partial predicates. Predicates like *healthy, closed, clean, dry, rejected, move away from, spotless,* etc. belong to the former, while the latter include *sick, open, dirty, wet, accepted, move towards, spotted,* and so on. These two types of predicates give us different readings when they are predicated of definite plural subjects, as shown in (10).

(10) a. The glasses are spotless.
b. The glasses are spotted. (Yoon 1996: 222)

(10a) is true only if all of the glasses are spotless, whereas (10b) can be true even if not all of the glasses are spotted. The same contrast is also observed in donkey sentences. I give a pair of sentences from Krifka 1996 for the sake of exposition, for all of the English donkey examples Yoon discusses are involved with adverbs of quantification.

(11) a. Every boy who had a baseball card kept it clean. (strong reading)
b. Every boy who had a baseball card got it dirty. (weak reading)
(Krifka 1996: 141-42)

(11a) is true if every boy kept clean all of the baseball cards he had, and this is the strong reading. On the other hand, the most natural interpretation of (11b) is the weak reading, in which the sentence can be true even if every boy who had more than one baseball card got just one of them dirty.

A definition of the two types of predicates is given in (12).

(12) If P and Q are a pair of lexicalized antonyms, it holds that
a. if $P(x) \wedge y \subseteq x \rightarrow P(y)$, and
b. if $Q(x) \wedge x \subseteq y \rightarrow Q(y)$,
then P is a total predicate and Q is a partial predicate, where $\subseteq$ is the semantically relevant part relation. (Yoon 1996: 224)

(11a) and (11b) are represented as in (13a) and (13b), respectively, where following Neale 1990, Yoon treats the donkey pronouns as individual sums represented as 'σy[baseball-card'(y) $\wedge$ have'(y)(x)]', which means 'all of the baseball cards that x has'.

(13) a. EVERYx([boy'(x) $\wedge$ $\exists$y[baseball-card'(y) $\wedge$ have'(y)(x)]]
[keep-clean'(σy[baseball-card'(y) $\wedge$ have'(y)(x)])(x)])
b. EVERYx([boy'(x) $\wedge$ $\exists$y[baseball-card'(y) $\wedge$ have'(y)(x)]],
[get-dirty'($\exists$y[baseball-card'(y) $\wedge$ have'(y)(x)])(x)])

Although Yoon's approach seems very attractive, as Krifka 1996 points out, there are cases where the total/partial distinction of predicates does not correspond to the strong/weak interpretations of definite sum individuals. According to Yoon's classification, *open* is a partial predicate and *closed* a total one, but Krifka gives examples where *open* functions as a total predicate whereas *closed* is interpreted as a partial predicate. The contrast between (14a) and (14b) makes the point. A situation where these sentences are interpreted is: The local bank has a safe that is accessible only through a hallway with three doors, all of which must be open to reach the safe.

(14) a. I could reach the safe because the doors were open.
b. I could not reach the safe because the doors were closed.
(Krifka 1996: 139)

This suggests that the distinction between total and partial predicates is not a matter of lexical semantics, but rather it is a matter of pragmatics. Whatever the nature of total and partial predicates is, however, it must be stressed that Yoon's insight about the relevance of predicate meanings to interpretation of donkey pronouns deserves attention.

Giannakidou and Merchant 1997 also try to derive the strong and weak readings from the meanings of predicates. They claim that in Greek the difference between perfective aspect and imperfective aspect of the predicate of nuclear scope plays a crucial role in determining the interpretation of donkey pronouns. They observe the contrast between (15a) and (15b).

(15) a. Kahe xorikos pou ixe enen gaidaro ton **ederne**.
every farmer that had a donkey him beat.past.**imperf**.3sg.
'Every farmer who owned a donkey (used to) beat it.'

b. Xthes tomesimeri, kathe xorikos pou ixe enan gaidaro ton **edire**.
yesterday the noon, every farmer that had a donkey him beat.past.**perf**.3sg
'Yesterday at noon, every farmer who owned a donkey beat it.'
(Giannakidou and Merchant 1997: their (1) and (2))

(15a), which has imperfective aspect in the matrix clause, is true iff every farmer beat all the donkeys that he owns. That is, only the strong reading is available. On the other hand, the pronoun in (15b) can be interpreted either as existential or as universal.

The ambiguity observed in (15b) is not surprising, since we have seen that English donkey sentences also can be ambiguous. Particularly interesting to us is, rather, the fact that imperfective sentences like (15a) lack the weak reading.

Giannakidou and Merchant's story goes as follows. First, they propose two principles of quantification, as given in (16) and (17).

(16) The Individual-based Quantification Principle
In individual-based quantificational domains, quantificational cases are provided by individual assignment or equivalence classes of assignment.

(17) The Situation-based Individuation Principle
A situation *s* is distinct from a situation *s'* iff there is at least one individual in *s* that is not in *s'*.

Perfective sentences (or episodic sentences) obey (16) while imperfective sentence (or habitual/generic sentences) are subject to (17). Intuitively this distinction is understandable. Perfective sentences describe single events, so that quantifiers in them quantify over individuals rather than situations. On the other hand, imperfective sentences or habitual/generic sentences express generalization over situations, and the domain of quantification is individuated based on them.

The notion of equivalence class in (16) is defined as in (18) (cf. Barker 1996).

(18) Given a formula φ with at least one free occurrence of a variable x, two assignment functions g and g' are members of an equivalence class relative to φ iff they agree on what they assign to x.

Let us see a simple example. Suppose that there were three farmers, f_1, f_2, and f_3, and f_1 and f_2 each owned exactly one donkey while f_3 owned three donkeys, d_1, d_2, and d_3. In this case, pairs $<f_3, d_1>$, $<f_3, d_2>$ and $<f_3, d_3>$ constitute an equivalence class. Suppose further that f_3 did not beat d_2 or d_3. This does not falsify perfective donkey sentences of the form [every $\varphi\psi$], because pairs $<f_3, d_1>$, $<f_3, d_2>$ and $<f_3, d_3>$ are regarded as an equivalence class, not as three distinct cases, with respect to the variable x in φ, namely $[\text{farmer}'(x) \wedge \exists y[\text{donkey}'(y) \wedge \text{own}'(y)(x)]$. So, the weak reading is allowed in (15b). On the other hand, this case falsifies (15a) since with respect to the notion of situation, $<f_3, d_1>$, $<f_3, d_2>$ and $<f_3, d_3>$ are considered to be three distinct situations. This is the reason why imperfective donkey sentences systematically lack the weak readings.

It is interesting to see what happens in the sentences with imperfective aspect which correspond to Schubert and Pelletier's 1989 dime-meter sentences in (2). The data in (19) are due to Anastasia Giannakidou (personal communication).

(19) a. Ekini tin epoxi, kathe odigos pu ixe mia draxmi stin tsepi tou
that the era, every driver that had a drachma in-the pocket his
tin **evaze** s' afto to telios avolo parkometro
her put.**imperf** in this the absolutely inconvenient park-meter
'In those days, every driver who had a dime in his pocket used to put it in this absolutely inconvenient meter.'

b. Ekini tin epoxi, otan enas odigos ixe mia draxmi stin tsepi tou
that the era, when a driver had a drachma in-the pocket his
tin **evaze** s' afto to telios avolo parkometro
her put.**imperf** in this the absolutely inconvenient park-meter
'In those days, when a driver had a dime in his pocket, he always put it in this absolutely inconvenient parkmeter.'

In spite of the fact that imperfective aspect is used, the donkey pronouns in these examples are interpreted only as existential. That is, the expected strong readings of imperfective sentences are not available in them.

This fact seems to indicate that semantics and pragmatics interact with each other in determining preferred readings of donkey pronouns. Anastasia Giannakidou (personal communication) suggested to me that the lack of the strong reading in (19) comes from pragmatic factors like world knowledge. Chierchia's 1995 approach does not say anything about how to choose the preferred readings. His position concerning this problem is that semantics allows both readings, and which is preferred is a matter of pragmatics. In the next section, I would like to propose a pragmatic principle which forces the weak reading and show that this pragmatic principle interacts with other semantic constraints in the Optimality Theoretic fashion.

4. Effort Minimization

First, I address the cases of relative clause donkey sentences with *every*, and conditional donkey sentences. The fact that the donkey pronouns in sentences like (1) are interpreted universally when used out of the blue suggests that the strong reading is a default interpretation. This is captured by assuming two constraints and their ranking in (20).

(20) a. UNIV: Interpret donkey pronouns universally.
b. EXIST: Interpret donkey pronouns existentially.
c. UNIV >> EXIST

Now let us consider how the weak reading is obtained in relative clause donkey sentences with *every* and conditional donkey sentences. I would like to propose a pragmatic constraint, Effort Minimization, defined in (21).

(21) Effort Minimization (EMIN):
Make a necessary and sufficient effort to accomplish the purpose.

Let me begin with Schubert and Pelletier's examples in (2), repeated as (22).

(22) a. Everyone who has a donkey must donate its service for one day during the festival. (Schubert and Pelletier 1989: 200)
b. If I have a quarter in my pocket, I will put it in the parking meter. (ibid.)
c. Every man who owns a donkey will ride it to town tomorrow. (ibid.: 201)

The purpose described in (22a) is to donate the donkey-service for one day during the festival. Since this is a kind of volunteer activity, each person in the relevant domain does not have to provide all the donkeys that he has. For example, if person A is expected to provide two donkeys for the festival work, it is enough for him to provide just two donkeys, even if he has more donkeys. Here Effort Minimization works, and this is the source of the weak interpretation. The same kind of story applies to (22b)

and (22c). What is expected in (22b) is the necessary and sufficient amount of money for parking, and the speaker in (22b) does not have to put all the quarters that he has in his pocket for the purpose. In (22c), one donkey is necessary and sufficient to ride to go to town.

In the context given in (3), the purpose described is to relieve the farmers' stress, and the number of donkeys beaten by them increases until this purpose is accomplished, but once the aim is achieved, the farmers do not have to beat their donkeys. The point is that they do not have to beat all the donkeys that they have for the purpose of channeling their aggressiveness.

Effort Minimization is in fact not just for interpretations of donkey pronouns. It is relevant to interpretations of definite plurals. In Krifka's examples (14), repeated as (23), the effect is observed.

(23) a. I could reach the safe because the doors were open.
b. I could not reach the safe because the doors were closed.

In (23a), the plural subject of the *because*-clause is interpreted universally in spite of the fact that the predicate is a partial predicate, whereas it is interpreted existentially although the predicate is a total predicate. The reason is obvious. (23a) describes the situation where in order for the speaker to reach the safe, it was necessary and sufficient that all the doors were open. By the same token, in (23b), just one closed door is enough for the speaker not to have been able to reach the safe. Effort Minimization is thus independently motivated.

Effort Minimization is ranked higher than the two constraints in (20). As discussed above, I follow Chierchia's view that semantics generates both the strong and the weak interpretations. These are considered to be candidates. Now let us consider the case where *every farmer who has a donkey beats it* is used out of context. Semantics generates candidate a and candidate b in tableau (24); the former has the strong reading and the latter the weak reading. Candidate a violates Exist for the obvious reason. Likewise candidate b violates Univ. Since Univ is higher than Exist, the strong reading is chosen.

(24)

	EMIN	UNIV	EXIST
a. ☞ strong			*
b. weak		*	
c. strong	*		*
d. ☞ weak		*	

If the context requires Effort Minimization, then the candidate with the weak reading is the winner, as shown by the competition between candidate c and candidate d.

Now let us consider cases of relative clause donkey sentences with determiners other than *every*. Following Kanazawa's 1993 observation above, I would like to assume the following constraint:

(25) MONOTONICITY DIRECTION (MON): Give the weak reading to donkey pronouns in relative clause donkey sentences with determiners that are downward monotone or upward monotone in both arguments (e.g. *a, some, several, at least* n, *many, no, few, at most* n, etc).

This constraint outranks UNIV and EXIST, so that donkey pronouns in the relative clause donkey sentences with determiner ↑MON↑ or ↓MON↓ are interpreted existentially even if no specific context is given. Let us consider the case in which the input is *a farmer who owns a donkey beats it.* As shown in tableau (26), the two readings are generated as candidates.

(26)

	MON	UNIV	EXIST
a. strong	*		*
b. ☞ weak		*	

Since the input sentence has the ↑MON↑ determiner *a*, Mon requires a candidate to have the weak reading. Obviously candidate a violates this constraint and consequently candidate b wins this competition.

5. Concluding Remarks

This paper has discussed how interpretations of donkey pronouns are determined. Chierchia 1995 assumes that semantics derives the strong and weak readings and the choice is determined pragmatically. It has been shown that his view can be captured in the framework of OT; the possible interpretations that semantics generates serve as candidates, and constraints interaction including a pragmatic factor chooses the best interpretation among them. The fact that the strong reading is default in relative clause donkey sentences with *every* and conditional donkey sentences can be obtained by assuming the ranking UNIV >> EXIST. For the cases where the weak reading is obtained, I proposed a pragmatic constraint, Effort Minimization, which says, "Make a necessary and sufficient effort for accomplishing the purpose." This constraint is ranked higher than UNIV >> EXIST, which makes the weak reading is the winner, since the strong reading, involving the maximum effort (e.g. what a farmer beats is all the donkeys he owns, rather than some of them), violates this pragmatic constraint.

There are some remaining problems concerning interpretations of donkey pronouns. One of them is the proportion problem as observed in a sentence like *Mostly if a farmer owns a donkey, he beats it.* The sentence is true when the adverb of quantification *mostly* quantifies over the domain of donkey-owning farmers. But as is often pointed out, the sentence can be also interpreted as true in the following scenario. There are three farmers, and one of them owns 98 donkeys and beats all of them, and the other two farmers own one donkey each, and neither of them beats the donkeys. This means that *mostly* quantifies over farmer-donkey pairs. Which interpretation is preferred is a matter of pragmatics, as is discussed in Chierchia 1995 among others, so that the proportion problem also can be formulated in OT. I leave this problem open.

The OT that I used in the present project is the monodirectional one in that the input is the form generated by syntax and the best interpretation is determined by constraints interaction. This type of OT can be regarded as the model from the hearer's perspective since the task is to find the best interpretation. There is another monodirectional OT from the speaker's perspective, in which the input is the interpretation and constraints interaction chooses the best form for that interpretation. To deal with pragmatic aspects of linguistic phenomena, however, both perspectives are inevitable, and if the strong/weak distinction of interpretations of donkey pronouns involves pragmatic factors, it should be modeled by the bidirectional OT, proposed by Blutner 2000 among others. I am speculating that if bidirectional OT is adopted, Effort Minimization will be simplified. This is a topic for future research.

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