Free Variable Economy

Floris Roelofsen
University of Amsterdam

1 Introduction

This paper explores the idea that semantic interpretation is subject to so-called *economy constraints* (Fox, 1999; Reinhart, 2006). The general idea is that a logical form is illicit if there is an alternative logical form which is (i) semantically equivalent, and (ii) syntactically simpler/more economical. Of course, to make this general idea more concrete, a particular *measure* of economy needs to be specified, determining exactly when one logical form is more economical than another. We will focus here on a particular measure of economy proposed by Fox (1999), which favors local pronominal binding over non-local binding. This economy measure gives rise to a constraint on logical forms, which we will call BINDING ECONOMY. Fox showed that this constraint accounts for a range of interesting data. In particular, given certain background assumptions about VP ellipsis, BINDING ECONOMY deals with a long-standing puzzle concerning strict and sloppy readings in VP ellipsis, dating back to Dahl (1973).

However, we will draw attention to several variants of Dahl's puzzle which are problematic for BINDING ECONOMY.[1] Our aim, then, will be to resolve this problem in a conservative way. That is, we will try to preserve the general idea that semantic interpretation is subject to economy constraints, but we will reconsider what it means exactly for one logical form to be more economical than another. Fox's measure of economy is concerned with *locality* of pronominal binding. The economy constraint that we will propose, FREE VARIABLE ECONOMY (FVE), disfavors *free variables* rather than non-local binding. We will show that, given suitable background assumptions about VP ellipsis, FVE accounts for Dahl's original puzzle, and also for the variants of Dahl's puzzle that

[1] The new variants of Dahl's puzzle are not only problematic for BINDING ECONOMY but also for other accounts of Dahl's original puzzle (e.g, Kehler, 1993; Fiengo and May, 1994; Schlenker, 2005; Büring, 2005b; Kehler and Büring, 2008).

are problematic for BINDING ECONOMY.

The paper is organized as follows. §2 establishes some basic theoretical assumptions, terminology, and notation. BINDING ECONOMY and Dahl's puzzle are presented in §3, followed by a first problematic variant of Dahl's puzzle in §4. FVE is introduced in §5, and §6 presents two additional variants of Dahl's puzzle that are problematic for BINDING ECONOMY but not for FVE. §7 discusses a final variant, which will force us to refine our background assumptions about VP ellipsis, and §8 concludes.

2 Preliminaries

We will start by fixing some theoretical assumptions, terminology and notation.

Syntax-semantics interface. We will assume that syntax generates logical forms, and that each of these logical forms is associated with a certain semantic meaning (or with an expression in a typed lambda-calculus representing such a meaning) in a compositional fashion, along the lines of Heim and Kratzer (1998).

Quantifier raising and predicate abstraction. We will assume that a determiner phrase which undergoes quantifier raising receives a *binder index*, which is adjoined to it in superscript (e.g., [everyone]^3). It also leaves behind a *trace* which has that same index as its *binding index*. Binding indices are adjoined in subscript (e.g., the trace of [everyone]^3 would be t_3). We will assume that DPs *always* undergo QR. This assumption will make some of the formulations below run smoother, but nothing hinges on it. A trace with a binding index n is interpreted as a variable x_n, and a constituent of the form $X^n Y$ is interpreted as $X'(\lambda x_n.Y')$, where X' is the interpretation of X and Y' is the interpretation of Y. This composition rule is what Heim and Kratzer (1998) call *predicate abstraction*.

Pronouns. We will assume a basic distinction between bound and referential pronouns (cf. Reinhart, 1983). This means that pronouns come in two variants: with or without binding index. If a pronoun has a binding index n, it is interpreted as a variable x_n. Pronouns without binding indices are taken to refer to contextually salient individuals.

Binding. Let A be a determiner phrase with a binder index, and let P be a pronoun with a binding index. Then we say that A *binds* P iff (i) A c-commands P, (ii) A's binder index matches P's binding index, and (iii) A does not c-command any other DP which satisfies (i) and (ii). For instance, in (1), [John] binds [his].

(1) [John]^1[t_1 called his$_1$ mother]

This notion of binding is what Heim and Kratzer (1998) and Büring (2005a) call *semantic binding* and what Reinhart (2006) calls *A-binding*. To enhance readability, we will often use the following graphical notation:

(2) John called his mother

Think of (2) as shorthand for (1): the arrow indicates that [his] is bound by [John].

For referential pronouns we will also use a graphical notation. For instance, if [his] is taken to refer to John, we will write:

(3) John called his mother
↓
John

VP ellipsis. Elided verb phrases containing pronouns are often ambiguous between so-called *strict* and *sloppy* readings. Consider the following example:

(4) Max called his mother and Bob did too.

This sentence can be taken to mean that Max and Bob both called *their own* mother. This is called a *sloppy* reading. It arises when the pronoun in the elided VP and the pronoun in the antecedent VP are both *bound*. This configuration is depicted in (5), where the elided VP is represented in gray.

(5) Max called his mother and Bob called his mother too

Sentence (4) can also be taken to mean that Max and Bob both called *Max's* mother. This is called a *strict* reading. It arises when the pronoun in the elided VP and the

pronoun in the antecedent VP are both taken to refer to Max:

(6) Max called his mother and Bob called his mother too
↓ ↓
Max Max

Sentence (4) can also be taken to mean that Max and Bob both called the mother of a some third person, say Jack. This is also called a strict reading, and it arises if the pronouns in the elided and the antecedent VP are both taken to refer to Jack.

Crucially, (4) *cannot* be interpreted as saying that Max called Jack's mother and that Bob called his own mother. This means that the following LFs must be ruled out:

(7) Max called his mother and Bob called his mother too
↓ ↑
Jack

(8) Max called his mother and Bob called his mother too
↓ ↓
Jack Bob

How the grammar should rule out LFs like (7) and (8) is subject to much debate (see, for instance, Johnson, 2008). Fox's original argument for BINDING ECONOMY assumes a constraint on VP ellipsis called PARALLELISM: pronouns in the elided and the antecedent VP must either (i) have the same referential value, or (ii) be bound in parallel. We will initially follow Fox in assuming that VP ellipsis is constrained by PARALLELISM, and that this is what rules out LFs like (7) and (8). In §7, when dealing with a more complex case of VP ellipsis, we will reconsider this assumption and argue for a refinement.

3 Binding Economy

We are now ready to have a closer look at BINDING ECONOMY. The idea is perhaps best illustrated by means of an example. Consider the following two logical forms:

(9) Max said that he called his mother

(10) Max said that he called his mother

These logical forms are semantically equivalent. However, in (9), [his] is bound *locally* by [he], while in (10) it is bound non-locally by [Max]. According to BINDING ECONOMY, then, (9) is more economical than (10), and (10) is therefore ruled out. A general and precise formulation of BINDING ECONOMY is given in (11)–(13).

(11) **Alternatives.** Two LF constituents are alternatives iff they are (i) semantically equivalent, and (ii) formally identical modulo binding indices on pronouns.

(12) **Economy measure.**
Let Σ and Π be alternatives. Then we say that Π is more economical than Σ iff there is a pronoun P and determiner phrases A and B in Σ and Π such that (i) A binds P in Σ, (ii) B binds P in Π, and (iii) A c-commands B in Σ and Π.

(13) **Binding economy.**
An LF constituent is illicit if it has a more economical alternative.

Empirical evidence for BINDING ECONOMY mainly comes from a puzzle concerning VP ellipsis, dating back to (Dahl, 1973). Consider the following sentence:

(14) Max said that he called his mother and Bob did too.

Notice that the first conjunct of (14) contains two pronouns. It may be expected, then, that the second conjunct will have at least four readings: one in which both pronouns are interpreted strictly, one in which they are both interpreted sloppily, and two 'mixed' readings where one of the pronouns is interpreted strictly and the other sloppily. Surprisingly, one of these mixed readings is not available (in neutral contexts):

(14) Max said that he called his mother and Bob did too.

a. ...Bob too said that Max called Max's mother. [strict-strict]

b. ...Bob too said that Bob called Bob's mother. [sloppy-sloppy]

c. ...Bob too said that Bob called Max's mother. [sloppy-strict]

d. #...Bob too said that Max called Bob's mother. [strict-sloppy]

The challenge, then, is to account for the fact that (14-a), (14-b), and (14-c) are possible readings of (14), while (14-d) is not.

BINDING ECONOMY and PARALLELISM account for this fact. To see this, first consider the strict-sloppy reading in (14-d). This reading could in principle be derived from the following logical forms (among several others):

(15) Max said he called his mother and Bob said he called his mother too

(16) Max said he called his mother and Bob said he called his mother too

However, (15) is ruled out by BINDING ECONOMY, because (16) is a more economical alternative. Moreover, (16) itself is ruled out by PARALLELISM, and the same holds for all other logical forms that would in principle yield the strict-sloppy reading of (14). Thus, the reading is successfully blocked by BINDING ECONOMY and PARALLELISM.

The other three readings, (14-a), (14-b), and (14-c), *can* be derived, through the following three logical forms. Each of these satisfies BINDING ECONOMY and PARALLELISM.

(17) Max said he called his mother and Bob said he called his mother too.

(18) Max said he called his mother and Bob said he called his mother too.

(19) Max said he called his mother and Bob said he called his mother too.

4 A Problem for Binding Economy

Consider the following variant of Dahl's original example:

(20) No student said that he liked his paper, but
every student hoped that the teacher would.

This sentence has a reading on which every student x hoped that the teacher would like x's paper. This reading could in principle be derived from the following logical forms:

(21) No S said he liked his paper, but every S hoped T would like his paper

(22) No S said he liked his paper, but every S hoped T would like his paper

However, (21) is ruled out by BINDING ECONOMY, because (22) is a more economical alternative, and (22) itself is ruled out by PARALLELISM. So in this case the desired reading is wrongly blocked.

To appreciate the problem, compare the first conjuncts of (15) and (21):

(23) Max said he called his mother

Max

(24) No student said he liked his paper

In both cases, BINDING ECONOMY predicts that non-local binding of [his] is ungrammatical. In the case of (23) this is a welcome prediction, as it leads to an account of Dahl's puzzle. But in the case of (24) it is not, because it blocks the pertinent reading of (20).

5 Free Variable Economy

We will try to overcome this impasse in a way that preserves the general idea that semantic interpretation is subject to economy constraints. BINDING ECONOMY is derived from this general idea by assuming that one logical form is more economical than another if the pronominal binding relations it encodes are more local. This particular assumption seems to be problematic, but that does not mean that the general idea has to be abandoned. There may be other reasonable measures of economy. Indeed, one such measure will be formulated below. It is concerned with *free variables*, which are defined as follows:

(25) **Free variables.** Let Σ be an LF constituent, and let P be a pronoun in Σ that has a binding index, but no binder within Σ. Then the binding index of P is called a free variable in Σ.

Let us consider some examples (returning for a moment to fully explicit index-notation):

(26) a. [[Max]^2 [t_2 called his$_2$ mother]]

b. [[Max]^2 [t_2 called his$_1$ mother]]

c. [[he$_1$]^2 [t_2 called his$_1$ mother]]

d. [[he$_1$]^2 [t_2 called his$_2$ mother]]

(26-a) does not contain any free variables, because the pronoun it contains is bound within the given constituent. (26-b) does contain a free variable, because the pronoun [his$_1$] has a binding index, and is not bound within the given constituent. (26-c) also contains one free variable. Notice that we are not counting *occurrences* of free variables. The constituent contains two unbound pronouns, but both have the same index, so there is only one free variable. If one of the pronouns is bound, as in (26-d), the number of free variables does not change, it is still one.

(27) **Economy measure.** Let Σ and Π be alternatives. Then we say that Π is more economical than Σ if and only if some sub-constituent Π' of Π contains fewer free variables than the corresponding sub-constituent Σ' of Σ.

(28) **Free variable economy.**

An LF constituent is illicit if it has a more economical alternative.

Notice that the formulation of FREE VARIABLE ECONOMY (FVE) is identical to that of BINDING ECONOMY. The only thing that has changed is the measure of economy.

FVE accounts for Dahl's puzzle, and it does *not* rule out the pertinent reading of (20). In other words, it prohibits non-local binding in (23) but not in (24). To see this, first consider (23), repeated in (29) with the relevant indices made explicit:

(29) Max^1 said that he^2 called his$_1$ mother

Max

This logical form has the following alternative:

(30) Max^1 said that he^2 called his$_2$ mother
↓↖⌣
Max

These two logical forms are semantically equivalent and, crucially, (30) is more economical than (29). To see this, consider the embedded clause. In (29), the embedded clause contains a free variable; in (30) it does not. This is enough for (30) to be considered more economical than (29), and thus for FVE to account for Dahl's puzzle.

Now consider (24), repeated in (31) with explicit indices. Recall that this logical form should *not* be ruled out (otherwise the pertinent reading of (20) cannot be derived).

(31) No student^1 said that he$^2_1$ liked his$_1$ paper
↑↖⌣ ⌣

This logical form has the following alternative:

(32) No student^1 said that he$^2_1$ liked his$_2$ paper
↑⌣ ↑⌣

But this alternative is *not* more economical. Consider, in particular, the embedded clause. In (31), neither [he$^2_1$] nor [his$_1$] is bound within the embedded clause, but both carry the same binding index, so the embedded clause contains *one* free variable. In (32), [his$_2$] is bound within the embedded clause, but [he$^2_1$] is not, so the clause still contains one free variable. Thus, the embedded clause in (32) does not contain fewer free variables than the embedded clause in (31). It can be shown that no other constituent in (32) contains fewer free variables than the corresponding constituent in (31), and that the same holds for other alternatives of (31). Thus, FVE does not rule out (31) and correctly derives the pertinent reading of (20).

6 Additional evidence: reverse Dahl effects and more

Fox (1999) shows that BINDING ECONOMY, besides accounting for Dahl's original puzzle, also accounts for what Kehler and Büring (2008) call *reverse Dahl effects*. Consider:

(33) Max claims that Bob called his mother, and Bob does too.

The crucial observation is that this sentence does *not* have a reading on which both Max and Bob claim that their own respective mother was called by Bob. BINDING ECONOMY accounts for this observation by ruling out the following LF (unlike in Dahl's original example, now it's the *second* conjunct that exhibits illicit non-local binding):

(34) Max claims Bob called his mother, and Bob claims Bob called his mother too

However, the following variant of (33) is problematic for BINDING ECONOMY.

(35) Every boy claimed that the jury loved his dish, and added that he did too.

This sentence has a reading on which every boy added that he loved his own dish. This reading could in principle be derived from one of the following logical forms:

(36) Every boy claimed that the jury loved his dish,
and added that he loved his dish too

(37) Every boy claimed that the jury loved his dish,
and added that he loved his dish too

However, (36) violates PARALLELISM and (37) violates BINDING ECONOMY, because it is less economical than (36). Thus, the pertinent reading of (35) is wrongly blocked.

FVE avoids this undesirable result. If economy is measured in terms of free variables, then (37) is just as economical as (36). Hence, (37) is not ruled out and the pertinent reading is licensed.

Yet another type of example that is problematic for BINDING ECONOMY, but not for FVE, is the following variant of Dahl's example:

(38) Every boy said that he called his mother, and that the teacher did too.

This sentence has a reading on which every boy x said that the teacher called x's mother. This reading could in principle be derived from the following logical forms:

(39) Every boy said that he called his mother

and that T called his mother too

(40) Every boy said that he called his mother

and that T called his mother too

However, (39) violates PARALLELISM and (40) is ruled out by BINDING ECONOMY because it is less economical than (39). Thus, the pertinent reading is wrongly blocked.

Again, FVE fares better: it does not take (39) to be more economical than (40). Hence, (40) is not ruled out and the pertinent reading of (38) is accounted for.

7 Embedded Dahl effects

Finally, consider the example in (41), which is constructed by embedding an ordinary Dahl sentence under an additional layer of quantification.

(41) Every worker said that he knows when he can take home his tools,
and that the boss does too.

We will make two observations about this type of sentence, both of which will force us to further refine the theory established so far.

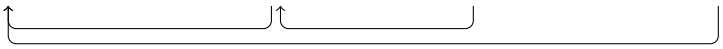
7.1 First observation: a mixed reading

The first observation is that (41) has a 'mixed' reading, on which every worker x said that the boss knows when he, the boss, can take home x's tools. This reading could in principle be derived from one of the following logical forms (among several others):

(42) Every worker said that he knows when he can take home his tools,

and that tb knows when he can take home his tools too

(43) Every worker said that he knows when he can take home his tools,



and that tb knows when he can take home his tools too

However, (42) violates PARALLELISM and (43) is ruled out by BINDING ECONOMY because it is less economical than (42). Other logical forms that would in principle yield the pertinent reading all violate PARALLELISM. Thus, the reading is wrongly blocked.

Strikingly, FVE does *not* directly fare better in this case. Just as BINDING ECONOMY, it regards (43) as more economical than (42): in the first embedded conjunct of (43), the constituent [he can take home his tools] contains two free variables, while in the first embedded conjunct of (42) it only contains one free variable. Again, all other logical forms that would in principle yield the pertinent reading of (41) violate PARALLELISM. Thus, the reading is still wrongly blocked.

We could of course conclude from this that there is something wrong with FVE. But there is another potential culprit, namely PARALLELISM. And indeed, there is something quite arbitrary about the fact that (42) is ruled out by PARALLELISM. After all, the pronoun [his] in the antecedent VP is ultimately 'dependent on' the quantifier [every worker], just like the corresponding pronoun in the elided VP. The only difference is that the pronoun in the elided VP is directly bound by the quantifier, while the pronoun in the antecedent VP is linked to the quantifier more indirectly. If we were allowed to ignore this difference—and why shouldn't we?—then (42) would no longer be ruled out, and the pertinent reading of (41) would be derived.

It seems, then, that this is the place where we have to start refining our working assumptions about VP ellipsis. And there is a natural way to do so. As a starting point, we will assume—following Rooth (1992), Heim (1997), and many others—that a VP can only be elided if it is contained in a constituent that *contrasts appropriately* with some other constituent in the surrounding discourse. This idea can be implemented in terms of a theory of focus, as has been developed in (Rooth, 1985) and much subsequent work. We will assume the following implementation (see Heim, 1997 for detailed discussion and a slightly more involved implementation).

(44) **Focus Match.** A VP can only be elided if it is contained in a constituent Σ that *contrasts appropriately* with another constituent Π in the surrounding discourse. Σ contrasts appropriately with Π if and only if for every assignment function g, the normal semantic value of Π with respect to g, $[\![\Pi]\!]_g$, entails an element of the focus semantic value of Σ with respect to g, $[\![\Sigma]\!]^F_g$.

FOCUS MATCH immediately accounts for the data that we used initially to justify PARALLELISM. To see this, briefly consider the pertinent logical forms from §2, now adorned with the relevant indices and focus features (traces are still omitted).

(45) Max^1 called his_1 mother and Bob^2_F called his_2 mother too

(46) Max^1 called his mother and Bob^2_F called his mother too
↓ ↓
Max Max

(47) Max^1 called his mother and Bob^2_F called his_2 mother too
↓
Jack

(48) Max^1 called his mother and Bob^2_F called his mother too
↓ ↓
Jack Bob

Recall that (45) and (46) must be licensed, while (47) and (48) must be ruled out. In (45), the elided VP is contained in the constituent $\Sigma = [\text{Bob}^2_F \text{ called his}_2 \text{ mother}]$. This constituent contrasts appropriately with $\Pi = [\text{Max}^1 \text{ called his}_1 \text{ mother}]$, since, for any assignment function g, $[\![\Pi]\!]_g$ is an element of $[\![\Sigma]\!]^F_g$. Thus, the ellipsis is licensed, as desired, and a similar reasoning applies to (46).

Now consider (47), which should be ruled out. Again, the elided VP is contained in the constituent $\Sigma = [\text{Bob}^2_F \text{ called his}_2 \text{ mother}]$. However, this constituent does not contrast appropriately with any other constituent in (47). In particular, it does not contrast appropriately with $\Pi = [\text{Max}^1 \text{ called his}_J \text{ mother}]$, since for no assignment function g, $[\![\Pi]\!]_g$ entails an element of $[\![\Sigma]\!]^F_g$. So (47) is ruled out, as desired, and a similar reasoning applies to (48). Thus, FOCUS MATCH accounts for the basic contrast that was used to justify PARALLELISM.

However, there are certain cases where FOCUS MATCH needs to be supplemented with further constraints on indexing. Consider the following sentence:

(49) Max said that Bill thinks that Mary will vote for him,
and that Bob thinks that Sue will.

Crucially, this sentence does *not* have a reading on which, according to Max, Bill thinks that Mary will vote for *Bill*, and that Bob thinks that Sue will vote for *Max*. However, this reading *can* in principle be derived from the following LF.

(50) Max^1 said that Bill^1 thinks that Mary^2 will vote for him_1
and that Bob^3 thinks that Sue^4_F will vote for him_1

This LF would be ruled out by PARALLELISM, but it is not ruled out by FOCUS MATCH, since the elided VP is contained in [Sue^4_F will vote for him_1], which contrasts appropriately with [Mary^2 will vote for him_1].

Intuitively, what has gone wrong in (50) is that [Max] and [Bill] have received the same binder index. As a consequence, the pronoun in the elided VP and the pronoun in the antecedent VP have the same binding index, even though they have different antecedents. This is how FOCUS MATCH is 'fooled'. The assumed notion of appropriate contrast only makes sense if we make sure that pronouns with the same binding index indeed always have the same antecedent. In the terminology of (Heim, 1997) we have to rule out *meaningless coindexing*. This is not enforced by the assumptions we have made so far. Therefore, following Heim, we will adopt the following additional constraint.[2]

(51) **No meaningless coindexing (NMC).** If a logical form contains a pronoun P that is bound by an antecedent A, then any other pronoun in that logical form with the same binding index as P must also be bound by A.

[2]Rather than adopting a separate 'filter' on logical forms, we could also achieve the desired effect by slightly adjusting the QR mechanism. That is, if we require that every DP undergoing QR receives a binder index that *has not been used before*, then two pronouns with the same binding index can never have different antecedents.

Now, assuming FOCUS MATCH and NMC instead of PARALLELISM, let us return to the logical form in (42), repeated below with the relevant indices and focus features:

(52) Every worker^1 said that he$^2_1$ knows when he$^3_2$ can take home his$_3$ tools,

and that tb^4_F knows when he$_4$ can take home his$_1$ tools too

Clearly, this logical form does not violate NMC. It does not violate FOCUS MATCH either, since the elided VP is contained in [the boss^4_F knows when he$_4$ can take home his$_1$ tools], which contrasts appropriately with [he$^2_1$ knows when he$^3_2$ can take home his$_3$ tools]. Thus, the pertinent mixed reading of (41) is now licensed, as desired.

It is important to check whether replacing PARALLELISM by FOCUS MATCH and NMC might actually alleviate BINDING ECONOMY from some of the objections that we raised against it earlier. After all, we observed that BINDING ECONOMY *in combination with* PARALLELISM wrongly blocked certain readings. But now that PARALLELISM has been replaced by weaker constraints, it may be that these readings are not blocked anymore.

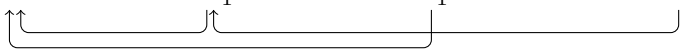
This is indeed the case for one of the examples that we discussed, namely (38). The logical form in (39), which was ruled out by PARALLELISM, is no longer ruled out by FOCUS MATCH and NMC. So the pertinent reading of (38) is licensed, even if BINDING ECONOMY is taken back on board.

However, the other examples we discussed, (20) and (35), are still problematic for BINDING ECONOMY, since the logical forms in (22) and (36) *are* ruled out by FOCUS MATCH and NMC. Thus, we still have reasons to favor FVE over BINDING ECONOMY.

7.2 Second observation: a *missing* mixed reading

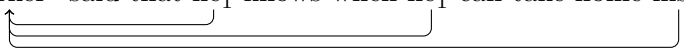
Now let us turn to the second observation concerning example (41), which is that this sentence does *not* have a reading on which every worker x said that the boss knows when x can take home the boss' tools. This is another 'mixed' reading, which could in principle be derived from the following logical forms (among several others):

(53) Every worker^1 said that he$^2_1$ knows when he$^3_1$ can take home his$_2$ tools,



and that tb^4_F knows when he$_1$ can take home his$_4$ tools too

(54) Every worker^1 said that he$^2_1$ knows when he$^3_1$ can take home his$_1$ tools,



and that tb^4_F knows when he$_1$ can take home his$_4$ tools too

Notice, first of all, that (53) is ruled out by FVE because it is less economical than (54). In particular, the constituent [he can take home his tools] contains two free variables in the first embedded conjunct of (53), while it contains only one free variable in the first embedded conjunct of (54). This is a desirable result.

However, the constraints that we assume at this point, FVE, FOCUS MATCH, and NMC, do *not* rule out the logical form in (54). It is straightforward to see that (54) satisfies FVE and NMC. To see that it also satisfies FOCUS MATCH, notice that the constituent Σ = [the-boss^4_F knows when he$_1$ can take home his$_4$ tools] contrasts appropriately with Π = [he$^2_1$ knows when he$^3_1$ can take home his$_1$ tools]. After all, for any assignment function g, we can find some element of $[\![\Sigma]\!]^F_g$ that coincides with $[\![\Pi]\!]_g$.

Notice also that (54) *would* be ruled out by PARALLELISM. Thus, FOCUS MATCH and NMC should either be modified or be supplemented with an additional constraint in order to be considered worthy replacements of PARALLELISM. We will opt for the second alternative here: we will assume the following additional constraint on VP ellipsis.

(55) **Preserve coindexing (PCI).** If two pronouns in the antecedent VP are coindexed then they must also be coindexed in the elided VP.

This constraint should ultimately follow from more general principles. Indeed, most likely it will follow from a suitable modification of FOCUS MATCH. However, at this point we do not see exactly how FOCUS MATCH could be modified in order to yield PCI as a corollary. Therefore, for now, we adopt PCI as a separate constraint.

With PCI on board, our overall theory preserves exactly those effects of PARALLELISM that are indeed desirable, while suppressing the undesirable ones. In particular, (54) is now ruled out, and the pertinent reading of (41) is successfully blocked (besides (53) and (54), there are several other LFs that would in principle derive the reading, but these LFs are all ruled out by FVE or PCI). Crucially, however, our theory is still weak enough, unlike PARALLELISM, to license the logical form in (52), and thereby the attested mixed reading of (41). Moreover, adopting PCI as an additional constraint on VP ellipsis does not affect any of the results obtained in previous sections. Thus, with FOCUS MATCH, NMC, and PCI serving as background assumptions, FVE accounts for all cases considered.[3]

8 Conclusion

The general aim of this paper was to assess the merits and the potential pitfalls of the idea that semantic interpretation is subject to economy constraints. We focused on one particular constraint, BINDING ECONOMY, proposed by Fox (1999), which favors local pronominal binding over non-local binding. Fox showed that, given certain background assumptions about VP ellipsis, BINDING ECONOMY accounts for a long-standing puzzle concerning strict and sloppy readings in VP ellipsis, dating back to Dahl (1973).

We have drawn attention to several variants of Dahl's original puzzle, which were shown to be problematic for BINDING ECONOMY. In response to this, we proposed an alternative constraint, FREE VARIABLE ECONOMY, which disfavors free variables rather than non-local binding. We also refined the background assumptions about VP ellipsis that Fox (1999) made. Together, FREE VARIABLE ECONOMY and the refined assumptions about VP ellipsis account for all variants of Dahl's puzzle. We take this to vindicate the general idea that semantic interpretation is subject to economy constraints.

[3] Kehler and Büring (2008) observe that Dahl effects do not only occur in sentences involving ellipsis, but also in sentences involving *deaccenting*, and in sentences involving focus-sensitive operators like *only*. The theory proposed here seems to provide a suitable account of these constructions as well, under the assumption—argued for in detail by Rooth (1992) and others—that FOCUS MATCH applies uniformly to both ellipsis and deaccenting. A detailed analysis of these cases, however, is left for a future occasion.

Acknowledgements

I am very grateful to an *LI* reviewer for extremely sharp and constructive feedback, and in particular for pointing out to me the relevance of examples like (35) and (41). Also, I am very grateful to Maria Aloni, Rajesh Bhatt, Liz Coppock, Paul Dekker, Danny Fox, Jeroen Groenendijk, Irene Heim, Kyle Johnson, Salvador Mascarenhas, Tanya Reinhart, Eric Reuland, and Philippe Schlenker for encouragement and feedback at various stages.

References

Büring, D. (2005a). *Binding Theory*. Cambridge University Press.

Büring, D. (2005b). Bound to bind. *Linguistic Inquiry*, **36**(2), 259–274.

Dahl, O. (1973). On so-called sloppy identity. *Synthese*, **26**, 81–112.

Fiengo, R. and May, R. (1994). *Indices and Identity*. MIT Press, Cambridge, Massachusetts.

Fox, D. (1999). *Economy and Semantic Interpretation*. MIT Press, Cambridge, Massachusetts.

Heim, I. (1997). Predicates or formulas? Evidence from ellipsis. In A. Lawson, editor, *Proceedings of the Seventh Conference on Semantic and Linguistic Theory*, pages 197–221.

Heim, I. and Kratzer, A. (1998). *Semantics in Generative Grammar*. Blackwell Publishers.

Johnson, K., editor (2008). *Topics in Ellipsis*. Cambridge University Press.

Kehler, A. (1993). A discourse copying algorithm for ellipsis and anaphora resolution. In *Proceedings of the Sixth European Chapter of the Association for Computational Linguistics*, pages 203–212.

Kehler, A. and Büring, D. (2008). Be bound or be disjoint! In *Proceedings of the 38th Meeting of the North East Linguistic Society (NELS)*.

Reinhart, T. (1983). *Anaphora and Semantic Interpretation*. Croom Helm, London.

Reinhart, T. (2006). *Interface stragegies: optimal and costly computations*. MIT Press, Cambridge, Massachusetts.

Rooth, M. (1985). *Association with Focus*. Ph.D. thesis, University of Massachusetts, Amherst.

Rooth, M. (1992). Ellipsis redundancy and reduction redundancy. In S. Berman and A. Hestvik, editors, *Proceedings of the Stuttgart Workshop on Ellipsis*.

Schlenker, P. (2005). Non-redundancy: towards a semantic reinterpretation of binding theory. *Natural Language Semantics*, **13**, 1–92.