

**PARTIAL CONTROL
AND ANAPHORIC CONTROL IN LFG**

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Abstract

In this paper I discuss the phenomenon of partial control, which has been widely discussed in the derivational literature but almost completely ignored in LFG. I argue that it requires a treatment in terms of ‘quasi-obligatory’ anaphoric control, a type of control that is implicit in some earlier LFG work but has never been properly formalized. Quasi-obligatory anaphoric control does not involve syntactic specification of the controller but rather a semantic constraint that requires the controller to be a logocenter of the matrix predicate, combined with normal (pragmatic) resolution of anaphora.

1 Introduction

‘Partial control’ is a phenomenon that has attracted much attention in the derivational and recently also the semantic literature, cf. Landau (2000, 2004) and related work for syntactic and Grano (2012); Pearson (2013) for semantic analyses. The basic phenomenon, apparently first noticed by Lawler (1976), is that in some cases, there is only an indirect referential relationship between the controller and the controllee in a control construction. One of Lawler’s original examples is (1).

- (1) Mary wants to bomb Hanoi.

(1) has a natural reading where Mary wants *her country’s air force* to bomb Hanoi, not herself. Lawler’s example is unusual in that there is not even an inclusion relation between the controller and the controllee.¹ In the normal case of indirect referential relation between controller and controllee, the controllee denotes a plurality that includes the controller. Some predicates allow this construction and others do not. The difference appears for example when we embed a collective predicate, requiring a semantically plural subject, under a control verb with a semantically singular subject, as in (2).

- (2) a. The chair_{*i*} wanted to gather_{*i+*} at six.
b. The chair_{*i*} preferred to gather_{*i+*} at six.
c. The chair_{*i*} agreed to gather_{*i+*} at six.
- (3) a. *The chair tried to gather at six.
b. *The chair began to gather at six.
c. *The chair managed to gather at six.

The subscript *i+* indicates that the subject of the infinitive is to be interpreted as a plurality containing the controller *i*. Following Landau we refer to this as partial control (PC). The verbs in (3) exhibit exhaustive control (EC).

[†]Thanks to Mary Dalrymple and John Lowe for comments on this paper.

¹Or maybe there is. One informant reports that (1) is more naturally paraphrased as *Mary wants her country to bomb Hanoi*. This would give a regular inclusion relation but with a metonymic interpretation of the controllee position. See also footnote 3.

In the derivational literature, the PC/EC distinction has been brought to bear on the issue of whether control should be accounted for in terms of PRO (as argued by Landau in the above cited works) or movement (as in the movement theory of control (MTC), see Hornstein and Polinsky (2010); Boeckx et al. (2010)). In the LFG literature, with the exception of Asudeh (2005), PC has not been discussed. But insofar as the PRO/MTC distinction in derivational theories is isomorphic to the distinction between anaphoric and functional control in LFG, it would seem to bear on similar, important theoretical questions. In particular, PC suggests that the LFG theory of control as it stands is not sufficiently fine-grained: as we will see, the PC reading is looser than we would predict on an analysis as functional control or obligatory anaphoric control, but it is also stricter than an arbitrary anaphoric control analysis would lead us to expect.

2 The phenomenology of partial control

2.1 PC is obligatory control

The derivational literature has often focused on whether PC is obligatory or non-obligatory control. The notion of obligatory control in derivational grammar is not an entirely well-defined one, but it is clear that PC predicates pattern with prototypical obligatory control predicates such as *try* on a number of tests.

2.1.1 No arbitrary control

PC predicates do not allow the controller to be arbitrary/generic, as shown in (4).

- (4) *John tried to be_{arb} quiet. (Landau, 2000, p. 34)
 (5) *John expected to be_{arb} quiet together. (Pearson, 2013, p. 305)

This contrasts with e.g. subject gerunds, which *can* have arbitrary control:

- (6) Amy_i told Tom_j that dancing_{i/j/arb} with Dan might be fun.
 (Culicover and Jackendoff, 2005, p. 422)

2.1.2 No long-distance antecedents

The controller must be in the clause directly governing the infinitive in both PC and EC cases.

- (7) *Mary_i knew that John tried [to perjure_i herself_i].
 adapted from Landau (2000, p. 34)
 (8) *Mary_i knew that John expected [to be_{i+} found guilty as a group].
 (Pearson, 2013, p. 306)

This is not the case with subject gerunds, as shown by the indexations *i/j* in (6).

2.1.3 Only sloppy readings of PRO in OC

It is a hallmark of obligatory control that we only get sloppy readings under ellipsis, i.e. (9) can only have a reading where Bill tried for Bill to leave early.

(9) John tried [to leave early], and Bill did too.

We find the same pattern in partial control, as shown in (10).

(10) Obama expected [to succeed as a party], and McCain did too.
(Pearson, 2013, p. 306).

On the other hand, non-obligatory PRO constructions give rise to an ambiguity between strict and sloppy readings, as shown in (11).

(11) John thinks that getting his résumé in order is crucial and Bill does too.
(Hornstein, 2003, p. 13)

(11) can mean that Bill thinks it is crucial that John gets his résumé in order, or that Bill thinks it is crucial that he himself gets his résumé in order.

2.1.4 Only *de se* readings of PRO in OC

In the semantics literature, much attention has been paid to the fact that PRO is infelicitous in ‘mistaken-identity’ scenarios, typically involving attitude reports where the attitude holder is unaware that the attitude involves herself. Typical examples, adapted from Pearson (2013, 318–319), are given in (12) (EC) and (13) (PC).

(12) John is an amnesiac. He is watching footage of an Olympic event in which he competed, although he has forgotten this fact, and does not even recognise himself on the screen. Bill asks him ‘Who won the medal?’ John points at himself on the screen and says ‘He did’.

- a. #John claimed to have won the medal.
- b. John claimed that he had won the medal.

(13) The same scenario in a team sport like figure skating. John says ‘I think that team is going to win the medal, look how well they work together.’

- a. #John expects to win the medal by working well together.
- b. John_{*i*} expects that they_{*i+*} will win the medal by working well together.

This means that PRO is a perspective-sensitive item, whose reference is dependent on whose point of view is taken, i.e. it is a logophor in the sense of Hagège (1974); Clements (1975); Sells (1987). However, PRO is only a logophor in obligatory control contexts. If in the scenario in (12), John points to himself and says ‘He won. But it looks boring’, it seems we can report this truthfully as in (14).

- (14) John_{*i*} thinks that getting_{*i*} a medal looks boring.
adapted from Hornstein (2003, p. 13)

This is a *de re* reading, since John is not aware of his identity.

2.1.5 Conclusion

In conclusion, PC seems to form a natural class with EC according to the tests above. But notice that there are other properties sometimes taken to define obligatory control but which cross-cut the PC/EC division, such as the possibility of *for*-complements. In any case, it is not clear that obligatory control in derivational syntax corresponds one-to-one to a concept in LFG, so for us the properties illustrated in sections 2.1.1–2.1.4 are not criteria determining a specific analysis but properties of the PC construction that our analysis should account for.

2.2 Semantic versus syntactic plurality

It has been observed that the controllee in PC is only semantically plural, while it remains syntactically singular and fails to license a plural anaphor in (15-b).

- (15) a. John told Mary_{*i*} that he preferred to meet_{*i+*} at 6 today.
b. *John told Mary that he_{*i*} preferred to meet_{*i+*} each other at 6 today.

The idea that plural anaphors require syntactic and not just semantic plurality is borne out by the behaviour of group nouns in American and British English, as reported in Pearson (2013). Group nouns are by definition semantically plural, but it is only in British English that they are syntactically plural in the sense of licensing plural agreement on the verb (16), or a plural anaphor (17).²

- (16) The committee hope that you will accept the job. Pearson (2011, p. 161)
(17) The committee met each other in the hall. Pearson (2013, p. 309)

In American English, by contrast, group nouns are syntactically singular, so that only singular agreement is acceptable, and group nouns also cannot bind plural anaphors. In a similar way, the failure of the PC controllee in (15) to bind a plural anaphor can be explained if the plurality in (15) is semantic only.

This contrasts with the behaviour of split control, which is otherwise in many respects similar to partial control, cf. (18)–(19), adapted from Landau (2000, p. 53). The a. examples display partial control (indexed with *i+*) and the b. examples display split control (indexed with *i + j*).

- (18) a. John told Mary that he_{*i*} preferred to meet_{*i+*} (*each other) at 6 today.
b. John_{*i*} proposed to Mary_{*j*} to meet_{*i+j*} each other at 6.

²The data is actually more complex, cf. Hristov (2012), but we cannot go into details here.

- (19) a. John_i told Mary_j that he_i wondered whether to get_{i(+)} (*themselves) a new car.
 b. John_i asked Mary_j whether to get_{i+j} themselves a new car.

The intuition here is that the assignment of a controller in (18-a) and (19-a) is limited to the governing clause, so only *he_i* is the controller. In (18-a), the embedded verb requires a plural antecedent, so the controllee position is coerced semantically to a plural reading. In the given context, this is most naturally interpreted as *John + Mary*, but this reinterpretation does not give *Mary* the status of a controller. In (18-b) and (19-b), by contrast, both *John* and *Mary* are (split) controllers, and the controllee is therefore syntactically plural and licenses a plural anaphor.

This does not mean that PC precludes split control. Since PC does not allow remote controllers, as we saw in section 2.1.2, split control is ruled out in (18-a) and (19-a). In (18-b) and (19-b), on the other hand, there are two possible *local* controllers. So the syntactic number facts follow from the locality constraint on controllers: only local antecedents are strictly speaking controllers and therefore antecedents for number agreement (in the way to be described in section 4.1); non-local antecedents merely act to facilitate the semantic reinterpretation of the controllee as a plurality including the controller.

2.3 The anaphoric nature of partial control

PC is a marked option which requires contextual support. It is much improved if the context offers a salient plurality that contains the syntactic controller and is a suitable semantic subject for the embedded infinitive. For example, we saw in (18)–(19) that *John + Mary* is a suitable salient plurality. Similarly, in (2), the subject noun *chair* primes a group or committee that the chair is the head of.

The marked nature of partial control is corroborated by the questionnaire study reported (without much detail, unfortunately) in Pearson (2013), where speakers were asked to rate sentences for grammaticality on a scale from 1 (unacceptable) to 6 (perfect). The mean rating for partial control sentences was 3.56.

This suggests that PC is not a straightforward semantic phenomenon but involves some pragmatic reinterpretation. It is in many respects similar to ‘bridging’ (Clark, 1975; Asher and Lascarides, 1998): when the discourse context does not provide a suitable antecedent for an anaphoric expression, the anaphor is resolved to an inferred expression instead, as in (20).

- (20) The chair despaired. The committee was already late with its report.

We easily understand *the committee* as *the chair’s committee*, in a similar way to how we understand the controlled position in (2). Conversely, PC is distinctly odd if we try to force the interpretation of the controllee as a new discourse referent:

- (21) John is lonely. #He wants to have lunch together.

It seems possible to interpret (21) as ‘he wants to have lunch with me’, but not as ‘he wants to have lunch with someone’, which introduces a new discourse referent.

It is well known that bridging is more constrained with pronouns than with definite descriptions, cf. the contrast in (22).

- (22) We cannot use John’s car.
a. The tires are flat.
b. #All four of them are flat. from Nouwen (2003, p. 73)

Nevertheless, it is clear that pronouns can in some cases take inferred antecedents when the contextual support is strong enough.

- (23) John kept on staring at the newly-wed couple. *She* resembled a childhood sweetheart of his. from Nouwen (2003, p. 73)
(24) The priest was tortured for days. *They* wanted him to reveal where the insurgents were hiding out.
(25) The restaurant went bust when the liquor license *they* applied for was refused.

It seems possible, therefore, to capture the anaphoric nature of PC by assimilating control in these structures to pronominal anaphora with a locality constraint.

An anaphoric account sits well with the generally marked nature of PC, since as we just saw, bridging is a marked option for the anaphoric resolution of pronominal anaphora. Moreover, an account in terms of anaphoric resolution predicts that the semantics of both the governing and the embedded clause can influence the control behavior. This is borne out, for as observed by Borkin (1972, p. 384), PC is not an option in (26).

- (26) Mary badly/desperately wants to bomb Hanoi.

Here it seems that the intensifier modifies the meaning of the matrix predicate in such a way as to rule out bridging relations that imply no personal participation in the event described by the control infinitive.³

However, while the acceptability of PC is not perfect, and highly contingent

³The issue is in fact complicated by examples such as (i), which seems fine on a PC reading.

- (i) Nixon badly wants to bomb Hanoi.

However, similar readings are possible even with strictly EC predicates such as *try* in (ii), suggesting these examples involve metonymy.

- (ii) Nixon tried to bomb Hanoi.

One informant finds PC acceptable in (26), and even better in (currently) more realistic scenarios such as *I badly want to leave the EU*. On the present account, there is no reason to expect categorical intersubjective judgments on such constraints.

Class	Examples
Factives	glad, sad, regret, like, dislike, hate, loath, surprised, shocked, sorry
Propositional	believe, think, suppose, imagine, say, claim, assert, affirm, declare, deny
Desideratives	want, prefer, yearn, arrange, hope, afraid, refuse, agree, plan, aspire, decide, mean, intend, resolve, strive, demand, promise choose, offer, eager, ready
Interrogatives	wonder, ask, find out, interrogate, inquire, contemplate, deliberate, guess, grasp, understand, know, unclear

Table 1: PC Verbs according to Landau

Class	Examples
Implicatives	dare, manage, make sure, bother, remember, get, see fit, condescend, avoid, forget, fail, refrain, decline, neglect, force, compel
Aspectual	begin, start, continue, finish, stop, resume
Modal	have, need, may, should, is able, must

Table 2: EC Verbs according to Landau

on semantics and contextual support, the contrast with EC verbs is clear, cf. (2)–(3). We cannot undertake an empirical investigation of the behaviour of different control verbs here, but Tables 1–2 show Landau’s classification of predicates that take a control complement (either an infinitive or a gerund). Notice that *try* is lacking from the classification but clearly behaves like an EC verb. *Believe* is included, although its status as a control verb is controversial.

3 Against a functional control analysis

A functional control analysis equates the controller and the controllee at the level of f-structure. However, the defining feature of PC is that the two positions are *not* equal in the semantics. Consequently, a functional control analysis requires some footwork at the syntax-semantics interface. The problem is that it is hard to do this in a way that adequately captures the anaphoric nature of PC.

Asudeh (2005) provides the meaning constructors in (27) in his analysis of PC as functional control. For comparison, (28) provides his analysis of EC.

$$(27) \quad \lambda x. \lambda P. \exists y. x \sqsubseteq y \wedge \text{want}(x, P(y)) : \\ (\uparrow \text{SUBJ})_{\sigma} \multimap [(\uparrow \text{XCOMP SUBJ})_{\sigma} \multimap (\uparrow \text{XCOMP})_{\sigma}] \multimap \uparrow_{\sigma}$$

$$(28) \quad \lambda x. \lambda P. \text{try}(x, P(x)) : \\ (\uparrow \text{SUBJ})_{\sigma} \multimap [(\uparrow \text{XCOMP SUBJ})_{\sigma} \multimap (\uparrow \text{XCOMP})_{\sigma}] \multimap \uparrow_{\sigma}$$

The idea here is that PC verbs explicitly introduce a variable y denoting an improper superset of the controller x . y can be identical to x , or a plurality containing x . This is a very weak semantics, merely requiring there to exist some plurality including x to which the property P can be applied. No justice is done to the fact that the existence of this plurality must be supported by the discourse context.

Another problem is that in (27) the semantic representation of the controllee is introduced in the lexical entry of the control verb. Therefore, its scope must be fixed by that entry. This gives the wrong result in quantified contexts:

(29) Everybody wanted to have lunch together.

This has a strong preference for the collective rather than the distributive reading where for each x there is a plurality y such that x wants y to have lunch together. However, since the quantifier corresponding to the controllee subject is introduced in the lexical entry of *want*, there is no way *everybody* can scope under it. That is, we only derive the meaning in (30), which does not predict the strong preference for the collective reading of (29).

(30) $\forall x. \exists y. x \sqsubseteq y \wedge \text{want}(x, \text{have_lunch_together}(y))$

Another scope problem arises once we take into account that PC predicates like *want* are generally intensional verbs. To see this, we follow the analysis in Pearson (2013) which is very close in spirit to Asudeh's analysis (and would fit a functional control analysis in LFG), but also takes account of intensionality.

If we simplify Pearson's analysis by ignoring tense and the obligatory *de se* reading, which are of no immediate concern here, her analysis amounts to a traditional analysis of propositional attitude verbs as quantifiers over possible worlds. Let us write \mathbf{boul}_x for the set of possible worlds compatible with with x 's desires (in the actual world). We can then recast (27) as (31).

(31) $\lambda x. \lambda P. \forall w. w \in \mathbf{boul}_x \rightarrow \exists y. x \sqsubseteq y \wedge P(y)(w)$
 'In all worlds compatible with x 's (actual) preferences, there is a y such that x is a (possibly improper) part of y and $P(y)$ holds.'

Again, the problem is that the lexical entry of the control verb fixes the scope of the controllee. In (31), the scope of the controllee is inside the reported attitude, but this wrongly predicts that (21) is good. We could conceivably fix this by requiring the controllee to outscope the attitude, but this would give the wrong results in intensional contexts such as (32).

(32) John is looking for a group of elves. He wants to have lunch together.

On the most natural reading of (32), the second sentence elaborates on John's desires and so the controlled subject must scope under the attitude. This is the opposite of what we see in (21), showing that the relative scope of the attitude and the controlled subject cannot be fixed in the lexical entry of the control verb.

4 An anaphoric control analysis

In this section, we prepare the ground for an analysis of PC in terms of anaphoric control. In section 4.1 we discuss the fact that the controllee is syntactically singular, which Asudeh (2005) argued was incompatible with anaphoric control, and propose an analysis in terms of anaphor-antecedent agreement. In section 4.2 we consider the various flavours of anaphoric control that are available in the LFG literature. As it turns out, none of the formalized versions of anaphoric control are adequate for PC, but there are hints in the literature of an intuitive notion of ‘quasi-obligatory’ anaphoric control which, if properly developed, could account for PC.

4.1 The syntactic number feature

Under the functional control analysis, the controllee and the controller are identical and hence share all syntactic features. This is a welcome result since, as we have seen, the controllee position is syntactically singular even if it is semantically plural. In functional control, then, this would follow automatically from the sharing of features. In anaphoric control the mechanism is less obvious.

However, it is clear that anaphoric control generally involves agreement in number and gender with the controller in languages where number and gender are agreement features. This is shown in for Icelandic in (33).

- (33) **Ólafi** finnst gott að PRO vera
Olaf.DAT.MASC.SG finds good to NOM.MASC.SG be
ríkur
rich.NOM.MASC.SG
‘Olaf finds it nice to be rich.’

This must be anaphoric control (Andrews, 1982, 1990), since the CASE feature is not shared: but NUMBER and GENDER *are* shared.

In PC, the issue is slightly more complicated however, since one could expect that the inherent semantic features of the referent would override features from antecedent agreement. After all, pronouns with plural reference are usually morphosyntactic plurals too. However, it has been observed by Schlenker (2003, p. 79) that semantic features do not override agreement features in the case of PRO.

- (34) John (a transsexual) hopes to become a woman and he hopes PRO to buy himself/*herself a car.

Here the first sentence sets up the context so that in all worlds compatible with John’s hopes, John is a woman. The second sentence elaborates on John’s hope worlds and so the referent of PRO must be female in those worlds if John’s hopes are consistent. Nevertheless, PRO is syntactically masculine as shown by the reflexive.

There are other cases too which show that bound pronouns more generally (and not only PRO) can retain features from antecedent agreement in spite of the semantic features:

(35) We_i all sometimes believe that we_i are the only person in the world.

In sum, therefore, the agreement facts are non-conclusive. Although it is true that functional control predicts the singular number directly, there is evidence that the control target in anaphoric control (and in bound pronouns more generally) agrees with the controller even the agreement features contradict the semantic features.

4.2 On ‘quasi-obligatory’ anaphoric control

In the LFG literature since Bresnan (1982), there are mainly two variants of anaphoric control, arbitrary and obligatory anaphoric control. The contrast is described in the following way in Dalrymple (2001, p. 324):

In an obligatory anaphoric control construction, coreference is required between an argument of the matrix clause and the controlled position in the subordinate clause. In contrast, in an arbitrary control construction, no coreference constraints are imposed by the control verb. Instead, the controlled argument in the subordinate clause finds its referent in a way very similar to an ordinary pronoun, and split antecedents and syntactically remote controllers are possible.

The pronoun-like nature of anaphoric control is also the basis for Falk’s tests for control type (Falk, 2001, p. 142f.), which rely on the following three properties taken to be jointly characteristic of functional control:

syn-local The controller must be a core function in the immediately governing f-structure⁴

no-split Split control is not possible

identity Controller and controllee share all syntactic features

(Arbitrary) anaphoric control violates all three principles precisely because it patterns with typical semantic-pragmatic properties of pronouns: they need not have local antecedents and there is no restriction on the GF of their antecedents, they can take split antecedents, and they do not usually agree with their antecedents in features other than GENDER and NUMBER. This accords well with Bresnan’s goal to achieve a (near-)unification of GB’s pro and PRO via a rule of functional anaphora (36) (Bresnan, 1982, p. 380).

⁴Falk only says ‘in the f-structure’, but it is clear that he thinks control must be local.

(36) **Rule of functional anaphora**

For all lexical entries L, for all $G \in \Delta$, assign the optional pair of equations $\{((\uparrow G \text{ PRED}) = \text{'PRO'}), (\uparrow \text{FIN}) =_c \alpha\}$ to L.

English fixes the parameters $\alpha = -$ and $\Delta = \{\text{SUBJ}\}$ and therefore only allows null anaphora for the subjects of nonfinite verbs (infinitives and gerunds), whereas languages with 'prodrop' allow null anaphora in finite contexts too, possibly in non-subject function.

However, as observed by Dalrymple, most of the pronoun-like features of PRO disappear in obligatory anaphoric control contexts. In particular, **syn-local** and **split**, while untypical of pronouns, do hold in obligatory anaphoric control: the controller must be a term (Dalrymple, 2001, p. 344) and split antecedence is not possible (Dalrymple, 2001, p. 339),

Although there are only two well-explored types of anaphoric control, there is consciousness in the LFG literature that with some verbs, the control patterns are looser than in obligatory anaphoric control, but stricter than in arbitrary anaphoric control. For example, Falk (2001, p. 143) observes that *agree* and *try* pattern differently with regards to tests for functional/anaphoric control. In particular *agree* allows control by an implicit (37) or explicit (38) agent.

- (37) a. It was agreed to clone dinosaurs.
b. *It was tried to clone dinosaurs.
- (38) a. It was agreed by the geneticists to clone dinosaurs.
b. *It was tried by the geneticists to clone dinosaurs.

Falk concludes that *agree* instantiates anaphoric control and *try* functional control. The possibility of control by (implicit) agents is used as a test for anaphoric control also in Lødrup (2011, p. 163) who notes the contrast in (39).

- (39) a. It was decided to start.
b. *It was hesitated to start.

Decide and *agree* are treated as *obligatory* anaphoric control, implicitly in Falk (2001) and explicitly in Lødrup (2011). And indeed it is clear that these verbs are not as free in their control patterns as e.g. *gesture*, which allows a syntactically remote antecedent, cf. (40)–(42).

- (40) *The geneticist_i thought it was clear that the paleontologist_j had decided to clone_i dinosaurs.
- (41) *The geneticist_i thought it was clear that the paleontologist_j had agreed to clone_i dinosaurs.
- (42) The geneticist_i thought it was clear that the paleontologist_j had gestured to follow_i Ken.

adapted from Dalrymple (2001, p. 339)

This points to a locality constraint on the controller, but since these verbs do allow control by implicit agents, which are not represented at f-structure, the locality constraint cannot be syntactic. We therefore propose that instead of **syn-local**, the syntactic locality constraint associated with functional and obligatory control, these verbs have a *semantic* locality constraint, viz. they require that the controller is a (possibly unexpressed) participant in the matrix event.

On the other hand, Falk claims that *agree* allows split antecedence as in (43).

(43) The geneticist_{*i*} said that the paleontologist_{*j*} agreed to clone_{*i+j*} dinosaurs.

But Falk was writing at a time when PC was not well known in the syntactic literature. It seems likely that the correct indexation in (43) is *i+* (partial control) rather than *i + j* (split antecedence), for the examples in (44)–(45) suggest that PRO in these cases, albeit semantically plural, is syntactically singular.

(44) The geneticist said that the paleontologist agreed to have lunch together.

(45) *The geneticist said that the paleontologist agreed to meet each other.

This means that there is no reason to view *the geneticist* as a non-local controller in (43): It merely serves to make salient a plurality, as in other cases of PC.

In sum, the observations of Falk and Lødrup motivate an intermediate class of ‘quasi-obligatory’ anaphoric control verbs: unlike arbitrary anaphoric control, these have a locality constraint, but unlike obligatory anaphoric control the constraint is semantic rather than syntactic in nature. Many of these verbs, including Falk’s *agree* and Lødrup’s *decide*, allow both implicit agent control and PC, so we will tentatively analyze them as a single class. It is unlikely, however, that the class is completely homogenous in its control behaviour. As we saw in section 2.3, semantics plays an important role in PC and hence we expect that the lexical semantics of both the governing and the embedded predicate to influence the control behavior. The challenge, then, is to develop a formal framework within which this can be studied. This is all the more important since LFG’s control theory as it stands cannot easily accommodate the intuitions of Falk and Lødrup nor the PC phenomenon.⁵

5 Formalizing quasi-obligatory anaphoric control

We have stressed the anaphoric nature of PC. It is natural, then, to look to treatments of pronominal anaphora to develop an analysis of PC.

The traditional treatment of anaphora in LFG + Glue is to view them as functions on their antecedents (Asudeh, 2012, p. 83f.).

(46) $\lambda z.z \times z: (\uparrow_{\sigma} \text{ ANTECEDENT}) \multimap ((\uparrow_{\sigma} \text{ ANTECEDENT}) \otimes (\uparrow_{\sigma}))$

⁵A similar range of phenomena has been classified as ‘nearly free control’ by Jackendoff and Culicover (2003), although this concept is wider in also covering generic (but not arbitrary) control.

While this approach has been put to good use notably in the study of pronominal resumption (Asudeh, 2012), it cannot provide a general account of pronominal anaphora (nor, to be fair, is it clear that a unified account is desirable). An oft-mentioned problem is that it cannot work for cross-sentence anaphoric resolution. This has motivated attempts to use a dynamic semantics instead, either by coupling Glue to a dynamic meaning language (as set out in detail in Kokkonidis 2005) or by handling the dynamics in the Glue itself (Dalrymple, 2001) by treating pronouns as functions on their context (represented as Glue resources) rather than directly on their antecedent.

For the purposes of control, cross-sentential anaphora is not relevant. But there is another problem that we need to deal with: PC involves bridging, where the anaphor and the antecedent are related by relations other than identity. This is beyond the expressive power of linear logic, which is restricted to copying resources (using \otimes). To avoid this problem I will handle anaphora on the meaning side and use a dynamic meaning language.

5.1 Partial compositional discourse representation theory

The dynamic meaning language that I will be using is Partial compositional discourse representation theory (PCDRT, Haug 2013). PCDRT is a version of compositional DRT (CDRT, Muskens 1996) that aims at providing a clear separation of monotonic (semantic) and non-monotonic (pragmatic) content. To that end, it provides a model-theoretic semantics for unresolved anaphors (including accessibility constraints) but treats coreference resolution post-semantically in the pragmatics. (47) (from Kokkonidis 2005) is analyzed as in (48) (ignoring constraints from binding theory).

(47) An elephant saw a mouse. She frightened her.

x_1	x_2	x_3	x_4
$elephant(x_1)$			
$mouse(x_2)$			
$see(x_1, x_2)$			
$\partial(female(x_3))$			
$\partial(female(x_4))$			
$frighten(x_3, x_4)$			

The DRS in (48) models the monotonic content of the discourse, i.e. the part of the meaning that cannot be denied in the subsequent discourse without making the discourse inconsistent. This is dealt with in the same way as in DRT (superficially at least – behind the scenes, the DRS in (48) in fact has no theoretical status but simply abbreviates a lambda term). Notice that the last sentence introduces *new* DRs x_3 and x_4 , so the monotonic content does not make a claim about the reference

of the anaphoric expressions.

To deal with anaphora we need to add some more machinery. In particular, the underlying logic is partial, discourse referents (DRs) are ordered (the relative ordering of variable indices is meaningful, so anaphors can only refer to DRs with lower indices⁶), anaphoric DRs are underlined and the descriptive content of anaphoric expressions is embedded inside the ∂ connective. Underlining is interpreted as a predicate *ant* which is true of a DR that corefers with its antecedent and follows it according to the DR order, and is undefined for all other DRs. ∂ (Beaver, 1992) is a unary truth-functional connective: $\partial\phi$ is true iff ϕ is true; otherwise it is undefined. A DRS is in effect interpreted as the weak Kleene conjunction of all its conditions, hence if one of the conditions is undefined, the entire DRS is.

A discourse with anaphoric DRs can only be evaluated for truth in the context of an anaphoric resolution, \mathcal{R} .⁷ However, \mathcal{R} itself is not part of the monotonic content, but arises through non-monotonic reasoning and can be destructively updated. For example the discourse in (47) could suggest an anaphoric resolution as in (49).

$$(49) \quad \mathcal{R} = \{3 \mapsto 1, 4 \mapsto 2\}$$

But if the subsequent discourse suggests that it was the mouse that frightened the elephant, we can update \mathcal{R} non-monotonically with $3 \mapsto 2$ and $4 \mapsto 1$.

5.2 Bridging in PCDRT

The short presentation in 5.1 follows Haug (2013) in assuming that anaphoric relationships always entail identity between the anaphor and the antecedent. But this is not always the case since anaphora allows bridging inferences as we saw in section 2.3. To capture this we need a more finely grained resolution function. We will take \mathcal{R} to map anaphoric indices to pairs of antecedent indices and bridging relations, with the latter defaulting to identity. Now we can analyze (25) as in (50).⁸

$$(50) \quad \text{The}_1 \text{ restaurant went bust when the}_2 \text{ liquor license they}_3 \text{ applied for was refused.}$$

$$\mathcal{R} = \{3 \mapsto \langle 1, \lambda x. \lambda y. \text{owner}(x, y) \rangle\}$$

We change the semantics of the *ant* predicate (underlining of DRs) accordingly, so that it is true of a DR x iff $\forall y. \text{snd}(\mathcal{R}(x))(\text{fst}(\mathcal{R}(x)), y) \rightarrow y = x$.⁹ So the resolution in (50) satisfies *ant* iff

⁶How exactly the ordering of DRs relates to linear order and/or c-command facts depends on the syntax-semantics interface and PCDRT is not committed to any particular view.

⁷In Haug (2013), \mathcal{R} is a function from word indices to word indices, which is used to compute a function \mathcal{A} from discourse referents to discourse referents within particular DRSs. In the simple examples we consider here we can take \mathcal{R} to model anaphoric relations between discourse referents directly.

⁸The indices refer to DRs introduced by NPs and are put on the determiner since in the compositional semantics, it is the determiner that introduces the DR.

⁹Here we abuse the notation somewhat, since CDRT distinguishes between DRs and their ‘inhabitants’ (real world referents). $y = x$ should be taken to mean that the DRs x and y refer to the same

$$(51) \quad \forall y. \text{owner}(1, y) \rightarrow y = 3$$

i.e. the DR 3 refers to the (contextually) unique referent such that the bridging relation holds between the antecedent and the anaphor, in this case the owner of the restaurant.

This is not intended as a theory of bridging, but as a formal framework in which such a theory could be stated. Indeed PCDRT is not a theory of anaphora resolution, although it has been explicitly designed to easily fit with such a theory. But that theory must be cast in a non-monotonic logic, for our assumptions about what anaphoric relations hold are liable to change as the discourse proceeds. This is no less true of PC than other anaphoric relationships. For example, the correct interpretation of (1) clearly requires there to be a bridging relationship between Mary and the group of people that she wants to bomb Hanoi, but our exact understanding of this relationship may change as the discourse proceeds.

5.3 An analysis of PC as bridging

Let us now see how a bridging analysis can be made to work compositionally for PC. We will use the example in (52).

$$(52) \quad (\text{The chair told the committee}) \text{he}_1 \text{ preferred PRO}_2 \text{ to gather at six.}$$

For simplicity, we are only going to look at the meaning of *he preferred to gather*, ignoring tense. We assume the lexical meanings in (53).

$$(53) \quad \begin{array}{lll} \mathbf{he} & \lambda P. [\underline{x_1} |]; P(\underline{x_1}) & (h \multimap p) \multimap p \\ \mathbf{prefer} & \lambda K. \lambda x. [| \text{prefer}(x, K)] & g \multimap h \multimap p \\ \mathbf{pro} & \lambda P. [\underline{x_2} |]; P(\underline{x_2}) & (\text{pro} \multimap g) \multimap g \\ \mathbf{gather} & \lambda X. [| \text{gather}(X)] & \text{pro} \multimap g \end{array}$$

These meanings can combine as in (54).

$$(54) \quad \begin{array}{c} \mathbf{gather:} \quad \mathbf{pro:} \\ \frac{\text{pro} \multimap g}{g} \quad \frac{(\text{pro} \multimap g) \multimap g}{g} \quad \mathbf{prefer:} \\ \frac{\quad}{g \multimap h \multimap p} \quad \mathbf{he:} \\ \frac{\quad}{(h \multimap p) \multimap p} \\ \frac{\quad}{p: [\underline{x_1} | \text{prefer}(\underline{x_1}, [\underline{x_2} | \text{gather}(\underline{x_2}))]} \end{array}$$

This gives us a plausible meaning if we combine the semantic representation with a resolution $\mathcal{R} = \{2 \mapsto \langle 1, \lambda y. \lambda x. \text{chair}(x, y) \rangle\}$.

Moreover, the same approach can deal with control by implicit agents in passives, if we assume (as is standard) that the implicit agent is represented in the semantics. For example, *it was agreed* will be represented as in (55).

real world referents, not that the DRs themselves are identical.

$$(55) \quad \text{it was agreed: } \lambda K.[x|agree(x, K)]$$

where K is a DRS representing the infinitive complement and x provides a suitable antecedent for PRO.

These representations achieve Bresnan’s desired unification of PRO and other pronouns – witness the exactly parallel representations for PRO and *he*. But they also overgenerate, since there is nothing to stop discourse binding of PRO. To eliminate this problem, we must make sure that PRO finds its antecedent in the matrix clause, and not higher up (in the case of multiple embeddings), or even in the discourse. Since discourse referents are part of the object language in PCDRT (as in CDRT), we can achieve this if we enrich our system with two components.

First, let us represent the special status of PRO as a logophor (section 2.1.4) with a special predicate of discourse referents. Parallel to the underlining of anaphoric discourse referents (x_1) we will use overlining of logophoric discourse referents (\bar{x}_1).

Second, we will assume that PC predicates, qua attitude verbs, are sensitive to logophoricity and therefore require logophors to bind to one of the logophoric centers that they introduce, i.e. one of their arguments. The notion of attitude verb that we have in mind is a broad one, covering not only attitude reports where there is only one logophoric center (the attitude holder, or experiencer of a verb like e.g. *believe*), but also transitive attitude verbs like *persuade* and *promise* where are two possible logocenters, the speaker and the addressee. If an individual x is a logocenter of an eventuality e , we will write this as $log(e, x)$ – this can be thought of as a ‘cover relation’ for the relevant logocentric thematic roles.

Formally, we ensure that logophors are bound to a logocenter by introducing a two place function $bind$ mapping pairs of events e and DRS K to DRSs, as in (56). $U(K)$ denotes the universe of K , i.e. the discourse referents introduced in K . Recall that $\mathcal{R}(d)$ denotes the antecedent of d . It is important for PC that it is the *antecedent* of d that is a logocenter, not d itself, as we do not want to predict for scenarios like (13) that the entire team is the logocenter of John’s expectations.

$$(56) \quad bind(e, K) \equiv K \wedge \forall \bar{d}.\bar{d} \in U(K) \rightarrow log(e, \mathcal{R}(\bar{d}))$$

Basically, $bind(e, K)$ returns the DRS K augmented with the condition that the antecedents of any logophors in the universe of K should be logocenters of e . (Note that this blocks binding into embedded DRSs in K .) We can now revise the meanings of **prefer** and **PRO** as in (57). I assume a Davidsonian event representation, i.e. the verb is a predicate of its ‘standard arguments’ plus an event argument, rather than a neo-Davidsonian representation where the verb only takes an event argument and the other arguments are introduced via thematic relations. Nothing hinges on this however.

$$(57) \quad \begin{array}{ll} \text{prefer} & \lambda K.\lambda x.[|prefer(e, x, bind(e, K))|] \quad g \multimap h \multimap p \\ \text{PRO} & \lambda P.[\bar{x}_2|]; P(\bar{x}_2) \quad (pro \multimap g) \multimap g \end{array}$$

Notice that although **PRO** is marked as logophoric discourse referent, its logophoricity is only ‘activated’ as it were by the meaning of the attitude verb **prefer**. This maintains Bresnan’s unification of PRO and other pronouns: unless PRO is trapped inside a logophoric context it behaves like any other pronoun.

5.4 The properties of PC revisited

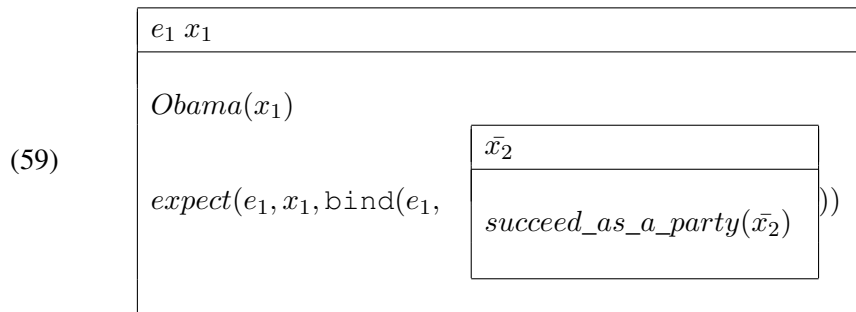
Let us now revisit the properties of PC that we saw in section 2. We took the anaphoric nature of PC that we saw in section 2.3 as the starting point of our analysis, so we do capture that. And the syntactic singularhood of PRO in PC constructions (section 2.2) is dealt with in section 4.1. But what about the other properties discussed in section 2.1?

That there is no arbitrary control in PC (2.1.1) clearly follows from our account, since the controller must be a logocenter in the matrix event. For the same reason, there can be no long-distance antecedents (2.1.2).

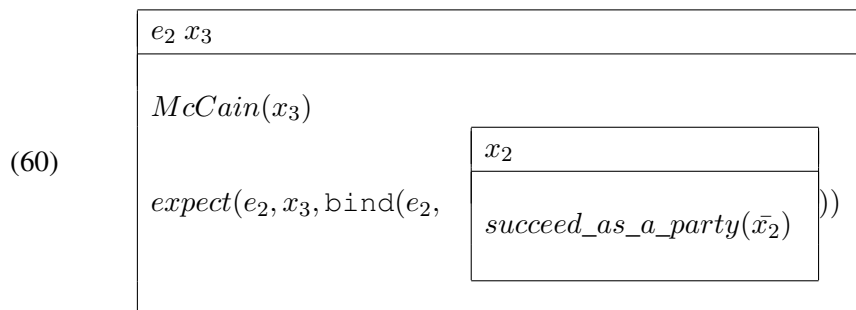
The absence of strict readings (2.1.3) also follows, although much depends on the details of the particular theory of ellipsis assumed. I can only offer a cursory treatment here. Consider (10), repeated here as (58).

(58) Obama expected [to succeed as a party], and McCain did too.

We assume the representation in (59) for the first conjunct.



A sloppy reading of the second conjunct will look as in (60), where the redeclaration of x_2 in the embedded DRS introduces a *new* discourse referent x_2 .



But several theories of ellipsis resolution, including Dalrymple et al. (1991), will

also generate a similar representation *without* redeclaration of x_2 , i.e. a strict reading. Dalrymple et al. (1991, p.445) block this by treating PRO as a ‘primary occurrence’ on a par with its controller, but this is essentially just a restatement of the facts. In the current approach, by contrast, we see that (59) and (60) are not jointly satisfiable if x_2 is not redeclared in (60), for `bind` would require x_2 to be resolved to a logocenter in both e_1 and e_2 , i.e. simultaneously to both McCain and Obama. Hence the strict reading is ruled out on semantic grounds.

As for the obligatory *de se* reading, the theory presented here offers only the beginnings of an analysis. To have a complete account, we need to spell out the *log* predicate (overlining of DRs) in such a way as to force *de se* readings, rather than just designate logophoric discourse referents. This remains to be done.

6 Conclusion

We have seen that the standard LFG theory of control cannot properly deal with partial control. Both functional control and obligatory anaphoric control are too strict, and arbitrary anaphoric control is too loose. But we observed that there is an intuitive notion of ‘quasi-obligatory’ anaphoric control in the LFG literature, which would generalize well to PC. This gives us a four-way typology of control as in (61).¹⁰

(61)		obligatory	quasi-obligatory	arbitrary
	f-control	a-control	a-control	a-control
locality	syntactic	syntactic	semantic	discourse
identity	+	-	-	-

We provided a formalization of quasi-obligatory anaphoric control in terms of dynamic semantics. Our notion of quasi-obligatory anaphoric control is a quite general one, covering verbs that allow partial control, control shift, split (but local) antecedence and/or implicit agent control, but disallow arbitrary and long distance control. However, since the process is semantic-pragmatic rather than purely syntactic (as in functional and obligatory anaphoric control) we do not necessarily expect the class to behave in a unified manner but to be influenced by semantic factors. I leave to future research how these processes work.

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¹⁰The **no-split** property discussed in section 4.2 can be derived from the way the controller in functional and obligatory anaphoric control is syntactically assigned.

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