E-type pronouns:
congressmen, sheep and paychecks[*]

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Abstract

This chapter concerns a type of pronominal anaphora commonly referred to with terms like *descriptive pronouns* or *e-type pronouns*. For a whole range of reasons, such cases of anaphora have played an important role in semantic theory. Most prominently among these is the fact that e-type pronouns force us to explicate what concepts like quantification, binding and reference involve.

1   E-type pronouns

This chapter is about the relation between the reference of a pronoun and the linguistic context it occurs in. In some cases, this relation is relatively clear. For instance, there are cases where the pronoun's reference is fully independent of the linguistic context, but is instead determined by what is salient in the non-linguistic context. *She* in (1-a) could refer to the woman or girl on all the interlocutor's minds, or the woman or girl the speaker is pointing at, etc.

(1)   She won!

Cases like (2) could be thought about in a similar way: *she* in (2) refers to something that is made salient in the context by the fact that some other expression refers to it (*Scarlett*). In such examples, *she* is often said to *corefer* with that antecedent expression.

(2)   Scarlett dashed across the finishing line. She won!

Cases like (1) and (2) are starkly different from examples like (3). Here, *she* does not refer to anything at all. Instead, its referent *co-varies* with the quantification over girls brought about by the subject quantifier.

(3)   Every girl thought she won.

If we think of pronouns as *variables*, a relatively straightforward analysis presents itself. *She won* is interpreted as "$won(x)$" and the variable "x" ends up bound in (3): $\forall x[girl(x) \rightarrow won(x)]$. In (1) and (2), the variable is not bound and needs to receive its value in some other way.

Evans (1977, 1980) observes that there are pronouns that depend on the linguistic context, but that do not neatly fall into the characterization of pronouns as either *bound* or *coreferring*. He calls such pronouns *e-type*. An example of this is (4).

(4)   Every student failed the test. They will have to do a resit next week.

They in this example refers to the set of all students. The subject quantifier *every student* does not refer like *Scarlett* refers - it quantifies. One way of stating this is that it refers to an object of type $\langle\langle e, t\rangle, t\rangle$ rather than to something of type e. This example therefore cannot be a case of coreference, since there is nothing in the linguistic context of the plural pronoun that refers to the set of all students. More generally, if the pronoun does not appear to be bound by anything (see below), we would need to say that (4) involves a *free variable* pronoun *they* referring to a plural object made salient in the linguistic context. But it is not immediately clear what kind of theory could predict that quantifiers, notwithstanding their non-referential nature, make certain pluralities salient enough to set the values of free variables.

It is a bit harder (but instructive) to spell out the reason for dismissing the idea that *they* in (4) is a bound pronoun. That is, we should dismiss an analysis of (4) as (5), where the second sentence has been moved within the scope of the quantifier and the pronoun is bound by it.[1]

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[1]A bound analysis of *they* in (4) is unlikely for several reasons, most of which have to do with anaphora. For instance, it is traditionally assumed that the scope of a quantifier is what is c-commanded by the quantifier (Reinhart, 1976). This makes scope a necessarily sentence-internal notion. The c-command characterisation of scope, however, is based on the observation that dependencies (anaphoric and other) occur only in c-command domains. As far as I am aware, the literature actually contains no argument independent of anaphora or some other kind of dependency relation for why the scope of a quantifier is limited to the sentence the quantifier occurs in. But it shouldn't be difficult to come up with such an argument. If quantifiers could take subsequent sentences as part of their scope, then we would wrongly predict that there is a reading of the following two sentences which is true in any model in which Socrates is *not* a goat: *No man is mortal. Socrates is a goat.* This is because the relevant reading would amount to saying that one cannot find a man that makes two things true: (a) that the man in question is mortal and (b) that Socrates is a goat.

However, an anonymous reviewer points out that this is a difficult argument to make, since it is not inconceivable that extending the scope of a quantifier beyond a clausal boundary is only possible if this quantifier binds a variable in the subsequent clause.

(5)   Every student is such that he or she failed the test and he or she will do a resit next week.

Intuitively, (4) is indeed equivalent to (5). However, this equivalence is a logical coincidence. For different quantifiers such an equivalence cannot be found. Take (6) and (7).

(6)   Exactly two students failed the test. They will do a resit next week.

(7)   Exactly two students are such that they failed the test and will do a resit next week.

These two examples are truth-conditionally distinct. To see this, take a situation in which four students failed the test. Two of these students will do a resit next week, while the other two will not do a resit at all. In this situation (7) is true, but (6) is false. This is because (6) entails that exactly two of the student failed the test, while (7) does not entail that.

By this reasoning, the pronoun *they* in (6) cannot be a *bound-variable* pronoun, for if it were, then we would expect (6) to have a reading which is synonymous to that of (7). Indeed, Evans' own example, (8), also purposefully involved a non-universal quantifier, so as to allow this reasoning.

(8)   Few congressmen admire Kennedy, and they are very junior.

If the pronoun were bound, (8) would have to be equivalent to saying that *few congressmen are such that they at the same time admire Kennedy and are very junior*. There is no such equivalence and, so, the pronoun cannot be a bound one. Even though we cannot apply a similar argument to (4), it is natural to assume that the observations regarding (6) and (8) point out a general constraint on the scope of quantifiers (cf. footnote 1).

If the plural pronouns in (4), (6) and (8) are neither of the bound-variable kind nor of the salient/coreference kind, then how should we characterise the relevant anaphoric relation? A common conceptual answer to this question is that these pronouns are *descriptive*. What this means is that their referent can be *described* relative to the material in the antecedent sentence. Both occurrences of *they* in (4) and (6) refer to *the students who failed the test*. The pronoun in (8) refers to *the congressmen that do admire Kennedy*.

There are now two routes forward. In the first, this notion of descriptive pronouns is taken quite literally, in such a way that the resemblance between such pronouns and definite descriptions becomes the guiding intuition behind the analysis. The second route is more conservative and holds that cases where pronouns have descriptive features are cases where the pronoun in question *is* bound after all. It is just that our traditional understanding of binding is too restricted.

My main focus in this chapter will be on the latter strategy and I will discuss it in some detail towards the end of this chapter. Before I do so, I will describe the e-type data in much detail. The literature that touches on e-type anaphora tends not to describe a truly uniform phenomenon. Different parts of the literature focus on

different examples. For this reason, I believe it will be instructive to discuss e-type phenomena along two separate dimensions: (i) whether the reference of the pronoun is *maximal* and (ii) whether the pronoun refers at all or whether it *co-varies* instead. As we will see, various phenomena unfold along these two dimensions.

Connected to this variation is the fact that there isn't really a uniform terminology for describing the phenomena. There are quite a few terms used in the literature – examples include *donkey pronoun*, *paycheck pronoun*, and *pronoun of laziness* – that refer to specific subsets of e-type phenomena, but are sometimes also used as a term for e-type anaphora generally. When I use such terms below, I am simply referring to specific cases of e-type pronouns. Throughout the chapter I will be using the term *e-type pronoun* as the catch-all term for all pronouns that satisfy the following conditions:

(9) 1. the pronoun has a linguistic antecedent
    2. the pronoun is not bound by its antecedent in the sense that the pronoun occurs in the syntactic scope of its antecedent and its reference co-varies with the antecedent
    3. the pronoun does not refer to the same referent its antecedent refers to

In what follows, I will summarize this way of looking at the concept as follows: an e-type pronoun is a pronoun that is neither coreferential nor bound.

I need to make two important caveats. First of all, using the term e-type in the way defined in (9) is not entirely uncontroversial. The term *e-type* is sometimes taken to be inseparable from the claim that such pronouns are rigid designators, a proposition that was forcefully challenged by Neale (1990). (See below). The danger is, then, that the term *e-type* is not just a descriptive term for a particular observation, but that it comes with certain expectations for the analysis of that observation. The truth is, however, that other commonly used terms are also laden with theoretical claims. I will for instance avoid the term *descriptive pronoun*, since it appears to take for granted that these pronouns have a interpretation akin to descriptions. Similarly, I will avoid Neale's term *d-type pronoun*, which he explicitly defines in terms of an analysis. (A d-type pronoun is a pronoun that goes proxy for some definite description; Neale (1990), p.131). So, when I write *e-type pronoun*, I mean what I believe is the simplest empirical conception that Evans had in mind. With the term e-type pronoun I thus hope to describe a class of pronouns that falls outside our classical understanding of reference and binding, without giving any hint at what an alternative characterisation of such a pronoun may be. That said, my second caveat is that, to quite a considerable extent, my characterization above rests on theoretical assumptions. What ends up being characterized as an e-type pronoun depends on what you think *binding* and *referring* means. We will encounter such subtleties below.

2   Maximal reference

Some (yet not all) e-type pronouns have *maximal* or *exhaustive* reference.[2] This can be illustrated by returning to Evans' congressmen example, repeated here.

(8)   Few congressmen admire Kennedy, and they are very junior.

Given that *few congressmen* is a quantifier and given that binding cannot take place across a clausal border, the plural pronoun in (8) cannot be considered to be a bound-variable pronoun. Instead it obtains maximal reference to a contextually provided set: the set of *all* congressmen who admire Kennedy. This observation extends to all sorts of quantificational DPs: *they* in (10) corresponds to *all the students that passed* no matter what the antecedent quantifier is.

(10)   { All / most / exactly 12 / between 10 and 15 / several } students passed.
        They were very happy.

Since the exhaustive reference in these cases concerns an (at least potentially) plural set of entities, the e-type pronoun has to be plural. Singular pronouns in the same configuration are infelicitous, except when the quantifier in question makes it clear that the exhaustive reference only concerns a single entity, as with the quantifier *exactly one* in (12).

(11)   { All / most / exactly 12 / between 10 and 15 / several } boys passed.
        #He was very happy.

(12)   Exactly one boy passed. He was very happy.

The clearest way to illustrate *maximal reference* in e-type pronouns is to contrast it with cases like (13):

(13)   *A and B are parking their car. B is looking for coins to put in the parking
        meter. A observes this and says*:
        I have some coins. They are in my bag.

On its most natural understanding, the plural pronoun in (13) does not refer exhaustively. If it did, then A would be saying that all the coins she has are in her bag. Instead she seems to be referring to some specific set of coins and she is conveying that *these* coins are in her bag. The coins in question are just a subset of the set she owns, so this is clearly not a case of exhaustive reference. A similar example would be (14). This example is in contrast with (11): Even though the first sentence of (14) is compatible with the speaker having many pens, the singular pronoun is felicitous.

(14)   *B needs to write something down and is looking for a pen. A observed this and
        says*:
        I have a pen. It's in my bag.

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[2]I will use both these terms interchangeably.

Under the assumption that *a pen* and *some coins* are quantifiers, the pronouns in (13) and (14) qualify as e-type pronouns. And, so, e-type pronouns can be either maximal or non-maximal. There is the theoretical option, however, that indefinite DPs like *a pen* and *some coins* are ambiguous between something expressing existential quantification and something that *refers* to some indeterminate entity. On that view, the non-maximal readings of (13) and (14) could be classified as cases of coreference instead of e-type. As I indicated above, the very notion of an e-type pronoun is tightly linked to theoretical assumptions.

Importantly, indefinite DPs do also trigger maximal reference e-type anaphora. In fact, Evans gave the famous example of e-type anaphora in (15), using the indefinite *some sheep*.

(15)   John owns some sheep and Harry vaccinates them in the spring.

On its most salient reading, *them* in (15) has exhaustive reference and (15) entails that Harry vaccinates *all the sheep that John owns*. Again, this is clearly not compatible with a bound understanding of *them*, which would say that there are some sheep that John owns and Harry vaccinates, leaving open the possibility that there may furthermore be sheep that John owns that Harry does not vaccinate. But it is similarly incompatible with a referential reading, which means that the speaker is referring to a group of sheep s and she is asserting that s is owned by John and that s is vaccinated by Harry.[3] Once more, this does not exclude the possibility that Harry fails to vaccinate other sheep owned by John.

How do we characterise *maximal reference* more precisely? I mean, maximal reference is reference to *what*? Let us return to the congressmen example once more. *They* in the second sentence of (8) refers to *the congressmen that admire Kennedy*. If we view determiners as relations between two sets (Barwise and Cooper, 1981), then these definite description paraphrases of e-type pronouns correspond to what has been called the *reference set* of the quantificational relation (see e.g. Nouwen 2003b):

(8)   Few congressmen admire Kennedy. They are very junior.

(16)   For any quantificational statement Q(A)(B), the *reference set* for this statement is A∩B.

We could represent the meaning of the quantificational statement that makes up the first sentence in (15) schematically as FEW(the set of congressmen)(the set of Kennedy-admirers). The reference set is now the intersection between the set of congressmen and the set of Kennedy-admirers. In other words, it is the set of congressmen who admire Kennedy. This reference set is what is available for subsequent maximal-reference e-type anaphora.

This is not yet a formal theory of how e-type anaphora works, but it is a hopefully illuminating way of describing the observation. It captures the intuition that the pronoun refers to the totality of individuals that instantiate the relation be-

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[3]To be clear, such a non-maximal reading is probably available as well for (15), parallel to (13).

tween the quantifier's restrictor, i.e. set A in (16) and its scope, the set B in (16). It also makes clear how limited this way of thinking about the data is. Reference to the reference set only captures a very specific part of the data involving maximal-reference anaphora. Consider a variation on Evans' sheep example, (17).

(17)   Every one of Harry's neighbours owns a sheep. Harry vaccinates them in the spring.

The indefinite in (17) cannot be referential, since on a referential construal, there is a single sheep that is co-owned by all of Harry's neighbours. In that case, the plural marking on the pronoun in the second sentence does not make sense. In other words, the indefinite in (17) must have narrow scope with respect to the subject. The result is that the pronoun *them* refers exhaustively to the set of all sheep owned by Harry's neighbours. However, it is not clear in which sense that reference corresponds to a reference set. This is because the quantificational relation expressed by *a sheep* is itself quantified over. The interpretation of the first sentence in (17) could be represented as: EVERY(the set of Harry's neighbours)(the set of individuals such that SOME(sheep)(the set of things this individual owns)). It is not clear how this representation is going to return a reference set for *some sheep*, since that quantifier is embedded in the scope of *every one of Harry's neighbours* and dependent on it.

Note that this issue is independent of the fact that the embedded DP is an indefinite. I could make exactly the same point using other DPs. For instance, (18) contains an embedded quantifier *most*. The plural pronoun refers to (19).

(18)   All the boys gave away most of their toys. The local charity shop got almost all of them.

(19)   *the toys that were given away by* some *or other boy.*

It is remarkably difficult to give a model for maximal-reference e-type anaphora that is fully predictive of which are the potential anaphoric relations following a quantificational statement. One example of the problem is that the paraphrase of the referent of the plural pronoun's in (18) contains *some* while the antecedent sentence itself does not, as is also clear from its representation as a quantificational statment: ALL(the set of boys)(the set of individuals such that MOST(toys owned by the individual)(the set of toys given away). To fully appreciate the difficulties, consider the example in (20). We want a model that predicts that (20) has the potential to resolve subsequent pronouns in the three ways in (21). (Again, I am assuming narrow scope for the indefinite.)

(20)   Every boy gave a flower to most of his sisters. They...

(21)   a.   all the boys who gave a flower to most of their sisters
        b.   all the sisters that received a flower from one of their brothers
        c.   all the flowers that were given by a boy to one of his sisters

I will now describe an algorithm intended to retrieve these sets. This is not meant

as a theory, but rather as a further illustration of how complex it is to get a grip on the correct predictions. The algorithm transforms a sentence into a definite description with a relative clause based on the sentence.

(22)   Step 1: take a DP in the sentence, call it [Det NP].
         Step 2: create a relative clause with a gap replacing the position of the DP in question.
         Step 3: in that relative clause replace all determiners that outscope the DP in question in the original sentence by an appropriate indefinite determiner, making sure that the indefinite is understood to be narrow scope, for instance by using the complex determiner *some or other*.
         Step 4: now create the a definite description by combining *the (set of all) NP* with the relative clause that is the result of step 3. Fix agreement where necessary.

Here is how this algorithm provides (21-a) and (21-c) for (20).

(23)
step 1	every boy
step 2	that gave a flower to most of his sisters
step 3	that gave a flower to most of his sisters
step 4	the (set of all) boys that gave a flower to most of their sisters

(24)
step 1	a flower
step 2	that every boy gave to most of his sisters
step 3	that some or other boy gave to some of his sisters
step 4	the (set of all) flowers that some or other boy gave to some of his sisters

For (21-b) matters are a bit more complicated. The algorithm will yield the problematic *the set of all his sisters that some boy gave a flower to*. What we want instead is something like *the set of all girls that one of their brothers gave a flower to*. Needless to say, such cases complicate the algorithm hopelessly.

My intentions with the above exercise in accounting for maximal-reference in e-type pronouns is to clarify the theoretical goal: to find a (more) natural mechanism that can be shown to be responsible for the particular sets that maximally referring e-type pronouns refer to. Before I turn to such a theory, I will need to introduce the second dimension at play in e-type anaphora: whether the pronoun co-varies or not.

3 Co-variation

For an e-type pronoun to have maximal or non-maximal reference, it has to first refer. There are cases of e-type anaphora that do not, however. In these cases, the pronoun co-varies. The most well-known examples of such cases are donkey pronouns (Geach 1962, cf. Brasoveanu and Dotlačil, this volume). *It* in (25) is not bound by its antecedent *a donkey*. *It* also doesn't refer to the same referent as its antecedent - there simply is no such referent.

(25)   Every farmer who owns a donkey beats it.

As in (17) in the previous section, the antecedent here is an indefinite. But there is an important difference with maximal-reference anaphora that we saw there: the pronoun in (25) does not refer at all.

More generally, maximal reference is impossible for a pronoun in the position that *it* takes in (25): for any statement with quantifiers in it, no maximal reference anaphora involving any of these quantifiers as antecedent is available *within* that statement. For instance, there is no interpretation of (26) that says that each collector who brought a rare stamp was familiar with most of the totality of rare stamps that was brought in by collectors.

(26)   Every collector who brought a rare specimen to the stamp collection fair was familiar with most of them.

In some other sense, though, there could be said to be exhaustive reference in (25). In its most salient reading, (25) says that every farmer who owns a donkey is such that this farmer beats *all the donkeys that s/he owns.* In other examples, however, this exhaustivity is absent, as in (27), due to Robin Cooper. (See Brasoveanu and Dotlačil, this volume, for discussion.)

(27)   Yesterday, everyone who had a credit card used it to pay his bill with it.

Co-variation in e-type pronouns brings a challenge to accounts of e-type phenomena that is separate from the difficult challenge of accounting for maximal reference that I described above. The core issue is that e-type pronouns may display co-variation despite the fact that the pronoun in question is not in the scope of its antecedent. In fact, this is the classical puzzle concerning donkey sentences: how can we account for co-variation without binding?

Importantly, donkey anaphora is not the only kind of e-type anaphora that involves co-variation. Here are two further cases that have played key roles in the literature:

(28)   Most students wrote an article. They sent it to L&P.

(29)   Each boy walked to the stage. He took his diploma from the dean and returned to his seat.

The second sentence in (28), based on an example from Krifka (1996), contains two

pronouns. On the most salient reading, the plural pronoun is to be interpreted as an e-type pronoun with maximal reference, referring to all the students that wrote an article. On that reading, the singular pronoun *it* co-varies over articles in such a way that this second sentence may be paraphrased by a donkey sentence: *Every student who wrote an article sent it to L&P.*

The example in (29) is often referred to using the term *telescoping*, after Roberts (1987), who attributes (29) to Partee. (See also Poesio and Zucchi 1992). Presumably, the term *telescoping* is to capture the idea that it seems as if the quantifier *each boy* has scope over both sentences in (29). However, as most of the analyses, including Roberts', make clear, such an analysis is indistinguishable from one in which the singular pronouns in the second sentence are bound by a quantifier universally quantifying over the exhaustive reference referent *the set of boys that walked to the stage*, yielding: *Each of the boys that walked to the stage is such that he took his diploma from the dean and returned to his seat.*

So, whereas (28) may descriptively be analysed as donkey anaphora involving quantification over the referent of a maximal reference pronoun, (29) can be seen as straightforward binding on the basis of quantification over a similar referent. As we will see, this will indeed be the intuition behind one kind of theoretical proposal we discuss below.

4 Accounting for e-type anaphora: Pronouns as variables

4.1 Coreference, binding and variables

The thesis that pronouns and variables are in some sense alike goes back at least to Quine (1960).[4] Put crudely, the idea is that a successful account of pronominal reference is to equate the logical impact of the pronoun to that of an individual variable in predicate logic. There is a correspondence between the co-variation of a pronoun in a sentence like *Every girl saw a boy she once dated* and the interpretation of an individual variable in the scope of a quantifier in first order predicate logic, $\forall x[girl(x) \rightarrow \exists y[boy(y) \land dated(x,y) \land saw(x,y)]]$. The co-variation effect of a bound variable is due to the fact that the interpretation of a quantificational statement involves varying the assignment function used to evaluate the scope of the quantifier. This becomes clear when we look at the semantics of a quantificational statement in predicate logic:

(30) $\forall x\varphi$ is true in a world w with respect to an assignment function g if and only if for each d in the domain of entities, it holds that φ is true in w with respect to $g[x/d]$, where $g[x/d]$ is exactly like g, except that $g(x) = d$.

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[4]It should be noted that Quine himself at the same time also entertained the idea that some pronouns are to be analysed as definite descriptions. See Geach (1962) and Geach (1973), section 3, for another discussion of the relation between pronouns, variables and quantification, roughly contemporary with the work of Quine.

Any occurrence of x in φ will now be evaluated with respect to a series of assignment functions $g[x/d]$. The value of x varies accordingly. Co-variation is thus a logical effect of variable binding by a quantifier. The upshot is that bound pronouns then have a very natural likeness to bound variables. In the bound cases, the referent of a pronoun is simply its value in the assignment function of evaluation. Co-variation is due to variation of the assignment in the scope of a quantifier. The question now is what to do with pronouns that are *not* bound. Here, too, however there is a natural choice. In the case of unbound pronouns, the assumption need now only be that it refers to whatever value the current non-varying assignment function provides. That is, the idea is that assignment functions, at least when they have not been altered in the scope of a quantifier, provide the contextually given referents that unbound pronouns need. To illustrate, a sentence like *he won* receives a uniform interpretation, independent of whether the pronoun is bound or referential.

(31) $[\![\text{he}_x \text{ won}]\!] = won(x)$

(32) $won(x)$ is true in world w with respect to an assignment function g if and only if $g(x)$ is in the extension of won in w.

What is crucial here is that we assume that pronouns come with an index which tells us which variable the pronoun is going to correspond with. This allows us to link the pronoun to its antecedent. So we get that *Every boy$_x$ thinks he$_x$ won* is going to be interpreted with x as a bound variable. But in *John$_x$ thinks he$_x$ won* no covariation takes place.[5] In order to get this latter example right, we will need to assume that proper names make sure that the variable corresponding to their index is assigned their referent as a value. We could do this by means of a presuppositional entry for *John*, as in (33), where ↑ indicates undefinedness. (See Geurts 1997 for an advanced, and moreover dynamic, presuppositional semantics for proper names.)

(33) $[\![\text{John}_i]\!]^{w,g} = \begin{cases} j & \text{in case } g(i) = j \\ \uparrow & \text{otherwise} \end{cases}$

In summary, the pronouns as variables view offers a unified account of reference and binding by assuming that pronouns are simple variables and that the different anaphoric relations they can occur in are simply the effect of whether the value of the variable is determined by a covarying assignment function or not.

4.2   Assigning maximal reference to variables

To account for e-type anaphora, we need two extra things. First of all, we will need to introduce a dynamic aspect to interpretation. This amounts to the assumption

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[5]This is simplifying matters quite a bit. See Heim and Kratzer (1998) for a textbook introduction to a slightly more advanced way of thinking about coreference, binding and variables and for a treatise of evidence pointing out that even proper names can bind pronouns. However, such considerations have no bearing on the discussion below.

that quantifiers do not just interpret their scope with respect to a contextual assignment function, they actively *change* this assignment function in such a way that the result contains information about potential subsequent anaphoric reference. On top of that, a second desirable addition is that our logic of interpretation will need some way of dealing with plurality, for as we have seen, cases of maximal e-type anaphora involves potentially plural reference.

In this subsection, I will follow the spirit of a number of similar proposals, most notably, van den Berg (1994, 1996); Elworthy (1995); Nouwen (2003b, 2007) and Brasoveanu (2008). Having said that, what I will present is in many ways a rather specific implementation of this spirit. Moreover, I will simplify quite a bit. Providing a dynamic semantics for quantifiers is a notoriously complex matter. Here I attempt an exposition of such a system which is as simple as possible, but the reader should bear in mind that a full semantics will be quite a bit more involved.[6]

One of the complexities that I *will* address is the way the above-mentioned works deal with plurality. You would think that it would suffice to simply assume that assignment functions do not just assign atomic values from the domain D_e to variables, but that they can also assign pluralities (say, a set of atoms). For reasons that will become clearer as we proceed, the standard assumption following the works mentioned above is now rather that in order to be able to deal with e-type anaphora and plurality, a lift of the standard assignment functions is needed.[7] Rather than evaluating propositions with respect to a function from the set of variable names V to the set of atoms D_e, I will use sets of such assignments as the vehicle of evaluation.[8] I will call these sets *assignment states*. They are sets of functions from V to D_e.

The idea of having *dynamic interpretation* is now that propositions express functions that take an assignment state as input and produce an output assignment state.[9] I will write $F[p]$ to represent the output state resulting of interpreting p with respect to input state F. Now take a sentence like (34), where I have indicated the associated variable names by subscripts, as before. This sentence will express a function that given some input state produces an output state G that has the properties in (35)-(38).

(34)   Every boy$_x$ gave a flower$_z$ to most of his sisters$_y$.

(35) $G(x)$ is the set of boys who gave a flower to most of their sisters.

(36) $G(y)$ is the set of girls who got a flower from their brother (i.e. one of the boys).

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[6]To give one example, Nouwen (2003a, 2007) argues that there are good reasons to abandon the use of assignment functions that link entities to variable names in favour of an approach that uses stack positions instead of variable names. See also van Eijck (2001).

[7]There is a recent interesting alternative to this style of proposal, namely the dynamic update anaphora logic of Keshet (2018). In that framework instead of lifting standard assignment functions, these functions are extended to include discourse referents for dynamic relations.

[8]The first such proposal is due to van den Berg (1994). See Krifka (1996) for an alternative, and Nouwen (2003b) for a comparison of different implementations of similar ideas.

[9]This is different from much of the literature. See below.

(37) $G(z)$ is the set of flowers that were given by one of the boys to one of their sisters

(38)   For every $g \in G$: $g(x)$ is a boy, $g(y)$ is a sister of $g(x)$ and $g(z)$ is a flower that $g(x)$ gave to $g(z)$.

Here $G(x)$ is simply the projection of all the values assigned to x in some assignment function in G: $G(x) = \{g(x) | g \in G\}$.[10] The advantage of the lift from assignment functions to assignment states becomes apparent in (38). Not only does the state G keep track of the pluralities assigned to x, y and z, it also keeps track of the dependencies between parts of these referents. As such, G contains information about the relevant boys, flowers and sisters, but also about how they relate to one another. This will be crucial once we turn to co-varying e-type anaphora.

Before I delve into the details of how a dynamic interpretation of (34) yields the result in (35)-(38) in a systematic way, it is instructive to zoom out a little bit. I should stress that the account of exhaustive e-type anaphora discussed here is basically treating such anaphoric relations as a kind of salient entity reference (recall the first two examples of this chapter), albeit one where the antecedent does not refer itself, but only deposits a referent in the assignment function once the full proposition is formed. That is, outside the scope of a quantifier, a pronoun can refer to the plurality that a quantificational statement has introduced. Within its scope, a pronoun will be bound.

I will now show how this works, but not before I provide some reading advice however. The following few pages will be harder to follow than the rest of this chapter. It may be tempting to skip the details of the dynamic interpretation mechanism and simply accept the idea behind it that I have sketched up to now. And if the following really is too much of a hurdle, you could now proceed to section 4.3. If you do, the following will be the most important things you miss out on. You will not be able to appreciate the fact that the dynamic account *explains* (i) why some e-type pronouns have *exhaustive* reference; (ii) why the existence of co-varying e-type pronouns follows straightforwardly and (iii) why pronouns in the scope of a quantifier are not e-type but bound.

For our interpretations, I am assuming a simplified language for quantificational statements that contains the following. (For instance, I am ignoring negation and disjunction).

- terms: comprising individual variables (v, x, y, z, etc.) and individual constants (a, b, j, m, etc.)

- predicate constants (boy, sister, flower, gave, etc.)

- quantifier constants (EVERY, MOST, SOME, etc.)

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[10]Here, $G(x)$ returns a set. One could just as well have a theory where G is not a set of assignment functions, but an assignment plurality, which in turn maps variables not to sets but to plural individuals. Cf. the discussion in Nouwen (2014).

- atomic propositions: suitable combinations of a predicate constant and one or more terms

- If p and q are propositions, then $p; q$ is a proposition (conjunction)

- If p and q are propositions, Q a quantifier constant and v is a variable, then $Qv(p)(q)$ is a proposition

- Nothing else is a proposition

To give an example, (34) looks like (39) in this language:

(39) $\text{EVERY}_x(\text{boy}(x))(\text{MOST}_y(\text{sister}(y,x))(\text{SOME}_z(\text{flower}(z))(\text{gave}(x, y, z))))$

The semantics of this language is as follows. I assume I to be the interpretation function for the predicate and quantifier constants.[11]

(40) $F[P(v)] = \begin{cases} F & \text{if } F(v) \in I(P) \\ \emptyset & \text{otherwise} \end{cases}$

This is the standard interpretation of predication as a *test* (Groenendijk and Stokhof, 1991). That is, a predication acts like an identity function for exactly those states that satisfy the predication. It has no dynamic effect other than that it fails to return any information in case the predication fails. (We will need similar rules for binary and ternary predication, but I will leave it as a very easy exercise to the reader to provide these.)

In contrast to predication, quantification *is* dynamic. We will define its effect via two other operations. Σv takes care of collecting all the output states that result from interpreting its scope with respect to parts of the input state.

(41) $F[\Sigma v(p)] = \cup\{\{f[x/d]\}[p] \mid d \in D_e, f \in F\}$

Let me illustrate how this operator works on the basis of a simple example. Let F now be any assignment state. To keep things simple, let us assume there are only three variables, x, y and z. F will contain information on the values of these variables. If we now apply $\Sigma x(\text{boy}(x))$ to F, all this information will remain intact, except for whatever F tells us about x. That is, it will rewrite the values at x in a specific way. Namely, it takes individual functions f in F and it takes random (atomic) entities in the domain d and it applies p to the state just containing $f[x/d]$. (Recall that $f[x/d]$ is the function which is exactly like f, except that $f(x) = d$.) The output is either $\emptyset$ (if d is not a boy) or $\{f[x/d]\}$. The result of $\Sigma v(\text{boy}(x))$ is now the collection of all these outputs. Say, our domain consists of two boys, b_1 and b_2, and three girls g_1, g_2 and g_3. For each $f \in F$ we now get the following result:

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[11]In other words, I is interpretation in some fixed model / world. For simplicity's sake, I am keeping things extensional.

$$
\begin{array}{rcl}
\{f[x/b_1]\}[\text{boy}(x)] & = & \{f[x/b_1]\} \\
\{f[x/b_2]\}[\text{boy}(x)] & = & \{f[x/b_2]\} \\
\{f[x/g_1]\}[\text{boy}(x)] & = & \emptyset \\
\{f[x/g_2]\}[\text{boy}(x)] & = & \emptyset \\
\{f[x/g_3]\}[\text{boy}(x)] & = & \emptyset
\end{array}
$$

Grouping all these together gives us $\{\{f[x/b_1]\}, \{f[x/b_2]\}, \emptyset\}$. This means that if we apply this process to consecutive functions $f \in F$, we get an output like $\{\{f_1[x/b_1]\}, \{f_1[x/b_2]\}, \{f_2[x/b_1]\}, \{f_2[x/b_2]\}, \ldots, \emptyset\}$. The output of $F[\Sigma x(\text{boy}(x)]$ is now the union of all these output states, which is:

$$
\{f_1[x/b_1], f_1[x/b_2], f_2[x/b_1], f_2[x/b_2], \ldots\}
$$

The Σ operation has a number of key properties. First of all, the output state is such that x is assigned the maximal set that satisfies the scope of Σ. This will be crucial to account for the exhaustive nature of some e-type anaphora. Second, the way this maximal set is built up is distributively. That is, the set of boys is collected by considering one atomic individual at a time. This will explain why in the scope of a quantifier, the value of x does not refer exhaustively, but rather via co-variation.[12]

Before we can use Σ to state a dynamic interpretation for quantifiers, we need one more definition. A form $p; q$ expresses conjunction, or perhaps more intuitively the consecutive application of p and q (*first p, then q*). The definition is basically one of *function composition*.

(42) $F[p; q] = (F(p))(q)$

A dynamic quantifier now compares two applications of Σ, one to just the restrictor, the other to the consecutive application of restrictor and scope. The two corresponding outputs should yield values for x that stand in the appropriate quantificational relation $I(Q)$.

(43) $F[Qv(p)(q)] = \left\{ \begin{array}{ll} F[\Sigma v(p; q)] & \text{if } I(Q)(F[\Sigma v(p)](v))(F[\Sigma v(p; q)](v)) \\ \emptyset & \text{otherwise} \end{array} \right.$

To illustrate how this definition works, let us compare (44) with (45). The former is the interpretation of the original congressmen example by Evans. The latter corresponds to a version where the predication of being junior is inside the scope of the quantifier, such as for instance in: *Few congressmen admire Kennedy and are very junior.*

(44) $\text{FEW}_x(\text{congressmen}(x))(\text{admire-Kennedy}(x)); \text{very-junior}(x)$

(45) $\text{FEW}_x(\text{congressmen}(x))(\text{admire-Kennedy}(x); \text{very-junior}(x))$

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[12]Essentially, the above definition of Σ is a fully dynamic version of the so-called *abstraction procedure* of discourse representation theory (DRT, Kamp and Reyle 1993). However, in DRT, this operation is used to extract maximal anaphora out of an existing static representation of a quantificational statement. Here, it is used to arrive at a fully dynamic interpretation of quantifiers.

The final occurrence of x in (44) is not in the scope of the quantifier FEW. As such, it will refer to the value that the output state for $\text{FEW}_x(\text{congressmen}(x))(\text{admire-Kennedy}(x))$ assigns to x. This will be the reference set of congressmen who admire Kennedy. In (45), the final occurrence of x is in the scope of the quantifier. As such in the interpretation it will be involved in creating the output state $\Sigma x(\text{congressmen}(x);\text{admire-Kennedy}(x);\text{very-junior}(x))$. This is the state that consists of individual assignment functions that assign a junior Kennedy-admiring congressmen to x. In this case, x is bound by the quantifier (or more precisely Σ.)

4.3 Non-maximal reference and variables

The above treatment of quantifiers fails to provide referents for pronouns that refer non-exhaustively with an indefinite quantifier as their antecedent. That is, it fails to account for examples like (46), where the pronoun *"it"* refers non-exhaustively to a pen.

(46)   I have a pen$_x$. It$_x$'s in my bag.

There are at least two ways to go now. One route is to say that some quantifiers, the indefinite ones,[13] do not just have the ability to change assignment states in such a way as to introduce reference sets, they also provide possibilities for future reference to non-maximal sets. This, in fact, is the idea behind classical approaches to the dynamic semantics of existential quantification (Kamp, 1981; Heim, 1982; Groenendijk and Stokhof, 1991). The semantic effect of an existential quantifier is to *randomly reset* the value of a variable. Since this reset is not determinate, we can then no longer think of dynamic semantics as providing a function from an old context to a new one. Since there are many values a variable could be reset to - i.e. since there are (potentially) many possible referents that satisfy the scope of the existential quantification - the dynamic semantics would need to be relational rather than functional, mapping each input assignment to a multitude of output assignments. *Indefiniteness*, in other words, corresponds to dynamic non-determinism.

For the example above, say that the speaker has in fact three pens: one in her bag, one at home and one on her desk. On a dynamic non-maximal approach to indefinites, the first sentence in (46) would create three potential output states G, one for each of the pens the speaker could be referring to. In the subsequent discourse, the value for x will now be indeterminate. In fact, at any point in the discourse there will be a multitude of possible states and, thus, potentially a multitude of possible values for variables.

A different take can be found in van Rooij (2001), who argues that the possibility that indefinites actually *refer* should be seriously considered. Van Rooij's arguments find their origin amongst others in the work of Strawson (1952). This

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[13]See de Swart (1999) for discussion on what constitutes *indefiniteness* and how it relates to a host of semantic properties.

is Strawson's example:[14]

(47)   A: A man jumped off the cliff.
       B: He didn't jump, he was pushed.

It would not do to analyse the contribution of B's pronoun in this example as *the individual who jumped off the cliff*. Rather, what this example suggests is that coreference involves reference to *the referent the speaker has in mind.* To this end van Rooij augments the notion of context to include information on speaker's reference: context keeps track of which referent the speaker intends to refer to for each indefinite that she used.

In the remainder of this section, I will follow van Rooij in assuming that indefinites are either used referentially or quantificationally. I do so for entirely practical reasons, since it allows me to keep the dynamic interpretation mechanism relatively simple (i.e. functional rather than relational). As far as I can see, although the vast majority of the literature follows the classical dynamic take on indefiniteness, there is no real consensus of how to deal with both maximal and non-maximal reference to indefinites. The reader should bear in mind, however, that what follows is somewhat unorthodox.

Following van Rooij's take, whether an indefinite is referential or quantificational, in both cases it introduces a unique referent. In the former case, it is the unique (singular or plural) individual that the speaker has in mind when using the indefinite. In the latter case, it is the maximal and (therefore) unique individual that satisfies restrictor and scope. Or, more accurately, it is the maximal referent as defined by (43). Non-maximal e-type anaphora concerns cases where the indefinite is referential. For example, under a referential interpretation of (46), there may be many pens that the speaker owns, but only one of them is the intended referent for x. Since this referent is the value assigned to x, this is also the referent for the pronoun. This means the pronoun refers only to the intended pen, not to any other pen owned by the speaker. As such, this kind of pronominal reference is non-maximal.

4.4   E-type co-variation and variables

The effect of the dynamic interpretation for quantifiers, (43), is that, following a quantificational statement, there is access to an assignment state which contains (i) all the sets that could be potentially involved in exhaustive reference; (ii) the relation between parts of these sets, as dictated by the quantificational statement. Here is a procedural paraphrase of the dynamic semantics for that $Qv(p)(q)$ that I defined above:

1. group together all output states that result from interpreting the restrictor: $\Sigma v(p)$

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[14]Heim (1990) has an entirely different take on these (p. 172). In fact, she suggests there that the pronoun's reference in the example in (47) is *deictic* in nature.

2. group together all output states that result from interpreting the restrictor and the scope consecutively: $\Sigma v(p; q)$

3. check whether the value of v in the former stands in the Q relation to the value of v in the latter

4. if so, output $\Sigma v(p; q)$

5. if not, output $\emptyset$

Now note the following. The restrictor p could of course have a dynamic effect of its own, either due to a quantifier or due to a referential indefinite. In that case, $\Sigma v(p)$ will contain information about some other variable, say y. This is for instance what happens in a donkey sentence, like (48), interpreted like (49).

(48)   Every farmer$_x$ who owns a donkey$_y$ beats it.

(49)   EVERY$_x$(SOME$_y$(donkey(y))(own(x, y);farmer(x)))(beat(x, y))

In dynamic quantification, the scope is always interpreted in a context already altered by the restrictor. For the donkey example here this means that individual assignments f from the input state will be considered one at a time and, by applying the restrictor to f, two things will change. Firstly, the output will now assign a farmer to x and, following the dynamic interpretation of the embedded quantified statement, this local output state will assign the donkeys owned by this farmer to y. The scope of this donkey sentence *beat(x, y)* will now be applied to local output states like that. The result is that the occurrence of y in the scope will co-vary (different donkeys for different farmers), even though it is not technically bound by the quantifier.

    Other types of e-type co-variation involve a similar mechanism, but *in discourse* rather than in the scope of the quantifier. Take Krifka's L&P submissions example (decorated with some initial information on the variables involved).

(50)   Most students$_x$ wrote an article$_y$. They sent it to L&P.

In order to account for this example, all we need to assume is that the second sentence is a donkey sentence quantifying over the atoms in the exhaustive e-type referent for x. The interpretation is in (51), where $\top$ is the trivially successful dynamic action, i.e. it expresses the identity function.

(51)   MOST$_x$(student(x))(SOME$_y$(article(y))(wrote(x, y)))
        ;
        EVERY$_x$($\top$)(sent-to-L&P(x, y))

The quantificational statement before the semicolon outputs a state which contains at x the majority of students that wrote articles and which contains the papers written by these students at y. Each assignment function in this state is moreover such that the student at x wrote the article at y. The second part quantifies over

such individual functions and says that every one of these functions should more-over be such that the article-writing student at x sent the article s/he wrote at y to L&P.

  As I explained above, I am making the unusual (yet simplifying) decision here to have dynamic interpretation be deterministic in nature. The results of this sub-section are the most likely places where this determinacy makes wrong predictions. The examples (48) and (50) both involve embedded indefinites. On a quantificational construal of these indefinites we would make the strong prediction that for each farmer/student, we introduce a maximal referent for the donkeys/articles. But since we use singular e-type pronouns here, this means that we predict (48)-(50) only to be felicitous under the assumption that each student that wrote an article only wrote just a single one and that each farmer only owned just a single donkey. This prediction is too strong: (48), for instance, seems to be fine if some farmers own multiple donkeys. In fact, in such cases it seems to entail that the farmers in question beat *all* the donkeys he or she owns.

  In other words, the deterministic functional framework I have presented so far has a hard time accounting for one of the central cases of e-type pronouns: donkey pronouns. To give the reader a glimpse of how non-deterministic dynamic semantics, i.e. the classical dynamic semantic frameworks get things right, I will briefly sketch how such approaches differ from what I have presented so far.[15] As explained above, classical dynamic semantics has it that (non-quantificational) indefinites introduce non-determinism. The output of interpreting *a man$_x$* in some state is the set of states that differ from the input state only in that x points to a man. This means that for each man in the domain of discourse, there will be one output state. Following the recipe, above, quantificational DPs are different in that they involve the comparison of two potential updates: that of the restrictor of the quantifier and that of the restrictor followed by the scope. In a classical framework, interpreting the restrictor of (48) results in (52-a), while interpreting the scope yields (52-b).

(52) a. all states in which x is a farmer, y is a donkey and the farmer in question owns the donkey in question.
  b. all states in which x is a farmer, y is a donkey and the farmer in question owns the donkey in question and the farmer in question also beats the donkey in question.

The donkey sentence is true if the set of successful x's for (52-b) is exactly the set of successful x's for (52-a). And this means that each of the donkey-owning farmers beats all the donkeys he or she owns. The key to this result is that in the classical approaches, the interpretation of a referential indefinite involves enumerating all the possible referents the speaker could have in mind, by creating a space of potential resulting states. In the context of a quantifier, all the values in these states are compared and in that way the indefinite receives something akin to universal

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[15]See Brasoveanu and Dotlačil (this volume) for details on approaches to donkey anaphora.

force.

Zooming out again and abstracting away from the technicalities, the core idea of dynamic analyses of e-type co-variation is that the co-variation is brought about via quantificational subordination. That is, the e-type pronoun is licensed by the fact that it is in the scope of a quantifier that sets up the context in such a way that it makes available referents unavailable in the global context. For (50) this concerns the dependency between two variables created by an antecedent complex quantificational statement. For the case of telescoping in (53), there is no dependency involved, but rather straightforward quantification over the maximal referent set up in the first sentence, as becomes clear in the analysis in (54)

(53)   Each boy walked to the stage. He took his diploma from the dean and returned to his seat.

(54) $\text{EACH}_x(\text{boy}(x))(\text{walked-to-the-stage}(x))$
        ;
        $\text{EACH}_x(\top)(\text{take-diploma-and-return-to-seat}(x))$

In this section, I have given my take on the pronouns as variables view as can be found in van den Berg (1996); Nouwen (2003a) or Brasoveanu (2008), among quite a few others. These proposals give a uniform analysis of the various sub-kinds of e-type anaphora. At the core of the analysis is the proposal that the dynamic semantics of quantifiers is responsible for both the introduction of a single (exhaustive) referent and for co-variation in their scope.

In the next section, I will describe the main rival to the pronouns as variables approach, the style of analysis that takes the descriptive nature of e-type pronouns quite literally.

5   An alternative: Pronouns as descriptions

The idea that there is some relation between pronouns and definite descriptions is not a recent one. In fact, just like the pronouns-as-variables view it can be traced back to the classic works of Quine (1960) and Geach (1962). The first proper theory of this kind, however, was Cooper (1979), followed a decade later by Heim (1990) and Neale (1990) and, yet another decade later, by Elbourne (2001) and Elbourne (2005).

The literature reflects many ways to make sense of a relationship between pronouns and descriptions. What most theories share is their assumption that *at some level of description* pronouns go proxy for a definite description that is recoverable from the context.[16]

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[16]See Evans (1977) for arguments against proxy theories, and Neale (1990) for a reply. See also the discussion on *pronouns of laziness* below.

5.1 A sketch of description accounts

In its simplest variant, this view holds that pronouns are semantically like descriptions in that they refer to a unique (for the singular case) or maximal (for the plural case) instantiation of descriptive material recoverable from the context. One may be tempted to assume that recovering this material is an entirely pragmatic process, as indeed Cooper (1979) did. It turns out that this makes a wrong prediction, as can be shown by the contrast between (55) and (56), from Heim (1982), who attributes the example to Barbara Partee.

(55)   I dropped ten marbles and found all of them, except for one. It is probably under the sofa.

(56)   I dropped ten marbles and found only nine of them. #It is under the sofa.

If e-type anaphora is a matter of the pragmatic inference of a referent from antecedent statements, then no contrast between (55) and (56) is to be expected. Contrasts like (55)/(56), however, show that e-type anaphora is licensed only if there is a *formal link* (Kadmon, 1987). The two sentences in (55) are felicitous since the pronoun *it* stands in a formal anaphoric relation with its antecedent *one*. *Formally* no such antecedent is available in (56) and, so, even though we may infer from the first sentence of (56) that there is a missing marble, anaphoric reference to that marble is prohibited.[17]

Note that the pronouns as variables view has no issues with (55) and (56) at all, since it contains no pragmatic component. The assumption in that view is that anaphoric pronouns need referents introduced by antecedent quantifiers, and so there is always a formal link. The pronouns as description view can provide explicitly semantic or syntactic accounts of what the formal link between pronoun and referent is, however, as for instance Heim (1990) and Neale (1990) have done. Neale provides the formal link in (57). (This is my paraphrase; I am using terminology and notation consistent with what I have used throughout this chapter. See Neale (1990), page 182 for details.)

(57)   If the antecedent to a pronoun is a quantifier $Q_x(p)$ and this pronoun is not in the scope of that quantifier, and the quantifier forms a statement $Q_x(p)(q)$, then the pronoun is interpreted as "the x such that p and q".

This is comparable to our earlier descriptive generalisation that maximal e-type anaphora involves the reference set of a quantificational statement. As we stated there, a rule like (57) is too simplistic, since it will not be able to handle cases like (58), where the antecedent is in the scope of a quantifier itself.

(58)   Every one of Harry's neighbours own a sheep. Harry vaccinates them in the spring.

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[17]It is likely, however, that some pronouns *are* best analysed in terms of an inferential process that determines the referent. For instance, (56) improves quite a lot if there is a long pause between the first and the second sentence. See the final section of this chapter for discussion.

The most recent approach in the pronouns as description line is that of Elbourne (2005), who takes pronouns to be definite descriptions that contain NP deletion. For instance, in a donkey sentence, *it* is the spell-out of *it donkey*, where *it* functions as a definite article. Since NP deletion has to be licensed, Elbourne has no problem explaining why e-type anaphora should involve a formal link.

Elbourne assumes a framework that makes heavy use of situation semantics. Part of that framework is the idea that quantification involves quantification over *minimal situations*. Such narrowed down situations relax the predictions made by the uniqueness involved in the definite interpretation of pronouns, for the uniqueness is only required with respect to the local minimal situation. For instance, in a donkey sentence, quantification involves creating subsequent minimal situations in which there is a (single) farmer who owns a (single) donkey. The scope is then interpreted with respect to such minimal situations. The donkey pronoun is simply translated as *the donkey* and since each of the minimal situations contains a unique donkey the pronoun ends up co-varying.

In these cases, there is a remarkable overlap between the dynamic pronouns-as-variables approach and the situation semantic pronouns-as-descriptions approach. In many ways, minimal situations resemble the assignment function parts of assignment states.[18] However, Schlenker (2011) shows that even though e-type theories in the style of Elbourne provide a formal link to the antecedent (via ellipsis), their lack of interpreted indices at the basis of anaphoric relations is problematic once these theories are to be used to account for e-type anaphora in sign languages, where something quite like indices are formally expressed.[19]

There is a further hurdle for the NP deletion approach, which, as far as I can see, is not acknowledged in the literature. The issue is that Elbourne's deletion and minimal situations approach does not improve on Neale's (57) with respect to examples like (58). Just like in Neale's approach, Elbourne's theory lacks a component that explains why *them* in (58), when interpreted as *the sheep*, refers to the sheep Harry's neighbours own. The upshot is that the pronouns as description view lacks a complete account of maximal e-type anaphora, and its account of e-type co-variation, in particular that of donkey sentences, is very close to the pronouns as variables view. I would speculate that if the pronouns as description view had to provide a theory covering the full range of maximal and co-varying e-type anaphora, we would end up with an approach whose core mechanisms are notational variants of the kind of mechanisms one finds in the dynamic quantifier semantics discussed above. That is, the views then end up merely making different claims about the morphosyntax of pronouns.

This characterisation of the field depicts the pronouns as description view as

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[18]However, in his general and formal comparison of assignment functions and situations, Dekker (2004a) concludes that this resemblance is far from straightforward. Nevertheless, one could think of hybrid accounts that treat pronouns as descriptions, but that resolve the referent of descriptions not with respect to situations, but with respect to assignment functions. The pronouns as oracles view of de Grootte (2006) may come close.

[19]Schlenker's main argument is quite elaborate and centers around so-called bishop sentences, which I have not discussed here.

quite an unattractive theory. This is unfair, however, since that depiction is fully dependent on the empirical focus one has. There are cases of e-type anaphora that do not neatly fit the two dimensions I have used above (exhaustive reference and co-variation). I will discuss two of these next and show that in these cases, the description view has a natural appeal.

5.2 Pronouns of laziness and paycheck pronouns

The term pronouns of laziness was coined by Geach (1962), who used it to refer to pronouns that appear to go proxy for their antecedent. The term has led a muddled existence subsequently (e.g. Cooper (1979) uses it roughly in the way I used the term *e-type*), but I believe that one way to make sense of the term in the current literature is to refer to a very specific class of pronominal anaphoric phenomena where the pronoun goes proxy for its antecedent. One example would be (59). The types of e-type anaphora that I discussed so far all involved quantification. Here, there are no real signs of quantification and, so, maximal reference and/or co-variation are not an option. There is no coreference either. Clearly, *he* does not refer to this year's president. The best analysis seems to be to assume that *he* goes proxy for *the president* and that in the second sentence that definite description picks out a different individual from what it picks out in the first.

(59)   This year the president is a democrat. Next year, he will be a republican.

There is an interesting link with Evans's conception of e-type pronouns as being rigid designators. Evans (1977) explicitly claimed that pronouns *do not go proxy for definite descriptions.* He did so on the basis of examples like (60) and (61). His observation was that while (60) claims that the current mayor of Boston switched political pursuasion, (61) can in addition be interpreted as claiming that Boston has had a Democrat mayor in the past.

(60)   Boston has a mayor and he used to be a democrat.

(61)   Boston has a mayor and the mayor of Boston used to be a democrat.

Certainly, Geach's observation concerning lazy pronouns, as in (59), is at odds with Evans's conclusion. Also, Neale (1990) has pointed out that if pronouns do go proxy for definite descriptions, then (61) is not the correct paraphrase for (60). Instead, the interesting clause to look at would be *the mayor Boston has used to be a democrat*, which behaves differently from (61).

   It appears then that genuine pronouns of laziness exist and that they are different from the phenomena discussed above under the rubrics of maximal reference and co-variation. As such, pronouns of laziness are outside the reach of the pronouns as variables approach as it was presented above. Clearly, however, the line of analysis that treats pronouns as descriptions does have a natural account to offer for examples like (59). Here, in other words, we find a phenomenon where the description view has clear advantages over the variables view.

Description theories are also at an advantage when it concerns so-called pay-check pronouns (sometimes called *functional pronouns*). Consider (62).

(62)   The man who gave his paycheck to his wife was wiser than the man who gave it to his mistress.

The example in (62) is the original example by Karttunen (1969) of a *paycheck sentence*. As with donkey pronouns, the *it* in (62) covaries with the men. However, just like with (59) the problem for dynamic accounts is that the pronoun refers to an entity that has not been contextually introduced. Just like *he* in (59) refers to a different president from its antecedent, the paycheck *it* refers to is not the pay-check that was given by the man to his wife, nor is it part of a quantificational range introduced in an antecedent statement. For this reason Elbourne (2005), refers to such pronouns as *neontological pronouns*.

One could take examples like (62) as an indication that pronouns can refer to functions. Indeed, elsewhere one finds similar evidence that expressions ranging over type e can also range over functions, as becomes clear from (63), for instance. The question Q can of course be answered by naming a single person universally admired by Englishmen. However, the answer in A does something different. It yields a functional answer.

(63)   Q: Who does every Englishman admire?   Jacobson (1999)
        A: His mother.

Accepting these data, one could think of paycheck pronouns as simple coreferential pronouns with a functional antecedent. This possibility is for instance worked out within Jacobson's variable free framework (Jacobson, 1999, 2000), where pronouns correspond to identity functions over individuals, which can be type-shifted into identity functions over functions. The variable-free framework is quite a bit different from both the pronouns-as-variables and the pronouns-as-description view I discuss here, yet Dekker (2004b) offers a philosophy of indefinites and pronouns that is close to dynamic semantics and which incorporates Jacobson's ideas in order to deal with functional pronouns.

If we allow functional referents in our dynamic framework, we end up in a situation where for this part of the data the pronouns-as-variables view starts to resemble the description view. According to the latter, the kinds of e-type anaphora discussed in this section are effects of laziness: the pronoun is used as a lazy proxy for the antecedent definite description. Rather than ending up being coreferential to that antecedent, the proxy results in a sloppy interpretation. This sloppy interpretation is a result of the fact that in the pronouns as description view (especially in that of Elbourne), pronouns are always functional, since their reference always depends on the local environment they refer in.

6 Concluding remarks

In this chapter, I have used the term e-type anaphora to refer to those anaphoric relations that cannot be understood as classical coreference or binding. This class is probably rather larger than what I have discussed above and what Evans initially had in mind. That is to say that I believe that there are in fact quite a few more uses of pronouns that are e-type in this broad sense, even though they fall quite outside of what theories of e-type pronouns generally talk about.

I want to mention one such often-ignored class, namely what one may call *inferential* e-type anaphora. Above, I discussed how *it* in (64) is infelicitous, since it lacks a formally explicit antecedent.

(64)   I dropped ten marbles and found only nine of them. #It is under the sofa.

Under specific circumstances, though, reference without such a formal link does become possible. Take (65), for instance.

(65)   I dropped ten marbles and found only nine of them. [pause] Oh! It is under the sofa.

Intuitively, the pause increases the salience of the missing marble. (The hearer may indeed easily expect the speaker is trying to find the tenth marble after hearing the first sentence.) If this increase in salience is high enough, sentences like (65) become felicitous. The examples in (66)-(67), both from Nouwen (2003a), provide further examples of e-type anaphora that is only licensed in pragmatically ideal circumstances. That is, they contrast with the infelicitous cases in (68)-(69), respectively.

(66)   Few of the MPs came to the party. They were too busy.

(67)   The couple living next door make a lot of noise. He plays the drums and she keeps on shouting at him.

(68)   Most MPs came to the party. #They were too busy.

(69)   Four men entered the room. #He sighed.

What goes wrong in (68)-(69) is that some minimal conditions that make inferential anaphora possible are missing. In (68), the plural pronoun is intended to refer to the MPs who did not come to the party. However, the first sentence does not guarantee that there are such MPs, since it is compatible with all MPs attending. In contrast, the downward monotone quantifier in (66) does guarantee there being a set of non-party-going MPs. In (69), the pronoun *he* has no way of identifying a unique part of the referent of four men introduced in the first sentence. In contrast, it is not unlikely that the couple next door in (67) are a man and a woman, and thus *he* and *she* in (67) uniquely identify one of the couple.

According to the general definition of e-type I gave throughout this chapter, the pronouns in (65), (66) and (67) are definitely that. I do believe however that these

inferential cases of anaphora are fundamentally different from the cases I have discussed above (maximal, co-varying and neontological). This is because they are only available in certain ideal contextual circumstances, and they are infelicitous otherwise, as the contrast (66)-(67)/(68)-(69) makes clear. There is one case of e-type co-variation, namely that of *telescoping*, however, that in terms of licensing very much resembles the examples of inferential anaphora I give above. Recall that the general idea for telescoping is that it involves an implicit universal quantifier: (70) may be paraphrased as (71).

(70)   Each boy walked to the stage. He took his diploma from the dean and returned to his seat.

(71)   Each boy walked to the stage. Each such boy is such that he took his diploma from the dean and returned to his seat.

It is quite clear, however, that singular pronouns cannot generally be interpreted as being bound by a covert universal quantifier. In fact, data meant to show that quantifier scope is limited to the clause included examples like (72) from Hornstein (1984) (cf. Poesio and Zucchi (1992)).

(72)   #If John owes every man money, then Sam pays him.

(73)   If John owes every man money, then every man is such that Sam pays him.

If (70) can be understood as (71), then why can't (72) be understood as (73)? Some suggestions for (inconclusive) answers can be found in Roberts (1987) and Poesio and Zucchi (1992). For the current discussion, the main observation is though that telescoping resembles inferential anaphora in that it is not generally licensed.

Importantly, however, other types of e-type anaphora are just as unconditionally available as binding and coreference. Take for instance, maximal e-type anaphora. In contrast to what we observed for (68), the reference set pronoun in (74) is felicitous even though the quantificational statement does not by itself guarantee that this set contains any individuals (as can be observed by (75)).

(74)   Few MPs attended the party. But they did have a good time.

(75)   Few MPs attended the party. In fact, none did.

I believe that here lies the real puzzle of e-type anaphora, that which the theories described above try to explain. The core of the e-type data displays a generality that reveals that they are very closely tied to the antecedent. In other words, e-type anaphora involves reference to referents that are directly provided by grammar and semantics, without any need for secondary processes, just as is the case for coreference and binding.

References

Barwise, J. and R. Cooper (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy 4*(2), 159–219.

van den Berg, M. (1994). A direct definition of generalized dynamic quantifiers.

van den Berg, M. (1996). *Some aspects of the internal structure of discourse: the dynamics of nominal anaphora.* Ph. D. thesis, ILLC, Universiteit van Amsterdam.

Brasoveanu, A. (2008). Donkey pluralities: plural information states versus non-atomic individuals. *Linguistics and Philosophy 31*(2), 129–209.

Brasoveanu, A. and J. Dotlačil (2020). Donkey anaphora: farmers and bishops. In *The Semantics Companion.*

Cooper, R. (1979). The interpretation of pronouns. In F. Heny and H.Schnelle (Eds.), *Syntax and Semantics 10.* New York: Academic Press.

de Grootte, P. (2006). Towards a montagovian account of dynamics. In M. Gibson and J. Howell (Eds.), *SALT 16.* Ithaca, NY: Cornell.

Dekker, P. (2004a). Cases, adverbs, situations and events. In *Proceedings of the Workshop on Context Dependence*, IMS, Stuttgart and UFAL.

Dekker, P. (2004b). The pragmatic dimension of indefinites. *Research on language and computation 2*(3), 365–399.

van Eijck, J. (2001, Summer). Incremental dynamics. *Journal of Logic Language and Information 10*(3), 319–351.

Elbourne, P. (2001). E-type anaphora as NP-deletion. *Natural Language Semantics 9*, 241–288.

Elbourne, P. (2005). *Situations and individuals.* MIT press.

Elworthy, D. (1995). A theory of anaphoric information. *Linguistics and Philosophy 18*, 297–332.

Evans, G. (1977). Pronouns, quantifiers and relative clauses. *Canadian journal of philosophy 7*, 467–536.

Evans, G. (1980). Pronouns. *Linguistic Inquiry 11*(2), 337–362.

Geach, P. (1962). *Reference and Generality.* Ithaca: Cornell University Press.

Geach, P. (1973). *Logic Matters.* Blackwell.

Geurts, B. (1997). Book review of Linda M. Moxey and Anthony J. Sanford. Communicating Quantities. 1993. *Journal of semantics 14*(1), 87–94.

Groenendijk, J. and M. Stokhof (1991). Dynamic Predicate Logic. *Linguistics and Philosophy 14*, 39–100.

Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases.* Ph. D. thesis, University of Massachusetts at Amherst.

Heim, I. (1990). E-type pronouns and donkey anaphora. *Linguistics and Philosophy 13*(2), 137–138.

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

Hornstein, N. (1984). *Logic as Grammar.* Cambridge: The MIT Press.

Jacobson, P. (1999). Towards a variable-free semantics. *Linguistics and Philosophy 22*(2), 117–185.

Jacobson, P. (2000). Paycheck pronouns, bach-peters sentences, and variable-free semantics. *Natural Language Semantics 8*(2), 77–155.

Kadmon, N. (1987). *On Unique and non-Unique Reference and Asymmetric Quantification.* Ph. D. thesis, University of Massachusetts.

Kamp, H. (1981). A theory of truth and semantic representation. In J. A. G. Groenendijk, T. M. V. Janssen, and M. J. B. Stokhof (Eds.), *Formal Methods in the Study of Language.* Amsterdam: Mathematical Centre.

Kamp, H. and U. Reyle (1993). *From Discourse to Logic.* Dordrecht: D. Reidel.

Karttunen, L. (1969). Discourse referents. In *Proceedings of the Inernational Conference on Computational Linguistics COLING.*

Keshet, E. (2018). Dynamic update anaphora logic: A simple analysis of complex anaphora. *Journal of Semantics 35*(2), 263–303.

Krifka, M. (1996). Parametrized sum individuals for plural reference and partitive quantification. *Linguistics and Philosophy 19*, 555–598.

Neale, S. (1990). *Descriptions.* Cambridge, MA: MIT Press.

Nouwen, R. (2003a). Complement anaphora and interpretation. *Journal of Semantics 20*(1), 73–113.

Nouwen, R. (2003b). *Plural pronominal anaphora in context.* Number 84 in Netherlands Graduate School of Linguistics Dissertations. Utrecht: LOT.

Nouwen, R. (2007). On dependent pronouns and dynamic semantics. *Journal of Philosophical Logic 36*(2), 123–154.

Nouwen, R. (2014). Plurality. In M. Aloni and P. Dekker (Eds.), *Cambridge Handbook of Semantics*. Cambridge University Press.

Poesio, M. and S. Zucchi (1992). On telescoping. In *Proceedings of SALT 2*.

Quine, W. v. O. (1960). *Word and Object*. MIT press.

Reinhart, T. (1976). *The Syntactic Domain of Anaphora*. Ph. D. thesis, Massachusetts Institute of Technology.

Roberts, C. (1987). *Modal Subordination, anaphora and distributivity*. Ph. D. thesis, University of Massachussets, Amherst.

Schlenker, P. (2011). Donkey anaphora: the view from sign language. *Linguistics and Philosophy 34*, 341–395.

Strawson, P. (1952). *Introduction to Logical Theory*. London: Methuen.

de Swart, H. (1999). Indefinite between Predication and Reference. In *SALT9*.

van Rooij, R. (2001). Exhaustivity in dynamic semantics; referential and descriptive pronouns. *24*(5), 621–657.